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1

1 Introduction

1.1 Purpose of the Operating Guide

This operating guide provides information for safe installation and commissioning of the frequency converter.

The operating guide is intended for use by qualified personnel.
Read and follow the instructions to use the frequency converter safely and professionally, and pay particular attention to the safety instructions and general warnings. Always keep this operating guide available with the frequency converter.

VLT® is a registered trademark.

1.2 Additional Resources

Other resources are available to understand advanced frequency converter functions and programming.

- The *VLT® AQUA Drive FC 202 Programming Guide* provides greater detail on working with parameters and many application examples.
- The *VLT® AQUA Drive FC 202 Design Guide* provides detailed information about capabilities and functionality to design motor control systems.
- Instructions for operation with optional equipment.

Supplementary publications and manuals are available from Danfoss. See *www.vlt-drives.danfoss.com/Support/Technical-Documentation/* for listings.

1.3 Manual and Software Version

This manual is regularly reviewed and updated. All suggestions for improvement are welcome.

Table 1.1 shows the manual version and the corresponding software version.

Edition	Remarks	Software version
MG20MDxx	The parameter list is updated to reflect software version 2.6x. Editorial update.	2.6x

Table 1.1 Manual and Software Version

1.4 Product Overview

1.4.1 Intended Use

The frequency converter is an electronic motor controller intended for:

- Regulation of motor speed in response to system feedback or to remote commands from external controllers. A power drive system consists of the frequency converter, the motor, and equipment driven by the motor.
- System and motor status surveillance.

Depending on configuration, the frequency converter can be used in standalone applications or form part of a larger appliance or installation.

The frequency converter is allowed for use in residential, industrial, and commercial environments in accordance with local laws, standards, and emission limits as described in the design guide.

Single-phase frequency converters (S2 and S4) installed in the EU
The following limitations apply:

- Units with an input current below 16 A and an input power above 1 kW (1.5 hp) are only intended for professional use in trades, professions, or industries and not for sale to the general public.
- Designated application areas are public pools, public water supplies, agriculture, commercial buildings, and industries. All other single-phase units are only intended for use in private low-voltage systems interfacing with public supply only at a medium or high-voltage level.
- Operators of private systems must ensure that the EMC environment complies with IEC 610000-3-6 and/or the contractual agreements.

NOTICE

In a residential environment, this product can cause radio interference, in which case supplementary mitigation measures may be required.

Foreseeable misuse
Do not use the frequency converter in applications, which are non-compliant with specified operating conditions and environments. Ensure compliance with the conditions specified in *chapter 8 Specifications*.

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1.4.2 Features

The VLT® AQUA Drive FC 202 is designed for water and wastewater applications. The range of standard and optional features includes:

- Cascade control.
- Dry run detection.
- End-of-curve detection.
- SmartStart.
- Motor alternation.
- Deragging.
- 2-step ramps.
- Flow confirmation.
- Check valve protection.
- Safe Torque Off.
- Low flow detection.
- Pre/post lubrication.
- Pipe fill mode.
- Sleep mode.
- Real-time clock.
- User-configurable info texts.
- Warnings and alarms.
- Password protection.
- Overload protection.
- Smart logic control.
- Dual power rating (high/normal overload).

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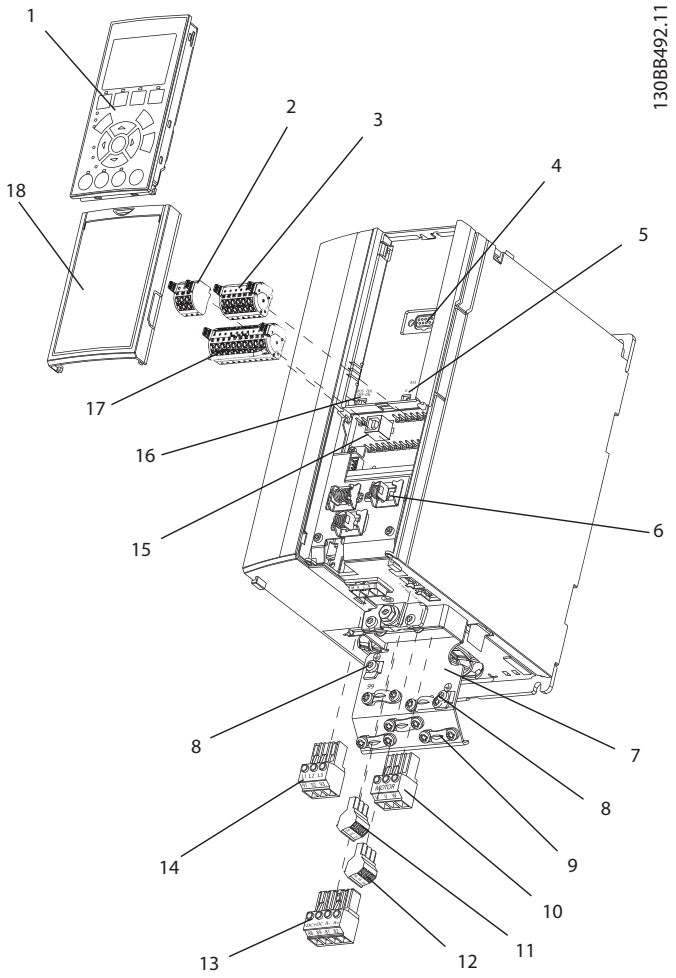
1.4.3 Exploded Views



1	Local control panel (LCP)	10	Motor output terminals 96 (U), 97 (V), 98 (W)
2	RS485 fieldbus connector (+68, -69)	11	Relay 2 (01, 02, 03)
3	Analog I/O connector	12	Relay 1 (04, 05, 06)
4	LCP input plug	13	Brake (-81, +82) and load sharing (-88, +89) terminals
5	Analog switches (A53), (A54)	14	Mains input terminals 91 (L1), 92 (L2), 93 (L3)
6	Cable shield connector	15	USB connector
7	Ground termination plate	16	Fieldbus terminal switch
8	Grounding clamp (PE)	17	Digital I/O and 24 V supply
9	Shielded cable grounding clamp and strain relief	18	Cover

Illustration 1.1 Exploded View Enclosure Size A, IP20

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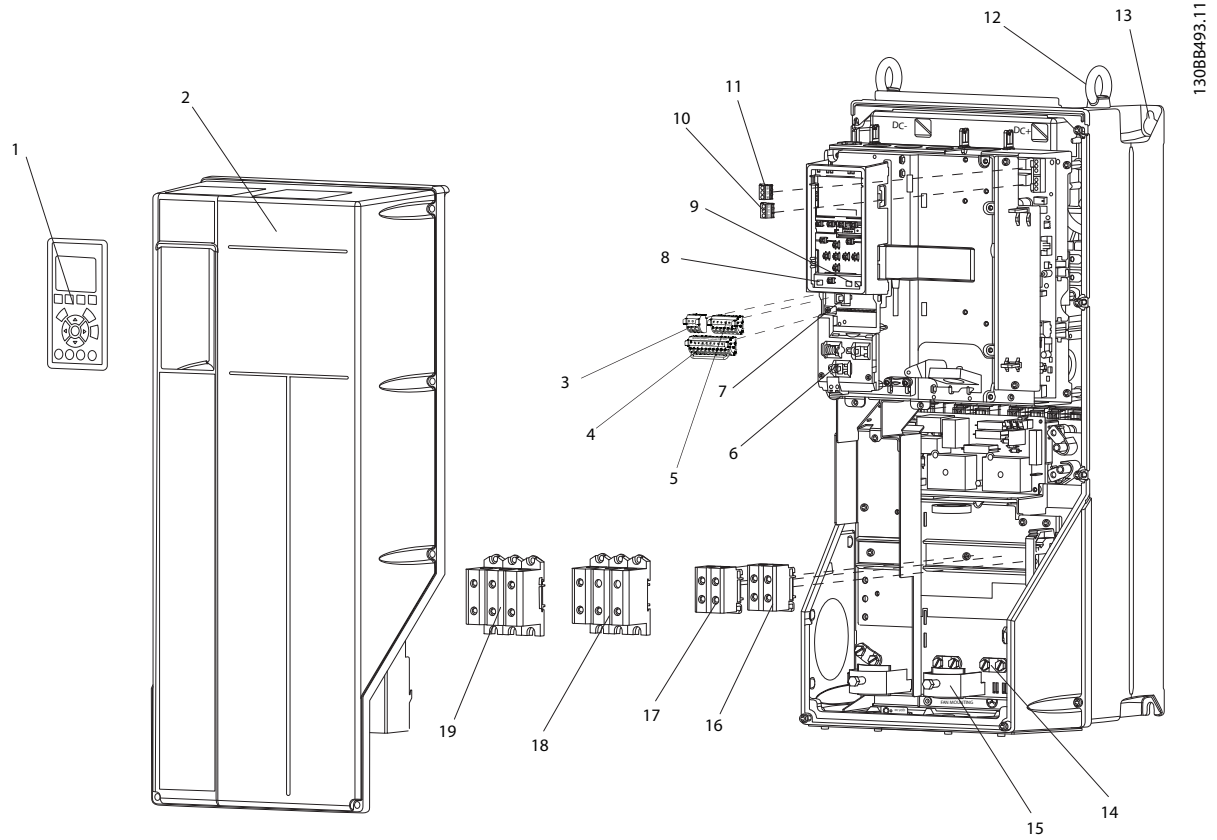

1	Local control panel (LCP)	11	Relay 2 (04, 05, 06)
2	Cover	12	Lifting ring
3	RS485 fieldbus connector	13	Mounting slot
4	Digital I/O and 24 V supply	14	Grounding clamp (PE)
5	Analog I/O connector	15	Cable shield connector
6	Cable shield connector	16	Brake terminal (-81, +82)
7	USB connector	17	Load sharing terminal (DC bus) (-88, +89)
8	Fieldbus terminal switch	18	Motor output terminals 96 (U), 97 (V), 98 (W)
9	Analog switches (A53), (A54)	19	Mains input terminals 91 (L1), 92 (L2), 93 (L3)
10	Relay 1 (01, 02, 03)	–	–

Illustration 1.2 Exploded View Enclosure Sizes B and C, IP55 and IP66

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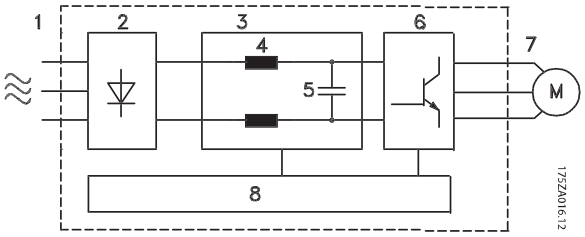
Illustration 1.3 is a block diagram of the internal components of the frequency converter.



Area	Title	Functions
1	Mains input	• 3-phase AC mains supply to the frequency converter.
2	Rectifier	• The rectifier bridge converts the AC input to DC current to supply inverter power.
3	DC bus	• The intermediate DC bus circuit handles the DC current.
4	DC reactors	• Filter the intermediate DC circuit voltage. • Prove mains transient protection. • Reduce RMS current. • Raise the power factor reflected back to the line. • Reduce harmonics on the AC input.
5	Capacitor bank	• Stores the DC power. • Provides ride-through protection for short power losses.
6	Inverter	• Converts the DC into a controlled PWM AC waveform for a controlled variable output to the motor.
7	Output to motor	• Regulated 3-phase output power to the motor.
8	Control circuitry	• Input power, internal processing, output, and motor current are monitored to provide efficient operation and control. • User interface and external commands are monitored and performed. • Status output and control can be provided.

Illustration 1.3 Frequency Converter Block Diagram

1.4.4 Enclosure Sizes and Power Ratings

For enclosure sizes and power ratings of the frequency converters, refer to *chapter 8.9 Power Ratings, Weight, and Dimensions*.

1.5 Approvals and Certifications

Table 1.2 Approvals and Certifications

More approvals and certifications are available. Contact the local Danfoss partner. Frequency converters of enclosure size T7 (525–690 V) are UL certified for only 525–600 V.

The frequency converter complies with UL 508C thermal memory retention requirements. For more information, refer to the section *Motor Thermal Protection* in the product-specific *design guide*.

For compliance with the European Agreement concerning International Carriage of Dangerous Goods by Inland Waterways (ADN), refer to *ADN-compliant Installation* in the product-specific design guide.

1.6 Disposal

Do not dispose of equipment containing electrical components together with domestic waste.
Collect it separately in accordance with local and currently valid legislation.

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2 Safety

2.1 Safety Symbols

The following symbols are used in this guide:

⚠WARNING

Indicates a potentially hazardous situation that could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation that could result in minor or moderate injury. It can also be used to alert against unsafe practices.

NOTICE

Indicates important information, including situations that can result in damage to equipment or property.

2.2 Qualified Personnel

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of the frequency converter. Only qualified personnel are allowed to install and operate this equipment.

Qualified personnel are defined as trained staff, who are authorized to install, commission, and maintain equipment, systems, and circuits in accordance with pertinent laws and regulations. Also, the qualified personnel must be familiar with the instructions and safety measures described in this manual.

2.3 Safety Precautions

⚠WARNING

HIGH VOLTAGE

Frequency converters contain high voltage when connected to AC mains input, DC supply, or load sharing. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.

- **Only qualified personnel must perform installation, start-up, and maintenance.**

⚠WARNING

UNINTENDED START

When the frequency converter is connected to AC mains, DC supply, or load sharing, the motor may start at any time. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage. The motor can start via an external switch, a fieldbus command, an input reference signal from the LCP, or after a cleared fault condition.

To prevent unintended motor start:

- **Disconnect the frequency converter from the mains.**
- **Press [Off/Reset] on the LCP before programming parameters.**
- **Completely wire and assemble the frequency converter, motor, and any driven equipment before connecting the frequency converter to AC mains, DC supply, or load sharing.**

⚠WARNING

DISCHARGE TIME

The frequency converter contains DC-link capacitors, which can remain charged even when the frequency converter is not powered. High voltage can be present even when the warning LED indicator lights are off. Failure to wait the specified time after power has been removed before performing service or repair work can result in death or serious injury.

- **Stop the motor.**
- **Disconnect AC mains and remote DC-link power supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters.**
- **Disconnect or lock PM motor.**
- **Wait for the capacitors to discharge fully. The minimum duration of waiting time is specified in *Table 2.1*.**
- **Before performing any service or repair work, use an appropriate voltage measuring device to make sure that the capacitors are fully discharged.**

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Voltage [V]	Minimum waiting time (minutes)		
	4	7	15
200–240	0.25–3.7 kW (0.34–5 hp)	–	5.5–45 kW (7.5–60 hp)
380–480	0.37–7.5 kW (0.5–10 hp)	–	11–90 kW (15–121 hp)
525–600	0.75–7.5 kW (1–10 hp)	–	11–90 kW (15–121 hp)
525–690	–	1.1–7.5 kW (1.5–10 hp)	11–90 kW (15–121 hp)

Table 2.1 Discharge Time

⚠WARNING

LEAKAGE CURRENT HAZARD

Leakage currents exceed 3.5 mA. Failure to ground the frequency converter properly can result in death or serious injury.

- **Ensure the correct grounding of the equipment by a certified electrical installer.**

⚠WARNING

EQUIPMENT HAZARD

Contact with rotating shafts and electrical equipment can result in death or serious injury.

- **Ensure that only trained and qualified personnel perform installation, start-up, and maintenance.**
- **Ensure that electrical work conforms to national and local electrical codes.**
- **Follow the procedures in this guide.**

⚠WARNING

UNINTENDED MOTOR ROTATION WINDMILLING

Unintended rotation of permanent magnet motors creates voltage and can charge the unit, resulting in death, serious injury, or equipment damage.

- **Ensure that permanent magnet motors are blocked to prevent unintended rotation.**

⚠CAUTION

INTERNAL FAILURE HAZARD

An internal failure in the frequency converter can result in serious injury when the frequency converter is not properly closed.

- **Ensure that all safety covers are in place and securely fastened before applying power.**

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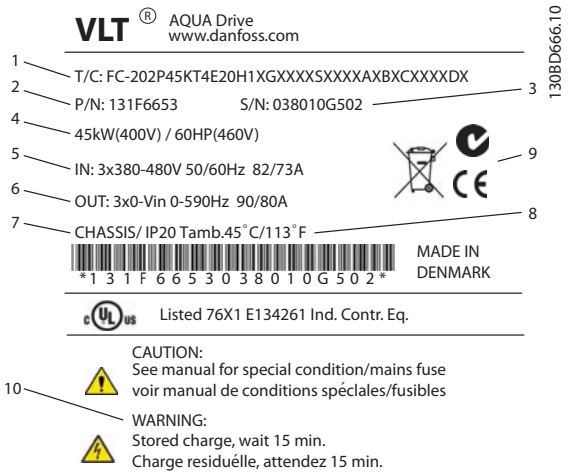
3 Mechanical Installation

3.1 Unpacking

3.1.1 Items Supplied

Items supplied may vary according to product configuration.

- Make sure the items supplied and the information on the nameplate correspond to the order confirmation.
- Check the packaging and the frequency converter visually for damage caused by inappropriate handling during shipment. File any claim for damage with the carrier. Retain damaged parts for clarification.



1	Type code
2	Ordering number
3	Serial number
4	Power rating
5	Input voltage, frequency, and current (at low/high voltages)
6	Output voltage, frequency, and current (at low/high voltages)
7	Enclosure type and IP rating
8	Maximum ambient temperature
9	Certifications
10	Discharge time (Warning)

Illustration 3.1 Product Nameplate (Example)

NOTICE

Do not remove the nameplate from the frequency converter. Removing the nameplate voids the warranty.

3.1.2 Storage

Ensure that the requirements for storage are fulfilled. Refer to *chapter 8.4 Ambient Conditions* for further details.

3.2 Installation Environments

NOTICE

In environments with airborne liquids, particles, or corrosive gases, ensure that the IP/type rating of the equipment matches the installation environment. Failure to meet requirements for ambient conditions can reduce the lifetime of the frequency converter. Ensure that requirements for air humidity, temperature, and altitude are met.

Vibration and shock

The frequency converter complies with requirements for units mounted on the walls and floors of production premises, and in panels bolted to walls or floors.

For detailed ambient conditions specifications, refer to *chapter 8.4 Ambient Conditions*.

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3

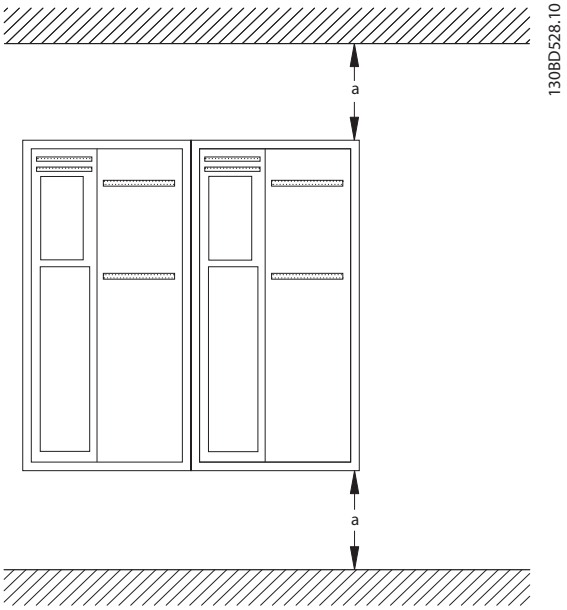
3.3 Mounting

NOTICE

Improper mounting can result in overheating and reduced performance.

Cooling

- Ensure that top and bottom clearance for air cooling is provided. See *Illustration 3.2* for clearance requirements.



Enclosure	A2–A5	B1–B4	C1, C3	C2, C4
a [mm (in)]	100 (3.9)	200 (7.9)	200 (7.9)	225 (8.9)

Illustration 3.2 Top and Bottom Cooling Clearance

Lifting

- To determine a safe lifting method, check the weight of the unit, see *chapter 8.9 Power Ratings, Weight, and Dimensions*.
- Ensure that the lifting device is suitable for the task.
- If necessary, plan for a hoist, crane, or forklift with the appropriate rating to move the unit.
- For lifting, use the hoist rings on the unit, when provided.

Mounting

1. Ensure that the strength of the mounting location supports the unit weight. The frequency converter allows side-by-side installation.
2. Locate the unit as near to the motor as possible. Keep the motor cables as short as possible.
3. Mount the unit vertically to a solid flat surface or to the optional backplate to provide cooling airflow.
4. Use the slotted mounting holes on the unit for wall mounting, when provided.

Mounting with backplate and railings

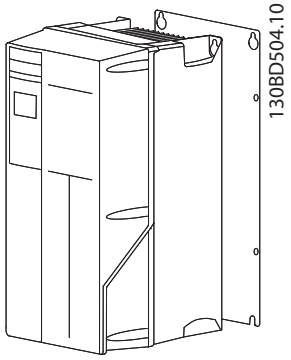


Illustration 3.3 Proper Mounting with Backplate

NOTICE

A backplate is required when mounted on railings.

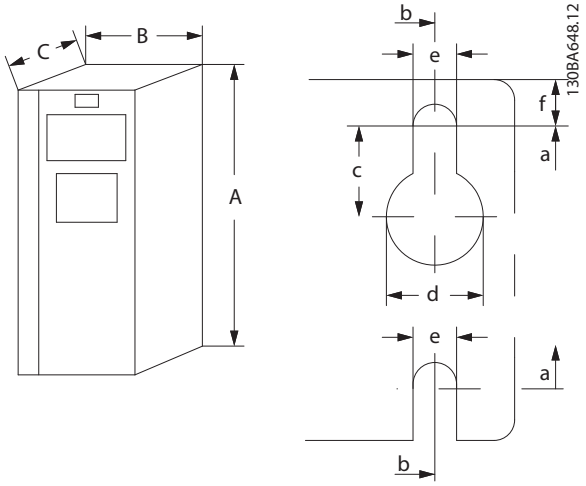


Illustration 3.4 Top and Bottom Mounting Holes (See *chapter 8.9 Power Ratings, Weight, and Dimensions*)

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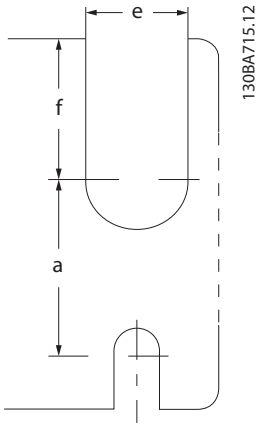

Illustration 3.5 Top and Bottom Mounting Holes (B4, C3, and C4)

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4 Electrical Installation

4.1 Safety Instructions

See *chapter 2 Safety* for general safety instructions.

4

⚠WARNING

INDUCED VOLTAGE

Induced voltage from output motor cables that run together can charge equipment capacitors, even with the equipment turned off and locked out. Failure to run output motor cables separately or to use shielded cables could result in death or serious injury.

- **Run output motor cables separately, or**
- **Use shielded cables.**

⚠CAUTION

SHOCK HAZARD

The frequency converter can cause a DC current in the PE conductor. Failure to follow the recommendation may lead to the RCD not providing the intended protection.

- **When a residual current-operated protective device (RCD) is used for protection against electrical shock, only an RCD of Type B is allowed on the supply side.**

Overcurrent protection

- Extra protective equipment, such as short-circuit protection or motor thermal protection between frequency converter and motor, is required for applications with multiple motors.
- Input fusing is required to provide short circuit and overcurrent protection. If not factory-supplied, the installer must provide fuses. See maximum fuse ratings in *chapter 8.8 Fuses and Circuit Breakers*.

Wire type and ratings

- All wiring must comply with local and national regulations regarding cross-section and ambient temperature requirements.
- Power connection wire recommendation: Minimum 75 °C (167 °F) rated copper wire.

See *chapter 8.1 Electrical Data* and *chapter 8.5 Cable Specifications* for recommended wire sizes and types.

4.2 EMC-compliant Installation

To obtain an EMC-compliant installation, follow the instructions provided in *chapter 4.3 Grounding*, *chapter 4.4 Wiring Schematic*, *chapter 4.6 Motor Connection*, and *chapter 4.8 Control Wiring*.

4.3 Grounding

⚠WARNING

LEAKAGE CURRENT HAZARD

Leakage currents exceed 3.5 mA. Failure to ground the frequency converter properly could result in death or serious injury.

- **Ensure the correct grounding of the equipment by a certified electrical installer.**

For electrical safety

- Ground the frequency converter in accordance with applicable standards and directives.
- Use a dedicated ground wire for input power, motor power, and control wiring.
- Do not ground 1 frequency converter to another in a daisy-chain fashion (see *Illustration 4.1*).
- Keep the ground wire connections as short as possible.
- Follow motor manufacturer wiring requirements.
- Minimum cable cross-section: 10 mm^2 (7 AWG). Separately terminate 2 ground wires, both complying with the dimension requirements.

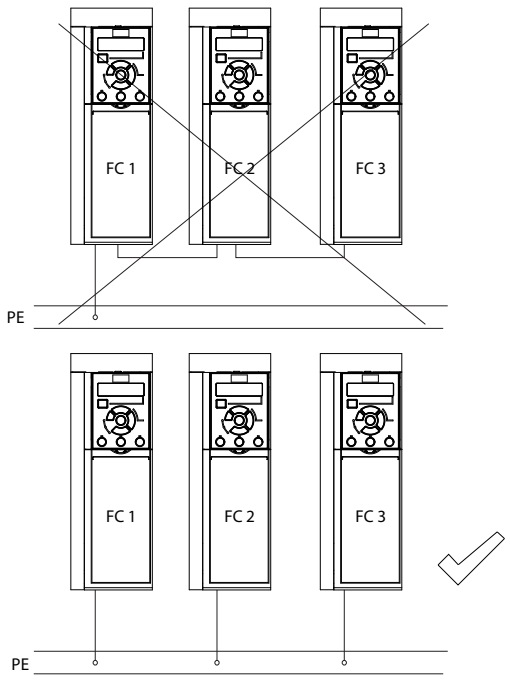

Illustration 4.1 Grounding Principle

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For EMC-compliant installation

- Establish electrical contact between the cable shield and the frequency converter enclosure by using metal cable glands or by using the clamps provided on the equipment (see *chapter 4.6 Motor Connection*).
- Use high-strand wire to reduce burst transient.
- Do not use pigtails.

NOTICE

POTENTIAL EQUALIZATION

Risk of burst transient when the ground potential between the frequency converter and the control system is different. Install equalizing cables between the system components. Recommended cable cross-section: 16 mm^2 (6 AWG).

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4.4 Wiring Schematic

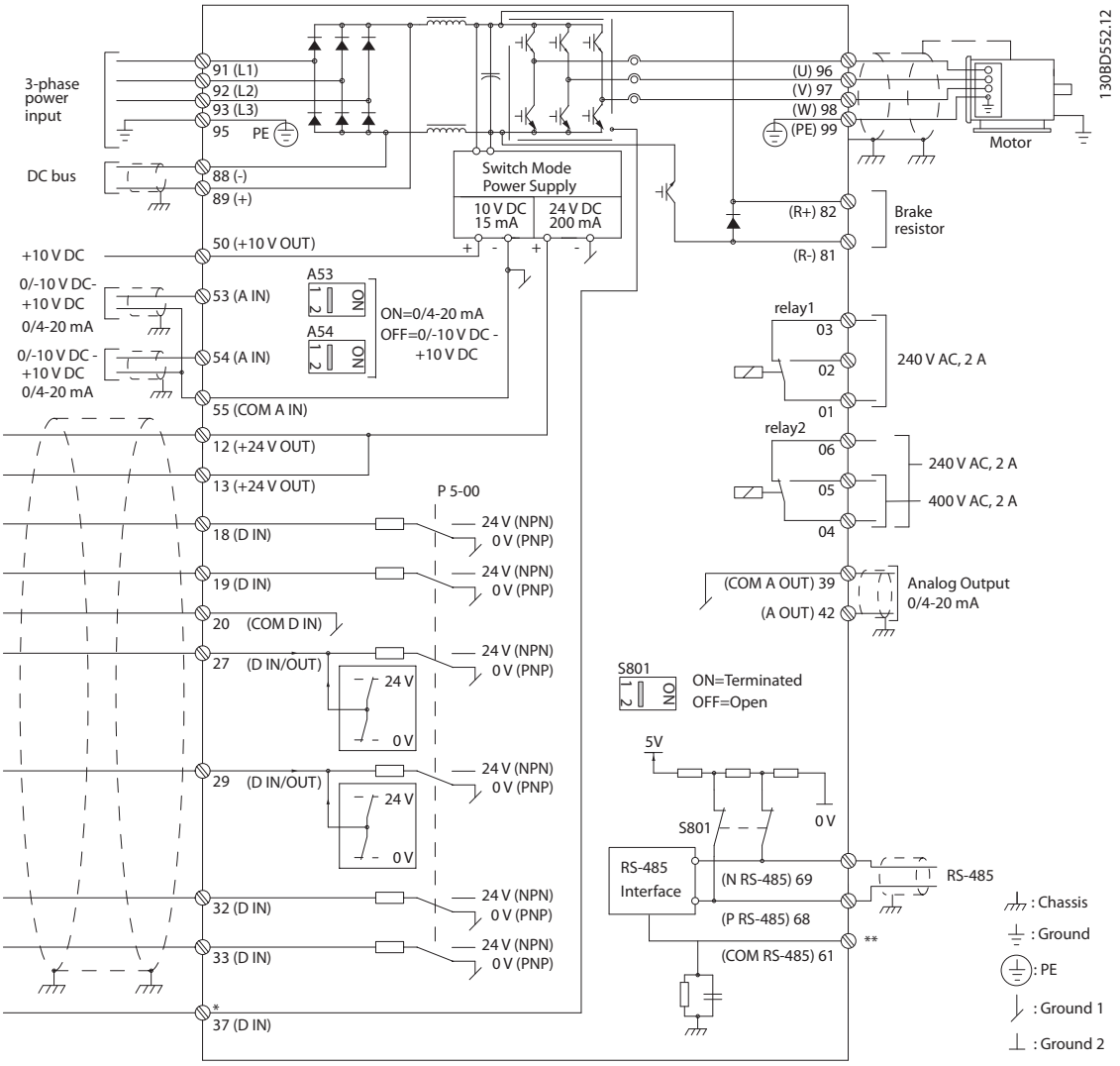

Illustration 4.2 Basic Wiring Schematic

A=Analog, D=Digital

*Terminal 37 (optional) is used for Safe Torque Off. For Safe Torque Off installation instructions, refer to the *VLT® Frequency Converters - Safe Torque Off Operating Guide*.

**Do not connect cable shield.

NOTICE

Actual configurations vary with unit types and optional equipment.

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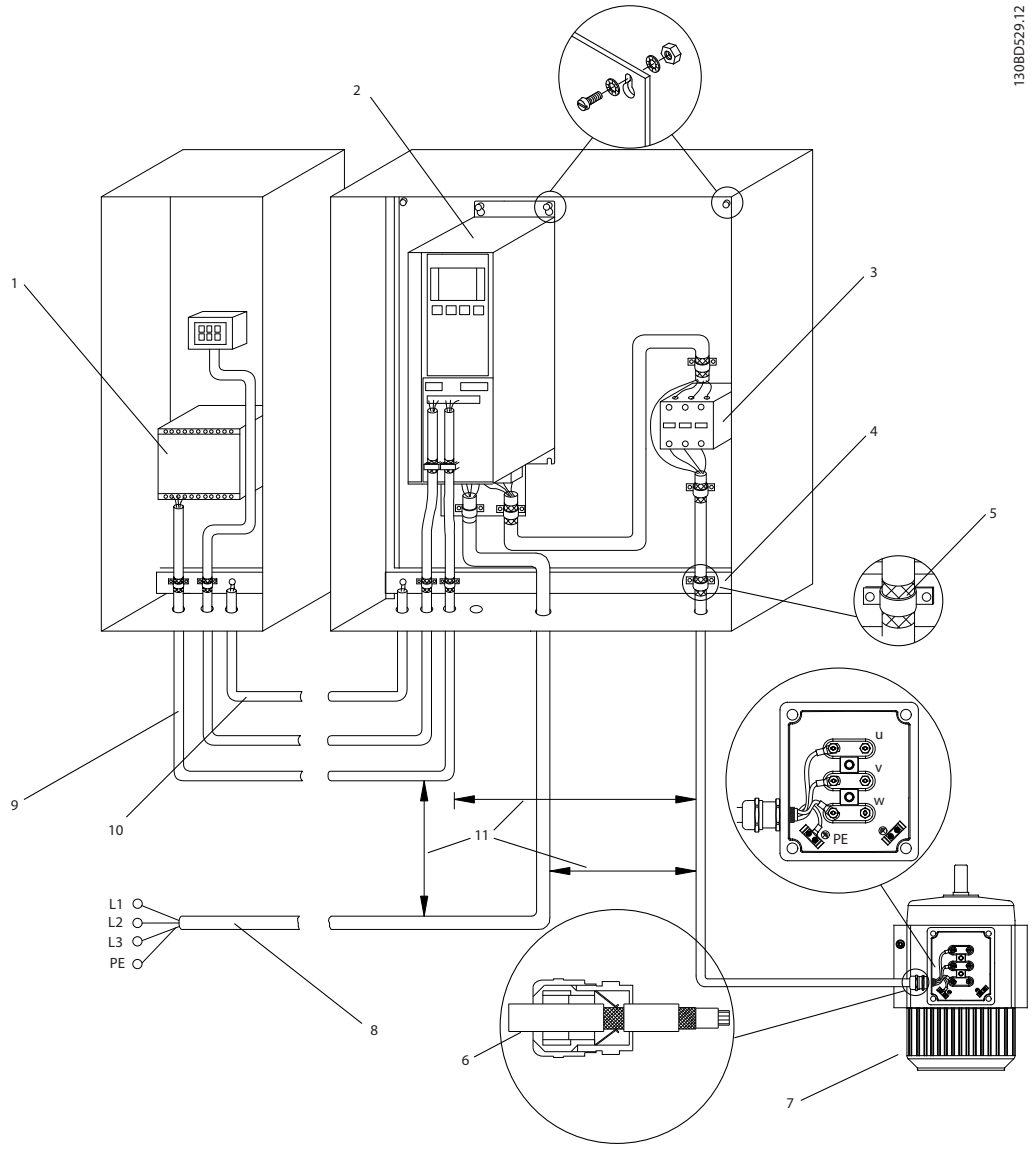

1	PLC	6	Cable gland
2	Frequency converter	7	Motor, 3-phase, and PE
3	Output contactor	8	Mains, 3-phase, and reinforced PE
4	Grounding rail (PE)	9	Control wiring
5	Cable insulation (stripped)	10	Equalizing minimum 16 mm^2 (5 AWG)

Illustration 4.3 EMC-compliant Connection of Mains

NOTICE

EMC INTERFERENCE

Use shielded cables for motor and control wiring and separate cables for input power, motor wiring, and control wiring. Failure to isolate power, motor, and control cables can result in unintended behavior or reduced performance. Minimum clearance requirement between power, motor, and control cables is 200 mm (7.9 in).

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4

4.5 Access

1. Remove the cover with a screwdriver (See *Illustration 4.4*) or by loosening the attaching screws (See *Illustration 4.5*).

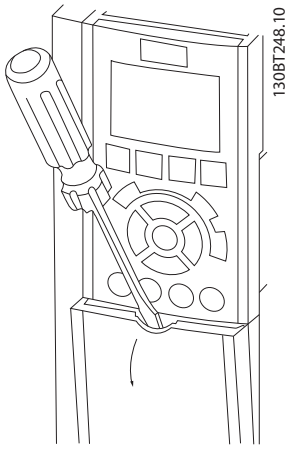

Illustration 4.4 Access to Wiring for IP20 and IP21 Enclosures

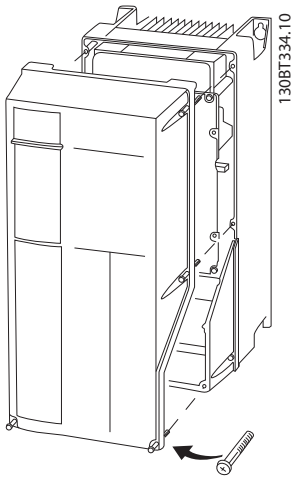

Illustration 4.5 Access to Wiring for IP55 and IP66 Enclosures

Tighten the cover screws using the tightening torques specified in *Table 4.1*.

Enclosure	IP55	IP66
A4/A5	2 (18)	2 (18)
B1/B2	2.2 (19)	2.2 (19)
C1/C2	2.2 (19)	2.2 (19)
No screws to tighten for A2/A3/B3/B4/C3/C4.		

Table 4.1 Tightening Torques for Covers [N•m (in-lb)]

4.6 Motor Connection

⚠WARNING

INDUCED VOLTAGE

Induced voltage from output motor cables that run together can charge equipment capacitors, even with the equipment turned off and locked out. Failure to run output motor cables separately or use shielded cables could result in death or serious injury.

- Run output motor cables separately, or
- Use shielded cables.
- Comply with local and national electrical codes for cable sizes. For maximum wire sizes, see *chapter 8.1 Electrical Data*.
- Follow motor manufacturer wiring requirements.
- Motor wiring knockouts or access panels are provided at the base of IP21 (NEMA1/12) and higher units.
- Do not wire a starting or pole-changing device (for example Dahlander motor or slip ring asynchronous motor) between the frequency converter and the motor.

Procedure

1. Strip a section of the outer cable insulation.
2. Position the stripped wire under the cable clamp to establish mechanical fixation and electrical contact between the cable shield and ground.
3. Connect the ground wire to the nearest grounding terminal in accordance with the grounding instructions provided in *chapter 4.3 Grounding*, see *Illustration 4.6*.
4. Connect the 3-phase motor wiring to terminals 96 (U), 97 (V), and 98 (W), see *Illustration 4.6*.
5. Tighten the terminals in accordance with the information provided in *chapter 8.7 Connection Tightening Torques*.

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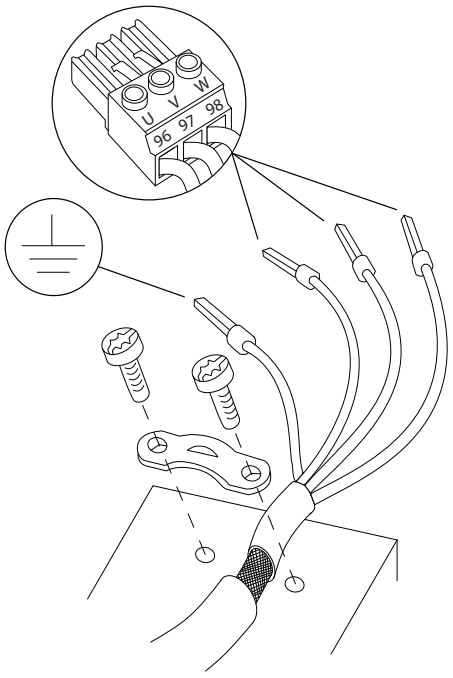

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Illustration 4.6 Motor Connection

Illustration 4.7 shows mains input, motor, and grounding for basic frequency converters. Actual configurations vary with unit types and optional equipment.

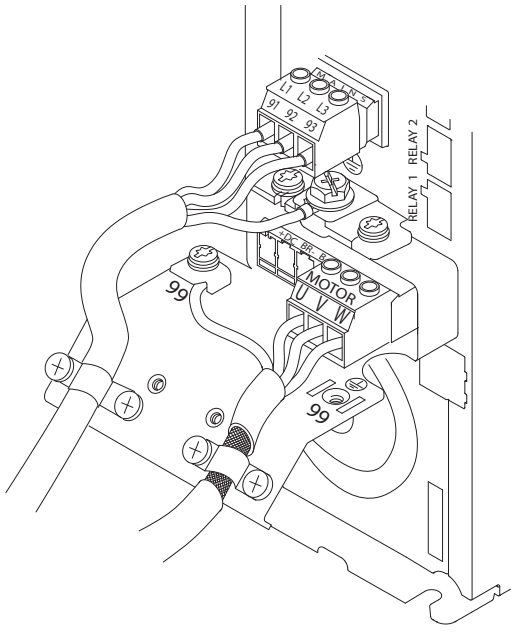

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Illustration 4.7 Example of Motor, Mains, and Ground Wiring

4.7 AC Mains Connection

- Size the wiring based on the input current of the frequency converter. For maximum wire sizes, see *chapter 8.1 Electrical Data*.
- Comply with local and national electrical codes for cable sizes.

Procedure

1. Connect the 3-phase AC input power wiring to terminals L1, L2, and L3 (see *Illustration 4.7*).
2. Depending on the configuration of the equipment, connect the input power to the mains input terminals or the input disconnect.
3. Ground the cable in accordance with the grounding instructions provided in *chapter 4.3 Grounding*.
4. When supplied from an isolated mains source (IT mains or floating delta) or TT/TN-S mains with a grounded leg (grounded delta), ensure that *parameter 14-50 RFI Filter* is set to *[0] Off* to avoid damage to the DC link and to reduce ground capacity currents in accordance with IEC 61800-3.

4.8 Control Wiring

- Isolate the control wiring from the high-power components in the frequency converter.
- When the frequency converter is connected to a thermistor, ensure that the thermistor control wiring is shielded and reinforced/double insulated. A 24 V DC supply voltage is recommended. See *Illustration 4.8*.

4.8.1 Control Terminal Types

Illustration 4.8 and *Illustration 4.9* show the removable frequency converter connectors. Terminal functions and default settings are summarized in *Table 4.2*.

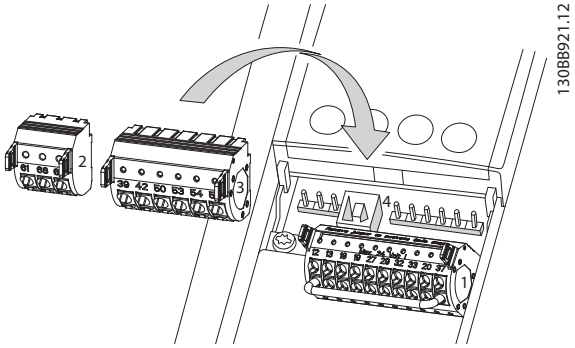

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Illustration 4.8 Control Terminal Locations

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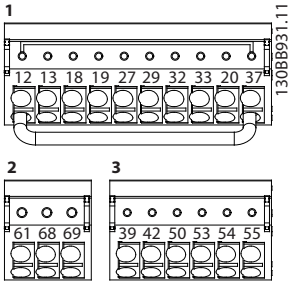

Illustration 4.9 Terminal Numbers

- **Connector 1** provides:
  - 4 programmable digital inputs terminals.
  - 2 extra digital terminals programmable as either input or output.
  - 24 V DC terminal supply voltage.
  - Optional customer supplied 24 V DC voltage.
- **Connector 2** terminals (+)68 and (-)69 are for an RS485 serial communication connection.
- **Connector 3** provides:
  - 2 analog inputs.
  - 1 analog output.
  - 10 V DC supply voltage.
  - Commons for the inputs and output.
- **Connector 4** is a USB port available for use with the MCT 10 Set-up Software.

Terminal description			
Terminal	**Parameter**	**Default setting**	**Description**
Digital Inputs/Outputs			
12, 13	–	+24 V DC	24 V DC supply voltage for digital inputs and external transducers. Maximum output current 200 mA for all 24 V loads.

Terminal description			
Terminal	**Parameter**	**Default setting**	**Description**
18	*Parameter 5 -10 Termina l 18 Digital Input*	*[8] Start*	Digital inputs.
19	*Parameter 5 -11 Termina l 19 Digital Input*	*[0] No operation*	
32	*Parameter 5 -14 Termina l 32 Digital Input*	*[0] No operation*	
33	*Parameter 5 -15 Termina l 33 Digital Input*	*[0] No operation*	
27	*Parameter 5 -12 Termina l 27 Digital Input*	*[2] Coast inverse*	For digital input or output. Default setting is input.
29	*Parameter 5 -13 Termina l 29 Digital Input*	*[14] Jog*	
20	–	–	Common for digital inputs and 0 V potential for 24 V supply.
37	–	Safe Torque Off (STO)	Safe input (optional). Used for STO.
Analog Inputs/Outputs			
39	–	–	Common for analog output
42	*Parameter 6 -50 Termina l 42 Output*	Speed 0 – High Limit	Programmable analog output. 0–20 mA or 4–20 mA at a maximum of 500 Ω
50	–	+10 V DC	10 V DC analog supply voltage for potenti-ometer or thermistor. 15 mA maximum
53	*Parameter group 6-1* Analog Input 53*	Reference	Analog input. For voltage or current. Switches A53 and A54 select mA or V.
54	*Parameter group 6-2* Analog Input 54*	Feedback	
55	–	–	Common for analog input
Serial Communication			

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Terminal description			
Terminal	Parameter	Default setting	Description
61	–	–	Integrated RC-Filter for cable shield. ONLY for connecting the shield if EMC problems occur.
68 (+)	*Parameter group 8-3* FC Port Settings*	–	RS485 Interface. A control card switch is provided for termination resistance.
69 (-)	*Parameter group 8-3* FC Port Settings*	–	
Relays			
01, 02, 03	*Parameter 5 -40 Function Relay* [0]	*[9] Alarm*	Form C relay output. For AC or DC voltage and resistive or inductive loads.
04, 05, 06	*Parameter 5 -40 Function Relay* [1]	*[5] Running*	

Table 4.2 Terminal Description

Extra terminals

- 2 form C relay outputs. Location of the outputs depends on frequency converter configuration.
- Terminals on built-in optional equipment. See the manual provided with the equipment option.

4.8.2 Wiring to Control Terminals

Control terminal connectors can be unplugged from the frequency converter for ease of installation, as shown in *Illustration 4.10*.

NOTICE

Keep control wires as short as possible and separate from high-power cables to minimize interference.

1. Open the contact by inserting a small screwdriver into the slot above the contact and push the screwdriver slightly upwards.

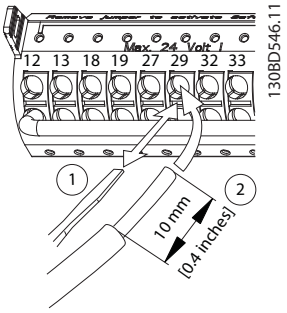

Illustration 4.10 Connecting Control Wires

2. Insert the bare control wire into the contact.
3. Remove the screwdriver to fasten the control wire into the contact.
4. Ensure that the contact is firmly established and not loose. Loose control wiring can be the source of equipment faults or less than optimal operation.

See *chapter 8.5 Cable Specifications* for control terminal wiring sizes and *chapter 6 Application Set-up Examples* for typical control wiring connections.

4.8.3 Enabling Motor Operation (Terminal 27)

A jumper wire is required between terminal 12 (or 13) and terminal 27 for the frequency converter to operate when using factory default programming values.

- Digital input terminal 27 is designed to receive 24 V DC external interlock command.
- When no interlock device is used, wire a jumper between control terminal 12 (recommended) or 13 to terminal 27. The jumper provides an internal 24 V signal on terminal 27.
- When the status line at the bottom of the LCP reads *AUTO REMOTE COAST*, it indicates that the unit is ready to operate but is missing an input signal on terminal 27.
- When factory installed optional equipment is wired to terminal 27, do not remove that wiring.

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4.8.4 Voltage/Current Input Selection (Switches)

The analog input terminals 53 and 54 allow setting of input signal to voltage (0–10 V) or current (0/4–20 mA).

Default parameter setting

- Terminal 53: Speed reference signal in open loop (see *parameter 16-61 Terminal 53 Switch Setting*).
- Terminal 54: Feedback signal in closed loop (see *parameter 16-63 Terminal 54 Switch Setting*).

NOTICE

Disconnect power to the frequency converter before changing switch positions.

1. Remove the LCP (see *Illustration 4.11*).
2. Remove any optional equipment covering the switches.
3. Set switches A53 and A54 to select the signal type. U selects voltage, I selects current.

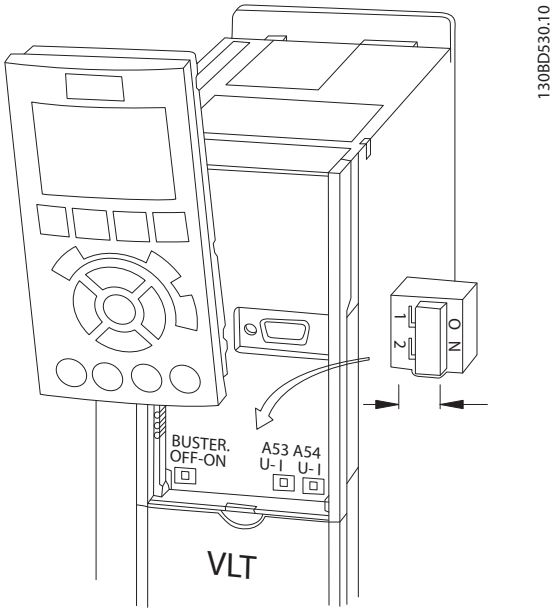

Illustration 4.11 Location of Terminal 53 and 54 Switches

To run STO, more wiring for the frequency converter is required. Refer to *VLT® Frequency Converters Safe Torque Off Operating Guide* for further information.

4.8.5 RS485 Serial Communication

Connect RS485 serial communication wiring to terminals (+)68 and (-)69.

- Use shielded serial communication cable (recommended).
- See *chapter 4.3 Grounding* for proper grounding.

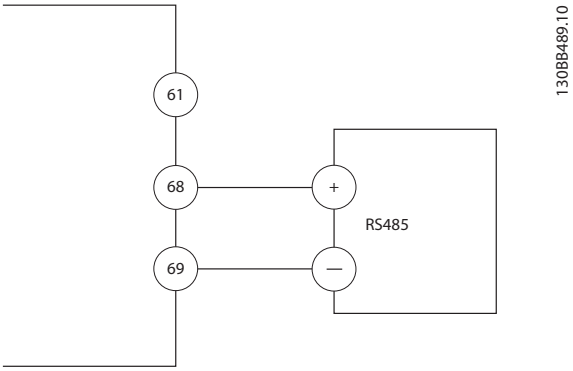

Illustration 4.12 Serial Communication Wiring Diagram

For basic serial communication set-up, select the following:

1. Protocol type in *parameter 8-30 Protocol*.
2. Frequency converter address in *parameter 8-31 Address*.
3. Baud rate in *parameter 8-32 Baud Rate*.

- 2 communication protocols are internal to the frequency converter:
  - Danfoss FC.
  - Modbus RTU.
- Functions can be programmed remotely using the protocol software and RS485 connection or in *parameter group 8-** Communications and Options*.
- Selecting a specific communication protocol changes various default parameter settings to match that protocol's specifications and makes more protocol-specific parameters available.
- Option cards for the frequency converter are available to provide extra communication protocols. See the option card documentation for installation and operation instructions.

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4.9 Installation Check List

Before completing installation of the unit, inspect the entire installation as detailed in *Table 4.3*. Check and mark the items when completed.

Inspect for	Description	☑
Auxiliary equipment	• Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers, residing on the input power side of the frequency converter, or output side to the motor. Ensure that they are ready for full-speed operation. • Check the function and installation of any sensors used for feedback to the frequency converter. • Remove any power factor correction caps on the motor. • Adjust any power factor correction caps on the mains side and ensure that they are dampened.	
Cable routing	• Ensure that the motor wiring and control wiring are separated, shielded, or in 3 separate metallic conduits for high frequency interference isolation.	
Control wiring	• Check for broken or damaged wires and loose connections. • Check that the control wiring is isolated from power and motor wiring for noise immunity. • Check the voltage source of the signals, if necessary. The use of shielded cable or twisted pair is recommended. Ensure that the shield is terminated correctly.	
Cooling clearance	• Ensure that the top and bottom clearance is adequate to ensure proper airflow for cooling, see *chapter 3.3 Mounting*.	
Ambient conditions	• Check that requirements for ambient conditions are met.	
Fusing and circuit breakers	• Check for proper fusing or circuit breakers. • Check that all fuses are inserted firmly and are in operational condition, and that all circuit breakers are in the open position.	
Grounding	• Check for sufficient ground connections and ensure that those connections are tight and free of oxidation. • Grounding to conduit, or mounting the back panel to a metal surface, is not a suitable grounding.	
Input and output power wiring	• Check for loose connections. • Check that the motor and mains cables are in separate conduit or separated shielded cables.	
Panel interior	• Inspect that the unit interior is free of dirt, metal chips, moisture, and corrosion. • Check that the unit is mounted on an unpainted metal surface.	
Switches	• Ensure that all switch and disconnect settings are in the proper positions.	
Vibration	• Check that the unit is mounted solidly, or that shock mounts are used, as necessary. • Check for an unusual amount of vibration.	

Table 4.3 Installation Check List

⚠CAUTION

POTENTIAL HAZARD IN THE EVENT OF INTERNAL FAILURE

Risk of personal injury if the frequency converter is not properly closed.

- **Before applying power, ensure that all safety covers are in place and securely fastened.**

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5 Commissioning

5.1 Safety Instructions

See *chapter 2 Safety* for general safety instructions.

⚠WARNING

HIGH VOLTAGE

Frequency converters contain high voltage when connected to AC mains input power. Failure to perform installation, start-up, and maintenance by qualified personnel could result in death or serious injury.

- **Installation, start-up, and maintenance must be performed by qualified personnel only.**

Before applying power:

1. Close the cover properly.
2. Check that all cable glands are firmly tightened.
3. Ensure that input power to the unit is off and locked out. Do not rely on the frequency converter disconnect switches for input power isolation.
4. Verify that there is no voltage on input terminals L1 (91), L2 (92), and L3 (93), phase-to-phase, and phase-to-ground.
5. Verify that there is no voltage on output terminals 96 (U), 97 (V), and 98 (W), phase-to-phase, and phase-to-ground.
6. Confirm continuity of the motor by measuring Ω values on U–V (96–97), V–W (97–98), and W–U (98–96).
7. Check for proper grounding of the frequency converter and the motor.
8. Inspect the frequency converter for loose connections on the terminals.
9. Confirm that the supply voltage matches the voltage of the frequency converter and the motor.

5.2 Applying Power

Apply power to the frequency converter using the following steps:

1. Confirm that the input voltage is balanced within 3%. If not, correct the input voltage imbalance before proceeding. Repeat this procedure after the voltage correction.
2. Ensure that any optional equipment wiring matches the installation application.
3. Ensure that all operator devices are in the OFF position. Panel doors must be closed and covers securely fastened.
4. Apply power to the unit. Do not start the frequency converter now. For units with a disconnect switch, turn it to the ON position to apply power to the frequency converter.

5.3 Local Control Panel Operation

The local control panel (LCP) is the combined display and keypad on the front of the unit.

The LCP has several user functions:

- Start, stop, and control speed when in local control.
- Show operational data, status, warnings, and cautions.
- Program frequency converter functions.
- Manually reset the frequency converter after a fault when auto reset is inactive.

An optional numeric LCP (NLCP) is also available. The NLCP operates in a manner similar to the LCP. See the product relevant *programming guide* for details on use of the NLCP.

NOTICE

For commissioning via PC, install the MCT 10 Set-up Software. The software is available for download (basic version) or for ordering (advanced version, code number 130B1000). For more information and downloads, see *www.danfoss.com/BusinessAreas/DrivesSolutions/Software+MCT10/MCT10+Downloads.htm*.

5.3.1 Graphic Local Control Panel Layout

The graphic local control panel (GLCP) is divided into 4 functional groups (see *Illustration 5.1*).

A. Display area.

B. Display menu keys.

C. Navigation keys and indicator lights.

D. Operation keys and reset.

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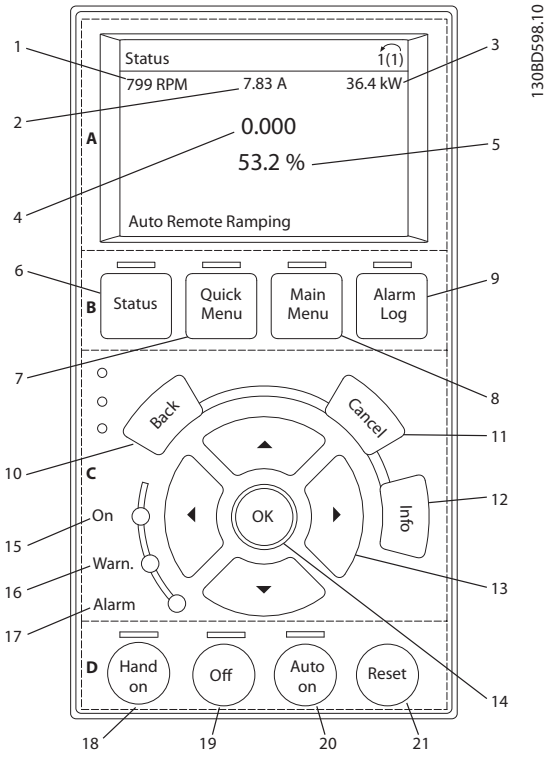

Illustration 5.1 GLCP

A. Display area

The display area is activated when the frequency converter receives power from the mains voltage, a DC bus terminal, or a 24 V DC external supply.

The information shown on the LCP can be customized for user applications. Select options in the *Quick Menu Q3-13 Display Settings*.

Display	Parameter	Default setting
1	*Parameter 0-20 Display Line 1.1 Small*	*[1617] Speed [RPM]*
2	*Parameter 0-21 Display Line 1.2 Small*	*[1614] Motor Current*
3	*Parameter 0-22 Display Line 1.3 Small*	*[1610] Power [kW]*
4	*Parameter 0-23 Display Line 2 Large*	*[1613] Frequency*
5	*Parameter 0-24 Display Line 3 Large*	*[1602] Reference %*

Table 5.1 Legend to *Illustration 5.1*, Display Area

B. Display menu keys

Menu keys are used for menu access for parameter set-up, toggling through status display modes during normal operation, and viewing fault log data.

	Key	Function
6	Status	Shows operational information.
7	Quick Menu	Allows access to programming parameters for initial set-up instructions and many detailed application instructions.
8	Main Menu	Allows access to all programming parameters.
9	Alarm Log	Shows a list of current warnings, the last 10 alarms, and the maintenance log.

Table 5.2 Legend to *Illustration 5.1*, Display Menu Keys

C. Navigation keys and indicator lights (LEDs)

Navigation keys are used for programming functions and moving the display cursor. The navigation keys also provide speed control in local operation. There are also 3 frequency converter status indicator lights in this area.

	Key	Function
10	Back	Reverts to the previous step or list in the menu structure.
11	Cancel	Cancels the last change or command as long as the display mode is not changed.
12	Info	Press for a definition of the function being showed.
13	Navigation Keys	Press the navigation keys to move between items in the menu.
14	OK	Press to access parameter groups or to enable a selection.

Table 5.3 Legend to *Illustration 5.1*, Navigation Keys

	Indicator	Color	Function
15	On	Green	The ON indicator light activates when the frequency converter receives power from the mains voltage, a DC bus terminal, or a 24 V external supply.
16	Warn	Yellow	When warning conditions are met, the yellow WARN indicator light comes on and text appears in the display area identifying the problem.
17	Alarm	Red	A fault condition causes the red alarm LED to flash and an alarm text is shown.

Table 5.4 Legend to *Illustration 5.1*, Indicator Lights (LEDs)

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D. Operation keys and reset
Operation keys are at the bottom of the LCP.

	Key	Function
18	[Hand On]	Starts the frequency converter in local control. • An external stop signal by control input or serial communication overrides the local hand on.
19	Off	Stops the motor but does not remove power to the frequency converter.
20	[Auto On]	Puts the system in remote operational mode. • Responds to an external start command by control terminals or serial communication.
21	Reset	Resets the frequency converter manually after a fault has been cleared.

Table 5.5 Legend to *Illustration 5.1*, Operation Keys and Reset

NOTICE

The display contrast can be adjusted by pressing [Status] and the [▲]/[▼] keys.

5.3.2 Parameter Settings

Establishing the correct programming for applications often requires setting functions in several related parameters. Details for parameters are provided in *chapter 9.2 Parameter Menu Structure*.

Programming data is stored internally in the frequency converter.

- For back-up, upload data into the LCP memory.
- To download data to another frequency converter, connect the LCP to that unit and download the stored settings.
- Restoring factory default settings does not change data stored in the LCP memory.

5.3.3 Uploading/Downloading Data to/from the LCP

1. Press [Off] to stop the motor before uploading or downloading data.
2. Press [Main Menu], select *parameter 0-50 LCP Copy* and press [OK].
3. Select *[1] All to LCP* to upload data to the LCP or select *[2] All from LCP* to download data from the LCP.
4. Press [OK]. A progress bar shows the uploading or downloading progress.
5. Press [Hand On] or [Auto On] to return to normal operation.

5.3.4 Changing Parameter Settings

Access and change parameter settings from the *Quick Menu* or from the *Main Menu*. The *Quick Menu* only gives access to a limited number of parameters.

1. Press [Quick Menu] or [Main Menu] on the LCP.
2. Press [▲] [▼] to browse through the parameter groups, press [OK] to select a parameter group.
3. Press [▲] [▼] to browse through the parameters, press [OK] to select a parameter.
4. Press [▲] [▼] to change the value of a parameter setting.
5. Press [◄] [►] to shift digit when a decimal parameter is in the editing state.
6. Press [OK] to accept the change.
7. Press either [Back] twice to enter *Status*, or press [Main Menu] once to enter the *Main Menu*.

View changes
Quick Menu Q5 - Changes Made lists all parameters changed from default settings.

- The list only shows parameters, which are changed in the current edit set-up.
- Parameters, which were reset to default values, are not listed.
- The message *Empty* indicates that no parameters are changed.

5.3.5 Restoring Default Settings

NOTICE

Risk of losing programming, motor data, localization, and monitoring records by restoration of default settings. To provide a back-up, upload data to the LCP before initialization.

Restoring the default parameter settings is done by initialization of the frequency converter. Initialization is carried out through *parameter 14-22 Operation Mode* (recommended) or manually.

- Initialization using *parameter 14-22 Operation Mode* does not reset frequency converter settings such as hours run, serial communication selections, personal menu settings, fault log, alarm log, and other monitoring functions.
- Manual initialization erases all motor, programming, localization, and monitoring data and restores factory default settings.

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Recommended initialization procedure via *parameter 14-22 Operation Mode*

1. Press [Main Menu] twice to access parameters.
2. Scroll to *parameter 14-22 Operation Mode* and press [OK].
3. Scroll to *[2] initialization* and press [OK].
4. Remove power to the unit and wait for the display to turn off.
5. Apply power to the unit.

Default parameter settings are restored during start-up. The start-up may take slightly longer than normal.

6. *Alarm 80, Drive initialized to default value* is shown.
7. Press [Reset] to return to operating mode.

Manual initialization procedure

1. Remove power to the unit and wait for the display to turn off.
2. Press and hold [Status], [Main Menu], and [OK] at the same time while applying power to the unit (approximately 5 s or until audible click and fan starts).

Factory default parameter settings are restored during start-up. The start-up may take slightly longer than usual.

Manual initialization does not reset the following frequency converter information:

- *Parameter 15-00 Operating hours*.
- *Parameter 15-03 Power Up's*.
- *Parameter 15-04 Over Temp's*.
- *Parameter 15-05 Over Volt's*.

5.4 Basic Programming

5.4.1 Commissioning with SmartStart

The SmartStart wizard enables fast configuration of basic motor and application parameters.

- SmartStart starts automatically at first power-up or after initialization of the frequency converter.
- Follow the on-screen instructions to complete the commissioning of the frequency converter. Always reactivate SmartStart by selecting *Quick Menu Q4 - SmartStart*.
- For commissioning without use of the SmartStart wizard, refer to *chapter 5.4.2 Commissioning via [Main Menu]* or the programming guide.

NOTICE

Motor data is required for the SmartStart set-up. The required data is normally available on the motor nameplate.

The SmartStart configures the frequency converter in 3 phases, each consisting of several steps, see *Table 5.6*.

Phase		Action
1	Basic Programming	Perform the programming
2	Application Section	Select and program appropriate application: • Single pump/motor. • Motor alternation. • Basic cascade control. • Master/slave.
3	Water and Pump Features	Go to water and pump dedicated parameters.

Table 5.6 SmartStart, Setup in 3 Phases

5.4.2 Commissioning via [Main Menu]

Recommended parameter settings are intended for start-up and check-out purposes. Application settings may vary.

Enter data with power ON, but before operating the frequency converter.

1. Press [Main Menu] on the LCP.
2. Press the navigation keys to scroll to *parameter group 0-** Operation/Display* and press [OK].

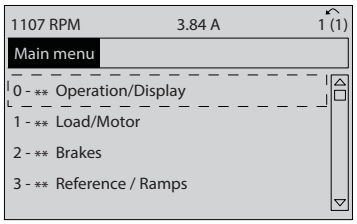

Illustration 5.2 Main Menu

3. Press the navigation keys to scroll to *parameter group 0-0* Basic Settings* and press [OK].

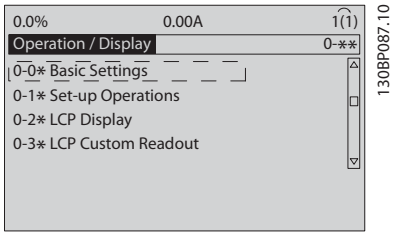

Illustration 5.3 Operation/Display

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4. Press the navigation keys to scroll to *parameter 0-03 Regional Settings* and press [OK].

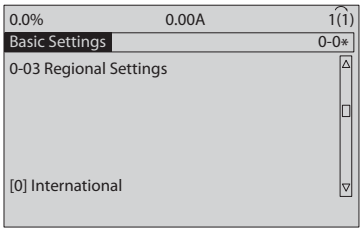

Illustration 5.4 Basic Settings

5. Press the navigation keys to select *[0] International* or *[1] North America* as appropriate and press [OK]. (This changes the default settings for several basic parameters).
6. Press [Main Menu] on the LCP.
7. Press the navigation keys to scroll to *parameter 0-01 Language*.
8. Select the language and press [OK].
9. If a jumper wire is in place between control terminals 12 and 27, leave *parameter 5-12 Terminal 27 Digital Input* at factory default. Otherwise, select *[0] No operation* in *parameter 5-12 Terminal 27 Digital Input*.
10. Make the application-specific settings in the following parameters:
    - 10a *Parameter 3-02 Minimum Reference*.
    - 10b *Parameter 3-03 Maximum Reference*.
    - 10c *Parameter 3-41 Ramp 1 Ramp Up Time*.
    - 10d *Parameter 3-42 Ramp 1 Ramp Down Time*.
    - 10e *Parameter 3-13 Reference Site*. Linked to Hand/Auto Local Remote.

5.4.3 Asynchronous Motor Set-up

Enter the following motor data. Find the information on the motor nameplate.

1. *Parameter 1-20 Motor Power [kW]* or *parameter 1-21 Motor Power [HP]*.
2. *Parameter 1-22 Motor Voltage*.
3. *Parameter 1-23 Motor Frequency*.
4. *Parameter 1-24 Motor Current*.
5. *Parameter 1-25 Motor Nominal Speed*.

For optimum performance in VVC+ mode, extra motor data is required to set up the following parameters. Find the data in the motor datasheet (this data is typically not available on the motor nameplate). Run a complete automatic motor adaptation (AMA) using *parameter 1-29 Automatic Motor Adaptation (AMA) [1] Enable Complete AMA* or enter the parameters manually. *Parameter 1-36 Iron Loss Resistance (Rfe)* is always entered manually.

6. *Parameter 1-30 Stator Resistance (Rs)*.
7. *Parameter 1-31 Rotor Resistance (Rr)*.
8. *Parameter 1-33 Stator Leakage Reactance (X1)*.
9. *Parameter 1-34 Rotor Leakage Reactance (X2)*.
10. *Parameter 1-35 Main Reactance (Xh)*.
11. *Parameter 1-36 Iron Loss Resistance (Rfe)*.

Application-specific adjustment when running VVC+
VVC+ is the most robust control mode. In most situations, it provides optimum performance without further adjustments. Run a complete AMA for best performance.

5.4.4 PM Motor Setup in VVC+

NOTICE

Only use permanent magnet (PM) motor with fans and pumps.

Initial programming steps

1. Activate PM motor operation
   Parameter 1-10 Motor Construction, select *[1] PM, non salient SPM.*
2. Set *parameter 0-02 Motor Speed Unit* to *[0] RPM*.

Programming motor data
After selecting PM motor in *parameter 1-10 Motor Construction*, the PM motor-related parameters in parameter groups *1-2* Motor Data*, *1-3* Adv. Motor Data* and *1-4** are active.
The necessary data can be found on the motor nameplate and in the motor datasheet.

Program the following parameters in the listed order:

1. *Parameter 1-24 Motor Current*.
2. *Parameter 1-26 Motor Cont. Rated Torque*.
3. *Parameter 1-25 Motor Nominal Speed*.
4. *Parameter 1-39 Motor Poles*.
5. *Parameter 1-30 Stator Resistance (Rs)*.
   Enter line to common stator winding resistance (Rs). If only line-line data is available, divide the line-line value with 2 to achieve the line to common (startpoint) value.
6. *Parameter 1-37 d-axis Inductance (Ld)*.
   Enter line to common direct axis inductance of the PM motor.

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If only line-line data is available, divide the line-line value by 2 to achieve the line-common (startpoint) value.

7. *Parameter 1-40 Back EMF at 1000 RPM*.
   Enter line-to-line back EMF of the PM motor at 1000 RPM mechanical speed (RMS value). Back EMF is the voltage generated by a PM motor when no frequency converter is connected and the shaft is turned externally. Back EMF is normally specified for nominal motor speed or for 1000 RPM measured between 2 lines. If the value is not available for a motor speed of 1000 RPM, calculate the correct value as follows: If back EMF is for example 320 V at 1800 RPM, it can be calculated at 1000 RPM as follows: Back EMF = (Voltage / RPM)*1000 = (320/1800)*1000 = 178. This is the value that must be programmed for *parameter 1-40 Back EMF at 1000 RPM*.

Test motor operation

1. Start the motor at low speed (100–200 RPM). If the motor does not turn, check installation, general programming, and motor data.
2. Check if the start function in *parameter 1-70 PM Start Mode* fits the application requirements.

Rotor detection
This function is the recommended choice for applications where the motor starts from standstill, for example pumps or conveyors. On some motors, a sound is heard when the impulse is sent out. This does not harm the motor.

Parking
This function is the recommended choice for applications where the motor is rotating at slow speed, for example windmilling in fan applications. *Parameter 2-06 Parking Current* and *parameter 2-07 Parking Time* can be adjusted. Increase the factory setting of these parameters for applications with high inertia.

Start the motor at nominal speed. If the application does not run well, check the VVC+ PM settings. Recommended settings in different applications can be found in *Table 5.7*.

Application	Settings
Low inertia applications I_{Load}/I_{Motor} <5	*Parameter 1-17 Voltage filter time const.* to be increased by factor 5–10. *Parameter 1-14 Damping Gain* should be reduced. *Parameter 1-66 Min. Current at Low Speed* should be reduced (<100%).
Low inertia applications 50>I_{Load}/I_{Motor} >5	Keep calculated values.
High inertia applications I_{Load}/I_{Motor} > 50	*Parameter 1-14 Damping Gain*, *parameter 1-15 Low Speed Filter Time Const.*, and *parameter 1-16 High Speed Filter Time Const.* should be increased.
High load at low speed <30% (rated speed)	*Parameter 1-17 Voltage filter time const.* should be increased. *Parameter 1-66 Min. Current at Low Speed* should be increased (>100% for a prolonged time can overheat the motor).

Table 5.7 Recommended Settings in Different Applications

If the motor starts oscillating at a certain speed, increase *parameter 1-14 Damping Gain*. Increase the value in small steps. Depending on the motor, a good value for this parameter can be 10% or 100% higher than the default value.

The starting torque can be adjusted in *parameter 1-66 Min. Current at Low Speed*. 100% provides nominal torque as starting torque.

5.4.5 SynRM Motor Set-up with VVC+

This section describes how to set up a SynRM motor with VVC+.

NOTICE

The SmartStart wizard covers the basic configuration of SynRM motors.

Initial programming steps
To activate SynRM motor operation, select *[5] Sync. Reluctance* in *parameter 1-10 Motor Construction*.

Programming motor data
After performing the initial programming steps, the SynRM motor-related parameters in *parameter groups 1-2* Motor Data*, *1-3* Adv. Motor Data*, and *1-4* Adv. Motor Data II* are active.

Use the motor nameplate data and the motor datasheet to program the following parameters in the order listed:

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1. *Parameter 1-23 Motor Frequency*.
2. *Parameter 1-24 Motor Current*.
3. *Parameter 1-25 Motor Nominal Speed*.
4. *Parameter 1-26 Motor Cont. Rated Torque*.

Run a complete AMA using *parameter 1-29 Automatic Motor Adaptation (AMA) [1] Enable Complete AMA* or enter the following parameters manually:

1. *Parameter 1-30 Stator Resistance (Rs)*.
2. *Parameter 1-37 d-axis Inductance (Ld)*.
3. *Parameter 1-44 d-axis Inductance Sat. (LdSat)*.
4. *Parameter 1-45 q-axis Inductance Sat. (LqSat)*.
5. *Parameter 1-48 Inductance Sat. Point*.

Application-specific adjustments

Start the motor at nominal speed. If the application does not run well, check the VVC+ SynRM settings. *Table 5.8* provides application-specific recommendations:

Application	Settings
Low-inertia applications I_{Load}/I_{Motor}<5	Increase *parameter 1-17 Voltage filter time const.* by factor 5–10. Reduce *parameter 1-14 Damping Gain*. Reduce *parameter 1-66 Min. Current at Low Speed* (<100%).
Low-inertia applications 50>I_{Load}/I_{Motor}>5	Keep the default values.
High-inertia applications I_{Load}/I_{Motor}>50	Increase *parameter 1-14 Damping Gain*, *parameter 1-15 Low Speed Filter Time Const.*, and *parameter 1-16 High Speed Filter Time Const.*
High-load at low speed <30% (rated speed)	Increase *parameter 1-17 Voltage filter time const.* Increase *parameter 1-66 Min. Current at Low Speed* to adjust the starting torque. 100% current provides nominal torque as starting torque. Working at a current level higher than 100% for a prolonged time can cause the motor to overheat.
Dynamic applications	Increase *parameter 14-41 AEO Minimum Magnetisation* for highly dynamic applications. Adjusting *parameter 14-41 AEO Minimum Magnetisation* ensures a good balance between energy efficiency and dynamics. Adjust *parameter 14-42 Minimum AEO Frequency* to specify the minimum frequency at which the frequency converter should use minimum magnetization.
Motor sizes less than 18 kW (24 hp)	Avoid short ramp-down times.

Table 5.8 Recommendations for Various Applications

If the motor starts oscillating at a certain speed, increase *parameter 1-14 Damping Gain*. Increase the damping gain value in small steps. Depending on the motor, this parameter can be set to 10–100% higher than the default value.

5.4.6 Automatic Energy Optimization (AEO)

NOTICE

AEO is not relevant for permanent magnet motors.

AEO is a procedure which minimizes voltage to the motor, as a result of that reducing energy consumption, heat, and noise.

To activate AEO, set *parameter 1-03 Torque Characteristics* to *[2] Auto Energy Optim. CT* or *[3] Auto Energy Optim. VT*.

5.4.7 Automatic Motor Adaptation (AMA)

AMA is a procedure which optimizes compatibility between the frequency converter and the motor.

- The frequency converter builds a mathematical model of the motor for regulating output motor current. The procedure also tests the input phase balance of electrical power. It compares the motor characteristics with the entered nameplate data.
- The motor shaft does not turn and no harm is done to the motor while running the AMA.
- Some motors may be unable to run the complete version of the test. In that case, select *[2] Enable reduced AMA*.
- If an output filter is connected to the motor, select *[2] Enable reduced AMA*.

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- If warnings or alarms occur, see *chapter 7.4 List of Warnings and Alarms*.
- Run this procedure on a cold motor for best results.

To run AMA

1. Press [Main Menu] to access parameters.
2. Scroll to *parameter group 1-** Load and Motor* and press [OK].
3. Scroll to *parameter group 1-2* Motor Data* and press [OK].
4. Scroll to *parameter 1-29 Automatic Motor Adaptation (AMA)* and press [OK].
5. Select *[1] Enable complete AMA* and press [OK].
6. Follow the on-screen instructions.
7. The test runs automatically and indicates when it is complete.
8. The advanced motor data is entered in *parameter group 1-3* Adv. Motor Data*.

5.5 Checking Motor Rotation

NOTICE

Risk of damage to pumps/compressors caused by motor running in wrong direction. Before running the frequency converter, check the motor rotation.

The motor runs briefly at 5 Hz or the minimum frequency set in *parameter 4-12 Motor Speed Low Limit [Hz]*.

1. Press [Main Menu].
2. Scroll to *parameter 1-28 Motor Rotation Check* and press [OK].
3. Scroll to *[1] Enable*.

The following text appears: *Note! Motor may run in wrong direction*.

4. Press [OK].
5. Follow the on-screen instructions.

NOTICE

To change the direction of rotation, remove power to the frequency converter and wait for power to discharge. Reverse the connection of any 2 of the 3 motor wires on the motor or frequency converter side of the connection.

5.6 Local-control Test

1. Press [Hand On] to provide a local start command to the frequency converter.
2. Accelerate the frequency converter by pressing [▲] to full speed. Moving the cursor left of the decimal point provides quicker input changes.
3. Note any acceleration problems.
4. Press [Off]. Note any deceleration problems.

If acceleration or deceleration problems occur, see *chapter 7.5 Troubleshooting*. See *chapter 7.4 List of Warnings and Alarms* for resetting the frequency converter after a trip.

5.7 System Start-up

The procedure in this section requires wiring and application programming to be completed. The following procedure is recommended after application set-up is completed.

1. Press [Auto On].
2. Apply an external run command.
3. Adjust the speed reference throughout the speed range.
4. Remove the external run command.
5. Check the sound and vibration levels of the motor to ensure that the system is working as intended.

If warnings or alarms occur, see *chapter 7.3 Warning and Alarm Types* or *chapter 7.4 List of Warnings and Alarms*.

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6 Application Set-up Examples

The examples in this section are intended as a quick reference for common applications.

- Parameter settings are the regional default values unless otherwise indicated (selected in *parameter 0-03 Regional Settings*).
- Parameters associated with the terminals and their settings are shown next to the drawings.
- Required switch settings for analog terminals A53 or A54 are also shown.

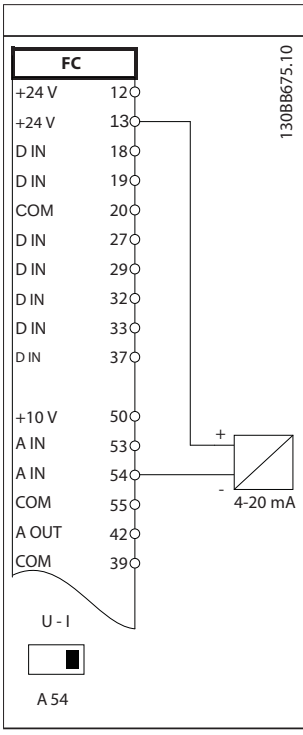
NOTICE

When using the optional STO feature, a jumper wire may be required between terminal 12 (or 13) and terminal 37 for the frequency converter to operate with factory default programming values.

6

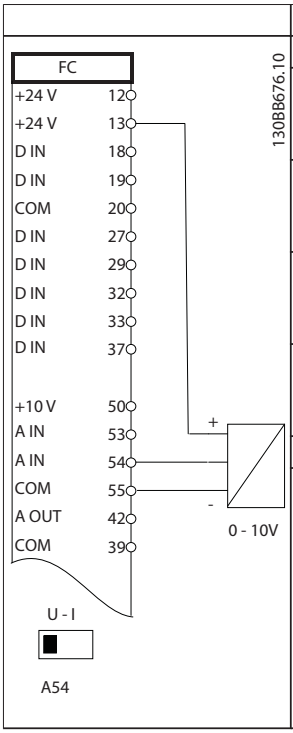
6.1 Application Examples

6.1.1 Feedback



	Parameters	
	Function	**Setting**
	Parameter 6-22 Terminal 54 Low Current	4 mA*
	Parameter 6-23 Terminal 54 High Current	20 mA*
	Parameter 6-24 Terminal 54 Low Ref./Feedb. Value	0*
	Parameter 6-25 Terminal 54 High Ref./Feedb. Value	50*
* = Default value		
Notes/comments: D IN 37 is an option.		

Table 6.1 Analog Current Feedback Transducer



	Parameters	
	Function	**Setting**
	Parameter 6-20 Terminal 54 Low Voltage	0.07 V*
	Parameter 6-21 Terminal 54 High Voltage	10 V*
	Parameter 6-24 Terminal 54 Low Ref./Feedb. Value	0*
	Parameter 6-25 Terminal 54 High Ref./Feedb. Value	50*
* = Default value		
Notes/comments: D IN 37 is an option.		

Table 6.2 Analog Voltage Feedback Transducer (3-wire)

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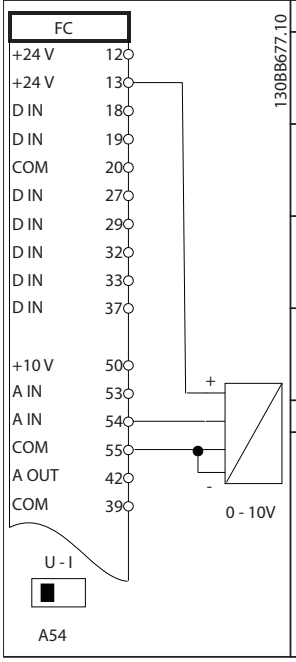
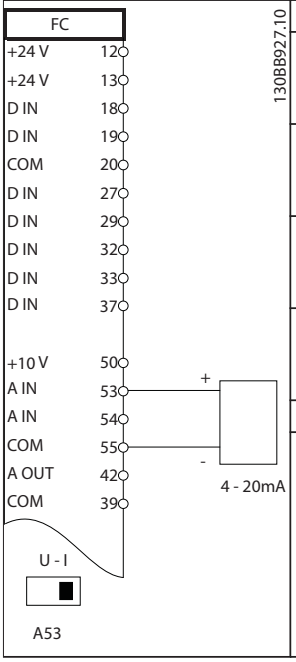


Parameters	
Function	**Setting**
Parameter 6-20 Terminal 54 Low Voltage	0.07 V*
Parameter 6-21 Terminal 54 High Voltage	10 V*
Parameter 6-24 Terminal 54 Low Ref./Feedb. Value	0*
Parameter 6-25 Terminal 54 High Ref./Feedb. Value	50*
* = Default value	
Notes/comments: D IN 37 is an option.	

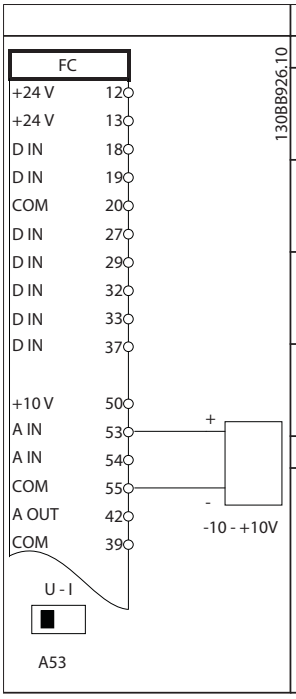
Table 6.3 Analog Voltage Feedback Transducer (4-wire)



Parameters	
Function	**Setting**
Parameter 6-12 Terminal 53 Low Current	4 mA*
Parameter 6-13 Terminal 53 High Current	20 mA*
Parameter 6-14 Terminal 53 Low Ref./Feedb. Value	0 Hz
Parameter 6-15 Terminal 53 High Ref./Feedb. Value	50 Hz
* = Default value	
Notes/comments: D IN 37 is an option.	

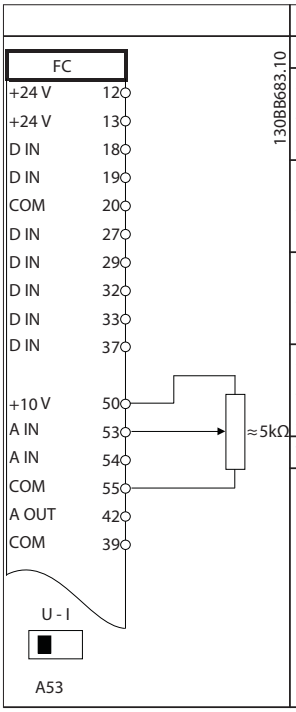
Table 6.5 Analog Speed Reference (Current)

6.1.2 Speed



Parameters	
Function	**Setting**
Parameter 6-10 Terminal 53 Low Voltage	0.07 V*
Parameter 6-11 Terminal 53 High Voltage	10 V*
Parameter 6-14 Terminal 53 Low Ref./Feedb. Value	0 Hz
Parameter 6-15 Terminal 53 High Ref./Feedb. Value	50 Hz
* = Default value	
Notes/comments: D IN 37 is an option.	

Table 6.4 Analog Speed Reference (Voltage)



Parameters	
Function	**Setting**
Parameter 6-10 Terminal 53 Low Voltage	0.07 V*
Parameter 6-11 Terminal 53 High Voltage	10 V*
Parameter 6-14 Terminal 53 Low Ref./Feedb. Value	0 Hz
Parameter 6-15 Terminal 53 High Ref./Feedb. Value	50 Hz
* = Default value	
Notes/comments: D IN 37 is an option.	

Table 6.6 Speed Reference (Using a Manual Potentiometer)

6

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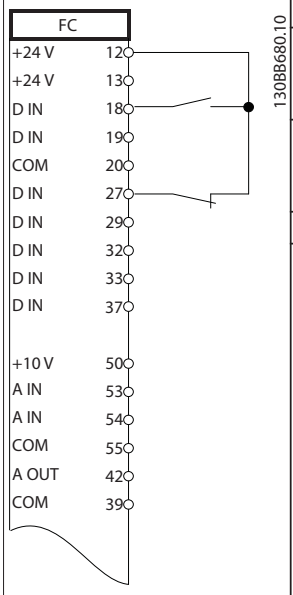
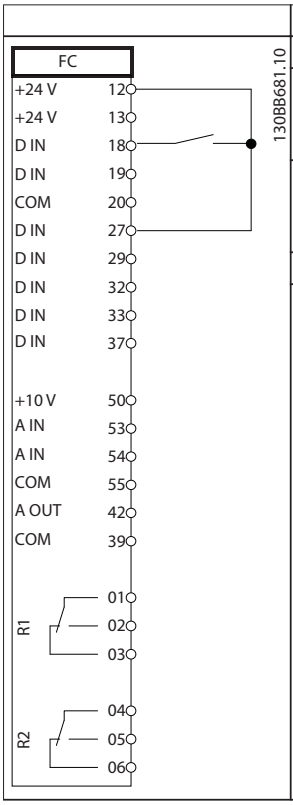
6.1.3 Run/Stop



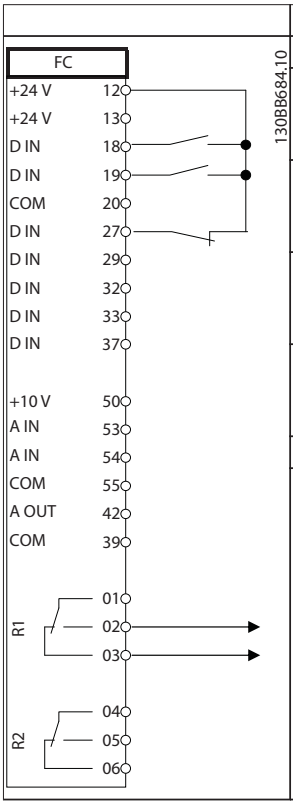
Parameters	
Function	**Setting**
Parameter 5-10 Terminal 18 Digital Input	*[8] Start**
Parameter 5-12 Terminal 27 Digital Input	*[7] External interlock*
* = Default value	
Notes/comments: D IN 37 is an option.	

Table 6.7 Run/Stop Command with External Interlock



Parameters	
Function	**Setting**
Parameter 5-10 Terminal 18 Digital Input	*[8] Start**
Parameter 5-12 Terminal 27 Digital Input	*[7] External interlock*
* = Default value	
Notes/comments: If *parameter 5-12 Terminal 27 Digital Input* is set to *[0] No operation*, a jumper wire to terminal 27 is not needed. D IN 37 is an option.	

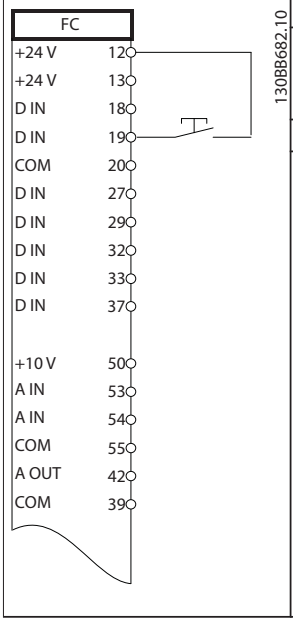
Table 6.8 Run/Stop Command without External Interlock



Parameters	
Function	**Setting**
Parameter 5-10 Terminal 18 Digital Input	*[8] Start**
Parameter 5-11 Terminal 19 Digital Input	*[52] Run Permissive*
Parameter 5-12 Terminal 27 Digital Input	*[7] External interlock*
Parameter 5-40 Function Relay	*[167] Start command act.*
* = Default value	
Notes/comments: D IN 37 is an option.	

Table 6.9 Run Permissive

6.1.4 External Alarm Reset



Parameters	
Function	**Setting**
Parameter 5-11 Terminal 19 Digital Input	*[1] Reset*
* = Default value	
Notes/comments: D IN 37 is an option.	

Table 6.10 External Alarm Reset

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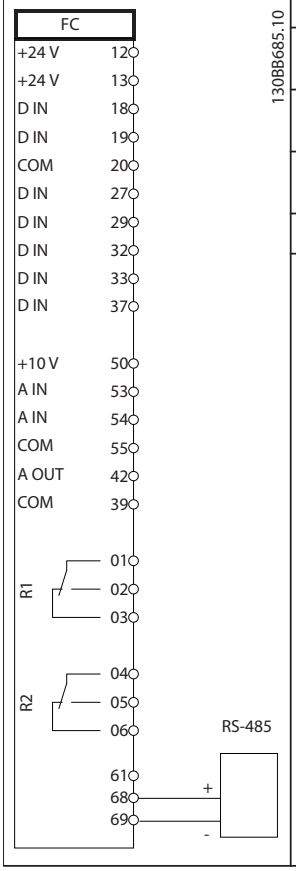
6.1.5 RS485



Parameters	
Function	**Setting**
Parameter 8-30 Protocol	FC*
Parameter 8-31 Address	1*
Parameter 8-32 Baud Rate	9600*
* = Default value	
Notes/comments: Select protocol, address, and baud rate in the above-mentioned parameters. D IN 37 is an option.	

Table 6.11 RS485 Network Connection

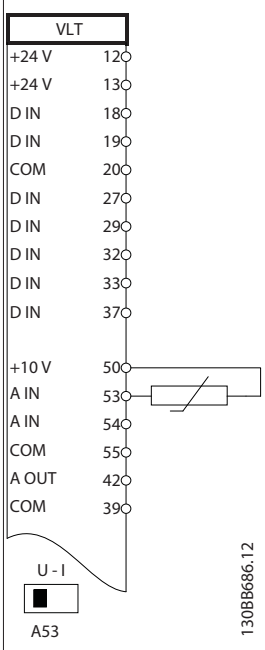
6.1.6 Motor Thermistor

⚠CAUTION

THERMISTOR INSULATION

Risk of personal injury or equipment damage.

- **Use only thermistors with reinforced or double insulation to meet PELV insulation requirements.**



Parameters	
Function	**Setting**
Parameter 1-90 Motor Thermal Protection	*[2] Thermistor trip*
Parameter 1-93 Thermistor Source	*[1] Analog input 53*
* = Default value	
Notes/comments: If only a warning is required, set *parameter 1-90 Motor Thermal Protection* to *[1] Thermistor warning*. D IN 37 is an option.	

Table 6.12 Motor Thermistor

6

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7 Maintenance, Diagnostics, and Troubleshooting

This chapter includes:

- Maintenance and service guidelines.
- Status messages.
- Warnings and alarms.
- Basic troubleshooting.

7.1 Maintenance and Service

Under normal operating conditions and load profiles, the frequency converter is maintenance-free throughout its designed lifetime. To prevent breakdown, danger, and damage, examine the frequency converter at regular intervals depending on the operating conditions. Replace worn or damaged parts with original spare parts or standard parts. For service and support, contact the local Danfoss supplier.

7

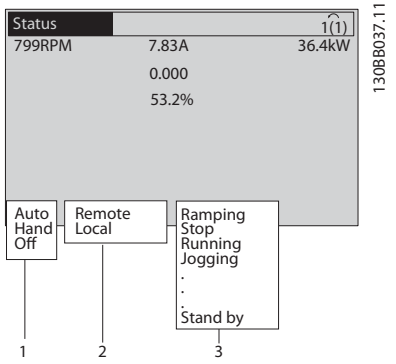
⚠WARNING

UNINTENDED START

When the frequency converter is connected to AC mains, DC supply, or load sharing, the motor may start at any time. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage. The motor can start via an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up Software, or after a cleared fault condition.

7.2 Status Messages

When the frequency converter is in *Status* mode, status messages are generated automatically and appear in the bottom line of the display (see *Illustration 7.1*).



1	Operating mode (see *Table 7.1*)
2	Reference site (see *Table 7.2*)
3	Operation status (see *Table 7.3*)

Illustration 7.1 Status Display

Table 7.1 to *Table 7.3* describe the status messages shown.

Off	The frequency converter does not react to any control signal until [Auto On] or [Hand On] is pressed.
Auto On	The frequency converter is controlled from the control terminals and/or the serial communication.
Hand On	Control the frequency converter via the navigation keys on the LCP. Stop commands, reset, reversing, DC brake, and other signals applied to the control terminals override local control.

Table 7.1 Operating Mode

Remote	The speed reference is given from external signals, serial communication, or internal preset references.
Local	The frequency converter uses [Hand On] control or reference values from the LCP.

Table 7.2 Reference Site

AC Brake	*[2] AC brake* is selected in *parameter 2-10 Brake Function*. The AC brake overmagnetizes the motor to achieve a controlled slow down.
AMA finish OK	AMA was carried out successfully.
AMA ready	AMA is ready to start. Press [Hand On] to start.
AMA running	AMA process is in progress.
Braking	The brake chopper is in operation. Generative energy is absorbed by the brake resistor.

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Braking max.	The brake chopper is in operation. The power limit for the brake resistor defined in *parameter 2-12 Brake Power Limit (kW)* has been reached.
Coast	• *[2] Coast inverse* was selected as a function for a digital input (*parameter group 5-1* Digital Inputs*). The corresponding terminal is not connected. • Coast activated by serial communication.
Ctrl. ramp-down	*[1] Control Ramp-down* was selected in *parameter 14-10 Mains Failure*. • The mains voltage is below the value set in *parameter 14-11 Mains Voltage at Mains Fault* at mains fault. • The frequency converter ramps down the motor using a controlled ramp down.
Current High	The frequency converter output current is above the limit set in *parameter 4-51 Warning Current High*.
Current Low	The frequency converter output current is below the limit set in *parameter 4-52 Warning Speed Low*.
DC Hold	*[1] DC hold* is selected in *parameter 1-80 Function at Stop* and a stop command is active. The motor is held by a DC current set in *parameter 2-00 DC Hold/Preheat Current*.
DC Stop	The motor is held with a DC current (*parameter 2-01 DC Brake Current*) for a specified time (*parameter 2-02 DC Braking Time*). • The DC brake cut-in speed is reached in *parameter 2-03 DC Brake Cut In Speed [RPM]* and a stop command is active. • *[5] DC-brake inverse* is selected as a function for a digital input (*parameter group 5-1* Digital Inputs*). The corresponding terminal is not active. • The DC brake is activated via serial communication.
Feedback high	The sum of all active feedbacks is above the feedback limit set in *parameter 4-57 Warning Feedback High*.
Feedback low	The sum of all active feedbacks is below the feedback limit set in *parameter 4-56 Warning Feedback Low*.
Freeze output	The remote reference is active, which holds the present speed. • *[20] Freeze output* is selected as a function for a digital input (*parameter group 5-1* Digital Inputs*). The corresponding terminal is active. Speed control is only possible via the terminal options *[21] Speed up* and *[22] Speed down*. • Hold ramp is activated via serial communication.
Freeze output request	A freeze output command was given, but the motor remains stopped until a run permissive signal is received.
Freeze ref.	*[19] Freeze reference* is selected as a function for a digital input (*parameter group 5-1* Digital Inputs*). The corresponding terminal is active. The frequency converter saves the actual reference. Changing the reference is now only possible via terminal options *[21] Speed up* and *[22] Speed down*.
Jog request	A jog command was given, but the motor remains stopped until a run permissive signal is received via a digital input.
Jogging	The motor is running as programmed in *parameter 3-19 Jog Speed [RPM]*. • *[14] Jog* was selected as a function for a digital input (*parameter group 5-1* Digital Inputs*). The corresponding terminal (for example, terminal 29) is active. • The jog function is activated via the serial communication. • The jog function is selected as a reaction for a monitoring function (for example, for the no signal function). The monitoring function is active.
Motor check	In *parameter 1-80 Function at Stop*, *[2] Motor Check* is selected. A stop command is active. To ensure that a motor is connected to the frequency converter, a permanent test current is applied to the motor.
OVC control	Overvoltage control is activated via *parameter 2-17 Over-voltage Control*, *[2] Enabled*. The connected motor supplies the frequency converter with generative energy. The overvoltage control adjusts the V/Hz ratio to run the motor in controlled mode and to prevent the frequency converter from tripping.
PowerUnit Off	(Only frequency converters with a 24 V external supply installed). Mains supply to the frequency converter was removed, and the control card is supplied by the external 24 V.

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Protection md	Protection mode is active. The unit detected a critical status (overcurrent or overvoltage). • To avoid tripping, switching frequency is reduced to 4 kHz. • If possible, protection mode ends after approximately 10 s. • Protection mode can be restricted in *parameter 14-26 Trip Delay at Inverter Fault*.
Qstop	The motor is decelerating using *parameter 3-81 Quick Stop Ramp Time*. • *[4] Quick stop inverse* is selected as a function for a digital input (*parameter group 5-1* Digital Inputs*). The corresponding terminal is not active. • The quick stop function is activated via serial communication.
Ramping	The motor is accelerating/decelerating using the active ramp up/down. The reference, a limit value, or a standstill is not yet reached.
Ref. high	The sum of all active references is above the reference limit set in *parameter 4-55 Warning Reference High*.
Ref. low	The sum of all active references is below the reference limit set in *parameter 4-54 Warning Reference Low*.
Run on ref.	The frequency converter is running in the reference range. The feedback value matches the setpoint value.
Run request	A start command was given, but the motor remains stopped until a run permissive signal is received via digital input.
Running	The frequency converter drives the motor.
Sleep Mode	The energy-saving function is enabled. The motor has stopped, but restarts automatically when required.
Speed high	Motor speed is above the value set in *parameter 4-53 Warning Speed High*.
Speed low	Motor speed is below the value set in *parameter 4-52 Warning Speed Low*.
Standby	In auto-on mode, the frequency converter starts the motor with a start signal from a digital input or serial communication.
Start delay	In *parameter 1-71 Start Delay*, a delay starting time was set. A start command is activated, and the motor starts after the start delay time expires.
Start fwd/rev	*[12] Enable start forward* and *[13] Enable start reverse* are selected as options for 2 different digital inputs (*parameter group 5-1* Digital Inputs*). The motor starts in forward or reverse direction depending on which terminal is activated.
Stop	The frequency converter received a stop command from the LCP, digital input, or serial communication.
Trip	An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, the frequency converter can be reset manually by pressing [Reset] or remotely by control terminals or serial communication.
Trip lock	An alarm occurred, and the motor is stopped. When the cause of the alarm is cleared, cycle power to the frequency converter. The frequency converter can then be reset manually by pressing [Reset], or remotely by control terminals or serial communication.

Table 7.3 Operation Status

7

NOTICE

In auto/remote mode, the frequency converter requires external commands to execute functions.

7.3 Warning and Alarm Types

Warnings
A warning is issued when an alarm condition is impending, or when an abnormal operating condition is present and may result in the frequency converter issuing an alarm. A warning clears by itself when the abnormal condition ceases.

Alarms
An alarm indicates a fault that requires immediate attention. The fault always triggers a trip or a trip lock. Reset the system after an alarm.

Trip
An alarm is issued when the frequency converter is tripped, meaning that the frequency converter suspends operation to prevent frequency converter or system damage. The motor coasts to a stop. The frequency converter logic continues to operate and monitor the frequency converter status. After the fault condition is remedied, the frequency converter can be reset. It is then ready to start operation again.

Resetting the frequency converter after trip/trip lock
A trip can be reset in any of 4 ways:

- Press [Reset] on the LCP.
- Digital reset input command.
- Serial communication reset input command.
- Auto reset.

Trip lock
Input power is cycled. The motor coasts to a stop. The frequency converter continues to monitor the frequency converter status. Remove input power to the frequency converter, correct the cause of the fault, and reset the frequency converter.

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Warning and alarm displays

- A warning is shown in the LCP along with the warning number.
- An alarm flashes along with the alarm number.

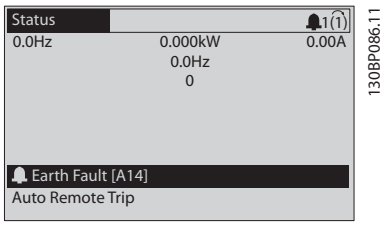
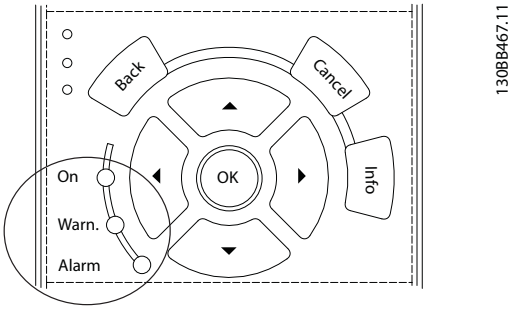


Illustration 7.2 Alarm Example

In addition to the text and alarm code in the LCP, there are 3 status indicator lights.



	Warning indicator light	Alarm indicator light
Warning	On	Off
Alarm	Off	On (flashing)
Trip lock	On	On (flashing)

Illustration 7.3 Status Indicator Lights

7.4 List of Warnings and Alarms

The warning/alarm information in this chapter defines each warning/alarm condition, provides the probable cause for the condition, and details a remedy or troubleshooting procedure.

WARNING 1, 10 Volts low
The control card voltage from terminal 50 is <10 V. Remove some of the load from terminal 50, as the 10 V supply is overloaded. Maximum 15 mA or minimum 590 Ω.

A short circuit in a connected potentiometer or improper wiring of the potentiometer can cause this condition.

Troubleshooting

- Remove the wiring from terminal 50.
- If the warning clears, the problem is with the customer wiring.
- If the warning does not clear, replace the control card.

WARNING/ALARM 2, Live zero error
This warning or alarm only appears if programmed in *parameter 6-01 Live Zero Timeout Function*. The signal on 1 of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or signals from a faulty device cause this condition.

Troubleshooting

- Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common. VLT® General Purpose I/O MCB 101 terminals 11 and 12 for signals, terminal 10 common. VLT® Analog I/O Option MCB 109 terminals 1, 3, 5 for signals, terminals 2, 4, 6 common).
- Check that the frequency converter programming and switch settings match the analog signal type.
- Perform an input terminal signal test.

WARNING/ALARM 3, No motor
No motor has been connected to the output of the frequency converter.

WARNING/ALARM 4, Mains phase loss
A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears in case of a fault in the input rectifier on the frequency converter. Options are programmed in *parameter 14-12 Function at Mains Imbalance*.

Troubleshooting

- Check the supply voltage and supply currents to the frequency converter.

WARNING 5, DC link voltage high
The DC-link voltage is higher than the high-voltage warning limit. The limit depends on the frequency converter voltage rating. The unit is still active.

WARNING 6, DC link voltage low
The DC-link voltage is lower than the low-voltage warning limit. The limit depends on the frequency converter voltage rating. The unit is still active.

WARNING/ALARM 7, DC overvoltage
If the DC-link voltage exceeds the limit, the frequency converter trips after some time.

Troubleshooting

- Connect a brake resistor.
- Extend the ramp time.
- Change the ramp type.
- Activate the functions in *parameter 2-10 Brake Function*.
- Increase *parameter 14-26 Trip Delay at Inverter Fault*.

WARNING/ALARM 8, DC under voltage
If the DC-link voltage drops below the undervoltage limit, the frequency converter checks if a 24 V DC back-up supply is connected. If no 24 V DC back-up supply is

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connected, the frequency converter trips after a fixed time delay. The time delay varies with unit size.

Troubleshooting

- Check that the supply voltage matches the frequency converter voltage.
- Perform an input voltage test.
- Perform a soft charge circuit test.

WARNING/ALARM 9, Inverter overload

The frequency converter is about to cut out because of an overload (too high current for too long). The counter for electronic thermal inverter protection issues a warning at 98% and trips at 100%, while issuing an alarm. The frequency converter *cannot* be reset until the counter is below 90%.

Troubleshooting

- Compare the output current shown on the LCP with the frequency converter rated current.
- Compare the output current shown on the LCP with measured motor current.
- Show the thermal load on the LCP and monitor the value. When running above the frequency converter continuous current rating, the counter should increase. When running below the frequency converter continuous current rating, the counter should decrease.

WARNING/ALARM 10, Motor overload temperature

According to the electronic thermal protection (ETR), the motor is too hot. Select whether the frequency converter issues a warning or an alarm when the counter reaches 100% in *parameter 1-90 Motor Thermal Protection*. The fault occurs when the motor overload exceeds 100% for too long.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the motor current set in *parameter 1-24 Motor Current* is correct.
- Ensure the motor data in parameters *1-20* through *1-25* is set correctly.
- If an external fan is used, check that it is selected in *parameter 1-91 Motor External Fan*.
- Running AMA in *parameter 1-29 Automatic Motor Adaptation (AMA)* tunes the frequency converter to the motor more accurately and reduces thermal loading.

WARNING/ALARM 11, Motor thermistor overtemp

The thermistor may be disconnected. Select whether the frequency converter issues a warning or an alarm in *parameter 1-90 Motor Thermal Protection*.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply) and that the terminal switch for 53 or 54 is set for voltage. Check *parameter 1-93 Thermistor Source* selects terminal 53 or 54.
- When using digital inputs 18 or 19, check that the thermistor is connected correctly between either terminal 18 or 19 (digital input PNP only) and terminal 50.
- If a KTY sensor is used, check for correct connection between terminals 54 and 55.
- If using a thermal switch or thermistor, check that the programming if *parameter 1-93 Thermistor Source* matches sensor wiring.

WARNING/ALARM 12, Torque limit

The torque has exceeded the value in *parameter 4-16 Torque Limit Motor Mode* or the value in *parameter 4-17 Torque Limit Generator Mode*. *Parameter 14-25 Trip Delay at Torque Limit* can change this from a warning-only condition to a warning followed by an alarm.

Troubleshooting

- If the motor torque limit is exceeded during ramp-up, extend the ramp-up time.
- If the generator torque limit is exceeded during ramp down, extend the ramp-down time.
- If torque limit occurs while running, possibly increase the torque limit. Be sure that the system can operate safely at a higher torque.
- Check the application for excessive current draw on the motor.

WARNING/ALARM 13, Over current

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 1.5 s, then the frequency converter trips and issues an alarm. Shock loading or fast acceleration with high-inertia loads can cause this fault. If extended mechanical brake control is selected, the trip can be reset externally.

Troubleshooting

- Remove power and check if the motor shaft can be turned.
- Check that the motor size matches the frequency converter.
- Check *parameters 1-20* to *1-25* for correct motor data.

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ALARM 14, Earth (ground) fault
There is current from the output phases to ground, either in the cable between the frequency converter and the motor, or in the motor itself.

Troubleshooting

- Remove power from the frequency converter and repair the ground fault.
- Check for ground faults in the motor by measuring the resistance to ground of the motor cables and the motor with a megohmmeter.
- Perform current sensor test.

ALARM 15, Hardware mismatch
A fitted option is not operational with the present control board hardware or software.

Record the value of the following parameters and contact the local Danfoss supplier:

- *Parameter 15-40 FC Type*.
- *Parameter 15-41 Power Section*.
- *Parameter 15-42 Voltage*.
- *Parameter 15-43 Software Version*.
- *Parameter 15-45 Actual Typecode String*.
- *Parameter 15-49 SW ID Control Card*.
- *Parameter 15-50 SW ID Power Card*.
- *Parameter 15-60 Option Mounted*.
- *Parameter 15-61 Option SW Version* (for each option slot).

ALARM 16, Short circuit
There is short-circuiting in the motor or motor wiring.

Troubleshooting

- Remove power from the frequency converter and repair the short circuit.

WARNING/ALARM 17, Control word timeout
There is no communication to the frequency converter. The warning is only active when *parameter 8-04 Control Timeout Function* is NOT set to *[0] Off*.
If *parameter 8-04 Control Timeout Function* is set to *[5] Stop and trip*, a warning appears and the frequency converter ramps down until it trips, then it shows an alarm.

Troubleshooting

- Check the connections on the serial communication cable.
- Increase *parameter 8-03 Control Timeout Time*.
- Check the operation of the communication equipment.
- Verify a proper installation based on EMC requirements.

WARNING/ALARM 22, Hoist mechanical brake
When this warning is active, the LCP shows the type of issue.
0 = The torque ref. was not reached before timeout.
1 = There was no brake feedback before timeout.

WARNING 23, Internal fan fault
The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in *parameter 14-53 Fan Monitor* (*[0] Disabled*).

Troubleshooting

- Check the fan resistance.
- Check the soft charge fuses.

WARNING 24, External fan fault
The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in *parameter 14-53 Fan Monitor* (*[0] Disabled*).

Troubleshooting

- Check the fan resistance.
- Check the soft charge fuses.

WARNING 25, Brake resistor short circuit
The brake resistor is monitored during operation. If a short circuit occurs, the brake function is disabled and the warning appears. The frequency converter is still operational but without the brake function. Remove power from the frequency converter and replace the brake resistor (see *parameter 2-15 Brake Check*).

WARNING/ALARM 26, Brake resistor power limit
The power transmitted to the brake resistor is calculated as a mean value over the last 120 s of run time. The calculation is based on the DC-link voltage and the brake resistance value set in *parameter 2-16 AC brake Max. Current*. The warning is active when the dissipated braking is higher than 90% of the brake resistance power. If *[2] Trip* is selected in *parameter 2-13 Brake Power Monitoring*, the frequency converter trips when the dissipated braking power reaches 100%.

WARNING/ALARM 27, Brake chopper fault
The brake transistor is monitored during operation. If a short circuit occurs, the brake function is disabled and a warning is issued. The frequency converter is still operational, but since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.
Remove power from the frequency converter and remove the brake resistor.

This alarm/warning could also occur if the brake resistor overheats. Terminals 104 and 106 are available as brake resistor Klixon inputs, see *Brake Resistor Temperature Switch* in the *design guide*.

WARNING/ALARM 28, Brake check failed
The brake resistor is not connected or not working. Check *parameter 2-15 Brake Check*.

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ALARM 29, Heat Sink temp
The maximum temperature of the heat sink has been exceeded. The temperature fault does not reset until the temperature drops below a defined heatsink temperature. The trip and reset points vary based on the frequency converter power size.

Troubleshooting
Check for the following conditions:

- Ambient temperature too high.
- Motor cable too long.
- Incorrect airflow clearance above and below the frequency converter.
- Blocked airflow around the frequency converter.
- Damaged heat sink fan.
- Dirty heat sink.

This alarm is based on the temperature measured by the heat sink sensor mounted inside the IGBT modules.

Troubleshooting

- Check the fan resistance.
- Check the soft charge fuses.
- Check the IGBT thermal sensor.

ALARM 30, Motor phase U missing
Motor phase U between the frequency converter and the motor is missing.

Troubleshooting

- Remove power from the frequency converter and check motor phase U.

ALARM 31, Motor phase V missing
Motor phase V between the frequency converter and the motor is missing.

Troubleshooting

- Remove power from the frequency converter and check motor phase V.

ALARM 32, Motor phase W missing
Motor phase W between the frequency converter and the motor is missing.

Troubleshooting

- Remove power from the frequency converter and check motor phase W.

ALARM 33, Inrush fault
Too many power-ups have occurred within a short time period. Let the unit cool to operating temperature.

WARNING/ALARM 34, Fieldbus communication fault
The fieldbus on the communication option card is not working.

WARNING/ALARM 36, Mains failure
This warning/alarm is only active if the supply voltage to the frequency converter is lost and *parameter 14-10 Mains Failure* is NOT set to *[0] No Function*.

Troubleshooting

- Check the fuses to the frequency converter and mains power supply to the unit.

ALARM 38, Internal fault
When an internal fault occurs, a code number defined in *Table 7.4* is shown.

Troubleshooting

- Cycle power.
- Check that the option is properly installed.
- Check for loose or missing wiring.

Contact the Danfoss supplier or Danfoss service if necessary. Note the code number for further trouble-shooting directions.

Number	Text
0	The serial port cannot be initialized. Contact the Danfoss supplier or Danfoss Service.
256–258	Power EEPROM data is defective or too old.
512	The control board EEPROM data is defective or too old.
513	Communication timeout reading EEPROM data.
514	Communication timeout reading EEPROM data.
515	Application-oriented control cannot recognize the EEPROM data.
516	Cannot write to the EEPROM because a write command is in progress.
517	Write command is under timeout.
518	Failure in the EEPROM.
519	Missing or invalid barcode data in EEPROM.
783	Parameter value outside of minimum/maximum limits.
1024–1279	Sending a CAN telegram failed.
1281	Digital signal processor flash timeout.
1282	Power micro software version mismatch.
1283	Power EEPROM data version mismatch.
1284	Cannot read digital signal processor software version.
1299	The option SW in slot A is too old.
1300	The option SW in slot B is too old.
1301	The option SW in slot C0 is too old.
1302	The option SW in slot C1 is too old.
1315	The option SW in slot A is not supported (not allowed).
1316	The option SW in slot B is not supported (not allowed).
1317	The option SW in slot C0 is not supported (not allowed).
1318	The option SW in slot C1 is not supported (not allowed).
1379	The option A did not respond when calculating the platform version.
1380	The option B did not respond when calculating the platform version.

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Number	Text
1381	The option C0 did not respond when calculating the platform version.
1382	The option C1 did not respond when calculating the platform version.
1536	An exception in the application-oriented control is registered. Debug information written in LCP.
1792	The DSP watchdog is active. Debugging of power part data, motor-oriented control data not transferred correctly.
2049	Power data restarted.
2064–2072	H081x: Option in slot x restarted.
2080–2088	H082x: Option in slot x issued a power-up wait.
2096–2104	H983x: Option in slot x issued a legal power-up wait.
2304	Could not read any data from power EEPROM.
2305	Missing SW version from power unit.
2314	Missing power unit data from power unit.
2315	Missing SW version from power unit.
2316	Missing lo_statepage from power unit.
2324	The power card configuration is determined to be incorrect at power-up.
2325	A power card has stopped communicating while main power is applied.
2326	The power card configuration is determined to be incorrect after the delay for power cards to register.
2327	Too many power card locations are registered as present.
2330	Power size information between the power cards does not match.
2561	No communication from DSP to ATACD.
2562	No communication from ATACD to DSP (state running).
2816	Stack overflow control board module.
2817	Scheduler slow tasks.
2818	Fast tasks.
2819	Parameter thread.
2820	LCP stack overflow.
2821	Serial port overflow.
2822	USB port overflow.
2836	cfListMempool too small.
3072–5122	Parameter value is outside its limits.
5123	Option in slot A: Hardware incompatible with control board hardware.
5124	Option in slot B: Hardware incompatible with control board hardware.
5125	Option in slot C0: Hardware incompatible with control board hardware.
5126	Option in slot C1: Hardware incompatible with control board hardware.
5376–6231	Out of memory.

Table 7.4 Code Numbers for Internal Faults

ALARM 39, Heat sink sensor
No feedback from the heat sink temperature sensor.

The signal from the IGBT thermal sensor is not available on the power card. The problem could be in the power card, in the gatedrive card, or the ribbon cable between the power card and the gatedrive card.

WARNING 40, Overload of digital output terminal 27
Check the load connected to terminal 27 or remove the short circuit connection. Check *parameter 5-00 Digital I/O Mode* and *parameter 5-01 Terminal 27 Mode*.

WARNING 41, Overload of digital output terminal 29
Check the load connected to terminal 29 or remove the short circuit connection. Check *parameter 5-00 Digital I/O Mode* and *parameter 5-02 Terminal 29 Mode*.

WARNING 42, Overload of digital output on X30/6 or overload of digital output on X30/7
For X30/6, check the load connected to X30/6 or remove the short circuit connection. Check *parameter 5-32 Term X30/6 Digi Out (MCB 101)*.

For X30/7, check the load connected to X30/7 or remove the short circuit connection. Check *parameter 5-33 Term X30/7 Digi Out (MCB 101)*.

ALARM 46, Power card supply
The supply on the power card is out of range.

There are 3 supplies powered by the switch mode power supply (SMPS) on the power card: 24 V, 5 V, ±18 V. When powered with 24 V DC with the VLT® 24V DC Supply MCB 107 option, only the 24 V and 5 V supplies are monitored. When powered with 3-phase mains voltage, all 3 supplies are monitored.

WARNING 47, 24 V supply low
The 24 V DC supply is measured on the control card. The external 24 V DC back-up supply may be overloaded, otherwise contact the Danfoss supplier.

WARNING 48, 1.8 V supply low
The 1.8 V DC supply used on the control card is outside of the allowable limits. The supply is measured on the control card. Check for a defective control card. If an option card is present, check for an overvoltage condition.

WARNING 49, Speed limit
When the speed is not within the specified range in *parameter 4-11 Motor Speed Low Limit [RPM]* and *parameter 4-13 Motor Speed High Limit [RPM]*, the frequency converter shows a warning. When the speed is below the specified limit in *parameter 1-86 Trip Speed Low [RPM]* (except when starting or stopping) the frequency converter trips.

ALARM 50, AMA calibration failed
Contact the Danfoss supplier or Danfoss Service.

ALARM 51, AMA check U_{nom} and I_{nom}
The settings for motor voltage, motor current, and motor power are wrong. Check the settings in *parameters 1-20* to *1-25*.

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ALARM 52, AMA low I_{nom}
The motor current is too low. Check the settings.

ALARM 53, AMA motor too big
The motor is too big for the AMA to operate.

ALARM 54, AMA motor too small
The motor is too small for the AMA to operate.

ALARM 55, AMA parameter out of range
The parameter values of the motor are outside of the acceptable range. AMA does not run.

ALARM 56, AMA interrupted by user
The user has interrupted the AMA.

ALARM 57, AMA internal fault
Try to restart AMA several times, until the AMA is carried out. Repeated runs may heat the motor to a level where the resistance R_s and R_r are increased. Usually this is not critical.

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ALARM 58, AMA Internal fault
Contact the Danfoss supplier.

WARNING 59, Current limit
The current is higher than the value in *parameter 4-18 Current Limit*. Ensure that motor data in parameters *1-20* to *1-25* are set correctly. Possibly increase the current limit. Be sure that the system can operate safely at a higher limit.

WARNING 60, External interlock
External interlock has been activated. To resume normal operation:

1. Apply 24 V DC to the terminal programmed for external interlock.
2. Reset the frequency converter via
   - 2a Serial communication.
   - 2b Digital I/O.
   - 2c The [Reset] key.

WARNING 62, Output frequency at maximum limit
The output frequency is higher than the value set in *parameter 4-19 Max Output Frequency*.

WARNING 64, Voltage Limit
The load and speed combination demands a motor voltage higher than the actual DC-link voltage.

WARNING/ALARM 65, Control card over temperature
The control card has reached its trip temperature of 75 °C (167 °F).

WARNING 66, Heat sink temperature low
The frequency converter is too cold to operate. This warning is based on the temperature sensor in the IGBT module. Also, a trickle amount of current can be supplied to the frequency converter whenever the motor is stopped by setting *parameter 2-00 DC Hold/Preheat Current* at 5% and *parameter 1-80 Function at Stop*.

Troubleshooting
- Check the temperature sensor.
- Check the sensor wire between the IGBT and the gatedrive card.

ALARM 67, Option module configuration has changed
One or more options have either been added or removed since the last power-down. Check that the configuration change is intentional and reset the unit.

ALARM 68, Safe Stop activated
STO is activated.

Troubleshooting
- To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal (via bus, digital I/O, or by pressing [Reset]).

ALARM 69, Power card temperature
The temperature sensor on the power card is either too hot or too cold.

Troubleshooting
- Check the operation of the door fans.
- Check that the filters for the door fans are not blocked.
- Check that the gland plate is properly installed on IP21/IP54 (NEMA 1/12) frequency converters.

ALARM 70, Illegal FC configuration
The control card and power card are incompatible.

Troubleshooting
- Contact the supplier with the type code of the unit from the nameplate and the part numbers of the cards to check compatibility.

ALARM 71, PTC 1 safe stop
Safe Torque Off is activated from the VLT® PTC Thermistor Card MCB 112 (motor too warm). Normal operation can be resumed when the MCB 112 applies 24 V DC to T37 again (when the motor temperature reaches an acceptable level) and when the digital input from the MCB 112 is deactivated. When that happens, a reset signal must be is be sent (via bus, digital I/O, or by pressing [Reset]).

NOTICE

If automatic restart is enabled, the motor may start when the fault is cleared.

ALARM 72, Dangerous failure
Safe Torque Off (STO) with trip lock. Unexpected signal levels on Safe Torque Off (STO) and digital input from the VLT® PTC Thermistor Card MCB 112.

WARNING 73, Safe Stop auto restart
Safe Torque Off (STO). With automatic restart enabled, the motor can start when the fault is cleared.

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WARNING 76, Power unit setup
The required number of power units does not match the detected number of active power units. When replacing an enclosure size F module, this warning occurs if the power-specific data in the module power card does not match the rest of the frequency converter. If the power card connection is lost, the unit also triggers this warning.

Troubleshooting
- Confirm that the spare part and its power card are the correct part number.
- Ensure that the 44-pin cables between the MDCIC and power cards are mounted properly.

WARNING 77, Reduced power mode
This warning indicates that the frequency converter is operating in reduced power mode (that is, less than the allowed number of inverter sections). This warning is generated on power cycle when the frequency converter is set to run with fewer inverters and remains on.

ALARM 79, Illegal power section configuration
The scaling card is the incorrect part number or not installed. Also, the MK102 connector on the power card could not be installed.

ALARM 80, Drive initialised to default value
Parameter settings are initialized to default settings after a manual reset.

Troubleshooting
- Reset the unit to clear the alarm.

ALARM 81, CSIV corrupt
CSIV (Customer-specific initialization values) file has syntax errors.

ALARM 82, CSIV parameter error
CSIV (Customer-specific initialization values) failed to initialize a parameter.

ALARM 85, Dang fail PB
PROFIBUS/PROFIsafe error.

ALARM 92, No flow
A no-flow condition is detected in the system. *Parameter 22-23 No-Flow Function* is set for alarm.

Troubleshooting
- Troubleshoot the system and reset the frequency converter after clearing the fault.

ALARM 93, Dry pump
A no-flow condition in the system with the frequency converter operating at high speed can indicate a dry pump. *Parameter 22-26 Dry Pump Function* is set for alarm.

Troubleshooting
- Troubleshoot the system and reset the frequency converter after clearing the fault.

ALARM 94, End of curve
The feedback is lower than the setpoint. This condition can indicate leakage in the system. *Parameter 22-50 End of Curve Function* is set for alarm.

Troubleshooting
- Troubleshoot the system and reset the frequency converter after clearing the fault.

ALARM 95, Broken belt
Torque is below the torque level set for no load, indicating a broken belt. *Parameter 22-60 Broken Belt Function* is set for alarm.

Troubleshooting
- Troubleshoot the system and reset the frequency converter after clearing the fault.

ALARM 100, Derag limit fault
The *Deragging* feature failed during execution. Check the pump impeller for blockage.

WARNING/ALARM 104, Mixing fan fault
The fan monitor checks that the fan is spinning at frequency converter power-up or whenever the mixing fan is turned on. If the fan is not operating, the fault is issued. The mixing-fan fault can be configured as a warning or an alarm trip by *parameter 14-53 Fan Monitor*.

Troubleshooting
- Cycle power to the frequency converter to determine if the warning/alarm returns.

WARNING 250, New spare part
A component in the frequency converter has been replaced. To resume normal operation, reset the frequency converter.

WARNING 251, New typecode
The power card or other components have been replaced and the type code changed.

Troubleshooting
- Reset to remove the warning and resume normal operation.

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7.5 Troubleshooting

Symptom	Possible cause	Test	Solution
Display dark/No function	Missing input power.	See *Table 4.3*.	Check the input power source.
	Missing or open fuses, or circuit breaker tripped.	See *Open fuses and tripped circuit breaker* in this table for possible causes.	Follow the recommendations provided.
	No power to the LCP.	Check the LCP cable for proper connection or damage.	Replace the faulty LCP or connection cable.
	Shortcut on control voltage (terminal 12 or 50) or at control terminals.	Check the 24 V control voltage supply for terminals 12/13 to 20-39 or 10 V supply for terminals 50–55.	Wire the terminals properly.
	Incompatible LCP (LCP from VLT® 2800 or 5000/6000/8000/ FCD or FCM).	–	Use only LCP 101 (P/N 130B1124) or LCP 102 (P/N 130B1107).
	Wrong contrast setting.	–	Press [Status] + [▲]/[▼] to adjust the contrast.
	Display (LCP) is defective.	Test using a different LCP.	Replace the faulty LCP or connection cable.
	Internal voltage supply fault or SMPS is defective.	–	Contact supplier.
Intermittent display	Overloaded supply (SMPS) due to improper control wiring or a fault within the frequency converter.	To rule out a problem in the control wiring, disconnect all control wiring by removing the terminal blocks.	If the display stays lit, the problem is in the control wiring. Check the wiring for short circuits or incorrect connections. If the display continues to cut out, follow the procedure for display dark.
Motor not running	Service switch is open or missing motor connection.	Check if the motor is connected and the connection is not interrupted (by a service switch or other device).	Connect the motor and check the service switch.
	No mains power with 24 V DC option card.	If the display is functioning but no output, check that mains power is applied to the frequency converter.	Apply mains power to run the unit.
	LCP stop.	Check if [Off] has been pressed.	Press [Auto On] or [Hand On] (depending on operating mode) to run the motor.
	Missing start signal (Standby).	Check *parameter 5-10 Terminal 18 Digital Input* for correct setting for terminal 18 (use default setting).	Apply a valid start signal to start the motor.
	Motor coast signal active (Coasting).	Check *parameter 5-12 Terminal 27 Digital Input* for correct setting for terminal 27 (use default setting).	Apply 24 V on terminal 27 or program this terminal to *No operation*.
	Wrong reference signal source.	Check the following: • Reference signal: Local, remote, or bus reference. • Preset reference. • Terminal connection. • Scaling of terminals. • Reference signal availability.	Program the correct settings. Check *parameter 3-13 Reference Site*. Set preset reference active in *parameter group 3-1* References*.
Motor running in wrong direction	Motor rotation limit.	Check that *parameter 4-10 Motor Speed Direction* is programmed correctly.	Program the correct settings.
	Active reversing signal.	Check if a reversing command is programmed for the terminal in *parameter group 5-1* Digital inputs*.	Deactivate reversing signal.
	Wrong motor phase connection.	–	See *chapter 5.5 Checking Motor Rotation*.

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Symptom	Possible cause	Test	Solution
Motor is not reaching maximum speed	Frequency limits are set incorrectly.	Check the output limits in *parameter 4-13 Motor Speed High Limit [RPM]*, *parameter 4-14 Motor Speed High Limit [Hz]* and *parameter 4-19 Max Output Frequency*.	Program the correct limits.
	Reference input signal is not scaled correctly.	Check the reference input signal scaling in *parameter group 6-0* Analog I/O Mode* and *parameter group 3-1* References*. Check the reference limits in *parameter group 3-0* Reference Limit*.	Program the correct settings.
Motor speed unstable	Possible incorrect parameter settings.	Check the settings of all motor parameters, including all motor compensation settings. For closed-loop operation, check the PID settings.	Check the settings in *parameter group 1-6* Load Depen. Setting*. For closed-loop operation, check the settings in *parameter group 20-0* Feedback*.
Motor runs rough	Possible overmagnetization.	Check for incorrect motor settings in all motor parameters.	Check the motor settings in *parameter groups 1-2* Motor Data, 1-3* Adv Motor Data*, and *1-5* Load Indep. Setting*.
Motor does not brake	Possible incorrect settings in the brake parameters. Possible too short ramp-down times.	Check the brake parameters. Check the ramp time settings.	Check *parameter groups 2-0* DC Brake* and *3-0* Reference Limits*.
Open power fuses or circuit breaker trip	Phase-to-phase short circuit.	The motor or panel has a short phase-to-phase. Check the motor and panel phase for short circuits.	Eliminate any short circuits detected.
	Motor overload.	Motor is overloaded for the application.	Perform a start-up test and verify that the motor current is within the specifications. If the motor current exceeds the nameplate full load current, the motor may run only with reduced load. Review the specifications for the application.
	Loose connections.	Perform a pre-startup check for loose connections.	Tighten any loose connections.
Mains current imbalance >3%	Problem with the mains power (See *alarm 4, Mains phase loss* description).	Rotate input power leads into the frequency converter 1 position: A to B, B to C, C to A.	If imbalanced leg follows the wire, it is a power problem. Check the mains supply.
	Problem with the frequency converter.	Rotate input power leads into the frequency converter 1 position: A to B, B to C, C to A.	If imbalance leg stays on the same input terminal, it is a problem with the unit. Contact the supplier.
Motor current imbalance >3%	Problem with the motor or motor wiring.	Rotate output motor cables 1 position: U to V, V to W, W to U.	If imbalanced leg follows the wire, the problem is in the motor or motor wiring. Check the motor and motor wiring.
	Problem with the frequency converter.	Rotate output motor cables 1 position: U to V, V to W, W to U.	If imbalance leg stays on same output terminal, it is a problem with the frequency converter. Contact the Danfoss supplier.
Frequency converter acceleration problems	Motor data was entered incorrectly.	If warnings or alarms occur, see *chapter 7.4 List of Warnings and Alarms*. Check that motor data is entered correctly.	Increase the ramp-up time in *parameter 3-41 Ramp 1 Ramp Up Time*. Increase the current limit in *parameter 4-18 Current Limit*. Increase the torque limit in *parameter 4-16 Torque Limit Motor Mode*.
Frequency converter deceleration problems	Motor data was entered incorrectly.	If warnings or alarms occur, see *chapter 7.4 List of Warnings and Alarms*. Check that motor data is entered correctly.	Increase the ramp-down time in *parameter 3-42 Ramp 1 Ramp Down Time*. Enable overvoltage control in *parameter 2-17 Over-voltage Control*.

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Symptom	Possible cause	Test	Solution
Acoustic noise or vibration	Resonances.	Bypass critical frequencies by using parameters in *parameter group 4-6* Speed Bypass*.	Check if noise and/or vibration have been reduced to an acceptable limit.
		Turn off overmodulation in *parameter 14-03 Overmodulation*.	
		Change the switching pattern and frequency in *parameter group 14-0* Inverter Switching*.	
		Increase resonance dampening in *parameter 1-64 Resonance Damping*.	

Table 7.5 Troubleshooting

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8 Specifications

8.1 Electrical Data

8.1.1 Mains Supply 1x200–240 V AC

Type designation	P1K1	P1K5	P2K2	P3K0	P3K7	P5K5	P7K5	P15K	P22K
Typical shaft output [kW]	1.1	1.5	2.2	3.0	3.7	5.5	7.5	15	22
Typical shaft output at 240 V [hp]	1.5	2.0	2.9	4.0	4.9	7.5	10	20	30
Protection rating IP20/Chassis	A3	–	–	–	–	–	–	–	–
Protection rating IP21/Type 1	–	B1	B1	B1	B1	B1	B2	C1	C2
Protection rating IP55/Type 12	A5	B1	B1	B1	B1	B1	B2	C1	C2
Protection rating IP66/NEMA 4X	A5	B1	B1	B1	B1	B1	B2	C1	C2
Output current									
Continuous (3x200–240 V) [A]	6.6	7.5	10.6	12.5	16.7	24.2	30.8	59.4	88
Intermittent (3x200–240 V) [A]	7.3	8.3	11.7	13.8	18.4	26.6	33.4	65.3	96.8
Continuous kVA at 208 V [kVA]	2.4	2.7	3.8	4.5	6.0	8.7	11.1	21.4	31.7
Maximum input current									
Continuous (1x200–240 V) [A]	12.5	15	20.5	24	32	46	59	111	172
Intermittent (1x200–240 V) [A]	13.8	16.5	22.6	26.4	35.2	50.6	64.9	122.1	189.2
Maximum pre-fuses [A]	20	30	40	40	60	80	100	150	200
Additional specifications									
Maximum cable cross-section (mains, motor, brake) [mm^2 (AWG)]	0.2–4 (4–10)					10 (7)	35 (2)	50 (1/0)	95 (4/0)
Maximum cable cross-section for mains with disconnect switch [mm2 (AWG)]	5.26 (10)	16 (6)	16 (6)	16 (6)	16 (6)	16 (6)	25 (3)	50 (1/0)	2 x 50 (2 x 1/0)[9) 10)]
Maximum cable cross-section for mains without disconnect switch [mm2 (AWG)]	5.26 (10)	16 (6)	16 (6)	16 (6)	16 (6)	16 (6)	25 (3)	50 (1/0)	95 (4/0)
Cable insulation temperature rating [°C (°F)]	75 (167)	75 (167)	75 (167)	75 (167)	75 (167)	75 (167)	75 (167)	75 (167)	75 (167)
Estimated power loss[3)] at rated maximum load [W][4)]	44	30	44	60	74	110	150	300	440
Efficiency[5)]	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98

Table 8.1 Mains Supply 1x200–240 V AC, Normal Overload 110% for 1 Minute, P1K1–P22K

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8.1.2 Mains Supply 3x200–240 V AC

Type designation	PK25		PK37		PK55		PK75	
High/normal overload[1]	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]	0.25		0.37		0.55		0.75	
Typical shaft output at 208 V [hp]	0.34		0.5		0.75		1	
Protection rating IP20/Chassis[6] Protection rating IP21/Type 1	A2		A2		A2		A2	
Protection rating IP55/Type 12 Protection rating IP66/NEMA 4X	A4/A5		A4/A5		A4/A5		A4/A5	
Output current								
Continuous (3x200–240 V) [A]	1.8		2.4		3.5		4.6	
Intermittent (3x200–240 V) [A]	2.7	2.0	3.6	2.6	5.3	3.9	6.9	5.1
Continuous kVA at 208 V [kVA]	0.65		0.86		1.26		1.66	
Maximum input current								
Continuous (3x200–240 V) [A]	1.6		2.2		3.2		4.1	
Intermittent (3x200–240 V) [A]	2.4	1.8	3.3	2.4	4.8	3.5	6.2	4.5
Maximum pre-fuses [A]	10		10		10		10	
Additional specifications								
Maximum cable cross-section[2] for mains, motor, brake, and load sharing [mm² (AWG)]	4, 4, 4 (12, 12, 12) (minimum 0.2 (24))							
Maximum cable cross-section[2] for mains disconnect [mm² (AWG)]	6, 4, 4 (10, 12, 12)							
Estimated power loss[3] at rated maximum load [W (hp)][4]	21 (0.03)		29 (0.04)		42 (0.06)		54 (0.07)	
Efficiency[5]	0.94		0.94		0.95		0.95	

Table 8.2 Mains Supply 3x200–240 V AC, PK25–PK75

Type designation	P1K1		P1K5		P2K2		P3K0		P3K7	
High/normal overload[1]	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]	1.1		1.5		2.2		3.0		3.7	
Typical shaft output at 208 V [hp]	1.5		2		3		4		5	
Protection rating IP20/Chassis[6] Protection rating IP21/Type 1	A2		A2		A2		A3		A3	
Protection rating IP55/Type 12 Protection rating IP66/NEMA 4X	A4/A5		A4/A5		A4/A5		A5		A5	
Output current										
Continuous (3x200–240 V) [A]	6.6		7.5		10.6		12.5		16.7	
Intermittent (3x200–240 V) [A]	9.9	7.3	11.3	8.3	15.9	11.7	18.8	13.8	25	18.4
Continuous kVA at 208 V [kVA]	2.38		2.70		3.82		4.50		6.00	
Maximum input current										
Continuous (3x200–240 V) [A]	5.9		6.8		9.5		11.3		15.0	
Intermittent (3x200–240 V) [A]	8.9	6.5	10.2	7.5	14.3	10.5	17.0	12.4	22.5	16.5
Maximum pre-fuses [A]	20		20		20		32		32	
Additional specifications										
Maximum cable cross-section[2] for mains, motor, brake, and load sharing [mm² (AWG)]	4, 4, 4 (12, 12, 12) (minimum 0.2 (24))									
Maximum cable cross-section[2] for mains disconnect [mm²] [(AWG)]	6, 4, 4 (10, 12, 12)									
Estimated power loss[3] at rated maximum load [W (hp)][4]	63 (0.09)		82 (0.11)		116 (0.16)		155 (0.21)		185 (0.25)	
Efficiency[5]	0.96		0.96		0.96		0.96		0.96	

Table 8.3 Mains Supply 3x200–240 V AC, P1K1–P3K7

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Type designation	P5K5		P7K5		P11K		P15K	
High/normal overload[1]	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]	3.7	5.5	5.5	7.5	7.5	11	11	15
Typical shaft output at 208 V [hp]	5.0	7.5	7.5	10	10	15	15	20
IP20/Chassis[7]	B3		B3		B3		B4	
Protection rating IP21/Type 1 Protection rating IP55/Type 12 Protection rating IP66/NEMA 4X	B1		B1		B1		B2	
Output current								
Continuous (3x200–240 V) [A]	16.7	24.2	24.2	30.8	30.8	46.2	46.2	59.4
Intermittent (3x200–240 V) [A]	26.7	26.6	38.7	33.9	49.3	50.8	73.9	65.3
Continuous kVA at 208 V [kVA]	6.0	8.7	8.7	11.1	11.1	16.6	16.6	21.4
Maximum input current								
Continuous (3x200–240 V) [A]	15.0	22.0	22.0	28.0	28.0	42.0	42.0	54.0
Intermittent (3x200–240 V) [A]	24.0	24.2	35.2	30.8	44.8	46.2	67.2	59.4
Maximum pre-fuses [A]	63		63		63		80	
Additional specifications								
IP20 maximum cable cross-section[2] for mains, brake, motor, and load sharing [mm² (AWG)]	10, 10, – (8, 8, –)		10, 10, – (8, 8, –)		10, 10, – (8, 8, –)		35, –, – (2, –, –)	
Protection rating IP21 maximum cable cross-section[2] for mains, brake, and load sharing [mm² (AWG)]	16, 10, 16 (6, 8, 6)		16, 10, 16 (6, 8, 6)		16, 10, 16 (6, 8, 6)		35, –, – (2, –, –)	
Protection rating IP21 maximum cable cross-section[2] for motor [mm² (AWG)]	10, 10, – (8, 8, –)		10, 10, – (8, 8, –)		10, 10, – (8, 8, –)		35, 25, 25 (2, 4, 4)	
Maximum cable cross-section[2] for mains disconnect [mm² (AWG)]	16, 10, 10 (6, 8, 8)						35 (2)	
Estimated power loss[3] at rated maximum load [W (hp)][4]	239 (0.33)	310 (0.42)	239 (0.33)	310 (0.42)	371 (0.51)	514 (0.7)	463 (0.63)	602 (0.82)
Efficiency[5]	0.96		0.96		0.96		0.96	

Table 8.4 Mains Supply 3x200–240 V AC, P5K5–P15K

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Type designation	P18K		P22K		P30K		P37K		P45K	
High/normal overload[1]	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]	15	18.5	18.5	22	22	30	30	37	37	45
Typical shaft output at 208 V [hp]	20	25	25	30	30	40	40	50	50	60
Protection rating IP20/Chassis[7]	B4		C3		C3		C4		C4	
Protection rating IP21/Type 1 Protection rating IP55/Type 12 Protection rating IP66/NEMA 4X	C1		C1		C1		C2		C2	
Output current										
Continuous (3x200–240 V) [A]	59.4	74.8	74.8	88.0	88.0	115	115	143	143	170
Intermittent (3x200–240 V) [A]	89.1	82.3	112	96.8	132	127	173	157	215	187
Continuous kVA at 208 V [kVA]	21.4	26.9	26.9	31.7	31.7	41.4	41.4	51.5	51.5	61.2
Maximum input current										
Continuous (3x200–240 V) [A]	54.0	68.0	68.0	80.0	80.0	104	104	130	130	154.0
Intermittent (3x200–240 V) [A]	81.0	74.8	102	88.0	120	114	156	143	195	169.0
Maximum pre-fuses [A]	125		125		160		200		250	
Additional specifications										
Protection rating IP20 maximum cable cross-section for mains, brake, motor, and load sharing [mm² (AWG)]	35 (2)		50 (1)		50 (1)		150 (300 MCM)		150 (300 MCM)	
Protection ratings IP21, IP55, IP66 maximum cable cross-section for mains and motor [mm² (AWG)]	50 (1)		50 (1)		50 (1)		150 (300 MCM)		150 (300 MCM)	
Protection ratings IP21, IP55, IP66 maximum cable cross-section for brake, and load sharing [mm² (AWG)]	50 (1)		50 (1)		50 (1)		95 (3/0)		95 (3/0)	
Maximum cable cross-section[2] for disconnect [mm² (AWG)]	50, 35, 35 (1, 2, 2)						95, 70, 70 (3/0, 2/0, 2/0)		185, 150, 120 (350 MCM, 300 MCM, 4/0)	
Estimated power loss[3] at rated maximum load [W (hp)][4]	624 (0.85)	737 (1)	740 (1)	845 (1.2)	874 (1.2)	1140 (1.6)	1143 (1.6)	1353 (1.8)	1400 (1.9)	1636 (2.2)
Efficiency[5]	0.96		0.97		0.97		0.97		0.97	

Table 8.5 Mains Supply 3x200–240 V AC, P18K–P45K

8.1.3 Mains Supply 1x380–480 V AC

Type designation	P7K5	P11K	P18K	P37K
Typical shaft output [kW]	7.5	11	18.5	37
Typical shaft output at 240 V [hp]	10	15	25	50
Protection rating IP21/Type 1	B1	B2	C1	C2
Protection rating IP55/Type 12	B1	B2	C1	C2
Protection rating IP66/NEMA 4X	B1	B2	C1	C2
Output current				
Continuous (3x380–440 V) [A]	16	24	37.5	73
Intermittent (3x380–440 V) [A]	17.6	26.4	41.2	80.3
Continuous (3x441–480 V) [A]	14.5	21	34	65
Intermittent (3x441–480 V) [A]	15.4	23.1	37.4	71.5
Continuous kVA at 400 V [kVA]	11.0	16.6	26	50.6
Continuous kVA at 460 V [kVA]	11.6	16.7	27.1	51.8
Maximum input current				
Continuous (1x380–440 V) [A]	33	48	78	151
Intermittent (1x380–440 V) [A]	36	53	85.5	166

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Type designation	P7K5	P11K	P18K	P37K
Continuous (1x441–480 V) [A]	30	41	72	135
Intermittent (1x441–480 V) [A]	33	46	79.2	148
Maximum pre-fuses [A]	63	80	160	250
Additional specifications				
Maximum cable cross-section for mains, motor, and brake [mm^2] (AWG)]	10 (7)	35 (2)	50 (1/0)	120 (4/0)
Estimated power loss[3] at rated maximum load [W (hp)][4]	300 (0.41)	440 (0.6)	740 (1)	1480 (2)
Efficiency[5]	0.96	0.96	0.96	0.96

Table 8.6 Mains Supply 1x380–480 V AC, Normal Overload 110% for 1 Minute, P7K5–P37K

8.1.4 Mains Supply 3x380–480 V AC

Type designation	PK37		PK55		PK75		P1K1		P1K5	
High/normal overload[1]	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]	0.37		0.55		0.75		1.1		1.5	
Typical shaft output at 460 V [hp]	0.5		0.75		1.0		1.5		2.0	
Protection rating IP20/Chassis[6]	A2		A2		A2		A2		A2	
Protection rating IP55/Type 12 Protection rating IP66/NEMA 4X	A4/A5		A4/A5		A4/A5		A4/A5		A4/A5	
Output current										
Continuous (3x380–440 V) [A]	1.3		1.8		2.4		3.0		4.1	
Intermittent (3x380–440 V) [A]	2.0	1.4	2.7	2.0	3.6	2.6	4.5	3.3	6.2	4.5
Continuous (3x441–480 V) [A]	1.2		1.6		2.1		2.7		3.4	
Intermittent (3x441–480 V) [A]	1.8	1.3	2.4	1.8	3.2	2.3	4.1	3.0	5.1	3.7
Continuous kVA at 400 V [kVA]	0.9		1.3		1.7		2.1		2.8	
Continuous kVA at 460 V [kVA]	0.9		1.3		1.7		2.4		2.7	
Maximum input current										
Continuous (3x380–440 V) [A]	1.2		1.6		2.2		2.7		3.7	
Intermittent (3x380–440 V) [A]	1.8	1.3	2.4	1.8	3.3	2.4	4.1	3.0	5.6	4.1
Continuous (3x441–480 V) [A]	1.0		1.4		1.9		2.7		3.1	
Intermittent (3x441–480 V) [A]	1.5	1.1	2.1	1.5	2.9	2.1	4.1	3.0	4.7	3.4
Maximum pre-fuses [A]	10		10		10		10		10	
Additional specifications										
Protection ratings IP20, IP21 maximum cable cross-section[2] for mains, motor, brake, and load sharing [mm^2 (AWG)]	4, 4, 4 (12, 12, 12) (minimum 0.2 (24))									
Protection ratings IP55, IP66 maximum cable cross-section[2] for mains, motor, brake, and load sharing [mm^2 (AWG)]	4, 4, 4 (12, 12, 12)									
Maximum cable cross-section[2] for disconnect [mm^2 (AWG)]	6, 4, 4 (10, 12, 12)									
Estimated power loss[3] at rated maximum load [W (hp)][4]	35 (0.05)		42 (0.06)		46 (0.06)		58 (0.08)		62 (0.08)	
Efficiency[5]	0.93		0.95		0.96		0.96		0.97	

Table 8.7 Mains Supply 3x380–480 V AC, PK37–P1K5

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Type designation	P2K2		P3K0		P4K0		P5K5		P7K5	
High/normal overload[1)]	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]	2.2		3.0		4.0		5.5		7.5	
Typical shaft output at 460 V [hp]	2.9		4.0		5.3		7.5		10	
Protection rating IP20/Chassis[6)]	A2		A2		A2		A3		A3	
Protection rating IP55/Type 12 Protection rating IP66/NEMA 4X	A4/A5		A4/A5		A4/A5		A5		A5	
Output current										
Continuous (3x380–440 V) [A]	5.6		7.2		10		13		16	
Intermittent (3x380–440 V) [A]	8.4	6.2	10.8	7.9	15.0	11.0	19.5	14.3	24.0	17.6
Continuous (3x441–480 V) [A]	4.8		6.3		8.2		11		14.5	
Intermittent (3x441–480 V) [A]	7.2	5.3	9.5	6.9	12.3	9.0	16.5	12.1	21.8	16.0
Continuous kVA at 400 V [kVA]	3.9		5.0		6.9		9.0		11.0	
Continuous kVA at 460 V [kVA]	3.8		5.0		6.5		8.8		11.6	
Maximum input current										
Continuous (3x380–440 V) [A]	5.0		6.5		9.0		11.7		14.4	
Intermittent (3x380–440 V) [A]	7.5	5.5	9.8	7.2	13.5	9.9	17.6	12.9	21.6	15.8
Continuous(3x441–480 V) [A]	4.3		5.7		7.4		9.9		13.0	
Intermittent (3x441–480 V) [A]	6.5	4.7	8.6	6.3	11.1	8.1	14.9	10.9	19.5	14.3
Maximum pre-fuses [A]	20		20		20		30		30	
Additional specifications										
Protection ratings IP20, IP21 maximum cable cross-section[2)] for mains, motor, brake, and load sharing [mm^2 (AWG)]	4, 4, 4 (12, 12, 12) (minimum 0.2 (24))									
Protection ratings IP55, IP66 maximum cable cross-section[2)] for mains, motor, brake, and load sharing [mm^2 (AWG)]	4, 4, 4 (12, 12, 12)									
Maximum cable cross-section[2)] for disconnect [mm^2 (AWG)]	6, 4, 4 (10, 12, 12)									
Estimated power loss[3)] at rated maximum load [W (hp)][4)]	88 (0.12)		116 (0.16)		124 (0.17)		187 (0.25)		225 (0.31)	
Efficiency[5)]	0.97		0.97		0.97		0.97		0.97	

Table 8.8 Mains Supply 3x380–480 V AC, P2K2–P7K5

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Type designation	P11K		P15K		P18K		P22K		P30K	
High/normal overload[1]	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]	7.5	11	11	15	15	18.5	22.0	22.0	22.0	30
Typical shaft output at 460 V [hp]	10	15	15	20	20	25	30	30	30	40
Protection rating IP20/Chassis[7]	B3		B3		B3		B4			B4
Protection rating IP21/Type 1	B1		B1		B1		B2		B2	
Protection rating IP55/Type 12 Protection rating IP66/NEMA 4X	B1		B1		B1		B2		B2	
Output current										
Continuous (3x380–440 V) [A]	–	24	24	32	32	37.5	37.5	44	44	61
Intermittent (60 s overload) (3x380–440 V) [A]	–	26.4	38.4	35.2	51.2	41.3	60	48.4	70.4	67.1
Continuous (3x441–480 V) [A]	–	21	21	27	27	34	34	40	40	52
Intermittent (60 s overload) (3x441–480 V) [A]	–	23.1	33.6	29.7	43.2	37.4	54.4	44	64	61.6
Continuous kVA at 400 V [kVA]	–	16.6	16.6	22.2	22.2	26	26	30.5	30.5	42.3
Continuous kVA at 460 V [kVA]	–	16.7	16.7	21.5	21.5	27.1	27.1	31.9	31.9	41.4
Maximum input current										
Continuous (3x380–440 V) [A]	–	22	22	29	29	34	34	40	40	55
Intermittent (60 s overload) (3x380–440 V) [A]	–	24.2	35.2	31.9	46.4	37.4	54.4	44	64	60.5
Continuous (3x441–480 V) [A]	–	19	19	25	25	31	31	36	36	47
Intermittent (60 s overload) (3x441–480 V) [A]	–	20.9	30.4	27.5	40	34.1	49.6	39.6	57.6	51.7
Maximum pre-fuses [A]	–	63		63		63		63		80
Additional specifications										
Protection ratings IP21, IP55, IP66 maximum cable cross-section[2] for mains, brake, and load sharing [mm^2 (AWG)]	16, 10, 16 (6, 8, 6)						35, –, – (2, –, –)			
Protection ratings IP21, IP55, IP66 maximum cable cross-section[2] for motor [mm^2 (AWG)]	10, 10,– (8, 8,–)						35, 25, 25 (2, 4, 4)			
Protection rating IP20 maximum cable cross-section[2] for mains, brake, motor, and load sharing [mm^2 (AWG)]	10, 10,– (8, 8,–)						35, –, – (2, –, –)			
Maximum cable cross-section[2] for disconnect [mm^2 (AWG)]	16, 10, 10 (6, 8, 8)									
Estimated power loss[3] at rated maximum load [W (hp)][4]	291 (0.4)	392 (0.53)	291 (0.4)	392 (0.53)	379 (0.52)	465 (0.63)	444 (0.61)	525 (0.72)	547 (0.75)	739 (1)
Efficiency[5]	0.98		0.98		0.98		0.98		0.98	

Table 8.9 Mains Supply 3x380–480 V AC, P11K–P30K

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Type designation	P37K		P45K		P55K		P75K		P90K	
High/normal overload[1]	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]	30	37	37	45	45	55	55	75	75	90
Typical shaft output at 460 V [hp]	40	50	50	60	60	75	75	100	100	125
Protection rating IP20/Chassis[6]	B4		C3		C3		C4		C4	
Protection rating IP21/Type 1	C1		C1		C1		C2		C2	
Protection rating IP55/Type 12 Protection rating IP66/NEMA 4X	C1		C1		C1		C2		C2	
Output current										
Continuous (3x380–440 V) [A]	61	73	73	90	90	106	106	147	147	177
Intermittent (60 s overload) (3x380–440 V) [A]	91.5	80.3	110	99	135	117	159	162	221	195
Continuous (3x441–480 V) [A]	52	65	65	80	80	105	105	130	130	160
Intermittent (60 s overload) (3x441–480 V) [A]	78	71.5	97.5	88	120	116	158	143	195	176
Continuous kVA at 400 V [kVA]	42.3	50.6	50.6	62.4	62.4	73.4	73.4	102	102	123
Continuous kVA at 460 V [kVA]	41.4	51.8	51.8	63.7	63.7	83.7	83.7	104	103.6	128
Maximum input current										
Continuous (3x380–440 V) [A]	55	66	66	82	82	96	96	133	133	161
Intermittent (60 s overload) (3x380–440 V) [A]	82.5	72.6	99	90.2	123	106	144	146	200	177
Continuous (3x441–480 V) [A]	47	59	59	73	73	95	95	118	118	145
Intermittent (60 s overload) (3x441–480 V) [A]	70.5	64.9	88.5	80.3	110	105	143	130	177	160
Maximum pre-fuses [A]	100		125		160		250		250	
Additional specifications										
Protection rating IP20 maximum cable cross-section for mains and motor [mm² (AWG)]	35 (2)		50 (1)		50 (1)		150 (300 MCM)		150 (300 MCM)	
Protection rating IP20 maximum cable cross-section for brake and load sharing [mm² (AWG)]	35 (2)		50 (1)		50 (1)		95 (4/0)		95 (4/0)	
Protection ratings IP21, IP55, IP66 maximum cable cross-section for mains and motor [mm² (AWG)]	50 (1)		50 (1)		50 (1)		150 (300 MCM)		150 (300 MCM)	
Protection ratings IP21, IP55, IP66 maximum cable cross-section for brake and load sharing [mm² (AWG)]	50 (1)		50 (1)		50 (1)		95 (3/0)		95 (3/0)	
Maximum cable cross-section[2] for mains disconnect [mm² (AWG)]	50, 35, 35 (1, 2, 2)						95, 70, 70 (3/0, 2/0, 2/0)		185, 150, 120 (350 MCM, 300 MCM, 4/0)	
Estimated power loss[3] at rated maximum load [W (hp)][4]	570 (0.78)	698 (0.95)	697 (0.95)	843 (1.1)	891 (1.2)	1083 (1.5)	1022 (1.4)	1384 (1.9)	1232 (1.7)	1474 (2)
Efficiency[5]	0.98		0.98		0.98		0.98		0.99	

Table 8.10 Mains Supply 3x380–480 V AC, P37K–P90K

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8.1.5 Mains Supply 3x525–600 V AC

Type designation	PK75		P1K1		P1K5		P2K2	
High/normal overload[1)]	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]	0.75		1.1		1.5		2.2	
Typical shaft output [hp]	1		1.5		2		3	
Protection rating IP20/Chassis Protection rating IP21/Type 1	A3		A3		A3		A3	
Protection rating IP55/Type 12	A5		A5		A5		A5	
Output current								
Continuous (3x525–550 V) [A]	1.8		2.6		2.9		4.1	
Intermittent (3x525–550 V) [A]	2.7	2.0	3.9	2.9	4.4	3.2	6.2	4.5
Continuous (3x551–600 V) [A]	1.7		2.4		2.7		3.9	
Intermittent (3x551–600 V) [A]	2.6	1.9	3.6	2.6	4.1	3.0	5.9	4.3
Continuous kVA at 550 V [kVA]	1.7		2.5		2.8		3.9	
Continuous kVA at 550 V [kVA]	1.7		2.4		2.7		3.9	
Maximum input current								
Continuous (3x525–600 V) [A]	1.7		2.4		2.7		4.1	
Intermittent (3x525–600 V) [A]	2.6	1.9	3.6	2.6	4.1	3.0	6.2	4.5
Maximum pre-fuses [A]	10		10		10		20	
Additional specifications								
Maximum cable cross-section[2)] for mains, motor, brake, and load sharing [mm^2 (AWG)]	4,4,4 (12,12,12) (minimum 0.2 (24))							
Maximum cable cross-section[2)] for mains disconnect [mm^2 (AWG)]	6,4,4 (10,12,12)							
Estimated power loss[3)] at rated maximum load [W (hp)][4)]	35 (0.05)		50 (0.07)		65 (0.09)		92 (0.13)	
Efficiency[5)]	0.97		0.97		0.97		0.97	

Table 8.11 Mains Supply 3x525–600 V AC, PK75–P2K2

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Type designation	P3K0		P4K0		P5K5		P7K5	
High/normal overload[1)]	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]	3.0		4.0		5.5		7.5	
Typical shaft output [hp]	4		5		7.5		10	
Protection rating IP20/Chassis Protection rating IP21/Type 1	A2		A2		A3		A3	
IP55/Type 12	A5		A5		A5		A5	
Output current								
Continuous (3x525–550 V) [A]	5.2		6.4		9.5		11.5	
Intermittent (3x525–550 V) [A]	7.8	5.7	9.6	7.0	14.3	10.5	17.3	12.7
Continuous (3x551–600 V) [A]	4.9		6.1		9.0		11.0	
Intermittent (3x551–600 V) [A]	7.4	5.4	9.2	6.7	13.5	9.9	16.5	12.1
Continuous kVA at 550 V [kVA]	5.0		6.1		9.0		11.0	
Continuous kVA at 550 V [kVA]	4.9		6.1		9.0		11.0	
Maximum input current								
Continuous (3x525–600 V) [A]	5.2		5.8		8.6		10.4	
Intermittent (3x525–600 V) [A]	7.8	5.7	8.7	6.4	12.9	9.5	15.6	11.4
Maximum pre-fuses [A]	20		20		32		32	
Additional specifications								
Maximum cable cross-section[2)] for mains, motor, brake, and load sharing [mm^2 (AWG)]	4,4,4 (12,12,12) (minimum 0.2 (24))							
Maximum cable cross-section[2)] for mains disconnect [mm^2 (AWG)]	6,4,4 (10,12,12)							
Estimated power loss[3)] at rated maximum load [W (hp)][4)]	122 (0.17)		145 (0.2)		195 (0.27)		261 (0.36)	
Efficiency[5)]	0.97		0.97		0.97		0.97	

Table 8.12 Mains Supply 3x525–600 V AC, P3K0–P7K5

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Type designation	P11K		P15K		P18K		P22K		P30K		P37K	
High/normal overload[1]	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]	7.5	11	11	15	15	18.5	18.5	22	22	30	30	37
Typical shaft output [hp]	10	15	15	20	20	25	25	30	30	40	40	50
Protection rating IP20/ Chassis	B3		B3		B3		B4		B4		B4	
Protection rating IP21/ Type 1 Protection rating IP55/ Type 12 Protection rating IP66/ NEMA 4X	B1		B1		B1		B2		B2		C1	
Output current												
Continuous (3x525–550 V) [A]	11.5	19	19	23	23	28	28	36	36	43	43	54
Intermittent (3x525–550 V) [A]	18.4	21	30	25	37	31	45	40	58	47	65	59
Continuous (3x551–600 V) [A]	11	18	18	22	22	27	27	34	34	41	41	52
Intermittent (3x551–600 V) [A]	17.6	20	29	24	35	30	43	37	54	45	62	57
Continuous kVA at 550 V [kVA]	11	18.1	18.1	21.9	21.9	26.7	26.7	34.3	34.3	41.0	41.0	51.4
Continuous kVA at 575 V [kVA]	11	17.9	17.9	21.9	21.9	26.9	26.9	33.9	33.9	40.8	40.8	51.8
Maximum input current												
Continuous at 550 V [A]	10.4	17.2	17.2	20.9	20.9	25.4	25.4	32.7	32.7	39	39	49
Intermittent at 550 V [A]	16.6	19	28	23	33	28	41	36	52	43	59	54
Continuous at 575 V [A]	9.8	16	16	20	20	24	24	31	31	37	37	47
Intermittent at 575 V [A]	15.5	17.6	26	22	32	27	39	34	50	41	56	52
Maximum pre-fuses [A]	40		40		50		60		80		100	
Additional specifications												
Protection rating IP20, maximum cable cross-section[2] for mains, brake, motor, and load sharing [mm² (AWG)]	10, 10,– (8, 8,–)						35,–,– (2,–,–)					
Protection ratings IP21, IP55, IP66 maximum cable cross-section[2] for mains, brake, and load sharing [mm² (AWG)]	16, 10, 10 (6, 8, 8)						35,–,– (2,–,–)					
Protection ratings IP21, IP55, IP66 maximum cable cross-section[2] for motor [mm² (AWG)]	10, 10,– (8, 8,–)						35, 25, 25 (2, 4, 4)					
Maximum cable cross-section[2] for mains disconnect [mm² (AWG)]	16, 10, 10 (6, 8, 8)										50, 35, 35 (1, 2, 2)	
Estimated power loss[3] at rated maximum load [W (hp)][4]	220 (0.3)	300 (0.41)	220 (0.3)	300 (0.41)	300 (0.41)	370 (0.5)	370 (0.5)	440 (0.6)	440 (0.6)	600 (0.82)	600 (0.82)	740 (1)
Efficiency[5]	0.98		0.98		0.98		0.98		0.98		0.98	

Table 8.13 Mains supply 3x525–600 V AC, P11K–P37K

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Type designation	P45K		P55K		P75K		P90K	
High/normal overload[1]	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]	37	45	45	55	55	75	75	90
Typical shaft output [hp]	50	60	60	75	75	100	100	125
Protection rating IP20/Chassis	C3		C3		C4		C4	
Protection rating IP21/Type 1 Protection rating IP55/Type 12 Protection rating IP66/NEMA 4X	C1		C1		C2		C2	
Output current								
Continuous (3x525–550 V) [A]	54	65	65	87	87	105	105	137
Intermittent (3x525–550 V) [A]	81	72	98	96	131	116	158	151
Continuous (3x525–600 V) [A]	52	62	62	83	83	100	100	131
Intermittent (3x525–600 V) [A]	78	68	93	91	125	110	150	144
Continuous kVA at 525 V [kVA]	51.4	61.9	61.9	82.9	82.9	100	100.0	130.5
Continuous kVA at 575 V [kVA]	51.8	61.7	61.7	82.7	82.7	99.6	99.6	130.5
Maximum input current								
Continuous at 550 V [A]	49	59	59	78.9	78.9	95.3	95.3	124.3
Intermittent at 550 V [A]	74	65	89	87	118	105	143	137
Continuous at 575 V [A]	47	56	56	75	75	91	91	119
Intermittent at 575 V [A]	70	62	85	83	113	100	137	131
Maximum pre-fuses [A]	150		160		225		250	
Additional specifications								
Protection rating IP20 maximum cable cross-section for mains and motor [mm² (AWG)]	50 (1)				150 (300 MCM)			
Protection rating IP20 maximum cable cross-section for brake and load sharing [mm² (AWG)]	50 (1)				95 (4/0)			
Protection ratings IP21, IP55, IP66 maximum cable cross-section for mains and motor [mm² (AWG)]	50 (1)				150 (300 MCM)			
Protection ratings IP21, IP55, IP66 maximum cable cross-section for brake and load sharing [mm² (AWG)]	50 (1)				95 (4/0)			
Maximum cable cross-section[2] for mains disconnect [mm² (AWG)]	50, 35, 35 (1, 2, 2)				95, 70, 70 (3/0, 2/0, 2/0)		185, 150, 120 (350 MCM, 300 MCM, 4/0)	
Estimated power loss[3] at rated maximum load [W (hp)][4]	740 (1)	900 (1.2)	900 (1.2)	1100 (1.5)	1100 (1.5)	1500 (2)	1500 (2)	1800 (2.5)
Efficiency[5]	0.98		0.98		0.98		0.98	

Table 8.14 Mains supply 3x525–600 V AC, P45K–P90K

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8.1.6 Mains Supply 3x525–690 V AC

Type designation	P1K1		P1K5		P2K2		P3K0		P4K0		P5K5		P7K5	
High/normal overload[1]	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]	1.1		1.5		2.2		3.0		4.0		5.5		7.5	
Typical shaft output [hp]	1.5		2		3		4		5		7.5		10	
IP20/Chassis	A3		A3		A3		A3		A3		A3		A3	
Output current														
Continuous (3x525–550 V) [A]	2.1		2.7		3.9		4.9		6.1		9.0		11.0	
Intermittent (3x525–550 V) [A]	3.2	2.3	4.1	3.0	5.9	4.3	7.4	5.4	9.2	6.7	13.5	9.9	16.5	12.1
Continuous (3x551–690 V) [A]	1.6		2.2		3.2		4.5		5.5		7.5		10.0	
Intermittent (3x551–690 V) [A]	2.4	1.8	3.3	2.4	4.8	3.5	6.8	5.0	8.3	6.1	11.3	8.3	15.0	11.0
Continuous kVA at 525 V [kVA]	1.9		2.5		3.5		4.5		5.5		8.2		10.0	
Continuous kVA at 690 V [kVA]	1.9		2.6		3.8		5.4		6.6		9.0		12.0	
Maximum input current														
Continuous (3x525–550 V) [A]	1.9		2.4		3.5		4.4		5.5		8.1		9.9	
Intermittent (3x525–550 V) [A]	2.9	2.1	3.6	2.6	5.3	3.9	6.6	4.8	8.3	6.1	12.2	8.9	14.9	10.9
Continuous (3x551–690 V) [A]	1.4		2.0		2.9		4.0		4.9		6.7		9.0	
Intermittent (3x551–690 V) [A]	2.1	1.5	3.0	2.2	4.4	3.2	6.0	4.4	7.4	5.4	10.1	7.4	13.5	9.9
Additional specifications														
Maximum cable cross–section[2] for mains, motor, brake, and load sharing [mm^2 (AWG)]	4, 4, 4 (12, 12, 12) (minimum (24)													
Maximum cable cross–section[2] for mains disconnect [mm^2 (AWG)]	6, 4, 4 (10, 12, 12)													
Estimated power loss[3] at rated maximum load [W (hp)][4]	44 (0.06)		60 (0.08)		88 (0.12)		120 (0.16)		160 (0.22)		220 (0.3)		300 (0.41)	
Efficiency[5]	0.96		0.96		0.96		0.96		0.96		0.96		0.96	

Table 8.15 A3 Enclosure, Mains Supply 3x525–690 V AC IP20/Protected Chassis, P1K1–P7K5

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Type designation	P11K		P15K		P18K		P22K		P30K	
High/normal overload[1]	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output at 550 V [kW]	5.9	7.5	7.5	11	11	15	15	18.5	18.5	22
Typical shaft output at 550 V [hp]	7.5	10	10	15	15	20	20	25	25	30
Typical shaft output at 690 V [kW]	7.5	11	11	15	15	18.5	18.5	22	22	30
Typical shaft output at 690 V [hp]	10	15	15	20	20	25	25	30	30	40
IP20/Chassis	B4		B4		B4		B4		B4	
IP21/Type 1 IP55/Type 12	B2		B2		B2		B2		B2	
Output current										
Continuous (3x525–550 V) [A]	11	14	14.0	19.0	19.0	23.0	23.0	28.0	28.0	36.0
Intermittent (60 s overload) (3x525–550 V) [A]	17.6	15.4	22.4	20.9	30.4	25.3	36.8	30.8	44.8	39.6
Continuous (3x551–690 V) [A]	10	13	13.0	18.0	18.0	22.0	22.0	27.0	27.0	34.0
Intermittent (60 s overload) (3x551–690 V) [A]	16	14.3	20.8	19.8	28.8	24.2	35.2	29.7	43.2	37.4
Continuous kVA at 550 V [kVA]	10	13.3	13.3	18.1	18.1	21.9	21.9	26.7	26.7	34.3
Continuous kVA at 690 V kVA]	12	15.5	15.5	21.5	21.5	26.3	26.3	32.3	32.3	40.6
Maximum input current										
Continuous at 550 V [A]	9.9	15	15.0	19.5	19.5	24.0	24.0	29.0	29.0	36.0
Intermittent (60 s overload) at 550 V [A]	15.8	16.5	23.2	21.5	31.2	26.4	38.4	31.9	46.4	39.6
Continuous (at 690 V) [A]	9	14.5	14.5	19.5	19.5	24.0	24.0	29.0	29.0	36.0
Intermittent (60 s overload) at 690 V [A]	14.4	16	23.2	21.5	31.2	26.4	38.4	31.9	46.4	39.6
Additional specifications										
Maximum cable cross–section[2] for mains, motor, brake, and load sharing [mm² (AWG)]	35, 25, 25 (2, 4, 4)									
Maximum cable cross–section[2)] for mains disconnect [mm² (AWG)]	16,10,10 (6, 8, 8)									
Estimated power loss[3)] at rated maximum load [W (hp)][4)]	150 (0.2)	220 (0.3)	150 (0.2)	220 (0.3)	220 (0.3)	300 (0.41)	300 (0.41)	370 (0.5)	370 (0.5)	440 (0.6)
Efficiency[5)]	0.98		0.98		0.98		0.98		0.98	

Table 8.16 B2/B4 Enclosure, Mains Supply 3x525–690 V AC IP20/IP21/IP55 – Chassis/NEMA 1/NEMA 12, P11K–P22K

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Type designation	P37K		P45K		P55K		P75K/N75K[8]		P90K/N90K[8]	
High/normal overload[1]	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output at 550 V [kW]	22	30	30	37	37	45	45	55	55	75
Typical shaft output at 550 V [hp]	30	40	40	50	50	60	60	75	75	100
Typical shaft output at 690 V [kW]	30	37	37	45	45	55	55	75	75	90
Typical shaft output at 690 V [hp]	40	50	50	60	60	75	75	100	199	125
IP20/Chassis	B4		C3		C3		D3h		D3h	
IP21/Type 1 IP55/Type 12	C2		C2		C2		C2		C2	
Output current										
Continuous (3x525–550 V) [A]	36.0	43.0	43.0	54.0	54.0	65.0	65.0	87.0	87.0	105
Intermittent (60 s overload) (3x525–550 V) [A]	54.0	47.3	64.5	59.4	81.0	71.5	97.5	95.7	130.5	115.5
Continuous (3x551–690 V) [A]	34.0	41.0	41.0	52.0	52.0	62.0	62.0	83.0	83.0	100
Intermittent (60 s overload) (3x551–690 V) [A]	51.0	45.1	61.5	57.2	78.0	68.2	93.0	91.3	124.5	110
Continuous kVA at 550 V [kVA]	34.3	41.0	41.0	51.4	51.4	61.9	61.9	82.9	82.9	100
Continuous kVA at 690 V [kVA]	40.6	49.0	49.0	62.1	62.1	74.1	74.1	99.2	99.2	119.5
Maximum input current										
Continuous at 550 V [A]	36.0	49.0	49.0	59.0	59.0	71.0	71.0	87.0	87.0	99.0
Intermittent (60 s overload) at 550 V [A]	54.0	53.9	72.0	64.9	87.0	78.1	105.0	95.7	129	108.9
Continuous at 690 V [A]	36.0	48.0	48.0	58.0	58.0	70.0	70.0	86.0	–	–
Intermittent (60 s overload) at 690 V [A]	54.0	52.8	72.0	63.8	87.0	77.0	105	94.6	–	–
Additional specifications										
Maximum cable cross-section for mains and motor [mm² (AWG)]	150 (300 MCM)									
Maximum cable cross-section for brake and load sharing [mm² (AWG)]	95 (3/0)									
Maximum cable cross-section[2] for mains disconnect [mm² (AWG)]	95 (3/0)						185, 150, 120 (350 MCM, 300 MCM, 4/0)		–	
Estimated power loss[3] at rated maximum load [W (hp)][4]	600 (0.82)	740 (1)	740 (1)	900 (1.2)	900 (1.2)	1100 (1.5)	1100 (1.5)	1500 (2)	1500 (2)	1800 (2.5)
Efficiency[5]	0.98		0.98		0.98		0.98		0.98	

Table 8.17 B4, C2, C3 Enclosure, Mains Supply 3x525–690 V AC IP20/IP21/IP55 – Chassis/NEMA1/NEMA 12, P30K–P75K

For fuse ratings see chapter 8.8 Fuses and Circuit Breakers.

1) High overload=150% or 160% torque for a duration of 60 s. Normal overload=110% torque for a duration of 60 s.

2) The 3 values for the maximum cable cross-section are for single core, flexible wire, and flexible wire with sleeve, respectively.

3) Applies for dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included. For power loss data according to EN 50598–2, refer to www.danfoss.com/vltenergyefficiency.

4) Efficiency measured at nominal current. For energy efficiency class see chapter 8.4.1 Ambient Conditions. For part load losses see www.danfoss.com/vltenergyefficiency.

5) Measured using 5 m (16 ft) shielded motor cables at rated load and rated frequency.

6) Enclosure sizes A2+A3 can be converted to IP21 using a conversion kit. See also chapters Mechanical mounting and IP21/Type 1 Enclosure kit in the design guide.

7) Enclosure sizes B3+B4 and C3+C4 can be converted to IP21 using a conversion kit. See also chapters Mechanical mounting and IP21/Type 1 Enclosure kit in the design guide.

8) Enclosure sizes for N75K, N90K are D3h for IP20/Chassis, and D5h for IP54/Type 12.

9) Two wires are required.

10) Variant not available in IP21.

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8.2 Mains Supply

Mains supply (L1, L2, L3)	
Supply voltage	200–240 V ±10%
Supply voltage	380–480 V ±10%
Supply voltage	525–600 V ±10%
Supply voltage	525–690 V ±10%

Mains voltage low/mains drop-out:
During low mains voltage or a mains drop-out, the frequency converter continues until the DC-link voltage drops below the minimum stop level. Typically, this corresponds to 15% below the lowest rated supply voltage of the frequency converter. Power-up and full torque cannot be expected at mains voltage <10% below the lowest rated supply voltage of the frequency converter.

Supply frequency	50/60 Hz +4/-6%

The frequency converter power supply is tested in accordance with IEC61000-4-28, 50 Hz +4/-6%.

Maximum imbalance temporary between mains phases	3.0% of rated supply voltage
True power factor (λ)	≥0.9 nominal at rated load
Displacement power factor (cosφ) near unity	(>0.98)
Switching on input supply L1, L2, L3 (power-ups) ≤7.5 kW (10 hp)	Maximum 2 times/minute
Switching on input supply L1, L2, L3 (power-ups) 11–90 kW (15–125 hp)	Maximum 1 time/minute
Environment according to EN 60664-1	Overvoltage category III/pollution degree 2

The unit is suitable for use on a circuit capable of delivering not more than 100000 RMS symmetrical Amperes, 240/480/600/690 V maximum.

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8.3 Motor Output and Motor Data

Motor output (U, V, W)	
Output voltage	0–100% of supply voltage
Output frequency	0–590 Hz[1)]
Switching on output	Unlimited
Ramp times	1–3600 s

1) Dependent on power size.

Torque characteristics, normal overload	
Starting torque (constant torque)	Maximum 110% for 1 minute, once in 10 minutes[2)]
Overload torque (constant torque)	Maximum 110% for 1 minute, once in 10 minutes[2)]

Torque characteristics, high overload	
Starting torque (constant torque)	Maximum 150/160% for 1 minute, once in 10 minutes[2)]
Overload torque (constant torque)	Maximum 150/160% for 1 minute, once in 10 minutes[2)]

2) Percentage relates to the nominal torque of the frequency converter, dependent on power size.

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8.4 Ambient Conditions

Environment	
Enclosure size A	IP20/Chassis, IP21/Type 1, IP55/Type 12, IP66/Type 4X
Enclosure size B1/B2	IP21/Type 1, IP55/Type 12, IP66/Type 4X
Enclosure size B3/B4	IP20/Chassis
Enclosure size C1/C2	IP21/Type 1, IP55/Type 12, IP66/Type 4X
Enclosure size C3/C4	IP20/Chassis
Enclosure kit available ≤ enclosure size A	IP21/TYPE 1/IP4X top
Vibration test enclosure A/B/C	1.0 g
Maximum relative humidity	5–95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 721-3-3), uncoated	Class 3C2
Aggressive environment (IEC 721-3-3), coated	Class 3C3
Test method according to IEC 60068-2-43 H2S (10 days)	
Ambient temperature	Maximum 50 °C (122 °F)

Derating for high ambient temperature, see chapter Special Conditions in the design guide.

Minimum ambient temperature during full-scale operation	0 °C (32 °F)
Minimum ambient temperature at reduced performance	-10 °C (14 °F)
Temperature during storage/transport	-25 to +65/70 °C (-13 to 149/158 °F)
Maximum altitude above sea level without derating	1000 m (3281 ft)
Maximum altitude above sea level with derating	3000 m (9843 ft)

Derating for high altitude, see chapter Special Conditions in the design guide.

EMC standards, Emission	EN 61800-3
EMC standards, Immunity	EN 61800-3
Energy efficiency class[1)]	IE2

1) Determined according to EN50598-2 at:

- *Rated load.*
- *90% rated frequency.*
- *Switching frequency factory setting.*
- *Switching pattern factory setting.*

8.5 Cable Specifications

Maximum motor cable length, shielded/armored	150 m (492 ft)
Maximum motor cable length, unshielded/unarmored	300 m (984 ft)
Maximum cross-section to motor, mains, load sharing, and brake[1)]	
Maximum cross-section to control terminals, rigid wire	1.5 mm^2 or 2 x 0.75 mm^2 (16 AWG)
Maximum cross-section to control terminals, flexible cable	1 mm^2 (18 AWG)
Maximum cross-section to control terminals, cable with enclosed core	0.5 mm^2 (20 AWG)
Minimum cross-section to control terminals	0.25 mm^2 (24 AWG)

1) See electrical data tables in chapter 8.1 Electrical Data for more information.

It is mandatory to ground the mains connection properly using T95 (PE) of the frequency converter. The ground connection cable cross-section must be at least 10 mm^2 (8 AWG) or 2 rated mains wires terminated separately according to EN 50178. See also*chapter 4.3.1 Grounding* . Use unshielded cable.

8.6 Control Input/Output and Control Data

Control card, RS485 serial communication	
Terminal number	68 (P,TX+, RX+), 69 (N,TX-, RX-)
Terminal number 61	Common for terminals 68 and 69

The RS485 serial communication circuit is functionally separated from other central circuits and galvanically isolated from the supply voltage (PELV).

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Analog inputs	
Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switches S201 and S202
Voltage mode	Switch S201/S202 = OFF (U)
Voltage level	0–10 V (scaleable)
Input resistance, R_i	Approximately 10 kΩ
Maximum voltage	±20 V
Current mode	Switch S201/S202=On (I)
Current level	0/4-20 mA (scaleable)
Input resistance, R_i	Approximately 200 Ω
Maximum current	30 mA
Resolution for analog inputs	10 bit (+ sign)
Accuracy of analog inputs	Maximum error 0.5% of full scale
Bandwidth	200 Hz

The analog inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

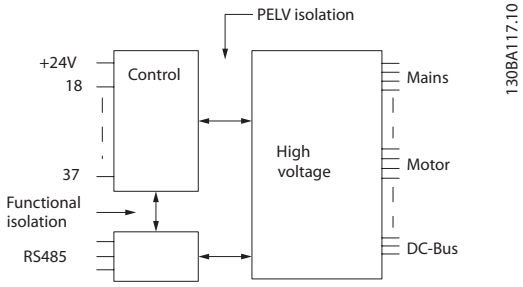

Illustration 8.1 PELV Isolation of Analog Inputs

Analog output	
Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4–20 mA
Maximum resistor load to common at analog output	500 Ω
Accuracy on analog output	Maximum error 0.8% of full scale
Resolution on analog output	8 bit

The analog output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Digital inputs	
Programmable digital inputs	4 (6)
Terminal number	18, 19, 27[1)], 29[1)], 32, 33,
Logic	PNP or NPN
Voltage level	0–24 V DC
Voltage level, logic 0 PNP	<5 V DC
Voltage level, logic 1 PNP	>10 V DC
Voltage level, logic 0 NPN	>19 V DC
Voltage level, logic 1 NPN	<14 V DC
Maximum voltage on input	28 V DC
Input resistance, R_i	Approximately 4 kΩ

All digital inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

1) Terminals 27 and 29 can also be programmed as output.

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Digital output	
Programmable digital/pulse outputs	2
Terminal number	27, 29[1)]
Voltage level at digital/frequency output	0–24 V
Maximum output current (sink or source)	40 mA
Maximum load at frequency output	1 kΩ
Maximum capacitive load at frequency output	10 nF
Minimum output frequency at frequency output	0 Hz
Maximum output frequency at frequency output	32 kHz
Accuracy of frequency output	Maximum error 0.1% of full scale
Resolution of frequency outputs	12 bit

1) Terminal 27 and 29 can also be programmed as input.

The digital output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Pulse inputs	
Programmable pulse inputs	2
Terminal number pulse	29, 33
Maximum frequency at terminal 29, 33	110 kHz (push-pull driven)
Maximum frequency at terminal 29, 33	5 kHz (open collector)
Minimum frequency at terminal 29, 33	4 Hz
Voltage level	See *Digital inputs*
Maximum voltage on input	28 V DC
Input resistance, R_i	Approximately 4 kΩ
Pulse input accuracy (0.1–1 kHz)	Maximum error 0.1% of full scale

Control card, 24 V DC output	
Terminal number	12, 13
Maximum load	200 mA

The 24 V DC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analog and digital inputs and outputs.

Relay outputs	
Programmable relay outputs	2
Relay 01 terminal number	1-3 (break), 1-2 (make)
Maximum terminal load (AC-1)[1)] on 1-3 (NC), 1-2 (NO) (resistive load)	240 V AC, 2 A
Maximum terminal load (AC-15)[1)] (inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Maximum terminal load (DC-1)[1)] on 1-2 (NO), 1-3 (NC) (resistive load)	60 V DC, 1 A
Maximum terminal load (DC-13)[1)] (inductive load)	24 V DC, 0.1 A
Relay 02 terminal number	4-6 (break), 4-5 (make)
Maximum terminal load (AC-1)[1)] on 4-5 (NO) (resistive load)[2) 3)]	400 V AC, 2 A
Maximum terminal load (AC-15)[1)] on 4-5 (NO) (inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Maximum terminal load (DC-1)[1)] on 4-5 (NO) (resistive load)	80 V DC, 2 A
Maximum terminal load (DC-13)[1)] on 4-5 (NO) (inductive load)	24 V DC, 0.1 A
Maximum terminal load (AC-1)[1)] on 4-6 (NC) (resistive load)	240 V AC, 2 A
Maximum terminal load (AC-15)[1)] on 4-6 (NC) (inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Maximum terminal load (DC-1)[1)] on 4-6 (NC) (resistive load)	50 V DC, 2 A
Maximum terminal load (DC-13)[1)] on 4-6 (NC) (inductive load)	24 V DC, 0.1 A
Minimum terminal load on 1-3 (NC), 1-2 (NO), 4-6 (NC), 4-5 (NO)	24 V DC, 10 mA, 24 V AC, 20 mA
Environment according to EN 60664-1	Overvoltage category III/pollution degree 2

1) IEC 60947 parts 4 and 5.

The relay contacts are galvanically isolated from the rest of the circuit by reinforced isolation (PELV).

2) Overvoltage category II.

3) UL applications 300 V AC 2 A.

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Control card, 10 V DC output	
Terminal number	50
Output voltage	10.5 V ±0.5 V
Maximum load	25 mA

The 10 V DC supply is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Control characteristics	
Resolution of output frequency at 0–590 Hz	±0.003 Hz
System response time (terminals 18, 19, 27, 29, 32, 33)	≤2 ms
Speed control range (open loop)	1:100 of synchronous speed
Speed accuracy (open loop)	30–4000 RPM: Maximum error of ±8 RPM

All control characteristics are based on a 4-pole asynchronous motor.

Control card performance	
Scan interval	5 ms

Control card, USB serial communication	
USB standard	1.1 (full speed)
USB plug	USB type B "device" plug

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NOTICE

Connection to a PC is carried out via a standard host/device USB cable.
The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.
The USB connection is not galvanically isolated from protective earth. Use only an isolated laptop/PC as a connection to the USB connector on the frequency converter, or an isolated USB cable/converter.

8.7 Connection Tightening Torques

	Torque [N•m (in-lb)]					
Enclosure	**Mains**	**Motor**	**DC connection**	**Brake**	**Ground**	**Ground**
A2	1.8 (16)	1.8 (16)	1.8 (16)	1.8 (16)	3 (27)	0.6 (5)
A3	1.8 (16)	1.8 (16)	1.8 (16)	1.8 (16)	3 (27)	0.6 (5)
A4	1.8 (16)	1.8 (16)	1.8 (16)	1.8 (16)	3 (27)	0.6 (5)
A5	1.8 (16)	1.8 (16)	1.8 (16)	1.8 (16)	3 (27)	0.6 (5)
B1	1.8 (16)	1.8 (16)	1.5 (13)	1.5 (13.3)	3 (27)	0.6 (5)
B2	4.5 (40)	4.5 (40)	3.7 (33)	3.7 (33)	3 (27)	0.6 (5)
B3	1.8 (16)	1.8 (16)	1.8 (16)	1.8 (16)	3 (27)	0.6 (5)
B4	4.5 (40)	4.5 (40)	4.5 (40)	4.5 (40)	3 (27)	0.6 (5)
C1	10 (89)	10 (89)	10 (89)	10 (89)	3 (27)	0.6 (5)
C2	14/24 (124/221)[1)]	14/24 (124/221)[1)]	14 (124)	14 (124)	3 (27)	0.6 (5)
C3	10 (89)	10 (89)	10 (89)	10 (89)	3 (27)	0.6 (5)
C4	14/24 (124/221)[1)]	14/24 (124/221)[1)]	14 (124)	14 (124)	3 (27)	0.6 (5)

Table 8.18 Terminal Tightening Torques

1) For different cable dimensions x/y, where x≤95 mm^2 (3 AWG) and y≥95 mm^2 (3 AWG).

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8.8 Fuses and Circuit Breakers

Use recommended fuses and/or circuit breakers on the supply side as protection if there is component break-down inside the frequency converter (first fault).

NOTICE

Use of fuses on the supply side is mandatory for IEC 60364 (CE) and NEC 2009 (UL) compliant installations.

Recommendations

- gG type fuses.
- Moeller type circuit breakers. For other circuit breaker types, ensure that the energy into the frequency converter is equal to or lower than the energy provided by Moeller types.

Use of recommended fuses and circuit breakers ensures that possible damage to the frequency converter is limited to damage inside the unit. For further information, see *Application Note Fuses and Circuit Breakers*.

The fuses in *chapter 8.8.1 CE Compliance* to *chapter 8.8.2 UL Compliance* are suitable for use on a circuit capable of delivering 100000 A_{rms} (symmetrical), depending on the frequency converter voltage rating. With the proper fusing, the frequency converter short circuit current rating (SCCR) is 100000 A_{rms}.

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8.8.1 CE Compliance

Enclosure	Power [kW (hp)]	Recommended fuse size	Recommended maximum fuse	Recommended circuit breaker Moeller	Maximum trip level [A]
A2	0.25–2.2 (0.34–3)	gG-10 (0.25–1.5) gG-16 (2.2)	gG-25	PKZM0-25	25
A3	3.0–3.7 (4–5)	gG-16 (3) gG-20 (3.7)	gG-32	PKZM0-25	25
A4	0.25–2.2 (0.34–3)	gG-10 (0.25–1.5) gG-16 (2.2)	gG-32	PKZM0-25	25
A5	0.25–3.7 (0.34–5)	gG-10 (0.25–1.5) gG-16 (2.2–3) gG-20 (3.7)	gG-32	PKZM0-25	25
B1	5.5–11 (7.5–15)	gG-25 (5.5) gG-32 (7.5)	gG-80	PKZM4-63	63
B2	15 (20)	gG-50	gG-100	NZMB1-A100	100
B3	5.5–11 (7.5–15)	gG-25	gG-63	PKZM4-50	50
B4	15–18 (20–24)	gG-32 (7.5) gG-50 (11) gG-63 (15)	gG-125	NZMB1-A100	100
C1	18.5–30 (25–40)	gG-63 (15) gG-80 (18.5) gG-100 (22)	gG-160 (15–18.5) aR-160 (22)	NZMB2-A200	160
C2	37–45 (50–60)	aR-160 (30) aR-200 (37)	aR-200 (30) aR-250 (37)	NZMB2-A250	250
C3	22–30 (30–40)	gG-80 (18.5) aR-125 (22)	gG-150 (18.5) aR-160 (22)	NZMB2-A200	150
C4	37–45 (50–60)	aR-160 (30) aR-200 (37)	aR-200 (30) aR-250 (37)	NZMB2-A250	250

Table 8.19 200–240 V, Enclosure Sizes A, B, and C

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Enclosure	Power [kW (hp)]	Recommended fuse size	Recommended maximum fuse	Recommended circuit breaker Moeller	Maximum trip level [A]
A2	1.1–4.0 (1.5–5)	gG-10 (0.37-3) gG-16 (4)	gG-25	PKZM0-25	25
A3	5.5–7.5 (7.5–10)	gG-16	gG-32	PKZM0-25	25
A4	1.1–4.0 (1.5–5)	gG-10 (0.37-3) gG-16 (4)	gG-32	PKZM0-25	25
A5	1.1–7.5 (1.5–10)	gG-10 (0.37-3) gG-16 (4-7.5)	gG-32	PKZM0-25	25
B1	11–18.5 (15–25)	gG-40	gG-80	PKZM4-63	63
B2	22–30 (30–40)	gG-50 (18.5) gG-63 (22)	gG-100	NZMB1-A100	100
B3	11–18 (15–24)	gG-40	gG-63	PKZM4-50	50
B4	22–37 (30–50)	gG-50 (18.5) gG-63 (22) gG-80 (30)	gG-125	NZMB1-A100	100
C1	37–55 (50–75)	gG-80 (30) gG-100 (37) gG-160 (45)	gG-160	NZMB2-A200	160
C2	75–90 (100–125)	aR-200 (55) aR-250 (75)	aR-250	NZMB2-A250	250
C3	45–55 (60–75)	gG-100 (37) gG-160 (45)	gG-150 (37) gG-160 (45)	NZMB2-A200	150
C4	75–90 (100–125)	aR-200 (55) aR-250 (75)	aR-250	NZMB2-A250	250

Table 8.20 380–480 V, Enclosure Sizes A, B, and C

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Enclosure	Power [kW (hp)]	Recommended fuse size	Recommended maximum fuse	Recommended circuit breaker Moeller	Maximum trip level [A]
A2	1.1–4.0 (1.5–5)	gG-10	gG-25	PKZM0-25	25
A3	5.5–7.5 (7.5–10)	gG-10 (5.5) gG-16 (7.5)	gG-32	PKZM0-25	25
A5	1.1–7.5 (1.5–10)	gG-10 (0.75-5.5) gG-16 (7.5)	gG-32	PKZM0-25	25
B1	11–18 (15–24)	gG-25 (11) gG-32 (15) gG-40 (18.5)	gG-80	PKZM4-63	63
B2	22–30 (30–40)	gG-50 (22) gG-63 (30)	gG-100	NZMB1-A100	100
B3	11–18.5 (15–25)	gG-25 (11) gG-32 (15)	gG-63	PKZM4-50	50
B4	22–37 (30–50)	gG-40 (18.5) gG-50 (22) gG-63 (30)	gG-125	NZMB1-A100	100
C1	37–55 (50–75)	gG-63 (37) gG-100 (45) aR-160 (55)	gG-160 (37-45) aR-250 (55)	NZMB2-A200	160
C2	75–90 (100–125)	aR-200 (75)	aR-250	NZMB2-A250	250
C3	45–55 (60–75)	gG-63 (37) gG-100 (45)	gG-150	NZMB2-A200	150
C4	75–90 (100–125)	aR-160 (55) aR-200 (75)	aR-250	NZMB2-A250	250

Table 8.21 525–600 V, Enclosure Sizes A, B, and C

Enclosure	Power [kW (hp)]	Recommended fuse size	Recommended maximum fuse	Recommended circuit breaker Danfoss	Maximum trip level [A]
A3	1.1 (1.5)	gG-6	gG-25	CTI25M 10-16	16
	1.5 (2)	gG-6	gG-25	CTI25M 10-16	16
	2.2 (3)	gG-6	gG-25	CTI25M 10-16	16
	3 (4)	gG-10	gG-25	CTI25M 10-16	16
	4 (5)	gG-10	gG-25	CTI25M 10-16	16
	5.5 (7.5)	gG-16	gG-25	CTI25M 10-16	16
	7.5 (10)	gG-16	gG-25	CTI25M 10-16	16
B2	11 (15)	gG-25	gG-63	–	–
	15 (20)	gG-25	gG-63	–	–
	18 (24)	gG-32	–	–	–
	22 (30)	gG-32	–	–	–
C2	30 (40)	gG-40	–	–	–
	37 (50)	gG-63	gG-80	–	–
	45 (60)	gG-63	gG-100	–	–
	55 (75)	gG-80	gG-125	–	–
	75 (100)	gG-100	gG-160	–	–
C3	37 (50)	gG-100	gG-125	–	–
	45 (60)	gG-125	gG-160	–	–

Table 8.22 525–690 V, Enclosure Sizes A, B, and C

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8.8.2 UL Compliance

Recommended maximum fuse													
Power [kW (hp)]	Maximum prefuse size [A]	Bussmann JFHR2	Bussmann RK1	Bussmann J	Bussmann T	Bussmann CC	Bussmann CC	Bussmann CC	SIBA RK1	Littelfuse RK1	Ferraz-Shawmut CC	Ferraz-Shawmut RK1	Ferraz-Shawmut J
1.1 (1.5)	15	FWX-15	KTN-R15	JKS-15	JJN-15	FNQ-R-15	KTK-R-15	LP-CC-15	5017906-016	KLN-R15	ATM-R15	A2K-15R	HSJ15
1.5 (2)	20	FWX-20	KTN-R20	JKS-20	JJN-20	FNQ-R-20	KTK-R-20	LP-CC-20	5017906-020	KLN-R20	ATM-R20	A2K-20R	HSJ20
2.2 (3)	30[1)]	FWX-30	KTN-R30	JKS-30	JJN-30	FNQ-R-30	KTK-R-30	LP-CC-30	5012406-032	KLN-R30	ATM-R30	A2K-30R	HSJ30
3.0 (4)	35	FWX-35	KTN-R35	JKS-35	JJN-35	–	–	–	–	KLN-R35	–	A2K-35R	HSJ35
3.7 (5)	50	FWX-50	KTN-R50	JKS-50	JJN-50	–	–	–	5014006-050	KLN-R50	–	A2K-50R	HSJ50
5.5 (7.5)	60[2)]	FWX-60	KTN-R60	JKS-60	JJN-60	–	–	–	5014006-063	KLN-R60	–	A2K-60R	HSJ60
7.5 (10)	80	FWX-80	KTN-R80	JKS-80	JJN-80	–	–	–	5014006-080	KLN-R80	–	A2K-80R	HSJ80
15 (20)	150	FWX-150	KTN-R150	JKS-150	JJN-150	–	–	–	2028220-150	KLN-R150	–	A2K-150R	HSJ150
22 (30)	200	FWX-200	KTN-R200	JKS-200	JJN-200	–	–	–	2028220-200	KLN-R200	–	A2K-200R	HSJ200

Table 8.23 1x200–240 V, Enclosure Sizes A, B, and C

1) Siba allowed up to 32 A.

2) Siba allowed up to 63 A.

Recommended maximum fuse													
Power [kW (hp)]	Maximum prefuse size [A]	Bussmann JFHR2	Bussmann RK1	Bussmann J	Bussmann T	Bussmann CC	Bussmann CC	Bussmann CC	SIBA RK1	Littelfuse RK1	Ferraz-Shawmut CC	Ferraz-Shawmut RK1	Ferraz-Shawmut J
7.5 (10)	60	FWH-60	KTS-R60	JKS-60	JJS-60	–	–	–	5014006-063	KLS-R60	–	A6K-60R	HSJ60
11 (15)	80	FWH-80	KTS-R80	JKS-80	JJS-80	–	–	–	2028220-100	KLS-R80	–	A6K-80R	HSJ80
22 (30)	150	FWH-150	KTS-R150	JKS-150	JJS-150	–	–	–	2028220-160	KLS-R150	–	A6K-150R	HSJ150
37 (50)	200	FWH-200	KTS-R200	JKS-200	JJS-200	–	–	–	2028220-200	KLS-200	–	A6K-200R	HSJ200

Table 8.24 1x380–500 V, Enclosure Sizes B and C

- *KTS-fuses from Bussmann may substitute KTN for 240 V frequency converters.*
- *FWH-fuses from Bussmann may substitute FWX for 240 V frequency converters.*
- *JJS-fuses from Bussmann may substitute JJN for 240 V frequency converters.*
- *KLSR fuses from Littelfuse may substitute KLNR fuses for 240 V frequency converters.*
- *A6KR fuses from Ferraz-Shawmut may substitute A2KR for 240 V frequency converters.*

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	Recommended maximum fuse					
Power [kW (hp)]	Bussmann Type RK1 [1]	Bussmann Type J	Bussmann Type T	Bussmann Type CC	Bussmann	Bussmann Type CC
0.25–0.37 (0.34–0.5)	KTN-R-05	JKS-05	JJN-05	FNQ-R-5	KTK-R-5	LP-CC-5
0.55–1.1 (0.75–1.5)	KTN-R-10	JKS-10	JJN-10	FNQ-R-10	KTK-R-10	LP-CC-10
1.5 (2)	KTN-R-15	JKS-15	JJN-15	FNQ-R-15	KTK-R-15	LP-CC-15
2.2 (3)	KTN-R-20	JKS-20	JJN-20	FNQ-R-20	KTK-R-20	LP-CC-20
3.0 (4)	KTN-R-25	JKS-25	JJN-25	FNQ-R-25	KTK-R-25	LP-CC-25
3.7 (5)	KTN-R-30	JKS-30	JJN-30	FNQ-R-30	KTK-R-30	LP-CC-30
5.5–7.5 (7.5–10)	KTN-R-50	JKS-50	JJN-50	–	–	–
11 (15)	KTN-R-60	JKS-60	JJN-60	–	–	–
15 (20)	KTN-R-80	JKS-80	JJN-80	–	–	–
18.5–22 (25–30)	KTN-R-125	JKS-125	JJN-125	–	–	–
30 (40)	KTN-R-150	JKS-150	JJN-150	–	–	–
37 (50)	KTN-R-200	JKS-200	JJN-200	–	–	–
45 (60)	KTN-R-250	JKS-250	JJN-250	–	–	–

Table 8.25 3x200–240 V, Enclosure Sizes A, B, and C

	Recommended maximum fuse							
Power [kW (hp)]	SIBA Type RK1	Littelfuse Type RK1	Ferraz-Shawmut Type CC	Ferraz-Shawmut Type RK1[2]	Bussmann Type JFHR2[3]	Littelfuse JFHR2	Ferraz-Shawmut JFHR2[4]	Ferraz-Shawmut J
0.25–0.37 (0.34–0.5)	5017906-005	KLN-R-05	ATM-R-05	A2K-05-R	FWX-5	–	–	HSJ-6
0.55–1.1 (0.75–1.5)	5017906-010	KLN-R-10	ATM-R-10	A2K-10-R	FWX-10	–	–	HSJ-10
1.5 (2)	5017906-016	KLN-R-15	ATM-R-15	A2K-15-R	FWX-15	–	–	HSJ-15
2.2 (3)	5017906-020	KLN-R-20	ATM-R-20	A2K-20-R	FWX-20	–	–	HSJ-20
3.0 (4)	5017906-025	KLN-R-25	ATM-R-25	A2K-25-R	FWX-25	–	–	HSJ-25
3.7 (5)	5012406-032	KLN-R-30	ATM-R-30	A2K-30-R	FWX-30	–	–	HSJ-30
5.5–7.5 (7.5–10)	5014006-050	KLN-R-50	–	A2K-50-R	FWX-50	–	–	HSJ-50
11 (15)	5014006-063	KLN-R-60	–	A2K-60-R	FWX-60	–	–	HSJ-60
15 (20)	5014006-080	KLN-R-80	–	A2K-80-R	FWX-80	–	–	HSJ-80
18.5–22 (25–30)	2028220-125	KLN-R-125	–	A2K-125-R	FWX-125	–	–	HSJ-125
30 (40)	2028220-150	KLN-R-150	–	A2K-150-R	FWX-150	L25S-150	A25X-150	HSJ-150
37 (50)	2028220-200	KLN-R-200	–	A2K-200-R	FWX-200	L25S-200	A25X-200	HSJ-200
45 (60)	2028220-250	KLN-R-250	–	A2K-250-R	FWX-250	L25S-250	A25X-250	HSJ-250

Table 8.26 3x200–240 V, Enclosure Sizes A, B, and C

1) KTS-fuses from Bussmann may substitute KTN for 240 V frequency converters.

2) A6KR fuses from Ferraz-Shawmut may substitute A2KR for 240 V frequency converters.

3) FWH-fuses from Bussmann may substitute FWX for 240 V frequency converters.

4) A50X fuses from Ferraz-Shawmut may substitute A25X for 240 V frequency converters.

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	Recommended maximum fuse					
Power [kW (hp)]	Bussmann Type RK1	Bussmann Type J	Bussmann Type T	Bussmann Type CC	Bussmann Type CC	Bussmann Type CC
–	KTS-R-6	JKS-6	JJS-6	FNQ-R-6	KTK-R-6	LP-CC-6
1.1–2.2 (1.5–3)	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
3 (4)	KTS-R-15	JKS-15	JJS-15	FNQ-R-15	KTK-R-15	LP-CC-15
4 (5)	KTS-R-20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20
5.5 (7.5)	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25
7.5 (10)	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30
11 (15)	KTS-R-40	JKS-40	JJS-40	–	–	–
15 (20)	KTS-R-50	JKS-50	JJS-50	–	–	–
22 (30)	KTS-R-60	JKS-60	JJS-60	–	–	–
30 (40)	KTS-R-80	JKS-80	JJS-80	–	–	–
37 (50)	KTS-R-100	JKS-100	JJS-100	–	–	–
45 (60)	KTS-R-125	JKS-125	JJS-125	–	–	–
55 (75)	KTS-R-150	JKS-150	JJS-150	–	–	–
75 (100)	KTS-R-200	JKS-200	JJS-200	–	–	–
90 (125)	KTS-R-250	JKS-250	JJS-250	–	–	–

Table 8.27 3x380–480 V, Enclosure Sizes A, B, and C

	Recommended maximum fuse							
Power [kW (hp)]	SIBA Type RK1	Littelfuse Type RK1	Ferraz-Shawmut Type CC	Ferraz-Shawmut Type RK1	Bussmann JFHR2	Ferraz-Shawmut J	Ferraz-Shawmut JFHR2[1)]	Littelfuse JFHR2
–	5017906-006	KLS-R-6	ATM-R-6	A6K-6-R	FWH-6	HSJ-6	–	–
1.1–2.2 (1.5–3)	5017906-010	KLS-R-10	ATM-R-10	A6K-10-R	FWH-10	HSJ-10	–	–
3 (4)	5017906-016	KLS-R-15	ATM-R-15	A6K-15-R	FWH-15	HSJ-15	–	–
4 (5)	5017906-020	KLS-R-20	ATM-R-20	A6K-20-R	FWH-20	HSJ-20	–	–
5.5 (7.5)	5017906-025	KLS-R-25	ATM-R-25	A6K-25-R	FWH-25	HSJ-25	–	–
7.5 (10)	5012406-032	KLS-R-30	ATM-R-30	A6K-30-R	FWH-30	HSJ-30	–	–
11 (15)	5014006-040	KLS-R-40	–	A6K-40-R	FWH-40	HSJ-40	–	–
15 (20)	5014006-050	KLS-R-50	–	A6K-50-R	FWH-50	HSJ-50	–	–
22 (30)	5014006-063	KLS-R-60	–	A6K-60-R	FWH-60	HSJ-60	–	–
30 (40)	2028220-100	KLS-R-80	–	A6K-80-R	FWH-80	HSJ-80	–	–
37 (50)	2028220-125	KLS-R-100	–	A6K-100-R	FWH-100	HSJ-100	–	–
45 (60)	2028220-125	KLS-R-125	–	A6K-125-R	FWH-125	HSJ-125	–	–
55 (75)	2028220-160	KLS-R-150	–	A6K-150-R	FWH-150	HSJ-150	–	–
75 (100)	2028220-200	KLS-R-200	–	A6K-200-R	FWH-200	HSJ-200	A50-P-225	L50-S-225
90 (125)	2028220-250	KLS-R-250	–	A6K-250-R	FWH-250	HSJ-250	A50-P-250	L50-S-250

Table 8.28 3x380–480 V, Enclosure Sizes A, B, and C

1) Ferraz-Shawmut A50QS fuses may substitute A50P fuses.

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	Recommended maximum fuse									
Power [kW (hp)]	Bussmann Type RK1	Bussmann Type J	Bussmann Type T	Bussmann Type CC	Bussmann Type CC	Bussmann Type CC	SIBA Type RK1	Littelfuse Type RK1	Ferraz-Shawmut Type RK1	Ferraz-Shawmut J
0.75–1.1 (1–1.5)	KTS-R-5	JKS-5	JJS-6	FNQ-R-5	KTK-R-5	LP-CC-5	5017906-005	KLS-R-005	A6K-5-R	HSJ-6
1.5–2.2 (2–3)	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10	5017906-010	KLS-R-010	A6K-10-R	HSJ-10
3 (4)	KTS-R15	JKS-15	JJS-15	FNQ-R-15	KTK-R-15	LP-CC-15	5017906-016	KLS-R-015	A6K-15-R	HSJ-15
4 (5)	KTS-R20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20	5017906-020	KLS-R-020	A6K-20-R	HSJ-20
5.5 (7.5)	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25	5017906-025	KLS-R-025	A6K-25-R	HSJ-25
7.5 (10)	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30	5017906-030	KLS-R-030	A6K-30-R	HSJ-30
11–15 (15–20)	KTS-R-35	JKS-35	JJS-35	–	–	–	5014006-040	KLS-R-035	A6K-35-R	HSJ-35
18 (24)	KTS-R-45	JKS-45	JJS-45	–	–	–	5014006-050	KLS-R-045	A6K-45-R	HSJ-45
22 (30)	KTS-R-50	JKS-50	JJS-50	–	–	–	5014006-050	KLS-R-050	A6K-50-R	HSJ-50
30 (40)	KTS-R-60	JKS-60	JJS-60	–	–	–	5014006-063	KLS-R-060	A6K-60-R	HSJ-60
37 (50)	KTS-R-80	JKS-80	JJS-80	–	–	–	5014006-080	KLS-R-075	A6K-80-R	HSJ-80
45 (60)	KTS-R-100	JKS-100	JJS-100	–	–	–	5014006-100	KLS-R-100	A6K-100-R	HSJ-100
55 (75)	KTS-R-125	JKS-125	JJS-125	–	–	–	2028220-125	KLS-R-125	A6K-125-R	HSJ-125
75 (100)	KTS-R-150	JKS-150	JJS-150	–	–	–	2028220-150	KLS-R-150	A6K-150-R	HSJ-150
90 (125)	KTS-R-175	JKS-175	JJS-175	–	–	–	2028220-200	KLS-R-175	A6K-175-R	HSJ-175

Table 8.29 3x525–600 V, Enclosure Sizes A, B, and C

	Recommended maximum fuse							
Power [kW (hp)]	Maximum pre-fuse [A]	Bussmann E52273 RK1/JDDZ	Bussmann E4273 J/JDDZ	Bussmann E4273 T/JDDZ	SIBA E180276 RK1/JDDZ	Littelfuse E81895 RK1/JDDZ	Ferraz-Shawmut E163267/E2137 RK1/JDDZ	Ferraz-Shawmut E2137 J/HSJ
11–15 (15–20)	30	KTS-R-30	JKS-30	JJS-30	5017906-030	KLS-R-030	A6K-30-R	HST-30
22 (30)	45	KTS-R-45	JKS-45	JJS-45	5014006-050	KLS-R-045	A6K-45-R	HST-45
30 (40)	60	KTS-R-60	JKS-60	JJS-60	5014006-063	KLS-R-060	A6K-60-R	HST-60
37 (50)	80	KTS-R-80	JKS-80	JJS-80	5014006-080	KLS-R-075	A6K-80-R	HST-80
45 (60)	90	KTS-R-90	JKS-90	JJS-90	5014006-100	KLS-R-090	A6K-90-R	HST-90
55 (75)	100	KTS-R-100	JKS-100	JJS-100	5014006-100	KLS-R-100	A6K-100-R	HST-100
75 (100)	125	KTS-R-125	JKS-125	JJS-125	2028220-125	KLS-150	A6K-125-R	HST-125
90 (125)	150	KTS-R-150	JKS-150	JJS-150	2028220-150	KLS-175	A6K-150-R	HST-150

Table 8.30 3x525–690 V, Enclosure Sizes B and C

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8.9 Power Ratings, Weight, and Dimensions

Enclosure size [kW (hp)]		A2		A3		A4	A5
3x525–690 V	T7	–		–		–	–
3x525–600 V	T6	–		0.75–7.5 (1–10)		–	0.75–7.5 (1–10)
3x380–480 V	T4	0.37–4.0 (0.5–5)		5.5–7.5 (7.5–10)		0.37–4.0 (0.5–5)	0.37–7.5 (0.5–10)
1x380–480 V	S4	–		–		1.1–4.0 (1.5–5)	–
3x200–240 V	T2	0.25–3.0 (0.34–4)		3.7 (0.5)		0.25–2.2 (0.34–3)	0.25–3.7 (0.34–5)
1x200–240 V	S2	–		1.1 (1.5)		1.1–2.2 (1.5–3)	1.1 (1.5)
IP NEMA		20 Chassis	21 Type 1	20 Chassis	21 Type 1	55/66 Type 12/4X	55/66 Type 12/4X
Height [mm (in)]							
Height of backplate	A[1)]	268 (10.6)	375 (14.8)	268 (10.6)	375 (14.8)	390 (15.4)	420 (16.5)
Height with de-coupling plate for fieldbus cables	A	374 (14.7)	–	374 (14.7)	–	–	–
Distance between mounting holes	a	257 (10.1)	350 (13.8)	257 (10.1)	350 (13.8)	401 (15.8)	402 (15.8)
Width [mm (in)]							
Width of backplate	B	90 (3.5)	90 (3.5)	130 (5.1)	130 (5.1)	200 (7.9)	242 (9.5)
Width of backplate with 1 C option	B	130 (5.1)	130 (5.1)	170 (6.7)	170 (6.7)	–	242 (9.5)
Width of backplate with 2 C options	B	90 (3.5)	90 (3.5)	130 (5.1)	130 (5.1)	–	242 (9.5)
Distance between mounting holes	b	70 (2.8)	70 (2.8)	110 (4.3)	110 (4.3)	171 (6.7)	215 (8.5)
Depth[2)] [mm (in)]							
Without option A/B	C	205 (8.1)	205 (8.1)	205 (8.1)	205 (8.1)	175 (6.9)	200 (7.9)
With option A/B	C	220 (8.7)	220 (8.7)	220 (8.7)	220 (8.7)	175 (6.9)	200 (7.9)
Screw holes [mm (in)]							
	c	8.0 (0.31)	8.0 (0.31)	8.0 (0.31)	8.0 (0.31)	8.25 (0.32)	8.2 (0.32)
	d	ø11 (0.43)	ø11 (0.43)	ø11 (0.43)	ø11 (0.43)	ø12 (0.47)	ø12 (0.47)
	e	ø5.5 (0.22)	ø5.5 (0.22)	ø5.5 (0.22)	ø5.5 (0.22)	ø6.5 (0.26)	ø6.5 (0.26)
	f	9 (0.35)	9 (0.35)	9 (0.35)	9 (0.35)	6 (0.24)	9 (0.35)
Maximum weight [kg (lb)]		4.9 (10.8)	5.3 (11.7)	6.6 (14.6)	7 (15.4)	9.7 (21.4)	14 (31)

1) See *Illustration 3.4* and *Illustration 3.5* for top and bottom mounting holes.
2) Depth of enclosure varies with different options installed.

Table 8.31 Power Ratings, Weight, and Dimensions, Enclosure Sizes A2-A5

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Enclosure size [kW (hp)]		B1	B2	B3	B4	C1	C2	C3	C4
3x525–690 V	T7	–	11–30 (15–40)	–	–	–	37–90 (50–125)	–	–
3x525–600 V	T6	11–18.5 (15–25)	22–30 (30–40)	11–18.5 (15–25)	22–37 (30–50)	37–55 (50–75)	75–90 (100–125)	45–55 (60–75)	75–90 (100–125)
3x380–480 V	T4	11–18.5 (15–25)	22–30 (30–40)	11–18.5 (15–25)	22–37 (30–50)	37–55 (50–75)	75–90 (100–125)	45–55 (60–75)	75–90 (100–125)
1x380–480 V	S4	7.5 (10)	11 (15)	–	–	18 (24)	37 (50)	–	–
3x200–240 V	T2	5.5–11 (7.5–15)	15 (20)	5.5–11 (7.5–15)	15–18.5 (20–25)	18.5–30 (25–40)	37–45 (50–60)	22–30 (30–40)	37–45 (50–60)
1x200–240 V	S2	1.5–3.7 (2–5)	7.5 (10)	–	–	15 (20)	22 (30)	–	–
IP NEMA		21/55/66 Type 1/12/4X	21/55/66 Type 1/12/4X	20 Chassis	20 Chassis	21/55/66 Type 1/12/4X	21/55/66 Type 1/12/4X	20 Chassis	20 Chassis
Height [mm (in)]									
Height of backplate	A[1)]	480 (18.9)	650 (25.6)	399 (15.7)	520 (20.5)	680 (26.8)	770 (30.3)	550 (21.7)	660 (26)
Height with de-coupling plate for fieldbus cables	A	–	–	419 (16.5)	595 (23.4)	–	–	630 (24.8)	800 (31.5)
Distance between mounting holes	a	454 (17.9)	624 (24.6)	380 (15)	495 (19.5)	648 (25.5)	739 (29.1)	521 (20.5)	631 (24.8)
Width [mm (in)]									
Width of backplate	B	242 (9.5)	242 (9.5)	165 (6.5)	231 (9.1)	308 (12.1)	370 (14.6)	308 (12.1)	370 (14.6)
Width of backplate with 1 C option	B	242 (9.5)	242 (9.5)	205 (8.1)	231 (9.1)	308 (12.1)	370 (14.6)	308 (12.1)	370 (14.6)
Width of backplate with 2 C options	B	242 (9.5)	242 (9.5)	165 (6.5)	231 (9.1)	308 (12.1)	370 (14.6)	308 (12.1)	370 (14.6)
Distance between mounting holes	b	210 (8.3)	210 (8.3)	140 (5.5)	200 (7.9)	272 (10.7)	334 (13.1)	270 (10.6)	330 (13)
Depth[2)][mm (in)]									
Without option A/B	C	260 (10.2)	260 (10.2)	248 (9.8)	242 (9.5)	310 (12.2)	335 (13.2)	333 (13.1)	333 (13.1)
With option A/B	C	260 (10.2)	260 (10.2)	262 (10.3)	242 (9.5)	310 (12.2)	335 (13.2)	333 (13.1)	333 (13.1)
Screw holes [mm (in)]									
	c	12 (0.47)	12 (0.47)	8 (0.32)	–	12 (0.47)	12 (0.47)	–	–
	d	ø19 (0.75)	ø19 (0.75)	12 (0.47)	–	ø19 (0.75)	ø19 (0.75)	–	–
	e	ø9 (0.35)	ø9 (0.35)	6.8 (0.27)	8.5 (0.33)	ø9 (0.35)	ø9 (0.35)	8.5 (0.33)	8.5 (0.33)
	f	9 (0.35)	9 (0.35)	7.9 (0.31)	15 (0.59)	9.8 (0.39)	9.8 (0.39)	17 (0.67)	17 (0.67)
Maximum weight [kg (lb)]		23 (51)	27 (60)	12 (26.5)	23.5 (52)	45 (99)	65 (143)	35 (77)	50 (110)

1) See *Illustration 3.4* and *Illustration 3.5* for top and bottom mounting holes.
2) Depth of enclosure varies with different options installed.

Table 8.32 Power Ratings, Weight, and Dimensions, Enclosure Sizes B1–B4, C1–C4

8

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9 Appendix

9.1 Symbols, Abbreviations, and Conventions

°C	Degrees Celsius
°F	Degrees Fahrenheit
AC	Alternating current
AEO	Automatic energy optimization
AWG	American wire gauge
AMA	Automatic motor adaptation
DC	Direct current
EMC	Electro-magnetic compatibility
ETR	Electronic thermal relay
$f_{M,N}$	Nominal motor frequency
FC	Frequency converter
I_{INV}	Rated inverter output current
I_{LIM}	Current limit
$I_{M,N}$	Nominal motor current
$I_{VLT,MAX}$	Maximum output current
$I_{VLT,N}$	Rated output current supplied by the frequency converter
IP	Ingress protection
LCP	Local control panel
MCT	Motion control tool
n_s	Synchronous motor speed
$P_{M,N}$	Nominal motor power
PELV	Protective extra low voltage
PCB	Printed circuit board
PM Motor	Permanent magnet motor
PWM	Pulse width modulation
RPM	Revolutions per minute
Regen	Regenerative terminals
T_{LIM}	Torque limit
$U_{M,N}$	Nominal motor voltage

Table 9.1 Symbols and Abbreviations

Conventions

Numbered lists indicate procedures. Bullet lists indicate other information.

Italicized text indicates:

- Cross-reference.
- Link.
- Parameter name.
- Parameter group name.
- Parameter option.
- Footnote.

All dimensions in drawings are in [mm] (in).

9.2 Parameter Menu Structure

NOTICE

The availability of some parameters depends on the hardware configuration (installed options and power rating).

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0-	**Operation / Display**
0-0*	**Basic Settings**
0-01	Language
0-02	Motor Speed Unit
0-03	Regional Settings
0-04	Operating State at Power-up
0-05	Local Mode Unit
0-1*	**Set-up Operations**
0-10	Active Set-up
0-11	Programming Set-up
0-12	This Set-up Linked to
0-13	Readout: Linked Set-ups
0-14	Readout: Prog. Set-ups / Channel
0-2*	**LCP Display**
0-20	Display Line 1.1 Small
0-21	Display Line 1.2 Small
0-22	Display Line 1.3 Small
0-23	Display Line 2 Large
0-24	Display Line 3 Large
0-25	My Personal Menu
0-3*	**LCP Custom Readout**
0-30	Custom Readout Unit
0-31	Custom Readout Min Value
0-32	Custom Readout Max Value
0-37	Display Text 1
0-38	Display Text 2
0-39	Display Text 3
0-4*	**LCP Keypad**
0-40	[Hand on] Key on LCP
0-41	[Off] Key on LCP
0-42	[Auto on] Key on LCP
0-43	[Reset] Key on LCP
0-44	[Off/Reset] Key on LCP
0-45	[Drive Bypass] Key on LCP
0-5*	**Copy/Save**
0-50	LCP Copy
0-51	Set-up Copy
0-6*	**Password**
0-60	Main Menu Password
0-61	Access to Main Menu w/o Password
0-65	Personal Menu Password
0-66	Access to Personal Menu w/o Password
0-67	Bus Password Access
0-7*	**Clock Settings**
0-70	Date and Time
0-71	Date Format
0-72	Time Format
0-74	DST/Summertime
0-76	DST/Summertime Start
0-77	DST/Summertime End
0-79	Clock Fault
0-81	Working Days
0-82	Additional Working Days
0-83	Additional Non-Working Days
0-89	Date and Time Readout
1-	**Load and Motor**
1-0*	**General Settings**
1-00	Configuration Mode
1-01	Motor Control Principle
1-03	Torque Characteristics
1-04	Overload Mode
1-06	Clockwise Direction
1-1*	**Motor Selection**
1-10	Motor Construction
1-1*	**VVC+ PM/SYN RM**
1-14	Damping Gain
1-15	Low Speed Filter Time Const.
1-16	High Speed Filter Time Const.
1-17	Voltage filter time const.
1-2*	**Motor Data**
1-20	Motor Power [kW]
1-21	Motor Power [HP]
1-22	Motor Voltage
1-23	Motor Frequency
1-24	Motor Current
1-25	Motor Nominal Speed
1-26	Motor Cont. Rated Torque
1-28	Motor Rotation Check
1-29	Automatic Motor Adaptation (AMA)
1-3*	**Adv. Motor Data**
1-30	Stator Resistance (Rs)
1-31	Rotor Resistance (Rr)
1-33	Stator Leakage Reactance (X1)
1-34	Rotor Leakage Reactance (X2)
1-35	Main Reactance (Xh)
1-36	Iron Loss Resistance (Rfe)
1-37	d-axis Inductance (Ld)
1-38	q-axis Inductance (Lq)
1-39	Motor Poles
1-40	Back EMF at 1000 RPM
1-44	d-axis Inductance Sat. (LdSat)
1-45	q-axis Inductance Sat. (LqSat)
1-46	Position Detection Gain
1-47	Torque Calibration
1-48	Inductance Sat. Point
1-5*	**Load Indep. Setting**
1-50	Motor Magnetisation at Zero Speed
1-51	Min Speed Normal Magnetising [RPM]
1-52	Min Speed Normal Magnetising [Hz]
1-55	V/f Characteristic - V
1-56	V/f Characteristic - f
1-58	Flying Start Test Pulses Current
1-59	Flying Start Test Pulses Frequency
1-6*	**Load Depen. Setting**
1-60	Low Speed Load Compensation
1-61	High Speed Load Compensation
1-62	Slip Compensation
1-63	Slip Compensation Time Constant
1-64	Resonance Damping
1-65	Resonance Damping Time Constant
1-66	Min. Current at Low Speed
1-7*	**Start Adjustments**
1-70	PM Start Mode
1-71	Start Delay
1-72	Start Function
1-73	Flying Start
1-77	Compressor Start Max Speed [RPM]
1-78	Compressor Start Max Speed [Hz]
1-79	Pump Start Max Time to Trip
1-8*	**Stop Adjustments**
1-80	Function at Stop
1-81	Min Speed for Function at Stop [RPM]
1-82	Min Speed for Function at Stop [Hz]
1-86	Trip Speed Low [RPM]
1-87	Trip Speed Low [Hz]
1-9*	**Motor Temperature**
1-90	Motor Thermal Protection
1-91	Motor External Fan
1-93	Thermistor Source
1-94	ATEX ETR cur.lim. speed reduction
1-98	ATEX ETR interpol. points freq.
1-99	ATEX ETR interpol points current
2-	**Brakes**
2-0*	**DC-Brake**
2-00	DC Hold/Preheat Current
2-01	DC Brake Current
2-02	DC Braking Time
2-03	DC Brake Cut In Speed [RPM]
2-04	DC Brake Cut In Speed [Hz]
2-06	Parking Current
2-07	Parking Time
2-1*	**Brake Energy Funct.**
2-10	Brake Function
2-11	Brake Resistor (ohm)
2-12	Brake Power Limit (kW)
2-13	Brake Power Monitoring
2-15	Brake Check
2-16	AC brake Max. Current
2-17	Over-voltage Control
3-	**Reference / Ramps**
3-0*	**Reference Limits**
3-02	Minimum Reference
3-03	Maximum Reference
3-04	Reference Function
3-1*	**References**
3-10	Preset Reference
3-11	Jog Speed [Hz]
3-13	Reference Site
3-14	Preset Relative Reference
3-15	Reference 1 Source
3-16	Reference 2 Source
3-17	Reference 3 Source
3-19	Jog Speed [RPM]
3-4*	**Ramp 1**
3-41	Ramp 1 Ramp Up Time
3-42	Ramp 1 Ramp Down Time
3-5*	**Ramp 2**
3-51	Ramp 2 Ramp Up Time
3-52	Ramp 2 Ramp Down Time
3-8*	**Other Ramps**
3-80	Jog Ramp Time
3-81	Quick Stop Ramp Time
3-84	Initial Ramp Time
3-85	Check Valve Ramp Time
3-86	Check Valve Ramp End Speed [RPM]
3-87	Check Valve Ramp End Speed [HZ]
3-88	Final Ramp Time
3-9*	**Digital Pot.Meter**
3-90	Step Size
3-91	Ramp Time
3-92	Power Restore
3-93	Maximum Limit
3-94	Minimum Limit
3-95	Ramp Delay
4-	**Limits / Warnings**
4-1*	**Motor Limits**
4-10	Motor Speed Direction
4-11	Motor Speed Low Limit [RPM]
4-12	Motor Speed Low Limit [Hz]
4-13	Motor Speed High Limit [RPM]
4-14	Motor Speed High Limit [Hz]
4-16	Torque Limit Motor Mode
4-17	Torque Limit Generator Mode
4-18	Current Limit
4-19	Max Output Frequency
4-5*	**Adj. Warnings**
4-50	Warning Current Low
4-51	Warning Current High
4-52	Warning Speed Low
4-53	Warning Speed High
4-54	Warning Reference Low
4-55	Warning Reference High
4-56	Warning Feedback Low
4-57	Warning Feedback High
4-58	Missing Motor Phase Function
4-6*	**Speed Bypass**
4-60	Bypass Speed From [RPM]
4-61	Bypass Speed From [Hz]
4-62	Bypass Speed To [RPM]
4-63	Bypass Speed To [Hz]
4-64	Semi-Auto Bypass Set-up
5-	**Digital In/Out**
5-0*	**Digital I/O mode**
5-00	Digital I/O Mode
5-01	Terminal 27 Mode
5-02	Terminal 29 Mode
5-1*	**Digital Inputs**
5-10	Terminal 18 Digital Input
5-11	Terminal 19 Digital Input
5-12	Terminal 27 Digital Input
5-13	Terminal 29 Digital Input
5-14	Terminal 32 Digital Input
5-15	Terminal 33 Digital Input
5-16	Terminal X30/2 Digital Input
5-17	Terminal X30/3 Digital Input
5-18	Terminal X30/4 Digital Input
5-19	Terminal 37 Digital Input
5-20	Terminal X46/1 Digital Input
5-21	Terminal X46/3 Digital Input
5-22	Terminal X46/5 Digital Input
5-23	Terminal X46/7 Digital Input
5-24	Terminal X46/9 Digital Input
5-25	Terminal X46/11 Digital Input
5-26	Terminal X46/13 Digital Input
5-3*	**Digital Outputs**
5-30	Terminal 27 Digital Output
5-31	Terminal 29 Digital Output
5-32	Term X30/6 Digi Out (MCB 101)
5-33	Term X30/7 Digi Out (MCB 101)
5-4*	**Relays**
5-40	Function Relay
5-41	On Delay, Relay
5-42	Off Delay, Relay
5-5*	**Pulse Input**
5-50	Term. 29 Low Frequency
5-51	Term. 29 High Frequency
5-52	Term. 29 Low Ref./Feedb. Value
5-53	Term. 29 High Ref./Feedb. Value
5-54	Pulse Filter Time Constant #29
5-55	Term. 33 Low Frequency
5-56	Term. 33 High Frequency
5-57	Term. 33 Low Ref./Feedb. Value
5-58	Term. 33 High Ref./Feedb. Value
5-59	Pulse Filter Time Constant #33
5-6*	**Pulse Output**
5-60	Terminal 27 Pulse Output Variable
5-62	Pulse Output Max Freq #27
5-63	Terminal 29 Pulse Output Variable
5-65	Pulse Output Max Freq #29
5-66	Terminal X30/6 Pulse Output Variable
5-68	Pulse Output Max Freq #X30/6
5-8*	**I/O Options**
5-80	AHF Cap Reconnect Delay
5-9*	**Bus Controlled**
5-90	Digital & Relay Bus Control
5-93	Pulse Out #27 Bus Control
5-94	Pulse Out #27 Timeout Preset
5-95	Pulse Out #29 Bus Control
5-96	Pulse Out #29 Timeout Preset
5-97	Pulse Out #X30/6 Bus Control
5-98	Pulse Out #X30/6 Timeout Preset
6-	**Analog In/Out**
6-0*	**Analog I/O Mode**
6-00	Live Zero Timeout Time
6-01	Live Zero Timeout Function
6-1*	**Analog Input 53**
6-10	Terminal 53 Low Voltage
6-11	Terminal 53 High Voltage
6-12	Terminal 53 Low Current
6-13	Terminal 53 High Current
6-14	Terminal 53 Low Ref./Feedb. Value
6-15	Terminal 53 High Ref./Feedb. Value
6-16	Terminal 53 Filter Time Constant
6-17	Terminal 53 Live Zero
6-2*	**Analog Input 54**
6-20	Terminal 54 Low Voltage
6-21	Terminal 54 High Voltage
6-22	Terminal 54 Low Current
6-23	Terminal 54 High Current
6-24	Terminal 54 Low Ref./Feedb. Value
6-25	Terminal 54 High Ref./Feedb. Value
6-26	Terminal 54 Filter Time Constant
6-27	Terminal 54 Live Zero
6-3*	**Analog Input X30/11**
6-30	Terminal X30/11 Low Voltage

6-31 Terminal X30/11 High Voltage
6-34 Term. X30/11 Low Ref./Feedb. Value
6-35 Term. X30/11 High Ref./Feedb. Value
6-36 Term. X30/11 Filter Time Constant
6-37 Term. X30/11 Live Zero
6-4* Analog Input X30/12
6-40 Terminal X30/12 Low Voltage
6-41 Terminal X30/12 High Voltage
6-44 Term. X30/12 Low Ref./Feedb. Value
6-45 Term. X30/12 High Ref./Feedb. Value
6-46 Term. X30/12 Filter Time Constant
6-47 Term. X30/12 Live Zero
6-5* Analog Output 42
6-50 Terminal 42 Output
6-51 Terminal 42 Output Min Scale
6-52 Terminal 42 Output Max Scale
6-53 Terminal 42 Output Bus Control
6-54 Terminal 42 Output Timeout Preset
6-55 Terminal 42 Output Filter
6-6* Analog Output X30/8
6-60 Terminal X30/8 Output
6-61 Terminal X30/8 Min. Scale
6-62 Terminal X30/8 Max. Scale
6-63 Terminal X30/8 Output Bus Control
6-64 Terminal X30/8 Output Timeout Preset
6-7* Analog Output X45/1
6-70 Terminal X45/1 Output
6-71 Terminal X45/1 Min. Scale
6-72 Terminal X45/1 Max. Scale
6-73 Terminal X45/1 Bus Control
6-74 Terminal X45/1 Output Timeout Preset
6-8* Analog Output X45/3
6-80 Terminal X45/3 Output
6-81 Terminal X45/3 Min. Scale
6-82 Terminal X45/3 Max. Scale
6-83 Terminal X45/3 Bus Control
6-84 Terminal X45/3 Output Timeout Preset
8- Comm. and Options**
8-0* General Settings
8-01 Control Site
8-02 Control Source
8-03 Control Timeout Time
8-04 Control Timeout Function
8-05 End-of-Timeout Function
8-06 Reset Control Timeout
8-07 Diagnosis Trigger
8-08 Readout Filtering
8-1* Control Settings
8-10 Control Profile
8-13 Configurable Status Word STW
8-14 Configurable Control Word CTW
8-17 Configurable Alarm and Warningword
8-3* FC Port Settings
8-30 Protocol
8-31 Address
8-32 Baud Rate
8-33 Parity / Stop Bits
8-35 Minimum Response Delay
8-36 Max Response Delay
8-37 Maximum Inter-Char Delay
8-4* FC MC protocol set
8-40 Telegram Selection
8-42 PCD Write Configuration
8-43 PCD Read Configuration
8-5* Digital/Bus
8-50 Coasting Select
8-51 Quick Stop Select
8-52 DC Brake Select
8-53 Start Select
8-54 Reversing Select
8-55 Set-up Select
8-56 Preset Reference Select
8-8* FC Port Diagnostics
8-80 Bus Message Count
8-81 Bus Error Count
8-82 Slave Message Rcvd
8-83 Slave Error Count
8-9* Bus Jog / Feedback
8-94 Bus Feedback 1
8-95 Bus Feedback 2
8-96 Bus Feedback 3
9- PROFIdrive**
9-00 Setpoint
9-07 Actual Value
9-15 PCD Write Configuration
9-16 PCD Read Configuration
9-18 Node Address
9-22 Telegram Selection
9-23 Parameters for Signals
9-27 Parameter Edit
9-28 Process Control
9-31 Safe Address
9-44 Fault Message Counter
9-45 Fault Code
9-47 Fault Number
9-52 Fault Situation Counter
9-53 Profibus Warning Word
9-63 Actual Baud Rate
9-64 Device Identification
9-65 Profile Number
9-67 Control Word 1
9-68 Status Word 1
9-70 Programming Set-up
9-71 Profibus Save Data Values
9-72 ProfibusDriveReset
9-75 DO Identification
9-80 Defined Parameters (1)
9-81 Defined Parameters (2)
9-82 Defined Parameters (3)
9-83 Defined Parameters (4)
9-84 Defined Parameters (5)
9-85 Defined Parameters (6)
9-90 Changed Parameters (1)
9-91 Changed Parameters (2)
9-92 Changed Parameters (3)
9-93 Changed Parameters (4)
9-94 Changed Parameters (5)
9-99 Profibus Revision Counter
10- CAN Fieldbus**
10-0* Common Settings
10-00 CAN Protocol
10-01 Baud Rate Select
10-02 MAC ID
10-05 Readout Transmit Error Counter
10-06 Readout Receive Error Counter
10-07 Readout Bus Off Counter
10-1* DeviceNet
10-10 Process Data Type Selection
10-11 Process Data Config Write
10-12 Process Data Config Read
10-13 Warning Parameter
10-14 Net Reference
10-15 Net Control
10-2* COS Filters
10-20 COS Filter 1
10-21 COS Filter 2
10-22 COS Filter 3
10-23 COS Filter 4
10-3* Parameter Access
10-30 Array Index
10-31 Store Data Values
10-32 Devicenet Revision
10-33 Store Always
10-34 DeviceNet Product Code
10-39 Devicenet F Parameters
12- Ethernet**
12-0* IP Settings
12-00 IP Address Assignment
12-01 IP Address
12-02 Subnet Mask
12-03 Default Gateway
12-04 DHCP Server
12-05 Lease Expires
12-06 Name Servers
12-07 Domain Name
12-08 Host Name
12-09 Physical Address
12-1* Ethernet Link Parameters
12-10 Link Status
12-11 Link Duration
12-12 Auto Negotiation
12-13 Link Speed
12-14 Link Duplex
12-18 Supervisor MAC
12-19 Supervisor IP Addr.
12-2* Process Data
12-20 Control Instance
12-21 Process Data Config Write
12-22 Process Data Config Read
12-27 Primary Master
12-28 Store Data Values
12-29 Store Always
12-3* EtherNet/IP
12-30 Warning Parameter
12-31 Net Reference
12-32 Net Control
12-33 CIP Revision
12-34 CIP Product Code
12-35 EDS Parameter
12-37 COS Inhibit Timer
12-38 COS Filter
12-4* Modbus TCP
12-40 Status Parameter
12-41 Slave Message Count
12-42 Slave Exception Message Count
12-8* Other Ethernet Services
12-80 FTP Server
12-81 HTTP Server
12-82 SMTP Service
12-83 SNMP Agent
12-84 Address Conflict Detection
12-85 ACD Last Conflict
12-89 Transparent Socket Channel Port
12-9* Advanced Ethernet Services
12-90 Cable Diagnostic
12-91 MDI-X
12-92 IGMP Snooping
12-93 Cable Error Length
12-94 Broadcast Storm Protection
12-95 Inactivity timeout
12-96 Port Config
12-97 QoS Priority
12-98 Interface Counters
12-99 Media Counters
13- Smart Logic**
13-0* SLC Settings
13-00 SL Controller Mode
13-01 Start Event
13-02 Stop Event
13-03 Reset SLC
13-1* Comparators
13-10 Comparator Operand
13-11 Comparator Operator
13-12 Comparator Value
13-1* RS Flip Flops
13-15 RS-FF Operand S
13-16 RS-FF Operand R
13-2* Timers
13-20 SL Controller Timer
13-4* Logic Rules
13-40 Logic Rule Boolean 1
13-41 Logic Rule Operator 1
13-42 Logic Rule Boolean 2
13-43 Logic Rule Operator 2
13-44 Logic Rule Boolean 3
13-5* States
13-51 SL Controller Event
13-52 SL Controller Action
13-9* User Defined Alerts
13-90 Alert Trigger
13-91 Alert Action
13-92 Alert Text
13-9* User Defined Readouts
13-97 Alert Alarm Word
13-98 Alert Warning Word
13-99 Alert Status Word
14- Special Functions**
14-0* Inverter Switching
14-00 Switching Pattern
14-01 Switching Frequency
14-03 Overmodulation
14-04 PWM Random
14-1* Mains On/Off
14-10 Mains Failure
14-11 Mains Voltage at Mains Fault
14-12 Function at Mains Imbalance
14-16 Kin. Backup Gain
14-2* Reset Functions
14-20 Reset Mode
14-21 Automatic Restart Time
14-22 Operation Mode
14-25 Trip Delay at Torque Limit
14-26 Trip Delay at Inverter Fault
14-28 Production Settings
14-29 Service Code
14-3* Current Limit Ctrl.
14-30 Current Lim Ctrl, Proportional Gain
14-31 Current Lim Ctrl, Integration Time
14-32 Current Lim Ctrl, Filter Time
14-4* Energy Optimising
14-40 VT Level
14-41 AEO Minimum Magnetisation
14-42 Minimum AEO Frequency
14-43 Motor Cosphi
14-5* Environment
14-50 RFI Filter
14-51 DC Link Compensation
14-52 Fan Control
14-53 Fan Monitor
14-55 Output Filter
14-56 Capacitance Output Filter
14-57 Inductance Output Filter
14-58 Voltage Gain Filter
14-59 Actual Number of Inverter Units
14-6* Auto Derate
14-60 Function at Over Temperature
14-61 Function at Inverter Overload
14-62 Inv. Overload Derate Current
14-8* Options
14-80 Option Supplied by External 24VDC
14-9* Fault Settings
14-90 Fault Level
15- Drive Information**
15-0* Operating Data
15-00 Operating hours
15-01 Running Hours
15-02 kWh Counter
15-03 Power Up's
15-04 Over Temp's
15-05 Over Volt's
15-06 Reset kWh Counter
15-07 Reset Running Hours Counter
15-08 Number of Starts
15-1* Data Log Settings
15-10 Logging Source

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15-11 Logging Interval
15-12 Trigger Event
15-13 Logging Mode
15-14 Samples Before Trigger
15-2* Historic Log
15-20 Historic Log: Event
15-21 Historic Log: Value
15-22 Historic Log: Time
15-23 Historic log: Date and Time
15-3* Alarm Log
15-30 Alarm Log: Error Code
15-31 Alarm Log: Value
15-32 Alarm Log: Time
15-33 Alarm Log: Date and Time
15-34 Alarm Log: Setpoint
15-35 Alarm Log: Feedback
15-36 Alarm Log: Current Demand
15-37 Alarm Log: Process Ctrl Unit
15-4* Drive Identification
15-40 FC Type
15-41 Power Section
15-42 Voltage
15-43 Software Version
15-44 Ordered Typecode String
15-45 Actual Typecode String
15-46 Frequency Converter Ordering No
15-47 Power Card Ordering No
15-48 LCP Id No
15-49 SW ID Control Card
15-50 SW ID Power Card
15-51 Frequency Converter Serial Number
15-53 Power Card Serial Number
15-54 Config File Name
15-58 SmartStart Filename
15-59 Filename
15-6* Option Ident
15-60 Option Mounted
15-61 Option SW Version
15-62 Option Ordering No
15-63 Option Serial No
15-70 Option in Slot A
15-71 Slot A Option SW Version
15-72 Option in Slot B
15-73 Slot B Option SW Version
15-74 Option in Slot C0/E0
15-75 Slot C0/E0 Option SW Version
15-76 Option in Slot C1/E1
15-77 Slot C1/E1 Option SW Version
15-8* Operating Data II
15-80 Fan Running Hours
15-81 Preset Fan Running Hours
15-9* Parameter Info
15-92 Defined Parameters
15-93 Modified Parameters
15-98 Drive Identification
15-99 Parameter Metadata
16- Data Readouts**
16-0* General Status
16-00 Control Word
16-01 Reference [Unit]
16-02 Reference [%]
16-03 Status Word
16-05 Main Actual Value [%]
16-09 Custom Readout
16-1* Motor Status
16-10 Power [kW]
16-11 Power [hp]
16-12 Motor Voltage
16-13 Frequency
16-14 Motor current
16-15 Frequency [%]
16-16 Torque [Nm]
16-17 Speed [RPM]
16-18 Motor Thermal
16-20 Motor Angle
16-22 Torque [%]
16-23 Motor Shaft Power [kW]
16-24 Calibrated Stator Resistance
16-26 Power Filtered [kW]
16-27 Power Filtered [hp]
16-3* Drive Status
16-30 DC Link Voltage
16-31 System Temp.
16-32 Brake Energy /s
16-33 Brake Energy Average
16-34 Heatsink Temp.
16-35 Inverter Thermal
16-36 Inv. Nom. Current
16-37 Inv. Max. Current
16-38 SL Controller State
16-39 Control Card Temp.
16-40 Logging Buffer Full
16-49 Current Fault Source
16-5* Ref. & Feedb.
16-50 External Reference
16-52 Feedback[Unit]
16-53 Digi Pot Reference
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B-501/2 - Filter, Silencer, Solberg, FS-230P-300

SMALL COMPACT FILTER SILENCERS WITH STANDARD FILTER DESIGN
"FS" Series 1/2" - 3" MPT

APPLICATIONS

- Blowers-PD Type
- Blowers-Side Channel
- Compressor-Piston
- Compressor-Screw
- Construction\Contractor Industry
- Dental
- Engines
- Hydraulic Breathers - fine filtration
- Industrial & Severe Duty
- Medical
- Pneumatic Conveying Systems
- Sparging
- Waste Water Aeration
- Workshop

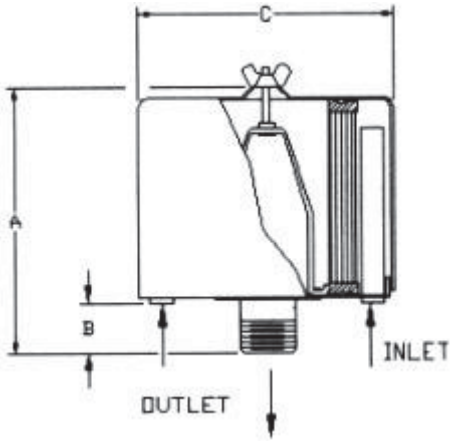
FEATURES & SPECIFICATIONS

- ;99%+ removal efficiency std: Paper=2 micron, Polyester=5 micron
- Durable carbon steel construction with powder coated finish or galvanized steel
- Filter change out differential: 10"-15" in. H_2O above initial delta P
- Fully drawn weatherhood - no welds to rust or vibrate apart
- Interchangeable elements: Polyester, Paper, HEPA
- Low pressure drop center bracket and outlet pipe design
- Pressure drop graphs available upon request
- Temp (continuous): min -15° F (-26° C) max 220° F (104° C)
- Tubular silencing design - tube is positioned to maximize attenuation and air flow while minimizing pressure drop
- Typical noise attenuation up to 15 dB's (due to the wide range of applications and machines these units are used on, a single graph is insufficient. Please inquire for your specific requirement)

OPTIONS

- 1/8" tap holes for differential pressure gauges
- Available in *Stainless Steel*
- Epoxy coated housings
- Hot dipped galvanized housings
- Special connections, BSPT/Metric
- Various elements available

Line Drawing



***All measurements are shown in standards.**

Typical Lead Times:
- Normally in stock
- 1 - 2 weeks
- 5 - 7 weeks
- 3 - 4 weeks
- 8 + weeks

Add To Order	Model Number	Element Type	Outlet in. NPT or FLG	Connection Style	Dim A in.	Dim B in.	Dim C in.	Rated Flow Piston SCFM	Rated Flow Screw Blower Fan SCFM	Element Parent Flow SCFM	Tube Count	Approx. Weight lbs.	CAD
■	FS-15-050	Polyester	0.5	MPT	4	1.5	6	10	10	35	1	1.8	CAD
■	FS-15-075	Polyester	0.75	MPT	4	1.5	6	20	25	35	2	2	CAD
■	FS-15-100	Polyester	1	MPT	4	1.5	6	25	35	35	3	2.1	CAD
■	FS-19P-100	Polyester	1	MPT	6.63	1.5	6	35	55	100	3	3	CAD
■	FS-19P-125	Polyester	1.25	MPT	6.63	1.63	6.1	55	70	100	5	3.3	CAD
■	FS-19P-150	Polyester	1.5	MPT	6.63	1.5	6	70	85	100	5	3.5	CAD

	FS-231P-200	Polyester	2	MPT	12.25	2.25	10	135	135	300	5	14	CAD
	FS-31P-200	Polyester	2	MPT	7.25	2.25	10	85	135	195	5	7.8	CAD
	FS-231P-250	Polyester	2.5	MPT	12.5	2.5	10	195	195	300	9	14.5	CAD
	FS-31P-250	Polyester	2.5	MPT	7.5	2.5	10	100	195	195	5	8.2	CAD
	FS-231P-300	Polyester	3	MPT	13	3	10	200	300	300	9	15	CAD
	FS-14-050	Paper	0.5	MPT	4	1.5	6	10	10	35	1	1.8	CAD
	FS-14-075	Paper	0.75	MPT	4	1.5	6	20	25	35	2	2	CAD
	FS-14-100	Paper	1	MPT	4	1.5	6	25	35	35	3	2.1	CAD
	FS-18P-100	Paper	1	MPT	6.63	1.5	6	35	55	100	3	3	CAD
	FS-18P-125	Paper	1.25	MPT	6.63	1.63	6.1	55	70	100	5	3.3	CAD
	FS-18P-150	Paper	1.5	MPT	6.63	1.5	6	70	85	100	5	3.5	CAD
	FS-230P-200	Paper	2	MPT	12.25	2.25	10	135	135	300	5	14	CAD
	FS-30P-200	Paper	2	MPT	7.25	2.25	10	85	135	195	5	8.2	CAD
	FS-230P-250	Paper	2.5	MPT	12.5	2.5	10	195	195	300	9	14.5	CAD
	FS-30P-250	Paper	2.5	MPT	7.5	2.5	10	100	195	195	5	8.2	CAD
	FS-230P-300	Paper	3	MPT	13	3	10	200	300	300	9	15	CAD

Solberg Mfg.
1151 W. Ardmore Ave.·Itasca, IL 60143·(630)773-1363· Fax: (630)773-0727

SFS_2-2

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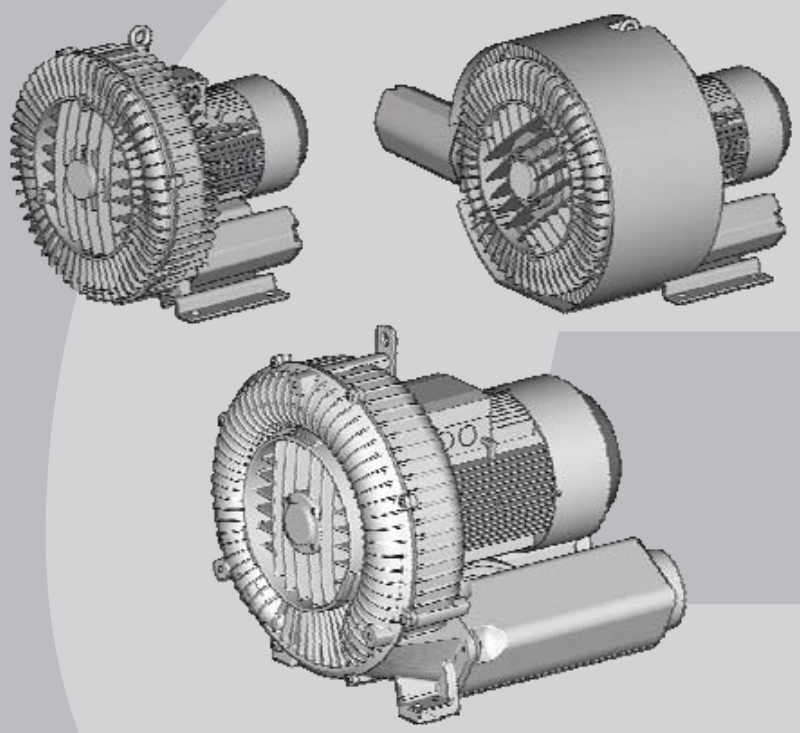
Original operating instructions · English

B601/2 - Blower, Elmo G200 2BH-1510-7HH56-Z

Operating instructions G-BH1, G-BH9

Elmo Rietschle
A Gardner Denver Product

CE



2BH1 1
2BH1 2
2BH1 3
2BH1 4
2BH1 5
2BH1 6
2BH1 8
2BH1 9
2BH9 23

G-Serie
G-Series
Seitenkanal
Side Channel

E-251

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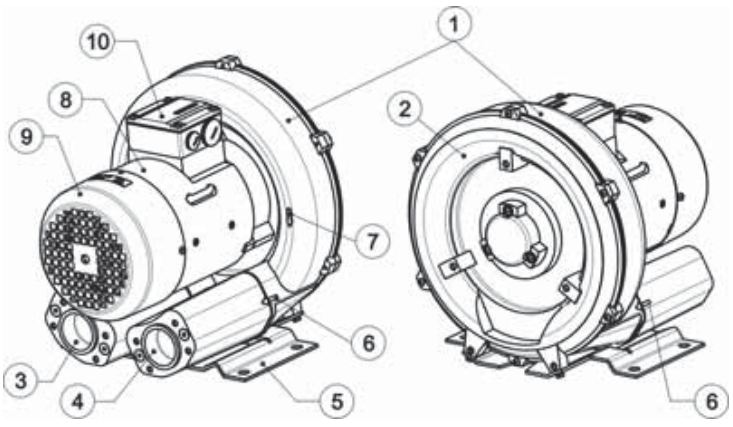

Fig. 1: Design of gas-ring vacuum pump/compressor

1 Vacuum pump/compressor housing
2 Vacuum pump/compressor cover
3 Inlet connection with muffler
4 Discharge connection with muffler
5 Base
6 Arrow indicating delivery direction
7 Arrow indicating direction of rotation
8 Drive motor
9 Fan guard (over external fan)
10 Terminal box

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1 Safety

1.1 Definitions

To point out dangers and important information, the following signal words and symbols are used in these operating instructions:

1.1.1 Safety alert symbol

The **safety alert symbol** ⚠ is located in the safety precautions in the highlighted heading field on the left next to the signal word (DANGER, WARNING, CAUTION).

Safety precautions **with** a safety alert symbol indicate a danger of **injuries**.

Be sure to follow these safety precautions to protect against **injuries or death**!

Safety precautions **without** a safety alert symbol indicate a danger of **damage**.

1.1.2 Signal words

DANGER **WARNING** **CAUTION** **NOTICE** **NOTE**	The **signal words** are located in the safety precautions in the highlighted heading field. They follow a certain hierarchy and indicate (in conjunction with the safety alert symbol, see Chapter 1.1.1) the **seriousness of the danger** and the **type of warning.** See the following explanations:

⚠ DANGER

Danger of injuries.
Indicates an imminently hazardous situation, that **will** result in **death or serious injury** if the corresponding measures are not taken.

⚠ WARNING

Danger of injuries.
Indicates a potentially hazardous situation, that **could** result in **death or serious injury** if the corresponding measures are not taken.

⚠ CAUTION

Danger of injuries.
Indicates a potentially hazardous situation, that may result in **minor or moderate injury** if the corresponding measures are not taken.

CAUTION

Danger of damage.
Indicates a potentially hazardous situation that may result in **property damage** if the corresponding measures are not taken.

NOTICE

Indicates a possible **disadvantage**, i.e. undesirable conditions or consequences can occur if the corresponding measures are not taken.

NOTE

Indicates a possible **advantage** if the corresponding measures are taken; tip.

1.2 General safety precautions

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
These operating instructions

- must have been read completely and understood before beginning any work with or at the pump-motor unit,
- must be strictly observed,
- must be available at the operating location of the pump-motor unit.

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
Only operate the pump-motor unit

- for the purposes indicated under "Intended Use"!
- with the fluids indicated under 'Intended Use'!
- with the values indicated under 'Technical Data'!

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
All work on and with the pump-motor unit (transport, installation, operation, shut-down, maintenance, disposal) may only be carried out by **trained, reliable expert personnel**!

⚠ WARNING

When working on the unit, there is a danger of injury, e.g. in the form of cuts/cutting off, crushing and burns!
During all work on and with the pump-motor unit (transport, installation, operation, shut-down, maintenance, disposal) wear **personal safety equipment (safety helmet, protective gloves, safety shoes)**!

⚠ WARNING

Hair and clothing can be pulled into the unit or caught and wound up moving parts!
Do not wear long, loose hair or wide, loose clothes! Use a hair net!

⚠ DANGER

Electrical danger!
Work on electrical installations may be carried out by trained and authorized electricians only!

⚠ DANGER

Electrical danger!
Before beginning work on the unit or system, the following measures must be carried out:

- Deenergize.
- Secure against being switched on again.
- Determine whether deenergized.
- Ground and short-circuit.
- Cover or block off adjacent energized parts.

⚠ DANGER

Electrical danger!
Do not open the motor terminal box until absence of electricity has been ensured!

⚠ WARNING

Danger due to vacuum and gauge pressure: sudden escape of fluids (skin and eye injuries),
sudden drawing in of hair and clothing!

Danger due to escaping fluid: Burns!
Use mounting elements, connections, lines, fittings and containers with sufficient freedom from leaks and strength for the pressures which occur.

Check the mounting elements, connections, lines, fittings and containers for strength, leaks and firm seating at regular intervals!

⚠ WARNING

Danger from rotating parts (external fan, impeller, shaft):
Cutting/cutting off of extremities, Grasping/winding up of hair and clothing!

Danger due to vacuum and gauge pressure: sudden escape of fluids (skin and eye injuries), sudden drawing in of hair and clothing!

Danger due to escaping fluid: Burns!
Start-up and operation only under the following conditions:

- The pump-motor unit must be completely assembled. When doing so, pay particular attention to the following components:
  - the vacuum pump/compressor cover,
  - the muffler on inlet and discharge connections,
  - the fan guard.
- The pipes/hoses must be connected to inlet and discharge connections.
- Inlet and discharge connections and the connected pipes/hoses may not be closed, clogged or soiled.
- Check the mounting elements, connections of the pipe/hose connections, lines, fittings and containers for strength, leaks and firm seating at regular intervals.

⚠ WARNING

Danger from rotating parts (external fan, impeller, shaft):
Cutting/cutting off of extremities, Grasping/winding up of hair and clothing!

Danger due to vacuum and gauge pressure: sudden escape of fluids (skin and eye injuries), sudden drawing in of hair and clothing!

Danger due to escaping fluid: Burns!
Before beginning work on the pump-motor unit, take the following measures:

- Shut down pump-motor unit and secure against being switched on again.
- Attach a sign on the system controller and on the control elements for the pump-motor unit: "DANGER! Maintenance work on vacuum pump/compressor! Do not switch on!"
- Wait for pump-motor unit to come to a complete stop. Observe run-on time!
- Allow pump-motor unit to cool!
- Shut-off lines. Release pressure.
- Make sure that no vacuum or gauge pressure is present in the lines/tanks to be opened.
- Make sure that no fluids can escape.

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⚠ WARNING

Danger from rotating impeller:
Cutting/cutting of off extremities!
The rotating impeller is accessible with the inlet and discharge connections open!

Do not reach into the unit through open connections!

Do not insert objects into the unit through the openings!

⚠ WARNING

Danger from rotating impeller:
Cutting/cutting of off extremities!
The rotating impeller is accessible with the inlet and discharge connections open!

With free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere without piping, the following therefore applies:

Provide the inlet and discharge connections of the pump-motor unit either with additional mufflers or with additional piping of a sufficient length to prevent access to the impeller!

⚠ WARNING

Danger of burns from hot surfaces of the pump-motor unit and from hot fluids!
High temperatures of up to approx. 160°C [320°F] can occur on the surface of the pump-motor unit.

Cover the pump-motor unit with a suitable touch protection (e.g. perforated plate cover or wire cover). Do not touch during operation!
Allow to cool after shut-down!

1.3 Residual risks

⚠ WARNING

Danger zone:
Hot surface up to approx. 160°C [320°F].

Hazard:
Possible burns.

Protective measures:
Cover the pump-motor unit with a suitable touch protection (e.g. perforated plate cover or wire cover).

⚠ WARNING

Danger zone:
Fan guard

Hazard:
Long, loose hair can be drawn into external fan through fan guard grate, even with fan guard mounted!

Protective measures:
Wear hair net!

⚠ WARNING

Danger zone:
Missing or defective muffler inlet or discharge connection.

Hazard:
Possible serious hearing damage due to emitted noise.

Protective measures:
Have missing or defective mufflers replaced. Conduct a noise measurement in the system after installing the pump-motor unit. The following measures can be taken from 85 dB(A) and must be taken from 90 dB(A):

- Mark noise area with a warning sign.
- Wear hearing protection.

⚠ WARNING

Danger zone:
Environment of pump-motor unit.

Hazard:
Possible serious hearing damage due to emitted noise.

Protective measures:
Conduct a noise measurement in the system during operation after installing the pump-motor unit.

The following measures can be taken from 85 dB(A) and must be taken from 90 dB(A):

- Mark noise area with a warning sign.
- Wear hearing protection.
- With free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere without piping, attach an additional muffler.

2 Intended Use

This operating manual

- is intended for side channel compressors of the
  G-BH1 and G-BH9 series, types 2BH1 1 2BH1 2 2BH1 3 2BH1 4 2BH1 5 2BH1 6 2BH1 8 2BH1 9 2BH9 23,
- contains instructions bearing on transport and handling, installation, commissioning, operation, shut-down, storage, servicing and disposal of the G-BH1,G-BH9,
- must be completely read and understood by all operating and servicing personnel before beginning to work with or on the G-BH1, G-BH9,
- must be strictly observed,
- must be available at the site of operation of the G-BH1, G-BH9.

About the operating and servicing personnel of the G-BH1, G-BH9

- These persons must be trained and authorized for the work to be carried out.
- Work on electrical installations may be carried out by trained and authorized electricians only.

The G-BH1,G-BH9

- are pump-motor units for generating vacuum or gauge pressure;
- are used to **extract**, **pump** and **compress the following gases**:
  - Air,
  - Non-flammable, non-aggressive, non-toxic and non-explosive gases or gas-air mixtures.
  - With differing gases/gas-air mixtures, inquire with the Service Department.
- are equipped with one of the following kind of drive motors:
  - 3-phase AC drive motor with a standard or explosion-protected design
  - Single-phase AC drive motor

  These operating instructions apply **only to** pump-motor units with a **standard design**. For an explosion-protected design (EEx e II), see the separate operating instructions.
- are intended for industrial applications,
- are designed for continuous operation. With increased switch-on frequency (6x per hour with equal pauses and operating times) or with increased gas inflow and ambient temperature, the excess temperature limit of the coil and the bearing can be exceeded. Consult the manufacturer when using under such conditions.

When operating the G-BH1, G-BH9 the limits listed in Chapter 3, "Technical Data", Pg. 7 ff. must always be complied with.

Foreseeable Misuse

It is prohibited

- to use the G-BH1, G-BH9 in applications other than industrial applications unless the necessary protection is provided on the system, e.g. guards suitable for children's fingers;
- to use the device in rooms in which explosive gases can occur if the G-BH1, G-BH9 is not expressly intended for this purpose;
- to extract, to deliver and to compress explosive, flammable, corrosive or toxic fluids, unless the G-BH1, G-BH9 is specifically designed for this purpose;
- to operate the G-BH1 with values other than those specified in Chapter 3, "Technical Data", Pg. 7 ff.

Any unauthorized modifications of the G-BH1, G-BH9 are prohibited for safety reasons.

The operator is only permitted to perform the maintenance and service work described in these operating instructions.

Maintenance and servicing work which goes beyond this may only be carried out by companies which have been authorised by the manufacturer (ask the service department for details).

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3 Technical Data

3.1 Mechanical data

Weight

Single-impeller design		
	Weight	
Type	[kg] approx.	[lbs] approx.
2BH1100-7..0.	9	20
2BH1200-7..0.	9	20
2BH1300-7..0.	9	20
2BH1300-7..1.	10	22
2BH1300-7..2.	11	24
2BH1330-7..0.	10	22
2BH1330-7..1.	11	24
2BH1330-7..2.	12	26
2BH1400-7..0.	13	29
2BH1400-7..1.	16	35
2BH1400-7..2.	17	37
2BH1430-7..0.	14	31
2BH1430-7..1.	17	37
2BH1430-7..2.	18	40
2BH1500-7..0.	20	44
2BH1500-7..1.	22	49
2BH1500-7..2.	23	51
2BH1500-7..3.	25	55
2BH1530-7..0.	21	46
2BH1530-7..1.	23	51
2BH1530-7..2.	24	53
2BH1530-7..3.	26	57
2BH1600-7..0.	27	60
2BH1600-7..1.	30	66
2BH1600-7..2.	36	79
2BH1600-7..3.	40	88
2BH1600-7..6.	32	71
2BH1600-7..7.	39	86
2BH1630-7..0.	29	64
2BH1630-7..1.	32	71
2BH1630-7..2.	37	82
2BH1630-7..3.	43	95
2BH1630-7..6.	34	75
2BH1630-7..7.	40	88

Single-impeller design		
	Weight	
Type	[kg] approx.	[lbs] approx.
2BH180.-7..0.	117	258
2BH180.-7..1.	126	278
2BH180.-7..2.	132	291
2BH183.-7..0.	120	265
2BH183.-7..1.	129	284
2BH183.-7..2.	135	298
2BH190.-7..0.	179	395
2BH190.-7..1.	198	437
2BH190.-7..3.	210	463
2BH193.-7..0.	179	395
2BH193.-7..1.	198	437
2BH193.-7..3.	209	463
2BH923..-…P	167	368
2BH923..-…Q	145	320
2BH923..-…H	151	333

Two-impeller design		
	Weight	
Type	[kg] approx.	[lbs] approx.
2BH1310-7..2.	15	33
2BH1410-7..3.	25	55
2BH1410-7..4.	27	60
2BH1510-7..4.	40	88
2BH1510-7..5.	44	97
2BH1610-7..1.	43	95
2BH1610-7..2.	48	106
2BH1610-7..3.	54	119
2BH1610-7..4.	66	146
2BH1610-7..5.	73	161
2BH1610-7..7.	50	110
2BH1610-7..8.	62	137
2BH1640-7..3.	54	119
2BH1640-7..4.	69	152
2BH1640-7..5.	75	165
2BH1640-7..8.	62	137
2BH181.-7..1.	171	377
2BH181.-7..2.	177	390

Two-impeller design		
Type	Weight [kg] approx.	Weight [lbs] approx.
2BH181.-7..3.	203	448
2BH181.-7..4.	215	474
2BH184.-7..2.	177	390
2BH184.-7..3.	203	448
2BH191.-7..1.	274	604
2BH191.-7..2.	288	635
2BH191.-7..3.	299	659
2BH191.-7..4.	309	681
2BH1940-7B.2.	275	606
2BH1940-7B.3.	314	692
2BH1940-7B.4.	324	714
2BH1943-7..2.	330	728
2BH1943-7..3.	339	747
2BH1943-7..4.	349	769

Minimum distances

Minimum distance to fan guard (for sucking in cooling air):

Type	[mm]	[inches]
2BH1 1.. - 2BH1 4	34	1.34
2BH1 5.. - 2BH1 9	53	2.09
2BH923…	52	2.05

Minimum distance to face of vacuum pump/compressor cover:

Type	[mm]	[inches]
2BH1 1.. - 2BH1 5	20	0.79
2BH1 6..	30	1.18
2BH1 8.. - 2BH1 9	40	1.57
2BH923..	52	2.05

Noise level

Measuring-surface sound-pressure level as per EN ISO 3744, measured at a distance of 1 m [3.28 ft] at an operating point of approximately 2/3 of the permissible total pressure difference with the lines connected without a vacuum or pressure relief valve, tolerance ±3 dB (A).

Single-impeller design		
Type	1-m measuring-surface sound pressure level L [dB (A)]	
	50 Hz approx.	60 Hz approx.
2BH1100-7..0.	52	55
2BH1200-7..0.	57	61
2BH1300-7..0.	53	56
2BH1300-7..1.	53	56
2BH1300-7..2.	53	56
2BH1330-7..0.	53	56
2BH1330-7..1.	53	56
2BH1330-7..2.	53	56
2BH1400-7..0.	63	64
2BH1400-7..1.	63	64
2BH1400-7..2.	63	64
2BH1430-7..0.	63	64
2BH1430-7..1.	63	64
2BH1430-7..2.	63	64
2BH1500-7..0.	64	70
2BH1500-7..1.	64	70
2BH1500-7..2.	64	70
2BH1500-7..3.	64	70
2BH1530-7..0.	64	70
2BH1530-7..1.	64	70
2BH1530-7..2.	64	70
2BH1530-7..3.	64	70
2BH1600-7..0.	69	72
2BH1600-7..1.	69	72
2BH1600-7..2.	69	72
2BH1600-7..3.	69	72
2BH1600-7..6.	69	72
2BH1600-7..7.	69	72
2BH1630-7..0.	69	72

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Single-impeller design		
Type	**1-m measuring-surface sound pressure level L [dB (A)]**	
	50 Hz approx.	**60 Hz approx.**
2BH1630-7..1.	69	72
2BH1630-7..2.	69	72
2BH1630-7..3.	69	72
2BH1630-7..6.	69	72
2BH1630-7..7.	69	72
2BH180.-7..0.	70	74
2BH180.-7..1.	70	74
2BH180.-7..2.	70	74
2BH183.-7..0.	70	74
2BH183.-7..1.	70	74
2BH183.-7..2.	70	74
2BH190.-7..0.	74	79
2BH190.-7..1.	74	79
2BH190.-7..3.	74	79
2BH193.-7..0.	75	80
2BH193.-7..1.	75	80
2BH193.-7..3.	75	80
2BH923..	79	81

Two-impeller design		
Type	**1-m measuring-surface sound pressure level L [dB (A)]**	
	50 Hz approx.	**60 Hz approx.**
2BH1310-7..2.	55	61
2BH1410-7..3.	66	69
2BH1410-7..4.	66	69
2BH1510-7..4.	72	74
2BH1510-7..5.	72	74
2BH1610-7..1.	73	76
2BH1610-7..2.	73	76
2BH1610-7..3.	73	76
2BH1610-7..4.	73	76
2BH1610-7..5.	73	76
2BH1610-7..7.	73	76
2BH1610-7..8.	73	76
2BH1640-7..3.	74	78
2BH1640-7..4.	74	78
2BH1640-7..5.	74	78
2BH1640-7..8.	74	---
2BH181.-7..1.	74	---
2BH181.-7..2.	74	78
2BH181.-7..3.	74	78
2BH181.-7..4.	74	78
2BH184.-7..2.	74	78
2BH184.-7..3.	74	78
2BH191.-7..1.	74	84
2BH191.-7..2.	74	84
2BH191.-7..3.	74	84
2BH1940-7B.2.	75	84
2BH1940-7B.3.	75	84
2BH1940-7B.4.	75	84
2BH1943-7..2.	75	84
2BH1943-7..3.	75	84
2BH1943-7..4.	75	84

Sound power level

Sound power level L_W as per EN ISO 3744, tolerance ±3 dB (A).

Two-impeller design		
	Sound power level L_W [dB (A)]	
Type	50 Hz	60 Hz
2BH191.	-	98
2BH1940	-	98
2BH1943	-	99
2BH923..	-	93

Tightening torques for screw connections

The following values apply if no other information is available.

With non-electrical connections, property classes of 8.8 and 8 or higher as per ISO 898-1 are assumed.

	Tightening torques for non-electrical connections	
Thread	[Nm]	[ft lbs]
M4	2.7 - 3.3	1.99 - 4.44
M5	3.6 - 4.4	2.65 - 3.25
M6	7.2 - 8.8	5.31 - 6.5
M8	21.6 - 26.4	15.9 - 19.5
M10	37.8 - 46.2	27.9 - 34.1
M12	63.0 - 77.0	46.5 - 56.8

The following information for electrical connection applies to all terminal board connections with the exception of terminal strips.

	Tightening torques for electrical connections	
Thread	[Nm]	[ft lbs]
M4	0.8 - 1.2	0.59 - 0.89
M5	1.8 - 2.5	1.33 - 1.84

Especially for metal and plastic threaded cable glands and pipe unions, the following values apply:

	Tightening torques for metal threaded glands/unions	
Thread	[Nm]	[ft lbs]
M12x1,5	4 - 6	2.95 - 4.43
M16x1,5	5 - 7.5	3.69 - 5.53
M25x1,5	6 - 9	4.43 - 6.64
M32x1,5	8 - 12	5.9 - 8.85
M40x1,5		

	Tightening torques for plastic threaded glands/unions	
Thread	[Nm]	[ft lbs]
M12x1,5	2 - 3.5	1.48 - 2.58
M16x1,5	3 - 4	2.21 - 2.95
M25x1,5	4 - 5	2.95 - 3.69
M32x1,5	5 - 7	3.69 - 5.16
M40x1,5		

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3.2 Electrical data

See rating plate.

3.3 Operating conditions

Temperatures

Temperature of pumped gases:	max. permissible temperature: +40°C [+104°F] Nominal value: +15°C [+59°F] Pump-motor units for higher fluid temperatures on request.
Ambient temperature:	max. permissible temperature: +40°C [+104°F] min. permissible temperature: -15°C [+5°F] Nominal value: +25°C [+77°F] Ambient temperatures between 25°C [+77°F] and 40°C [+104°F] affect the permissible total pressure difference. At higher temperatures the winding may be damaged and the grease change interval may be shortened.

Pressures

Min. suction pressure:	See rating plate
Max. discharge pressure in compressor mode:	See rating plate

* The total pressure difference, shown on the rating plate, applies only for the following conditions:

- Ambient temperature: 25°C
- Pressure for vacuum operation: 1013 mbar at pressure connection;
- Pressure for compressor operation: 1013 mbar at suction connection;
- Intake temperature (temperature of conveyed gases at suction connection): 15°C
  For ambient temperatures between 25°C and 40°C, the total pressure difference specified on the rating plate must be reduced (at 40°C by 10%).

Consultation with the manufacturer is essential for such operational conditions.

Installation altitude

Max. of 1,000 m [3,280 ft] above sea level.

When installing the pump-motor unit at an altitude of more than 1,000 m [3,280 ft] above sea level, first inquire with the Service department.

4 Transport and Handling

⚠ WARNING

Tipping or falling can lead to crushing, broken bones etc.! Sharp edges can cause cuts!
Wear personal safety equipment (gloves, safety shoes and protective helmet) during transport!

⚠ WARNING

Danger from tipping or falling loads!
Prior to transport and handling make sure that all components are securely assembled and secure or remove all components the fasteners of which have been loosened!

Manual handling:

⚠ WARNING

Danger from lifting heavy loads!
Manual handling of the unit is only permitted within the following limits:

- max. 30 kg [max. 66 lbs] for men
- max. 10 kg [max. 22 lbs] for women
- max. 5 kg [max. 11 lbs] for pregnant women

For the weight of the pump-motor unit, see Chapter 3.1, "Mechanical data", Section "Weight", Pg. 7. For weights above the given values use suitable lifting appliances and handling equipment!

Handling by means of lifting equipment:

⚠ WARNING

Danger from tipping or falling loads!
When transporting with lifting equipment, observe the following basic rules:

- Before each transport, check the tight fit of the eye bolt/lifting attachment, see "Tightening torques for screw connections", p. 10.
- The lifting capacity of lifting equipment and lifting gear must be at least equal to the unit's weight. For the weight of the pump-motor unit, see Chapter 3.1, "Mechanical data", Section "Weight", Pg. 7.
- The pump-motor unit must be secured so that it cannot tip or fall.
- Do not stand or walk under suspended loads!

The transport must be carried out in different ways depending on the type:

- 2BH11., 2BH12., 2BH13., 2BH14., 2BH15. (single-impeller): Manual handling
- 2BH15. (two-impeller), 2BH16., 2BH18., 2BH19., 2BH923…
  Transport with crane, hooked onto eye bolt/lifting attachment (1 attachment point)
- 2BH1943:
  Transport with crane, hooked with lifting belts onto eye bolt and onto the holes in the two feet of the vacuum pump/compressor housing (3 attachment points).

For **transport with a crane**, the pump-motor unit can be hooked into the crane hook as follows:

- directly on the eye bolt/lifting attachment (With 2BH194 the eye bolt and the two foot holes should be used)

or possibly

- with lifting belts.

Eye bolt/lifting attachment:

Types with a weight of up to 30 kg [66 lbs] are **not** equipped with an eye bolt/lifting attachment (2BH11., 2BH12., 2BH13., 2BH14., 2BH15 [single-impeller]).

Types with a weight of more than 30 kg [66 lbs] are equipped with an eye bolt/lifting attachment as **standard** (2BH15. [two-impeller], 2BH16., 2BH18., 2BH19., 2BH9…).

The eye bolt/lifting attachment is mounted on the vacuum pump/compressor housing.

In case of possible removal and remounting of the eye bolt, it must be ensured that the eye level is positioned exactly in the axis direction of the pump-motor unit. Lay shims under the eye bolt if necessary.

The eye bolt/lifting attachment must be firmly tightened.

Loads laterally to the ring level are not permissible. Heavy impact loads during transport must be avoided.

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5 Installation

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.?

Otherwise you many not carry out any work with or on the pump-motor unit!

⚠ DANGER

Danger from missing view into area of pump-motor unit!
When operating the control elements without a view into the area of the pump-motor unit, there is a danger that the pump-motor unit will be switched on while other persons are still performing work on it. Extreme injuries are possible!

Provide control elements at a location with a view of the pump-motor unit.

⚠ DANGER

Electrical danger!
The pump-motor unit must be installed so that the electrical device cannot be damaged by external influences!

In particular, the feed pipes must be securely routed, e.g. in cable ducts, in the floor etc.

⚠ WARNING

Danger from balance damage caused by vibration!
Vibrating environments can cause balance damage!

Install the pump-motor unit on a solid foundation or on a solid mounting surface.

Check screw glands/unions for mounting the pump-motor unit on the mounting surface regularly for strength and firm seating.

⚠ WARNING

Danger from crushing due to pump-motor unit tipping over!
Wear personal safety equipment (protective gloves and safety shoes). Handle the unit with the appropriate care. Install the pump-motor unit on a solid foundation or on a solid mounting surface! Check screw glands/unions for mounting the pump-motor unit on the mounting surface regularly for strength.

⚠ WARNING

Danger of fire from flammable substances!
The pump-motor unit must never come into contact with flammable substances.

⚠ WARNING

Danger of burns from hot surfaces of the pump-motor unit and from hot fluids!
High temperatures of up to approx. 160°C [320°F] can occur on the surface of the pump-motor unit.

The pump-motor unit must be installed so that accidental touch of its surface is not possible. Cover the pump-motor unit with a suitable touch protection (e.g. perforated plate cover or wire cover).

⚠ WARNING

Danger of injuries from flying parts!
Select installation so that parts that are thrown out through the grate if the external fan breaks cannot hit persons!

⚠ CAUTION

Danger of tripping and falling!
Make sure the unit does not present a danger of tripping. Lay cables and pipes so that they cannot be reached during operation(recessed in floor, in ducts on the wall etc.).

CAUTION

Danger of overheating due to hot surface of pump-motor unit!
High temperatures can occur on the surface of the pump-motor unit.

Temperature sensitive parts, such as lines or electronic components, may not come into contact with the surface of the pump-motor unit.

The pump-motor unit is ready to connect on delivery. However, if the time from delivery to commissioning of the pump-motor unit exceeds a certain period, the lubrication of the rolling bearings must be renewed.
See Chapter 8.2, "Storage conditions", Section "Lubrication of rolling bearings after longer storage", Pg. 24 for information on this topic.

Carry out the following work to install the pump-motor unit:

- Installation and securing,
- Attachment of the included loose muffler if necessary,
- Attachment of threaded flange or hose flange (available as accessories)
  for the connection of inlet or discharge pipe to the muffler,
- Electrical connection,
- Connection of inlet and discharge connection to the system.

5.1 Installation

⚠ WARNING

For an installation that differs from the following specifications, it is necessary to inquire with the Service Department!

Ambient conditions:

The pump-motor unit is suitable for installation in the following environments:

- In a dusty or damp environment,
- in buildings,
- in the open.
  When properly installed in the open, the pump-motor unit must be protected from exposure to intensive sunlight, e.g. by attaching a protective roof. Otherwise, no special protective devices against the effects of weathering are required.

The drive motors of the pump-motor units have the following design:

- with degree of protection IP55 (see rating plate),
- with tropicalized insulation.

Installation conditions:

The pump-motor unit must be installed as follows:

- on level surfaces,
- at a maximum height of 1000 m [3280 ft] above sea level.
  When installing at an altitude of more than 1,000 m [3,280 ft] above sea level, first inquire with the Service Department.

Minimum distances:

To ensure sufficient cooling of the pump-motor unit, it is absolutely necessary that the required minimum distances to the **fan guard** and to the **face of the vacuum pump/compressor cover** be maintained. see Chapter 3.1, "Mechanical data", Section "Minimum distances", Pg. 8.

The minimum distances to the face of the vacuum pump/compressor cover are especially important when installing on the vacuum pump/compressor cover or near a wall.

CAUTION

To ensure sufficient cooling of the pump-motor unit, also observe the following:

- Ventilation screens and openings must remain clear.
- Discharge air of other units may not be directly sucked in again!

Noise radiation:

To reduce the noise radiation, the following must be observed:

- Do not mount pump-motor unit on noise-conducting or noise-radiating parts (e.g. thin walls or sheet-metal plates).
- Provide pump-motor unit with sound-insulating intermediate layers (e.g. rubber buffers under the base of the pump-motor unit) if necessary.
- Install the pump-motor unit on a stable foundation or on a rigid mounting surface. This provides for smooth, low-vibration running of the pump-motor unit.

Components for reducing noise on the pump-motor unit:

- **Mufflers** (included as standard equipment):
  On delivery the pump-motor units are equipped with attached mufflers as standard. The noise radiation is considerably reduced by the mufflers. See Fig. 2 to Fig. 9, Pg. 18 ff.
- **Additional silencer** (available as an accessory for the 2BH1):
  The additional mufflers enable a further noise reduction. They may only be used with free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere **without piping**.

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- **Sound protection hood** (available as an accessory for the 2BH1):
  Noise protection hoods are suitable for installation in rooms and in the open. They reduce both the total sound pressure level and tonal components that are perceived as particularly annoying.

Installation variants/axis position:

Basically, when installing the pump-motor unit, the following variants are possible with a different axis position (horizontal or vertical):

- Horizontal installation
- Vertical installation on the vacuum pump/compressor cover ("cover installation")
- Vertical mounting on the wall

Basically, all variants are possible with all type.

Exceptions

- For the 2BH1943, vertical axis mounting on the compressor cover ("cover position") is necessary.
- For the 2BH923, only horizontal axis mounting and vertical axis mounting on the compressor cover are possible.
- For units with condensate water opening, horizontal axis mounting with a foot below is necessary.

Horizontal axis mounting

The foot of the unit has fastening holes.

- Screw the foot of the unit to the base using suitable screws.
  All fastening holes must have screws!

Vertical axis mounting on the compressor cover ("cover position")

For vertical axis mounting on the compressor cover, use spring elements.

Spring elements are available as accessories and come in a set of 3. The upper part has a threaded stud and the lower part a threaded hole.

- fFastening spring elements to the unit:
  Screw threaded studs of the spring elements into the holes on the front side of the compressor cover and tighten.
- Fastening the unit with spring elements to the foundation:
  Select suitable fastening elements for the threaded hole.
  Screw spring elements over the threaded hole into the base or foundation.

Vertical axis mounting on the wall with the compressor cover pointing downward

For vertical axis mounting of the unit on the wall, the unit is fastened using the holes in the foot. The foot of the unit has fastening holes.

- Place the unit with the foot to the wall on a base plate with sufficient load-bearing capability in the mounting position.
- Screw the foot of the unit to the wall using suitable screws.
  All fastening holes must have screws!
- Remove the base plate.

Eye bolt/lifting attachment:

After set-up, the eye bolt/lifting attachment can be removed.

5.2 Electrical connection (motor)

⚠ DANGER

Electrical danger!
Malpractice can result in severe injuries and material damage!

⚠ DANGER

Electrical danger!
The electrical connection may be carried out by trained and authorized electricians only!

⚠ DANGER

Electrical danger!
Before beginning work on the unit or system, the following measures must be carried out:

- Deenergize.
- Secure against being switched on again.
- Determine whether deenergized.
- Ground and short-circuit.
- Cover or block off adjacent energized parts.

CAUTION

Incorrect connection of the motor can lead to serious damage to the unit!

Regulations:

The electrical connection must be carried out as follows:

- according to the applicable national and local laws and regulations,
- according to the applicable system-dependent prescriptions and requirements,
- according to the applicable regulations of the utility company.

Electrical power supply:

Observe the **rating plate**.
It is imperative that the operating conditions correspond to the data given on the rating plate!

Deviations permissible without reduction in performance:

- ±5 % voltage deviation
- ±2 % frequency deviation

Connection to drive-motor terminal box:

Open the required cable entry openings on the terminal box. Here the following two cases are differentiated:

- The cable entry opening is prefabricated and provided with a sealing plug.
- Screw out sealing plug.

OR

- The cable entry opening is closed off with a casting skin (only on pump-motor units with drive-motor axis heights of 100 to 160 in standard design).
- Break out casting skin using a suitable tool. For example, use a metal pin with a corresponding diameter or a chisel and hammer.

CAUTION

When pounding out the casting skin on the cable entry openings in the terminal box, the terminal box or its parts can be damaged (e.g. terminal board, cable connections).

Proceed with suitable caution and precision when doing so! Prevent flash formation!

Mount cable glands on the terminal box. Proceed as follows:

- Select one cable gland in each case which is suitable for the cable diameter.
- Insert this cable gland in the opening of the terminal box.
  Use a reducer if necessary.
- Screw on the cable gland so that no moisture, dirt etc. can penetrate into the terminal box.

Carry out the connection and the arrangement of the jumpers in accordance with the **circuit diagram in the terminal box**.

Connect the protective conductor to the terminal with the following symbol:
.

The electrical connection must be carried out as follows:

- The electrical connection must be permanently safe.
- There may be no protruding wire ends.
- Clearance between bare live parts and between bare live parts and ground: ≥ 5.5 mm [0.217"] (at a nominal voltage of $U_N \leq 690V$).
- For the tightening torques for terminal board connections (except terminal strips), see Chapter 3.1, "Mechanical data", Section "Tightening torques for screw connections", Pg. 10.
- For terminals with clamping straps (e.g. as per DIN 46282), the conductors must be inserted so that approximately the same clamping height results on both sides of the bar. Individual conductors must therefore be bent into a U-shape or connected with a cable lug (DIN 46234).

This also applies to:

- the protective conductor,
- the outer ground conductor.

Both conductors can be recognized from their color (green/yellow).

⚠ DANGER

Electrical danger!
The terminal box must be free from

- foreign bodies,
- dirt,
- humidity.

Terminal box cover and cable entries must be tightly closed so as to make them dustproof and waterproof. Check for tightness at regular intervals.

⚠ DANGER

Electrical danger!
Clearance between bare live parts and between bare live parts and ground:

at least **5.5 mm [0.217"]** (at a nominal voltage of $U_N \leq 690V$).

There may be no protruding wire ends!

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For **motor overload protection**:

- Use motor circuit breakers.
- This must be adjusted to the specified nominal current (see rating plate).

⚠ DANGER

Electrical danger!
There is danger of an electrical shock when a defective pump-motor unit is touched!

Mount motor circuit breaker.
Have electrical equipment checked regularly by an electrician.

Interference immunity of drive motor:

For drive motors with integrated sensors, the operator must provide for a sufficient interference immunity itself. Select a suitable sensor signal cable (e.g. with screening, connection as for a motor power-supply cable) and analyzing unit.

Operation with frequency converter:

⚠ WARNING

Pump-motor units with a UL approbation may not be operated on frequency converters in the US without testing by a suitable test agency!

With a power supply by a frequency converter, the following must be observed:

- High-frequency current and voltage harmonics in the motor supply cables can lead to emitted electromagnetic interference. This is dependent on the converter design (type, manufacturer, interference suppression measures).
- Be sure to observe the EMC notes of the converter manufacturer!
- Use screened power supply cables if necessary. For optimal screening, the screen must be conductively connected over a large area to the metal terminal box of the drive motor with a screwed metal gland.
- In the case of drive motors with integrated sensors (e.g. PTC thermistors) interference voltage can occur on the sensor cable depending on the converter type.
- Limit speed:
  see specifications on the rating plate.

5.3 Connecting pipes/hoses (vacuum pump/compressor)

Mufflers:

The pump-motor units are delivered with mufflers (indicated with arrows in the following illustrations) for the inlet and discharge connections as standard equipment.

On delivery the mufflers are already mounted on the following pump-motor units.

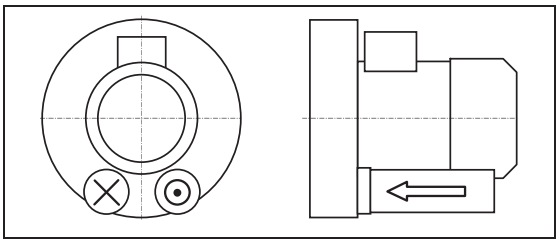

Fig. 2: 2BH1… (single-impeller pump-motor units), 2BH9 23

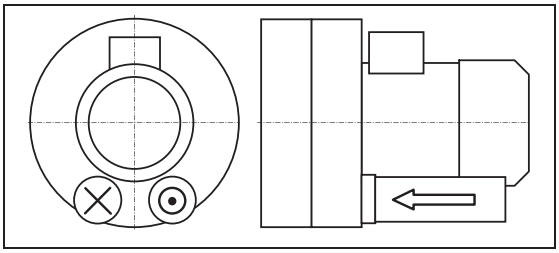

Fig. 3: 2BH1640 (two-impeller pump-motor unit with double-flow design)

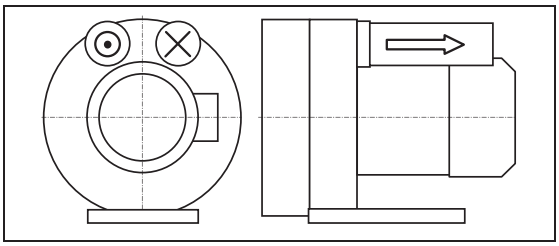

Fig. 4: 2BH1840-7G... (two-impeller pump-motor unit with double-flow design)

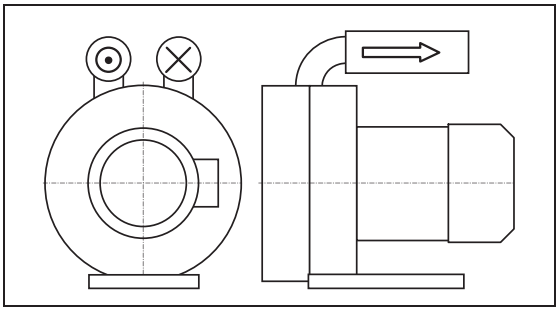

Fig. 5: 2BH1840-7J... (two-impeller pump-motor unit with double-flow design)

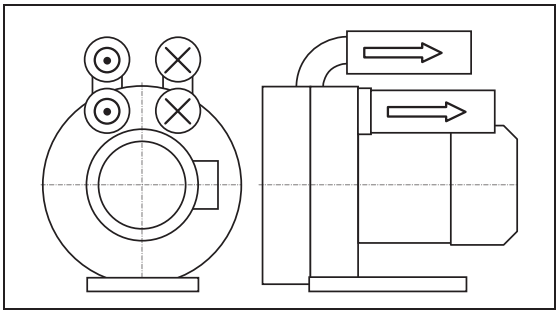

Fig. 6: 2BH1840-7L... (two-impeller pump-motor unit with double-flow design)

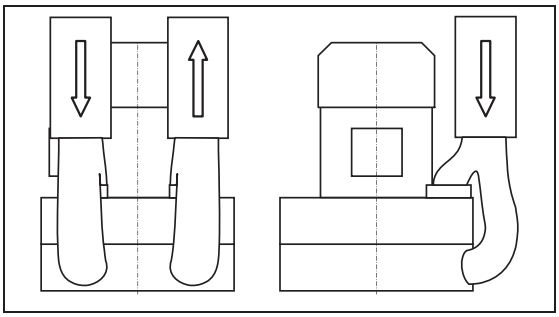

Fig. 7: 2BH1943 (two-impeller pump-motor unit with double-flow design)

On **two-impeller pump-motor units with a two-stage design of the types 2BH1310 to 2BH1910** the discharge-side muffler is included loose for packing-related reasons and must be mounted by the customer.

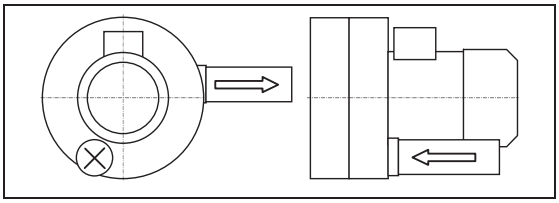

Fig. 8: 2BH1310 ... 2BH1610, 2BH1910 (two-impeller pump-motor units with a two-stage design)

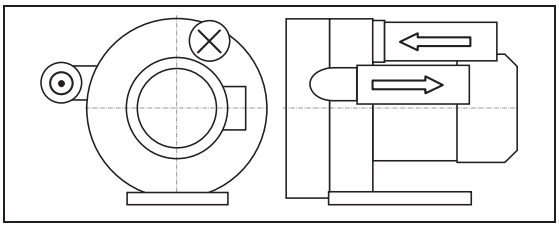

Fig. 9: 2BH1810 (two-impeller pump-motor unit with a two-stage design)

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⚠ WARNING

Danger from rotating impeller:
Cutting/cutting of off extremities!

The rotating impeller is accessible with the inlet and discharge connections open!

With free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere without piping, the following therefore applies:

Provide the inlet and discharge connections of the pump-motor unit either with additional mufflers or with additional piping of a sufficient length to prevent access to the impeller!

Connections:

To prevent foreign bodies from entering the unit, all connections are sealed off when delivered. Do not remove the sealing plugs until immediately before connecting the pipes/hoses.

The following applies for the arrangement of the pipe/hose connections:

The **pumped gases** are sucked in via the inlet connection (see Chapter 5.3.1, Pg. 19) and discharged via the discharge connection (see Chapter 5.3.2, Pg. 19).

The **shaft rotating direction** is marked with an arrow on the back of the vacuum pump/compressor housing (Fig. 1, Pg. 2, Item 7).

The **delivery direction of the gases** is marked with arrows on both connections (Fig. 1, Pg. 2, Item 6).

⚠ WARNING

Danger from interchanging inlet and pressure line!

Interchanged inlet and pressure lines can lead to damage to the pump-motor unit and the system, and as a result of this to serious injuries!

Make sure that the inlet and pressure line cannot be confused when connecting.

Look for the clear marking with the arrow indicating the delivery direction on the inlet and discharge connections.

⚠ WARNING

Danger due to vacuum and gauge pressure!

Danger due to escaping fluid!

During operation, connected pipes and vessels are vacuumized or pressurized!

Use only mounting elements, connections, lines, fittings and containers with sufficient freedom from leaks and strength for the pressures which occur.

Make sure that the mounting elements and connections are mounted sufficiently firmly and leak-free!

CAUTION

If the pumped gases are passed on on the discharge side in a closed pipe system, then it must be ensured that the pipe system is adapted to the maximum discharge pressure. See Chapter 3.3: "Operating conditions", Section "Pressures", Pg. 11. Connect a pressure relief valve upstream if necessary.

NOTICE

Attach pipes/hoses free of mechanical tensions. Support the weight of the pipes/hoses.

5.3.1 Inlet connection

The inlet connection with the related muffler (Fig. 1, Pg. 2, Item 3) is marked with an arrow pointing into the vacuum pump/compressor. Connect the inlet pipe here. The pumped gases are sucked in via this.
Procedure: see Chapter 5.3.3.

⚠ WARNING

Danger from solid bodies and impurities in the pump-motor unit!

If solid bodies penetrate into the pump-motor unit, blades of the impellers can break and broken pieces can be thrown out.

Install a filter in the inlet pipe.
Replace filter regularly!

5.3.2 Discharge connection

The discharge connection with the related muffler (Fig. 1, Pg. 2, Item 4) is marked with an arrow pointing out of the vacuum pump/compressor. Connect the discharge pipe here. The pumped gases are discharged via this. Procedure: see Chapter 5.3.3.

5.3.3 Procedure when connecting pipes/hoses

Attach the pipes/hoses to the unit as described in the following. The pipes/hoses are connected differently to inlet and discharge connections depending on the muffler design and the type of line (pipe or hose):

- Muffler with inside threads:
  The pipe is screwed directly into the muffler.
- Muffler without inside thread:
  - Screw threaded flange (available as an accessory) onto the muffler.
  - Screw the pipe into the threaded flange.
- Hose connection:
  - for 2BH1 Screw the hose flange (available as an accessory) onto the silencer.
  - Push the hose onto the hose flange and secure it with a hose clamp. See Chapter 3.1, "Mechanical data", Section "Tightening torques for screw connections", Pg. 10 for information on this topic.

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6 Commissioning

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!

Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.? Otherwise you many not carry out any work with or on the pump-motor unit!

⚠ WARNING

Danger from rotating parts (external fan, impeller, shaft): Cutting/cutting off of extremities, Grasping/winding up of hair and clothing!

Danger due to vacuum and gauge pressure: sudden escape of fluids (skin and eye injuries), sudden drawing in of hair and clothing!

Danger due to escaping fluid: Burns!

Start-up and operation only under the following conditions:

- The pump-motor unit must be completely assembled. When doing so, pay particular attention to the following components:
  - the vacuum pump/compressor cover,
  - the muffler on inlet and discharge connections,
  - the fan guard.
- The pipes/hoses must be connected to inlet and discharge connections.
- Inlet and discharge connections and the connected pipes/hoses may not be closed, clogged or soiled.
- Check the mounting elements, connections of the pipe/hose connections, lines, fittings and containers for strength, leaks and firm seating at regular intervals.

6.1 Preparation

⚠ WARNING

Danger from closed connections!

With closed/soiled intake or discharge connections vacuum or gauge pressure results in the pump-motor unit.

This can overheat and damage the drive motor winding.

Before start-up, make sure that the inlet and discharge connections are not closed, clogged or soiled!

CAUTION

Before starting up again after a longer standstill: Measure the insulation resistance of the motor. With values ≤ 1 kΩ per volt of nominal voltage, the winding is too dry.

Measures before start-up:

- If a shut-off device is installed in the discharge pipe:
  Make sure that the unit is NOT operated with the shut-off device closed.
- Before starting up the pump-motor unit, observe the values specified on the rating plate. Specifications on the drive-motor nominal current apply at a gas entry and ambient temperature of +40° C [104°F].
- Adjust the motor circuit breaker to the drive-motor nominal current.

Check direction of rotation:

- The intended rotating direction of the shaft is marked with arrows on the vacuum pump/compressor housing (Fig. 1, Pg. 2, Item. 7).
- The gas delivery direction is marked with arrows on the inlet and discharge connections (Fig. 1, Pg. 2, Item 6).
- Make sure the pipes/hoses on the inlet and discharge connections are properly connected.
- Switch the pump-motor unit on briefly and then off again.
- Compare the actual rotating direction of the external fan with the intended shaft rotating direction indicated with the arrows shortly before the pump-motor unit comes to a standstill.
- If necessary, reverse the direction of rotation of the motor.

⚠ WARNING

Danger due to rotating parts! Danger due to vacuum and gauge pressure! Danger due to escaping fluid!
Test runs may also only be conducted with the pump-motor unit completely mounted.

⚠ DANGER

Electrical danger!
The electrical connection may be carried out by trained and authorized electricians only!

⚠ DANGER

Electrical danger!
Before beginning work on the unit or system, the following measures must be carried out:

- Deenergize.
- Secure against being switched on again.
- Determine whether deenergized.
- Ground and short-circuit.
- Cover or block off adjacent energized parts.

Check operating speeds:

Observe the operating speed specified on the rating plate. This may not be exceeded, as otherwise the noise radiation, vibration behavior, grease consumption duration and bearing change interval worsen. To prevent damage as a result of higher speeds, it may be necessary to inquire with the Service Department as to the maximum speed.

⚠ WARNING

Danger of hearing damage due to noise radiation!
For the noise emission of the pump-motor unit measured by the manufacturer, see Chapter 3.1, "Mechanical data", Section "Noise level", Pg. 8. However, the actual noise emission during operation is highly dependent on the installation and system conditions. Conduct a noise measurement in the system during operation after installing the pump-motor unit. The following measures can be taken from 85 dB(A) and must be taken from 90 dB(A):

- Mark noise area with a warning sign.
- Wear hearing protection.
- With free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere without piping, attach an additional muffler.

6.2 Start-up and shut-down

Start-up

- Open shut-off device in intake/discharge pipe.
- Switch on power supply for drive motor.

Shut-down:

- Switch off power supply for drive motor.
- Close shut-off device in intake/discharge pipe.

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7 Operation

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.?
Otherwise you many not carry out any work with or on the pump-motor unit!

Also **be sure** to read the safety precautions in Chapter 6, "Commissioning", Pg. 21!

Starting up and shutting down

See Chapter 6, "Commissioning", Sub-Chapter 6.2, "Start-up and shut-down", Pg. 22.

Also be sure to observe the following important notes especially for operation:

⚠ WARNING

Danger of burns from hot surfaces of the pump-motor unit and from hot fluids!
High temperatures of up to approx. 160°C [320°F] can occur on the surface of the pump-motor unit.

Do not touch during operation!
Allow to cool after shut-down!

CAUTION

Danger of overheating due to hot surface of pump-motor unit!
High temperatures of up to approx. 160°C [320°F] can occur on the surface of the pump-motor unit.

Temperature sensitive parts, such as lines or electronic components, may not come into contact with the surface of the pump-motor unit.

CAUTION

Danger of overheating!
During operation the standstill heating may, if installed, **not** be switched on!

CAUTION

Danger of rusting due to collection of condensed water in drive motor area!
On drive motors with closed condensed water openings:
Remove closures occasionally to allow any water which has collected to drain off.

CAUTION

Danger of bearing damage!
Heavy mechanical impacts must be avoided during operating and while at a standstill.

8 Shut-Down and Longer Standstills

8.1 Preparing for shut-down or longer standstill

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.?
Otherwise you many not carry out any work with or on the pump-motor unit!

CAUTION

Danger of rusting due to collection of condensed water in drive motor area!
On drive motors with closed condensed water openings:
Remove closures occasionally to allow any water which has collected to drain off.

CAUTION

Danger of bearing damage!
Avoid mechanical shocks during operation and shut-down.

Prior to shut-down or longer standstill, proceed as follows:

- Switch off the pump-motor unit.
- Close shut-off device in inlet and pressure line if installed.
- Disconnect pump-motor unit from power supply.
- Release pressure.
  When doing so, open pipes/hoses slowly and carefully so that the vacuum or gauge pressure in the pump-motor unit can be released.
- Remove pipes/hoses.
- Provide mufflers on inlet and discharge side with sealing plugs.

8.2 Storage conditions

To prevent standstill damage during storage, the environment must provide the following conditions:

- dry,
- dust-free,
- low-vibration (V_{eff} ≤ 2.8 mm/s [0.11"/sec]).
- Ambient temperature:
  min. -30°C [-22°F]
  max. 40°C [+104°F].

CAUTION

Danger of overheating due to high temperature!
When storing in an environment with a temperature of over 40°C [104°F], the winding may be damaged and the grease change interval may be shortened.

Lubrication of rolling bearings after longer storage:

The new pump-motor unit may at first be stored following delivery. If the time from deliver to commissioning exceeds the following periods, the lubrication of the rolling bearings must be renewed:

- Under advantageous storage conditions (as specified above): 4 years.
- Under disadvantageous storage conditions (e.g. high humidity, salty air, sandy or dusty air): 2 years.

In these cases open rolling bearings must be relubricated and closed rolling bearings must be completely replaced. In this case be sure to inquire with the Service Department. In particular, exact information with regard to the procedure and grease type are required.

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
All maintenance work on the pump-motor unit must always be performed by the Service Department!

Maintenance work on the pump-motor unit may only be conducted by the operator itself when the related **maintenance manual** on hand!

Inquire with the Service Department!

Commissioning after longer standstill:

Before recommissioning after a longer standstill, measure the insulation resistance of the drive motor. With values ≤ 1 kΩ per volt of nominal voltage, the winding is too dry.

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9 Servicing

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.?

Otherwise you many not carry out any work with or on the pump-motor unit!

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
All maintenance work on the pump-motor unit must always be performed by the Service Department!

Maintenance work on the pump-motor unit may only be conducted by the operator itself when the related **maintenance manual** on hand!

Inquire with the Service Department!

9.1 Emptying/Rinsing/Cleaning

Before any maintenance/servicing work, empty, rinse and clean the outside of the unit.

- Empty unit with air and rinse until all residues have been removed.
- Clean the outside of the unit with compressed air.
  - Wear gloves and protective safety glasses.
  - Secure the surrounding area.
  - Clean the entire surface of the unit and exterior fan with compressed air.

9.2 Repairs/troubleshooting

Fault	Cause	Remedy	Carried out by
Motor does not start; no motor noise.	At least two power supply leads interrupted.	Eliminate interruption by fuses, terminals or power supply cables.	Electrician
Motor does not start; humming noise..	One power supply lead interrupted.	Eliminate interruption by fuses, terminals or power supply cables.	Electrician
	Impeller is jammed.	Open vacuum pump/compressor cover, remove foreign body, clean.	Service*)
		Check or correct impeller gap setting if necessary.	Service
	Impeller defective.	Replace impeller.	Service*)
	Rolling bearing on drive motor side or vacuum pump/compressor side defective.	Replace motor bearing or vacuum pump/compressor bearing.	Service*)
Protective motor switch trips when motor is switched on. Power consumption too high.	Winding short-circuit.	Have winding checked.	Electrician
	Motor overloaded. Throttling does not match specification on rating plate.	Reduce throttling.	Service*)
		Clean filters, mufflers and connection pipes if necessary.	Service*)
	Compressor is jammed.	See fault: "Motor does not start; humming noise." with cause: "Impeller is jammed.".	Service*)

Fault	Cause	Remedy	Carried out by
Pump-motor unit does not generate any or generates insufficient pressure difference.	Leak in system.	Seal leak in the system.	Operator
	Wrong direction of rotation.	Reverse direction of rotation by interchanging two connecting leads.	Electrician
	Incorrect frequency (on pump-motor units with frequency converter).	Correct frequency.	Electrician
	Shaft seal defective.	Replace shaft seal.	Service*)
	Different density of pumped gas.	Take conversion of pressure values into account. Inquire with Service Department.	Service
	Change in blade profile due to soiling.	Clean impeller, check for wear and replace if necessary.	Service*)
Abnormal flow noises.	Flow speed too high.	Clean pipes. Use pipe with larger cross-section if necessary.	Operator
	Muffler soiled.	Clean muffler inserts, check condition and replace if necessary.	Service*)
Abnormal running noise.	Ball bearing lacking grease or defective.	Regrease or replace ball bearing.	Service*)
Compressor leaky.	Seals on muffler defective.	Check muffler seals and replace if necessary.	Service*)
	Seals in motor area defective.	Check motor seals and replace if necessary.	Service

*) Only when the maintenance manual is at hand: rectification by the operator.

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9.3 Service/After-sales service

Our Service is available for work (in particular the installation of spare parts, as well as maintenance and repair work), not described in these operating instruction.

A list of spare parts with an exploded drawing is available on the Internet at www.gd-elmorietschle.com.

Observe the following when **returning** pump-motor unit:

- The pump-motor unit must be delivered complete, i.e. not dismantled.
- The pump-motor unit may not present a danger to the workshop personnel.
  Each pump motor unit on delivery to the workshop must be accompanied with a fully completed "Statement on health safety and on the protection of the environment", Pg. 29.
- The original rating plate of the pump-motor unit must be properly mounted, intact and legible.
  All warranty claims are voided for pump-motor units delivered for a damage expertise without the original rating plate or with a destroyed original rating plate.
- In case of warranty claims, the manufacturer must be informed of the operating conditions, operating duration etc. and additional detailed information provided on request if necessary.

10 Disposal

Have the entire pump-motor unit scrapped by a suitable disposal company. No special measures are required when doing so.
For additional information on disposing of the unit, ask the Service Department.

11 Explosion-Protected Design

An additional set of operating instructions with supplementary or specific information is provided with these pump-motor units.

EU declaration of conformity

Manufacturer:	Gardner Denver Deutschland GmbH Industriestraße 26 97616 Bad Neustadt Germany
Responsible for documentation:	Holger Krause Industriestraße 26 97616 Bad Neustadt Germany
Designation:	G series Side channel blower G-BH1, G-BH9 Types 2BH1 1 2BH1 2 2BH1 3 2BH1 4 2BH1 5 2BH1 6 2BH1 8 2BH1 9 2BH9 23

The side channel blower described above meets the following applicable Community harmonisation legislation:

2004/108/EC[*)]	Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC
2006/42/EC	Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC The protection targets of the directive 2006/95/EC have been met

Harmonised standards applied:

EN 1012-1:2010	Compressors and vacuum pumps - Safety requirements - Part 1: Air compressors
EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps - Safety requirements - Part 2: Vacuum pumps
EN ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines Part 1: General requirements

Bad Neustadt, 26.09.2011
(Place and date of issue)
Thomas Kurth, Managing Director
(Name and function)

(Signature)

[*)] Only applicable for version with frequency converter 2FC

664.44434.40.000

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Gardner Denver

Statement on health safety and on the protection of the environment

- For the safety of our employees and to comply with statutory requirements on handling substances harmful to the health and the environment, this statement must be enclosed, fully completed, with **each** unit/system sent.
- **Without the fully completed statement, repair/disposal is not possible and delays are unavoidable!**
- The statement is to be completed and signed by suitably qualified, authorised personnel at the operating organisation.
- In the case of shipment to Germany, the statement is to be completed in German or English.
- The statement is to be attached to the outside of the packing on shipment.
- If necessary, the carrier is to be informed.

1. **Product designation (type):** .....
2. **Serial number (no. BN):** .....
3. **Reason for sending:** .....
4. **The unit/system**
   - ☐ has **not** come into contact with hazardous substances. There will be **no** hazards for personnel or the environment during repair/disposal. Continue with "6. Legally binding statement“
   - ☐ has come into contact with hazardous substances. Continue with "5. Information on the contamination“
5. **Information on the contamination** (if necessary provide more information on an additional sheet)
   The unit/system was used in the following application:

   .....

   and has come into contact with the following classifiable substances or substances presenting a hazard to health/environment:

Trade name:	Chemical designation:	Hazardous substance class:	Properties (e.g. toxic, inflammable, caustic, radioactive):

   - ☐ The unit/system has been emptied in accordance with the operating instructions, flushed and cleaned externally.
   - ☐ Safety data sheets in accordance with the applicable regulations are enclosed (..... sheet).
   - ☐ The following safety precautions are necessary for handling (e.g. personal protective equipment):

     .....

     .....
6. **Legally binding statement**
   I herewith guarantee that the details specified are true and complete and that I, as signatory, am in a position to judge that this is so.
   We are aware that we are liable to the contractor for any damages arising from incomplete or incorrect specifications. We are obliged to indemnify the contractor against claims for damages by third parties arising from incomplete or incorrect specifications. We are aware that, irrespective of this statement, we are directly liable to third parties - in particular including the contractor's employees tasked with repair/disposal.

Company/institute:	.....		
Name, position:	.....	Phone:	.....
Street:	.....	Fax:	.....
Post code, city:	.....		
Country:	.....	Stamp:	
Date, signature:	.....		

© Gardner Denver Deutschland GmbH
P.O. box 1510
97605 Bad Neustadt
Phone: +49 7622 392 0
Fax: +49 7622 392 300
E-mail: er.de@gardnerdenver.com
Internet: www.gd-elmorietschle.com
610.00250.40.905
10.2009
English

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Elmo Rietschle
A Gardner Denver Product

www.gd-elmorietschle.de
er.de@gardnerdenver.com

Gardner Denver
Schopfheim GmbH
Roggenbachstraße 58
79650 Schopfheim · Deutschland
Tel. +49 7622 392-0
Fax +49 7622 392-300

Gardner Denver
Deutschland GmbH
Industriestraße 26
97616 Bad Neustadt · Deutschland
Tel. +49 9771 6888-0
Fax +49 9771 6888-4000

Gardner Denver

Elmo Rietschle is a brand of Gardner Denver's Industrial Products Group and part of Blower Operations.

B-7911 - Blower, Cincinnati LM-4, 4.3" X 2.9" Width Alum wheel
B7914 - Blower, Cincinnati, LM-6, Direct drive

cincinnati fan

Form: OMM-01-0509
Effective: 5/4/09
Supersedes OMM-01-0207
Part No.: 01218

Installation, Safety, Operation & Maintenance Instructions And Parts List

For Models PB, PBS, SPB, LM and LMF.

Arrangement 4 Blowers

NOTE

READ ENTIRE MANUAL, INCLUDING "SECTION IV. INITIAL UNIT STARTUP" BEFORE ATTEMPTING TO INSTALL AND OPERATE THIS EQUIPMENT.

BLOWER SPECIFICATIONS

BLOWER SERIAL NUMBER: _____ **MFG. DATE:** _____

NOTE: The serial number above is a required reference for any assistance. It is stamped on the blower nameplate.

BLOWER SPECIFICATIONS:

Model: _____ **Arrangement:** _____ **Rotation:** _____ **Discharge:** _____

Nominal Inlet Size: _____ (in Inches) **Wheel Size and Type:** _____

BLOWER PERFORMANCE DATA: (If entered on order)

CFM: _____ **SP:** _____ (Inches of Water Gauge) **Motor BHP:** _____

Density: _____ **Altitude:** _____ (Ft. above S.L.) **Airstream Temperature:** _____**°F.**

Fan RPM: _____ **Maximum Safe Fan RPM:** _____ **DO NOT EXCEED THIS RPM**

MOTOR DATA: (This section is completed only if the motor was supplied by Cincinnati Fan)

HP: _____ **RPM:** _____ **Voltage:** _____ **Phase:**_____

Hz: _____ **Frame Size:** _____ **Enclosure:** _____ **Efficiency:** _____

IF Motor is EXP, Class(es) & Group(s) are:_____

Manufacturers Model Number: _____ **CFV Part Number:** _____

ATTENTION: RECEIVING DEPARTMENT

All Cincinnati Fan products are packaged to minimize any damage during shipment. The freight carrier is responsible for delivering all items in their original condition as received from Cincinnati Fan. The individual receiving this equipment is responsible for inspecting this unit for any obvious or concealed damage. If any damage is found, it should be noted on the bill of lading before the freight is accepted and the receiver must file a claim with the freight carrier.

LONG TERM STORAGE NOTICE

If this blower will NOT be installed and put into operation within 30 days, refer to the "Long Term Storage Instructions" on pages 12 and 13. Failure to follow all applicable long term storage instructions, will void your warranty. This blower should be stored indoors in a clean, dry location.

⚠ DANGER				
Hazardous voltage can cause electrical shock and death.	High speed rotating equipment can cause severe personal injury.	Lock out/Tag out to prevent personal injury BEFORE starting ANY service or inspection.	Avoid injury. NEVER operate without ALL required safety guards in place.	Avoid injury. You MUST read and understand all instructions in this manual BEFORE installing.

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I. GENERAL

A. Unpacking:

Be careful not to damage or deform any parts of the blower when removing it from the packaging container. **All the packaging material should be kept in the event the blower needs to be returned.**

Handling:

Handling of the blower should be performed by trained personnel and be consistent with all safe handling practices. Verify that all lifting equipment is in good operating condition and has the proper lifting capacity. The blower should be lifted using well-padded chains, cables or lifting straps with spreader bars. Some blower models have lifting eye locations provided in the blower base. **NEVER lift the blower by an inlet or discharge flange, motor shaft, motor eye bolt, or any other part of the blower assembly that could cause distortion of the blower assembly.**

B. Safety Instructions & Accessories:

1. **Safety Instructions:**
   All installers, operators and maintenance personnel should read AMCA Publication 410-96, **"Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans".** This manual is included with the blower. Additional copies can be requested by writing us at Cincinnati Fan, 7697 Snider Rd., Mason, OH 45040-9135
2. **Sound:**
   Some blowers can generate sound that could be hazardous to personnel. It is the responsibility of the user to measure the sound levels of the blower and/or system, determine the degree of personnel exposure, and comply with all applicable safety laws and requirements to protect personnel from excessive noise.

3. Air Pressure and Suction:

In addition to the normal dangers of rotating machinery, the blower can present additional hazards from the suction or pressure created at the blower inlet or discharge. Suction at the blower inlet can draw materials into the blower where they become high velocity projectiles at the discharge and cause severe personal injury or death. It can also be extremely dangerous to persons in close proximity to the inlet or discharge as the forces involved can overcome the strength of most individuals.

⚠ WARNING

NEVER OPERATE A BLOWER WITH A NON-DUCTED INLET AND/OR DISCHARGE. IF THE BLOWER INLET AND/OR DISCHARGE IS NON-DUCTED, IT IS THE USERS RESPONSIBILITY TO INSTALL AN INLET AND/OR DISCHARGE GUARD.

4. Temperature:

Many blowers, blower components and all motors operate at temperatures that could burn someone if they come in contact with them. If this potential hazard could exist in your installation, steps must be taken by the user to protect anyone from coming in contact with this equipment.

5. Spark Resistance; (Per AMCA Standard 99-0401-86 and ISO 13499)

⚠ DANGER

NO GUARANTEE OF ANY LEVEL OF SPARK RESISTANCE IS IMPLIED BY SPARK RESISTANT CONSTRUCTION. IT HAS BEEN DEMONSTRATED THAT ALUMINUM IMPELLERS RUBBING ON RUSTY STEEL CAN CAUSE HIGH INTENSITY SPARKS. AIR STREAM MATERIAL AND DEBRIS OR OTHER SYSTEM FACTORS CAN ALSO CAUSE SPARKS.

6. Safety Accessories;

Guards:

All moving parts must be guarded to protect personnel. Safety requirements can vary, so the number and types of guards required to meet company, local, state and OSHA regulations must be determined and specified by the actual user or operator of the equipment.

NEVER start any blower without having all required safety guards properly installed. All blowers should be checked on a regular schedule, for missing or damaged guards. If any required guards are found to be missing or defective, the power to the blower should be immediately turned off and locked out in accordance with OSHA regulations. Power to the blower should NOT be tuned back on until the required guards have been repaired or replaced.

This blower can become dangerous due to a potential “windmill” effect, even though all electrical power has been turned off or disconnected. The blower wheel should be **carefully** secured to prevent any rotational turning ***BEFORE*** working on any parts of the blower/motor assembly that could move.

7. Access or Inspection Doors:

⚠ DANGER

NEVER OPEN ANY ACCESS OR INSPECTION DOORS WHILE THE BLOWER IS OPERATING. SERIOUS INJURY OR DEATH COULD RESULT FROM THE AFFECTS OF AIR PRESSURE, AIR SUCTION OR MATERIAL THAT IS BEING CONVEYED. DISCONNECT OR LOCK OUT POWER TO THE BLOWER AND LET THE BLOWER WHEEL COME TO A COMPLETE STOP *BEFORE* OPENING ANY TYPE OF ACCESS OR INSPECTION DOOR.

II. INSTALLATION

A. Vibration:

Before any mounting method is selected, the user should be aware of the effects vibration will have on the blower, motor and other parts. Improper blower installation can cause excessive vibration causing premature wheel and/or motor bearing failure, that is not covered under warranty. Vibration eliminator pads, springs or bases should be properly installed to prevent any blower vibration from transmitting to the foundation, support structure or ducting.

⚠ WARNING

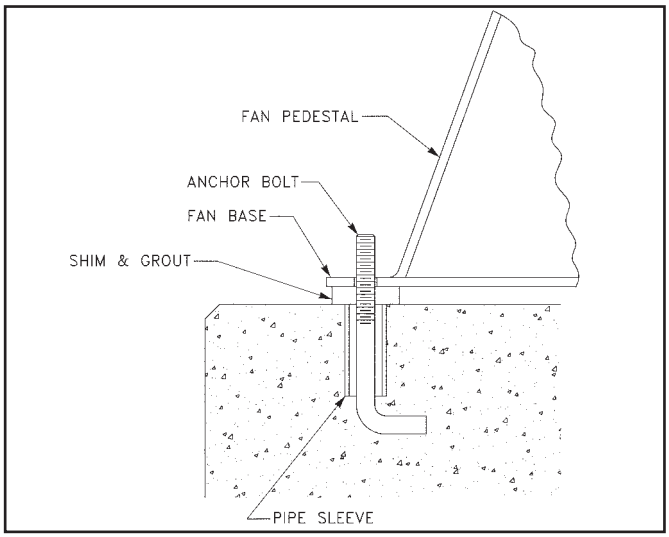
SHUT THE BLOWER DOWN IMMEDIATELY IF THERE IS ANY SUDDEN INCREASE IN VIBRATION.

B. Mounting Methods:

1. Floor Mounted Units;

Centrifugal blowers should be mounted on a flat, level, concrete foundation weighing 2-3 times the weight of the complete blower/motor assembly. It is recommended that the foundation be at least 6 inches larger than the base of the blower. The foundation should include anchor bolts such as shown in **Fig. 1** on page 4. Place the blower over the anchor bolts and shim under each bolt until the blower is level. After shimming, flat washers, lock washers and lock nuts should be tightened at each anchor bolt. Any gaps between the blower base and the foundation should be grouted. If the blower will be sitting on some type of vibration pads or mounts, follow the recommended mounting procedures supplied with the vibration elimination equipment.

Fig. 1



2. Elevated Units;

Improper mounting of elevated blowers can cause vibration problems. The structure that the blower/motor assembly will be mounted on must be strong enough to support at least 3 times the weight of the entire blower/motor assembly. **An insufficient support will cause excessive vibration and lead to premature wheel and/or motor bearing failure**. Bracing of the support structure must be sufficient enough to prevent any side sway. The entire structure should be welded at all connection joints to maintain constant alignment of the platform.

⚠ DANGER

THE IMPROPER DESIGN OF AN ELEVATED PLATFORM STRUCTURE COULD RESULT IN A RESONANT CONDITION, AND CONSEQUENTLY, CAUSE A LIFE THREATENING, CATASTROPHIC, STRUCTURAL FAILURE.

C. Duct Work Connections:

All duct connections to the blower should include flexible connectors between the ducting and the blower inlet and/or discharge. This will eliminate distortion, noise and vibration from transmitting to the duct and building. The connectors should be selected to handle the operating conditions for air volume and pressure that the blower will produce. **All ducting or accessories, added by the user, should be independently supported. DO NOT use the blower/motor assembly to support any additional weight.** Inlet and/or discharge duct elbows should be located a minimum of 2 blower wheel diameters from the blower. Any duct elbows located closer than 2 wheel diameters to the blower inlet or discharge **WILL** reduce the air performance and blower efficiency. Any duct elbows near the blower discharge should be in the **same rotational direction** as the **blower rotation**.

Non-Ducted Blower Inlet:

Any blower with no ducting on the inlet **must** have an inlet guard. The blower should be located so the blower inlet is, at least, 1 wheel diameter away from any wall or bulkhead to eliminate a reduction in air flow.

Non-Ducted Blower Discharge:

Any blower with no ducting on the discharge **must** have a discharge guard.

D. Safety Guards:

Cincinnati Fan offers guards, as optional, to keep your blower in compliance with OSHA safety regulations. These include inlet or discharge guards. Any blowers built with high temperature construction, a “heat slinger guard” is standard. It is the responsibility of the user to make sure this blower meets all local, state and OSHA safety regulations. If you have a specific guard requirement not covered by OSHA, please contact the local Cincinnati Fan sales office for assistance.

E. Dampers and Valves: (Airflow control devices)

If the blower is supplied with any type of air flow control device, it should be closed before initial start-up of the blower to minimize overloading of the motor. Any airflow control device, with bearings, should be maintained in accordance with the manufacturers instructions. Any air flow control device, with an automatic control mechanism, should be adjusted per the manufacturers recommendations.

F. Set Screw and Taper-lock Bushing Torque Values:

All blower wheel set screws are tightened to the proper torque prior to shipment. Some wheels may have taper-lock hubs and split, taper-lock bushings to secure the wheel to the motor shaft.

NOTE: Check all set screw or taper-lock bushing torques. Forces encountered during shipment, handling, rigging and temperature can affect factory settings. For correct torque values, see **Tables 1** and **2** below.

Table 1

SET SCREW TORQUE VALUES		
Diameter & Number of Treads/Inch	**Hex Wrence Size (Across Flats)**	**Required Torque (Inch Pounds)**
1/4-20	1/8"	65
5/16-18	5/32"	165
3/8-16	3/16"	228
7/16-14	7/32"	348
1/2-13	1/4"	504
5/8-11	5/16"	1104

Table 2

TORQUE VALUES FOR TAPER-LOCK BUSHINGS	
Taper-lock Bushing Size	**Required Torque (Inch Pounds)**
H	95
B	192
P	192
Q	350
R	350

⚠ CAUTION

Set screws should NEVER be used more than once. If the set screws are loosened, they MUST be replaced. Use only knurled, cup-point, set screws with a nylon locking patch.

III. ELECTRICAL

A. Disconnect Switches:

All blower motors should have an independent disconnect switch located in close visual proximity to turn off the electrical service to the blower motor. **Disconnects must be locked out in accordance with OSHA "lock out-tag out" procedures any time inspection or maintenance is being performed on the blower and/or motor assembly. The "lock out-tag out" procedure should be performed by a licensed electrician or authorized personnel.** All disconnects should be sized in accordance with the latest NEC codes (National Electric Codes) and any local codes and should be installed only by a licensed electrician. "Slow blow" or "time delay" fuses or breakers should be used since the initial start-up time for the blower motor, although rare, can be up to 10 seconds.

B. Motors:

⚠ DANGER

ALL WIRING CONNECTIONS, INSPECTION AND MAINTENANCE OF ANY MOTOR MUST BE PERFORMED BY A LICENSED ELECTRICIAN IN ACCORDANCE WITH THE MOTOR MANUFACTURERS RECOMMENDATIONS, ALL ELECTRICAL CODES AND OSHA REGULATIONS. FAILURE TO PROPERLY INSTALL, MAKE WIRING CONNECTIONS, INSPECT OR PERFORM ANY MAINTENANCE TO A MOTOR CAN RESULT IN MOTOR FAILURE, PROPERTY DAMAGE, EXPLOSION, ELECTRICAL SHOCK AND DEATH.

1. **DO NOT connect or operate a motor without reading the motor manufacturers instructions supplied with the blower.** The basic principle of motor maintenance is: **KEEP THE MOTOR CLEAN AND DRY.** This requires periodic inspections of the motor. The frequency of the inspections depends on the type of motor, the service and environment it will be subjected to and the motor manufacturers instructions.
2. **Cleaning:** Cleaning should be limited to exterior surfaces only. **Follow motor manufacturers cleaning instructions.**
3. **Lubrication:** Most small motors have sealed bearings that are permanently lubricated for the life of the motor. Some larger motors have grease plugs that should be replaced with grease fittings to perform re-lubrication. These motors, or any motor with grease fittings, should be lubricated in accordance with the motor manufacturers recommendations. Lubrication frequency depends on the motor horsepower, speed and service. **BE SURE** you use compatible grease and **DO NOT** over grease.
4. **Location:** If the motor will be outside and subjected to the weather, it is recommended that a weather cover be installed to keep rain and snow off of the motor. No motors are guaranteed to be "watertight". Be careful to allow enough openings between the motor and the motor cover to let the motor "breath". If the back end of the motor is covered, the cover should be no closer than 3" to the back of the motor for proper ventilation.

5. **Wiring Connections:** All wiring connections should be made for the proper voltage and phase as shown on the motor nameplate. Connections should follow the motor manufacturers recommendations as shown on the wiring schematic. This wiring diagram will be located on the outside of the motor, inside of the motor conduit box or on the motor nameplate. **Reversing some wires might be necessary to get the correct blower rotation.**
6. **Motors with Thermal Overload Protection:** If a motor is equipped with thermal overloads, the thermal overload must be wired per the wiring schematic to be operable. ***There are 3 types of thermal overloads:***
   a. **Automatic:** These will automatically shut the motor down if the internal temperature exceeds the design limits.

⚠ DANGER

MAKE SURE YOU LOCK OUT THE POWER TO THE MOTOR BEFORE INSPECTING ANY MOTOR WITH AUTOMATIC THERMALS. WHEN THE THERMALS COOL DOWN, THEY WILL ALLOW THE MOTOR TO AUTOMATICALLY START UP AGAIN, UNLESS YOU HAVE LOCKED OUT THE POWER TO THE MOTOR.

   b. **Manual:** These motors will have a button on them. If the motor overheats, it will shut down. After you have inspected the motor and eliminated the over heating problem, you will need to "reset" it by pushing the button. **You should still lock out the power BEFORE inspecting the motor.**
   c. **Thermostats:** This type of thermal is a temperature sensing device **ONLY**. If the motor overheats, the thermostats will open or close (depending on the type) and send a **"signal"** to the electrical box. ***THEY WILL NOT TURN THE MOTOR OFF.*** **These are pilot circuit devices that must be connected to the magnetic starter circuit.**

7. **EXPLOSION PROOF Motors:** No motor is explosion proof. Explosion proof (EXP) motors are designed so if there is an explosion **WITHIN** the motor, the explosion will be **CONTAINED INSIDE** the motor and not allowed to get out to the atmosphere. All explosion proof motors must be selected based on the atmosphere and/or the environment the motor will be operating in. Explosion proof motors are designed, rated, and labeled for their operating conditions based on Classes, Groups and "T" Codes. **The Class, Group and "T" Code of an EXP motor MUST be selected based on the atmosphere and/or environmental conditions the motor will be operating in. Consult the NEC (National Electric Code) and the NFPA (National Fire Protection Association) for the proper EXP motor Class, Group and "T" Code required for your specific application and location.**

⚠ DANGER

IF AN EXPLOSION PROOF MOTOR IS USED IN AN AREA CONTAINING VOLITILE LIQUIDS, GASES, FUMES OR DUST FOR WHICH THE MOTOR WAS NOT DESIGNED TO OPERATE IN, AN EXPLOSION AND/OR FIRE CAN OCCUR.

NOTICE:

   a. **All EXP motors have some type of thermal overload as required by UL (Underwriters Laboratories). Refer to all of Section 6 above.**
   b. **All EXP motors are required to have the UL (Underwriters Laboratories) and CSA (Canadian Standards Association) listing numbers on the motor name plate or on a separate plate attached to the motor. The Class, Group and "T" Code the motor is designed for must also be listed.**

8. **Normal Motor Operating Temperatures:**
   Using your hand to test the normal running temperature of a motor can be a very painful experience;
   The normal operating temperature of a fully loaded, open type, electric motor operating in a 70°F. (21° C.) ambient temperature is 174°F. (79° C.)

C. Maximum Blower Speed and Motor Speed Controllers:

If you will be using any type of motor speed controller with this blower, **DO NOT** exceed the **maximum safe blower speed**. Installing and using a speed control device requires special training and certification as required by the speed control manufacturer. See the manufacturers instructions for proper use, installation and wiring connections for the maximum speed settings. It may also be necessary to "block out" some speeds to eliminate a resonant vibration problem. The maximum safe blower speed is shown on the data sheet shipped with the blower. If you have lost the data sheet, contact Cincinnati Fan or our sales office for your area. You must have the serial number from the **blower** name plate for us to determine the maximum safe blower speed. Cincinnati Fan will only extend the motor manufacturers warranty, when used with a speed controlling device, if the motor has the words **"Inverter Duty"** marked on the motor name plate. If the motor does not have **"Inverter Duty"** marked on the motor name plate, and you have a motor failure, you will be required to contact the motor manufacturer for any service or warranty claims.

IV. INITIAL UNIT STARTUP

NOTICE: Failure to complete and document all the following pre-startup and both post-startup checks, listed in sections A (below) and B on page 8, could void all warranties.

A. Pre-Startup & Post-Startup Checks: (Check blocks as each step is completed. Retain this for your records.)

A1. Pre-Startup Checks Completed By: _____ DATE: _____

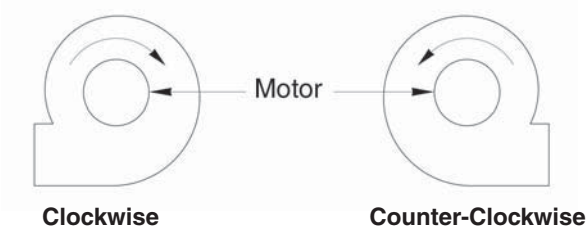
A2. 8 Hour, Post-Startup Checks Completed By: _____ DATE: _____

A3. 3 Day, Post-Startup Checks Completed By: _____ DATE: _____

MAKE SURE POWER TO THE MOTOR IS LOCKED OUT BEFORE STARTING PRE-STARTUP OR POST-STARTUP CHECKS.

1. ☐☐☐ If possible, *CAREFULLY* spin the blower wheel by hand to ensure it rotates freely and no rubbing or clicking noise is heard.
2. ☐☐☐ Check all blower, foundation and duct work hardware to make sure it is tight.
3. ☐☐☐ Check all blower wheel set screws to make sure they are tight per **Table 1** on page 5.
4. ☐☐☐ If the wheel has a taper-lock bushing, make sure the bolts are tightened per **Table 2** on page 5.
5. ☐☐☐ Make certain there is no foreign material in the blower or duct work that can become a projectile.
6. ☐☐☐ Make sure any inspection doors in the duct work are securely bolted or locked.
7. ☐☐☐ Ensure all electrical power components are properly sized and matched for your electrical system.
8. ☐☐☐ Check that all required guards are properly secured.
9. ☐☐☐ Any dampers should be fully opened and closed to make sure there is no binding or interference.
10. ☐☐☐ If your blower is mounted on an elevated support structure, make sure the structure is welded at all the joint connections and the structure is properly braced to prevent “side sway”.
11. ☐☐☐ Close any dampers to minimize load on motor. Especially on blowers with high temperature construction. **Never** subject a “cold” blower to a “hot” gas stream. If the blower will be handling “hot gases” greater than 150°F (65°C) it is imperative that the blower be subjected to a gradual rate of temperature increase, not to exceed 15°F/minute (8°C/minute). The same temperature limits are also important when the blower is experiencing a drop in temperature until the temperature drops down to 150°F (65°C). Only, when the entire blower has reached an equilibrium temperature of 150°F (65°C), or less, should the power be turned off.
12. ☐☐☐ Make sure the power source connections to the blower motor are per the motor manufacturers instructions.
13. ☐☐☐ Make sure the blower wheel is stationary prior to startup. **Starting a blower with a wheel that is rotating backwards can cause wheel damage.**
14. ☐☐☐ Apply power to the blower motor momentarily (i.e. “bump start”) to check for proper blower wheel rotation. If the blower is rotating in the wrong direction, reconnect the motor leads per the motor manufacturers wiring schematic. **Blower rotation is determined by viewing the blower from the motor side of the blower, NOT from the inlet side**. After reconnecting the leads, repeat this step. **See Fig. 2 below.**

Fig. 2



Clockwise (CW) Rotation **Counter-Clockwise (CCW) Rotation**

15. ☐☐☐ Apply power to the blower motor and let it come up to full speed. **Turn off the power.** Look and listen for any unusual noise or mechanical abnormality while the blower wheel is still spinning. If any are noticed, lock out the power, wait for the blower wheel to come to a complete stop, locate the cause and correct it.
16. ☐☐☐ Unlock power and start the blower.
17. ☐☐☐ Measure, record and keep the following motor data for future reference and comparison:
(Single phase motors will only have L1 and L2 leads)

Amperage draw on each motor lead: L1 _____ L2 _____ L3 _____
(Running amps **SHOULD NOT** exceed the motor nameplate amps for the voltage being operated on)

Voltage coming to motor leads: L1_____ L2_____ L3_____
(Should be about the same input voltage on all leads)

B. Vibration:

The blower was balanced at the factory to comply with ANSI/AMCA Standard 204-05, Category BV-2. However, rough handling in shipment and/or erection, weak and/or non-rigid foundations, and misalignment may cause a vibration problem after installation. After installation, the vibration levels should be checked by personnel experienced with vibration analysis and vibration analysis equipment.

NOTE:

The blower SHOULD NOT be operated if the vibration velocity of the fan exceeds 0.50 inches per second, filter out, if the blower is rigidly mounted. If the blower is mounted on isolators or on an isolator base, it SHOULD NOT be operated if the vibration velocity of the blower exceeds 0.75 inches per second, filter out.

Vibration readings for direct driven blowers should be taken on the motor at the top, sides and end as per **Fig. 3** below. After you have taken your vibration readings, write them down in the spaces below and keep for future comparison.

⚠ DANGER

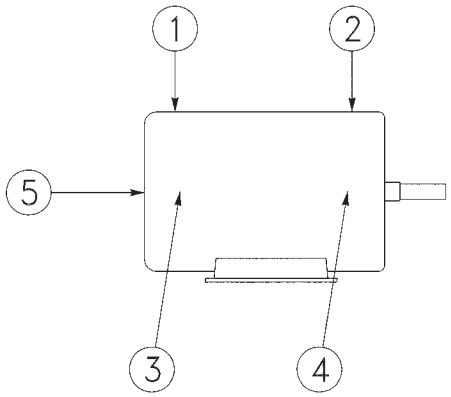
If the blower is going to be conveying material, it is the users responsibility to periodically turn the blower off and lock out the power. The blower wheel should then be checked for material build-up and/or erosion. If material has built up on any parts of the wheel, it MUST be removed and cleaned before it is put back into service. If any parts of the wheel have been eroded, the wheel MUST be replaced. Failure to perform this inspection can cause excessive vibration that will damage the blower and/or motor bearings. When vibration becomes excessive, it will lead to complete blower failure that could cause property damage, severe personal injury and death. The user must determine the frequency of this inspection based on the actual circumstances of their operation, BUT checking the vibration readings should NEVER exceed a 12 month period. For the AMCA/ANSI standard for vibration limits, see Fig. 4 on page 9.

Fig. 3

VIBRATION METER PROBE POSITIONS

For Arrangement 4 Blowers

	1	2	3	4	5
A					
B					
C					

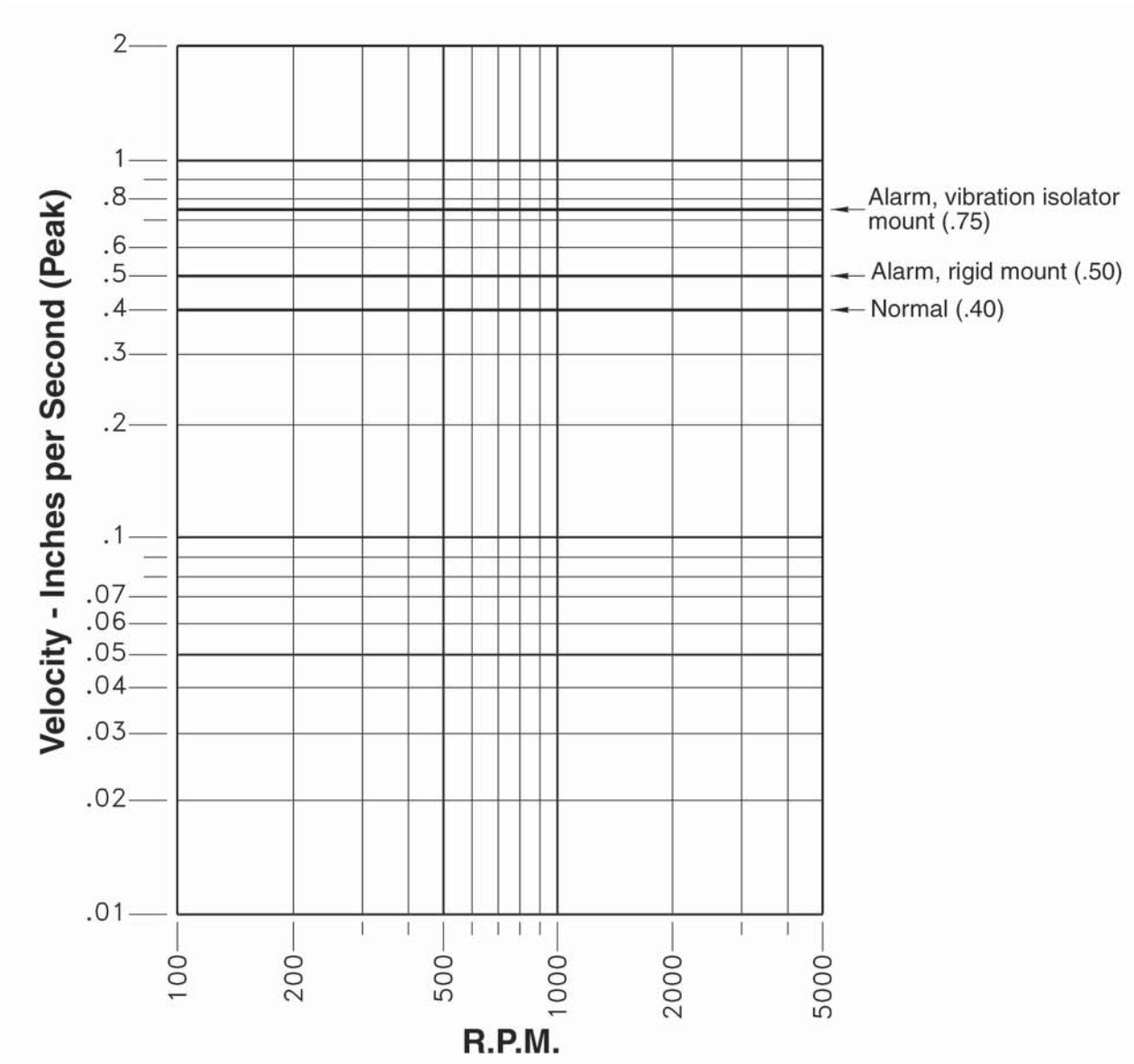


A Pre-Startup ..... Readings taken by: _____ **Date:** _____

B 8 Hour Post-Startup ..... Readings taken by: _____ **Date:** _____

C 3 Day Post-Startup ..... Readings taken by: _____ **Date:** _____

Fig. 4 Vibration Severity Chart



V. ROUTINE INSPECTION & MAINTENANCE

Periodic inspection of all the blower parts is the key to good maintenance and trouble-free operation. The frequency of inspections must be determined by the user and is dependent upon the severity of the application. **BUT,** it should **NEVER** exceed a 12 month period. The user should prepare an inspection and maintenance schedule and make sure it is adhered to.

⚠ WARNING

BEFORE STARTING ANY INSPECTION OR MAINTENANCE, BE SURE BLOWER IS TURNED OFF, POWER IS LOCKED OUT AND THE BLOWER WHEEL HAS BEEN CAREFULLY SECURED TO PREVENT WIND MILLING. IF THE OPERATING CONDITIONS OF THE BLOWER ARE TO BE CHANGED (SPEED, PRESSURE, TEMPERATURE, ETC.) CONSULT CINCINNATI FAN, OR OUR SALES OFFICE FOR YOUR TERRITORY, TO DETERMINE IF THE UNIT WILL OPERATE SAFELY AT THE NEW CONDITIONS.

A. Hardware:

All blower and foundation hardware should be checked to make sure it is tight. Wheel set screws or taper-lock bushings should be tightened to the torque values shown in **Tables 1 and 2** on page 5.

NOTE: If any set screws have come loose, they must be thrown away and replaced. **NEVER** use set screws more than once. **Replace with knurled, cup-point set screws with a nylon locking patch.**

B. Motor Bearing Lubrication:

1. Motor Bearings:

Most smaller motors have sealed bearings that never require re-lubrication for the life of the motor. For any motors with grease fittings, consult the motor manufacturers recommendations with reference to the lubrication frequency and the type of grease that should be used.

DO NOT over grease the motor bearings. Generally, 1-2 shots should be enough. Use a hand operated grease gun at no more than 40 PSI. ***IF POSSIBLE, CAREFULLY*** **lubricate the motor bearings while the motor is running.**

C. Wheel Balance:

All blower wheels are balanced at the factory. It is not uncommon that additional "trim balancing" is required after the blower is assembled. Trim balancing of the blower assembly, in the field, is typically always necessary for all replacement wheels. **After any wheel is installed, the final balance of the entire blower assembly should be checked.** Refer to Section B on page 8 and Fig. 4 on page 9. Air stream material or chemicals can cause abrasion or corrosion of the blower parts. This wear is generally uneven and, over time, will lead to the wheel becoming unbalanced, causing excessive vibration. When that happens, the wheel must be rebalanced or replaced. The other air stream components should also be inspected for wear or structural damage and cleaned or replaced if necessary. **After cleaning any blower wheel, it should be balanced and then "trim balanced" on the motor shaft.**

There are three ways to balance a blower wheel:

1. **Add balancing weights for fabricated aluminum, steel or stainless steel wheels:**
   Balance weights should be rigidly attached to the wheel at a location that will not interfere with the blower housing nor disrupt air flow. They should (if at all possible) be welded to the wheel. When trim balancing the wheel, **on the blower,** be sure to ground the welder **directly** to the blower wheel. Otherwise, the welding current will likely pass through the motor and damage the motor bearings.
2. **Grinding off material for cast aluminum wheels:**
   If you are grinding on the wheel to remove material, be very careful not to grind too much in one area. That could affect the structural integrity of the wheel.
3. **Forward curved wheels, Model LM only (also known as squirrel cage or multivane wheels).**
   These wheels have balancing clips attached to individual blades around the wheel. That is the only proper way to balance this type of wheel.
   NOTE:
   Removing any forward curve wheel from the blower to clean it, requires special attention when reinstalling the wheel back into the blower housing. Make sure you reinstall the wheel so the proper wheel-to-inlet clearance is maintained. Failure to do this will affect the blowers airflow (CFM), static pressure (SP) capabilities and efficiency. Consult Cincinnati Fan or our local sales office for your area for assistance if necessary.

D. Vibration:

As mentioned previously in this manual, excessive vibration can cause premature motor bearing failure that could lead to catastrophic failure of the blower. After performing any routine maintenance, the vibration readings should be taken again. New readings should be taken (maximum every 12 months) and compared to the readings you recorded in **Figure 3**, on page 8, during the initial startup. **If any major differences are present, the cause should be determined and corrected before the blower is put back into operation.**

The most common causes of vibration problems are:

1. Wheel unbalance.
2. Mechanical looseness.
3. Poor blower inlet and/or discharge conditions.
4. Foundation stiffness.

E. Dampers and Valves: (Airflow control devices)

Turn off and lock out power to the blower motor. Any dampers or valves should be periodically inspected to make sure all parts are still operable within their full range and there is no interference with any other damper or blower components. Any bearings or seals should be checked for their proper function. The manufacturers maintenance instructions should be followed.

F. Safety Equipment & Accessories:

It is the users responsibility to make sure that all safety guards required by the company, local, state and OSHA regulations are properly attached and fully functional at all times. If any guards become defective or non-functional at any time, **the power to the blower MUST be turned off and locked out** until complete repairs and/or replacements have been made, installed and inspected by authorized personnel.

Any accessories used in conjunction with the blower should also be inspected to make sure they are functioning within their intended limits and design specifications. The manufacturers maintenance manuals should be referred to for correct maintenance procedures. These accessories include, but are not limited to, the following:

Shaft seals, inspection doors, vibration isolators or vibration bases, air flow or pressure measuring equipment, hoods, controls, special coatings, silencers, expansion joints, valves, flexible connectors and filters.

VI. ORDERING REPLACEMENT PARTS:

Under normal conditions, you should not need any spare or replacement parts for at least 24 months after shipment from Cincinnati Fan. That does not include any wear due to abrasion, corrosion, excessive temperatures, abuse, misuse, accident or any severe conditions the fan was not designed for.

NOTICE:

1. **If this blower is vital to any process that could cost you lost revenue, we strongly recommend that you keep a replacement blower wheel and motor at your location.**

2. **If this blower is vital for the safety of any people and/or animals, we strongly recommend that you keep a complete blower/motor assembly, as originally ordered, at your location.**

To order any parts or complete units, contact us for the name of our sales office for your area. Or you can find them on our website at: **www.cincinnatifan.com**

WE MUST HAVE THE BLOWER SERIAL NUMBER FROM THE BLOWER NAME PLATE TO IDENTIFY PARTS CORRECTLY.

VII. TROUBLESHOOTING

⚠ DANGER

Troubleshooting should only be performed by trained personnel. Any potential electrical problems should only be checked by a licensed electrician. All safety rules, regulations and procedures MUST be followed. Failure to follow proper procedures can cause property damage, severe bodily injury and death.

Potential problems and causes listed below are in no order of importance or priority. The causes are only a list of the most common items to check to correct a problem. If you find the cause of a problem, **DO NOT** assume it is the **ONLY** cause of that problem. Different problems can have the same causes.

PROBLEM	CAUSE
Excessive Vibration	1. Loose mounting bolts, wheel set screws, taper-lock hubs. 2. Worn or corroded blower wheel. 3. Accumulation of foreign material on blower wheel. 4. Bent motor shaft. 5. Worn motor bearings. 6. Motor out of balance. 7. Inadequate structural support. 8. Support structure not sufficiently cross braced. 9. Weak or resonant foundation. 10. Foundation not flat and level.
Airflow (CFM) Too Low	1. Blower wheel turning in wrong direction (**rotation**). 2. Actual system static pressure (**SP**) is higher than expected. 3. Motor speed (**RPM**) too low. 4. Dampers or valves not adjusted properly. 5. Leaks or obstructions in duct work. 6. Filters dirty. 7. Inlet and/or discharge guards are clogged. 8. Duct elbow too close to blower inlet and/or discharge. 9. Improperly designed duct work 10. Blower wheel not properly located relative to the inlet bell (**LM** Model only).
Airflow (CFM) Too High	1. Actual system static pressure (**SP**) is lower than expected. 2. Motor speed (**RPM**) too high. 3. Filter not in place. 4. Dampers or valves not adjusted properly.

PROBLEM	CAUSE
Motor Overheating	**NOTE: A normal motor will operate at 174°F. See B-8 on page 6.** 1. Actual system static pressure **(SP)** is lower than expected. 2. Voltage supplied to motor is too high or too low. 3. Motor speed (**RPM**) too high or defective motor. 4. Air density higher than expected. 5. Motor wired incorrectly or loose wiring connections. 6. Cooling fan cover on back of motor is clogged. (Fan cooled motors only.)
Excessive Noise	1. Wheel rubbing inside of housing. 2. Worn or corroded blower wheel. 3. Accumulation of foreign material on blower wheel. 4. Loose mounting bolts, wheel set screws, or taper-lock hubs. 5. Bent motor shaft. 6. Worn motor bearings. 7. Motor out of balance. 8. Motor bearings need lubrication. 9. Vibration originating elsewhere in system. 10. System resonance or pulsation. 11. Inadequate or faulty design of blower support structure. 12. Blower operating near "stall" condition due to incorrect system design or installation.
Fan Doesn't Operate	1. Motor wired incorrectly. 2. Incorrect voltage supply. 3. Defective fuses or circuit breakers. 4. Power turned off elsewhere. 5. Motor wired incorrectly or loose wiring connections. 6. Defective motor.

VIII. LONG TERM STORAGE INSTRUCTIONS: (Storage exceeding 30 days after receipt of equipment)

NOTE: Failure to adhere to these instructions voids all warranties in their entirety.

1. Storage site selection:
   a. Level, well-drained, firm surface, in clean, dry and warm location. Minimum temperature of 50°F (10°C).
   b. Isolated from possibility of physical damage from construction vehicles, erection equipment, etc.
   c. Accessible for periodical inspection and maintenance.
2. The blower should be supported under each corner of its base to allow it to "breath". Supports (2 x 4's, timbers, or railroad ties) should be placed diagonally under each corner.
3. If the equipment is to be stored for more than three (3) months, the entire blower assembly must be loosely covered with plastic, **but not tightly wrapped**.
4. Storage Maintenance:

   A periodic inspection and maintenance log, by date and action taken, must be developed and maintained for each blower. See example below. Each item must be checked monthly.

EXAMPLE:

Storage / Maintenance Schedule Log

ITEM	ACTION	DATES CHECKED
1	Re-inspect units to insure any protective devices used are functioning properly. Check for scratches in the finish which will allow corrosion or rust to form.	
2	Rotate wheel a minimum of 10 full revolutions to keep the motor bearing grease from separating and drying out. ***This is a critical step.***	

Long Term Storage instructions continued on page 13.

5. General Motor Procedure:

   If the motor is not put into service immediately, the motor must be stored in a clean, dry, warm location. Minimum temperature of 50°F. (10°C,). Several precautionary steps must be performed to avoid motor damage during storage.

   a. Use a “Megger” each month to ensure that integrity of the winding insulation has been maintained. Record the Megger readings. Immediately investigate any significant drop in insulation resistance.
   b. **DO NOT** lubricate the motor bearings during storage. Motor bearings are packed with grease at the factory.
   c. If the storage location is damp or humid, the motor windings **must** be protected from moisture. This can be done by applying power to the motor’s space heaters, (IF AVAILABLE) while the motor is in storage. If the motor does not have space heaters, storing it in a damp or humid location will, very quickly, cause internal corrosion and motor failure which is not warranted.

   ***NOTE*:**
   For specific storage instructions, for the <u>actual</u> motor and any accessory parts that were supplied, refer to the manufacturer’s instructions.

IX. LIMITED WARRANTY:

Cincinnati Fan & Ventilator Company (Seller) warrants products of its own manufacture, against defects of material and workmanship under normal use and service for a period of eighteen (18) months from date of shipment or twelve (12) months from date of installation, whichever occurs first. This warranty does not apply to any of Seller's products or any part thereof which has been subject to extraordinary wear and tear, improper installation, accident, abuse, misuse, overloading, negligence or alteration. This warranty does not cover systems or materials not of Seller's manufacture. On products furnished by Seller, but manufactured by others, such as motors, Seller extends the same warranty as Seller received from the manufacturer thereof. Expenses incurred by Purchaser's in repairing or replacing any defective product will not be allowed except where authorized in writing and signed by an officer of the Seller.

The obligation of the Seller under this warranty shall be limited to repairing or replacing F.O.B. the Seller's plant, or allowing credit at Seller's option. **THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES EITHER EXPRESSED OR IMPLIED INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND OF ALL OTHER OBLIGATIONS AND LIABILITIES OF THE SELLER. THE PURCHASER ACKNOWLEDGES THAT NO OTHER REPRESENTATIONS WERE MADE TO PURCHASER OR RELIED UPON BY PURCHASER WITH RESPECT TO THE QUALITY OR FUNCTION OF THE PRODUCTS HEREIN SOLD.**

Removal of the Sellers nameplate or any generic fan nameplate containing the fan serial number voids all warranties, either written or implied. Failure to complete and document all the pre-startup and post startup checks and perform the suggested routine maintenance checks voids all warranties, either written or implied.

LIMITATION OF LIABILITY:

Notice of any claim, including a claim for defect in material or workmanship, must be given to Seller in writing within 30 days after receipt of the equipment or other products. Seller reserves the right to inspect any alleged defect at Purchaser's facility before any claim can be allowed and before adjustment, credit, allowance replacement or return will be authorized. See **RETURNS** below. Seller's liability with respect to such defects will be limited to the replacement, free of charge, of parts returned at Purchaser's expense F.O.B. Seller's plant and found to be defective by the Seller.

IN NO EVENT WILL SELLER BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTACT, TORT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, INCLUDING WITHOUT LIMITATION DAMAGES FOR INJURY TO PERSONS OR PROPERTY, LOST PROFITS OR REVENUE, LOST SALES OR LOSS OF USE OF ANY PRODUCT SOLD HEREUNDER. PURCHASER'S SOLE AND EXCLUSIVE REMEDY AGAINST SELLER WILL BE THE REPLACEMENT OF DEFECTIVE PARTS AS PROVIDED HEREIN OR REFUND OF THE PURCHASE PRICE FOR DEFECTIVE PRODUCTS, AT SELLER'S SOLE OPTION. SELLER'S LIABILITY ON ANY CLAIM, WHETHER IN CONTRACT, TORT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, FOR ANY LOSS OR DAMAGE ARISING OUT OF OR IN CONNECTION WITH PURCHASER'S ORDER OR THE PRODUCTS OR EQUIPMENT PURCHASED HEREUNDER, SHALL IN NO CASE EXCEED THE PURCHASE PRICE OF THE EQUIPMENT GIVING RISE TO THE CLAIM.

RESPONSIBILITY:

It is the understanding of the Seller that Purchaser and/or User will use this equipment in conjunction with additional equipment or accessories to comply with all Federal, State and local regulations. The Seller assumes no responsibility for the Purchaser's or Users compliance with any Federal, State and local regulations.

RETURNS:

Cincinnati Fan & Ventilator Company assumes no responsibility for any material returned to our plant without our permission. An **RMA** (Return Material Authorization) number must be obtained and clearly shown on the outside of the carton or crate and on a packing slip. Any items returned must be shipped freight prepaid. Failure to comply will result in refusal of the shipment at our receiving department.

DISCLAIMER

This manual, and all its content herein, is based on all applicable known material at the time this manual was created. **Any parts of this manual are subject to change at any time and without notice.**

If any statements, diagrams and/or instructions contained herein, **for components not manufactured by the Seller,** conflict with instructions in the manufacturer's manual (i.e.: motors, dampers, etc.), the instructions in the manufacturer's manual, for that component take precedent.

Should you want the latest version of this manual, please contact us or our sales office for your area. Or, you can print a current version by going to our website at: **www.cincinnatifan.com**

cincinnati fan

7697 Snider Road, Mason, OH 45040-9135
Phone: (513) 573-0600 Fax: (513) 573-0640
E-Mail: sales@cincinnatifan.com

X. PARTS DRAWING:

PLEASE NOTE

Cincinnati Fan manufactures many models and arrangements with special variations. For that reason, the maintenance manuals contained on our website do not include a parts drawing nor the completed blower or fan specifications on page 1. For the parts drawing of all the standard components and specifications for the specific blower or fan that you have, please contact our local Cincinnati Fan sales office for your area.

You will need to give them the serial number shown on the blower or fan nameplate so they can supply you the correct information.

Click on ***"Contact a Sales Rep"*** on our website for the name and contact information for our local sales office for your area. **www.cincinnatifan.com**

Innovations in Water Monitoring

Operator's Manual

RDO® PRO-X Process Optical Dissolved Oxygen Probe

DO-501 - Transmitter, Dissolved Oxygen, OpticalRDO Pro-x (10m cable)

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Optical RDO PRO-X Dissolved Oxygen Probe Specifications

Optical RDO PRO-X Dissolved Oxygen Probe	
Sensor Type	Optical (luminescent) dissolved oxygen sensor
RDO PRO-X Probe	Range: 0 to 50 mg/L concentration
	Accuracy: ±0.1 mg/L, 0 to 8 mg/L ±0.2 mg/L, 8 to 20 mg/L ±10% of reading, 20 to 50 mg/L
	Resolution: 0.01 mg/L
	Response time: T90 < 45 sec; T95 < 60 sec @ 25°C
	Storage conditions: -5° to 60° C (23° to 140° F)
RDO-X Sensor Cap	Usage life: 2 years typical
	Storage conditions: 1° to 60° C (33° to 140° F), in factory container
Temperature sensor	Range: 0° to 50° C (32° to 122° F)
	Accuracy: ±0.1° C typical
	Resolution: 0.01° C
Transmitter/local display	Optional, or use with Con TROLL PRO System
Communications options	Modbus/RS485, 4-20 mA, SDI-12
Max. power consumption	50 mA at 12 VDC
Measure current	6 mA typical at 24 VDC
Idle current (no measurement or communication)	160 µA typical at 24 VDC
Maximum cable length	Up to 1,219 m (4,000 ft) (for Modbus and 4-20 mA) or up to 60.96 (200 ft) for SDI-12
Cable options	10 m fixed stripped-and-tinned; Twist-lock connector with user-selectable cable length
Internal mounting thread	1¼ - 11 ½ NPT
IP rating	IP-67 with cap off, IP-68 with cap installed
Compliance	Heavy industrial, IEC 61000-6-2:2005
Salinity compensation	Fixed or real-time capable (using controller)
Barometric pressure	Fixed or real-time capable (using controller)
Maximum pressure	150 psi from 0 to 50° C; 300 psi @ 25° C
Warranty	Probe: 3 years from date of shipment RDO-X Sensor Cap: 2 years in typical applications
Methods	Standard Methods 4500-O; In-Situ Methods 1002-8-2009,1003-8-2009, 1004-8-2009 (EPA approved)

Introduction

The RDO PRO-X Probe is a rugged, reliable instrument designed to deliver accurate dissolved oxygen (DO) data across a wide measurement range and to reduce maintenance costs. The probe features the latest optical technology for DO measurement.

System Description

The RDO PRO-X system consists of the following items.

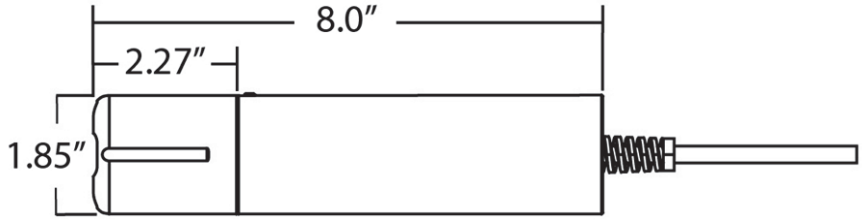
- Black probe body with removable nose cone
- Optical RDO-X Sensor Cap
- Titanium thermistor

RuggedCable System

- 10-m standard length with stripped-and-tinned ends
- Customized lengths with titanium twist-lock connectors

1	Cable end, stripped-and-tinned
2	Nose cone
3	RDO-X Sensor Cap
4	Thermistor

1	Probe
2	Cable end, twist-lock connector and RuggedCable System



Serial Numbers

The probe serial number is engraved on the side of the unit. The cap serial number is programmed on the memory chip inside the cap.

Unpack the Probe

1. Remove the probe from the box and other packaging materials.
2. Unscrew the nose cone from the probe and remove the red protective dust cap from the sensor. Save the dust cap for later use.

1	Dust cap
2	Nose cone

3. Remove the RDO cap from the storage sleeve.

4. Align the arrow on the cap with the index mark on the probe and firmly press the cap onto the probe, without twisting, until it seals over the probe body.

1	Alignment arrow on cap
2	Cap installed over lens
3	Nose cone

✔ Do not allow moisture or atmospheric humidity inside the cap. Keep the cap in its sealed package until you are ready to install it. Install promptly. Ensure that O-ring grooves are dry and that the O-ring is not rolled or pinched inside the cap.
The typical cap lifetime is two years after the first reading has been taken.

5. Reattach the nose cone.

Calibrate the RDO PRO-X Probe

Calibrate the sensor with the Comm Kit Software and the RDO PRO Communication Device, or calibrate the sensor directly with your controller.

1-Point Calibration

The optical Rugged Dissolved Oxygen sensor is very stable. The factory calibration should produce readings within 3% accuracy. If you require readings with greater accuracy we recommend that you perform a 1-point, 100% water-saturated air calibration as described below.

Water-Saturated Air

1. Remove the storage cap from the top of the calibration chamber and replace it with the vented calibration cap.

1	Storage cap
2	Vented calibration cap

Figure 6.1 Storage cap and vented calibration cap shown together

2. Place the sponge wafer in the bottom of the calibration chamber and saturate with approximately 10 mL water.
3. Gently dry the instrument and sensing material with a paper towel, making sure there is no water or debris on the instrument or on the sensing surface.
4. Place the instrument into the calibration chamber about 2.5 cm (1 in.) above the water-saturated sponge.

Figure 6.2 Calibration chamber with water-saturated sponge

5. Allow 5 to 10 minutes for temperature stabilization prior to starting the calibration procedure. Do not leave the instrument in the calibration chamber for more than 30

minutes. This can allow condensation to form on the sensing material, which will produce false low readings after calibration. If condensation does occur, remove the instrument, dry the sensing material, place the instrument in the chamber, and calibrate.

2-Point Calibration

100% and 0% Saturation

We recommend that you perform the 0 % oxygen calibration only if you intend to measure dissolved oxygen at a concentration of less than 4 mg/L.

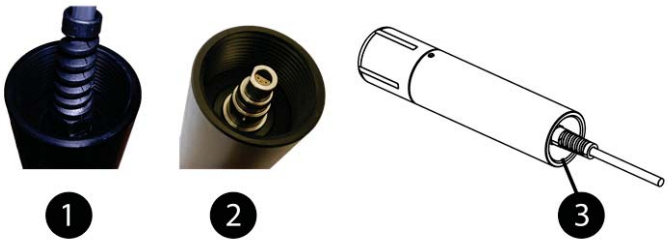
1. Set up the calibration procedure as previously described, and perform a water-saturated air calibration.
2. Remove the water-saturated sponge from the calibration chamber and fill the chamber to the fill line with approximately 60 mL of fresh sodium sulfite solution.

1	Fill line
2	Temperature sensor

2. Place the instrument into the solution. Leave at least 13 mm (0.5 in.) between the surface of the sensing material and the bottom of the chamber.
3. Ensure that the temperature sensor is completely submerged in the solution.
4. Allow at least 5 minutes for the temperature to stabilize prior to performing the calibration procedure.
5. Once calibration is complete, remove the sensor, and thoroughly rinse to remove all of the sodium sulfite.

Probe Deployment

The cable end of the RDO PRO-X Probe is internally threaded (1¼ - 11½ NPT) and can be attached to a male threaded pipe. When deployed, make sure that the nose cone and thermistor are completely submerged.



1	10 m cable attached
2	Twist-lock connector
3	1 1/4 NPT threading

Care and Maintenance

Clean the RDO-X Sensor Cap

1. The cap and nose cone must remain on the probe.
2. Rinse the sensor with clean water from a squirt bottle or spray bottle.
3. Gently wipe with a soft-bristled brush or soft cloth if biofouling is present. Use Alconox to remove grease.
4. If extensive fouling or mineral build-up is present, soak the cap end in vinegar for 15 minutes, then soak in deionized (DI) water for 15 minutes.

> ⚠ Do not use organic solvents—they will damage the sensing element. Do not remove the cap from the sensor prior to cleaning.

5. After cleaning, perform a 1- or 2-point user calibration or calibration check.

Clean the Optical Window

1. Clean the optical window only when you change the cap. See full instructions in the sensor cap replacement kit.
2. Remove the cap and gently wipe the lens with the supplied lens cloth.

> ⚠ Do not wet the lens area with water or any solution. Use only the supplied lens cloth for cleaning. Do not use any other cloth or material.

Clean the Probe

With the RDO cap installed on probe, gently scrub the probe with a soft-bristled brush or nylon dish scrubber. Use Alconox to remove grease or other matter. Soak in vinegar and DI water to remove mineral deposits or extensive fouling.

RDO-X Sensor Cap Storage

Prior to installation–Store in factory supplied container.

Installed–Store in the calibration chamber with the storage cap attached and a few drops of clean water.

Replace the RDO-X Sensor Cap

The RDO cap has a 2-year typical life after the sensor takes its first reading. Replacement caps are available from In-Situ Inc. or your authorized In-Situ distributor.

1. Remove the probe nose cone.
2. Use a lint-free cloth to remove any moisture from the probe.

3. Pull the used RDO cap off of the sensor, without twisting.
4. Remove the existing O-rings from the sensor.

> ⚠ Ensure that there is no moisture in the O-ring grooves. Do not touch or clean the lens with anything other than the supplied lens wipe.

5. Use your finger to apply a very light layer of silicone-based lubricant around the O-ring grooves.
6. Place the O-rings on the sensor. Apply another thin layer of lubricant to the O-rings and grooves.

> ✔ Note: Do not transfer grease to the lens or sensor pins.

7. Clean the sensor lens with the wipe provided in the kit and allow it to thoroughly dry. Inspect for scratches or dirt.
8. Remove the new cap from its sealed packaging and attach it to the sensor, being careful to press firmly, without twisting, until it seals over the lens. Make sure that the O-rings are not pinched or rolled between the cap and sensor.
9. Replace the nose cone.
10. Perform a 1- or 2-point calibration.

Maintain Desiccant

Desiccant installed in a controller or transceiver protects probe electronics from condensation. A desiccant pack changes color from blue to pink as it becomes saturated with moisture.

> ⚠ It is extremely important to use the proper size desiccant for your deployment and to change desiccant often. Desiccant should be changed before the entire pack has turned pink, and you should use enough to effectively keep cables and probes dry until your next scheduled maintenance. Desiccant lifespan is dependent on site conditions.

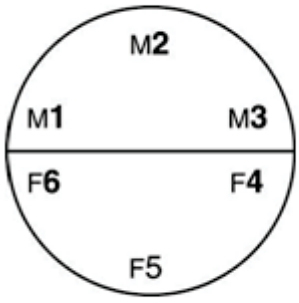
Controller Requirements and Connections

The RDO PRO-X Probe may be connected to a controller or logger for communication via the following options.

- Analog (4-20 mA) provides a configurable 4-20 mA current loop output
- SDI-12
- RS485 Modbus
- RS232 to Modbus

Wiring Overview

Refer to diagrams on the following pages. Trim and insulate unused wires. The shielded wire should be connected to a chassis ground or earth ground.

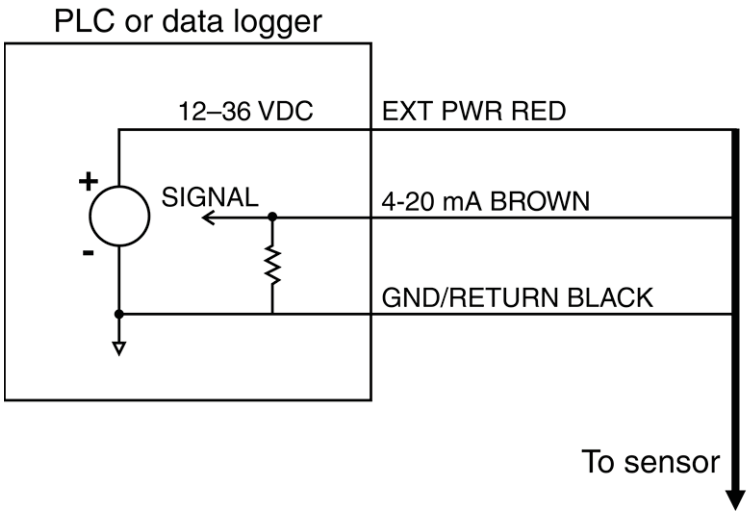


Signal	Color
Ground/Return	Black
External Power	Red
4-20 mA	Brown
RS485 (-)	Green
RS485 (+)	Blue
SDI-12	White

⚠ The inside of the controller must be kept free of moisture and humidity. Condensed moisture can migrate through the wiring and cause the probe to fail. Therefore, desiccant should be installed in the controller and be replaced on a regular basis.

Analog (4-20 mA) 3-wire

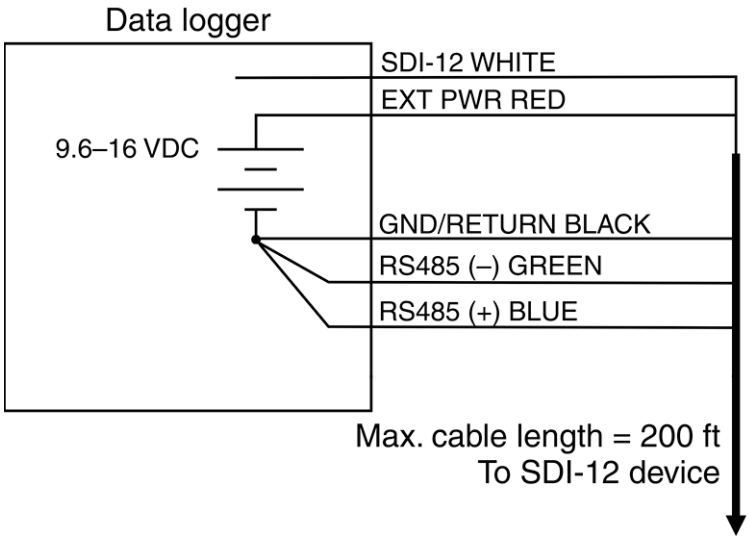
Signal	Color
Ground/Return	Black
External Power (12-36 VDC)	Red
4-20 mA	Brown



✔ Cable length must not exceed 1219 m (4000 ft.)
Analog signal must be enabled in Win-Situ 5 Software or the Comm Kit Software prior to use.

SDI-12 (3-wire)

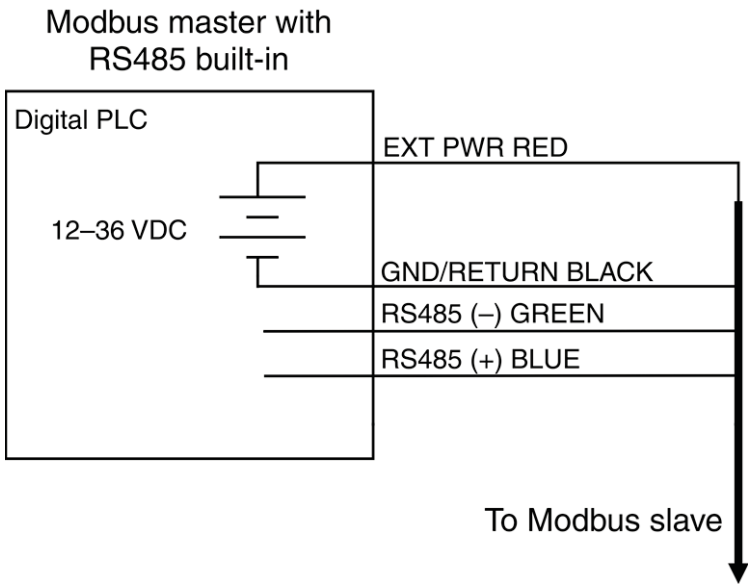
Signal	Color
Ground/Return	Black
External Power (9.6-16 VDC)	Red
RS485 (-)	Green
RS485 (+)	Blue
SDI-12	White



✔ Cable length must not exceed 60.96 m (200 ft.)

Modbus Master with Built-in RS485

Signal	Color
Ground/Return	Black
External Power (12-36 VDC)	Red
RS485 (-)	Green
RS485 (+)	Blue

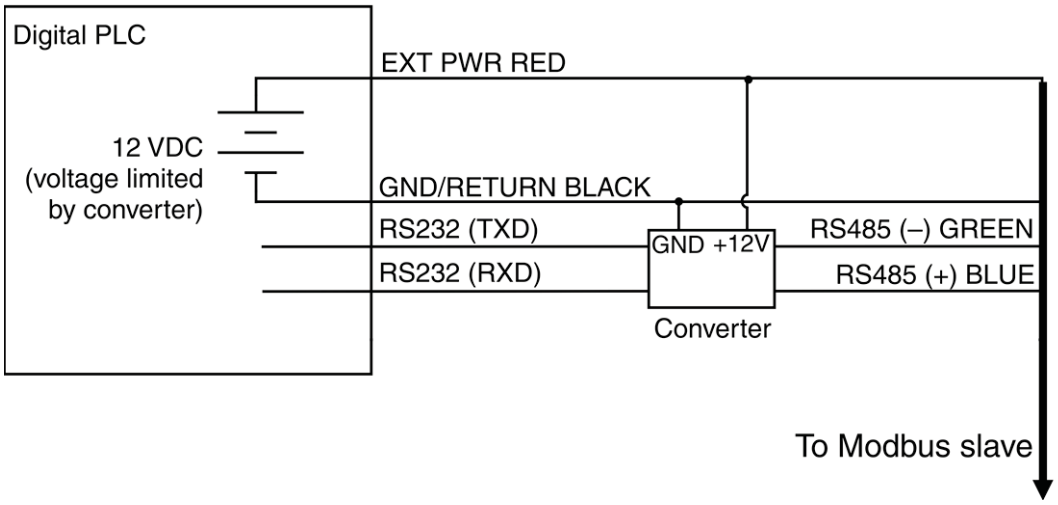


✔ Cable length must not exceed 1219 m (4000 ft.)

Modbus Master with Built-in RS232 (Converter Required)

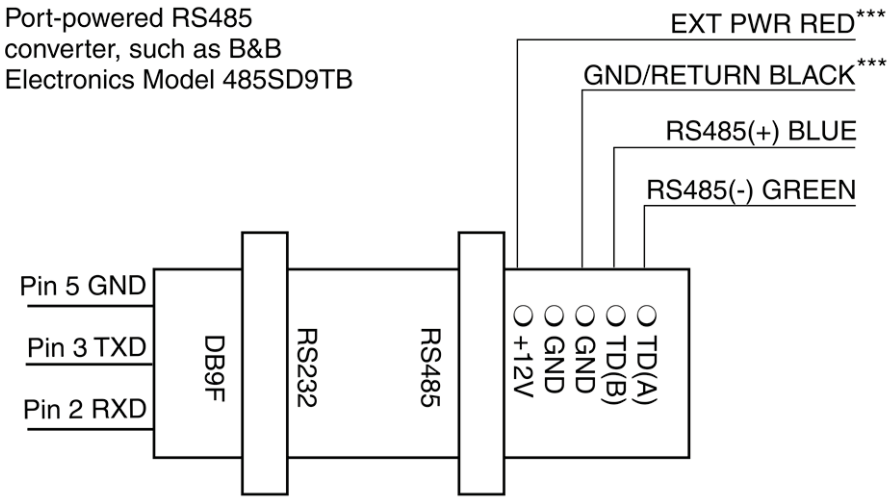
Signal	Color
Ground/Return	Black
External Power (12 VDC, voltage limited by converter)	Red
RS485 (-)	Green
RS485 (+)	Blue

Modbus master with
RS232 built-in
(converter required)



✔ Cable between converter and master must not exceed 60.96 m (20 ft.)
Cable between master and slave must not exceed 1219 m (4000 ft.)

Converter



*** Required if port power is not available

Power Connections

The red wire provides power for all system modes. Analog output is disabled by default. However, the 4-20 mA current loop output can be continuous in Modbus or SDI-12 mode as long as Modbus device register 9507 is set to 1.

Communications

The device automatically switches between Modbus and SDI-12 modes depending on which of the two interfaces has activity. Modbus and SDI-12 cannot be used at the same time–whichever one is currently in use will block communication on the other.

Modbus Registers

Common Registers

Register	Size	Mode & Access Level (R/W)	Data Type	Description
9001	1	R/W	ushort	Device ID = 31 for RDO PRO-X
9002	2	R/W	ulong	Device serial number
9004	3	R/W	time	Manufacture date

Sensor Status Registers

Register	Size	Mode & Access Level (R/W)	Data Type	Description
0005	3	R1	time	Cap start date/time 0 = no cap
0008	3	R1	time	Cap end of usable life date/time 0 = no cap

Device Specific Register 0042 Data Quality ID

Register 0042 is responsible for returning the various data quality IDs for the RDO sensor. For a list of the Data Quality IDs and definitions, see the Sensor Health Table in the Service and Troubleshooting section of this manual.

Device Specific Registers

Register	Size	Mode & Access Level (R/W)	Data Type	Description
Dissolved Oxygen Concentration				
0038	2	R1	float	Measured value, C_o
0040	1	R1	ushort	Parameter ID = 20
0041	1	R1/W2	ushort	Units ID 117 = mg/L (default) 118 = ug/L
0042	1	R1	ushort	Data quality ID (See the Sensor Health Table)
0043	2	R1/W3	float	Offline sentinel value (default = 0.0)
0045	1	R1	16 bits	Available units = 0x0030 (48)
Temperature				
0046	2	R1	float	Measured value
0048	1	R1	ushort	Parameter ID = 1
0049	1	R1/W2	ushort	Units ID 1= °C (default) 2= °F
0050	1	R1	ushort	Data quality ID
0051	2	R1/W3	float	Offline sentinel value (default = 0.0)
0053	1	R1	16 bits	Available units = 0x00030 (3)
Dissolved Oxygen % Saturation				
0054	2	R1	float	Measured value
0056	1	R1/W2	ushort	Parameter ID = 21
0057	1	R1/W2	ushort	Units ID 177 = percent saturation (default)
0058	1	R1	ushort	Data quality ID
0059	2	R1/W3	float	Offline sentinel value (default = 0.0)
0061	1	R1	16 bits	Available units = 0x0001 (1)
Oxygen Partial Pressure				
0062	2	R1	float	Measured value
0064	1	R1	ushort	Parameter ID = 2 (pressure)
0065	1	R1/W2	ushort	Units ID 26 = torr (default)
0066	1	R1	ushort	Data quality ID
0067	2	R1/W3	float	Offline sentinel value (default = 0.0)
0069	1	R1	16 bits	Available Units = 0x0200 (512)

Dissolved Oxygen Equations

Dissolved Oxygen Concentration

DO concentration is internally calculated in mg/L. Conversion to other units is as follows:

$\mu g/L = 1000 * mg/L$

Oxygen concentration C_o (mg/L) is calculated as:

$$C_o = 31.9988 \times 1E6 \times (\rho P_o / k_o M)\,(1 - \Theta_o) \times S_c$$

Where:

P_o is the partial pressure of O_2 in atmospheres.

$$P_{torr} = 759.999876 \times P_{atm}$$

S_c is the salinity correction:

$$\ln S_c = S(B_0 + B_1 T_s + B_2 T_s^2 + B_3 T_s^3) + C_0 S^2$$

$B_0 = -6.246090 \times 10^{-3}$

$B_1 = -7.423444 \times 10^{-3}$

$B_2 = -1.048635 \times 10^{-2}$

$B_3 = -7.987907 \times 10^{-3}$

$C_0 = -4.679983 \times 10^{-7}$

T_s is the scaled temperature:

$$T_s = \ln[(298.15 - t) / (273.15 + t)]$$

t is temperature in degrees C.

S is the salinity in PSU.

k_o is Henry's constant:

$$\ln k_o = 3.71814 + (5596.17/T) - (1{,}049{,}668/T^2)$$

T is temperature in Kelvin.

Θ_o is the negative of the second pressure coefficient:

$$\Theta_o = 0.000975 - (1.426 \times 10^{-5} t) + (6.436 \times 10^{-8} t^2)$$

t is temperature in degrees C.

ρ is the density of water in g/cm^3:

$$\ln \rho = -0.589581 + (326.785/T) - (45{,}284.1/T^2)$$

T is the temperature in Kelvin.

Molar mass of water: M = 18.0152 g/mole

References:

Benson and Krause. Jr.. 1980. The concentration and isotopic fractionation of gases dissolved in freshwater in equilibrium with the atmosphere. *Limnol, Oceanogr*, 25(4), 662-671.

Gordon and Garcia. 1992. Oxygen Solubility in Seawater: Better Fitting Equations. *Limnol, Oceaongr*, 37(6), 1307-1312.

Dissolved Oxygen, % Saturation

$O_2\%Sat = O_2Reading / O_2100\%Sat$

Where:

O_2 reading is the mg/L reading from the RDO Sensor.

O_2 100% Sat is the theoretical saturation value in mg/L and is derived as:

$$O_2100\%Sat = 31.9988 \times 10^6 \times \frac{\rho\,[0.20946 \times (P - P_{wv})] \times (1 - \Theta_o P) \times S_c}{k_o M}$$

Where:

ρ is the density of water in g/cm^3:

$$\ln \rho = -0.589581 + (326.785/T) - (45{,}284.1/T^2)$$

T is the temperature in Kelvin.

P is the atmospheric pressure in atm.

P_{wv} is the partial pressure of water vapor at saturation in atm:

$$\ln P_{wv} = 11.8571 - (3{,}840.70/T) - (216{,}961/T^2)$$

k_o is Henry's constant:

$$\ln k_o = 3.71814 + (5596.17/T) - (1{,}049{,}668/T^2)$$

T is the temperature in Kelvin.

Molar mass of water: M = 18.0152 g/mole

Θ_o is the negative of the second pressure coefficient:

$$\Theta_o = 0.000975 - (1.426 \times 10^{-5} t) + (6.436 \times 10^{-8} t^2)$$

t is temperature in degrees C.

S_c is the salinity correction:

$$\ln S_c = S(B_0 + B_1 T_s + B_2 T_s^2 + B_3 T_s^3) + C_0 S^2$$

$$B_0 = -6.246090 \times 10^{-3}$$

$$B_1 = -7.423444 \times 10^{-3}$$

$$B_2 = -1.048635 \times 10^{-2}$$

$$B_3 = -7.987907 \times 10^{-3}$$

$$C_0 = -4.679983 \times 10^{-7}$$

T_s is the scaled temperature:

$$T_s = \ln [(298.15 - t) / (273.15 + t)]$$

Where t is temperature in °C

S is the salinity in PSU

References:

Benson and Krause. Jr.. 1980. The concentration and isotopic fractionation of gases dissolved in freshwater in equilibrium with the atmosphere. *Limnol, Oceanogr*, 25(4), 662-671.

Calibration Registers

Register	Size	Mode & Access Level (R/W)	Data Type	Description
0118	2	R1/W3	float	Live salinity value (PSU)
0120	2	R1/W3	float	Default salinity value (PSU, default = 0.0)
0122	2	R1/W3	float	Live barometric pressure (mbar)
0124	2	R1/W3	float	Default barometric pressure (mbar, default = 1013.25)
0126	2	R1/W3	float	100% saturation calibration reading (mg/L)
0128	2	R1/W3	float	100% saturation temperature reading (°C)
0130	2	R1/W3	float	100% saturation salinity value (PSU)
0132	2	R1/W3	float	100% saturation barometric pressure (mbar)
0134	2	R1/W3	float	0% saturation calibration reading (mg/L)
0136	2	R1/W3	float	0% saturation temperature reading (°C)
0138	2	R1/W3	float	Calibration slope (default = 1.0)
0140	2	R1/W3	float	Calibration offset (default = 0.0)

Live Salinity Value

The live salinity value is used to correct the oxygen concentration value for salinity. Values must be written in Practical Salinity Units (PSU) in the range 0 to 42 PSU. This is not a measured parameter.

Default Salinity Value

The default salinity value is loaded into the live salinity value register when power is first applied to the probe. The default salinity value is used in calculations until a live salinity value is written. This is not a measured parameter.

Live Barometric Pressure

The live barometric pressure is used in the calculation of percent saturation and to determine the theoretical saturation point during calibration. Values must be written in millibars in the range 506.625 to 1114.675 mbar. This is not a measured parameter.

Default Barometric Pressure

The default barometric pressure is loaded into the live barometric pressure register when power is applied to the probe. The default barometric pressure is used in calculations until a live barometric pressure is written. This is not a measured parameter.

100% Saturation Calibration Values

These values represent the sensor conditions while the probe is in a 100% saturation calibration environment. These are not measured values, they are written by the controller during the calibration process.

Writes to these registers are only accepted if the probe is in the calibration mode. The probe will return exception 0x85 (invalid device command sequence) if an attempt is made to write these registers when the calibration mode is off.

0% Saturation Calibration Values

These values represent the sensor conditions while the probe is in a 0% saturation calibration environment. These are not measured values, they are written by the controller during the calibration process.

Writes to these registers are only accepted if the probe is in the calibration mode. The probe will return exception 0x85 (invalid device command sequence) if an attempt is made to write these registers when the calibration mode is off.

Calibration Slope and Offset

These values represent the slope and offset that will be applied to the raw concentration reading from the sensor to generate the final values reported by the sensor parameters. These registers may be written independently of the normal internal calibration procedure.

Entering Calibration Registers

The sensor is calibrated using the following procedure.

1. Optional: Read the Sensor Data Cache Timeout register 9463 and store the value.
2. Write the Sensor Data Cache Timeout register 9463 to a value less than your intended sample rate and greater than 1000 milliseconds. This will ensure that you get new sensor readings during the stabilization process.
3. Optional: Read the temperature units register 0049 and saturation units register 0041 and store their values.
4. Write the temperature units register 0049 to its default value (1) and write the saturation units register 0041 to its default value (117).
5. Write the Calibration Mode On command (0xE000) to the sensor command register 9305.
6. Update the live salinity and barometric pressure registers if necessary.
7. Prompt the user to place the probe in a 100% saturation environment.
8. Read the oxygen concentration and temperature parameters. When these values have reached equilibrium, record them in their respective 100% saturation calibration registers. Write the current live salinity and barometric pressure readings to their respective calibration registers.
9. Place the sensor in a 0% saturation environment. When these registers have reached equilibrium, record them in their respective 0% saturation calibration registers. If a zero calibration is not to be performed, these registers can be set to zero or left at their previous values.

10. Write the Calibration Update command (0xE001) to the sensor command register. The sensor will calculate a new slope and offset, write the current time to the last user calibration time register, and set the next user calibration time register to zero (disabled). If the concentrations at 100% and 0% saturation are equal, the probe will return an exception response with code 0x97 (invalid calibration) and not attempt to compute a new slope and offset due to possible division by zero. If the slope does not calculate between 0.85 and 1.20 inclusive, or if the offset does not calculate between -0.2 and +0.2 inclusive, then the probe will return an exception response with code 0x97 (invalid calibration).The slope and offset will be available for read but will not be committed to flash.
11. Optional: Read the last user calibration time register, add the next calibration interval, and write the result to the next user calibration time register.
12. Write the Calibration Mode Off command (0xE002) to the sensor command register to place the sensor in normal operation. If the calibration mode is turned off without a calibration update command, or the calibration command returned an exception, the previous calibration shall be restored.
13. Optional: If you saved the temperature and saturation parameter units at the start of the process, write the original values back.
14. Optional: If you saved the Sensor Data Cache Timeout register 9463 at the start of the process, write the original value back.

Calibration Calculations

Calibrated oxygen reading:

$$O_{2RC} = c_o + c_1 \times O_{2RU}$$

Where:

$$c1 = (O_2100\%Sat)/(O_{2RUS} - O_{2RUZ})$$

$$c_o = -c_1 \times O_{2RUZ}$$

Where:

$O_2100\%Sat$ is the theoretical 100% saturation point

O_{2RUS} is the un-calibrated reading at 100% saturation

O_{2RUZ} is the un-calibrated reading at 0% saturation

References:

Standard Methods for the Examination of Water and Wastewater. 20th Ed. 2008. 4500-0 C. Azide Modification. American Public Health Association, USA.

Service

The RDO PRO-X Probe contains no user-serviceable parts. Do not attempt to open the probe case or service the unit yourself.

RDO-X Software Troubleshooting

✔ Sensor health diagnostics indicate when the RDO sensor has been damaged in the field. If the sensor has sustained moderate damage, the probe provides a DO value that includes a (DIS or Data Quality ID 5) warning. The same warning is included with readings taken after the sensor has reached its 24-month recommended lifespan.

However, if the sensor has been severely damaged, an error message is shown (ERR or Data Quality ID 3), a DO value is not provided and the sentinel value is shown. This prevents you from receiving an erroneous reading.

Sensor Health Table

The following error messages appear in the software and the data file when a sensor issue has been detected.

Abbreviation	Data Quality ID	Text	Description
None	0	None	Normal Data Quality
UC	1	User Cal Expired	Parameter measured without errors using an expired user calibration.
FC	2	Factory Cal Expired	Parameter measured without errors using an expired factory calibration.
ERR	3	Unknown Error	Parameter measured with error, sentinel value supplied.
WU	4	Sensor Warm-up	Sensor is warming up, sentinel value supplied.
DIS	5	Sensor Warning	Parameter measured but does not meet normal quality criteria. The sensor has sustained moderate damage, or the recommended lifespan has been reached.

Abbreviation	Data Quality ID	Text	Description
CAL	6	Sensor Calibrating	Sensor is calibrating, calibration value supplied.
OL	7	Sensor Missing	Sensor communication failed, sentinel value supplied. Make sure the sensor cap is installed and properly seated.

Appendix A - Communication Device

The Communication Device is an accessory product that can be used to calibrate and set up RDO probes.

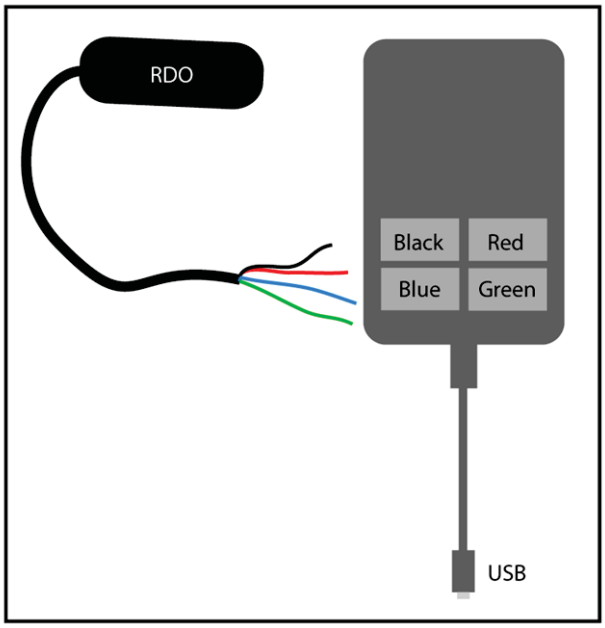
Install and Open the Software

The Comm Kit Software must be installed on a computer before you connect to the probe.

Connect the Probe to the Communication Device

The Communication Device connects a stripped-and-tinned probe to a computer via USB connection.

1. Disconnect the instrument from the PLC.
2. The communication device includes an electrical connection diagram label. To attach the instrument to the communication device, depress a lever and insert the appropriate wire in the location specified by the diagram.
3. Attach the USB connector to a USB port on the computer. Follow the directions provided in the Communication Device Kit to set up the probe.



Declaration of Similarity

Equipment

Type of equipment: Measurement instrumentation
Product name: RDO PRO-X Optical Dissolved Oxygen Probe
Model: RDO PRO-X Dissolved Oxygen Probe

Manufacturer: In-Situ, Inc.
221 East Lincoln Avenue
Fort Collins, CO 80524
USA

Category Standards

- **Immunity**
  EN 61000-6-2, Electromagnetic Compatibility (EMC) – part 6-2: Generic standards – Immunity for industrial environments
- **Emissions**
  Class A requirements of CISPR 11: 2004, Specification for limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment

Supplementary Information:
The device complies with the requirements of the EU Directive 73/23/EEC, and the CE mark is affixed accordingly.

Summary

We confirm that the equipment referenced above, without reasonable doubt, will fulfill the requirements concerning electromagnetic compatibility according to the above mentioned standards harmonized with the 2004/108/EC for Electromagnetic Compatibility (EMC) Directive—part 6-2. The RDO PRO Optical Dissolved Oxygen Sensor was tested and found to be in compliance in the month of October 2008.

Date of Issue: October 7, 2013

Signature:

Name: Ben Kimbell
Title: Vice President of Research and Development

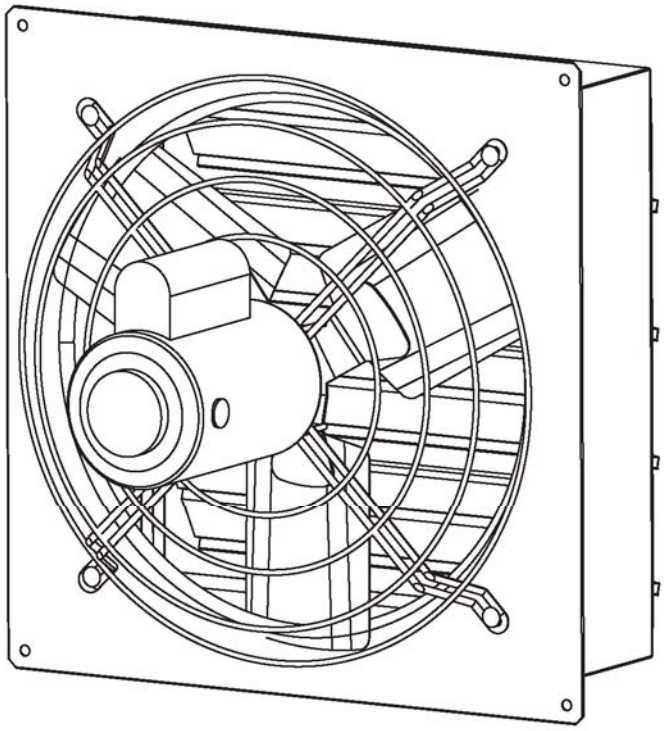
Test Report reference: 3161946DEN-003

F-7961 - Fan, Building, 12", 1/4hp, 1750rpm, 120V, 1ph, TEAOCSA Approved, S12-E1

CANARM®

Standard Exhaust Fans

Instruction Manual



WARRANTY

CANARM Ltd. warrants every new fan to be free of defects in material and workmanship, to the extent that, within a period of one year from the date of purchase CANARM Ltd. shall either repair or replace at CANARM's option, any unit or part thereof, returned freight prepaid, and found to be defective.
This warranty does not include any labour or transportation costs incidental to the removal and reinstallation of the unit at the user's premises.
Components repaired or replaced are warranted through the remainder of the original warranty period only.
This warranty applies to the original purchaser-user only; it is null and void in case of alteration, accident, abuse, neglect, and operation not in accordance with instructions.

NOTICE: No warranty claims will be honored by CANARM Ltd. unless prior authorization is obtained.

Installation or Product problems? Do not return to store of purchase.
Contact Canarm Service at 1-800-265-1833 (CANADA) 1-800-267-4427 (U.S.A.)
1-800-567-2513 (EN FRANCAIS) Monday to Friday 8:00 - 5:00pm e.s.t.

CANARM®

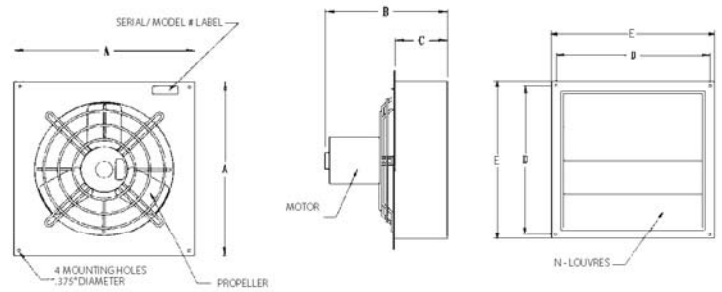
Instruction Manual for Standard Exhaust Fans

Read Instructions Completely Before Installation & Save For Reference

Congratulations on the purchase of your quality built direct drive, wall exhaust ventilation fan. All of these models use totally enclosed ball bearing motors with thermal over load protection. Variable speed motors are high efficiency motors which save on electrical costs and can be run as a single speed motor. The motors are mounted on heavy gauge welded steel rod motor mounts that have a powder coated finish. Fans come fully assembled and 100% of fans are tested for proper operation before shipping.

Standard Fans:

These models have a rugged, welded steel box housing with a powder coated finish and aluminum or plastic exhaust louvers that are supported by long life nylon bushings. The louvers open automatically when the fan starts up and close when the fan stops.



Fan Dimensions							
Fan Size	A	B	C	D	E	N	Framing
8"	13-1/4"	10"	4"	12"	10-3/4"	2	11x11
10"	15-1/4"	10"	4"	14"	12-3/4"	2	13x13
12"	17-1/4"	14"	6"	16"	14-3/4"	3	15x15
14"	19-1/4"	14"	6"	18"	16-3/4"	3	17x17
16"	21-1/4"	14"	6"	20"	18-3/4"	4	19x19
18"	23-1/4"	15"	6"	22"	20-3/4"	4	21x21
20"	25-1/4"	16"	6"	24"	22-3/4"	5	23x23
24"	29-1/4"	16"	6"	28"	26-3/4"	5	27x27
30"	35-1/4"	19"	6"	34"	32-3/4"	8	33x33
36"	41-1/4"	16"	6"	40"	38-3/4"	10	39x39

Explosion Proof Fans:

Explosion proof fans are equipped with explosion proof motors and aluminum blades so sparks cannot occur if a metal object obstructs the blade path. Explosion proof fans have the same quality welded steel box housing and heavy gauge welded guard as the standard fans. These fans should be used to ventilate hazardous areas. Locations are considered hazardous if the atmosphere contains or may contain gas, vapor, or dust in explosive quantities.

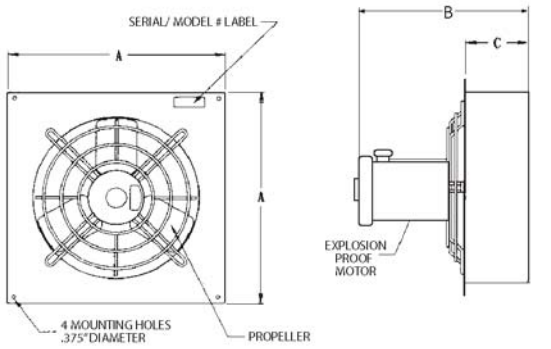
The motor ambient temperature is not to exceed +40ºC or -25ºC unless the motor nameplate specifically permits another value. Canarm explosion proof fans are approved for the hazardous classifications below only.

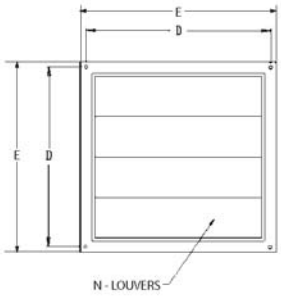
Class 1, Division 1 (Gases, Vapors)

~~Group A~~	Acetylene
~~Group B~~	Butadiene, ethylene oxide, hydrogen, Propylene oxide
Group C	Acetaldehyde, cyclopropane, diethlether, Ethylene, isoprene
Group D	Acetone, acrylonitrile, ammonia, benzene, Butane, ethylene dichloride, gasoline, hexane, methane, methanol, naphtha, propane, propylene styrene, toluene, vinyl, acetate, vinyl chloride, xylene

Class 2, Division 1 (Combustible Dusts)

~~Group E~~	Aluminum, magnesium and other metal dusts with similar characteristics
Group F	Carbon black, coke or coal dust
Group G	Flour, starch or graindust





Fan Dimensions							
Fan Size	A	B	C	D	E	N	Framing
12"	17-1/4"	20-1/2"	6"	16"	14-3/4"	3	15x15
18"	23-1/4"	20-1/2"	6"	22"	20-3/4"	4	21x21
24"	29-1/4"	20-1/2"	6"	28"	26-3/4"	5	27x27

INSTALLATION

Installation is fast and simple. A sturdy framed wall opening should be prepared in advance to the size indicated for your fan in the charts above. With lag bolts for wooden frames or nut, bolt and lock washers for steel frames, secure the fan using the four mounting holes provided, one in each corner of the fan.

ELECTRICAL CONNECTIONS

WARNING: BE SURE POWER IS OFF AT THE ELECTRICAL PANEL BEFORE WIRING.

WARNING: ALL ELECTRICAL WORK SHOULD BE PERFORMED BY A QUALIFIED ELECTRICIAN.

These fans are supplied with single, two or variable speed motors. Single and two speed motors are 120V only. Variable speed motors are dual voltage. All dual voltage motors are pre-wired at 240V in our factory. Rewire motor as per motor nameplate if running fan at 120V. Please see the motor nameplate for wiring diagram. Make electrical connections in motor connection box as per the motor nameplate. Follow ***Chart #1*** for wire sizes. Two speed fans require a two speed control or 3 position toggle switch to change from high/ low/off. See wiring diagram with control for 2 speed wiring instructions.

CHART# 1

Table A Minimum Wire Sizes for Three-Phase Motors

Motor	25 to 50 Feet			100 Feet			150 to 200 Feet		
HP	200V	230V	460V	200V	230V	460V	200V	230V	460V
1/8	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(16)*	14(16)*	14(18)*
1/6	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14	14(16)*	14(18)*
1/4	14(18)*	14(18)*	14(18)*	14(16)*	14(18)*	14(18)*	14	14	14(18)*
1/3	14(18)*	14(18)*	14(18)*	14(16)*	14(16)*	14(18)*	12	14	14(18)*
1/2	14(16)*	14(18)*	14(18)*	12	14(16)*	14(18)*	10	12	14(18)*
3/4	14(16)*	14(16)*	14(18)*	12	14	14(18)*	10	10	14(16)*
1	14	14(16)*	14(18)*	12	12	14(18)*	8	10	14(16)*
1-1/2	12	14	14(18)*	10	10	14(16)*	6	8	14
2	12	12	14(18)*	8	10	14(16)*	6	6	12
3	10	12	14(18)*	6	8	14	4	6	12

Table B Minimum Wire Sizes for Single-Phase Motors

Motor	25 Feet			100 Feet			150 to 200 Feet		
HP	200V	230V	460V	200V	230V	460V	200V	230V	460V
1/8	14(18)*	14(18)*	14	14(18)*	12	14(18)*	10	8	14
1/6	14(16)*	14(18)*	12	14(18)*	10	14(16)*	6	6	12
1/4	14	14(18)*	10	14(16)*	8	14	6	4	10
1/3	14	14(18)*	10	14(16)*	8	14	6	4	10
1/2	12	14(18)*	8	14	6	12	4	3	8
3/4	10	14(16)*	6	12	4	10	2	1	6
1	10	14(16)*	6	12	4	10	2	1	6
1-1/2	8	14	6	12	3	8	1	1/0	6
2	8	14	4	10	2	8	1/0	2/0	4
3	6	12	3	8	1/0	6	2/0	4/0	3

NOTE:
- NEC Article 310-5 - * Minimum conductor size for general wiring at 115-440VAC is number 14AWG.
- Above wire sizes based on approximate 5% voltage drop during starting; copper conductors; and 75ºC type THHW, THW, THWN, RH, RHW insulation etc. For aluminum wire, increase two wire size steps minimum. See NEC Article 310 for ampacities af aluminum conductors.
- Type S, SO, SJ, SJO, etc flexible cable wire sizes. See NEC Article 400 for ampacity.

OPERATION

WARNING: VARIABLE SPEED FANS SHOULD HAVE THE MINIMUM SPEED SET TO OPEN LOUVERS AT LEAST ONE INCH FOR PROPER MOTOR COOLING AND TO PREVENT MOTOR FAILURE.
All fans are direct drive. Fans with variable speed motors can be operated as an energy efficient single speed fan or in variable operation with the proper controller. As mentioned above two speed fans require a two speed control or 3 position toggle switch to change from high speed to low and off.

WARNING: GUARDING SHOULD BE USED IF FANS ARE MOUNTED LOWER THAN SEVEN FEET (2 METRES) OFF FLOOR OR GROUND LEVEL.

ACCESSORIES
Canarm provides a complete line of manual and thermostatic controls. Canarm also offers wall mount exhaust shutter kits, replacement shutter sets, and weather protection hoods.

MAINTENANCE
Motors are equipped with automatic overload protection and may restart without warning. Always disconnect from power before attempting service. Motor, blade and louvers should be kept clean of any buildup to prevent premature motor failure and to achieve proper performance. Automatic louvers should be kept operating freely. As with all mechanical equipment scheduled inspections should include checking that all hardware is secure and blade set screws are tight.

WARRANTY

CANARM Ltd. warrants every new fan to be free of defects in material and workmanship, to the extent that, within a period of one year from the date of purchase CANARM Ltd. shall either repair or replace at CANARM's option, any unit or part thereof, returned freight prepaid, and found to be defective.
This warranty does not include any labour or transportation costs incidental to the removal and reinstallation of the unit at the user's premises.
Components repaired or replaced are warranted through the remainder of the original warranty period only.
This warranty applies to the original purchaser-user only; it is null and void in case of alteration, accident, abuse, neglect, and operation not in accordance with instructions.

NOTICE: No warranty claims will be honored by CANARM Ltd. unless prior authorization is obtained.

CANARM®

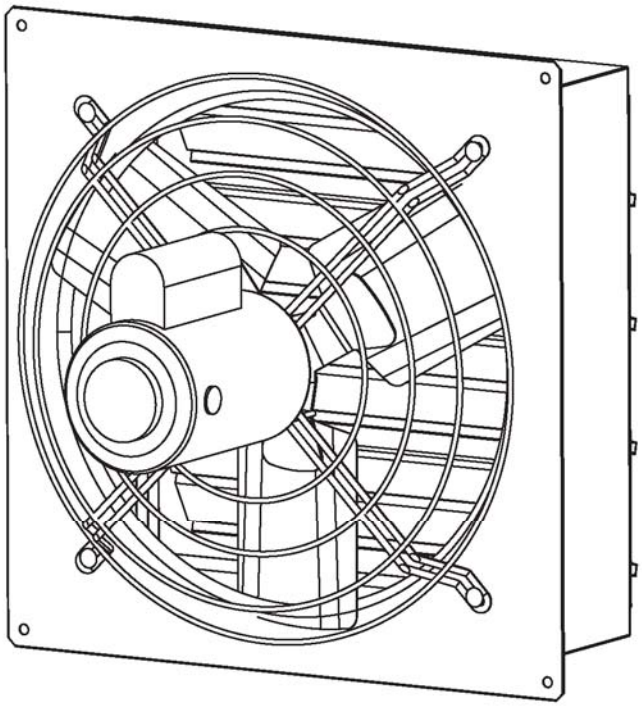
CANARM LTD.
2157 PARKEDALE AVENUE
BROCKVILLE, ONTARIO K6V 5V6
TELEPHONE: (613) 342-5424
FAX: 1-800-263-4598
E-MAIL: agsales@canarm.ca

CANARM LTEE.
8500 RUE GRENACHE
ANJOU, QUEBEC H1J 2B1
TELEPHONE: (514) 353-2255
FAX: (514) 353-2522
E-MAIL: agsales@canarm.ca

CANARM®

Ventilateurs d'évacuation Standard

Manuel de l'usager



GARANTIE

Canarm Ltée. garantie que chaque nouveau ventilateur ne comporte aucune défectuosité dans le matèriel et la main-d'oeuvre, et de ce fait, Canarm Ltée. remplacera ou réparera à son choix, tout unité ou partie de cette unité qui comporte une defectuosité, pour une période de un an suivant la date d'achat. L'unité doit être retournée frais de port payé et une défectuosité doit être décelée. Cette garantie ne couvre pas les frais de démontage et de réinstallation de l'unité sur les lieux de l'usager.
Les éléments réparés ou remplacés sont garanties pour la durée de la garantie originale seulement. Cette garantie s'applique à l'acheteur-usage initial seulement, elle est nulle dans le cas d'altérations, d'accident, d'abus, de négligence ou si l'opération n'est pas conforme aux instructions.

N.B.: Aucune réclamation ne sera honorée par Canarm Ltée. à moins d'autorisation obtenue au préalable.

Problèmes d'installation ou d'utilisation? Ne retournez pas au magasin. Communiquez avec le service à la clientèle chez Canarm au 1-800-265-1833 (Canada) 1-800-267-4427 (USA) 1-800-567-2513 (en français) du lundi au vendredi entre 8:00h et 17:00h HNE

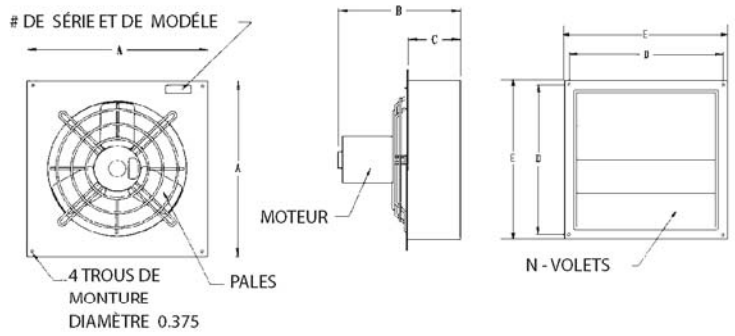
Mode d'emploi du Ventilateur d'évacuation Standard

Veuillez lire les instructions suivantes avant de procéder à l'installation et gardez ce manuel comme référence

Félicitations sur l'achat de votre ventilateur d'évacuation mural à entraînement direct de qualité. Tous ces modéles comportent un moteur fermé à roulements sur bille avec une protection thermique contre la surcharge. Les moteurs à vitesse variable sont hautement efficaces et consomment peu d'énergie et de plus, ils peuvent être opérés comme un moteur à vitesse simple.
Les moteurs sont soutenus par une monture de moteur trés robuste en tiges d'acier soudées de haut calibreet sont revĺtues d'un fini poudré. Les ventilateurs vous sont livrés tout assemblé et 100% de nos ventilateurs sont testés avant la livraison.

VENTILATEUR STANDARD:

Ces modéles portent un boîtier robuste en acier soudé avec un fini poudré ainsi que des volets en aluminium ou en plastique qui sont retenus par des douilles en nylon de longue durée. Les volets s'ouvrent automatiquement lorsque le ventilateur démarre et se ferment lorsqu'il s'arrête.



Dimensions du Ventilateur							
Ventilateur	A	B	C	D	E	N	Encadrement
8"	13-1/4"	10"	4"	12"	10-3/4"	2	11x11
10"	15-1/4"	10"	4"	14"	12-3/4"	2	13x13
12"	17-1/4"	14"	6"	16"	14-3/4"	3	15x15
14"	19-1/4"	14"	6"	18"	16-3/4"	3	17x17
16"	21-1/4"	14"	6"	20"	18-3/4"	4	19x19
18"	23-1/4"	15"	6"	22"	20-3/4"	4	21x21
20"	25-1/4"	16"	6"	24"	22-3/4"	5	23x23
24"	29-1/4"	16"	6"	28"	26-3/4"	5	27x27
30"	35-1/4"	19"	6"	34"	32-3/4"	8	33x33
36"	41-1/4"	16"	6"	40"	38-3/4"	10	39x39

VENTILATEUR ANTI-EXPLOSIF:

Les ventilateurs anti-explosifs sont munis de moteurs et de pales qui sont contre les explosions afin qu'une étincelle ne puisse pas se produire si un objet en métal obstruerait le mouvement de la pale. Les ventilateurs anti-explosifs sont fabriqués du même boîtier en acier robuste et de qualité et du même grillage à haut calibre que les ventilateurs Standard. Ces ventilateurs devront être utilisés pour ventilé les endroits hasardeux. L'endroit est considéré hasardeux si l'atmosphére contient ou peut contenir un gaz, une vapeur, ou de la poussiére en quantité explosive.

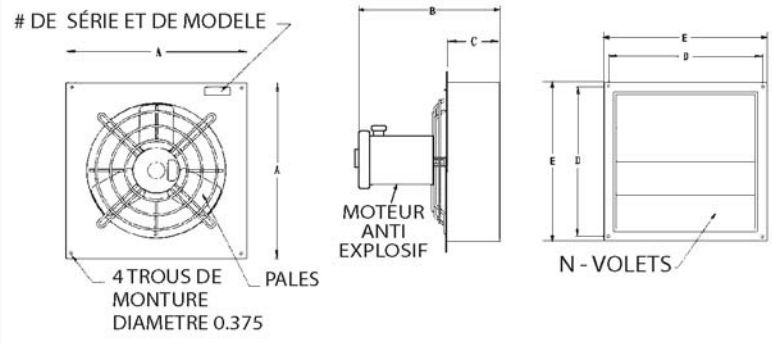
La température ambiante du moteur ne devrait pas excéder +40ºC ou -25ºC à moins que la plaque sur le moteur indique spécifiquement une autre valeur. Les ventilateurs anti-explosifs Canarm sont approuvés pour les classes hasardeuse ci-dessou seulement.

Classe 1, Division 1 (Gas et vapeurs)

~~Groupe~~ A	Aceetylène
~~Groupe~~ B	Butadiène, oxyde d'éthylène, hydrogène, oxyde de propylène
Groupe C	Acétaldéhyde, cyclopropane, diéthléther, éthylène, isoprène
Groupe D	Acétone, acrylonitrile, ammoniac, benzène, butane, éthylène dichloride, gazoline, hexane, méthane, méthanol, naphtha,propane, propylène styrène, toluène, vinyle, acétate, vinyle chloride, xylène

Classe 2, Division 1 (Poussières Combustibles)

~~Groupe~~ E	Aluminium, magnésium, et autres poussières de métal avec des caracteristiques similaires.
Groupe F	Carbon noir, coke ou poussière de charbon
Groupe G	Farine, amidon ou poussière de grain



Dimensions du Ventilateur							
Ventilateur	A	B	C	D	E	N	Encadrement
12"	17-1/4"	20-1/2"	6"	16"	14-3/4"	3	15x15
18"	23-1/4"	20-1/2"	6"	22"	20-3/4"	4	21x21
24"	29-1/4"	20-1/2"	6"	28"	26-3/4"	5	27x27

INSTALLATION

L'installation est simple et rapide. Un encadrement robuste dans l'ouverture du mur devrait être préparé à l'avance aux grandeurs mentionnes pour votre ventilateur dans le tableau ci-dessus. A l'aide de boulons pour cadrage de bois ou d'écrous, boulons et rondelles de blocage pour cadrage de métal, posez le ventilateur à l'aide des quatres trous de montage fournies, un dans chacun des coins.

CONNEXIONS ÉLECTRIQUES

MISE EN GARDE: FERMEZ LE COURANT AU DISJONCTEUR AVANT PROCÉDER AUX RACCORDEMENTS.

MISE EN GARDE: TOUS LES TRAVAUX ÉLECTRIQUES DEVRONT ÊTRE EXÉCUTÉS PAR UN ÉLECTRICIEN QUALIFIÉ.
Ces ventilateurs portent un moteur à une, deux ou vitesse variable. Les moteurs à une ou deux vitesses peuvent recevoir du 120V seulement. Les moteurs à vitesse variable sont à voltage double. Tous les moteurs à voltage double sont préparés en usine pour recevoir du 240V. Suivez les indications sur la plaque du moteur pour rebrancher le moteur sur le 120V. Faîtes les connexions dans la boîte de connexion du moteur selon les indications sur la plaque du moteur. Consultez le ***Tableau #1*** pour la grandeur de fil à être utilisé. Les ventilateurs à deux vitesses demandent un contrôle à 2 vitesses ou un interrupteur à levier 3 postions pour changer la vitesse de grande/petite/fermé. Consultez le diagramme fournie avec le contrôle pour l'installation à 2 vitesses.

TABLEAU #1

Tableau A Grosseur minium de fil pour moteur à trois phases

Moteur	25 à 50 Pieds			100 Pieds			150 à 200 Pieds		
HP	200V	230V	460V	200V	230V	460V	200V	230V	460V
1/8	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(16)*	14(16)*	14(18)*
1/6	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14(18)*	14	14(16)*	14(18)*
1/4	14(18)*	14(18)*	14(18)*	14(16)*	14(18)*	14(18)*	14	14	14(18)*
1/3	14(18)*	14(18)*	14(18)*	14(16)*	14(16)*	14(18)*	12	14	14(18)*
1/2	14(16)*	14(18)*	14(18)*	12	14(16)*	14(18)*	10	12	14(18)*
3/4	14(16)*	14(16)*	14(18)*	12	14	14(18)*	10	10	14(16)*
1	14	14(16)*	14(18)*	12	12	14(18)*	8	10	14(16)*
1-1/2	12	14	14(18)*	10	10	14(16)*	6	8	14
2	12	12	14(18)*	8	10	14(16)*	6	6	12
3	10	12	14(18)*	6	8	14	4	6	12

Tableau B Grosseur minium de fil pour moteur à phase simple

Moteur	25 à 50 Pieds			100 Pieds			150 à 200 Pieds		
HP	200V	230V	460V	200V	230V	460V	200V	230V	460V
1/8	14(18)*	14(18)*	14	14(18)*	12	14(18)*	10	8	14
1/6	14(16)*	14(18)*	12	14(18)*	10	14(16)*	6	6	12
1/4	14	14(18)*	10	14(16)*	8	14	6	4	10
1/3	14	14(18)*	10	14(16)*	8	14	6	4	10
1/2	12	14(18)*	8	14	6	12	4	3	8
3/4	10	14(16)*	6	12	4	10	2	1	6
1	10	14(16)*	6	12	4	10	2	1	6
1-1/2	8	14	6	12	3	8	1	1/0	6
2	8	14	4	10	2	8	1/0	2/0	4
3	6	12	3	8	1/0	6	2/0	4/0	3

N.B.:
- Article 310-5 NEC grosseur minium de conducteur pour filage général à 115- 440VAC est le numéro 14AWG
- Les grandeurs de fils ci-dessus sont basés sur une baisse approximative de 5% lors du départ; conducteurs en cuivre; et isolation type 75C THHW, THW, RH, RHW etc. Pour un fil en aluminium, augmentez le fil d'un minimum de deux grandeurs. Voir Article 310 NEC pour ampacités des conducteurs en aluminium.
- Type S, SO, SJ, SJO, ETC.. grandeur de fil de cable flexible. Voir article 400 NEC pour ampérage relatif.

OPÉRATION:

MISE EN GARDE: LES VENTILATEURS À VITESSE VARIABLE DEVRAIENT ÊTRE AJUSTÉS AFIN QUE LA VITESSE MINIUM OUVRE LES VOLETS D'AU MOINS 1" AFIN DE PERMETTRE UN AÉRATION ADÉQUATE DU MOTEUR. Tous les ventilateurs sont à entraînement direct. Les ventilateurs avec moteur à vitesse variable peuvent étre opérés comme moteur à une vitesse économe d'énergie ou comme moteur variable avec un contrôle adéquat. Tel que mentionné, les ventilateurs à 2 vitesses requiËrent un contrôle à 2 vitesses ou un interrupteur à levier à 3 positions pour pouvoir changer la vitesse du moteur de grande à petite.

MISE EN GARDE: UNE GRILLE INTÉRIEUR DEVRAIT ÊTRE UTILSÉ SI LE VENTILATEUR EST INSTALLÉ À MOINS DE 7 PEIDS (2 METRE) DU SOL.

ACCESSOIRES:

Canarm vous offre une gamme complète de contrôle manuel et thermostatique. Canarm vous offre également des ensembles de volets muraux d'évacuation, les volets de remplacement ainsi que des capots de protection contre les intempéries.

ENTRETIEN:

Les moteurs comportent une protection automatique contre la surcharge et pourraient démarrer sans avertissement. Débrancher toujours l'unité avant de procéder à l'entretien. Le moteur, les pales et les volets devraient être nettoyés régulièrement pour éviter une accumulation de saleté qui pourrait endommager le moteur et nuire au bon fonctionnement de votre ventilateur. Les volets automatiques devraient pouvoir opérer librement. Comme pour tout les appareils mécaniques, des inspections régulières devront être entreprises afin de s'assurer que toute la quincaillerie et les vis à pales soient bien serrées.

GARANTIE

Canarm Ltée. garantie que chaque nouveau ventilateur ne comporte aucune défectuosité dans le matériel et la main-d'oeuvre, et de ce fait, Canarm Ltée. remplacera ou réparera à son choix, tout unité ou partie de cette unité qui comporte une defectuosité, pour une période d'un an suivant la date d'achat. L'unité doit être retournée frais de port payé et une défectuosité doit être décelée. Cette garantie ne couvre pas les frais de démontage et de réinstallation de l'unité sur les lieux de l'usager. Les éléments réparés ou remplacés sont garanties pour la durée de la garantie originale seulement. Cette garantie s'applique à l'acheteur-usager initial seulement; elle est nulle dans le cas d'altérations, d'accident, d'abus, de négligence ou si l'opération n'est pas conforme aux instructions.

N.B.: Aucune réclamation ne sera honorée par Canarm Ltée. à moins d'autorisation obtenue au préalable.

CANARM®

CANARM LTD.
2157 PARKEDALE AVENUE
BROCKVILLE, ONTARIO K6V 5V6
TELEPHONE: (613) 342-5424
FAX: 1-800-263-4598
E-MAIL: agsales@canarm.ca

CANARM LTEE.
8500 RUE GRENACHE
ANJOU, QUEBEC H1J 2B1
TELEPHONE: (514) 353-2255
FAX: (514) 353-2522
E-MAIL: agsales@canarm.ca

FM 701/702 - Flow meter, IFM efector, SM9000, Magnetic flow meter

ifm electronic

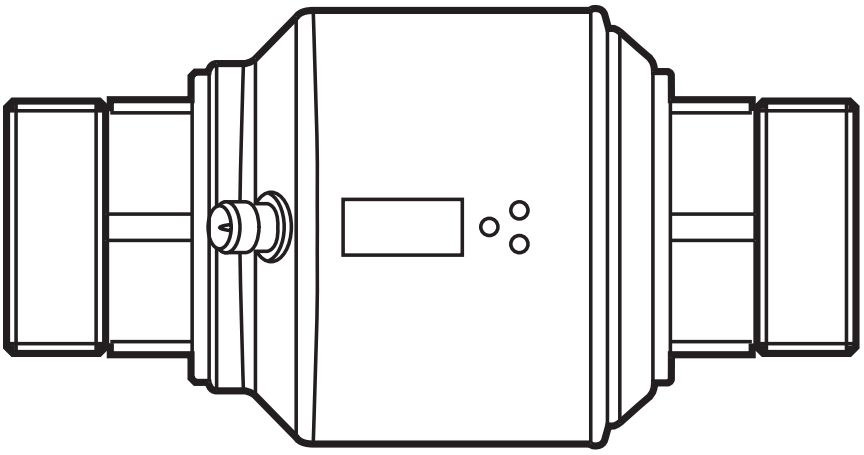
CE

Operating instructions
Magnetic-inductive flow meter

UK

efector300®

SM9000
SM9100
SM2000
SM2100



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1 Preliminary note

1.1 Symbols used

▶ Instructions

> Reaction, result

[…] Designation of pushbuttons, buttons or indications

→ Cross-reference

Important note
Non-compliance can result in malfunction or interference.

Information
Supplementary note.

1.2 Warning signs used

⚠ CAUTION

Warning of personal injury.
Slight reversible injuries may result.

2 Safety instructions

- Please read this document prior to set-up of the unit. Ensure that the product is suitable for your application without any restrictions.
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property can occur.
- Improper or non-intended use may lead to malfunctions of the unit or to unwanted effects in your application. That is why installation, electrical connection, set-up, operation and maintenance of the unit must only be carried out by qualified personnel authorised by the machine operator.
- In order to guarantee the correct condition of the device for the operating time it is necessary to use the device only for media to which the wetted materials are sufficiently resistant (→ Technical data).
- The responsibility whether the measurement devices are suitable for the respective application lies with the operator. The manufacturer assumes no liability for consequences of misuse by the operator. Improper installation and use of the devices result in a loss of the warranty claims.
- For medium temperatures above 50 °C some parts of the housing can heat up to over 65 °C. Moreover, during installation or in case of a fault (e.g. housing damage) media under high pressure or hot media can leak from the system. To avoid personal injury, take the following measures:
  ▶ Install the unit according to the applicable rules and regulations.
  ▶ Ensure that the system is free of pressure during installation.

- ▶ Protect the housing against contact with flammable substances and unintentional contact. To do so, equip the unit with suitable protection (e.g. protective cover).
- ▶ Do not press the pushbuttons manually; instead use another object (e.g. ballpoint pen).

3 Functions and features

Pressure Equipment Directive (PED): The units comply with section 3, article 3 of the Directive 97/23/EC and must be designed and manufactured for non-super-heated liquids of group 2 fluids in accordance with the sound engineering practice.

The unit monitors liquid media.

The unit detects the 3 process categories volumetric flow quantity, consumed quantity and medium temperature.

Application area

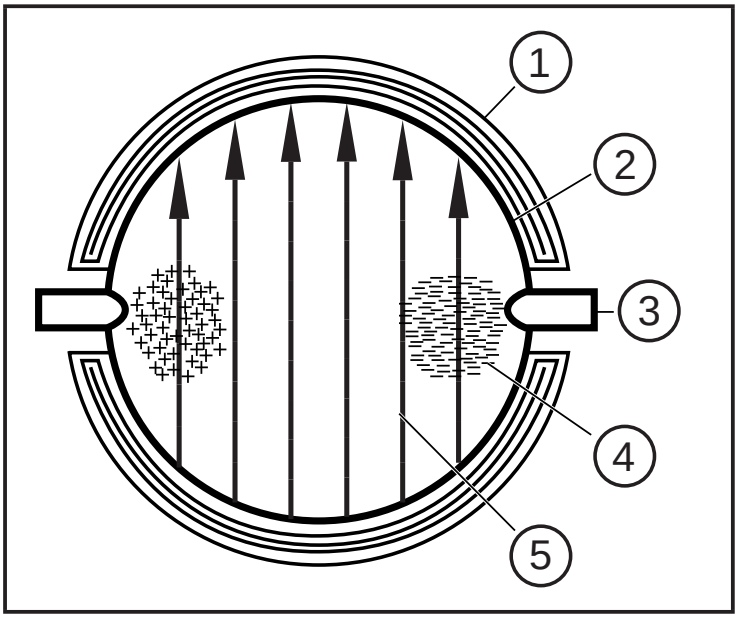
Conductive liquids with the following properties:

- Conductivity: ≥ 20 µS/cm
- Viscosity: < 70 mm^2/s at 40 °C

4 Function

4.1 Measuring principle for volumetric flow monitoring

The magnetic-inductive measuring principle means that a magnetic field is generated in the measuring pipe via current-carrying coils. When a conductive medium flows through the measuring pipe, the ions therein are diverted perpendicularly to the magnetic field. Positive and negative charge carriers flow in opposite directions. The voltage induced is measured by two electrodes that are in contact with the medium. This signal voltage is directly proportional to the average flow velocity. The volumetric flow quantity is derived from the inside pipe diameter.



1: Field coil
2: Measuring pipe
3: Electrode
4: Charge carrier in the medium
5: Magnetic field

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Both electrodes must be wetted by the medium. Otherwise the signal [SEnS] for empty pipe is provided, if empty pipe detection is enabled.

4.2 Processing of the measured signals

The unit displays the current process values.

It generates 2 output signals according to the parameter setting.

OUT1/IO-Link: 5 selection options	Parameter setting
- Switching signal for volumetric flow limit values	(→ 10.3.1)
- or frequency signal for volumetric flow quantity	(→ 10.3.4)
- or pulse signal for quantity meter	(→ 10.4.1)
- or switching signal for preset counter	(→ 10.4.2)
- or switching signal for empty pipe detection	(→ 10.6.9)

OUT2: 6 selection options	Parameter setting
- Switching signal for volumetric flow limit values	(→ 10.3.2)
- or switching signal for temperature limit value	(→ 10.5.1)
- or analogue signal for volumetric flow quantity	(→ 10.3.3)
- or analogue signal for temperature	(→ 10.5.2)
- or input for external reset signal (InD)	(→ 10.4.7)
- or switching signal for empty pipe detection	(→ 10.6.9)

4.3 Volumetric flow monitoring

4.3.1 Volumetric flow quantity

The signals for measuring the volumetric flow quantity can be provided as follows:

1. Two switching signals for volumetric flow quantity limit values on output 1 and output 2. On the switching functions → 4.7.
2. A frequency signal (10 Hz...10 kHz) on output 1.
   On the frequency functions → 4.9.
3. An analogue signal proportional to the volumetric flow (4...20 mA or 0...10 V) on output 2. On the analogue functions → 4.8.

4.3.2 Direction of flow

In addition to the flow velocity, the unit also detects the flow direction. An arrow on the unit indicates the positive flow direction.

The flow direction can be inversed (→ 10.6.3).

▶ Use the supplied label to mark the changed flow direction.

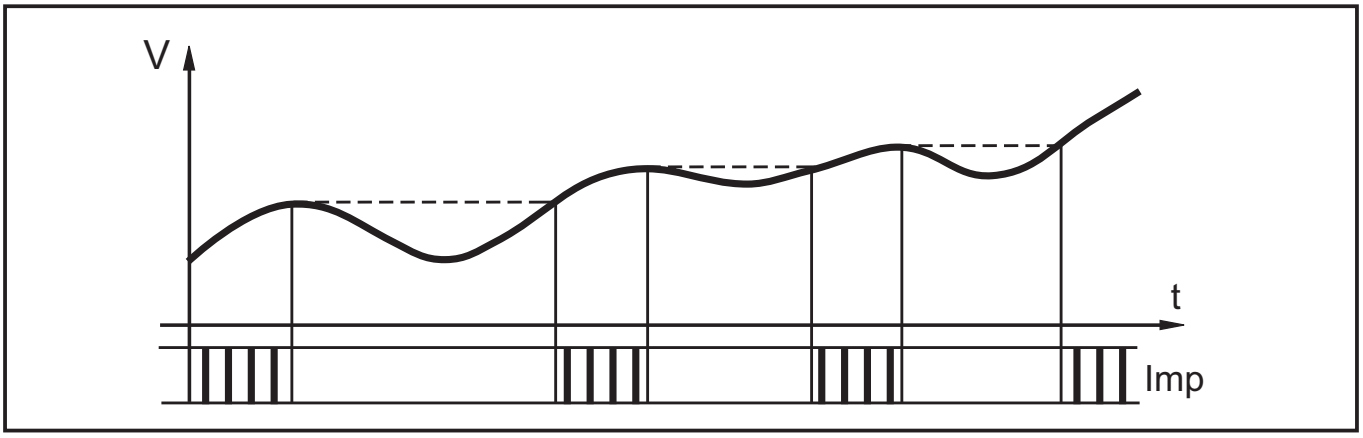
Direction of flow in accordance with "flow direction" > process value and display positive. Direction of flow against the "flow direction" > process value and display negative.

Only positive process values are processed for the signal output (limit values and analogue values for volumetric flow).

4.4 Consumed quantity monitoring (totaliser function)

The unit has an internal mass flow meter which continuously totals the volumetric flow. The sum corresponds to the current consumed quantity since the last reset.

- The quantity meter takes account of the flow direction for totalisation.
  - Flow according to the marked flow direction (arrow "flow direction"): meter adds.
  - Flow against the marked flow direction: meter subtracts (→ 10.6.12).
  - Meter pulses are only provided as the sum increases. After subtraction (consumed quantity decreases), the pulses are only provided again when the consumed quantity has exceeded the previous maximum value.



V = volumetric flow quantity, Imp = output pulses

- The current meter reading can be displayed (→ 11.1 Reading the process value).
- In addition the value before the last reset is stored. This value can also be displayed (→ 11.1 Reading the process value).

The meter saves the totalled consumed quantity every 10 minutes. In the event of a power failure this value is retained as the current meter reading. If a time-controlled reset is set, the elapsed time of the set reset interval is also stored. So the possible data loss can be maximum 10 minutes.

There are different ways to reset the meter

→ 10.4.4 Manual counter reset
→ 10.4.5 Time-controlled counter-reset
→ 10.4.7 Configure counter reset using an external signal

4.4.1 Consumed quantity monitoring with pulse output

Output 1 indicates a counting pulse when the set volumetric flow quantity has been reached (→ 10.4.1).

4.4.2 Consumed quantity monitoring with preset counter

Output 1 switches when the set volumetric flow quantity has been reached (→ 10.4.2).
2 types of monitoring are possible:

1. Time-dependent quantity monitoring (→ 10.4.5 Time-controlled counter-reset).
   - If the quantity x is reached during t, output 1 switches and remains switched until the meter is reset.

- If the quantity x is not reached during the time t, the meter is automatically reset and counting starts again; output 1 does not switch.

2. Quantity monitoring not time-dependent (→ 10.4.6 Deactivation of the counter reset).
   - If the quantity x is reached, output 1 switches and remains switched until the meter is reset.

4.5 Temperature monitoring

The following signals are provided for temperature monitoring:

- A switching signal for temperature limit values on output 2. On the switching functions → 4.7.
- An analogue signal proportional to the temperature (4...20 mA or 0...10 V) on output 2. On the analogue functions → 4.8.

4.6 Empty pipe detection

The unit detects when the two electrodes are not wetted by the medium (→ 4.1 Measuring principle for volumetric flow monitoring). The empty pipe detection can be activated or deactivated (→ 10.6.9). If it is active and the pipe is empty, the unit reacts as follows:

> [SEnS] is indicated in the display.

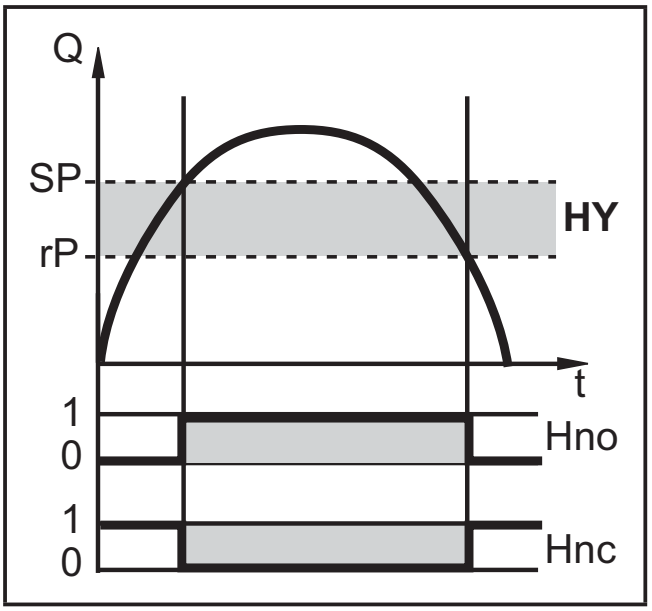
> The flow is set to zero.

The empty pipe detection can be set as time-depending or not time depending (→ 10.6.10).

4.7 Volumetric flow or temperature monitoring / switching function

OUTx changes its switching state if it is above or below the set switching limits (SPx, rPx). The following switching functions can be selected:

4.7.1 Hysteresis function



Example of volumetric flow monitoring
HY = hysteresis

Normally open: [OUx] = [Hno]

Normally closed: [OUx] = [Hnc]

First the set point (SPx) is set, then the reset point (rPx) with the requested difference.

When SPx is adjusted rPx is changed automatically; the difference remains constant.

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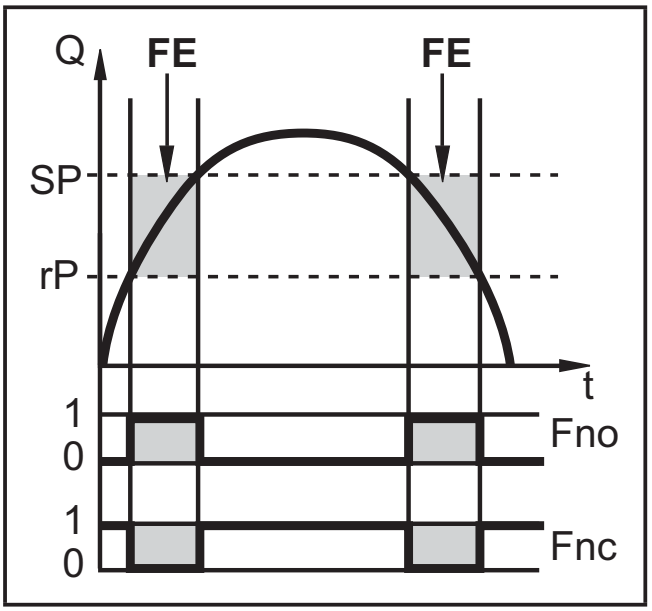
4.7.2 Window function



Example of volumetric flow monitoring
FE = window

Normally open: [OUx] = [Fno]

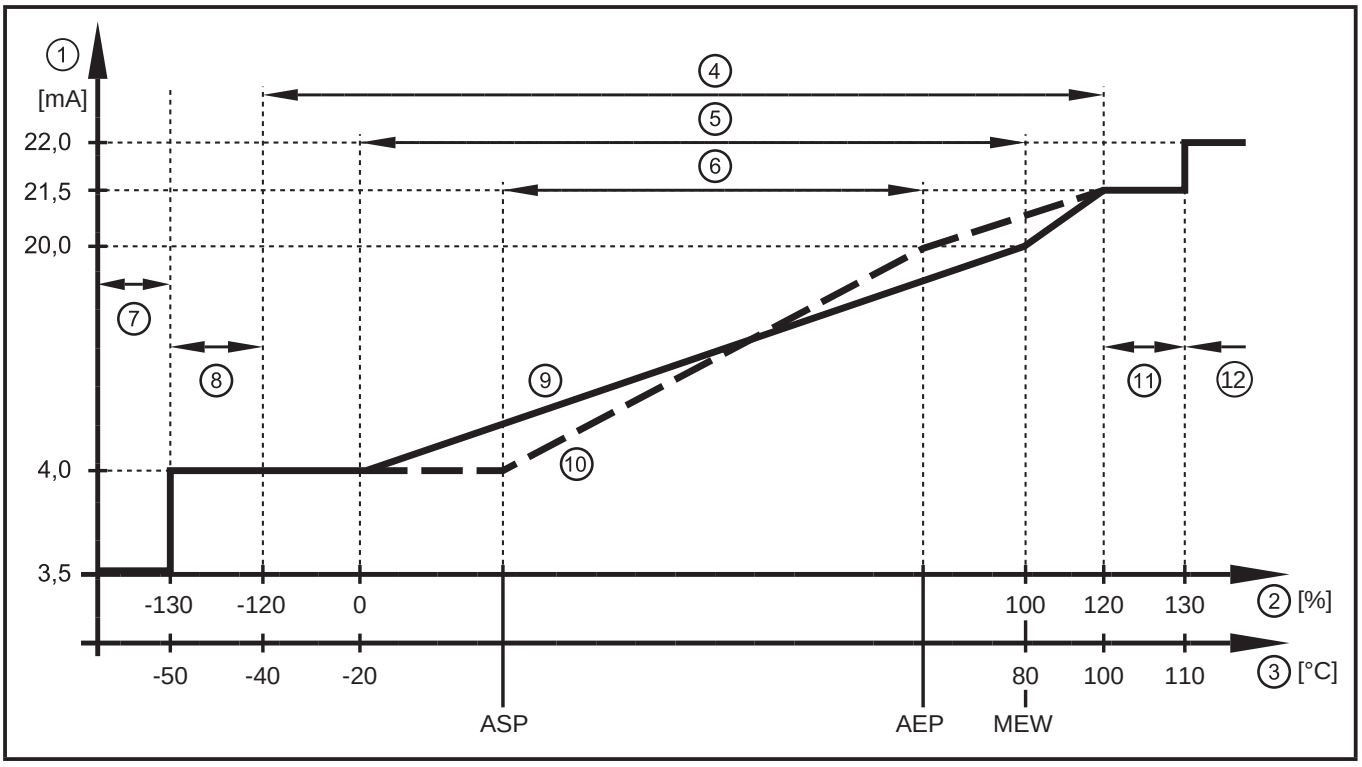
Normally closed: [OUx] = [Fnc]

The width of the window can be set by means of the difference between SPx and rPx.
SPx = upper value
rPx = lower value.

When set to the window function the set and reset points have a fixed hysteresis of 0.25 % of the final value of the measuring range. This keeps the switching state of the output stable if the volumetric flow varies slightly.

4.8 Volumetric flow or temperature monitoring / analogue function

4.8.1 Current output



Characteristics of the analogue output according to the standard IEC 60947-5-7

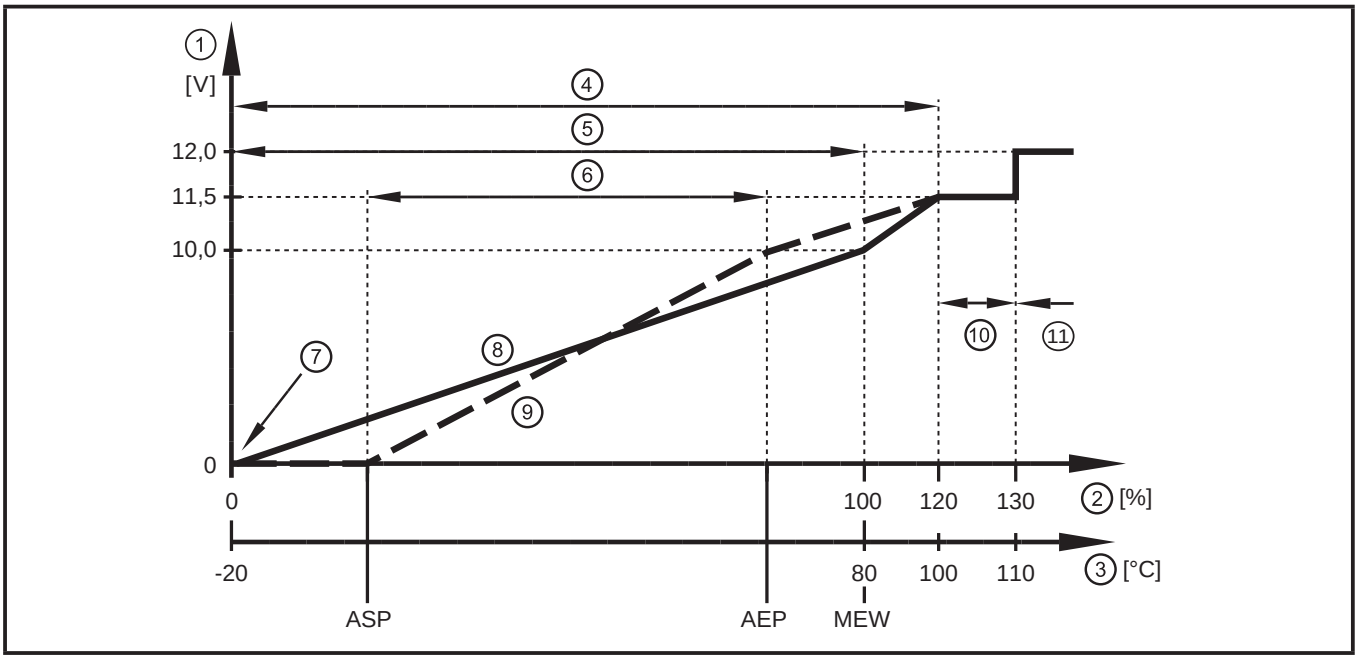
1: Output current
2: Volumetric flow quantity
3: Temperature
4: Display range
5: Measuring range
6: Range between analogue start point and analogue end point
7: The unit is in the error state (FOU = OFF).
8: The process value transmitted in an analogue way is therefore below the display range.
9: Curve of the analogue signal at factory setting
10: Curve of the analogue signal with shifted ASP and AEP
11: The process value transmitted in an analogue way is therefore above the display range.
12: The unit is in the error state (FOU = ON).

ASP = analogue start point: determines at which measured value the output signal is 4 mA
AEP = analogue end point: determines at which measured value the output signal is 20 mA
VMR = final value of the measuring range = 100 %

Minimum distance between ASP and AEP = 20 % of the measuring range

In the set scaling range the output signal is between 4 and 20 mA.

4.8.2 Voltage output



Characteristics of the analogue output according to the standard IEC 60947-5-7

1: Output voltage
2: Volumetric flow quantity
3: Temperature
4: Display range
5: Measuring range
6: Range between analogue start point and analogue end point
7: The unit is in the error state (FOU = OFF) or the process value transmitted in an analogue way is below the display range.
8: Curve of the analogue signal at factory setting
9: Curve of the analogue signal with shifted ASP and AEP
10: The process value transmitted in an analogue way is therefore above the display range.
11: The unit is in the error state (FOU = ON).

ASP = analogue start point: determines at which measured value the output signal is 0 V
AEP = analogue end point: determines at which measured value the output signal is 10 V
VMR = final value of the measuring range = 100 %

Minimum distance between ASP and AEP = 20 % of the measuring range

In the set scaling range the output signal is between 0 and 10 V.

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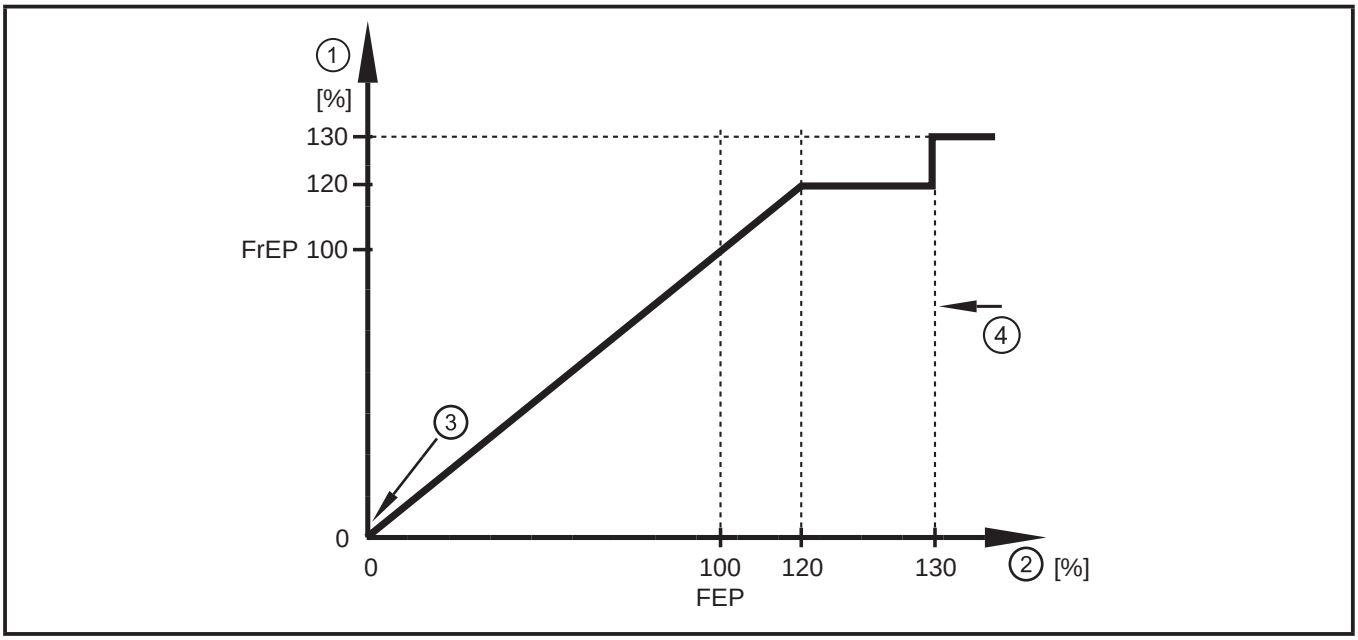
4.9 Volumetric flow monitoring / frequency output



Output curve frequency output
1: Frequency output
2: Volumetric flow quantity Q
3: The unit is in the error state (FOU = OFF) or the process value transmitted in an analogue way is below the display range.
4: The unit is in the error state (FOU = ON).

FrEP = configured frequency at FEP (→ 10.3.4 Setting the frequency value for volumetric flow)

4.10 Start-up delay

The start-up delay dST influences the switching outputs of the volumetric flow monitoring.

If the start-up delay is active (dST > 0), note: As soon as the volumetric flow quantity exceeds the LFC (LFC = low flow cut-off → 4.11), the following processes are carried out:

> The start-up delay is activated.

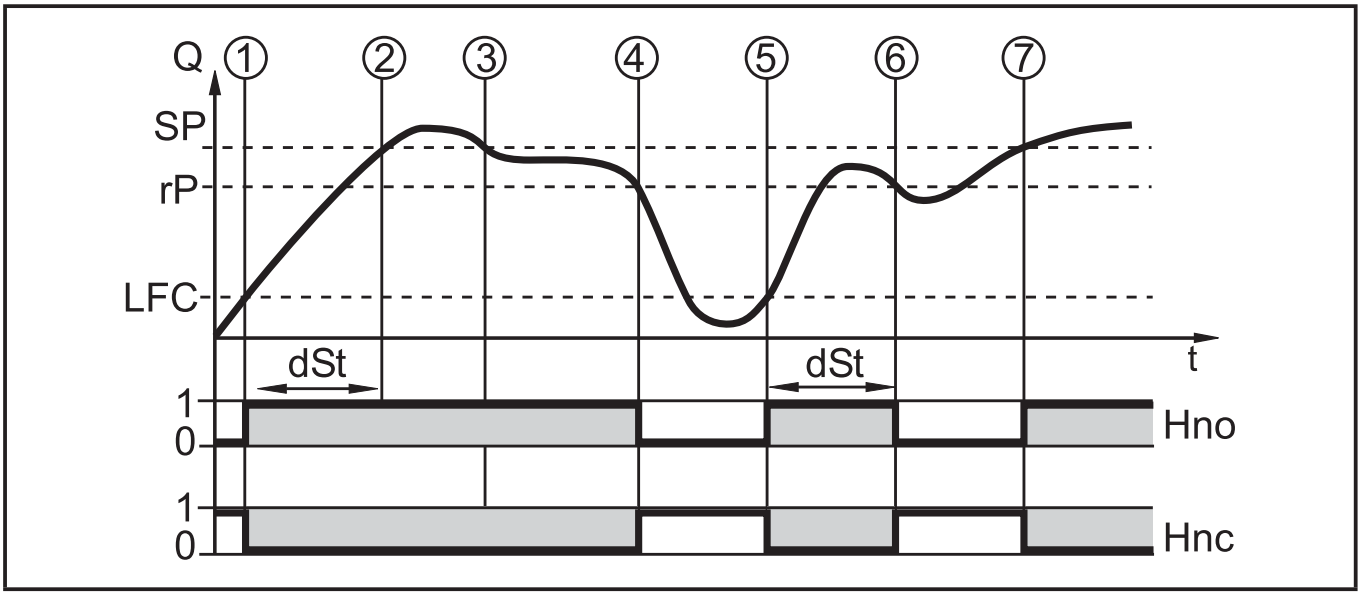
> The outputs switch as programmed:
ON for NO function, OFF for NC function.

After the start of the start-up delay there are 3 options:

1. The volumetric flow quantity increases quickly and reaches the set point / good range within dST.
> Outputs remain active.

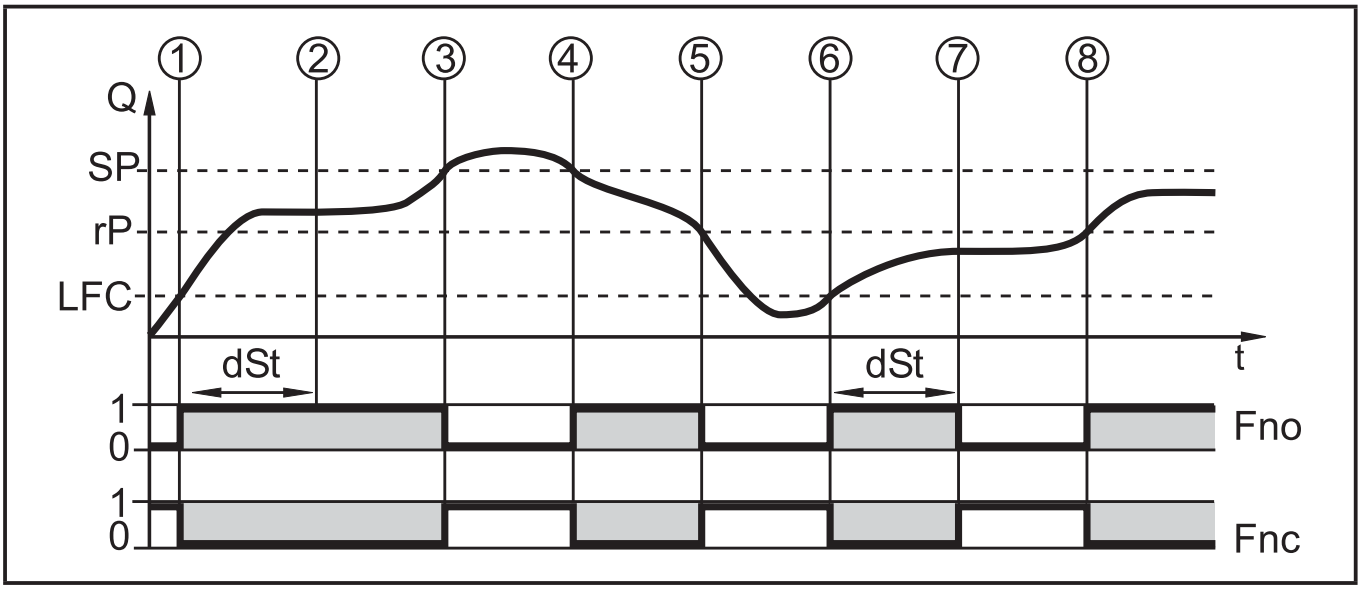
2. The volumetric flow increases slowly and does not reach the set point /good range within dST.
   > Outputs are reset.
3. Volumetric flow quantity falls below LFC within dST.
   > Outputs are reset at once; dST is stopped.

Example: dST for hysteresis function



	Condition	Reaction
1	Volumetric flow quantity Q reaches LFC	dST starts, output becomes active
2	dST elapsed, Q reached SP	output remains active
3	Q below SP but above rP	output remains active
4	Q below rP	output is reset
5	Q reaches again LFC	dST starts, output becomes active
6	dST elapsed, Q has not reached SP	output is reset
7	Q reaches SP	output becomes active

Example: dST for window function



	Condition	Reaction
1	Volumetric flow quantity Q reaches LFC	dST starts, output becomes active.
2	dST elapsed, Q reached good range	output remains active
3	Q above SP (leaves good range)	output is reset
4	Q again below SP	output becomes active again
5	Q below rP (leaves good range)	output is reset again
6	Q reaches again LFC	dST starts, output becomes active
7	dST elapsed, Q has not reached good range	output is reset
8	Q reaches good range	output becomes active

4.11 Low flow cut-off (LFC)

With this function small volumetric flow quantities can be ignored (→ 10.6.13). Flows below the LFC value are evaluated by the sensor as standstill (Q = 0).

4.12 Simulation

With this function small volumetric flow quantities can be suppressed (→ 10.7.3). The simulation does not have any effect on the totaliser or the current flow. The outputs operate as previously set.
When the simulation starts, the value of the totaliser is saved and then the simulated totaliser is set to 0. The simulated flow value then has an effect on the simulated totaliser. When the simulation is finished, the original totaliser value is restored.

During the simulation the original totaliser value remains saved without any changes even if there is a real flow.

5 Installation

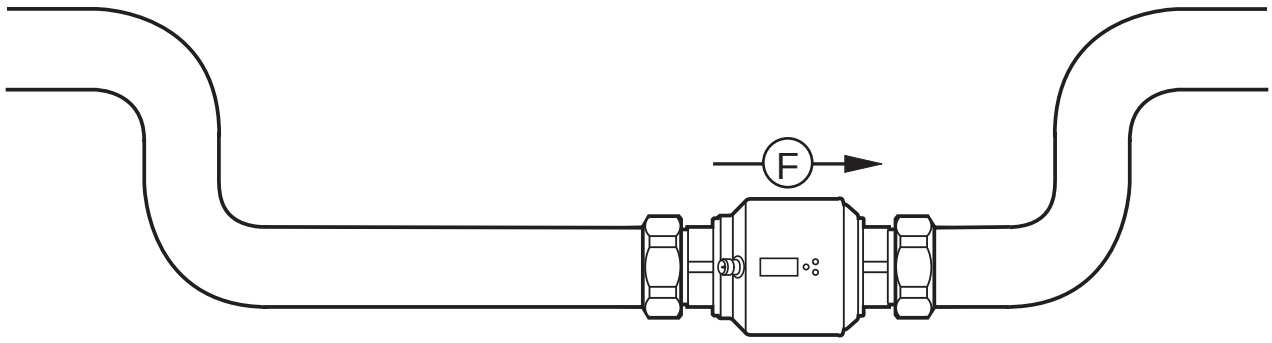
▶ Avoid deposits, accumulated gas and air in the pipe system.

5.1 Recommended installation position

Example of an optimised installation:

UK

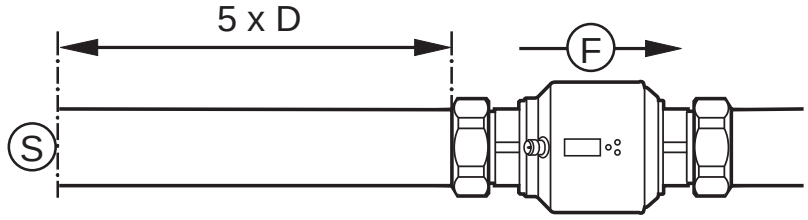
1



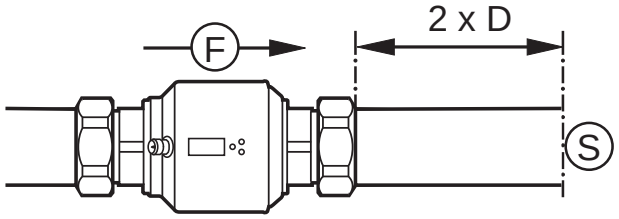
▶ Install the unit so that the measuring pipe is completely filled.

▶ Arrange for inlet and outlet pipe lengths. Disturbances caused by bends, valves, reductions, etc. are compensated for. It applies in particular: No shut-off and control devices are allowed directly in front of the unit.

2

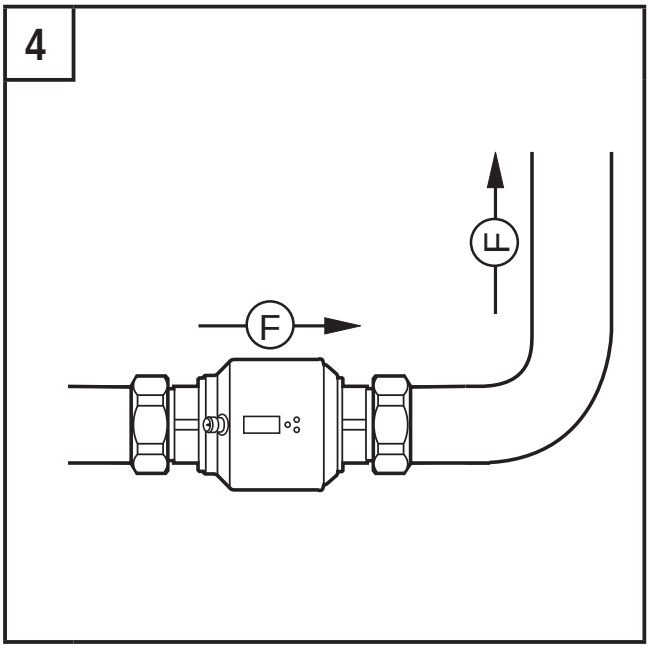


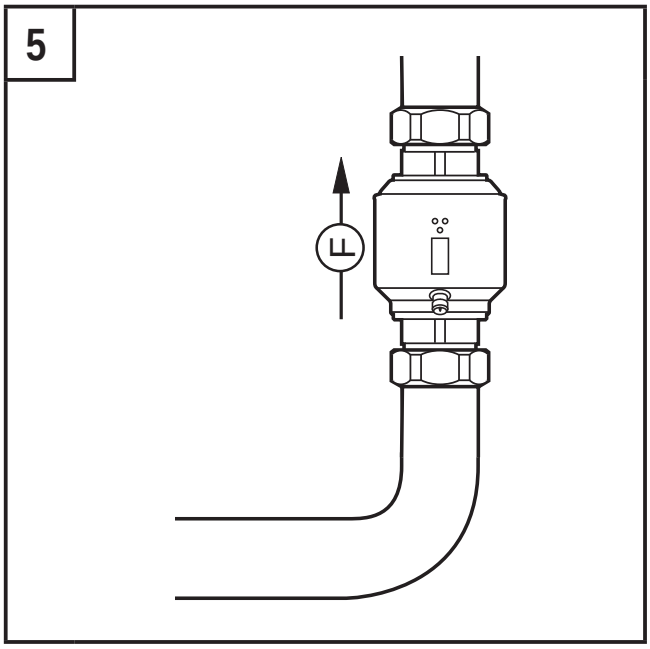
3



S = disturbance; D = pipe diameter; F = flow direction

▶ Install in front of or in a rising pipe:



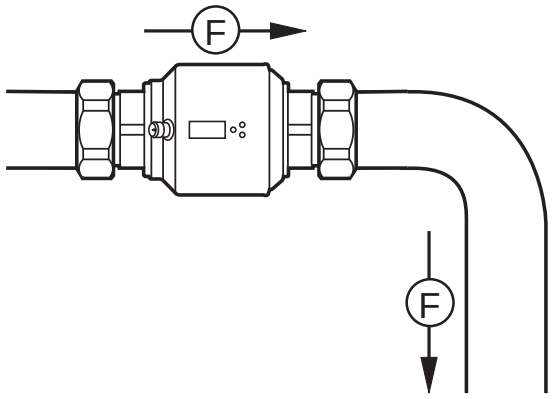


F = flow direction

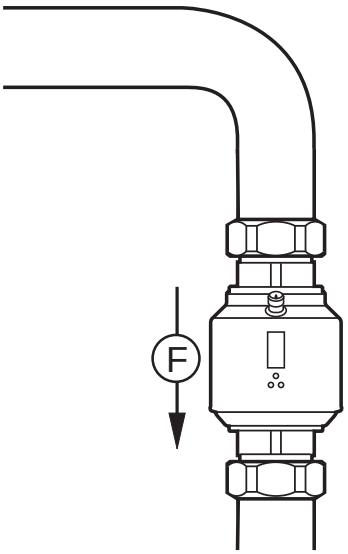
With empty pipe detection:
▶ Install the unit according to figure 1, 4 or 5.

5.2 Not recommended installation position

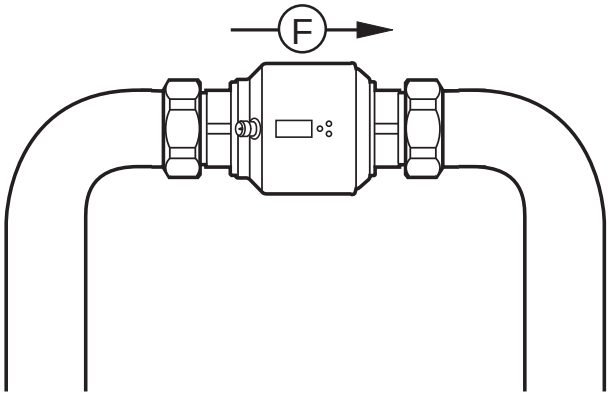
▶ Avoid the following installation positions:



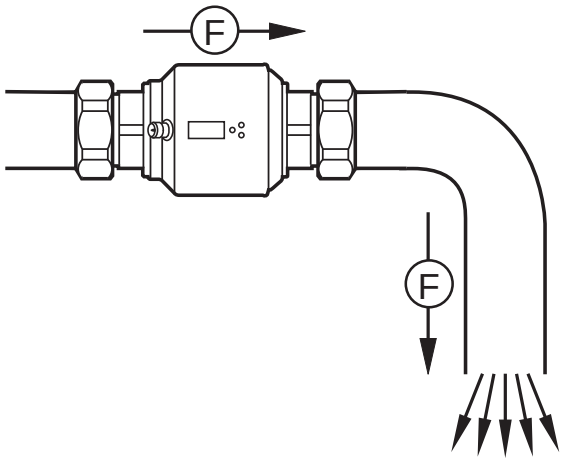
Directly in front of a falling pipe.



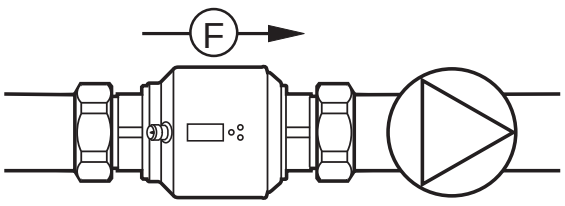
In a falling pipe.



At the highest point of the pipe system.



Directly in front of the spout of the pipe.



On the suction side of a pump.

F = flow direction

The unit can be installed independently of the orientation if the following is ensured:

- No air bubbles can form in the pipe system.
- The pipes are always completely filled.

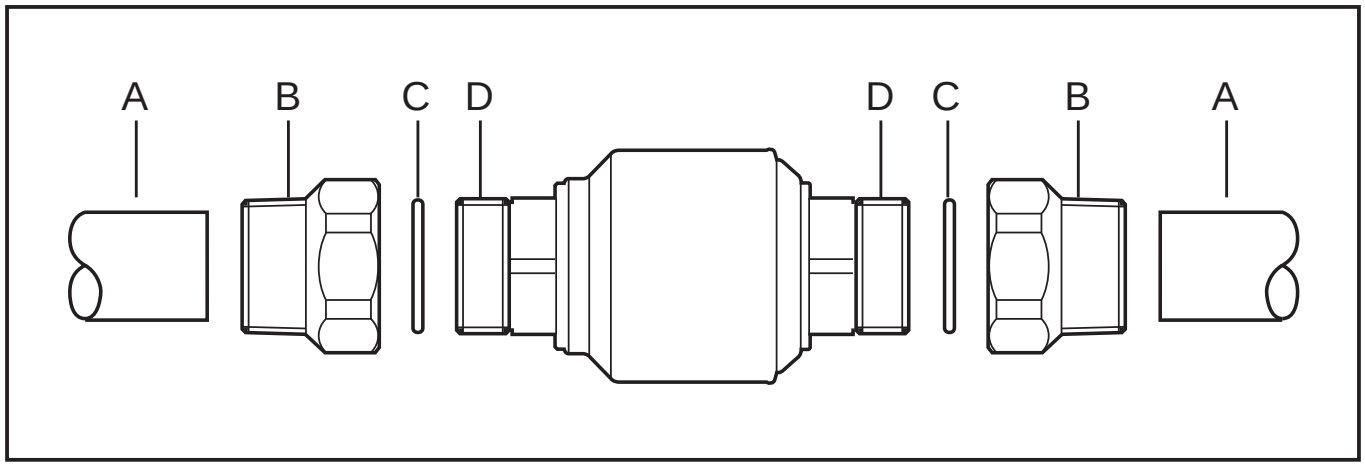
5.3 Grounding

If installed in an ungrounded pipe system (e.g. plastic pipes), the unit must be grounded (functional earth).

Ground brackets for the M12 connector are available as accessories (→ www.ifm.com).

5.4 Installation in pipes

The unit can be installed in pipes using adapters. The adapters have to be ordered separately as accessories (→ www.ifm.com).



1. Screw the adapter (B) into the pipe (A).
2. Place the seals (C) and install the unit according to the marked flow direction.

   ▶ To mount the adapters on the process connection of the sensor use suitable lubricants.
3. Screw the adapter (B) with the threads (D) until it is hand-tight.
4. Tighten the two adapters in opposite direction (tightening torque: 30 Nm).

After installation air bubbles in the system can affect the measurement.
Corrective measures:

▶ Rinse the system after installation for ventilation (rinsing quantity > 15 l/min.).

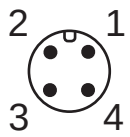
In case of horizontal installation: As a result of design requirements a small quantity of the medium always remains in the measuring channel after switching off the pump.

6 Electrical connection

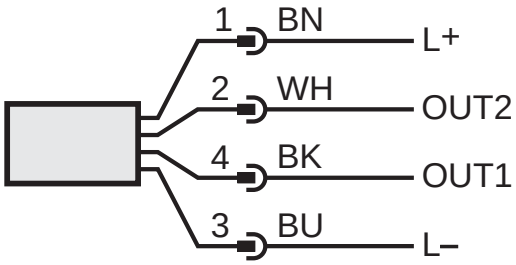
The unit must be connected by a qualified electrician.
The national and international regulations for the installation of electrical equipment must be adhered to.
Voltage supply according to EN 50178, SELV, PELV.

▶ Disconnect power.

▶ Connect the unit as follows:



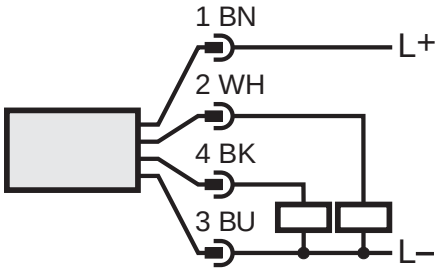
BK: black
BN: brown
BU: blue
WH: white



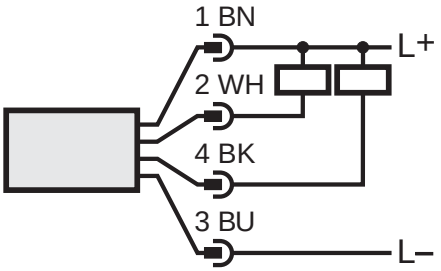
Colours to DIN EN 60947-5-6

Sample circuits:

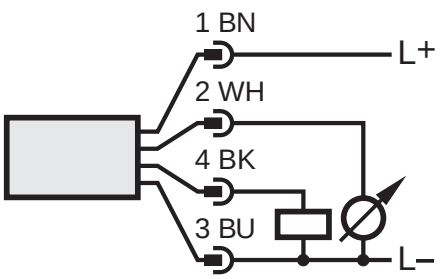
2 x positive switching



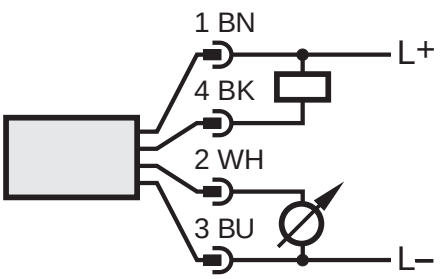
2 x negative switching



1 x positive switching / 1 x analogue



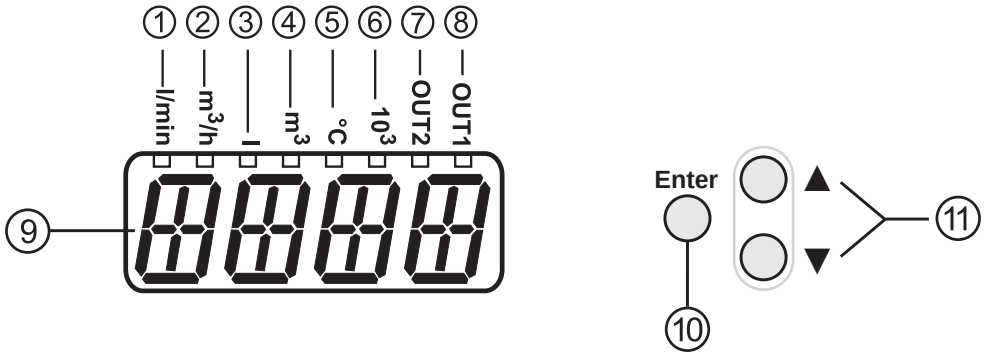
1 x negative switching / 1 x analogue



E-356

Pin 1	L+
Pin 3	L-
Pin 4 (OUT1)	• Switching signal: limit values for volumetric flow • Pulse signal: 1 pulse every time the defined volumetric flow quantity is reached. • Switching signal: quantity meter reached preset value • Frequency signal for volumetric flow quantity • Switching signal: empty pipe detection • IO-Link
Pin 2 (OUT2/ InD)	• Switching signal: limit values for volumetric flow • Switching signal: limit values for temperature • Analogue signal for volumetric flow quantity • Analogue signal for temperature • Switching signal: empty pipe detection • Input for external reset signal (InD)

7 Operating and display elements

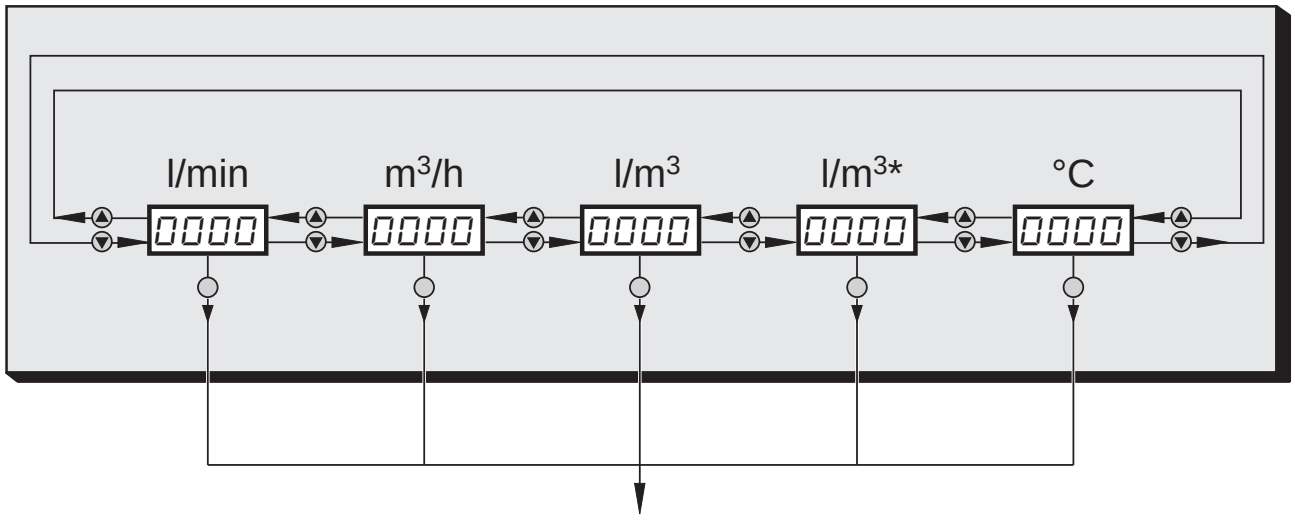


1 to 8: Indicator LEDs
• LEDs 1-6 = Unit of the currently represented numerical value → 11.1 Reading the process value • LED 7 = switching state of output OUT2 / of input InD • LED 8 = switching status of output OUT1
9: Alphanumeric display, 4 digits
• Current volumetric flow quantity (with setting [SELd] = [FLOW]) • Meter reading of the totaliser (with setting [SELd] = [TOTL]) • Current medium temperature (with setting [SELd] = [TEMP]) • Parameters and parameter values

10: [Enter] button
• Selecting the parameters • Reading the set values • Confirming the parameter values Representation in → 8 Menu: ○
11: Buttons up [▲] and down [▼]
• Selection of the parameters • Activation of the setting functions • Changing the parameter values • Change of the display unit in the normal operating mode (Run mode) • Locking / unlocking Representation in → 8 Menu: ▲ and ▼

8 Menu

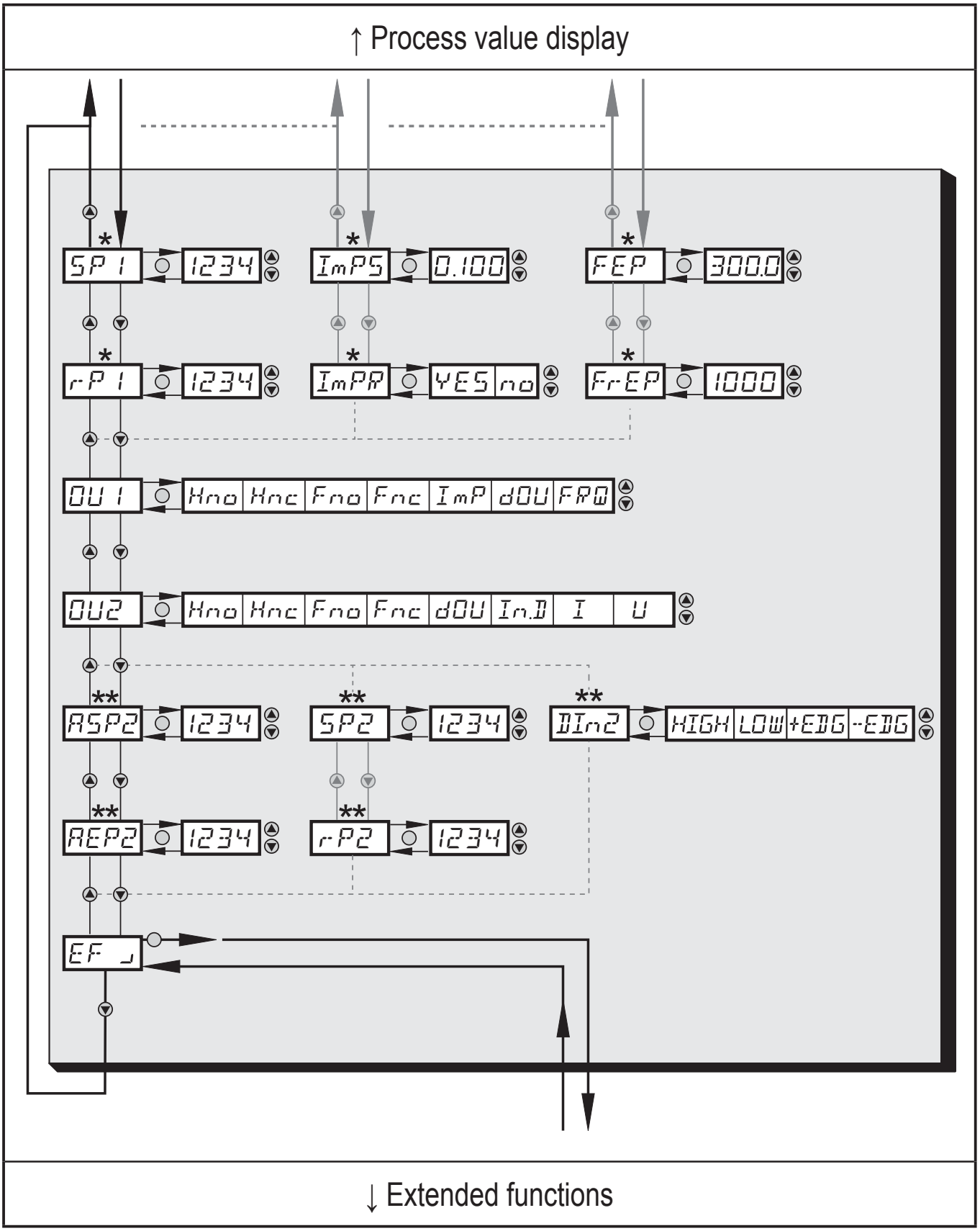
8.1 Process value display



* Stored totaliser value

↓ Main menu

8.2 Main menu

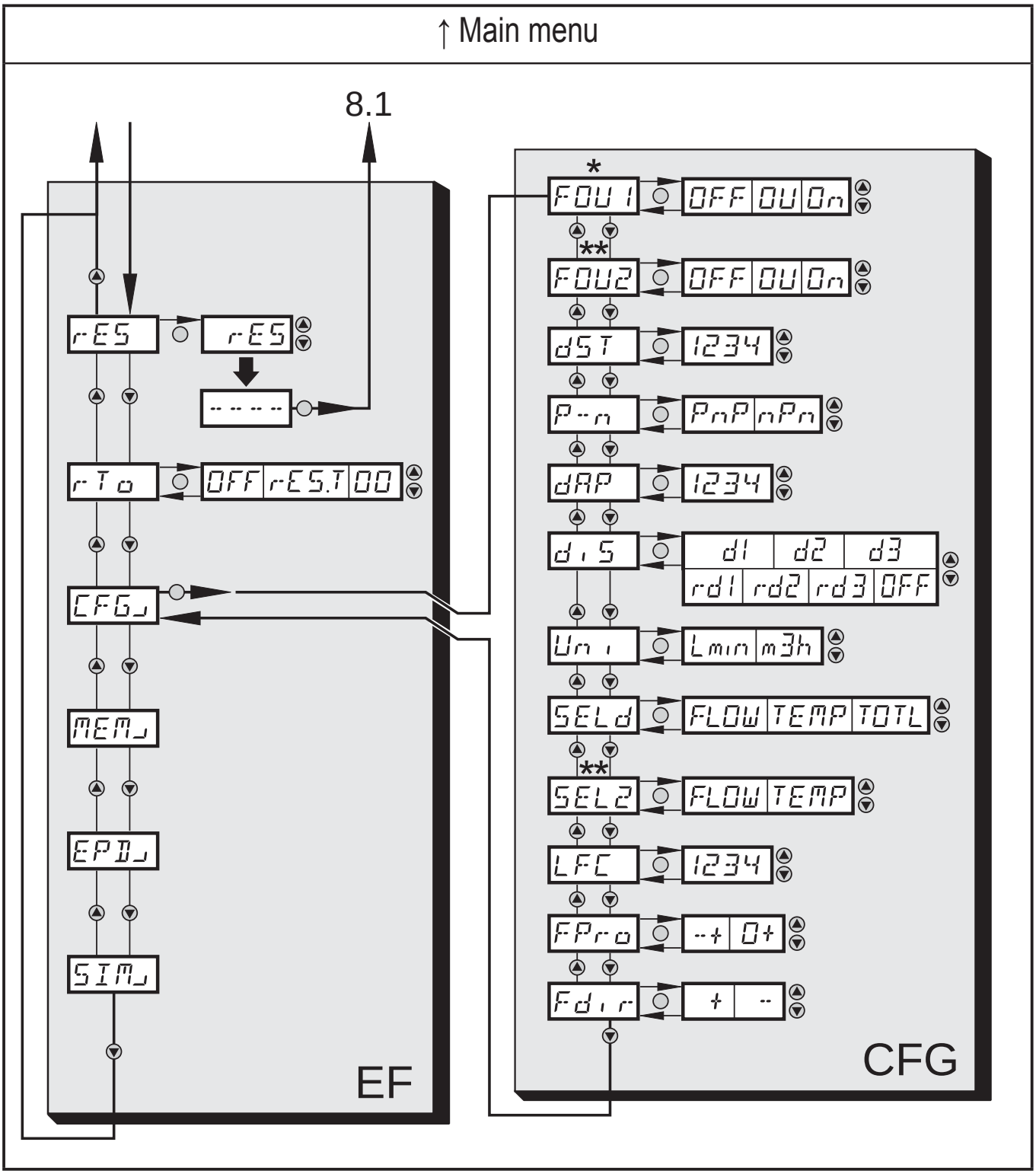


* The parameters are only displayed when selected at OU1.
** The parameters are only displayed when selected at OU2.

8.2.1 Explanation main menu

SP1	Maximum limit value for the set process value
rP1	Minimum limit value for the set process value
ImPS	Pulse value
ImPR	Pulse reset
FEP	Frequency output of the end point of the flow value
FrEP	Frequency output of the end point of the frequency
OU1	Output function for OUT1 (volumetric flow or consumed quantity)
OU2	Output function for OUT2 (volumetric flow or temperature)
	As an alternative: configure OUT2 (Pin2) as input for external reset signal: Setting: [OU2] = [In.D]
Hno	Hysteresis normally open
Hnc	Hysteresis normally closed
Fno	Window normally open
Fnc	Window normally closed
ImP	Pulse output
FRQ	Frequency output
dOU	Diagnostic output
I	Current output
U	Voltage output
In.D	External input
ASP2	Analogue start value for the set process value
AEP2	Analogue end value for the set process value
SP2	Maximum limit value for the set process value
rP2	Minimum limit value for the set process value
DIn2	Configuration of the input (Pin2) for counter reset
EF	Extended functions / opening of menu level 2

8.3 Extended functions – Basic settings



* The parameters are only displayed when selected at OU1.
** The parameters are only displayed when selected at OU2.

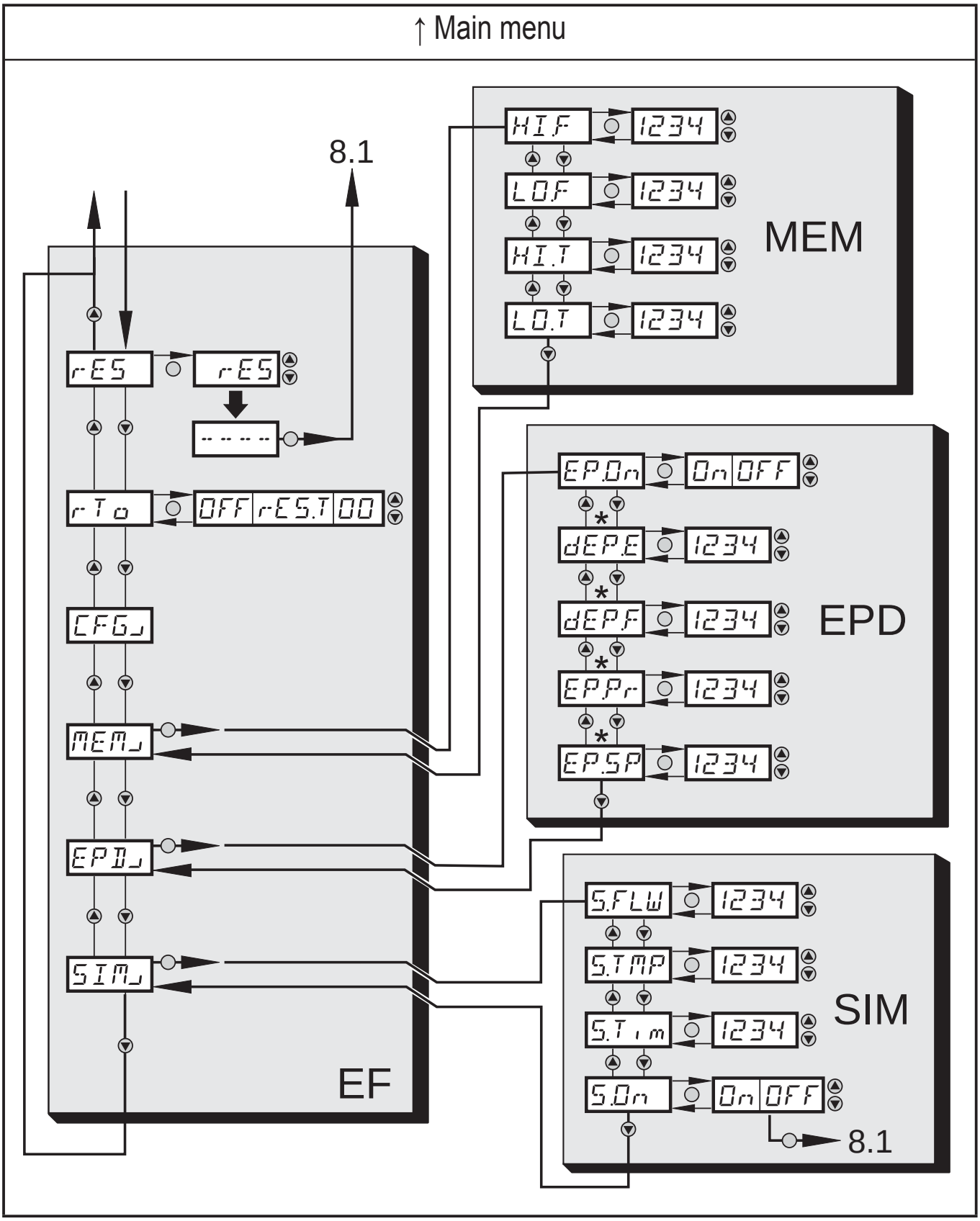
8.3.1 Explanation extended functions (EF)

rES	Restore the factory setting
rTo	Counter reset: manual reset / time-controlled reset
CFG	Submenu basic settings
MEM	Submenu min/max memory
EPD	Submenu empty pipe
SIM	Submenu simulation

8.3.2 Submenu basic settings (CFG)

FOU1	Behaviour of output 1 in case of an error
FOU2	Behaviour of output 2 in case of an error
dST	Start-up delay of volumetric flow monitoring
P-n	Output logic: pnp / npn
dAP	Measured value damping / damping constant in seconds
diS	Update rate and orientation of the display
Uni	Standard unit of measurement for volumetric flow: litres/minute or cubic metres/hour
SELd	Standard measuring unit of the display: volumetric flow value / medium temperature / meter reading
SEL2	Standard unit of measurement for evaluation via OUT2
LFC	Low flow cut-off
FPro	Totaliser: behaviour with negative flow
Fdir	Direction of flow

8.4 Extended functions – Min/max memory – Emtpy pipe – Simulation



* Parameters are only displayed for the selection EP.On = On.

8.4.1 Explanation extended functions (EF)

rES	Restore the factory setting
rTo	Counter reset: manual reset / time-controlled reset
CFG	Submenu basic settings
MEM	Submenu min/max memory
EPD	Submenu empty pipe
SIM	Submenu simulation

8.4.2 Submenu min/max memory (MEM)

HI.F	Max. value flow
LO.F	Min. value flow
HI.T	Max. value temperature
LO.T	Min. value temperature

8.4.3 Submenu empty pipe (EPD)

EP.On	Empty pipe detection on / off
dEP.E.	Delay time empty signal
dEP.F	Delay time full signal
EP.Pr	Current measured value of empty pipe detection
EP.SP	Switch point of empty pipe detection

8.4.4 Submenu simulation (SIM)

S.FLW	Simulation flow value
S.TMP	Simulation temperature value
S.TIM	Simulation time
S.ON	Simulation start

9 Set-up

After power on and expiry of the power-on delay time (approx. 5 seconds) the unit is in the normal operating mode. It carries out its measurement and evaluation functions and generates output signals according to the set parameters.

- During the power-on delay time the outputs are switched as programmed:
  - ON with normally open function (Hno / Fno)
  - OFF with normally closed function (Hnc / Fnc).
- If output 2 is configured as analogue output, the output signal is at 20 mA (current output) or 10 V (voltage output).

10 Parameter setting

Parameters can be set before installation and set-up of the unit or during operation.

If you change parameters during operation, this will influence the function.

▶ Ensure that there will be no malfunctions in your plant.

During parameter setting the unit remains in the operating mode. It continues to monitor with the existing parameter until the parameter setting has been completed.

⚠ CAUTION

For medium temperatures above 50 °C some parts of the housing can heat up to over 65 °C.

▶ Do not press the pushbuttons manually; instead use another object (e.g. ballpoint pen).

10.1 IO-Link

10.1.1 General information

This unit has an IO-Link communication interface which requires an IO-Link-capable module (IO-Link master) for operation.

The IO-Link interface enables direct access to the process and diagnostic data and provides the possibility to set the parameters of the unit during operation.

In addition communication is possible via a point-to-point connection with a USB adapter cable.

You will find more detailed information about IO-Link at www.ifm.com/gb/io-link.

10.1.2 Device-specific information

You will find the IODDs necessary for the configuration of the IO-Link unit and detailed information about process data structure, diagnostic information and parameter addresses at www.ifm.com/gb/io-link.

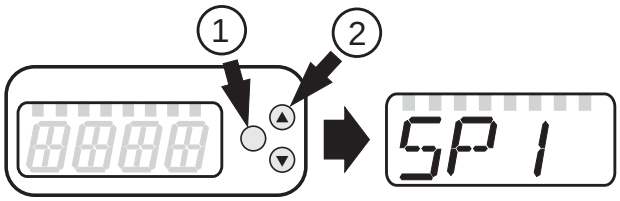
10.1.3 Parameter setting tools

You will find all necessary information about the required IO-Link hardware and software at www.ifm.com/gb/io-link.

10.2 Parameter setting in general

Select the parameter

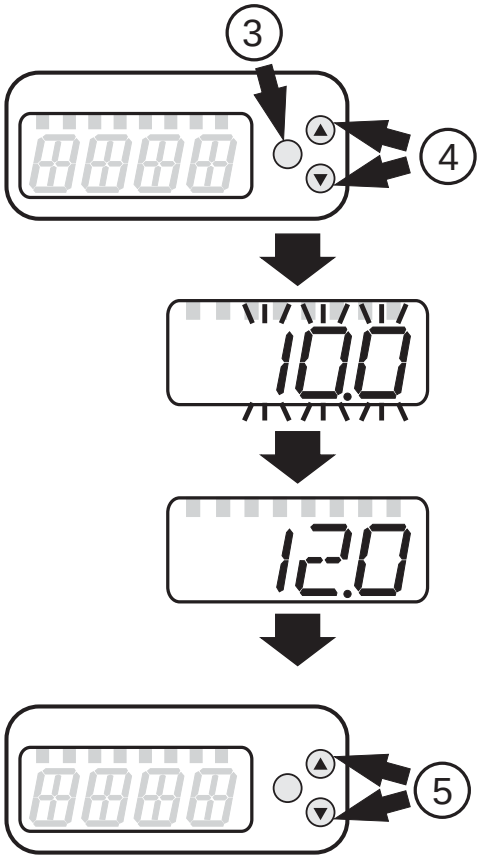
1. Press [Enter] briefly.
2. Press [▲] or [▼] until the requested parameter is displayed**.**



Changing the parameter value

3. Press [Enter] briefly.
   > The currently set value is displayed.
4. Keep [▲] or [▼] pressed for 1 s
   > Display flashes first, then permanent.
5. Change value by pressing [▲] or [▼].

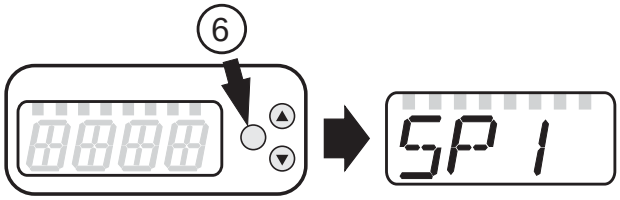
[▲] or [▼] pressed.
> Faster cycle of the numerical values.



Confirm the parameter value

6. Press [Enter] briefly.

> The parameter is displayed again. The new setting value is saved.



Finish parameter setting and change to the process value display:

▶ Wait for 30 seconds

or

▶ Change from the submenu to the main menu, from the main menu to the process value display with [▲] or [▼].

If [C.Loc] is displayed when an attempt is made to modify a parameter value, an IO-Link communication is active (temporary locking). If [S.Loc] is displayed, the sensor is permanently locked via software. This locking can only be removed using a parameter setting software.

10.2.1 Switching between the menu levels

Change to the submenu	Switching to the next submenu via the parameters [EF], [CFG], [MEM], [EPD] or [SIM]. ▶ Select a submenu with [▲] or [▼] and switch to the submenu by pressing [Enter].
Back to the process value display	▶ Wait for 30 seconds or ▶ Change from the submenu to the main menu, from the main menu to the process value display with [▲] or [▼].

10.2.2 Locking / unlocking

The unit can be locked electronically to prevent unintentional settings. Setting at the factory: not locked.

Locking is also possible via an IO-Link capable parameter setting tool.

Locking	▶ Make sure that the unit is in the normal operating mode. ▶ Press [▲] and [▼] simultaneously for 10 s. > [Loc] is displayed. During operation: [LOC] is briefly displayed if you try to change parameter values.
Unlocking	▶ Press [▲] and [▼] simultaneously for 10 s. > [uLoc] is displayed.

10.2.3 Timeout

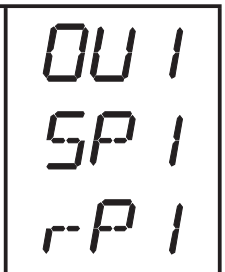
If no button is pressed for 30 s during parameter setting, the unit returns to the operating mode with unchanged parameter.

10.3 Settings for consumed quantity monitoring

10.3.1 Settings for limit value monitoring with OUT1

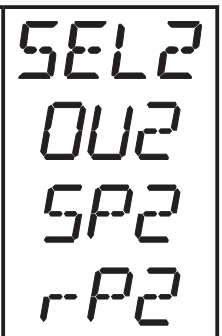
▶ Select [OU1] and set the switching function:
- [Hno] = hysteresis function/NO,
- [Hnc] = hysteresis function/NC,
- [Fno] = window function/NO,
- [Fnc] = window function/NC.

▶ Select [SP1] and set the value at which the output switches.
▶ Select [rP1] and set the value at which the output switches off.



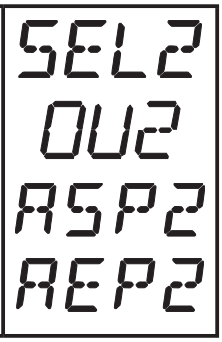
10.3.2 Settings for limit value monitoring with OUT2

- ▶ Select [SEL2] and set [FLOW].
- ▶ Select [OU2] and set the switching function.
  - [Hno] = hysteresis function/NO,
  - [Hnc] = hysteresis function/NC,
  - [Fno] = window function/NO,
  - [Fnc] = window function/NC.
- ▶ Select [SP2] and set the value at which the output switches.
- ▶ Select [rP2] and set the value at which the output switches off.



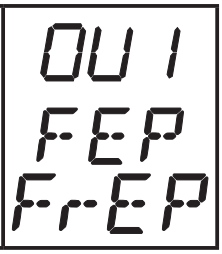
10.3.3 Setting the analogue value for volumetric flow

- ▶ Select [SEL2] and set [FLOW].
- ▶ Select [OU2] and set the function:
  - [I] = current signal proportional to volumetric flow (4…20 mA);
  - [U] = voltage signal proportional to volumetric flow (0…10 V).
- ▶ Select [ASP2] and set the value at which the minimum value is provided.
- ▶ Select [AEP2] and set the value at which the maximum value is provided.



10.3.4 Setting the frequency value for volumetric flow

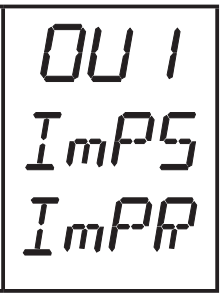
- ▶ Select [OU1] and set [FRQ].
- ▶ Select [FEP] and set the flow value at which the frequency set in FrEP is provided.
- ▶ Select [FrEP] and set the frequency.



10.4 Settings for consumed quantity monitoring

10.4.1 Settings for quantity monitoring via pulse output

- ▶ Select [OU1] and set [ImP].
- ▶ Select [ImPS] and set the volumetric flow quantity at which 1 pulse is provided (→ 10.4.3).
- ▶ Select [ImPR] and set [YES].
- > Pulse repetition is active. Output 1 provides a counting pulse each time the value set in [ImPS] is reached.



10.4.2 Settings for quantity monitoring via the preset counter

- ▶ Select [OU1] and set [ImP].
- ▶ Select [ImPS] and set the volumetric flow quantity at which output 1 switches (→ 10.4.3).
- ▶ Select [ImPR] and set [no].
- > Pulse repetition is not active. The output switches ON if the value set in [ImPS] is reached. It remains set until the counter is reset.

10.4.3 Setting the pulse value

UK

- ▶ Select [ImPS].
- ▶ Press [Enter] briefly.
- > The currently set value is displayed.
- ▶ Keep [▲] or [▼] pressed until "cccc" is displayed.
- ▶ Press [▲] or [▼] to select the setting range.
- > With each press of the pushbutton the display changes to the next setting range (decimal point shifts and / or LED changes).
- ▶ Press [Enter] to confirm the setting range.
- ▶ Press [▲] or [▼] until the requested numerical value is displayed.
- ▶ Press [Enter] briefly.

Setting ranges:

LED*	Unit	Display	Value	Step increment
3	l	000.1...999.9	0.1...999.9 l	0.1 l
4	m³	0.001...9.999	0.001...9.999 m³	0.001 m³
4	m³	00.01...99.99	0.01...99.99 m³	0.01 990 m³
4	m³	000.1...999.9	0,1...999,9 990 m³	0.1 990 m³
4 + 6	m³ x 10³	0.001...9.999	1...9999 m³	1 m³
4 + 6	m³ x 10³	00.01...99.99	10...99 990 m³	10 m³
4 + 6	m³ x 10³	000.1...999.9	100...999 900 m³	100 m³

* indicator LED → 7 Operating and display elements

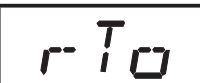
10.4.4 Manual counter reset

- ▶ Select [rTo] and set [rES.T].
- > The counter is reset to zero.

10.4.5 Time-controlled counter-reset

▶ Select [rTo] and set the requested value (intervals of hours, days or weeks). > The counter is reset automatically with the value now set.	

10.4.6 Deactivation of the counter reset

▶ Select [rTo] and set [OFF]. > The meter is only reset after overflow (= factory setting).	

10.4.7 Configure counter reset using an external signal

▶ Select [OU2] and set [InD]. ▶ Select [DIn2] and set the reset signal: - [HIGH] = reset for high signal, - [LOW] = reset for low signal, - [+EDG] = reset for rising edge, - [-EDG] = reset for falling edge.	

10.5 Settings for temperature monitoring

10.5.1 Settings for limit value monitoring with OUT2

▶ Select [SEL2] and set [TEMP]. ▶ Select [OU2] and set the switching function. - [Hno] = hysteresis function/NO, - [Hnc] = hysteresis function/NC, - [Fno] = window function/NO, - [Fnc] = window function/NC. ▶ Select [SP2] and set the value at which the output switches. ▶ Select [rP2] and set the value at which the output switches off.	

10.5.2 Setting the analogue value for temperature

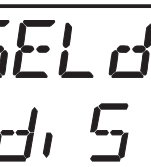
▶ Select [SEL2] and set [TEMP]. ▶ Select [OU2] and set the function: - [I] = temperature-proportional current signal (4…20 mA); - [U] = temperature-proportional voltage signal (0…10 V). ▶ Select [ASP2] and set the value at which the minimum value is provided. ▶ Select [AEP2] and set the value at which the maximum value is provided.	

10.6 User settings (optional)

10.6.1 Setting of the standard unit of measurement for volumetric flow

▶ Select [Uni] and set the unit of measurement: [Lmin] or [m3h]. The setting only has an effect on the volumetric flow value. The counter values (consumed quantity) are automatically displayed in the unit of measurement providing the highest accuracy.	

10.6.2 Configuration of the standard display

▶ Select [SELd] and determine the standard measuring unit: - [FLOW] = the current volumetric flow value in the standard unit of measurement is displayed. - [TOTL] = display indicates the current meter count in l, m^3 or 1000 m^3. - [TEMP] = the current medium temperature in °C is displayed. ▶ Select [diS] and set the update rate and orientation of the display: - [d1] = update of the measured values every 50 ms. - [d2] = update of the measured values every 200 ms. - [d3] = update of the measured values every 600 ms. - [rd1], [rd2], [rd3] = display as for d1, d2, d3; rotated by 180°. - [OFF] = the display is switched off in the operating mode.	

10.6.3 Changing the direction of the flow rate measurement

▶ Select [Fdir] and set the direction of flow: [+] = flow in the direction of the flow arrow (= factory setting) [-] = flow against the flow arrow ▶ label over the arrow	

10.6.4 Setting the output logic

▶ Select [P-n] and set [PnP] or [nPn].	

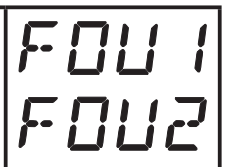
10.6.5 Setting the start-up delay

▶ Select [dST] and set the numerical value in seconds.	

10.6.6 Setting the measured value damping

▶ Select [dAP] and set the damping constant in seconds (τ value 63 %).	

10.6.7 Setting the error behaviour of the outputs

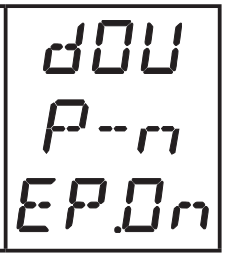


▶ Select [FOU1] and set the value:

1. Switching output:
   - [On] = output 1 switches ON in case of an error.
   - [OFF] = output 1 switches OFF in case of an error.
   - [OU1] = output 1 switches irrespective of the error as defined with the parameters.
2. Frequency output:
   - [On] = 130% of FrEP
   - [OFF] = 0 Hz
   - [OU1] = continues running

▶ Select [FOU2] and set the value:
- [On] = output 2 switches ON in case of an error, the analogue signal goes to the upper error value.
- [OFF] = output 2 switches OFF in case of an error, the analogue signal goes to the lower error value.
- [OU2] = output 2 switches irrespective of the error as defined with the parameters. The analogue signal corresponds to the measured value.

10.6.8 Configuring the empty pipe detection as diagnostic output



▶ Select [OU1] or [OU2] and set [dOU].
▶ Select [P-n] and set [PnP] or [nPn].

The empty pipe detection is only effective if it is activated at [EP. On] → 10.6.9. When the empty pipe state is detected, the diagnostic output is inactive.

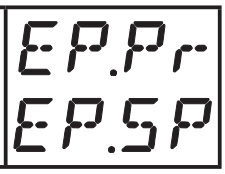
10.6.9 Activating / deactivating empty pipe detection

▶ Select [EP.On] and set the function:
- [OFF] = empty pipe detection deactivated.
- [On] = empty pipe detection activated.

10.6.10 Time-delay empty pipe detection

▶ Select [dEP.E] and set the delay time from 0…30 s, at which the signal should be provided when the pipe is empty.
▶ Select [dEP.F] and set the delay time from 0…30 s, at which the signal should be provided when the pipe is full.

10.6.11 Setting of the empty pipe detection

▶ Select [EP.Pr] to display the current value of the empty pipe detection in percent. ▶ Select [EP.SP] and set the switch point of empty pipe detection.	

10.6.12 Setting the counting method of the totaliser

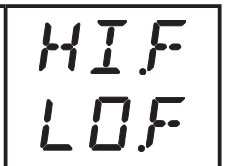
▶ Select [FPro] and set the value: [-+] = totalling the volumetric flow values with the correct sign. [0+] = totalling only positive volumetric flow values.	

10.6.13 Setting the low flow cut-off

▶ Select [LFC] and set the limit value.	

10.7 Service functions

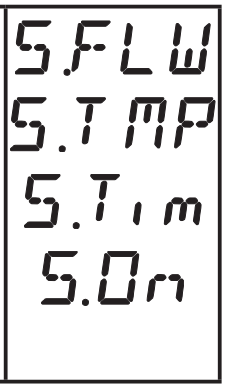
10.7.1 Reading the min/max values for the volumetric flow

▶ Select [HI.F] or [LO.F] [HI.F] = max. value, [LO.F] = min. value. Delete memory: ▶ Select [HI.F] or [LO.F]. ▶ Press [Enter] briefly. ▶ Keep [▲] or [▼] pressed. > [----] is displayed. ▶ Press [Enter] briefly. It makes sense to delete the memories as soon as the unit operates under normal operating conditions for the first time.	

10.7.2 Reading the min/max values for the temperature

▶ Select [HI.T] or [LO.T] [HI.T] = max. value, [LO.T] = min. value. Delete memory: ▶ Select [HI.T] or [LO.T]. ▶ Press [Enter] briefly. ▶ Keep [▲] or [▼] pressed. > [----] is displayed. ▶ Press [Enter] briefly. It makes sense to delete the memories as soon as the unit operates under normal operating conditions for the first time.	

10.7.3 Simulation menu

▶ Select [S.FLW] and set the flow value to be simulated. ▶ Select [S.TMP] and set the temperature value to be simulated. ▶ Select [S.Tim] and set the time of the simulation in minutes. ▶ Select [S.On] and set the function: - [On]: The simulation starts. The values are simulated for the time set at [S.Tim]. [SIM] is displayed simultaneously with the process values. Cancel with [Enter]. - [OFF]: The simulation is not active.	

10.7.4 Resetting all parameters to factory setting

▶ Select [rES]. ▶ Press [Enter] briefly. ▶ Keep [▲] or [▼] pressed. > [----] is displayed. ▶ Press [Enter] briefly. For the factory settings please refer to the end of these instructions → 13. We recommend taking down your own settings in that table before carrying out a reset.	

11 Operation

11.1 Reading the process value

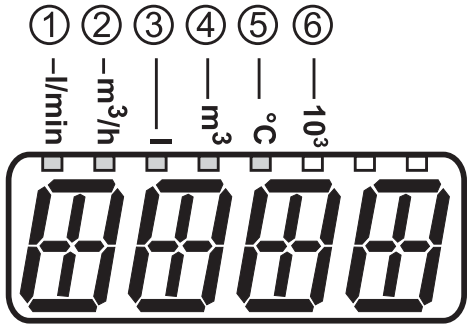
The LEDs 1-6 signal which process value is currently displayed.The process value to be displayed as standard (temperature, flow velocity or meter reading of the totaliser) can be preset → 10.6.2 Configuration of the standard display. A standard unit of measurement can be defined for the flow velocity (l/min or m^3/h → 10.6.1).

Further process values can be read in addition to the preset standard display:

▶ Press the buttons [▲] or [▼].

> The LED of the selected process value display is lit and the current process value is displayed.

> After 30 seconds the display changes to the standard display.



LED			Process value display	Unit
1	□		Current flow volume per minute	l/min
2	□		Current flow volume per hour	m^3 / h
3	□	Totaliser *	Current consumed quantity since the last reset	l
3	⌸		Consumed quantity before the last reset	L
4	□		Current consumed quantity since the last reset	m^3
4	⌸		Consumed quantity before the last reset	m^3
4 + 6	□		Current consumed quantity since the last reset	m^3 x 10^3
4 + 6	⌸		Consumed quantity before the last reset	m^3 x 10^3
5	□		Current medium temperature	°C

□ LED is lit; ⌸ LED flashes

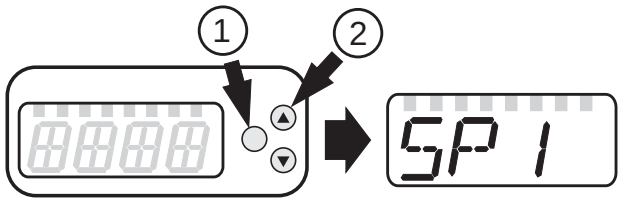
* The consumed quantity is automatically displayed in the unit of measurement providing the highest accuracy.

11.2 Reading the parameter value

To display the currently set parameter value, take the following steps:

Select the parameter

1. Press [Enter] briefly.
2. Press [▲] or [▼] until the requested parameter is displayed**.**

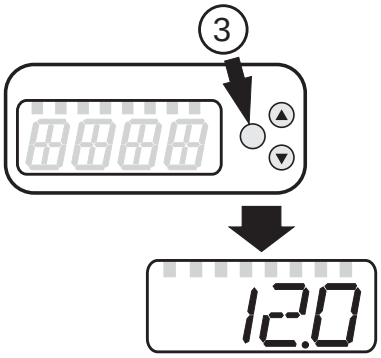


Display the parameter value

3. Press [Enter] briefly.

> The currently set value is displayed for 30 s.

By pressing [Enter] briefly several times, the display switches between parameter and parameter value.



Switching to the process value display

▶ Wait for 30 seconds

or

▶ Change from the submenu to the main menu, from the main menu to the process value display with [▲] or [▼].

11.3 Error indications

	Warning message
[SC1]	Short circuit in OUT1. LED8 for OUT1 flashes (→ 7 Operating and display elements).
[SC2]	Short circuit in OUT2. LED7 for OUT2 flashes (→ 7 Operating and display elements).
[SC]	Short circuit in both outputs. LED7 and LED8 flash (→ 7 Operating and display elements).
[OL]	Detection zone of volumetric flow or temperature exceeded. Measured value between 120 % and 130 % of the final value of the measuring range.
[UL]	Below the detection zone of volumetric flow or temperature. Measured value between -120 % and -130 % of the final value of the measuring range.
[Err]	• Unit faulty / malfunction. • Measured value greater than 130 % of the final value of the measuring range. • Measured value lower than -130 % of the final value of the measuring range.
[C.Loc]	Setting pushbuttons locked, parameter change rejected. Active IO-Link communication.
[S.Loc]	Setting pushbuttons locked, parameter change rejected. Unlock using parameter setting software.
[SEnS]	• Sensor signal invalid. • Measuring pipe not sufficiently filled. • Medium with too low a conductivity.
[IOE.n]	Malfunctioning. The unit is faulty and must be replaced.

12 Technical data

Technical data and scale drawing at www.ifm.com.

13 Factory setting

	Factory setting	User setting
SP1	20 % *	
rP1	19.5 % *	
ImPS	0.1	
ImPR	YES	
OU1	Hno	
OU2	I	
SP2 (FLOW)	40 % *	
rP2 (FLOW)	39.5 % *	
SP2 (TEMP)	20 °C	
rP2 (TEMP)	-19.6 °C	
ASP2 (FLOW)	0 % *	
AEP2 (FLOW)	100 % *	
ASP2 (TEMP)	-20 °C	
AEP2 (TEMP)	80 °C	
FEP	100 % *	
FrEP	1 kHz	
FDir	+	
FPro	- +	
LFC	5 l/min	
DIn2	+EDG	
FOU1	OFF	
FOU2	OFF	
dST	0	
P-n	PnP	
dAP	0.6 s	
rTo	OFF	
diS	d2	

Uni	**Lmin**	
SELd	**FLOW**	
SEL2	**FLOW**	
EP.On	**OFF**	
dEP.E	**0 s**	
dEP.F	**2 s**	
EP.SP	**75 %**	
S.FLW	**20 %**	
S.TMP	**20 °C**	
S.Tim	**3 min**	

* of the final value of the measuring range

BA00082D/06/EN/16.15
71280120

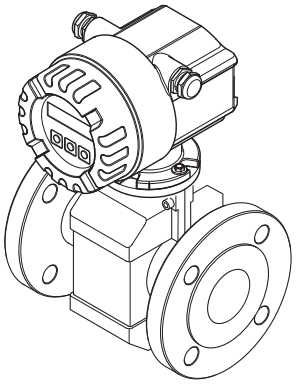
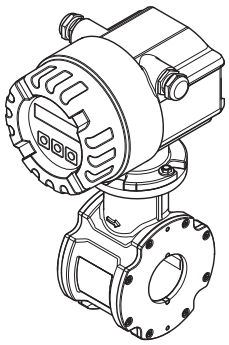
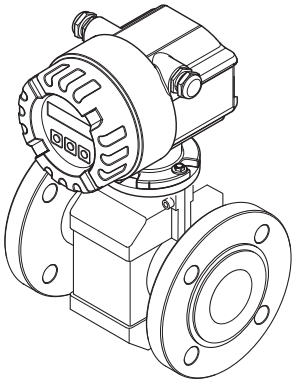
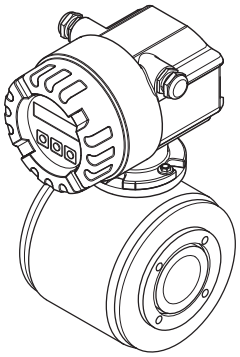
Valid as of software version
V 1.04.00 (device software)

FT-102/2 - Flow meter, Endress, Promag 10D50 2"10D50-4LGA1RA0B4AAM1 Compact head

Operating Instructions
Proline Promag 10
HART

Electromagnetic flowmeter

HART®
FIELD COMMUNICATION PROTOCOL

Endress+Hauser
People for Process Automation

E-381

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1 Safety instructions

1.1 Designated use

The measuring device described in this Operating Manual is to be used only for measuring the flow rate of conductive fluids in closed pipes.

Most liquids can be measured as of a minimum conductivity of 50 µS/cm.

Examples:
- Acids, alkalis
- Drinking water, wastewater, sewage sludge
- Milk, beer, wine, mineral water, etc.

Resulting from incorrect use or from use other than that designated the operational safety of the measuring devices can be suspended. The manufacturer accepts no liability for damages being produced from this.

1.2 Installation, commissioning and operation

Please note the following:
- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist must have read and understood this Operating Manual and must follow the instructions it contains.
- The device must be operated by persons authorized and trained by the facility's owner-operator. Strict compliance with the instructions in the Operating Manual is mandatory.
- With regard to special fluids, including fluids used for cleaning, Endress+Hauser will be happy to assist in clarifying the corrosion-resistant properties of wetted materials. However, minor changes in temperature, concentration or in the degree of contamination in the process may result in variations in corrosion resistance. For this reason, Endress+Hauser does not accept any responsibility with regard to the corrosion resistance of wetted materials in a specific application.
  The user is responsible for the choice of suitable wetted materials in the process.
- If welding work is performed on the piping system, do not ground the welding appliance through the Promag flowmeter.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be grounded apart from when special protective measures are taken (e.g. galvanically isolated SELV or PELV power supply)
- Invariably, local regulations governing the opening and repair of electrical devices apply.

1.3 Operational safety

Please note the following:
- Measuring systems for use in hazardous environments are accompanied by separate Ex documentation, which is an integral part of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this Ex documentation indicates the approval and the certification body (e.g. Ex Europe, FM USA, CSA Canada).
- The measuring device complies with the general safety requirements in accordance with EN 61010-1, the EMC requirements of IEC/EN 61326 and NAMUR Recommendations NE 21 and NE 43.
- Depending on the application, the seals of the process connections of the Promag H sensor require periodic replacement.
- When hot fluid passes through the measuring tube, the surface temperature of the housing increases. In the case of the sensor, in particular, users should expect temperatures that can be close to the fluid temperature. If the temperature of the fluid is high, implement sufficient measures to prevent burning or scalding.

- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser distributor will supply you with current information and updates to these Operating Instructions.

1.4 Return

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at www.services.endress.com/return-material

1.5 Notes on safety conventions and icons

The devices are designed to meet state-of-the-art safety requirements, have been tested, and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010-1 "Safety requirements for electrical equipment for measurement, control and laboratory use".
The devices can, however, be a source of danger if used incorrectly or for anything other than the designated use. Consequently, always pay particular attention to the safety instructions indicated in this Operating Manual by the following icons:

Warning!
"Warning" indicates an action or procedure which, if not performed correctly, can result in injury or a safety hazard. Comply strictly with the instructions and proceed with care.

Caution!
"Caution" indicates an action or procedure which, if not performed correctly, can result in incorrect operation or destruction of the device. Comply strictly with the instructions.

Note!
"Note" indicates an action or procedure which, if not performed correctly, can have an indirect effect on operation or trigger an unexpected response on the part of the device.

2 Identification

2.1 Device designation

The flow measuring system consists of the following components:

- Promag 10 transmitter
- Promag D/E/H/L/P/W sensor

In the *compact version*, the transmitter and sensor form a single mechanical unit; in the *remote version* they are installed separately.

2.1.1 Nameplate of the transmitter

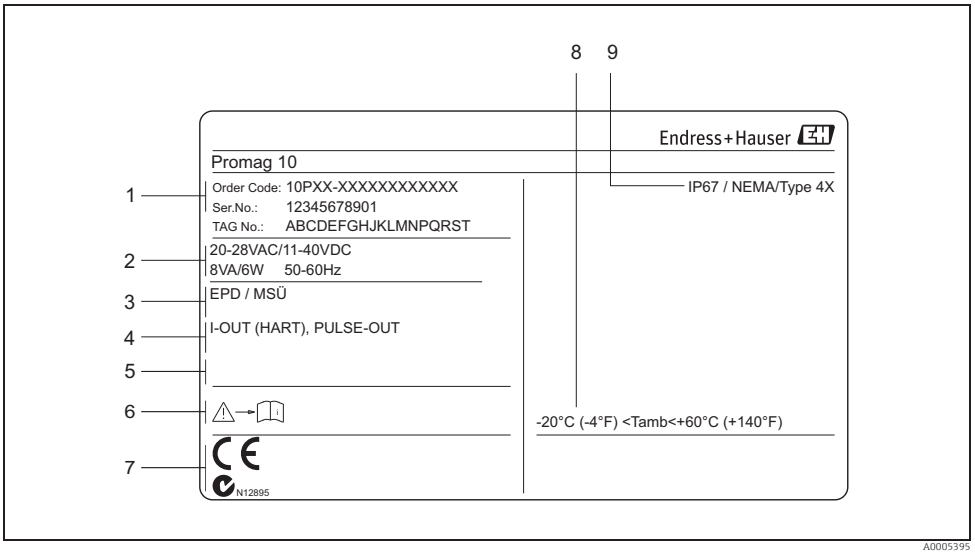


Fig. 1: Nameplate specifications for the "Promag 10" transmitter (example)

1 Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.
2 Power supply, frequency, power consumption
3 Additional information:
EPD/MSÜ: with Empty Pipe Detection
4 Outputs available:
I-OUT (HART): with current output (HART)
PULSE-OUT: with pulse/status output
5 Reserved for information on special products
6 Observe device documentation
7 Reserved for additional information on device version (approvals, certificates)
8 Permitted ambient temperature range
9 Degree of protection

2.1.2 Nameplate of the sensor

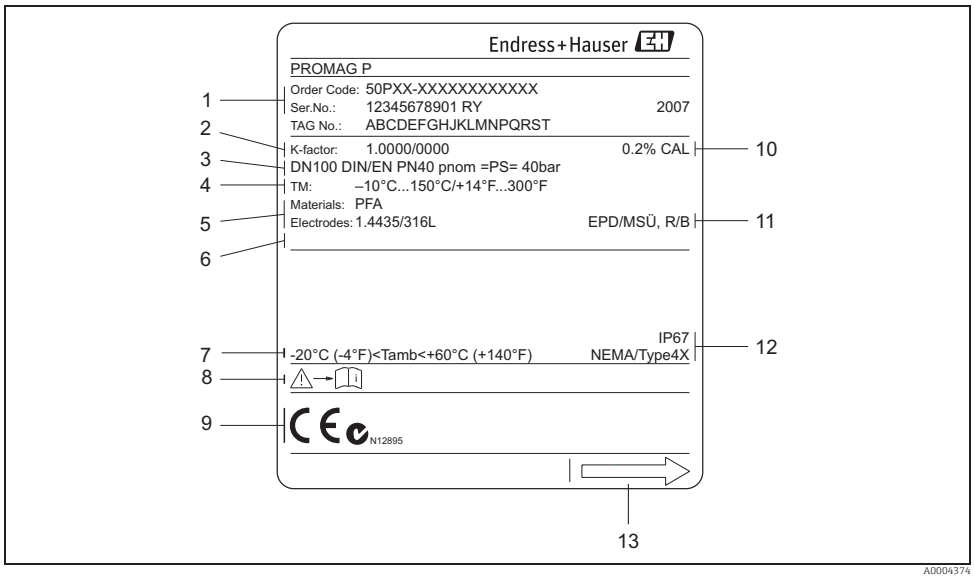


Fig. 2: Nameplate specifications for the "Promag" sensor (example)

1 *Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.*
2 *Calibration factor with zero point*
3 *Nominal diameter/Pressure rating*
4 *Fluid temperature range*
5 *Materials: lining/measuring electrodes*
6 *Reserved for information on special products*
7 *Permitted ambient temperature range*
8 *Observe device documentation*
9 *Reserved for additional information on device version (approvals, certificates)*
10 *Calibration tolerance*
11 *Additional information (examples):*
- *EPD/MSÜ: with Empty Pipe Detection electrode*
- *R/B: with reference electrode*

12 *Degree of protection*
13 *Flow direction*

2.1.3 Nameplate, connections

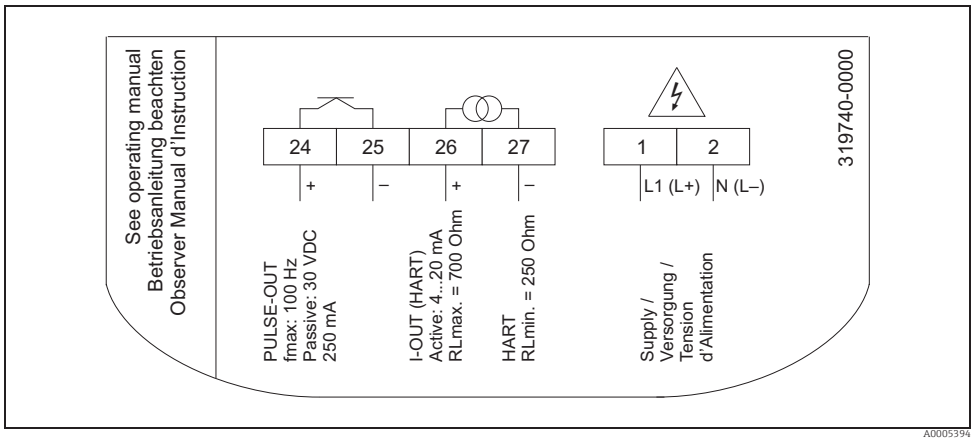


Fig. 3: Nameplate specifications for transmitter (example)

2.2 Certificates and approvals

The devices are designed to meet state-of-the-art safety requirements in accordance with sound engineering practice. They have been tested and left the factory in a condition in which they are safe to operate.

The devices comply with the applicable standards and regulations in accordance with EN 61010-1 "Safety requirements for electrical equipment for measurement, control and laboratory use" and with the EMC requirements of IEC/EN 61326.

The measuring system described in this Operating Manual is therefore in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

2.3 Registered trademarks

KALREZ® and VITON®
Registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

TRI-CLAMP®
Registered trademark of Ladish & Co., Inc., Kenosha, USA

HART®
Registered trademark of the HART Communication Foundation, Austin, USA

FieldCare®, Fieldcheck®, Applicator®
Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

3 Installation

3.1 Incoming acceptance, transport and storage

3.1.1 Incoming acceptance

On receipt of the goods, check the following:
- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

3.1.2 Transport

The following instructions apply to unpacking and to transporting the device to its final location:
- Transport the devices in the containers in which they are delivered.
- Do not remove the protective plates or caps on the process connections until you are ready to install the device. This is particularly important in the case of sensors with PTFE linings.

Special notes on flanged devices

Caution!
- The wooden covers mounted on the flanges from the factory protect the linings on the flanges during storage and transportation. In case of Promag L they are additionally used to hold the lap joint flanges in place. Do not remove these covers until immediately before the device in the pipe.
- Do not lift flanged devices by the transmitter housing, or the connection housing in the case of the remote version.

Transporting flanged devices DN ≤ 300 (12")

Use webbing slings slung round the two process connections.
Do not use chains, as they could damage the housing.

Warning!
Risk of injury if the measuring device slips. The center of gravity of the assembled measuring device might be higher than the points around which the slings are slung.
At all times, therefore, make sure that the device does not unexpectedly turn around its axis or slip.

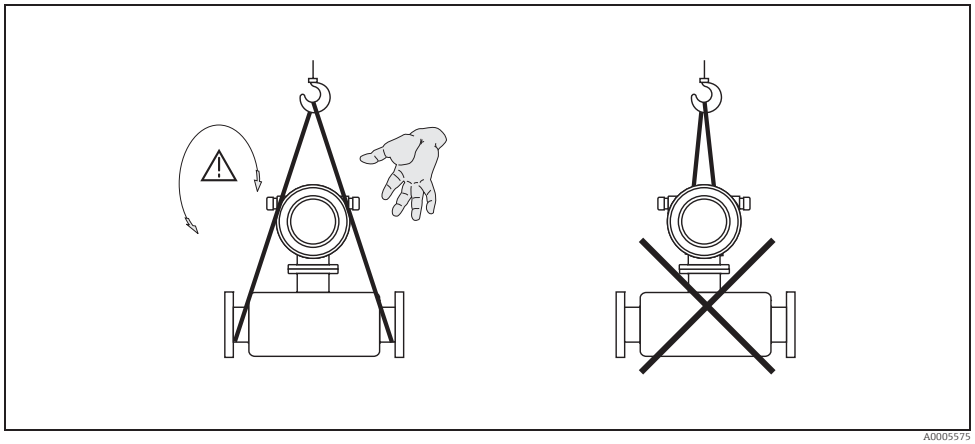


Fig. 4: Transporting sensors with DN ≤ 300 (12")

Transporting flanged devices DN ≥ 350 (14")

Use only the metal eyes on the flanges for transporting the device, lifting it and positioning the sensor in the piping.

Caution!
Do not attempt to lift the sensor with the tines of a fork-lift truck beneath the metal casing. This would buckle the casing and damage the internal magnetic coils.

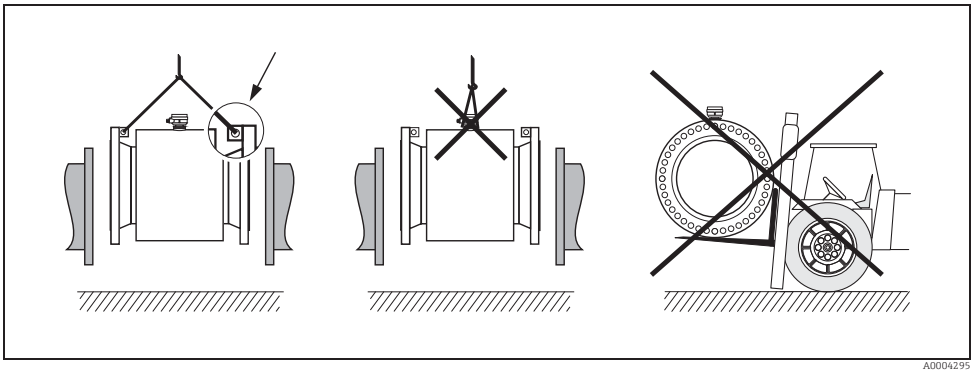


Fig. 5: Transporting sensors with DN ≥ 350 (14")

3.1.3 Storage

Please note the following:
- Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors → 86.
- Do not remove the protective plates or caps on the process connections until you are ready to install the device. This is particularly important in the case of sensors with PTFE linings.
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Choose a storage location where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.

3.2 Installation conditions

3.2.1 Dimensions

The dimensions and installation lengths of the sensor and transmitter can be found in the "Technical Information" for the device in question. This document can be downloaded as a PDF file from www.endress.com. A list of the "Technical Information" documents available is provided in the "Documentation" section on → 🖹 107.

3.2.2 Mounting location

Entrained air or gas bubble formation in the measuring tube can result in an increase in measuring errors.
Avoid the following locations:
- Highest point of a pipeline. Risk of air accumulating!
- Directly upstream from a free pipe outlet in a vertical pipeline.

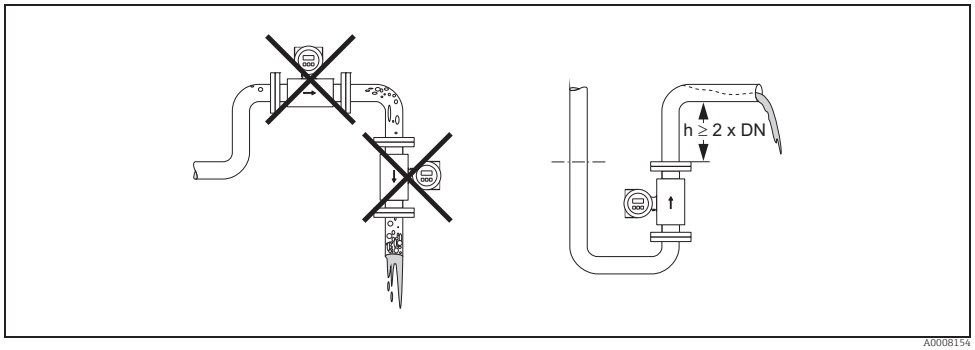


Fig. 6: Mounting location

Installation of pumps

Do not install the sensor on the intake side of a pump. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the lining's resistance to partial vacuum can be found on → 🖹 90.

It might be necessary to install pulse dampers in systems incorporating reciprocating, diaphragm or peristaltic pumps. Information on the measuring system's resistance to vibration and shock can be found on → 🖹 87.

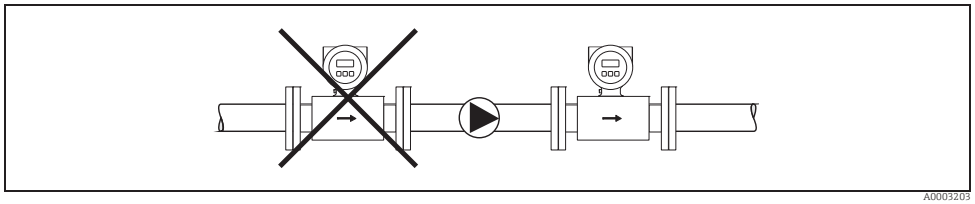


Fig. 7: Installation of pumps

Partially filled pipes

Partially filled pipes with gradients necessitate a drain-type configuration.
The Empty Pipe Detection function (EPD → 68) offers additional protection by detecting empty or partially filled pipes.

Caution!
Risk of solids accumulating. Do not install the sensor at the lowest point in the drain. It is advisable to install a cleaning valve.

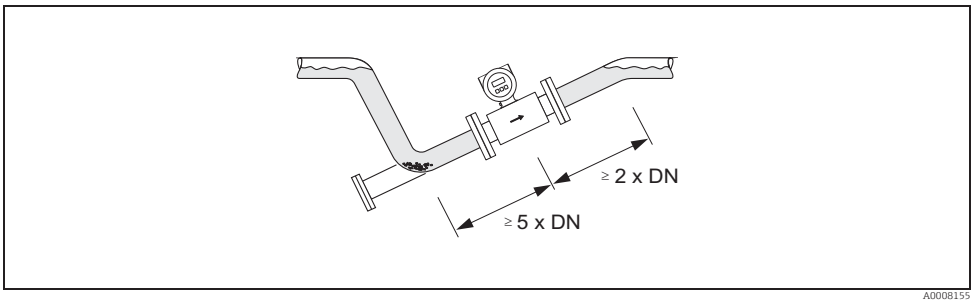


Fig. 8: Installation in a partially filled pipe

Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes whose length h ≥ 5 m (16.4 ft). This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube.
This measure also prevents the system losing prime, which could cause air pockets.
Information on the lining's resistance to partial vacuum can be found on → 90.

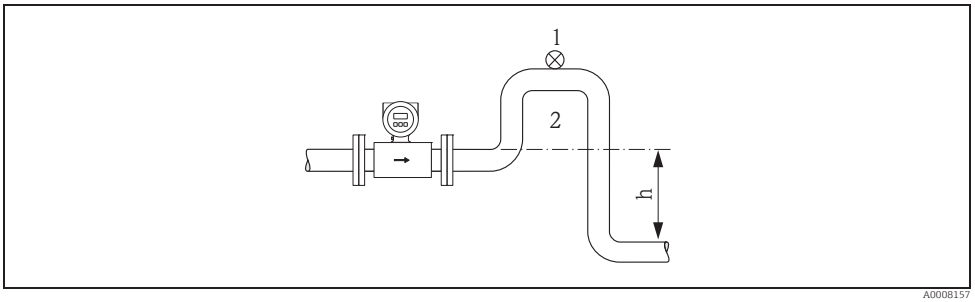


Fig. 9: Measures for installation in a down pipe

1 Vent valve
2 Pipe siphon
h Length of down pipe

3.2.3 Orientation

An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube. However, Promag offers the additional Empty Pipe Detection (EPD) function to ensure the detection of partially filled measuring tubes, e.g. in the case of degassing fluids or varying process pressure.

Vertical orientation

This is the ideal orientation for self-emptying piping systems and for use in conjunction with Empty Pipe Detection.

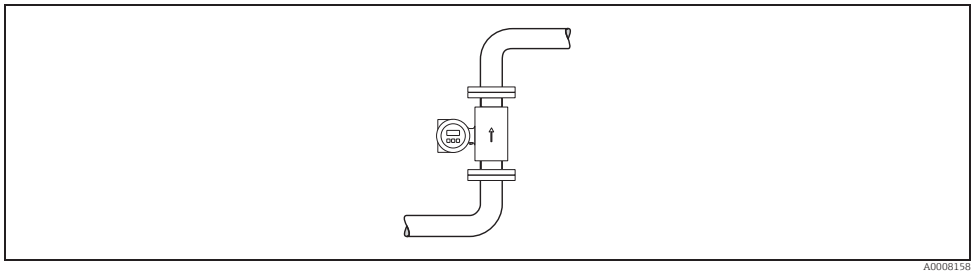


Fig. 10: Vertical orientation

Horizontal orientation

The measuring electrode plane should be horizontal. This prevents brief insulation of the two measuring electrodes by entrained air bubbles.

Caution!
Empty Pipe Detection functions correctly only when the measuring device is installed horizontally and the transmitter housing is facing upward (→ 10). Otherwise there is no guarantee that Empty Pipe Detection will respond if the measuring tube is only partially filled or empty.

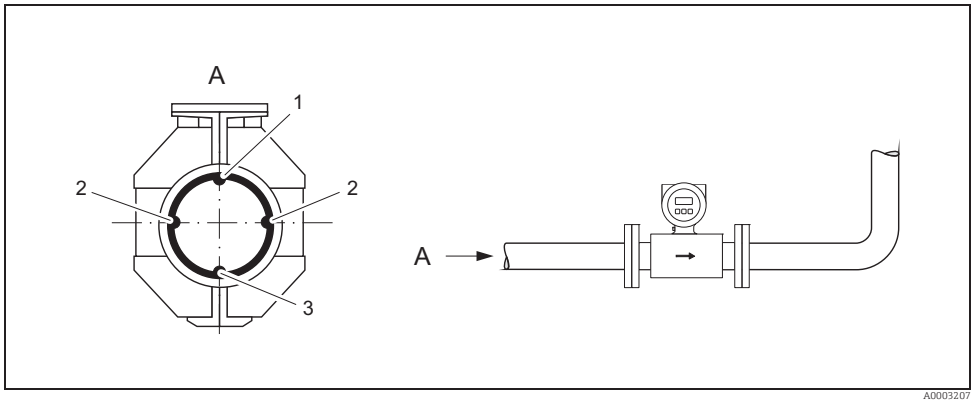


Fig. 11: Horizontal orientation

1 EPD electrode for the detection of empty pipes (not with Promag D and Promag H (DN 2 to 15 / 1/12 to ½"))
2 Measuring electrodes for signal detection
3 Reference electrode for the potential equalization (not with Promag D and H)

Inlet and outlet run

If possible, install the sensor upstream from fittings such as valves, T-pieces, elbows, etc.

The following inlet and outlet runs must be observed in order to meet accuracy specifications:
- Inlet run: ≥ 5 × DN
- Outlet run: ≥ 2 × DN

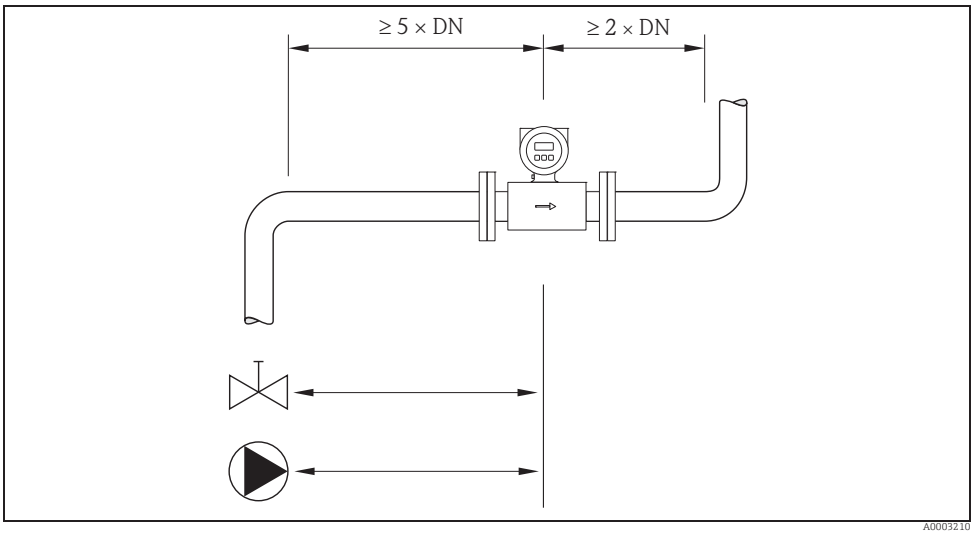


Fig. 12: Inlet and outlet runs

3.2.4 Vibrations

Secure the piping and the sensor if vibration is severe.

Caution!
If vibrations are too severe, we recommend the sensor and transmitter be mounted separately. Information on resistance to vibration and shock can be found on → 87.

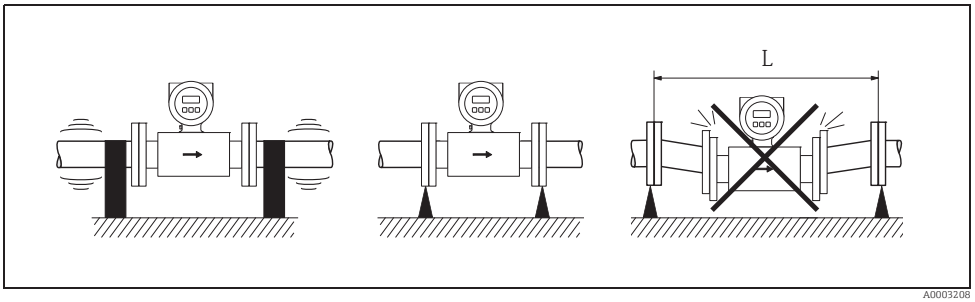


Fig. 13: Measures to prevent vibration of the device (L > 10 m (32.8 ft))

3.2.5 Foundations, supports

If the nominal diameter is DN ≥ 350 (14"), mount the sensor on a foundation of adequate load-bearing strength.

Caution!
Risk of damage.
Do not support the weight of the sensor on the metal casing: the casing would buckle and damage the internal magnetic coils.

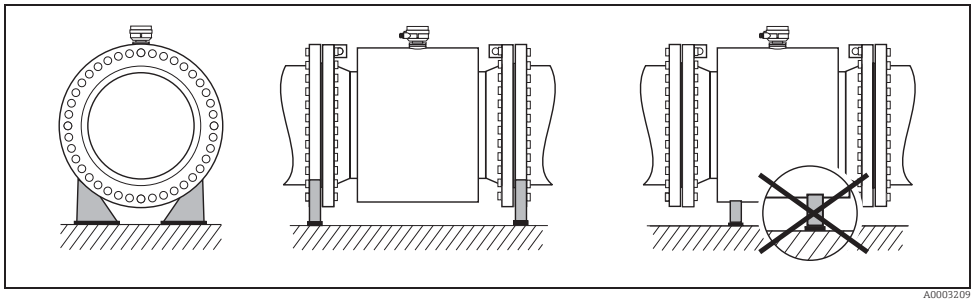


Fig. 14: Correct support for large nominal diameters (DN ≥ 350 / 14")

3.2.6 Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes.
The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids. The nomogram shown here can be used to calculate the pressure loss caused by reducers and expanders.

Note!
The nomogram only applies to liquids of viscosity similar to water.

1. Calculate the ratio of the diameters d/D.
2. From the nomogram read off the pressure loss as a function of flow velocity (*downstream* from the reduction) and the d/D ratio.

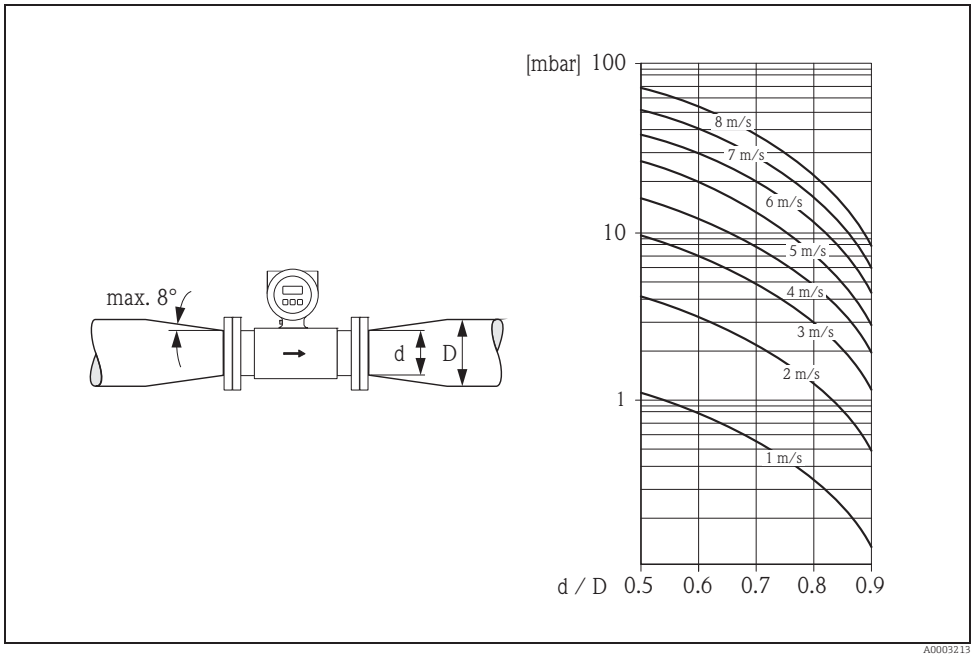


Fig. 15: Pressure loss due to adapters

3.2.7 Nominal diameter and flow rate

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum velocity of flow is between 2 and 3 m/s (6.5 to 9.8 ft/s)

The velocity of flow (v), moreover, has to be matched to the physical properties of the fluid:
- v < 2 m/s (6.5 ft/s): for abrasive fluids
- v > 2 m/s (6.5 ft/s): for fluids producing buildup

Note!
Flow velocity can be increased, if necessary, by reducing the nominal diameter of the sensor (→ 15).

Recommended flow (SI units)

Nominal diameter	Promag D	Promag E/P	Promag H	Promag L	Promag W
[mm]	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [dm³/min]				
2	–	–	0.06 to 1.8	–	–
4	–	–	0.25 to 7	–	–
8	–	–	1 to 30	–	–
15	–	4 to 100	4 to 100	–	–
25	9 to 300	9 to 300	9 to 300	9 to 300	9 to 300
32	–	15 to 500	–	15 to 500	15 to 500
40	25 to 700	25 to 700	25 to 700	25 to 700	25 to 700
50	35 to 1100	35 to 1100	35 to 1100	35 to 1100	35 to 1100
65	60 to 2000	60 to 2000	60 to 2000	60 to 2000	60 to 2000
80	90 to 3000	90 to 3000	90 to 3000	90 to 3000	90 to 3000
100	145 to 4700	145 to 4700	145 to 4700	145 to 4700	145 to 4700
125	–	220 to 7500	–	220 to 7500	220 to 7500
[mm]	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [m³/h]				
150	–	20 to 600	–	20 to 600	20 to 600
200	–	35 to 1100	–	35 to 1100	35 to 1100
250	–	55 to 1700	–	55 to 1700	55 to 1700
300	–	80 to 2400	–	80 to 2400	80 to 2400
350	–	110 to 3300	–	110 to 3300	110 to 3300
375	–	–	–	140 to 4200	140 to 4200
400	–	140 to 4200	–	140 to 4200	140 to 4200
450	–	180 to 5400	–	180 to 5400	180 to 5400
500	–	220 to 6600	–	220 to 6600	220 to 6600
600	–	310 to 9600	–	310 to 9600	310 to 9600
700	–	–	–	420 to 13500	420 to 13500
750	–	–	–	480 to 15200	480 to 15200
800	–	–	–	550 to 18000	550 to 18000
900	–	–	–	690 to 22500	690 to 22500
1000	–	–	–	850 to 28000	850 to 28000
1050	–	–	–	950 to 40000	950 to 40000
1200	–	–	–	1250 to 40000	1250 to 40000
1400	–	–	–	–	1700 to 55000
1600	–	–	–	–	2200 to 70000
1800	–	–	–	–	2800 to 90000
2000	–	–	–	–	3400 to 110000

Recommended flow (US units)

Nominal diameter	Promag D	Promag E/P	Promag H	Promag L	Promag W
[inch]	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [gal/min]				
1/12"	–	–	0.015 to 0.5	–	–
1/8"	–	–	0.07 to 2	–	–
8"	–	–	0.25 to 8	–	–
½"	–	1.0 to 27	1.0 to 27	–	–
1"	2.5 to 80	2.5 to 80	2.5 to 80	2.5 to 80	2.5 to 80
1 ¼"	–	4 to 130	–	–	4 to 130
1 ½"	7 to 190	7 to 190	7 to 190	7 to 190	7 to 190
2"	10 to 300	10 to 300	10 to 300	10 to 300	10 to 300
2 ½"	16 to 500	16 to 500	16 to 500	16 to 500	16 to 500
3"	24 to 800	24 to 800	24 to 800	24 to 800	24 to 800
4"	40 to 1250	40 to 1250	40 to 1250	40 to 1250	40 to 1250
5"	–	60 to 1950	–	60 to 1950	60 to 1950
6"	–	90 to 2650	–	90 to 2650	90 to 2650
8"	–	155 to 4850	–	155 to 4850	155 to 4850
10"	–	250 to 7500	–	250 to 7500	250 to 7500
12"	–	350 to 10600	–	350 to 10600	350 to 10600
14"	–	500 to 15000	–	500 to 15000	500 to 15000
15"	–	–	–	600 to 19000	600 to 19000
16"	–	600 to 19000	–	600 to 19000	600 to 19000
18"	–	800 to 24000	–	800 to 24000	800 to 24000
20"	–	1000 to 30000	–	1000 to 30000	1000 to 30000
24"	–	1400 to 44000	–	1400 to 44000	1400 to 44000
28"	–	–	–	1900 to 60000	1900 to 60000
30"	–	–	–	2150 to 67000	2150 to 67000
32"	–	–	–	2450 to 80000	2450 to 80000
36"	–	–	–	3100 to 100000	3100 to 100000
40"	–	–	–	3800 to 125000	3800 to 125000
42"	–	–	–	4200 to 135000	4200 to 135000
48"	–	–	–	5500 to 175000	5500 to 175000
[inch]	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [Mgal/d]				
54"	–	–	–	–	9 to 300
60"	–	–	–	–	12 to 380
66"	–	–	–	–	14 to 500
72"	–	–	–	–	16 to 570
78"	–	–	–	–	18 to 650

3.2.8 Length of connecting cable

In order to ensure measuring accuracy, comply with the following instructions when installing the remote version:

- Fix cable run or lay in armored conduit. Cable movements can falsify the measuring signal especially in the case of low fluid conductivities.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalization between sensor and transmitter, if necessary.
- The permitted connecting cable length L_{max} is determined by the fluid conductivity (→ 16). A minimum conductivity of 50 µS/cm is needed for all fluids.
- The maximum connecting cable length is 10 m (33 ft) when empty pipe detection (EPD → 68) is switched on.

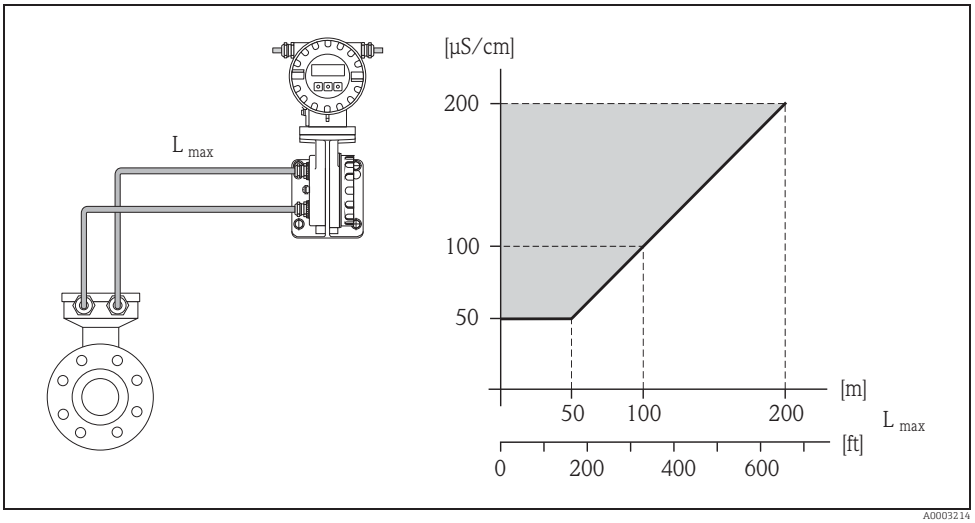


Fig. 16: Permissible cable length for the remote version

Area shaded gray = permitted range
Lmax = connecting cable length in [m]
Fluid conductivity in [µS/cm]

3.3 Installation instructions

3.3.1 Installing the Promag D sensor

The sensor is installed between the pipe flanges with a mounting kit. The device is centered using recesses on the sensor (→ 20).

Note!
A mounting kit consisting of mounting bolts, seals, nuts and washers can be ordered separately (→ 70). Centering sleeves are provided with the device if they are required for the installation.

Caution!
When installing the transmitter in the pipe, observe the necessary torques (→ 21).

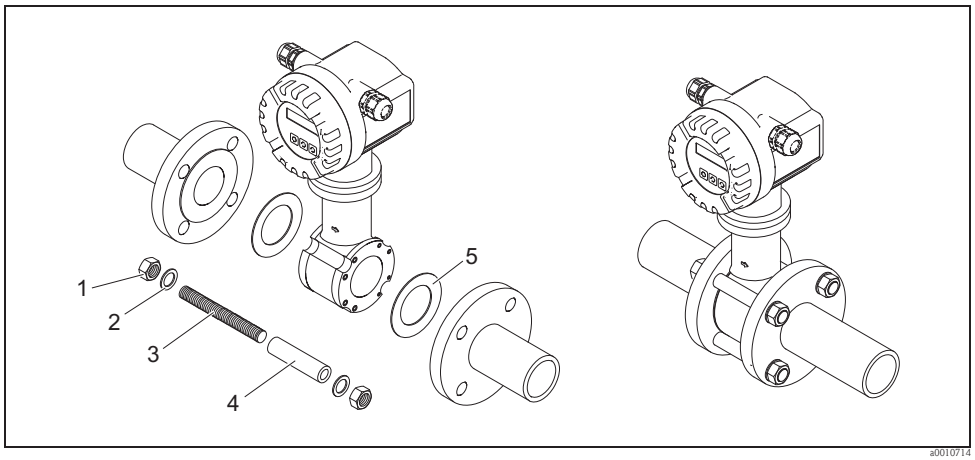


Fig. 17: Mounting the sensor

1 Nut
2 Washer
3 Mounting bolt
4 Centering sleeve
5 Seal

Seals

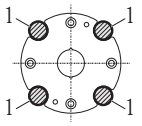
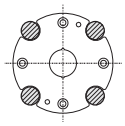
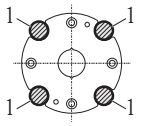
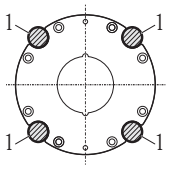
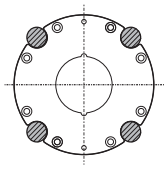
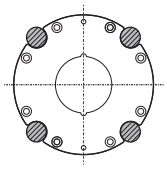
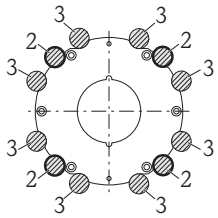
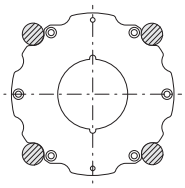
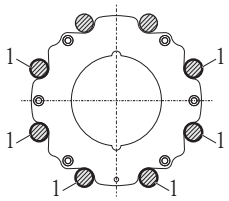
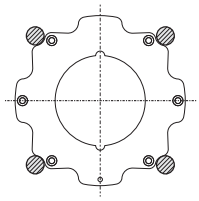
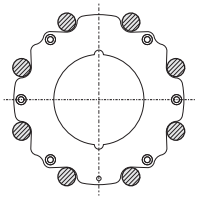
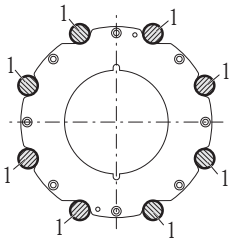
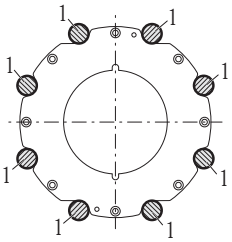
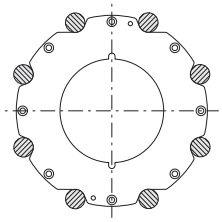
When installing the sensor, make sure that the seals used do not project into the pipe cross-section.

Caution!
Risk of short circuit! Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Note!
Use seals with a hardness rating of 70° Shore A.

Arrangement of the mounting bolts and centering sleeves

The device is centered using recesses on the sensor. The arrangement of the mounting bolts and the use of the centering sleeves supplied depend on the nominal diameter, the flange standard und the pitch circle diameter.

	Process connection		
	EN (DIN)	ASME	JIS
DN 25 to 40 (1 to 1 ½")	 A0010896	 A0010824	 A0010896
DN 50 (2")	 A0010897	 A0010825	 A0010825
DN 65 (–)	 A0012170	–	 A0012171
DN 80 (3")	 A0010898	 A0010827	 A0010826
DN 100 (4")	 A0012168	 A0012168	 A0012169

1 = Mounting bolts with centering sleeves
2 = EN (DIN) flanges: 4-hole → with centering sleeves
3 = EN (DIN) flanges: 8-hole → without centering sleeves

Screw tightening torques (Promag D)

Please note the following:
- The tightening torques listed below are for lubricated threads only.
- Always tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

The tightening torques apply to situations where an EPDM soft material flat seal (e.g. 70° Shore A) is used.

Tightening torques, mounting bolts and centering sleeves for EN (DIN) PN 16

Nominal diameter [mm]	Mounting bolts [mm]	Centering sleeve length [mm]	Tightening torque [Nm] with a process flange with a	
			smooth seal face	raised face
25	4 × M12 × 145	54	19	19
40	4 × M16 × 170	68	33	33
50	4 × M16 × 185	82	41	41
65[1)]	4 × M16 × 200	92	44	44
65[2)]	8 × M16 × 200	– [3)]	29	29
80	8 × M16 × 225	116	36	36
100	8 × M16 × 260	147	40	40

[1)] EN (DIN) flanges: 4-hole → with centering sleeves
[2)] EN (DIN) flanges: 8-hole → without centering sleeves
[3)] A centering sleeve is not required. The device is centered directly via the sensor housing.

Tightening torques, mounting bolts and centering sleeves for JIS 10 K

Nominal diameter [mm]	Mounting bolts [mm]	Centering sleeve length [mm]	Tightening torque [Nm] with a process flange with a	
			smooth seal face	raised face
25	4 × M16 × 170	54	24	24
40	4 × M16 × 170	68	32	25
50	4 × M16 × 185	– *	38	30
65	4 × M16 × 200	– *	42	42
80	8 × M16 × 225	– *	36	28
100	8 × M16 × 260	– *	39	37

* A centering sleeve is not required. The device is centered directly via the sensor housing.

Tightening torques, mounting bolts and centering sleeves for ASME Class 150

Nominal diameter [inch]	Mounting bolts [inch]	Centering sleeve length [inch]	Tightening torque [lbf · ft] with a process flange with a	
			smooth seal face	raised face
1"	4 × UNC 1/2" × 5.70"	– *	14	7
1 ½"	4 × UNC 1/2" × 6.50"	– *	21	14
2"	4 × UNC 5/8" × 7.50"	– *	30	27
3"	4 × UNC 5/8" × 9.25"	– *	31	31
4"	8 × UNC 5/8" × 10.4"	5.79	28	28

* A centering sleeve is not required. The device is centered directly via the sensor housing.

3.3.2 Installing the Promag E sensor

Caution!
- The protective covers mounted on the two sensor flanges guard the PTFE, which is turned over the flanges. Consequently, do not remove these covers until immediately before the sensor is installed in the pipe.
- The covers must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 📄 23
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment

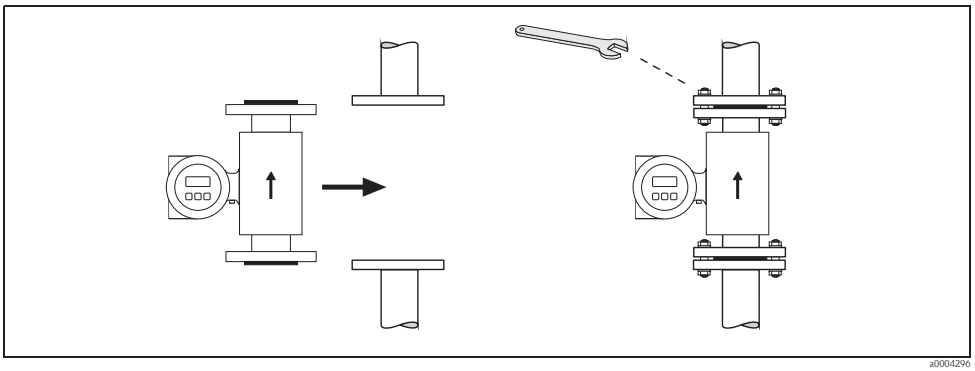


Fig. 18: Installing the Promag E sensor

Seals

Comply with the following instructions when installing seals:
- PTFE lining → No seals are required!
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit! Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable

- If necessary, special ground cables for potential equalization can be ordered as an accessory (→ 📄 70).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 📄 50

Tightening torques for threaded fasteners (Promag E)

Please note the following:
- The tightening torques listed below are for lubricated threads only.
- Always tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Tightening torques for:
- EN (DIN) → 🖹 23
- ASME → 🖹 24
- JIS → 🖹 24

Promag E tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]
15	PN 40	4 × M 12	11
25	PN 40	4 × M 12	26
32	PN 40	4 × M 16	41
40	PN 40	4 × M 16	52
50	PN 40	4 × M 16	65
65 *	PN 16	8 × M 16	43
80	PN 16	8 × M 16	53
100	PN 16	8 × M 16	57
125	PN 16	8 × M 16	75
150	PN 16	8 × M 20	99
200	PN 10	8 × M 20	141
200	PN 16	12 × M 20	94
250	PN 10	12 × M 20	110
250	PN 16	12 × M 24	131
300	PN 10	12 × M 20	125
300	PN 16	12 × M 24	179
350	PN 6	12 × M 20	200
350	PN 10	16 × M 20	188
350	PN 16	16 × M 24	254
400	PN 6	16 × M 20	166
400	PN 10	16 × M 24	260
400	PN 16	16 × M 27	330
450	PN 6	16 × M 20	202
450	PN 10	20 × M 24	235
450	PN 16	20 × M 27	300
500	PN 6	20 × M 20	176
500	PN 10	20 × M 24	265
500	PN 16	20 × M 30	448
600	PN 6	20 × M 24	242
600	PN 10	20 × M 27	345
600 *	PN 16	20 × M 33	658
* Designed acc. to EN 1092-1 (not to DIN 2501)			

Promag E tightening torques for ASME

Nominal diameter		ASME		Max. tightening torque PTFE	
[mm]	[inch]	Pressure rating [lbs]	Threaded fasteners	[Nm]	[lbf · ft]
15	½"	Class 150	4 × ½"	6	4
25	1"	Class 150	4 × ½"	11	8
40	1 ½"	Class 150	4 × ½"	24	18
50	2"	Class 150	4 × 5/8"	47	35
80	3"	Class 150	4 × 5/8"	79	58
100	4"	Class 150	8 × 5/8"	56	41
150	6"	Class 150	8 × ¾"	106	78
200	8"	Class 150	8 × ¾"	143	105
250	10"	Class 150	12 × 7/8"	135	100
300	12"	Class 150	12 × 7/8"	178	131
350	14"	Class 150	12 × 1"	260	192
400	16"	Class 150	16 × 1"	246	181
450	18"	Class 150	16 × 1 1/8"	371	274
500	20"	Class 150	20 × 1 1/8"	341	252
600	24"	Class 150	20 × 1 ¼"	477	352

Promag E tightening torques for JIS

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm] PTFE
15	20K	4 × M 12	16
25	20K	4 × M 16	32
32	20K	4 × M 16	38
40	20K	4 × M 16	41
50	10K	4 × M 16	54
65	10K	4 × M 16	74
80	10K	8 × M 16	38
100	10K	8 × M 16	47
125	10K	8 × M 20	80
150	10K	8 × M 20	99
200	10K	12 × M 20	82
250	10K	12 × M 22	133
300	10K	16 × M 22	99

3.3.3 Installing the Promag H sensor

The sensor is supplied to order, with or without pre-installed process connections. Pre-installed process connections are secured to the sensor with 4 or 6 hex-head threaded fasteners.

Caution!
The sensor might require support or additional attachments, depending on the application and the length of the piping run. When plastic process connections are used, the sensor must be additionally supported mechanically. A wall-mounting kit can be ordered separately from Endress+Hauser as an accessory (→ 📄 70).

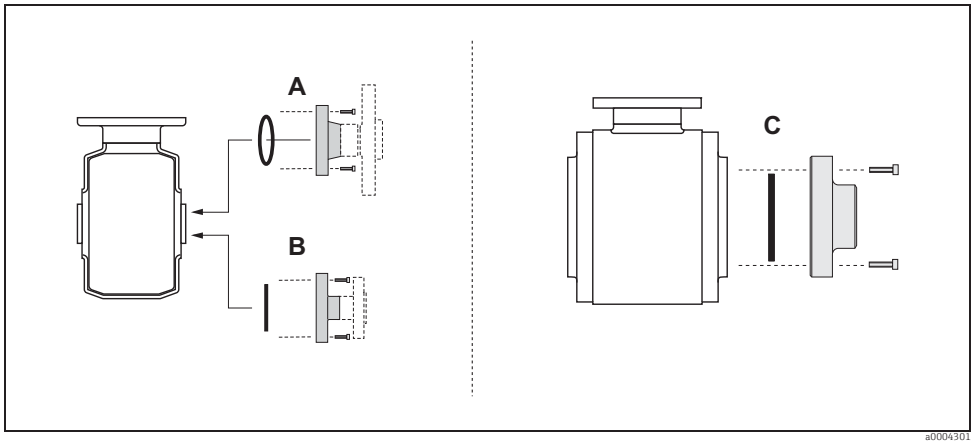


Fig. 19: Promag H process connections (DN 2 to 25 / 1/12 to 1", DN 40 to 100 / 1½ to 4")

A = DN 2 to 25 / process connections with O-ring
– Flanges (EN (DIN), ASME, JIS),
– External thread

B = DN 2 to 25 / process connections with aseptic gasket seal
– Weld nipples (DIN 11850, ODT/SMS)
– Tri-Clamp L14AM7
– Coupling (DIN 11851, DIN 11864-1, SMS 1145 (only DN 25)
– Flange DIN 11864-2

C = DN 40 to 100 / process connections with aseptic gasket seal
– Weld nipples (DIN 11850, ODT/SMS)
– Tri-Clamp L14AM7
– Coupling (DIN 11851, DIN 11864-1, SMS 1145)
– Flange DIN 11864-2

Seals

When installing the process connections, make sure that the seals are clean and correctly centered.

Caution!
- With metal process connections, you must fully tighten the screws. The process connection forms a metallic connection with the sensor, which ensures a defined compression of the seal.
- With plastic process connections, note the max. torques for lubricated threads (7 Nm / 5.2 lbf ft). With plastic flanges, always use seals between connection and counter flange.
- The seals must be replaced periodically, depending on the application, particularly in the case of gasket seals (aseptic version)!
  The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature. Replacement seals can be ordered as accessories → 📄 70.

Welding the transmitter into the piping (weld nipples)

Caution!
Risk of destroying the measuring electronics. Make sure that the welding machine is *not* grounded via the sensor or the transmitter.

1. Tack-weld the sensor into the pipe. A suitable welding jig can be ordered separately as an accessory (→ 🖹 70).
2. Loosen the screws on the process connection flange and remove the sensor, complete with the seal, from the pipe.
3. Weld the process connection to the pipe.
4. Reinstall the sensor in the pipe. Make sure that everything is clean and that the seal is correctly seated.

Note!
- If thin-walled foodstuffs pipes are not welded correctly, the heat could damage the installed seal. It is therefore advisable to remove the sensor and the seal prior to welding.
- The pipe has to be spread approximately 8 mm to permit disassembly.

Cleaning with pigs

If pigs are used for cleaning, it is essential to take the inside diameters of the measuring tube and process connection into account. All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation "Technical Documentation".

3.3.4 Installing the Promag L sensor

Caution!
- The protective covers mounted on the two sensor flanges (DN 25 to 300 / 1 to 12") are used to hold the lap joint flanges in place and to protect the PTFE liner during transportation. Consequently, do not remove these covers until immediately before the sensor is installed in the pipe.
- The covers must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 28
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment
- To comply with the device specification, a concentrical installation in the measuring section is required

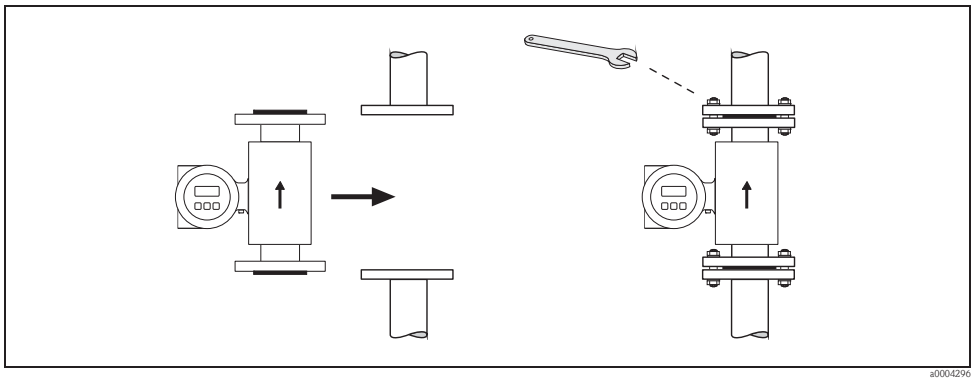


Fig. 20: Installing the Promag L sensor

Seals

Comply with the following instructions when installing seals:
- Hard rubber lining → additional seals are always necessary.
- Polyurethane lining → no seals are required.
- PTFE lining → no seals are required.
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit!
Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable

- If necessary, special ground cables for potential equalization can be ordered as an accessory (→ 70).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 50.

Screw tightening torques (Promag L)

Please note the following:
- The tightening torques listed below are for lubricated threads only.
- Always tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Promag L tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque Hard rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]
25	PN 10/16	4 × M 12	-	6	11
32	PN 10/16	4 × M 16	-	16	27
40	PN 10/16	4 × M 16	-	16	29
50	PN 10/16	4 × M 16	-	15	40
65*	PN 10/16	8 × M 16	-	10	22
80	PN 10/16	8 × M 16	-	15	30
100	PN 10/16	8 × M 16	-	20	42
125	PN 10/16	8 × M 16	-	30	55
150	PN 10/16	8 × M 20	-	50	90
200	PN 16	12 × M 20	-	65	87
250	PN 16	12 × M 24	-	126	151
300	PN 16	12 × M 24	-	139	177
350	PN 6	12 × M 20	111	120	-
350	PN 10	16 × M 20	112	118	-
400	PN 6	16 × M 20	90	98	-
400	PN 10	16 × M 24	151	167	-
450	PN 6	16 × M 20	112	126	-
450	PN 10	20 × M 24	153	133	-
500	PN 6	20 × M 20	119	123	-
500	PN 10	20 × M 24	155	171	-
600	PN 6	20 × M 24	139	147	-
600	PN 10	20 × M 27	206	219	-
700	PN 6	24 × M 24	148	139	-
700	PN 10	24 × M 27	246	246	-
800	PN 6	24 × M 27	206	182	-
800	PN 10	24 × M 30	331	316	-
900	PN 6	24 × M 27	230	637	-
900	PN 10	28 × M 30	316	307	-
1000	PN 6	28 × M 27	218	208	-
1000	PN 10	28 × M 33	402	405	-
1200	PN 6	32 × M 30	319	299	-
1200	PN 10	32 × M 36	564	568	-

* Designed acc. to EN 1092-1 (not to DIN 2501)

Promag L tightening torques for ASME

Nominal diameter		ASME	Threaded fasteners	Max. tightening torque					
		Pressure rating		Hard rubber		Polyurethane		PTFE	
[mm]	[inch]	[lbs]		[Nm]	[lbf · ft]	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
25	1"	Class 150	4 × 5/8"	-	-	5	4	14	13
40	1 ½"	Class 150	8 × 5/8"	-	-	10	17	21	15
50	2"	Class 150	4 × 5/8"	-	-	15	11	40	29
80	3"	Class 150	4 × 5/8"	-	-	25	18	65	48
100	4"	Class 150	8 × 5/8"	-	-	20	15	44	32
150	6"	Class 150	8 × ¾"	-	-	45	33	90	66
200	8"	Class 150	8 × ¾"	-	-	65	48	87	64
250	10"	Class 150	12 × 7/8"	-	-	126	93	151	112
300	12"	Class 150	12 × 7/8"	-	-	146	108	177	131
350	14"	Class 150	12 × 1"	135	100	158	117	-	-
400	16"	Class 150	16 × 1"	128	94	150	111	-	-
450	18"	Class 150	16 × 1 1/8"	204	150	234	173	-	-
500	20"	Class 150	20 × 1 1/8"	183	135	217	160	-	-
600	24"	Class 150	20 × 1 ¼"	268	198	307	226	-	-

Promag L tightening torques for AWWA

Nominal diameter		AWWA	Threaded fasteners	Max. tightening torque					
		Pressure rating		Hartgummi		Polyurethane		PTFE	
[mm]	[inch]			[Nm]	[lbf · ft]	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
700	28"	Class D	28 × 1 ¼"	247	182	292	215	-	-
750	30"	Class D	28 × 1 ¼"	287	212	302	223	-	-
800	32"	Class D	28 × 1 ½"	394	291	422	311	-	-
900	36"	Class D	32 × 1 ½"	419	309	430	317	-	-
1000	40"	Class D	36 × 1 ½"	420	310	477	352	-	-
1050	42"	Class D	36 × 1 ½"	528	389	518	382	-	-
1200	48"	Class D	44 × 1 ½"	552	407	531	392	-	-

Promag L tightening torques for AS 2129

Nominal diameter	AS 2129	Threaded fasteners	Max. tightening torque		
	Pressure rating		Hard rubber	Polyurethane	PTFE
[mm]			[Nm]	[Nm]	[Nm]
350	Table E	12 × M 24	203	-	-
400	Table E	12 × M 24	226	-	-
450	Table E	16 × M 24	226	-	-
500	Table E	16 × M 24	271	-	-
600	Table E	16 × M 30	439	-	-
700	Table E	20 × M 30	355	-	-
750	Table E	20 × M 30	559	-	-
800	Table E	20 × M 30	631	-	-
900	Table E	24 × M 30	627	-	-
1000	Table E	24 × M 30	634	-	-
1200	Table E	32 × M 30	727	-	-

Promag L tightening torques for AS 4087

Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque		
			Hard rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]
350	PN 16	12 × M 24	203	-	-
375	PN 16	12 × M 24	137	-	-
400	PN 16	12 × M 24	226	-	-
450	PN 16	12 × M 24	301	-	-
500	PN 16	16 × M 24	271	-	-
600	PN 16	16 × M 27	393	-	-
700	PN 16	20 × M 27	330	-	-
750	PN 16	20 × M 30	529	-	-
800	PN 16	20 × M 33	631	-	-
900	PN 16	24 × M 33	627	-	-
1000	PN 16	24 × M 33	595	-	-
1200	PN 16	32 × M 33	703	-	-

3.3.5 Installing the Promag P sensor

Caution!
- The protective covers mounted on the two sensor flanges guard the PTFE, which is turned over the flanges. Consequently, do not remove these covers until immediately before the sensor is installed in the pipe.
- The covers must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 31
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment

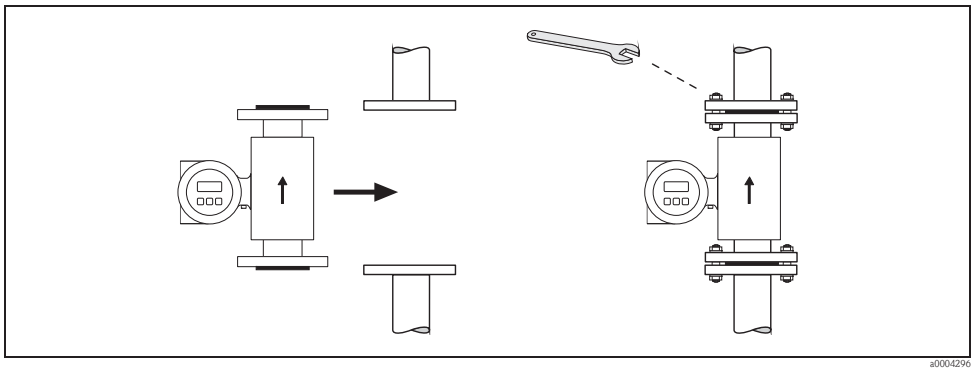


Fig. 21: Installing the Promag P sensor

Seals

Comply with the following instructions when installing seals:
- PTFE lining → No seals are required!
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit! Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable

- If necessary, special ground cables for potential equalization can be ordered as an accessory (→ 70).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 50

Tightening torques for threaded fasteners (Promag P)

Please note the following:
- The tightening torques listed below are for lubricated threads only.
- Always tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Tightening torques for:
- EN (DIN) → 32
- ASME → 32
- JIS → 33
- AS 2129 → 33
- AS 4087 → 33

Promag P tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]
25	PN 40	4 × M 12	26
32	PN 40	4 × M 16	41
40	PN 40	4 × M 16	52
50	PN 40	4 × M 16	65
65 *	PN 16	8 × M 16	43
65	PN 40	8 × M 16	43
80	PN 16	8 × M 16	53
80	PN 40	8 × M 16	53
100	PN 16	8 × M 16	57
100	PN 40	8 × M 20	78
125	PN 16	8 × M 16	75
125	PN 40	8 × M 24	111
150	PN 16	8 × M 20	99
150	PN 40	8 × M 24	136
200	PN 10	8 × M 20	141
200	PN 16	12 × M 20	94
200	PN 25	12 × M 24	138
250	PN 10	12 × M 20	110
250	PN 16	12 × M 24	131
250	PN 25	12 × M 27	200
300	PN 10	12 × M 20	125
300	PN 16	12 × M 24	179
300	PN 25	16 × M 27	204
350	PN 10	16 × M 20	188
350	PN 16	16 × M 24	254
350	PN 25	16 × M 30	380
400	PN 10	16 × M 24	260
400	PN 16	16 × M 27	330
400	PN 25	16 × M 33	488
450	PN 10	20 × M 24	235
450	PN 16	20 × M 27	300
450	PN 25	20 × M 33	385
500	PN 10	20 × M 24	265
500	PN 16	20 × M 30	448
500	PN 25	20 × M 33	533
600	PN 10	20 × M 27	345
600 *	PN 16	20 × M 33	658
600	PN 25	20 × M 36	731
* Designed acc. to EN 1092-1 (not to DIN 2501)			

Promag P tightening torques for ASME

Nominal diameter		ASME Pressure rating		Max. tightening torque PTFE	
[mm]	[inch]	[lbs]	Threaded fasteners	[Nm]	[lbf · ft]
25	1"	Class 150	4 × ½"	11	8
25	1"	Class 300	4 × 5/8"	14	10
40	1 ½"	Class 150	4 × ½"	24	18
40	1 ½"	Class 300	4 × ¾"	34	25
50	2"	Class 150	4 × 5/8"	47	35

Nominal diameter		ASME Pressure rating		Max. tightening torque PTFE	
[mm]	[inch]	[lbs]	Threaded fasteners	[Nm]	[lbf · ft]
50	2"	Class 300	8 × 5/8"	23	17
80	3"	Class 150	4 × 5/8"	79	58
80	3"	Class 300	8 × ¾"	47	35
100	4"	Class 150	8 × 5/8"	56	41
100	4"	Class 300	8 × ¾"	67	49
150	6"	Class 150	8 × ¾"	106	78
150	6"	Class 300	12 × ¾"	73	54
200	8"	Class 150	8 × ¾"	143	105
250	10"	Class 150	12 × 7/8"	135	100
300	12"	Class 150	12 × 7/8"	178	131
350	14"	Class 150	12 × 1"	260	192
400	16"	Class 150	16 × 1"	246	181
450	18"	Class 150	16 × 1 1/8"	371	274
500	20"	Class 150	20 × 1 1/8"	341	252
600	24"	Class 150	20 × 1 ¼"	477	352

Promag P tightening torques for JIS

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm] PTFE
25	10K	4 × M 16	32
25	20K	4 × M 16	32
32	10K	4 × M 16	38
32	20K	4 × M 16	38
40	10K	4 × M 16	41
40	20K	4 × M 16	41
50	10K	4 × M 16	54
50	20K	8 × M 16	27
65	10K	4 × M 16	74
65	20K	8 × M 16	37
80	10K	8 × M 16	38
80	20K	8 × M 20	57
100	10K	8 × M 16	47
100	20K	8 × M 20	75
125	10K	8 × M 20	80
125	20K	8 × M 22	121
150	10K	8 × M 20	99
150	20K	12 × M 22	108
200	10K	12 × M 20	82
200	20K	12 × M 22	121
250	10K	12 × M 22	133
250	20K	12 × M 24	212
300	10K	16 × M 22	99
300	20K	16 × M 24	183

Promag P tightening torques for AS 2129

Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] PTFE
25	Table E	4 × M 12	21
50	Table E	4 × M 16	42

Promag P tightening torques for AS 4087

Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] PTFE
50	PN 16	4 × M 16	42

3.3.6 Installing the Promag W sensor

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 📄 34
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment

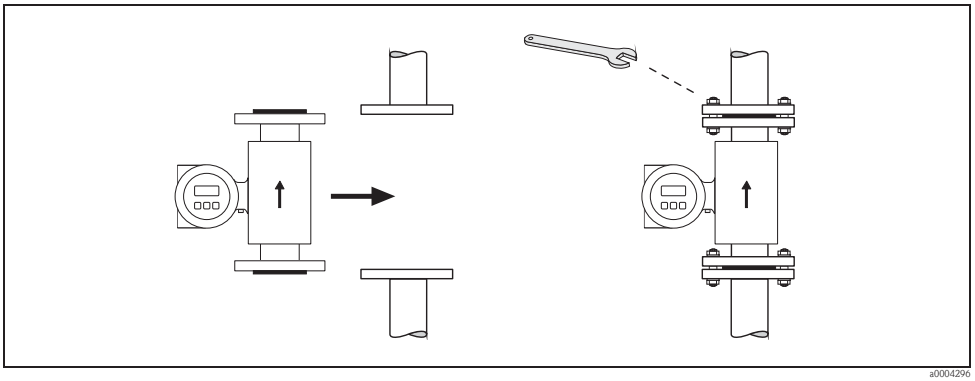


Fig. 22: Installing the Promag W sensor

Seals

Comply with the following instructions when installing seals:
- Hard rubber lining → additional seals are always necessary.
- Polyurethane lining → no seals are required.
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit!
Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable

- If necessary, special ground cables for potential equalization can be ordered as an accessory (→ 📄 70).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 📄 50

Screw tightening torques (Promag W)

Please note the following:
- The tightening torques listed below are for lubricated threads only.
- Always tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Tightening torques for:
- EN (DIN)→ 🖹 35
- JIS→ 🖹 37
- ASME→ 🖹 36
- AWWA → 🖹 37
- AS 2129 → 🖹 38
- AS 4087 → 🖹 38

Promag W tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm] Hard rubber	Polyurethane
25	PN 40	4 × M 12	-	15
32	PN 40	4 × M 16	-	24
40	PN 40	4 × M 16	-	31
50	PN 40	4 × M 16	48	40
65*	PN 16	8 × M 16	32	27
65	PN 40	8 × M 16	32	27
80	PN 16	8 × M 16	40	34
80	PN 40	8 × M 16	40	34
100	PN 16	8 × M 16	43	36
100	PN 40	8 × M 20	59	50
125	PN 16	8 × M 16	56	48
125	PN 40	8 × M 24	83	71
150	PN 16	8 × M 20	74	63
150	PN 40	8 × M 24	104	88
200	PN 10	8 × M 20	106	91
200	PN 16	12 × M 20	70	61
200	PN 25	12 × M 24	104	92
250	PN 10	12 × M 20	82	71
250	PN 16	12 × M 24	98	85
250	PN 25	12 × M 27	150	134
300	PN 10	12 × M 20	94	81
300	PN 16	12 × M 24	134	118
300	PN 25	16 × M 27	153	138
350	PN 6	12 × M 20	111	120
350	PN 10	16 × M 20	112	118
350	PN 16	16 × M 24	152	165
350	PN 25	16 × M 30	227	252
400	PN 6	16 × M 20	90	98
400	PN 10	16 × M 24	151	167
400	PN 16	16 × M 27	193	215
400	PN 25	16 × M 33	289	326
450	PN 6	16 × M 20	112	126
450	PN 10	20 × M 24	153	133
450	PN 16	20 × M 27	198	196
450	PN 25	20 × M 33	256	253
500	PN 6	20 × M 20	119	123
500	PN 10	20 × M 24	155	171
500	PN 16	20 × M 30	275	300
500	PN 25	20 × M 33	317	360
600	PN 6	20 × M 24	139	147
600	PN 10	20 × M 27	206	219
600 *	PN 16	20 × M 33	415	443
600	PN 25	20 × M 36	431	516
700	PN 6	24 × M 24	148	139
700	PN 10	24 × M 27	246	246
700	PN 16	24 × M 33	278	318

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm] Hard rubber	Polyurethane
700	PN 25	24 × M 39	449	507
800	PN 6	24 × M 27	206	182
800	PN 10	24 × M 30	331	316
800	PN 16	24 × M 36	369	385
800	PN 25	24 × M 45	664	721
900	PN 6	24 × M 27	230	637
900	PN 10	28 × M 30	316	307
900	PN 16	28 × M 36	353	398
900	PN 25	28 × M 45	690	716
1000	PN 6	28 × M 27	218	208
1000	PN 10	28 × M 33	402	405
1000	PN 16	28 × M 39	502	518
1000	PN 25	28 × M 52	970	971
1200	PN 6	32 × M 30	319	299
1200	PN 10	32 × M 36	564	568
1200	PN 16	32 × M 45	701	753
1400	PN 6	36 × M 33	430	398
1400	PN 10	36 × M 39	654	618
1400	PN 16	36 × M 45	729	762
1600	PN 6	40 × M 33	440	417
1600	PN 10	40 × M 45	946	893
1600	PN 16	40 × M 52	1007	1100
1800	PN 6	44 × M 36	547	521
1800	PN 10	44 × M 45	961	895
1800	PN 16	44 × M 52	1108	1003
2000	PN 6	48 × M 39	629	605
2000	PN 10	48 × M 45	1047	1092
2000	PN 16	48 × M 56	1324	1261
* Designed acc. to EN 1092-1 (not to DIN 2501)				

Promag W tightening torques for ASME

Nominal diameter [mm]	[inch]	ASME Pressure rating [lbs]	Threaded fasteners	Max. tightening torque Hard rubber [Nm]	[lbf · ft]	Polyurethane [Nm]	[lbf · ft]
25	1"	Class 150	4 × ½"	-	-	7	5
25	1"	Class 300	4 × 5/8"	-	-	8	6
40	1 ½"	Class 150	4 × ½"	-	-	10	7
40	1 ½"	Class 300	4 × ¾"	-	-	15	11
50	2"	Class 150	4 × 5/8"	35	26	22	16
50	2"	Class 300	8 × 5/8"	18	13	11	8
80	3"	Class 150	4 × 5/8"	60	44	43	32
80	3"	Class 300	8 × ¾"	38	28	26	19
100	4"	Class 150	8 × 5/8"	42	31	31	23
100	4"	Class 300	8 × ¾"	58	43	40	30
150	6"	Class 150	8 × ¾"	79	58	59	44
150	6"	Class 300	12 × ¾"	70	52	51	38
200	8"	Class 150	8 × ¾"	107	79	80	59
250	10"	Class 150	12 × 7/8"	101	74	75	55
300	12"	Class 150	12 × 7/8"	133	98	103	76
350	14"	Class 150	12 × 1"	135	100	158	117
400	16"	Class 150	16 × 1"	128	94	150	111
450	18"	Class 150	16 × 1 1/8"	204	150	234	173
500	20"	Class 150	20 × 1 1/8"	183	135	217	160
600	24"	Class 150	20 × 1 ¼"	268	198	307	226

Promag W tightening torques for JIS

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
25	10K	4 × M 16	-	19
25	20K	4 × M 16	-	19
32	10K	4 × M 16	-	22
32	20K	4 × M 16	-	22
40	10K	4 × M 16	-	24
40	20K	4 × M 16	-	24
50	10K	4 × M 16	40	33
50	20K	8 × M 16	20	17
65	10K	4 × M 16	55	45
65	20K	8 × M 16	28	23
80	10K	8 × M 16	29	23
80	20K	8 × M 20	42	35
100	10K	8 × M 16	35	29
100	20K	8 × M 20	56	48
125	10K	8 × M 20	60	51
125	20K	8 × M 22	91	79
150	10K	8 × M 20	75	63
150	20K	12 × M 22	81	72
200	10K	12 × M 20	61	52
200	20K	12 × M 22	91	80
250	10K	12 × M 22	100	87
250	20K	12 × M 24	159	144
300	10K	16 × M 22	74	63
300	20K	16 × M 24	138	124

Promag W tightening torques for AWWA

Nominal diameter		AWWA Pressure rating	Threaded fasteners	Max. tightening torque			
				Hard rubber		Polyurethane	
[mm]	[inch]			[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
700	28"	Class D	28 × 1 ¼"	247	182	292	215
750	30"	Class D	28 × 1 ¼"	287	212	302	223
800	32"	Class D	28 × 1 ½"	394	291	422	311
900	36"	Class D	32 × 1 ½"	419	309	430	317
1000	40"	Class D	36 × 1 ½"	420	310	477	352
1050	42"	Class D	36 × 1 ½"	528	389	518	382
1200	48"	Class D	44 × 1 ½"	552	407	531	392
1350	54"	Class D	44 × 1 ¾"	730	538	633	467
1500	60"	Class D	52 × 1 ¾"	758	559	832	614
1650	66"	Class D	52 × 1 ¾"	946	698	955	704
1800	72"	Class D	60 × 1 ¾"	975	719	1087	802
2000	78"	Class D	64 × 2"	853	629	786	580

Promag W tightening torques for AS 2129

Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] Hard rubber
50	Table E	4 × M 16	32
80	Table E	4 × M 16	49
100	Table E	8 × M 16	38
150	Table E	8 × M 20	64
200	Table E	8 × M 20	96
250	Table E	12 × M 20	98
300	Table E	12 × M 24	123
350	Table E	12 × M 24	203
400	Table E	12 × M 24	226
450	Table E	16 × M 24	226
500	Table E	16 × M 24	271
600	Table E	16 × M 30	439
700	Table E	20 × M 30	355
750	Table E	20 × M 30	559
800	Table E	20 × M 30	631
900	Table E	24 × M 30	627
1000	Table E	24 × M 30	634
1200	Table E	32 × M 30	727

Promag W tightening torques for AS 4087

Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] Hard rubber
50	Table E	4 × M 16	32
80	PN 16	4 × M 16	49
100	PN 16	4 × M 16	76
150	PN 16	8 × M 20	52
200	PN 16	8 × M 20	77
250	PN 16	8 × M 20	147
300	PN 16	12 × M 24	103
350	PN 16	12 × M 24	203
375	PN 16	12 × M 24	137
400	PN 16	12 × M 24	226
450	PN 16	12 × M 24	301
500	PN 16	16 × M 24	271
600	PN 16	16 × M 27	393
700	PN 16	20 × M 27	330
750	PN 16	20 × M 30	529
800	PN 16	20 × M 33	631
900	PN 16	24 × M 33	627
1000	PN 16	24 × M 33	595
1200	PN 16	32 × M 33	703

3.3.7 Turning the transmitter housing

1. Loosen the two securing screws.
2. Turn the bayonet lock as far as it will go.
3. Carefully lift the transmitter housing:
   – Promag D: approx. 10 mm (0.39 in) above the securing screws
   – Promag E/H/L/P/W: to the stop
4. Turn the transmitter housing to the desired position:
   – Promag D: max. 180° clockwise or max. 180° counterclockwise
   – Promag E/H/L/P/W: max. 280° clockwise or max. 20° counterclockwise
5. Lower the housing into position and re-engage the bayonet catch.
6. Retighten the two securing screws.

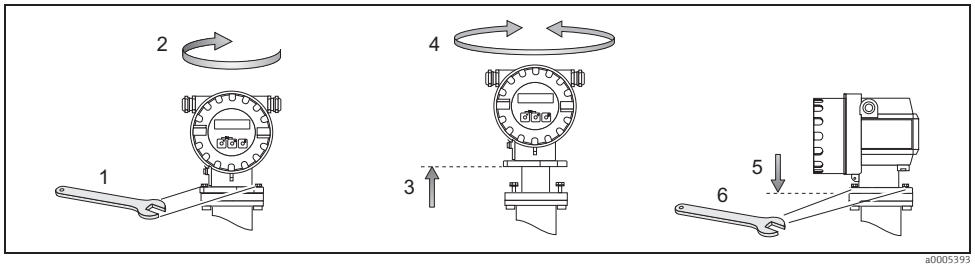


Fig. 23: Turning the transmitter housing

3.3.8 Turning the onsite display

1. Unscrew cover of the electronics compartment from the transmitter housing.
2. Remove the display module from the transmitter retaining rails.
3. Turn the display to the desired position (max. 4 × 45° in each direction).
4. Fit the display back onto the retaining rails.
5. Screw the cover of the electronics compartment firmly back onto the transmitter housing.

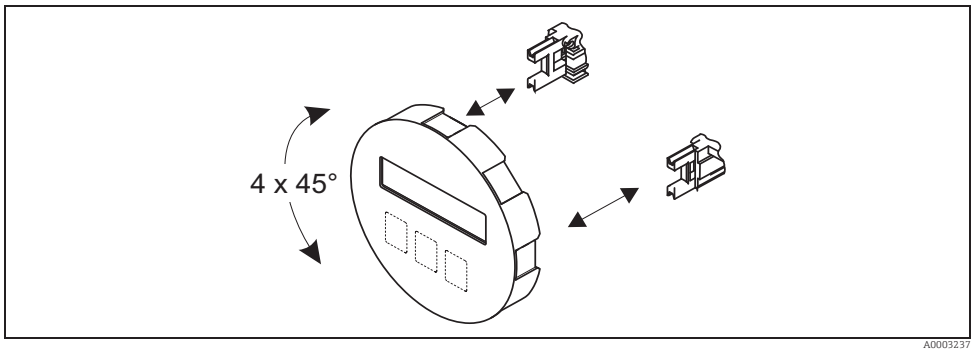


Fig. 24: Turning the local display

3.3.9 Mounting the transmitter (remote version)

The transmitter can be mounted in the following ways:
- Wall mounting
- Pipe mounting (with separate mounting kit, accessories → 📄 70)

The transmitter and the sensor must be mounted separate in the following circumstances:
- Poor accessibility
- Lack of space
- Extreme fluid/ambient temperatures (temperature ranges → 📄 86)
- Severe vibration (> 2 g/2 h per day; 10 to 100 Hz)

Caution!
- The ambient temperature range -20 to +60 °C (–4 to +140 °F) may not be exceeded at the mounting location. Avoid direct sunlight.
- If the device is mounted to a warm pipe, make sure that the housing temperature does not exceed +60 °C (+140 °F), which is the maximum permissible temperature.

Mount the transmitter as illustrated in → 🖼 25.

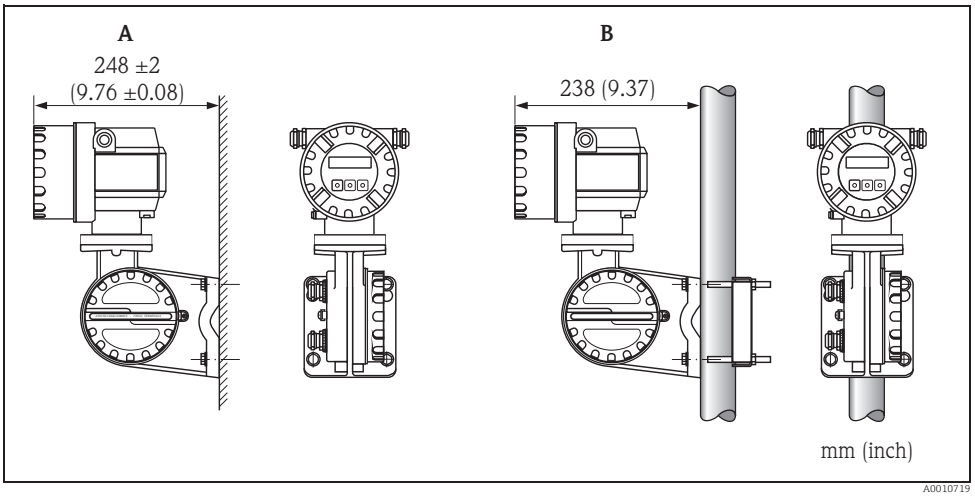


Fig. 25: Mounting the transmitter (remote version)

A Direct wall mounting
B Pipe mounting

3.4 Post-installation check

Perform the following checks after installing the measuring device in the pipe:

Device condition and specifications	Notes
Is the device damaged (visual inspection)?	–
Does the device correspond to specifications at the measuring point, including process temperature and pressure, ambient temperature, minimum fluid conductivity, measuring range, etc.?	→ 🖹 87
Installation	**Notes**
Does the arrow on the sensor nameplate match the actual direction of flow through the pipe?	–
Is the position of the measuring electrode plane correct?	→ 🖹 13
Is the position of the empty pipe detection electrode correct?	→ 🖹 13
Were all screws tightened to the specified torques when the sensor was installed?	Promag D → 🖹 21 Promag E → 🖹 23 Promag L → 🖹 28 Promag P → 🖹 31 Promag W → 🖹 34
Were the correct seals used (type, material, installation)?	Promag D → 🖹 19 Promag E → 🖹 22 Promag H → 🖹 25 Promag L→ 🖹 27 Promag P → 🖹 31 Promag W → 🖹 34
Are the measuring point number and labeling correct (visual inspection)?	–
Process environment / process conditions	**Notes**
Were the inlet and outlet runs respected?	Inlet run ≥ 5 × DN Outlet run ≥ 2 × DN
Is the measuring device protected against moisture and direct sunlight?	–
Is the sensor adequately protected against vibration (attachment, support)?	Acceleration up to 2 g by analogy with IEC 600 68-2-8

4 Wiring

Warning!
When using remote versions, only sensors and transmitters with the same serial number can be connected up. Measuring errors can occur if the devices are not connected in this way.

Note!
The device does not have an internal circuit breaker. For this reason, assign the device a switch or power-breaker switch capable of disconnecting the power supply line from the mains.

4.1 Connecting the remote version

4.1.1 Connecting Promag D/E/H/L/P/W

Warning!
- Risk of electric shock! Switch off the power supply before opening the device. Do not install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock! Connect the protective conductor to the ground terminal on the housing before the power supply is applied.

Caution!
- Only sensors and transmitters with the same serial number can be connected to one another. Communication problems can occur if the devices are not connected in this way.
- Risk of damaging the coil driver. Always switch off the power supply before connecting or disconnecting the coil cable.

Procedure

1. Transmitter: Loosen the securing clamp and remove the cover from the connection compartment (a).
2. Sensor: Remove the cover from the connection housing (b).
3. Feed the signal cable (c) and the coil cable (d) through the appropriate cable entries.

   Caution!
   Route the connecting cables securely (see "Length of connecting cable" → 18).
4. Terminate the signal and coil current cable as indicated in the table:
   Promag D/E/L/P/W → Refer to the table → 45
   Promag H → Refer to the "Cable termination" table → 46
5. Establish the wiring between the sensor and the transmitter.
   The electrical wiring diagram that applies to your device can be found:
   - In the corresponding graphic:
     → 26 (Promag D); → 27 (Promag E/L/P/W); → 28 (Promag H)
   - In the cover of the sensor and transmitter

   Note!
   The cable shields of the Promag H sensor are grounded by means of the strain relief terminals (see also the "Cable termination" table → 46)

   Caution!
   Insulate the shields of cables that are not connected to eliminate the risk of short-circuits with neighboring cable shields inside the connection housing.
6. Transmitter: Secure the cover to the connection compartment (a) and tighten the socket head cap screw of the securing clamp.
7. Sensor: Secure the cover on the connection housing (b).

Promag D

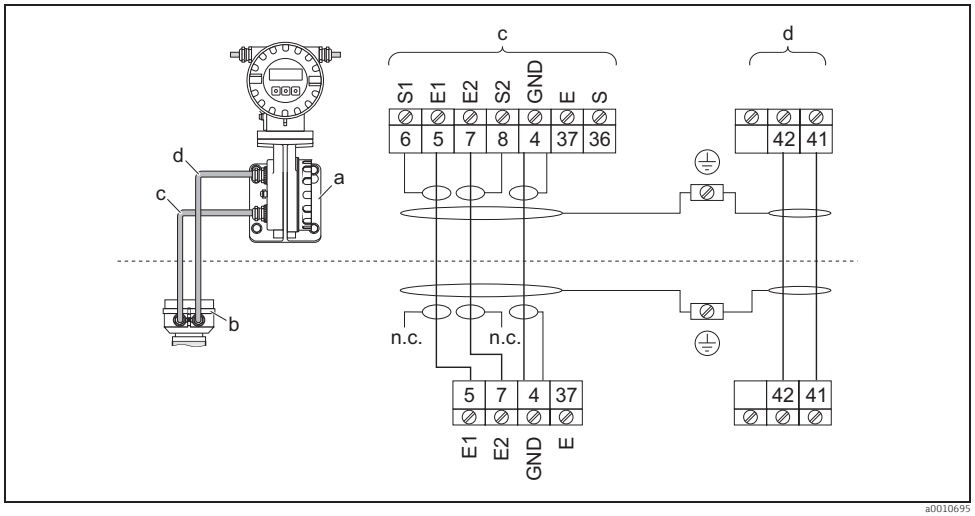


Fig. 26: Connecting the remote version of Promag D

a Wall-mount housing connection compartment
b Cover of the sensor connection housing
c Signal cable
d Coil current cable
n.c. Not connected, insulated cable shields

Wire colors/Terminal No.:
5/6 = braun, 7/8 = white, 4 = green, 37/36 = yellow

Promag E/L/P/W

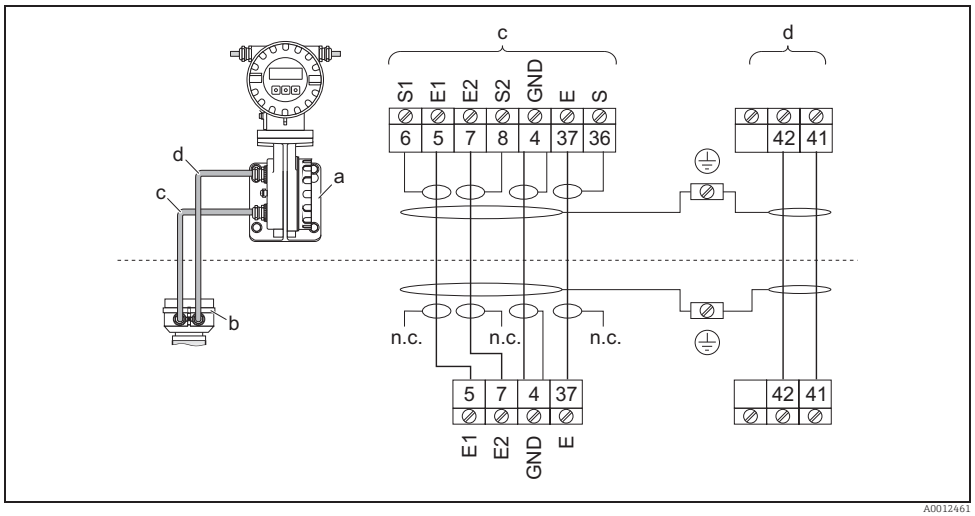


Fig. 27: Connecting the remote version of Promag E/L/P/W

a Wall-mount housing connection compartment
b Cover of the sensor connection housing
c Signal cable
d Coil current cable
n.c. Not connected, insulated cable shields

Wire colors/Terminal No.:
5/6 = braun, 7/8 = white, 4 = green, 37/36 = yellow

Promag H

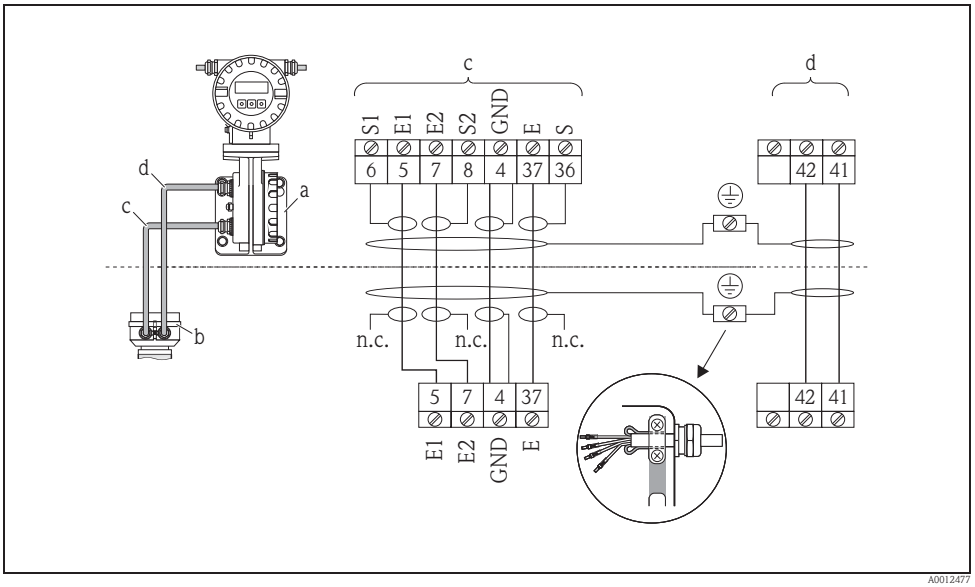


Fig. 28: Connecting the remote version of Promag H

a Wall-mount housing connection compartment
b Cover of the sensor connection housing
c Signal cable
d Coil current cable
n.c. Not connected, insulated cable shields

Wire colors/Terminal No.:
5/6 = braun, 7/8 = white, 4 = green, 37/36 = yellow

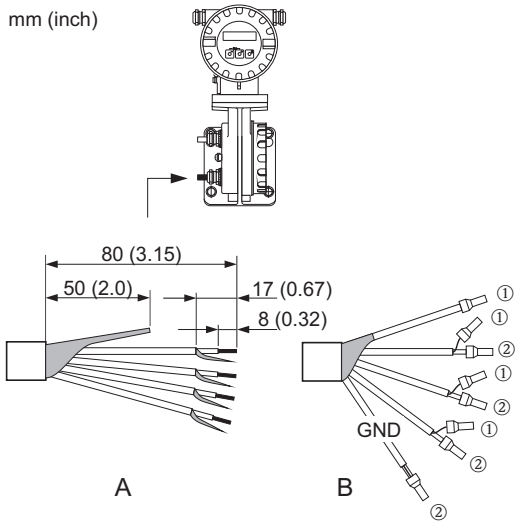
Cable termination for the remote version
Promag D/E/L/P/W

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Ferrules must be provided on the fine-wire cores (Detail B: ① = red ferrules, ∅ 1.0 mm; ② = white ferrules, ∅ 0.5 mm).

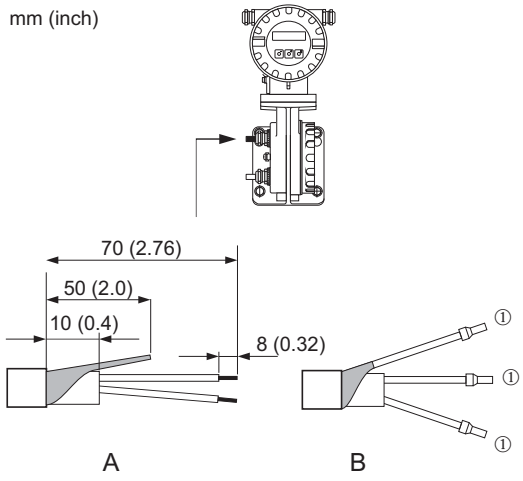
Caution!
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the ferrules do not touch the wire shield on the sensor side. Minimum distance = 1 mm (exception "GND" = green cable)
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.

TRANSMITTER

Signal cable

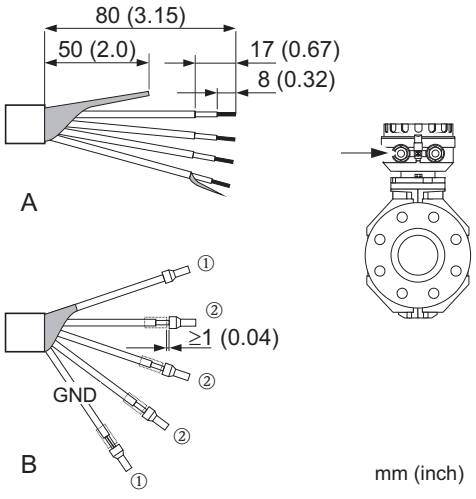


Coil current cable

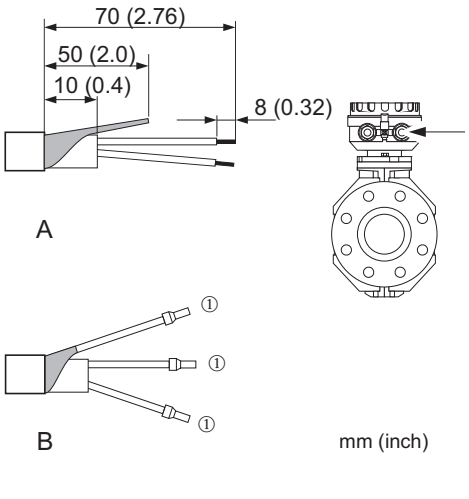


SENSOR

Signal cable



Coil current cable



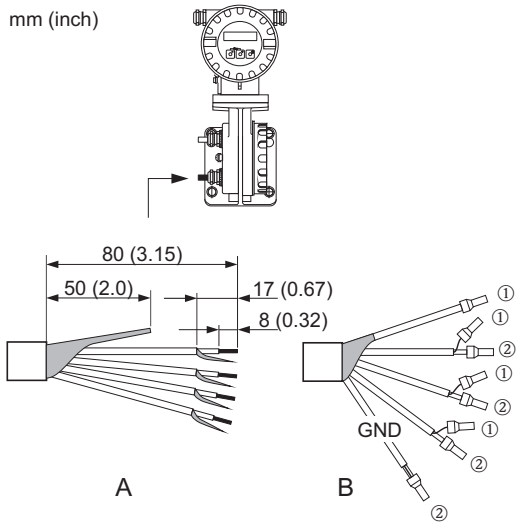
Cable termination for the remote version
Promag H

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Ferrules must be provided on the fine-wire cores (Detail B: ① = red ferrules, ∅ 1.0 mm; ② = white ferrules, ∅ 0.5 mm).

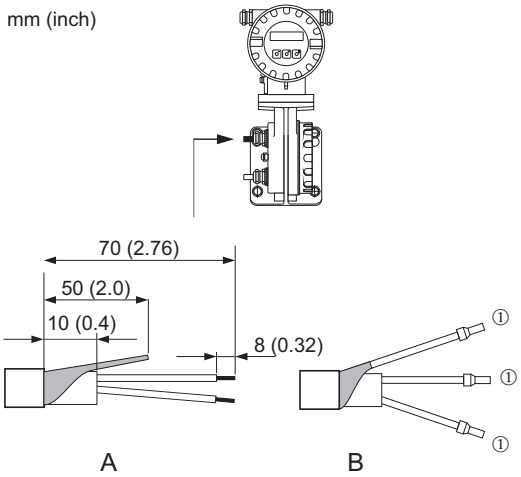
Caution!
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the ferrules do not touch the wire shield on the sensor side. Minimum distance = 1 mm (exception "GND" = green cable).
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.
- On the sensor side, reverse both cable shields approx. 15 mm over the outer jacket. The strain relief ensures an electrical connection with the connection housing.

TRANSMITTER

Signal cable

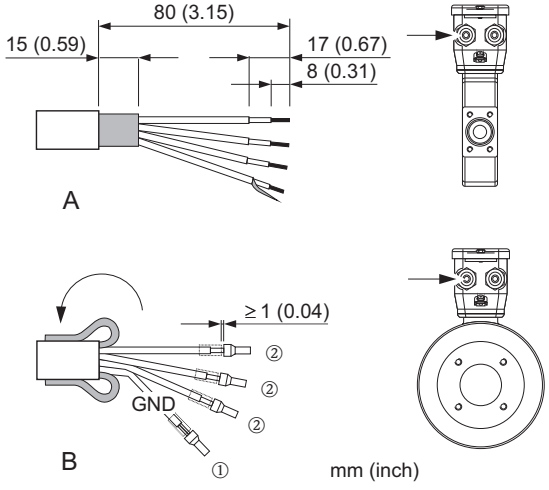


Coil current cable

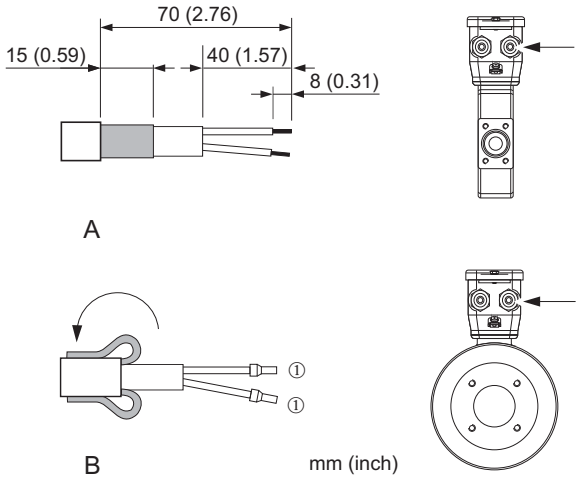


SENSOR

Signal cable



Coil current cable



4.1.2 Cable specifications

Signal cable

- 3 × 0.38 mm² PVC cable with common, braided copper shield (∅ ~7 mm) and individually shielded cores
- With Empty Pipe Detection (EPD): 4 × 0.38 mm² PVC cable with common, braided copper shield (∅ ~ 7 mm) and individually shielded cores
- Conductor resistance: ≤ 50 Ω/km
- Capacitance: core/shield: ≤ 420 pF/m
- Permanent operating temperature: –20 to +80 °C
- Cable cross-section: max. 2.5 mm²

Coil cable

- 2 × 0.75 mm² PVC cable with common, braided copper shield (∅ ~ 7 mm)
- Conductor resistance: ≤ 37 Ω/km
- Capacitance: core/core, shield grounded: ≤ 120 pF/m
- Operating temperature: –20 to +80 °C
- Cable cross-section: max. 2.5 mm²
- Test voltage for cable insulation: ≥ 1433 V AC r.m.s. 50/60 Hz or ≥ 2026 V DC

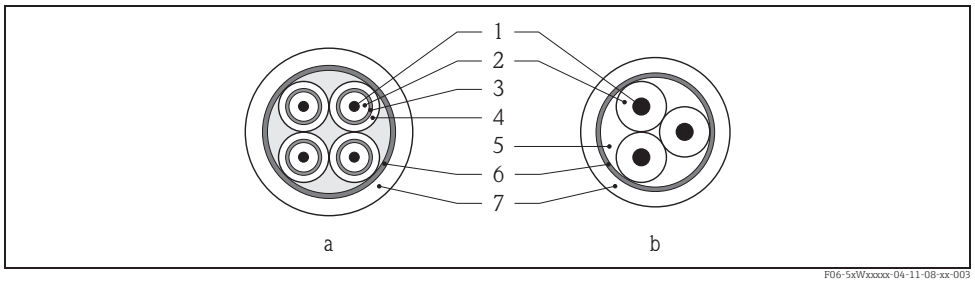


Fig. 29: Cable cross-section

a Signal cable
b Coil current cable

1 Core
2 Core insulation
3 Core shield
4 Core jacket
5 Core reinforcement
6 Cable shield
7 Outer jacket

Operation in zones of severe electrical interference:

The measuring device complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of IEC/EN 61326.

Caution!
Grounding is by means of the ground terminals provided for the purpose inside the connection housing. Ensure that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible.

4.2 Connecting the measuring unit

4.2.1 Transmitter

Warning!
- Risk of electric shock!
  Switch off the power supply before opening the device. Do not install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock!
  Connect the protective conductor to the ground terminal on the housing before the power supply is applied.
- Compare the specifications on the nameplate with the local supply voltage and frequency. The national regulations governing the installation of electrical equipment also apply.
- The transmitter must be included in the building fuse system.

1. Unscrew cover of the electronics compartment from the transmitter housing.
2. Press the side latches and flip down the cover of the connection compartment.
3. Feed the cable for the power supply and the signal cable through the appropriate cable entries.
4. Remove the terminal connectors from the transmitter housing and connect the cable for the power supply and the signal cable:
   – Wiring diagram → 30
   – Terminal assignment → 49
5. Plug the terminal connectors back into the transmitter housing.

   Note!
   The connectors are coded so you cannot mix them up.
6. Secure the ground cable to the ground terminal.
7. Flip up the cover of the connection compartment.
8. Screw the cover of the electronics compartment firmly onto the transmitter housing.

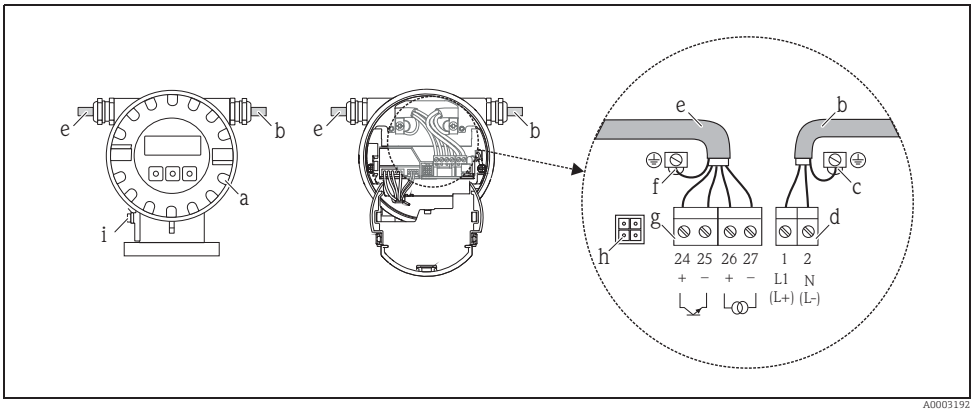


Fig. 30: Connecting the transmitter (aluminum field housing). Cable cross-section: max. 2.5 mm²

a Electronics compartment cover
b Cable for power supply: 85 to 250 V AC, 11 to 40 V DC, 20 to 28 V AC
c Ground terminal for power supply cable
*d Terminal connector for power supply: No. 1–2 → **49** (terminal assignment)*
e Signal cable
f Ground terminal for signal cable
*g Terminal connector for signal cable: No. 24–27 → **49** (terminal assignment)*
h Service connector
i Ground terminal for potential equalization

4.2.2 Terminal assignment

Order version	Terminal No. (outputs/power supply)		
	24 (+) / 25 (–)	26 (+) / 27 (–)	1 (L1/L+) / 2 (N/L–)
10***-**********A	Pulse output	Current output HART	Power supply

Note!
Functional values of the outputs and power supply → 83

4.2.3 HART connection

Users have the following connection options at their disposal:
- Direct connection to transmitter by means of terminals 26(+) and 27 (–)
- Connection by means of the 4 to 20 mA circuit.
- The measuring loop's minimum load must be at least 250 Ω.
- After commissioning, make the following settings:
  – CURRENT SPAN function → "4–20 mA HART"
  – Switch HART write protection on or off → 60

Connection of the HART handheld communicator

See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: "HART, a technical summary".

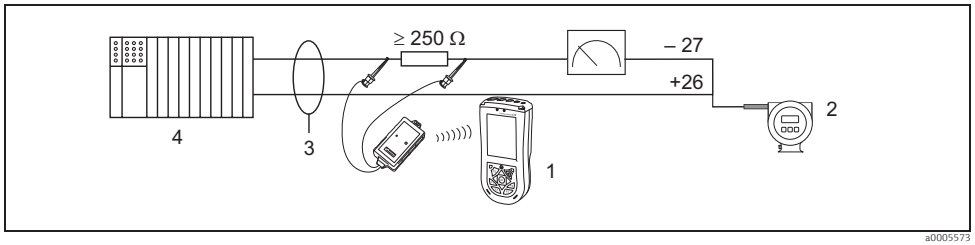


Fig. 31: Electrical connection of HART handheld Field Xpert SFX100

1 HART handheld Field Xpert SFX100
2 Auxiliary energy
3 Shielding
4 Other devices or PLC with passive input

Connection of a PC with an operating software

In order to connect a PC with an operating software (e.g. "FieldCare), a HART modem (e.g. Commubox FXA 195) is needed.

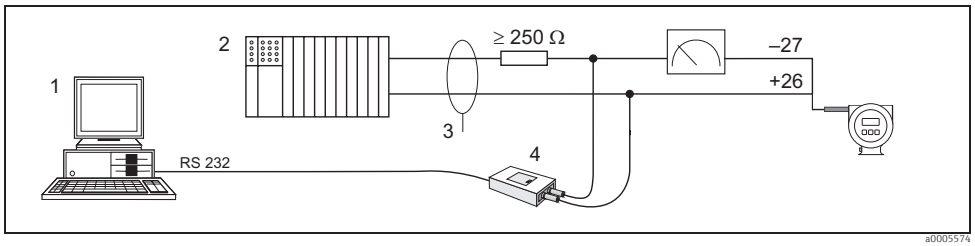


Fig. 32: Electrical connection of a PC with an operating software

1 PC with an operating software
2 Other evaluation devices or PLC with passive input
3 Shield
4 HART modem, e.g. Commubox FXA 195

4.3 Potential equalization

Warning!
The measuring system must be included in the potential equalization.

Perfect measurement is only ensured when the fluid and the sensor have the same electrical potential. This is ensured by the reference electrode integrated in the sensor as standard.

The following should also be taken into consideration for potential equalization:
- Internal grounding concepts in the company
- Operating conditions, such as the material/grounding of the pipes (see Table)

4.3.1 Potential equalization for Promag D

- No reference electrode is integrated!
  For the two ground disks of the sensor an electrical connection to the fluid is always ensured.
- Exampels for connections → 50

4.3.2 Potential equalization for Promag E/L/P/W

- Reference electrode integrated in the sensor as standard
- Exampels for connections → 51

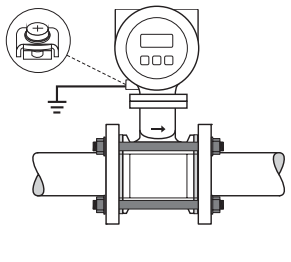
4.3.3 Potential equalization for Promag H

No reference electrode is integrated!
For the metal process connections of the sensor an electrical connection to the fluid is always ensured.

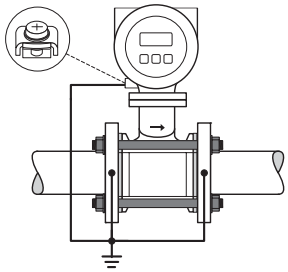
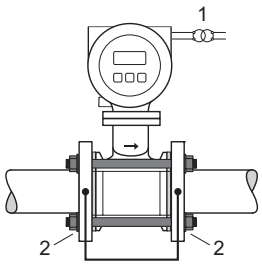
Caution!
If using process connections made of a synthetic material, ground rings have to be used to ensure that potential is equalized (→ 25). The necessary ground rings can be ordered separately from Endress+Hauser as accessories (→ 70).

4.3.4 Exampels for potential equalization connections for Promag D

Standard case

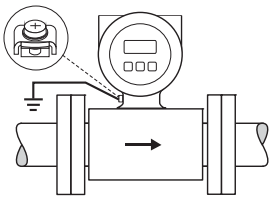
Operating conditions	Potential equalization
When using the measuring device in a: ▪ Metal, grounded pipe ▪ Plastic pipe ▪ Pipe with insulating lining Potential equalization takes place via the ground terminal of the transmitter (standard situation). Note! When installing in metal pipes, we recommend you connect the ground terminal of the transmitter housing with the piping.	 a0010702 *Fig. 33: Via the ground terminal of the transmitter*

Special cases

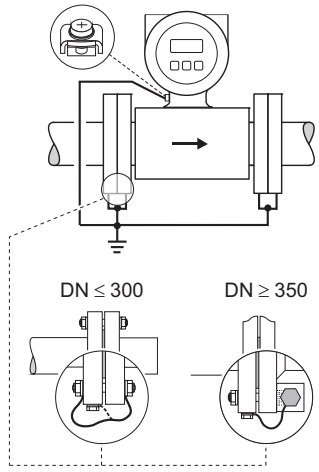
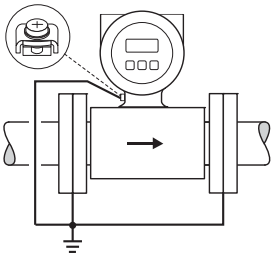
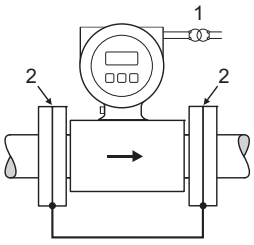
Operating conditions	Potential equalization
When using the measuring device in a: ▪ Metal pipe that is not grounded This connection method also applies in situations where: ▪ Customary potential equalization cannot be ensured ▪ Excessively high equalizing currents can be expected Potential equalization takes place via the ground terminal of the transmitter and the two pipe flanges. Here, the ground cable (copper wire, 6 mm² / 0.0093 in²) is mounted directly on the conductive flange coating with flange screws.	 a0010703 *Fig. 34: Via the ground terminal of the transmitter and the flanges of the pipe*
When using the measuring device in a: ▪ Pipe with a cathodic protection unit The device is installed potential-free in the pipe. Only the two flanges of the pipe are connected with a ground cable (copper wire, 6 mm² / 0.0093 in²). Here, the ground cable is mounted directly on the conductive flange coating with flange screws. Note the following when installing: ▪ The applicable regulations regarding potential-free installation must be observed. ▪ There should be no electrically conductive connection between the pipe and the device. ▪ The mounting material must withstand the applicable torques.	 a0010704 *Fig. 35: Potential equalization and cathodic protection* *1 Power supply isolation transformer* *2 Electrically isolated*

4.3.5 Exampels for potential equalization connections for Promag E/L/P/W

Standard case

Operating conditions	Potential equalization
When using the measuring device in a: ▪ Metal, grounded pipe Potential equalization takes place via the ground terminal of the transmitter (standard situation). Note! When installing in metal pipes, we recommend you connect the ground terminal of the transmitter housing with the piping.	 a0010702 *Fig. 36: Via the ground terminal of the transmitter*

Special cases

Operating conditions	Potential equalization
When using the measuring device in a: ■ Metal pipe that is not grounded This connection method also applies in situations where: ■ Customary potential equalization cannot be ensured ■ Excessively high equalizing currents can be expected Both sensor flanges are connected to the pipe flange by means of a ground cable (copper wire, 6 mm² / 0.0093 in²) and grounded. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose. Ground cable installation depends on the nominal diameter: ■ DN ≤ 300: The ground cable is mounted directly on the conductive flange coating with the flange screws. ■ DN ≥ 350: The ground cable is mounted directly on the metal transport bracket. Note! The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser.	 a0010703 *Fig. 37: Via the ground terminal of the transmitter and the flanges of the pipe*
When using the measuring device in a: ■ Plastic pipe ■ Pipe with insulating lining This connection method also applies in situations where: ■ Customary potential equalization cannot be ensured ■ Excessively high equalizing currents can be expected Potential equalization takes place using additional ground disks, which are connected to the ground terminal via a ground cable (copper wire, min. 6 mm² / 0.0093 in²). When installing the ground disks, please comply with the enclosed Installation Instructions.	 a0010702 *Fig. 38: Via the ground terminal of the transmitter*
When using the measuring device in a: ■ Pipe with a cathodic protection unit The device is installed potential-free in the pipe. Only the two flanges of the pipe are connected with a ground cable (copper wire, 6 mm² / 0.0093 in²). Here, the ground cable is mounted directly on the conductive flange coating with flange screws. Note the following when installing: ■ The applicable regulations regarding potential-free installation must be observed. ■ There should be no electrically conductive connection between the pipe and the device. ■ The mounting material must withstand the applicable torques.	 a0010704 *Fig. 39: Potential equalization and cathodic protection* *1 Power supply isolation transformer* *2 Electrically isolated*

4.4 Degree of protection

The devices meet all the requirements of IP 67 degree of protection.

Compliance with the following points is mandatory following installation in the field or servicing in order to ensure that IP 67 protection is maintained:
- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
- All threaded fasteners and screw covers must be firmly tightened.
- The cables used for connection must be of the specified outside diameter → 47.
- Firmly tighten the cable entries.
- The cables must loop down before they enter the cable entries ("water trap"). This arrangement prevents moisture penetrating the entry. Always install the measuring device in such a way that the cable entries do not point up.
- Remove all unused cable entries and insert plugs instead.
- Do not remove the grommet from the cable entry.

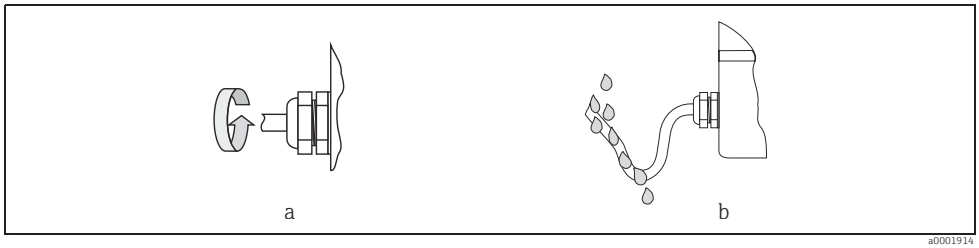


Fig. 40: Installation instructions, cable entries

Caution!
Do not loosen the threaded fasteners of the sensor housing, as otherwise the degree of protection guaranteed by Endress+Hauser no longer applies.

Note!
The Promag E/L/P/W sensors can be supplied with IP 68 rating (permanent immersion in water to a depth of 3 meters (10 ft)). In this case the transmitter must be installed remote from the sensor.
The Promag L sensors with IP 68 rating are only available with stainless steel flanges.

4.5 Post-connection check

Perform the following checks after completing electrical installation of the measuring device:

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	–
Electrical connection	**Notes**
Does the supply voltage match the specifications on the nameplate?	▪ 85 to 250 V AC (50 to 60 Hz) ▪ 20 to 28 V AC (50 to 60 Hz), 11 to 40 V DC
Do the cables used comply with the necessary specifications?	→ 🖹 47
Do the cables have adequate strain relief?	–
Is the cable type route completely isolated? Without loops and crossovers?	–
Are the power-supply and signal cables correctly connected?	See the wiring diagram inside the cover of the terminal compartment
Only remote version: Is the flow sensor connected to the matching transmitter electronics?	Check serial number on nameplates of sensor and connected transmitter.
Only remote version: Is the connecting cable between sensor and transmitter connected correctly?	→ 🖹 42
Are all screw terminals firmly tightened?	–
Have the measures for grounding/potential equalization been correctly implemented?	→ 🖹 50
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	→ 🖹 53
Are all housing covers installed and firmly tightened?	–

5 Operation

5.1 Display and operating elements

The local display enables you to read all important parameters directly at the measuring point and configure the device.
The display area consists of two lines; this is where measured values are displayed, and/or status variables (partially filled pipe, etc.). The assignment of the display lines in operating mode is specified. The top line displays the volume flow and the bottom line displays the totalizer status.

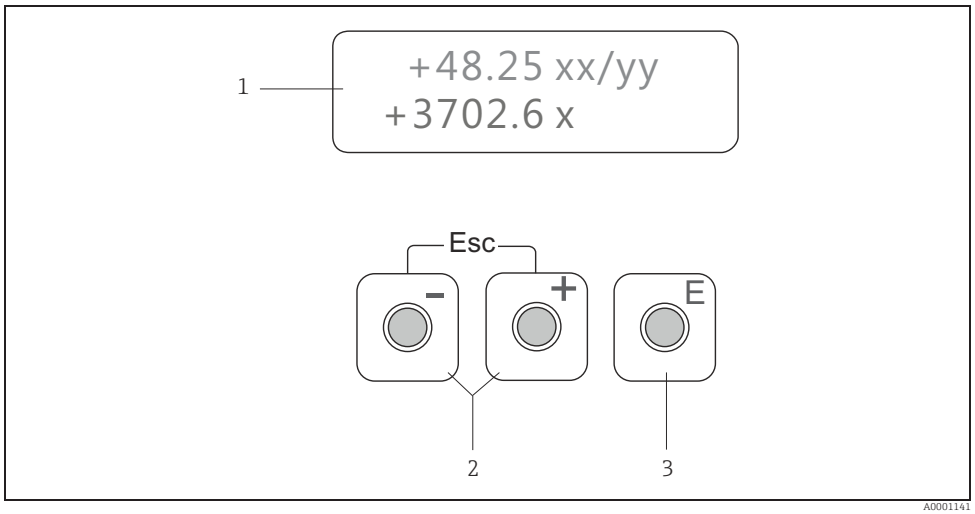


Fig. 41: Display and operating elements

1 Liquid crystal display
The two-line liquid-crystal display shows measured values, dialog texts, error messages and information messages. The display as it appears when normal measuring is in progress is known as the HOME position (operating mode).
- *Upper display line: Shows primary measured values, e.g. volume flow [e.g. in ml/min]*
- *Lower display line: Shows the totalizer status, [e.g. in m^3]*

2 Plus/minus keys
- *Enter numerical values, select parameters*
- *Select different function groups within the function matrix*

Press the +/- keys simultaneously to trigger the following functions:
- *Exit the function matrix step by step → HOME position*
- *Press and hold down +/- keys for longer than 3 seconds → Return directly to HOME position*
- *Cancel data entry*

3 Enter key
- *HOME position → Entry into the function matrix*
- *Save the numerical values you input or settings you change*

5.2 Brief operating instructions on the function matrix

Note!
- See the general notes on → 57.
- Function matrix overview → 108
- Detailed description of all functions → 109 ff.

The function matrix comprises two levels, namely the function groups and the functions of the function groups.
The groups are the highest-level grouping of the control options for the device. A number of functions is assigned to each group. You select a group in order to access the individual functions for operating and configuring the device.

1. HOME position → E → Enter the function matrix
2. Select a function group (e.g. OPERATION)
3. Select a function (e.g. LANGUAGE)
   Change parameter/enter numerical values:
   ± → select or enter enable code, parameters, numerical values
   E → save your entries
4. Exit the function matrix:
   – Press and hold down Esc key (Esc) for longer than 3 seconds → HOME position
   – Repeatedly press Esc key (Esc) → return step by step to HOME position

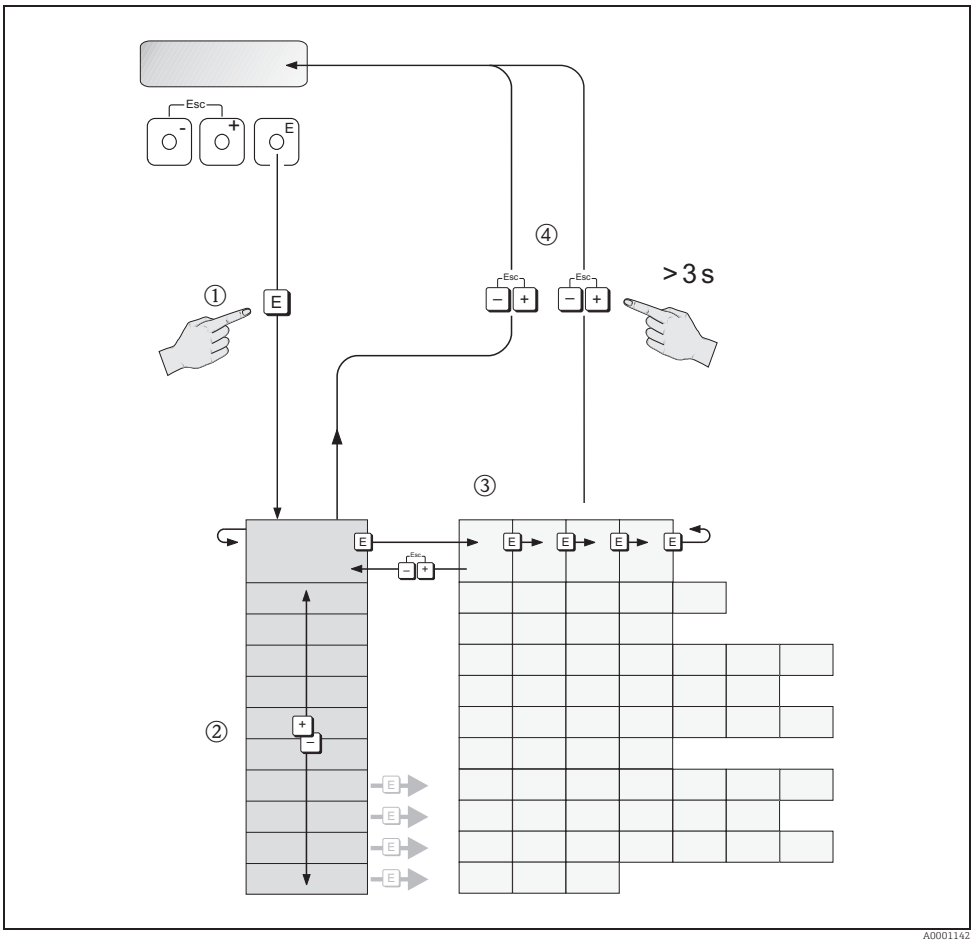


Fig. 42: Selecting functions and configuring parameters (function matrix)

5.2.1 General notes

The brief commissioning guide (→ 66) is adequate for commissioning in most instances. Complex measuring operations on the other hand necessitate additional functions that you can configure as necessary and customize to suit your process parameters. The function matrix, therefore, comprises a multiplicity of additional functions which, for the sake of clarity, are arranged in a number of function groups.

Comply with the following instructions when configuring functions:
- You select functions as described on → 56.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries.
  Press ± to select "SURE [YES]" and press E again to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.

Note!
- The transmitter continues to measure while data entry is in progress, i.e. the current measured values are output via the signal outputs in the normal way.
- If the power supply fails, all preset and configured values remain safely stored in the EEPROM.

5.2.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings. A numerical code (factory setting = 10) has to be entered before settings can be changed.
If you use a code of your choice, you exclude the possibility of unauthorized persons accessing data, see ACCESS CODE function → 111.

Comply with the following instructions when entering codes:
- If programming is disabled and the ± operating elements are pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is specified as the customer's code, programming is always enabled.
- The Endress+Hauser service organization can be of assistance if you mislay your personal code.

Caution!
Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy. Normally, such parameters may not be changed! Please contact Endress+Hauser if you have any questions.

5.2.3 Disabling the programming mode

Programming is disabled if you do not press the operating elements within 60 seconds following automatic return to the HOME position.
You can also disable programming in the "ACCESS CODE" function by entering any number (other than the customer's code).

5.3 Displaying error messages

5.3.1 Type of error

Errors which occur during commissioning or measuring operation are displayed immediately. If two or more system or process errors occur, the error with the highest priority is the one shown on the display.

The measuring system distinguishes between two types of error:
- *System errors* → 📄 *74:*
  This group comprises all device errors, e.g. communication errors, hardware faults, etc.
- *Process errors* → 📄 76:
  This group comprises all application errors, e.g. empty pipe, etc.

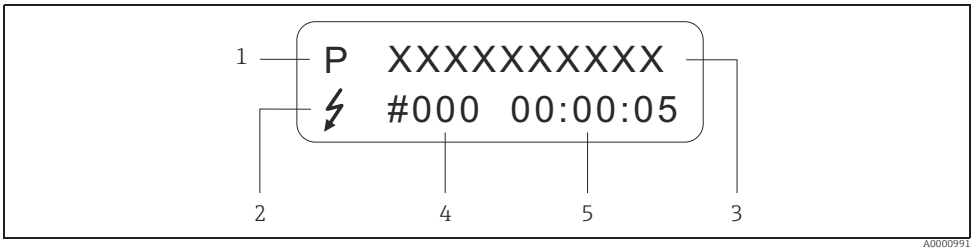


Fig. 43: Error messages on the display (example)

1 Error type:
– P = process error
– S = system error
2 Error message type:
– ϟ = fault message
– ! = notice message
3 Error designation: e.g. EMPTY PIPE = measuring tube is only partly filled or completely empty
4 Error number: e.g. #401
5 Duration of most recent error occurrence (in hours, minutes and seconds)

5.3.2 Error message types

Notice message (!)

- Displayed as → Exclamation mark (!), error type (S: system error, P: process error)
- The error in question has no effect on the outputs of the measuring device.

Fault message (ϟ)

- Displayed as → Lightning flash (ϟ), error type (S: system error, P: process error).
- The error in question has a direct effect on the outputs.
  The response of the individual outputs (failsafe mode) can be defined in the function matrix using the "FAILSAFE MODE" function → 📄 129.

Note!
For security reasons, error messages should be output via the status output.

5.4 Communication

In addition to local operation, the measuring device can be configured and measured values can be obtained by means of the HART protocol. Digital communication takes place using the 4–20 mA current output HART → 🖹 49.

The HART protocol allows the transfer of measuring and device data between the HART master and the field devices for configuration and diagnostics purposes.
The HART master, e.g. a handheld terminal or PC-based operating programs (such as FieldCare), require device description (DD) files which are used to access all the information in a HART device. Information is exclusively transferred using so-called "commands". There are three different command classes:

- *Universal commands:*
  All HART device support and use universal commands.
  The following functionalities are linked to them:
  – Identify HART devices
  – Reading digital measured values (volume flow, totalizer, etc.)
- *Common practice commands:*
  Common practice commands offer functions which are supported and can be executed by most but not all field devices.
- *Device-specific commands:*
  These commands allow access to device-specific functions which are not HART standard. Such commands access individual field device information, amongst other things, such as empty/full pipe calibration values, low flow cutoff settings, etc.

Note!
The device has access to all three command classes. A list of all the "Universal commands" and "Common practice commands" is provided on → 🖹 61.

5.4.1 Operating options

For the complete operation of the measuring device, including device-specific commands, there are DD files available to the user to provide the following operating aids and programs:

Field Xpert HART Communicator

Selecting device functions with a HART Communicator is a process involving a number of menu levels and a special HART function matrix.
The HART manual in the carrying case of the HART Communicator contains more detailed information on the device.

Operating program "FieldCare"

FieldCare is Endress+Hauser's FDT-based plant Asset Management Tool and allows the configuration and diagnosis of intelligent field devices. By using status information, you also have a simple but effective tool for monitoring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA193.

Operating program "SIMATIC PDM" (Siemens)

SIMATIC PDM is a standardized, manufacturer-independent tool for the operation, configuration, maintenance and diagnosis of intelligent field devices.

Operating program "AMS" (Emerson Process Management)

AMS (Asset Management Solutions): program for operating and configuring devices.

5.4.2 Current device description files

The following table illustrates the suitable device description file for the operating tool in question and then indicates where these can be obtained.

HART protocol:

Valid for device software:	1.04.XX	→ Function DEVICE SOFTWARE
Device data HART Manufacturer ID: Device ID:	 11_{hex} (ENDRESS+HAUSER) 56_{hex}	 → Function MANUFACTURER ID → Function DEVICE ID
HART version data:	Device Revision 5/ DD Revision 1	
Software release:	01.2012	

Operating program:	Sources for obtaining device descriptions:
Handheld Field Xpert SFX100	Use update function of handheld terminal
FieldCare / DTM	▪ www.endress.com → Download ▪ CD-ROM (Endress+Hauser order number 56004088) ▪ DVD (Endress+Hauser order number 70100690)
AMS	www.endress.com → Download
SIMATIC PDM	www.endress.com → Download

Tester/simulator:	Sources for obtaining device descriptions:
Fieldcheck	Update by means of FieldCare with the flow device FXA193/291 DTM in the Fieldflash module

Note!
The "Fieldcheck" tester/simulator is used for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed out and used for official certification. Contact your Endress+Hauser representative for more information.

5.4.3 Device variables

The following device variables are available using the HART protocol:

Code (decimal)	Device variable
0	OFF (not assigned)
1	Volume flow
250	Totalizer

At the factory, the process variables are assigned to the following device variables:
- Primary process variable (PV) → Volume flow
- Second process variable (SV) → Totalizer
- Third process variable (TV) → not assigned
- Fourth process variable (FV) → not assigned

5.4.4 Switching HART write protection on/off

The HART write protection can be switched on and off using the HART WRITE PROTECT device function → 🖹 121.

5.4.5 Universal and common practice HART commands

The following table contains all the universal commands supported by the device.

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Universal commands			
0	Read unique device identifier Access type = read	none	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, 69 = Promag 10 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
1	Read primary process variable Access type = read	none	– Byte 0: HART unit code of the primary process variable – Bytes 1-4: Primary process variable Factory setting: Primary process variable = Volume flow ✎ Note! Manufacturer-specific units are represented using the HART unit code "240".
2	Read the primary process variable as current in mA and percentage of the set measuring range Access type = read	none	– Bytes 0-3: actual current of the primary process variable in mA – Bytes 4-7: % value of the set measuring range Factory setting: Primary process variable = Volume flow
3	Read the primary process variable as current in mA and four dynamic process variables Access type = read	none	24 bytes are sent as a response: – Bytes 0-3: primary process variable current in mA – Byte 4: HART unit code of the primary process variable – Bytes 5-8: Primary process variable – Byte 9: HART unit code of the second process variable – Bytes 10-13: Second process variable – Byte 14: HART unit code of the third process variable – Bytes 15-18: Third process variable – Byte 19: HART unit code of the fourth process variable – Bytes 20-23: Fourth process variable *Factory setting:* ▪ Primary process variable = Volume flow ▪ Second process variable = Totalizer ▪ Third process variable = OFF (not assigned) ▪ Fourth process variable = OFF (not assigned) The assignment of the process variables is fixed and cannot be changed. ✎ Note! Manufacturer-specific units are represented using the HART unit code "240".
6	Set HART shortform address Access type = write	Byte 0: desired address (0 to 15) Factory setting: 0 ✎ Note! With an address >0 (multidrop mode), the current output of the primary process variable is set to 4 mA.	Byte 0: active address

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
11	Read unique device identification using the TAG (measuring point designation) Access type = read	Bytes 0-5: TAG	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID if the given TAG agrees with the one saved in the device: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, 69 = Promag 10 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
12	Read user message Access type = read	none	Bytes 0-24: User message ✎ Note! You can write the user message using Command 17.
13	Read TAG, descriptor and date Access type = read	none	– Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date ✎ Note! You can write the TAG, descriptor and date using Command 18.
14	Read sensor information on primary process variable	none	– Bytes 0-2: Sensor serial number – Byte 3: HART unit code of sensor limits and measuring range of the primary process variable – Bytes 4-7: Upper sensor limit – Bytes 8-11: Lower sensor limit – Bytes 12-15: Minimum span ✎ Note! ▪ The data relate to the primary process variable (= volume flow). ▪ Manufacturer-specific units are represented using the HART unit code "240".
15	Read output information of primary process variable Access type = read	none	– Byte 0: Alarm selection ID – Byte 1: Transfer function ID – Byte 2: HART unit code for the set measuring range of the primary process variable – Bytes 3-6: upper range, value for 20 mA – Bytes 7-10: lower range, value for 4 mA – Bytes 11-14: Damping constant in [s] – Byte 15: Write protection ID – Byte 16: OEM dealer ID, 17 = E+H Factory setting: Primary process variable = Volume flow ✎ Note! Manufacturer-specific units are represented using the HART unit code "240".
16	Read the device production number Access type = read	none	Bytes 0-2: Production number
17	Write user message Access = write	Save any 32-character text in the device. Bytes 0-23: Desired user message	Displays the current user message in the device: Bytes 0-23: Current user message in the device
18	Write TAG, descriptor and date Access = write	With this parameter, you can store an 8 character TAG, a 16 character descriptor and a date: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date	Displays the current information in the device: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date
19	Write the device production number Access = write	Bytes 0-2: Production number	Bytes 0-2: Production number

The following table contains all the common practice commands supported by the device:

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Common practice commands			
34	Write damping value for primary process variable Access = write	Bytes 0-3: Damping value of the primary process variable "volume flow" in seconds *Factory setting:* Primary process variable = Current output damping	Displays the current damping value in the device: Bytes 0-3: Damping value in seconds
35	Write measuring range of primary process variable Access = write	Write the desired measuring range: – Byte 0: HART unit code of the primary process variable – Bytes 1-4: upper range, value for 20 mA – Bytes 5-8: lower range, value for 4 mA *Factory setting:* Primary process variable = Volume flow Note! ▪ The start of the measuring range (4 mA) must correspond to the zero flow. ▪ If the HART unit code is not the correct one for the process variable, the device will continue with the last valid unit.	The currently set measuring range is displayed as a response: – Byte 0: HART unit code for the set measuring range of the primary process variable – Bytes 1-4: upper range, value for 20 mA – Bytes 5-8: lower range, value for 4 mA Note! Manufacturer-specific units are represented using the HART unit code "240".
38	Device status reset (configuration changed) Access = write	none Note! It is also possible to execute this HART command when write protection is activated (= ON)!	none
40	Simulate input current of primary process variable Access = write	Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode: Bytes 0-3: Output current in mA *Factory setting:* Primary process variable = Volume flow Note! You can set the assignment of device variables to process variables using Command 51.	The momentary output current of the primary process variable is displayed as a response: Bytes 0-3: Output current in mA
42	Perform master reset Access = write	none	none
44	Write unit of primary process variable Access = write	Set unit of primary process variable. Only units which are suitable for the process variable are transferred to the device: Byte 0: HART unit code *Factory setting:* Primary process variable = Volume flow Note! ▪ If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. ▪ If you change the unit of the primary process variable, this has a direct impact on the system units.	The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code Note! Manufacturer-specific units are represented using the HART unit code "240".
48	Read additional device status Access = read	none	The device status is displayed in extended form as the response: Coding: see table → 65.

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
50	Read assignment of the device variables to the four process variables Access = read	none	Display of the current variable assignment of the process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Factory setting:* ▪ Primary process variable: Code 1 for volume flow ▪ Second process variable: Code 250 for totalizer ▪ Third process variable: Code 0 for OFF (not assigned) ▪ Fourth process variable: Code 0 for OFF (not assigned)
53	Write device variable unit Access = write	This command sets the unit of the given device variables. Only those units which suit the device variable are transferred: – Byte 0: Device variable code – Byte 1: HART unit code *Code of the supported device variables:* See information → 🖹 60 ✎ Note! ▪ If the written unit is not the correct one for the device variable, the device will continue with the last valid unit. ▪ If you change the unit of the device variable, this has a direct impact on the system units.	The current unit of the device variables is displayed in the device as a response: – Byte 0: Device variable code – Byte 1: HART unit code ✎ Note! Manufacturer-specific units are represented using the HART unit code "240".
59	Write number of preambles in response message Access = write	This parameter sets the number of preambles which are inserted in the response messages: Byte 0: Number of preambles (4 to 20)	As a response, the current number of the preambles is displayed in the response message: Byte 0: Number of preambles

5.4.6 Device status and error messages

You can read the extended device status, in this case, current error messages, via Command "48". The command delivers information which is partly coded in bits (see table below).

Note!
- You can find a detailed explanation of the device status and error messages and their elimination on → 📄 65
- Bits and bytes not listed are not assigned.

Byte	Bit	Error No.	Short error description
0	0	001	Serious device error
	1	011	Measuring amplifier has faulty EEPROM
	2	012	Error when accessing data of the measuring amplifier EEPROM
3	3	111	Totalizer checksum error
5	0	321	Coil current of the sensor is outside the tolerance.
7	3	351	Current output: Flow is out of range
8	3	359	Pulse output: The pulse output frequency is out of range
10	7	401	Measuring tube partially filled or empty
11	2	461	EPD calibration not possible because the fluid's conductivity is either too low or too high
	4	463	The EPD calibration values for empty pipe and full pipe are identical, and therefore incorrect.
12	7	501	Amplifier software version is loaded. Currently no other commands are possible.
14	3	601	Positive zero return active
18	3	691	Simulation of response to error (outputs) active
	4	692	Simulation of volume flow active

6 Commissioning

6.1 Function check

Make sure that all final checks have been completed before you start up your measuring point:
- Checklist for "Post-installation check" → 41
- Checklist for "Post-connection check" → 54

6.2 Switching on the measuring device

Once the connection checks have been successfully completed, it is time to switch on the power supply. The device is now operational. The measuring device performs a number of post switch-on self-tests. As this procedure progresses the following sequence of messages appears on the local display:

PROMAG 10 V 1.XX.XX	Start-up message

Normal measuring mode commences as soon as start-up completes.
Various measured-value and/or status variables (HOME position) appear on the display.

Note!
If start-up fails, an error message indicating the cause is displayed.

6.3 Brief commissioning guide

HOME position → E → +

Configure display	
UI language	→ 111
Display contrast	→ 112
Number of decimal places	→ 112

Select engineering units	
Volume flow	→ 109
Totalizer	→ 113

Configure outputs			
Current output		*Pulse/status output*	
Current range	→ 114	Operating mode	→ 116
Full scale value	→ 115	Pulse value	→ 116
		Pulse width	→ 116
		or	
		Assign status output	→ 117
		Switch-on point	→ 117

Complex applications The quickest way to find information on configuring additional functions is via the following pages:	
Operating matrix	→ 108
Index	→ 135

For optimum measurement results	
Low flow cut off	→ 122
Empty pipe detection	→ 122

6.4 Commissioning after installing a new electronics board

After startup, the device checks whether a serial number is available. If this is not the case, the following setup is started. Installing a new electronics board → 79.

6.4.1 "Commissioning" setup

Note!
- The setup can no longer be called up once a serial number has been entered and stored. If a parameter is entered incorrectly during the setup, this must be corrected in the relevant function via the function matrix.
- The appropriate information is documented on the nameplate of the sensor and on the inside of the housing cover, → 2 → 7.

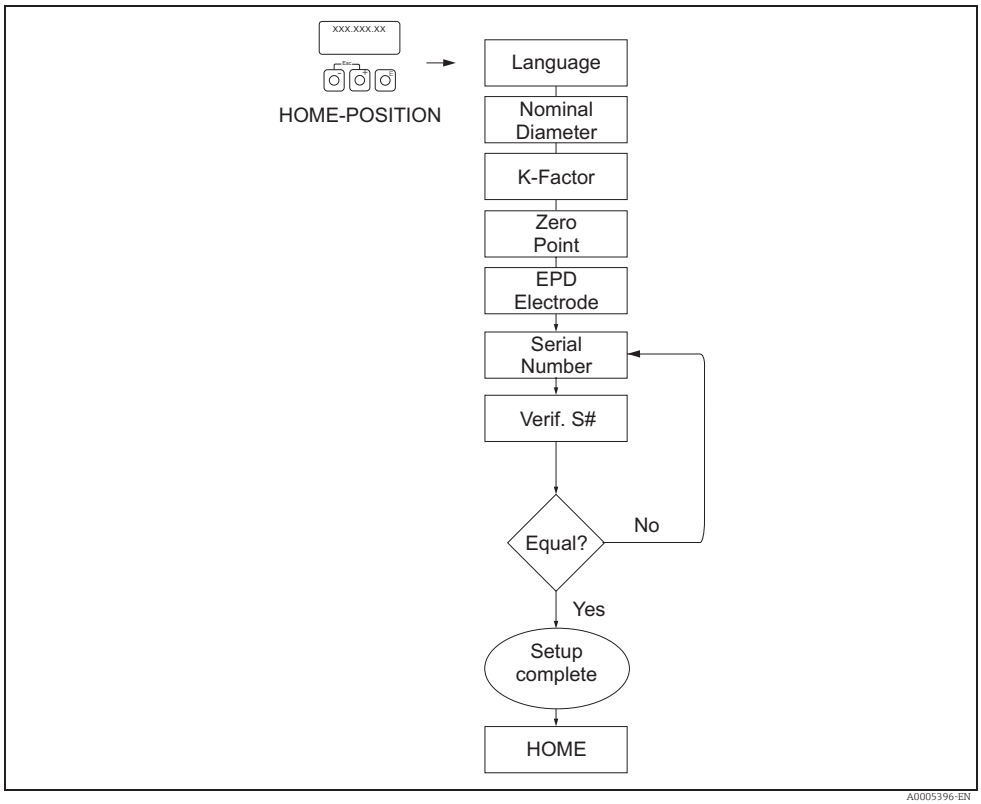


Fig. 44: The "Commissioning" setup starts after installation of a new electronics board if no serial number is present.

6.5 Empty-pipe/full-pipe adjustment

Flow cannot be measured correctly unless the measuring tube is completely full.
This status can be permanently monitored using the Empty Pipe Detection:
EPD = Empty Pipe Detection (with the help of an EPD electrode)

Caution!
More detailed information on empty-pipe and full-pipe adjustment can be found in the description of the functions:
- EPD ADJUSTMENT (carrying out the adjustment) → 123.
- EPD (switching empty pipe detection on and off) → 122

Note!
- The EPD function is not available unless the sensor is fitted with an EPD electrode.
- The devices are already calibrated at the factory with water (approx. 500 µS/cm). If the fluid conductivity differs from this reference, empty-pipe/full-pipe adjustment has to be performed again on site.
- The default setting for EPD when the devices are delivered is OFF; the function has to be activated if required.
- The EPD process error can be output by means of the configurable status output.

6.5.1 Performing empty-pipe and full-pipe adjustment (EPD)

1. Select the appropriate function in the function matrix:
   HOME → E → + → PROCESS PARAMETER → E → + → EPD ADJUSTMENT
2. Empty the piping. The wall of the measuring tube should still be wet with fluid during EPD empty pipe adjustment
3. Start empty-pipe adjustment: Select "EMPTY PIPE ADJUST" and press E to confirm.
4. After empty-pipe adjustment, fill the piping with fluid.
5. Start full-pipe adjustment: Select "FULL PIPE ADJUST" and press E to confirm.
6. Having completed the adjustment, select the setting "OFF" and exit the function by pressing E.
7. Now switch on empty pipe detection in the EPD function by selecting the option "ON".

   Caution!
   The adjustment coefficients must be valid before you can activate the EPD function. If adjustment is incorrect the following messages might appear on the display:
   – FULL = EMPTY
     The adjustment values for empty pipe and full pipe are identical. In cases of this nature you must repeat empty-pipe or full-pipe adjustment!
   – ADJUSTMENT NOT OK
     Adjustment is not possible because the fluid's conductivity is out of range.

7 Maintenance

No special maintenance work is required.

7.1 Exterior cleaning

When cleaning the exterior of measuring devices, always use cleaning agents that do not attack the surface of the housing and the seals.

7.2 Seals

The seals of the Promag H sensor must be replaced periodically, particularly in the case of gasket seals (aseptic version).
The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature.

Replacement seals (accessories) → 70.

8 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. Your Endress+Hauser service organization can provide detailed information on the specific order codes on request.

8.1 Device-specific accessories

Accessory	Description	Order code
Proline Promag 10 transmitter	Transmitter for replacement or storage. Use the order code to define the following specifications: ▪ Approvals ▪ Degree of protection/version ▪ Cable for remote version ▪ Cable entry ▪ Display/power supply/operation ▪ Software ▪ Outputs/inputs	10XXX – XXXXX******

8.2 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting set for Promag 10 transmitter	Mounting set for aluminum field housing (remote version). Suitable for Pipe mounting	DK5WM – B
Wall-mounting kit for Promag H	Wall-mounting kit for the Promag H sensor.	DK5HM – **
Cable for remote version	Coil and signal cables, various lengths.	DK5CA – **
Mounting kit for Promag D, wafer version	▪ Mounting bolts ▪ Nuts incl. washers ▪ Flange seals ▪ Centering sleeves (if required for the flange)	DKD** – **
Set of seals for Promag D	Set of seals consisting of two flange seals.	DK5DD – ***
Mounting kit for Promag H	▪ 2 process connections ▪ Threaded fasteners ▪ Seals	DKH** – ****
Set of seals for Promag H	For regular replacement of the seals of the Promag H sensor.	DK5HS – ***
Welding jig for Promag H	Weld nipple as process connection: welding jig for installation in pipe.	DK5HW – ***
Adapter connection for Promag A, H	Adapter connections for installing a Promag H instead of a Promag 30/33 A or Promag 30/33 H DN 25.	DK5HA – *****
Ground cable for Promag E/L/P/W	Ground cable for potential equalization.	DK5GC – ***
Ground disk for Promag E/L/P/W	Ground disk for potential equalization.	DK5GD – * * ***
Process display RIA45	Multifunctional 1-channel display unit: ▪ Universal input ▪ Transmitter power supply ▪ Limit relay ▪ Analog output	RIA45 – ******
Process display RIA251	Digital display device for looping into the 4 to 20 mA current loop.	RIA251 – **

Accessory	Description	Order code
Field display unit RIA16	Digital field display device for looping into the 4 to 20 mA current loop.	RIA16 – ***
Application Manager RMM621	Electronic recording, display, balancing, control, saving and event and alarm monitoring of analog and digital input signals. Values and conditions determined are output by means of analog and digital output signals. Remote transmission of alarms, input values and calculated values using a PSTN or GSM modem.	RMM621 – **********

8.3 Communication-specific accessories

Accessory	Description	Order code
HART Communicator Field Xpert SFX 100	Handheld terminal for remote configuration and for obtaining measured values via the HART current output (4 to 20 mA). Contact your Endress+Hauser representative for more information.	SFX100 – *******
Fieldgate FXA320	Gateway for remote interrogation of HART sensors and actuators via Web browser: ▪ 2-channel analog input (4 to 20 mA) ▪ 4 binary inputs with event counter function and frequency measurement ▪ Communication via modem, Ethernet or GSM ▪ Visualization via Internet/Intranet in Web browser and/or WAP cellular phone ▪ Limit value monitoring with alarm by e-mail or SMS ▪ Synchronized time stamping of all measured values.	FXA320 – *****
Fieldgate FXA520	Gateway for remote interrogation of HART sensors and actuators via Web browser: ▪ Web server for remote monitoring of up to 30 measuring points ▪ Intrinsically safe version [EEx ia]IIC for applications in hazardous areas ▪ Communication via modem, Ethernet or GSM ▪ Visualization via Internet/Intranet in Web browser and/or WAP cellular phone ▪ Limit value monitoring with alarm by e-mail or SMS ▪ Synchronized time stamping of all measured values ▪ Remote diagnosis and remote configuration of connected HART devices	FXA520 – ****
FXA195	The Commubox FXA195 connects intrinsically safe Smart transmitters with HART protocol to the USB port of a personal computer. This makes the remote operation of the transmitters possible with the aid of configuration programs (e.g. FieldCare). Power is supplied to the Commubox by means of the USB port	FXA195 – *

8.4 Service-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and planning flowmeters. The Applicator software can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC. Contact your Endress+Hauser representative for more information.	DXA80 – *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed out and used for official certification. Contact your Endress+Hauser representative for more information.	50098801
FieldCare	FieldCare is Endress+Hauser's FDT-based asset management tool. It can configure all intelligent field units in your system and helps you manage them. By using status information, it is also a simple but effective way of checking their status and condition.	See the product page on the Endress+Hauser Web site: www.endress.com
Memograph M graphic display recorder	The Memograph M graphic display recorder provides information on all the relevant process variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a DSD card or USB stick. Memograph M boasts a modular design, intuitive operation and a comprehensive security concept. The ReadWin® 2000 PC software is part of the standard package and is used for configuring, visualizing and archiving the data captured. The mathematics channels which are optionally available enable continuous monitoring of specific power consumption, boiler efficiency and other parameters which are important for efficient energy management.	RSG40 – **********
FXA193	Service interface from the device to the PC for operation via FieldCare.	FXA193 – *

9 Troubleshooting

9.1 Troubleshooting instructions

Always start troubleshooting with the checklist below if faults occur after start-up or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

Check the display	
No display visible and no output signals present.	1. Check the supply voltage → terminals 1, 2 2. Check the power line fuse → 🖹 81 85 to 250 V AC: TR5 1 A slow-blow / 250 V 11 to 40 V DC / 20 to 28 V AC: TR5 1.6A slow-blow / 250 V 3. Measuring electronics defective → order spare parts → 🖹 78
No display visible, but output signals are present.	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → 🖹 79 2. Display module defective → order spare parts → 🖹 78 3. Measuring electronics defective → order spare parts → 🖹 78
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the ± buttons and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal at the current or pulse output.	Electronics board defective → order spare parts → 🖹 78
↓	
Error messages on display	
Errors which occur during commissioning or measuring operation are displayed immediately. Error messages consist of a variety of icons: the meanings of these icons are as follows (example): – Error type: S = system error, P = process error – Error message type: ϟ = fault message, ! = notice message – EMPTY PIPE = Type of error, e.g. measuring tube is only partly filled or completely empty – 03:00:05 = duration of error occurrence (in hours, minutes and seconds) – #401 = error number ☝ Caution! ▪ See the information on → 🖹 58! ▪ The measuring system interprets simulations and positive zero return as system errors, but displays them as notice message only.	
Error number: No. 001 – 399 No. 501 – 699	System error (device error) has occurred → 🖹 74
Error number: No. 401 - 499	Process error (application error) has occurred → 🖹 76
↓	
Other error (without error message)	
Some other error has occurred.	Diagnosis and rectification → 🖹 76

9.2 System error messages

Serious system errors are always recognized by the device as "Fault message", and are shown as a lightning flash (ϟ) on the display. Fault messages immediately affect the outputs. Simulations and positive zero return, on the other hand, are only classed and displayed as notice messages.

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. Necessary procedures must be carried out before you return the measuring device to Endress+Hauser → 🖹 5.
Always enclose a duly completed "Declaration of Contamination" form. You will find a master copy of this form at the back of this manual.

Note!
- The error types listed in the following correspond to the factory settings.
- Also observe the information on → 🖹 58

Type	Error message / No.	Cause	Remedy (Replace electronics board → 🖹 79)
S = System error ϟ = Fault message (with an effect on the outputs) ! = Notice message (without an effect on the outputs)			
No. # 0xx→ Hardware error			
S ϟ	CRITICAL FAIL. # 001	Serious device error	Replace electronics board.
S ϟ	AMP HW EEPROM # 011	Electronics board: Defective EEPROM	Replace electronics board.
S ϟ	AMP SW EEPROM # 012	Amplifier: Error accessing EEPROM data.	The EEPROM data blocks in which an error has occurred are displayed in the TROUBLESHOOTING function. Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the errored parameter values. Note! The measuring device has to be restarted if an error has occurred in a totalizer block (see error No. 111 / CHECKSUM TOTAL).
No. # 1xx→ Software error			
S ϟ	GAIN ERROR AMP # 101	Impermissible gain deviation compared to reference.	Replace electronics board.
S ϟ	CHECKSUM TOTAL. # 111	Totalizer checksum error	1. Restart the measuring device 2. Replace electronics board if necessary.
No. # 3xx→ System limits exceeded			
S ϟ	TOL. COIL CURR. # 321	Sensor: Coil current is out of tolerance.	Warning! Switch off power supply before manipulating the coil current cable, coil current cable connector or measuring electronics boards! Remote version: 1. Check wiring of terminals 41/42 → 🖹 42 2. Check coil current cable connector. Compact and remote version: Replace measuring electronics boards if necessary
S !	CURRENT RANGE # 351	Current output: flow is out of range.	– Change the upper or lower limit setting, as applicable. – Increase or reduce flow, as applicable.

Type	Error message / No.	Cause	Remedy (Replace electronics board → 79)
S !	RANGE PULSE # 359	Pulse output: the pulse output frequency is out of range.	1. Increase the setting for pulse weighting 2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.). *Determine the pulse width:* – Variant 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Variant 2: Enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at the connected counter to ensure its registration. Example: The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is: 1 / (2 · 10 Hz) = 50 ms 3. Reduce flow.
No. # 5xx→ Application error			
S !	SW.-UPDATE ACT. # 501	Electronics board: New software version being loaded, no other commands are possible at present.	Wait until process is completed and restart device.
S !	UP-/DOWNL. ACT. # 502	Data are being uploaded or downloaded via FieldCare. ✎ Note! Measuring device configuration is locked during the upload/download.	Wait until uploading/downloading process is finished.
No. # 6xx→ Simulation mode active			
S !	POS. ZERO-RET. # 601	Positive zero return active	Switch off positive zero return.
S ϟ	SIM. FAILSAFE # 691	Simulation of response to error (outputs) active.	Switch off simulation.
S !	SIM. VOL. FLOW # 692	Simulation of volume flow active.	Switch off simulation.

9.3 Process error messages

Process errors are permanently defined as fault messages or notice messages.

Type	Error message / No.	Cause	Remedy / spare part
P = Process error ϟ = Fault message (with an effect on the outputs) ! = Notice message (without an effect on the outputs)			
P !	EMPTY PIPE # 401	Measuring tube partially filled or empty	1. Check the process conditions of the plant 2. Fill the measuring tube
P !	ADJ. NOT OK # 461	EPD calibration not possible because the fluid's conductivity is either too low or too high.	The EPD function cannot be used with fluids of this nature.
P ϟ	FULL = EMPTY # 463	The EPD calibration values for empty pipe and full pipe are identical, therefore incorrect.	Repeat calibration, making sure procedure is correct → 🖹 68.

9.4 Process errors without messages

Symptoms	Rectification
Remark: You may have to change or correct certain settings in functions in the function matrix in order to rectify the fault.	
Flow values are negative, even though the fluid is flowing forwards through the pipe.	1. Remote version: – Switch off the power supply and check the wiring → 🖹 42 – If necessary, reverse the connections at terminals 41 and 42 2. Change the setting in the "INSTALLATION DIRECTION SENSOR" function accordingly
Measured-value reading fluctuates even though flow is steady.	1. Check grounding and potential equalization → 🖹 50 2. Check the fluid for presence of gas bubbles. 3. In the "SYSTEM DAMPING" function → increase the value
Measured-value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	1. Check grounding and potential equalization → 🖹 50 2. Check the fluid for presence of gas bubbles. 3. Activate the "LOW FLOW CUTOFF" function, i.e. enter or increase the value for the switching point.
Measured-value reading on display, even though measuring tube is empty.	1. Perform empty-pipe/full-pipe adjustment and then switch on Empty Pipe detection → 🖹 68 2. Remote version: Check the terminals of the EPD cable → 🖹 42 3. Fill the measuring tube.
The current output signal is always 4 mA, irrespective of the flow signal at any given time.	1. Select the "BUS ADDRESS" function and change the setting to "0". 2. Value for creepage too high. Reduce the value in the "LOW FLOW CUTOFF" function.
The fault cannot be rectified or some other fault not described above has arisen. In these instances, please contact your Endress+Hauser service organization.	The following options are available for tackling problems of this nature: Request the services of an Endress+Hauser service technician If you contact our service organization to have a service technician sent out, please be ready to quote the following information: – Brief description of the fault – Nameplate specifications (→ 🖹 6): order code, serial number Returning devices to Endress+Hauser The necessary procedures on → 🖹 5 must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser. Always enclose a duly completed "Declaration of Conformity" form with the flowmeter. You will find a master copy of this form at the back of this manual. Replace transmitter electronics Components in the measuring electronics defective → order spare parts → 🖹 78

9.5 Response of outputs to errors

Note!
The response of the totalizer, current output, pulse output and status output is defined in the FAILSAFE MODE function (→ 129).

You can use positive zero return to set the signals of the current, pulse and status outputs to their fallback value, for example when measuring has to be interrupted while a pipe is being cleaned. This function takes priority over all other device functions: simulations, for example, are suppressed.

Failsafe mode of outputs and totalizers		
	Process/system error is current	**Positive zero return is activated**
Caution! System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs. See the information on → 58		
Current output	MINIMUM VALUE 4–20 mA (25 mA) → 2 mA 4–20 mA NAMUR →3.5 mA 4–20 mA US → 3.75 mA 4–20 mA (25 mA) HART → 2 mA 4–20 mA HART NAMUR →3.5 mA 4–20 mA HART US → 3.75 mA MAXIMUM VALUE 4–20 mA (25 mA) → 25 mA 4–20 mA NAMUR → 22.6 mA 4–20 mA US → 22.6 mA 4–20 mA (25 mA) HART → 25 mA 4–20 mA HART NAMUR → 22.6 mA 4–20 mA HART US → 22.6 mA HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Measured value display on the basis of the current flow measurement. The fault is ignored.	Output signal corresponds to "zero flow"
Pulse output	MIN/MAX VALUE → FALLBACK VALUE Signal output → no pulses HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Totalizer	*MINIMUM/MAXIMUM VALUE → STOP* The totalizers are paused until the error is rectified. *ACTUAL VALUE* The fault is ignored. The totalizer continues to count in accordance with the current flow value.	Totalizer stops
Status output	In the event of a fault or power supply failure: Status output → non-conductive	No effect on status output

9.6 Spare parts

Detailed troubleshooting instructions are provided in the previous sections → 🖹 73
The measuring device, moreover, provides additional support in the form of continuous self-diagnosis and error messages.

Fault rectification can entail replacing defective components with tested spare parts. The illustration below shows the available scope of spare parts.

Note!
You can order spare parts directly from your Endress+Hauser service organization by providing the serial number printed on the transmitter's nameplate → 🖹 6.

Spare parts are shipped as sets comprising the following parts:
- Spare part
- Additional parts, small items (threaded fasteners, etc.)
- Mounting instructions
- Packaging

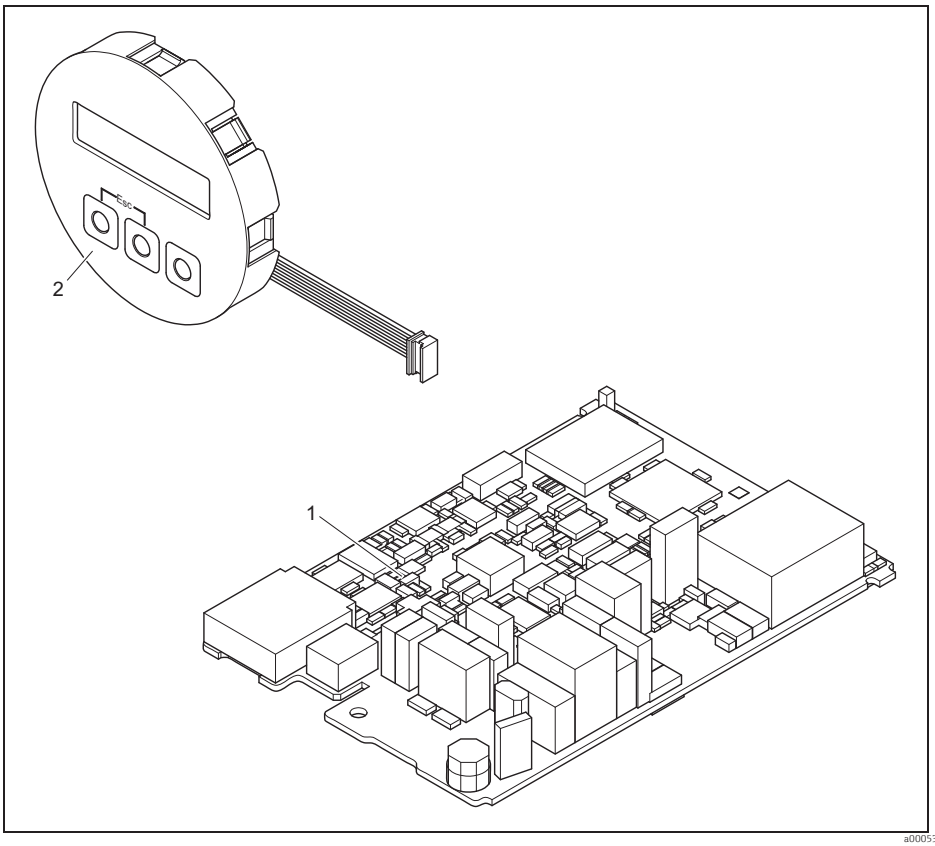


Fig. 45: Spare parts for Promag 10 transmitter

1 Electronics board
2 Display module

9.6.1 Removing and installing printed circuit boards

Field housing: removing and installing electronics boards → 46

Warning!
- Risk of electric shock!
  Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection). Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface purpose-built for electrostatically sensitive devices!
- If you cannot guarantee that the dielectric strength of the device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.

Caution!
Use only original Endress+Hauser parts.

Note!
Commissioning a new electronics board: → 67

1. Switch off power supply.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. Remove the local display (a) from the connection compartment cover.
4. Press the side latches (b) and flip down the cover of the connection compartment.
5. Disconnect the connector of the electrode signal cable (c) and the coil current cable (d).
6. Disconnect the connector for the power supply (e) and the outputs (f).
7. Disconnect the connector of the local display (g).
8. Remove the cover from the connection compartment (h) by loosening the screws.
9. Plug out the ground cable (i) of the electronics board.
10. Pull entire module (plastic retainer and electronics board) out of the housing.
11. Press the side latches (j) slightly outwards and partly push out the electronics board towards the rear from the front.
12. Remove the electronics board from the plastic retainer from the rear.
13. Installation is the reverse of the removal procedure.

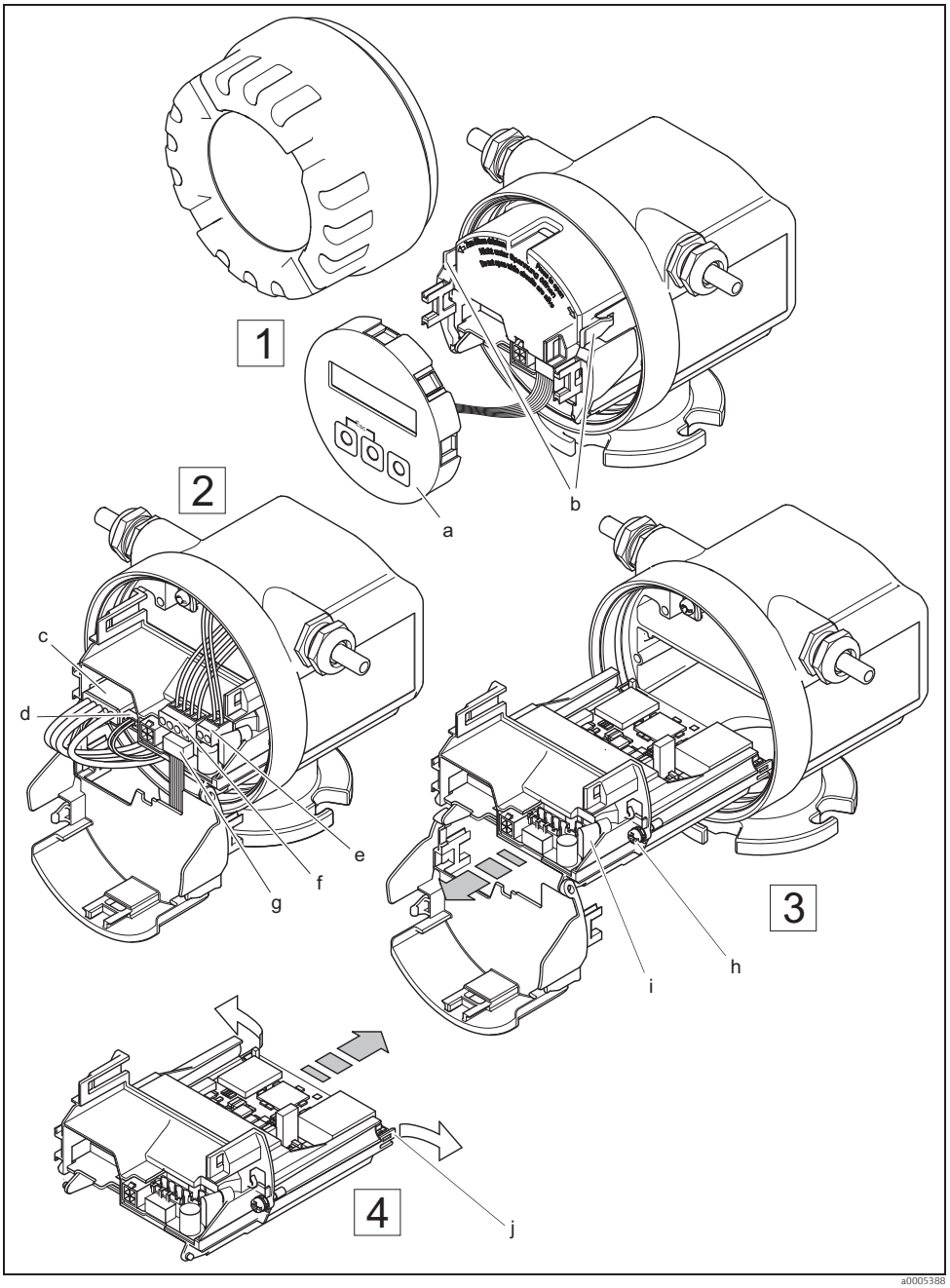


Fig. 46: Field housing: removing and installing printed circuit boards

a Local display
b Latches
c Connector of the electrode signal cable
d Connector of the coil current cable
e Connector for the power supply
f Connector for current output and pulse/status output
g Connector of local display
h Screws of electronics compartment cover
i Connector of the ground cable
j Latches for the electronics board

9.6.2 Replacing the device fuse

Warning!
Risk of electric shock!
Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

The main fuse is located on the electronics board (→ 47).
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. Press the side latches and flip down the cover of the connection compartment.
4. Remove the connector for the power supply (a).
5. Replace device fuse (b). Only use the following fuse type.
   Use only fuses of the following type:
   – Power supply 11 to 40 V DC / 20 to 28 V AC → 1.6 A slow-blow / 250 V TR5
   – Power supply 85 to 250 V DC → 1 A slow-blow / 250 V TR5
6. Installation is the reverse of the removal procedure.

Caution!
Use only original Endress+Hauser parts.

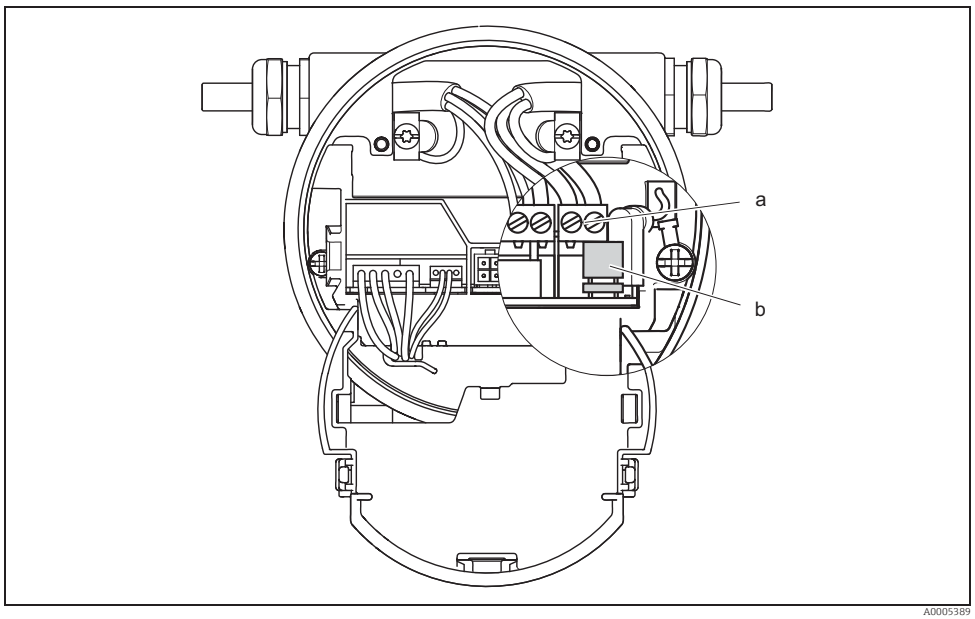


Fig. 47: Replacing the device fuse on the electronics board

a Connector for power supply
b Device fuse

9.7 Return

Caution!
Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
Costs incurred for waste disposal and injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.

The following steps must be taken before returning a flow measuring device to Endress+Hauser, e.g. for repair or calibration:
- Always enclose a duly completed "Declaration of contamination" form. Only then can Endress+Hauser transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EC REACH Regulation No. 1907/2006.
- Remove all residues. Pay special attention to the grooves for seals and crevices which could contain residues. This is particularly important if the substance is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

Note!
You will find a preprinted "Declaration of contamination" form at the back of these Operating Instructions.

9.8 Disposal

Observe the regulations applicable in your country!

9.9 Software history

Date	Software version	Changes to software	Operating Instructions
01.2012	V 1.04.00	Introduction of new nominal diameters; faster coil current control; calf-values to 2.5	71249469/15.14
11.2009	V 1.03.00	Introduction of Calf history	71106179/12.09 71105338/11.09
06.2009	V 1.02.00	Introduction of Promag L	71095705/06.09
03.2009	V 1.02.00	Introduction of Promag D; introduction of new nominal diameter.	71088674/03.09
10.2004	V 1.02.00	Software modification/extension Function: SELF CHECKING	50104787/05.05
09.2004	V 1.01.01	Software modification; extension of nominal diameter range	50104787/04.03
06.2004	V 1.01.00	Software extension; preparation for uploading/ downloading via ToF Tool - Fieldtool Package	50104787/04.03
08.2003	V 1.00.02	Production-related software modification	50104787/04.03
01.2003	V 1.00.00	Original software. Compatible with: ToF Tool - Fieldtool Package, HART Communicator DXR 275 (from OS 4.6) with Rev. 1, DD 1.	50104787/04.03

Note!
Uploads or downloads between the individual software versions are only possible with a special service software.

10 Technical data

10.1 Technical data at a glance

10.1.1 Application

→ 🖹 4

10.1.2 Function and system design

Measuring principle

Electromagnetic flow measurement on the basis of Faraday's Law.

Measuring system

→ 🖹 6

10.1.3 Input

Measured variable

Flow velocity (proportional to induced voltage)

Measuring range

Typically v = 0.01 to 10 m/s (0.033 to 33 ft/s) with the specified accuracy

Operable flow range

Over 1000 : 1

10.1.4 Output

Output signal

Current output

- Galvanically isolated
- Active: 4 to 20 mA, R_L <700 Ω (for HART: RL ≥250 Ω)
- Full scale value adjustable
- Temperature coefficient: typ. 2 µA/°C, resolution: 1.5 µA

Pulse/status output:

- Galvanically isolated
- Passive: 30 V DC / 250 mA
- Open collector
- Can be configured as:
  - Pulse output
    Pulse value and pulse polarity can be selected, max. pulse width adjustable (5 to 2000 ms), pulse frequency max. 100 Hz
  - Status output
    For example, can be configured for error messages, empty pipe detection, flow recognition, limit value

Signal on alarm

Current output

Failsafe mode can be selected (e.g. in accordance with NAMUR Recommendation NE 43) → 🖹 129

Pulse output

Failsafe mode can be selected → 🖹 129

Status output

"Not conductive" in the event of fault or power supply failure

Load

See "Output signal"

Low flow cut off

Low flow cut off, switch-on point can be selected as required

Galvanic isolation

All circuits for inputs, outputs, and power supply are galvanically isolated from each other.

10.1.5 Power supply

Electrical connections

→ 🖹 42

Supply voltage (power supply)

- 20 to 28 V AC, 45 to 65 Hz
- 85 to 250 V AC, 45 to 65 Hz
- 11 to 40 V DC

Cable entry

Power supply and signal cables (inputs/outputs):

- Cable entry M20 × 1.5 (8 to 12 mm/0.31 to 0.47 inch)
- Threads for cable entries ½" NPT, G ½"

Connecting cable for remote version:

- Cable entry M20 × 1.5 (8 to 12 mm/0.31 to 0.47 inch)
- Threads for cable entries ½" NPT, G ½"

Cable specifications

→ 🖹 47

Power consumption

Power consumption

- 20 to 28 V AC: <8 VA (incl. sensor)
- 85 to 250 V AC: <12 VA (incl. sensor)
- 11 to 40 V DC: <6 W (incl. sensor)

Switch-on current:

- Max. 3.3 A (<5 ms) for 24 V DC
- Max. 5.5 A (<5 ms) for 28 V DC
- Max. 16 A (<5 ms) for 250 V DC

Power supply failure

Lasting min. ½ cycle frequency: EEPROM saves measuring system data

Potential equalization

→ 🖹 50

10.1.6 Performance characteristics

Reference operating conditions

To DIN EN 29104 and VDI/VDE 2641:

- Fluid temperature: +28 ± 2 °C (+82 ± 4 °F)
- Ambient temperature: +22 ± 2 °C (+72 ± 4 °F)
- Warm-up period: 30 minutes

Installation:

- Inlet run >10 × DN
- Outlet run > 5 × DN
- Sensor and transmitter grounded.
- The sensor is centered in the pipe.

Maximum measured error

- Current output: plus typically ± 5 µA
- Pulse output: ± 0.5% o.r. ± 2 mm/s (o.r. = of reading)

Fluctuations in the supply voltage do not have any effect within the specified range.

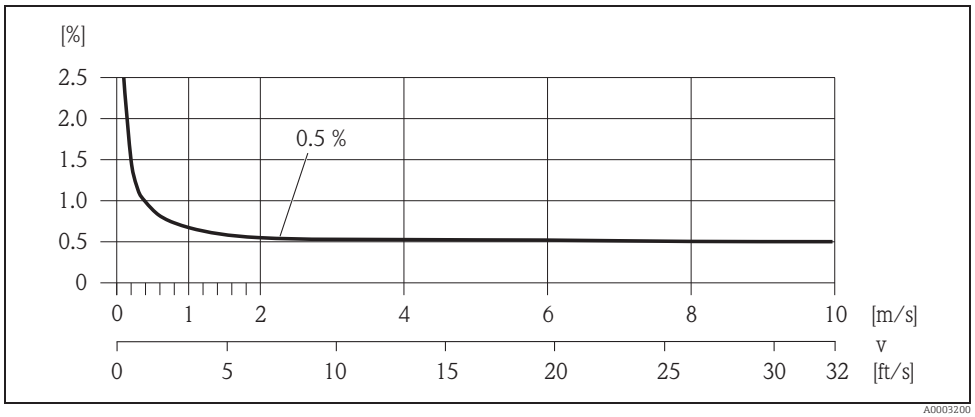


Fig. 48: Max. measured error in % of reading

Repeatability

Max. ± 0.2% o.r. ± 2 mm/s (o.r. = of reading)

10.1.7 Installation

Installation instructions

Any orientation (vertical, horizontal), restrictions and additional installation instructions → 11

Inlet and outlet runs

If possible, install the sensor upstream from fittings such as valves, T-pieces, elbows, etc. The following inlet and outlet runs must be observed in order to meet accuracy specifications (→ 14, → 12):
- Inlet run: ≥ 5 × DN
- Outlet run: ≥ 2 × DN

Adapters

→ 15

Length of connecting cable

- The permitted length of connecting cable L_{max} is determined by the fluid conductivity (→ 18, → 16). A minimum conductivity of 50 µS/cm is needed for all fluids.
- The maximum connecting cable length is 10 m (32.81 ft) when empty pipe detection (EPD → 68) is switched on.

10.1.8 Environment

Ambient temperature range

- Transmitter: −20 to +60 °C (−4 to +140 °F)

  Note!
  At ambient temperatures below −20 (−4 °F) the readability of the display may be impaired.
- Sensor (flange material carbon steel): −10 to +60 °C (+14 to +140 °F)

Caution!
- The permitted temperature range of the measuring tube lining may not be undershot or overshot (→ "Operating conditions: Process" → "Medium temperature range").
- Install the device in a shady location. Avoid direct sunlight, particularly in warm climatic regions.
- The transmitter must be mounted separate from the sensor if both the ambient and fluid temperatures are high.

Storage temperature

The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.

Caution!
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- A storage location must be selected where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.

Degree of protection

Standard: IP 67 (NEMA 4X) for transmitter and sensor

Shock and vibration resistance

Acceleration up to 2 g following IEC 600 68-2-6

CIP cleaning

Caution!
The maximum fluid temperature permitted for the device may not be exceeded.

CIP cleaning is possible:
Promag E (100 °C / 212 °F), Promag H/P

CIP cleaning is not possible:
Promag D/L/W

SIP cleaning

Caution!
The maximum fluid temperature permitted for the device may not be exceeded.

SIP cleaning is possible:
Promag H

SIP cleaning is not possible:
Promag D/E/L/P/W

Electromagnetic compatibility (EMC)

- As per IEC/EN 61326 and NAMUR Recommendation NE 21
- Emission: to limit value for industry EN 55011

10.1.9 Process

Medium temperature range

The permissible temperature depends on the lining of the measuring tube

Promag D

0 to +60 °C (+32 to +140 °F) for polyamide

Promag E

−10 to +110 °C (+14 to +230 °F) for PTFE,
Restrictions → see the following diagram

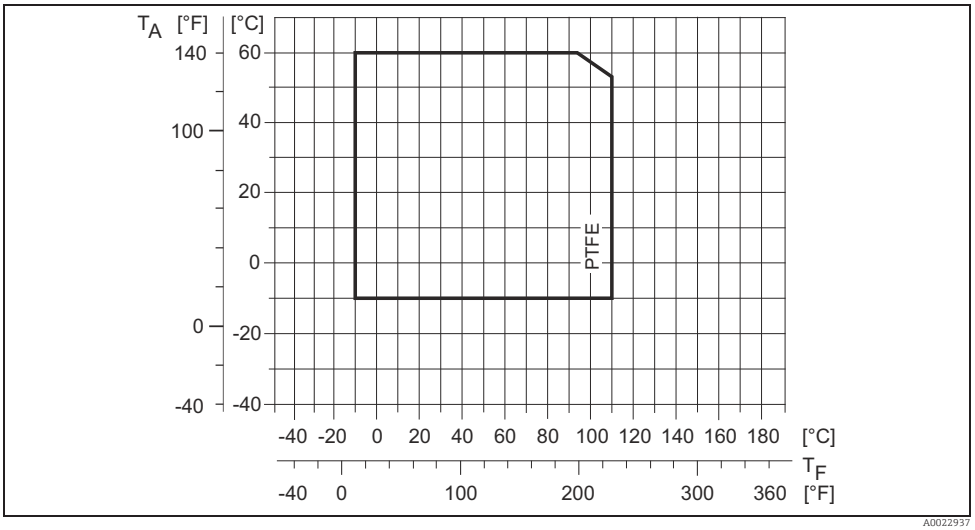


Fig. 49: Compact and remote version Promag E (TA = ambient temperature; TF = fluid temperature)

Promag H

Sensor:
- DN 2 to 25 (1/12 to 1"): −20 to +150 °C (−4 to +302 °F)
- DN 40 to 100 (1 ½ to 4"): −20 to +150 °C (−4 to +302 °F)

Seals:
- EPDM/Viton (FKM)/Kalrez: −20 to +150 °C (−4 to +302 °F)

Promag L

- 0 to +80 °C (+32 to +176 °F) for hard rubber (DN 350 to 2400 / 14 to 90")
- −20 to +50 °C (−4 to +122 °F) for polyurethane (DN 25 to 1200 / 1 to 48")
- −20 to +90 °C (−4 to +194 °F) for PTFE (DN 25 to 300 / 1 to 12")

Promag P

−40 to +130 °C (−40 to +266 °F) for PTFE (DN 25 to 600 / 1 to 24"),
Restrictions → see the following diagram

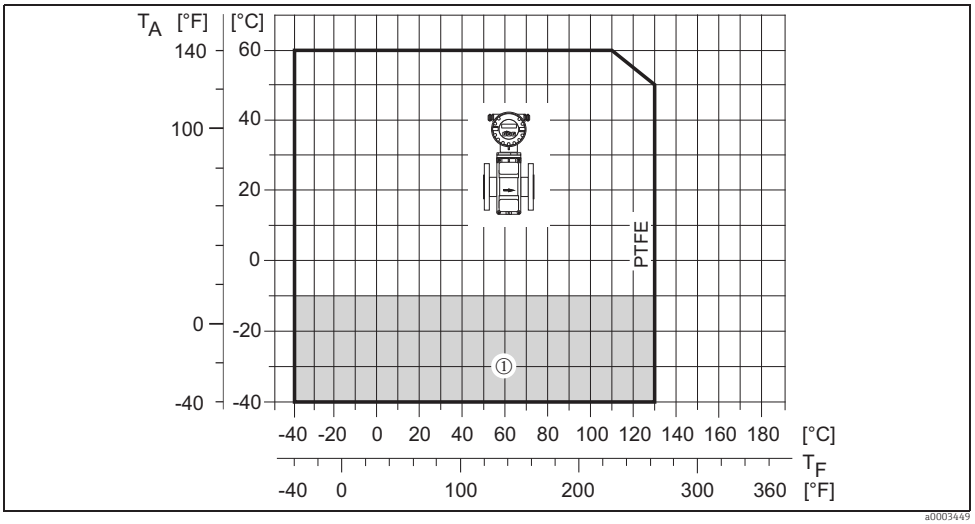


Fig. 50: Compact version Promag P with PTFE-lining

TA = ambient temperature; TF = fluid temperature
① = light gray area → temperature range from −10…−40 °C (−14…−40 °F) valid for stainless steel version only

Promag W

- 0 to +80 °C (+32 to +176 °F) for hard rubber (DN 65 to 2000 / 2 ½ to 78")
- −20 to +50 °C (−4 to +122 °F) for polyurethane (DN 25 to 1000 / 1 to 48")

Conductivity

The minimum conductivity is ≥ 50 µS/cm

Note!
Note that in the case of the remote version, the requisite minimum conductivity is also influenced by the length of the connecting cable → 18

Medium pressure range (nominal pressure)

Promag D

- EN 1092-1 (DIN 2501)
  - PN 16
- ASME B 16.5
  - Class 150
- JIS B2220
  - 10 K

Promag E

- EN 1092-1 (DIN 2501)
  - PN 10 (DN 200 to 600 / 8 to 24")
  - PN 16 (DN 65 to 600 / 3 to 24")
  - PN 40 (DN 15 to 150 / ½ to 2")
- ASME B 16.5
  - Class 150 (½ to 24")
- JIS B2220
  - 10 K (DN 50 to 300 / 2 to 12")
  - 20 K (DN 15 to 40 / ½ to 1½")

Promag H

The permissible nominal pressure depends on the process connection and the seal:
- PN 40, Class 150, 20 K → Couplings, flanges (with O-ring seal)
- PN 16 → Welding nipple, couplings, clamp, flange (with aseptic gasket seal)

Promag L

- EN 1092-1 (DIN 2501)
  - PN 6 (DN 350 to 2400 / 14 to 90")
  - PN 10 (DN 200 to 2400 / 8 to 90")
  - PN 16 (DN 25 to 300 / 1 to 12")
- EN 1092-1, lap joint flange, stampel plate
  - PN 10 (DN 25 to 300 / 1 to 12")
- ASME B16.5
  - Class 150 (1 to 24")
- AWWA
  - Class D (28 to 90")
- AS2129
  - Table E (350 to 1200 / 14 to 48")
- AS4087
  - PN 16 (350 to 1200 / 14 to 48")

Promag P

- EN 1092-1 (DIN 2501)
  - PN 10 (DN 200 to 600 / 8 to 24")
  - PN 16 (DN 65 to 600 / 3 to 24")
  - PN 25 (DN 200 to 600 / 8 to 24")
  - PN 40 (DN 25 to 150 / 1 to 6")
- ASME B 16.5
  - Class 150 (1 to 24")
  - Class 300 (1 to 6")
- JIS B2220
  - 10 K (DN 50 to 300 / 2 to 12")
  - 20 K (DN 25 to 300 / 1 to 12")
- AS 2129
  - Table E (DN 25 / 1"), 50 / 2")
- AS 4087
  - PN 16 (DN 50 / 2")

Promag W

- EN 1092-1 (DIN 2501)
  - PN 6 (DN 350 to 2000 / 14 to 84")
  - PN 10 (DN 200 to 2000 / 8 to 84")
  - PN 16 (DN 65 to 2000 / 3 to 84")
  - PN 25 (DN 200 to 1000 / 8 to 40")
  - PN 40 (DN 25 to 150 / 1 to 6")
- ASME B 16.5
  - Class 150 (1 to 24")
  - Class 300 (1 to 6")
- AWWA
  - Class D (28 to 78")
- JIS B2220
  - 10 K (DN 50 to 300 / 2 to 12")
  - 20 K (DN 25 to 300 / 1 to 12")
- AS 2129
  - Table E (DN 80 / 3", 100 / 4", 150 to 1200 / 6 to 48")
- AS 4087
  - PN 16 (DN 80 / 3", 100 / 4", 150 to 1200 / 6 to 48")

Pressure tightness

Promag D

Measuring tube: 0 mbar abs (0 psi abs) with a fluid temperature of ≤ 60 °C (140 °F)

Promag E (Measuring tube lining: PTFE)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures							
		25 °C		80 °C		100 °C		110 °C	
		77 °F		176 °F		212 °F		230 °F	
[mm]	[inch]	[mbar]	[psi]			[mbar]	[psi]	[mbar]	[psi]
15	½"	0	0	0	0	0	0	100	1.45
25	1"	0	0	0	0	0	0	100	1.45
32	–	0	0	0	0	0	0	100	1.45
40	1 ½"	0	0	0	0	0	0	100	1.45
50	2"	0	0	0	0	0	0	100	1.45
65	–	0	0	*	*	40	0.58	130	1.89

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures							
		25 °C		80 °C		100 °C		110 °C	
		77 °F		176 °F		212 °F		230 °F	
[mm]	[inch]	[mbar]	[psi]			[mbar]	[psi]	[mbar]	[psi]
80	3"	0	0	*	*	40	0.58	130	1.89
100	4"	0	0	*	*	135	1.96	170	2.47
125	–	135	1.96	*	*	240	3.48	385	5.58
150	6"	135	1.96	*	*	240	3.48	385	5.58
200	8"	200	2.90	*	*	290	4.21	410	5.95
250	10"	330	4.79	*	*	400	5.80	530	7.69
300	12"	400	5.80	*	*	500	7.25	630	9.14
350	14"	470	6.82	*	*	600	8.70	730	10.59
400	16"	540	7.83	*	*	670	9.72	800	11.60
450	18"	Partial vacuum is impermissible!							
500	20"								
600	24"								
* No value can be quoted.									

Promag H (Measuring tube lining: PFA)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures					
		25 °C	80 °C	100 °C	130 °C	150 °C	180 °C
[mm]	[inch]	77 °F	176 °F	212 °F	266 °F	302 °F	356 °F
2 to 100	1/12 to 4"	0	0	0	0	0	0

Promag L (Measuring tube lining: Polyurethane, Hard rubber)

Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures		
			25 °C	50 °C	80 °C
[mm]	[inch]		77 °F	122 °F	176 °F
25 to 1200	1 to 48"	25 to 1200	1 to 48"	0	–
350 to 2400	14 to 90"	Hard rubber	0	0	0

Promag L (Measuring tube lining: PTFE)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures			
		25 °C		90 °C	
		77 °F		194 °F	
[mm]	[inch]	[mbar]	[psi]	[mbar]	[psi]
25	1"	0	0	0	0
32	–	0	0	0	0
40	1 ½"	0	0	0	0
50	2"	0	0	0	0
65	–	0	0	40	0.58
80	3"	0	0	40	0.58
100	4"	0	0	135	1.96
125	–	135	1.96	240	3.48
150	6"	135	1.96	240	3.48

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures			
		25 °C		90 °C	
		77 °F		194 °F	
[mm]	[inch]	[mbar]	[psi]	[mbar]	[psi]
200	8"	200	2.90	290	4.21
250	10"	330	4.79	400	5.80
300	12"	400	5.80	500	7.25

Promag P (Measuring tube lining: PTFE)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures									
		25 °C		80 °C		100 °C		130 °C		150 °C	180 °C
		77 °F		176 °F		212 °F		266 °F		302 °F	356 °F
[mm]	[inch]	[mbar]	[psi]			[mbar]	[psi]	[mbar]	[psi]		
25	1"	0	0	0	0	0	0	100	1.45	–	–
32	–	0	0	0	0	0	0	100	1.45	–	–
40	1 ½"	0	0	0	0	0	0	100	1.45	–	–
50	2"	0	0	0	0	0	0	100	1.45	–	–
65	–	0	0	*	*	40	0.58	130	1.89	–	–
80	3"	0	0	*	*	40	0.58	130	1.89	–	–
100	4"	0	0	*	*	135	1.96	170	2.47	–	–
125	–	135	1.96	*	*	240	3.48	385	5.58	–	–
150	6"	135	1.96	*	*	240	3.48	385	5.58	–	–
200	8"	200	2.90	*	*	290	4.21	410	5.95	–	–
250	10"	330	4.79	*	*	400	5.80	530	7.69	–	–
300	12"	400	5.80	*	*	500	7.25	630	9.14	–	–
350	14"	470	6.82	*	*	600	8.70	730	10.59	–	–
400	16"	540	7.83	*	*	670	9.72	800	11.60	–	–
450	18"	Partial vacuum is impermissible!									
500	20"										
600	24"										
* No value can be quoted.											

Promag W

Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures						
			25 °C	50 °C	80 °C	100 °C	130 °C	150 °C	180 °C
[mm]	[inch]		77 °F	122 °F	176 °F	212 °F	266 °F	302 °F	356 °F
25 to 1200	1 to 40"	Polyurethane	0	0	–	–	–	–	–
50 to 2000	2 to 78"	Hard rubber	0	0	0	–	–	–	–

Limiting flow

→ 🖹 16

Pressure loss

- No pressure loss if the sensor is installed in a pipe with the same nominal diameter.
- Pressure losses for configurations incorporating adapters according to DIN EN 545 (see "Adapters" → 🖹 15)

10.1.10 Mechanical construction

Design, dimensions

The dimensions and installation lengths of the sensor and transmitter can be found in the "Technical Information" for the device in question. This document can be downloaded as a PDF file from www.endress.com. A list of the "Technical Information" documents available is provided in the "Documentation" section on → 🖹 107.

Weight (SI units)

Promag D

Weight data in kg				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]		Sensor	Transmitter
25	1"	2.9	2.5	3.1
40	1 ½"	3.5	3.1	3.1
50	2"	4.3	3.9	3.1
65	2 ½"	5.1	4.7	3.1
80	3"	6.1	5.7	3.1
100	4"	8.8	8.4	3.1
Transmitter Promag (compact version): 1.8 kg (Weight data valid without packaging material)				

Promag E

Weight data in kg							
Nominal diameter		Compact version					
		EN (DIN)				ASME	JIS
[mm]	[inch]	PN 6	PN 10	PN 16	PN 40	Class 150	10K
15	½"	–	–	–	6.5	6.5	6.5
25	1"	–	–	–	7.3	7.3	7.3
32	–	–	–	–	8.0	–	7.3
40	1½"	–	–	–	9.4	9.4	8.3
50	2"	–	–	–	10.6	10.6	9.3
65	–	–	–	12.0	–	–	11.1
80	3"	–	–	14.0	–	14.0	12.5
100	4"	–	–	16.0	–	16.0	14.7
125	–	–	–	21.5	–	–	21.0
150	6"	–	–	25.5	–	25.5	24.5
200	8"	–	45.0	46.0	–	45.0	41.9
250	10"	–	65.0	70.0	–	75.0	69.4
300	12"	–	70.0	81.0	–	110.0	72.3
350	14"	77.4	88.4	99.4	–	137.4	–
400	16"	89.4	104.4	120.4	–	168.4	–
450	18"	99.4	112.4	133.4	–	191.4	–
500	20"	114.4	132.4	182.4	–	228.4	–
600	24"	155.4	162.4	260.4	–	302.4	–

- Transmitter (compact version): 1.8 kg
- Weight data without packaging material

Weight data in kg								
Nominal diameter		Remote version (without cable)						
		Sensor						Transmitter
		EN (DIN)				ASME	JIS	
[mm]	[inch]	PN 6	PN 10	PN 16	PN 40	Class 150	10K	Wall-mount housing
15	½"	–	–	–	4.5	4.5	4.5	6.0
25	1"	–	–	–	5.3	5.3	5.3	
32	–	–	–	–	6.0	–	5.3	
40	1½"	–	–	–	7.4	7.4	6.3	
50	2"	–	–	–	8.6	8.6	7.3	
65	–	–	–	10.0	–	–	9.1	
80	3"	–	–	12.0	–	12.0	10.5	
100	4"	–	–	14.0	–	14.0	12.7	
125	–	–	–	19.5	–	–	19.0	
150	6"	–	–	23.5	–	23.5	22.5	
200	8"	–	43.0	44.0	–	43.0	39.9	
250	10"	–	63.0	68.0	–	73.0	67.4	
300	12"	–	68.0	79.0	–	108.0	70.3	
350	14"	73.1	84.1	95.1	–	133.1		
400	16"	85.1	100.1	116.1	–	164.1		
450	18"	95.1	108.1	129.1	–	187.1		
500	20"	110.1	128.1	178.1	–	224.1		
600	24"	158.1	158.1	256.1	–	298.1		

- Transmitter (remote version): 3.1 kg
- Weight data without packaging material

Promag H

Weight data in kg				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]	DIN	Sensor	Transmitter
2	1/12"	3.6	2	3.1
4	1/8"	3.6	2	3.1
8	3/8"	3.6	2	3.1
15	½"	3.7	1.9	3.1
25	1"	3.9	2.8	3.1
40	1 ½"	4.9	4.5	3.1
50	2"	7.4	7.0	3.1
65	2 ½"	7.9	7.5	3.1
80	3"	17.4	17.0	3.1
100	4"	16.9	16.5	3.1
Transmitter Promag (compact version): 1.8 (Weight data valid for standard pressure ratings and without packaging material)				

Promag L

Weight data in kg												
Nominal diameter		Compact version (including transmitter)[1]										
[mm]	[inch]	EN (DIN)						ASME/ AWWA		AS		
25	1"	PN 6	–	PN 10	–	PN 16	7.3	ASME / Class 150	7.9	PN 16	–	Tabelle E	–
32	1 ¼"		–		–		8.0		–		–		–
40	1 ½"		–		–		9.0		7.5		–		–
50	2"		–		–		9.4		7.6		–		–
65	2 ½"		–		–		10.4		–		–		–
80	3"		–		–		12.4		12.8		–		–
100	4"		–		–		14.4		16.1		–		–
125	5"		–		–		15.9		–		–		–
150	6"		–		–		23.9		24.4		–		–
200	8"		–		43.4		44.9		49.6		–		–
250	10"		–		63.4		70.7		75.1		–		–
300	12"		–		68.4		85.8		100		–		–
350	14"		77.4		88.4		103		137		99.4		99.4
375	15"		–		–		–		–		105		–
400	16"		89.4		104		124		168		120		120
450	18"		99.4		112		139		191		133		143
500	20"		114		132		174		228		182		182
600	24"		155		162		303		302		260		260
700	28"		190		240		288	AWWA / Class D	266		367		346
750	30"		–		–		–		318		445		433
800	32"		240		315		364		383		503		493
900	36"		308		393		456		470		702		690
1000	40"		359		468		579		587		759		761
1050	42"		–		–		–		670		–		–
1200	48"		529		717		866		901		–		1237
–	54"		–		–		–		1273		–		–
1400	–		784		1114		1274		–		–		–
–	60"		–		–		–		1594		–		–
1600	–		1058		1624		1872		–		–		–
1650	66"		–		–		–		2131		–		–
1800	72"		1418		2107		2409		2568		–		–
2000	78"		1877		2630		2997		3113		–		–
–	84"		–		–		–		3755		–		–
2200	–		2512		3422		–		–		–		–
–	90"		–		–		–		4797		–		–
2400	–		2996		4094		–		–		–		–
Transmitter Promag (compact version): 3.1 kg (Weight data valid without packaging material)													

1) Lap joint flanges / welded flanges DN > 300 (12")

Weight data in kg

Nominal diameter		Remote version (sensor plus sensor housing without cable)[1]											
[mm]	[inch]	EN (DIN)						ASME/ AWWA		AS			
25	1"	PN 6	–	PN 10	–	PN 16	5.3	ASME / Class 150	5.9	PN 16	–	Tabelle E	–
32	1 ¼"		–		–		6.0		–		–		–
40	1 ½"		–		–		7.0		5.5		–		–
50	2"		–		–		7.4		5.6		–		–
65	2 ½"		–		–		8.4		–		–		–
80	3"		–		–		10.4		10.8		–		–
100	4"		–		–		12.4		14.1		–		–
125	5"		–		–		13.9		–		–		–
150	6"		–		–		21.9		22.4		–		–
200	8"		–		41.4		42.9		47.6		–		–
250	10"		–		61.4		68.7		73.1		–		–
300	12"		–		66.4		83.8		98		–		–
350	14"		75.4		86.4		103		135		97.4		97.4
375	15"		–		102		–		–		103		–
400	16"		87.4		102		124		166		118		118
450	18"		97.4		110		139		189		131		141
500	20"		112		130		174		226		180		180
600	24"		153		160		303		300		258		258
700	28"		188		238		288	AWWA / Class D	264		365		344
750	30"		–		–		–		316		443		431
800	32"		238		313		364		381		501		491
900	36"		306		391		456		468		700		688
1000	40"		357		466		579		585		757		759
1050	42"		–		–		–		668		–		–
1200	48"		527		715		866		899				1235
–	54"		–		–		–		1271		–		–
1400	–		782		1112		1274		–		–		–
–	60"		–		–		–		1592		–		–
1600	–		1056		1622		1872		–		–		–
1650	66"		–		–		–		2129		–		–
1800	72"		1416		2105		2409		2566		–		–
2000	78"		1875		2628		2997		3111		–		–
–	84"		–		–		–		3753		–		–
2200	–		2510		3420		–		–		–		–
–	90"		–		–		–		4795		–		–
2400	–		2994		4092		–		–		–		–

Transmitter Promag (remote version): 3.4 kg
(Weight data valid without packaging material)

1) Lap joint flanges / welded flanges DN > 300 (12")

Weight data in kg						
Nominal diameter		Compact version[1]		Remote version (without cable)[1]		
[mm]	[inch]	EN (DIN)		Sensor EN (DIN)		Transmitter
25	1"	PN 10	5.8	PN 10	3.8	4.2
32	1 ¼"		5.4		3.4	4.2
40	1 ½"		6.3		4.7	4.2
50	2"		5.4		3.4	4.2
65	2 ½"		6.2		4.2	4.2
80	3"		7.2		5.2	4.2
100	4"		9.7		7.7	4.2
125	5"		13.2		11.2	4.2
150	6"		17.2		15.2	4.2
200	8"		35.7		33.7	4.2
250	10"		54.2		52.2	4.2
300	12"		55.2		53.2	4.2
Transmitter Promag (compact version): 1.8 kg (Weight data valid for standard pressure ratings and without packaging material)						

1) Lap joint flanges, stamped plate

Promag P

Weight data in kg														
Nominal diameter		Compact version						Remote version (without cable)						
								Sensor						Trans-mitter
[mm]	[inch]	EN (DIN) / AS*		JIS		ASME/ AWWA		EN (DIN) / AS*		JIS		ASME/ AWWA		
25	1"	PN 40	5.7	10K	5.7	Class 150	5.7	PN 40	5.3	10K	5.3	Class 150	5.3	3.1
32	1 ¼"		6.4		5.7		–		6.0		5.3		–	3.1
40	1 ½"		7.8		6.7		7.8		7.4		6.3		7.4	3.1
50	2"		9.0		7.7		9.0		8.6		7.3		8.6	3.1
65	2 ½"	PN 16	10.4		9.5		–	PN 16	10.0		9.1		–	3.1
80	3"		12.4		10.9		12.4		12.0		10.5		12.0	3.1
100	4"		14.4		13.1		14.4		14.0		12.7		14.0	3.1
125	5"		19.9		19.4		–		19.5		19.0		–	3.1
150	6"		23.9		22.9		23.9		23.5		22.5		23.5	3.1
200	8"	PN 10	43.4		40.3		43.4	PN 10	43		39.9		43	3.1
250	10"		63.4		67.8		73.4		63		67.4		73	3.1
300	12"		68.4		70.7		108.4		68		70.3		108	3.1
350	14"		113.4				172.4		113				173	3.1
400	16"		133.4				203.4		133				203	3.1
450	18"		173.4				253.4		173				253	3.1
500	20"		173.4				283.4		173				283	3.1
600	24"		233.4				403.4		233				403	3.1
Transmitter Promag (compact version): 1.8 kg (Weight data valid for standard pressure ratings and without packaging material) * Flanges according to AS are only available for DN 25 and 50.														

Promag W

Weight data in kg

Nominal diameter		Compact version						Remote version (without cable)						Transmitter
								Sensor						
[mm]	[inch]	EN (DIN) / AS*		JIS		ASME/ AWWA		EN (DIN) / AS*		JIS		ASME/ AWWA		
25	1"	PN 40	5.7	10K	5.7	Class 150	5.7	PN 40	5.3	10K	5.3	Class 150	5.3	3.1
32	1 ¼"		6.4		5.7		–		6.0		5.3		–	3.1
40	1 ½"		7.8		6.7		7.8		7.4		6.3		7.4	3.1
50	2"		9.0		7.7		9.0		8.6		7.3		8.6	3.1
65	2 ½"	PN 16	10.4		9.5		–	PN 16	10.0		9.1		–	3.1
80	3"		12.4		10.9		12.4		12.0		10.5		12.0	3.1
100	4"		14.4		13.1		14.4		14.0		12.7		14.0	3.1
125	5"		19.9		19.4		–		19.5		19.0		–	3.1
150	6"		23.9		22.9		23.9		23.5		22.5		23.5	3.1
200	8"	PN 10	43.4		40.3		43.4	PN 10	43		39.9		43	3.1
250	10"		63.4		67.8		73.4		63		67.4		73	3.1
300	12"		68.4		70.7		108.4		68		70.3		108	3.1
350	14"		113.4				172.4		113				173	3.1
400	16"		133.4				203.4		133				203	3.1
450	18"		173.4				253.4		173				253	3.1
500	20"		173.4				283.4		173				283	3.1
600	24"		233.4				403.4		233				403	3.1
700	28"		353.4			Class D	398.4		353			Class D	398	3.1
–	30"		–				458.4		–				458	3.1
800	32"		433.4				548.4		433				548	3.1
900	36"		573.4				798.4		573				798	3.1
1000	40"		698.4				898.4		698				898	3.1
–	42"	PN 6	–				1098.4	PN 6	–				1098	3.1
1200	48"		848.4				1398.4		848				1398	3.1
–	54"		–				2198.4		–				2198	3.1
1400	–		1298.4				–		1298				–	3.1
–	60"		–				2698.4		–				2698	3.1
1600	–		1698.4				–		1698				–	3.1
–	66"		–				3698.4		–				3698	3.1
1800	72"		2198.4				4098.4		2198				4098	3.1
–	78"		–				4598.4		–				4598	3.1
2000	–		2798.4				–		2798				–	3.1

Transmitter Promag (compact version): 1.8 kg
(Weight data valid for standard pressure ratings and without packaging material)
*Flanges according to AS are only available for DN 80, 100, 150 to 400, 500 and 600

Weight (US units)

Promag D

Weight data in lbs				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]		Sensor	Transformer
25	1"	6	6	7
40	1 ½"	8	7	7
50	2"	9	9	7
80	3"	13	13	7
100	4"	19	19	7
Transmitter Promag (compact version): 3.9 lbs (Weight data valid without packaging material)				

Promag E

Weight data in lbs				
Nominal diameter		Compact version	Remote version (without cable)	
			Sensor	Transmitter
		ASME	ASME	
[mm]	[inch]	Class 150	Class 150	Wall-mount housing
15	½"	14.3	9.92	13.2
25	1"	16.1	11.7	
40	1½"	20.7	16.3	
50	2"	23.4	19.0	
80	3"	30.9	26.5	
100	4"	35.3	30.9	
150	6"	56.2	51.8	
200	8"	99.2	94.8	
250	10"	165.4	161.0	
300	12"	242.6	238.1	
350	14"	303.0	293.5	
400	16"	371.3	361.8	
450	18"	422.0	412.6	
500	20"	503.6	494.1	
600	24"	666.8	657.3	

- Transmitter: 4.0 lbs (compact version); 6.8 lbs (remote version)
- Weight data without packaging material

Promag H

Weight data in lbs				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]		Sensor	Transformer
2	1/12"	8	4	7
4	1/8"	8	4	7
8	3/8"	8	4	7
15	½"	8	4	7
25	1"	9	6	7
40	1 ½"	11	10	7
50	2"	16	15	7
65	2 ½"	17	17	7
80	3"	38	37	7
100	4"	37	36	7
Transmitter Promag (compact version): 3.9 lbs (Weight data valid for standard pressure ratings and without packaging material)				

Promag L (ASME/AWWA)

Weight data in lbs					
Nominal diameter		Compact version[1]		Remote version1)	
[mm]	[inch]	ASME/AWWA		ASME/AWWA	
25	1"	ASME / Class 150	17.4	ASME / Class 150	13
32	1 ¼"		–		–
40	1 ½"		16.5		12.1
50	2"		16.8		12.3
65	2 ½"		–		–
80	3"		28.2		23.8
100	4"		35.5		31.1
125	5"		–		–
150	6"		53.8		49.4
200	8"		109		105
250	10"		166		161
300	12"		221		216
350	14"		302		298
375	15"		–		–
400	16"		370		366
450	18"		421		417
500	20"		503		498
600	24"		666		662
700	28"	AWWA / Class D	587	AWWA / Class D	582
750	30"		701		697
800	32"		845		840
900	36"		1036		1032
1000	40"		1294		1290
1050	42"		1477		1473
1200	48"		1987		1982
–	54"		2807		2803
1400	–		–		–
–	60"		3515		3510
1600	–		–		–
1650	66"		4699		4694
1800	72"		5662		5658
2000	78"		6864		6860
–	84"		8280		8275
2200	–		–		–
–	90"		10577		10573
2400	–		–		–
Transmitter Promag (compact version): 4.0 lbs Transmitter Promag (remote version): 6.8 lbs (Weight data valid without packaging material)					

1) Lap joint flanges / welded flanges DN > 300 (12")

Promag P (ASME/AWWA)

Weight data in lbs						
Nominal diameter		Compact version		Remote version (without cable)		
[mm]	[inch]				Sensor	Transformer
25	1"	Class 150	13	Class 150	12	7
40	1 ½"		17		16	7
50	2"		20		19	7
80	3"		27		26	7
100	4"		32		31	7
150	6"		53		52	7
200	8"		96		95	7
250	10"		162		161	7
300	12"		239		238	7
350	14"		380		381	7
400	16"		448		448	7
450	18"		559		558	7
500	20"		625		624	7
600	24"		889		889	7
Transmitter Promag (compact version): 3.9 lbs (Weight data valid for standard pressure ratings and without packaging material)						

Promag W (ASME/AWWA)

Weight data in lbs						
Nominal diameter		Compact version		Remote version (without cable)		
[mm]	[inch]				Sensor	Transformer
25	1"	Class 150	13	Class 150	12	7
40	1 ½"		17		16	7
50	2"		20		19	7
80	3"		27		26	7
100	4"		32		31	7
150	6"		53		52	7
200	8"		96		95	7
250	10"		162		161	7
300	12"		239		238	7
350	14"		380		381	7
400	16"		448		448	7
450	18"		559		558	7
500	20"		625		624	7
600	24"		889		889	7
700	28"	Class D	878	Class D	878	7
–	30"		1011		1010	7
800	32"		1209		1208	7
900	36"		1760		1760	7
1000	40"		1981		1980	7
–	42"		2422		2421	7
1200	48"		3083		3083	7
–	54"		4847		4847	7
–	60"		5950		5949	7
–	66"		8155		8154	7
1800	72"		9037		9036	7
–	78"		10139		10139	7
Transmitter Promag (compact version): 3.9 lbs (Weight data valid for standard pressure ratings and without packaging material)						

Material

Promag D

- Transmitter housing: powder-coated die-cast aluminum
- Sensor housing: powder-coated die-cast aluminum
- Measuring tube: polyamide, O-rings EPDM
  (Drinking water approvals: WRAS BS 6920, ACS, NSF 61, KTW/W270)
- Electrodes: 1.4435 (316, 316L)
- Ground disks: 1.4301 (304)

Promag E

- Transmitter housing: powder-coated die-cast aluminum
- Sensor housing
  – DN 15 to 300 (½ to 12"): powder-coated die-cast aluminum
  – DN 350 to 600 (14 to 24"): with protective lacquering
- Measuring tube
  – DN ≤ 300 (12"): stainless steel 1.4301 (304) or 1.4306 (304L) (with Al/Zn protective coating)
  – DN ≥ 350 (14"): stainless steel 1.4301 (304) or 1.4306 (304L) (with protective lacquering)
- Electrodes: 1.4435 (316, 316L), Alloy C22
- Flanges (with protective lacquering)
  – EN 1092-1 (DIN2501): RSt37-2 (S235JRG2); Alloy C22; Fe 410W B
  – ASME: A105
  – JIS: RSt37-2 (S235JRG2); HII
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435 (316, 316L) or Alloy C22

Promag H

- Transmitter housing: powder-coated die-cast aluminum
- Window material: glass or polycarbonate
- Sensor housing: stainless steel 1.4301 (304)
- Wall mounting kit: stainless steel 1.4301 (304)
- Measuring tube: stainless steel 1.4301 (304)
- Liner: PFA (USP class VI; FDA 21 CFR 177.1550: 3A)
- Electrodes: 11.4435 (316, 316L) (optional: Alloy C22, tantalum, platinum)
- Flanges: connections generally made of 1.4404 (316L)
- Seals
  – DN 2 to 25: O-ring (EPDM, Viton, Kalrez), gasket seal (EPDM*, Viton, Silicone*)
  – DN 40 to 100: gasket seal (EPDM*, Silicone*)

  * = USP class VI; FDA 21 CFR 177.2600: 3A
- Ground rings: 1.4435 (316, 316L) (optional: Alloy C22)

Promag L

- Transmitter housing:
  – Compact housing: powder-coated die-cast aluminum
  – Wall-mounted housing: powder-coated die-cast aluminum

- Sensor housing
  - DN 25 to 300 (1 to 12"): powder-coated die-cast aluminum
  - DN 350 to 1200 (14 to 48"): with protective lacquering
- Measuring tube:
  - DN ≤ 300 (12"); stainless steel 1.4301 (304) or 1.4306 (304L)
  - DN ≥ 350 (14"); stainless steel 202 or 304
- Electrodes: 1.4435 (316, 316L), Alloy C22
- Flange
  - EN 1092-1 (DIN 2501): DN ≤ 300: 1.4306; 1.4307; 1.4301 (304); 1.0038 (S235JRG2)
  - EN 1092-1 (DIN 2501): DN ≥ 350: A105; 1.0038 (S235JRG2)
  - AWWA: A181/A105; 1.0425 (316L) (P265GH); 1.0044 (S275JR)
  - AS 2129: A105; 1.0345 (P235GH); 1.0425 (316L) (P265GH); 1.0038 (S235JRG2); FE 410 WB
  - AS 4087: A105; 1.0425 (316L) (P265GH); 1.0044 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 11.4435 (316, 316L) or Alloy C22

Promag P/W

- Transmitter housing: powder-coated die-cast aluminum
- Sensor housing
  - DN 25 to 300: powder-coated die-cast aluminum
  - DN 350 to 2000: with protective lacquering
- Measuring tube
  - DN ≤ 300: stainless steel 1.4301 (304) or 1.4306 (304L)
    (Flange material: carbon steel with Al/Zn protective coating)
  - DN ≥ 350: stainless steel 1.4301 (304) or 1.4306 (304)
    (Flange material: carbon steel with protective lacquering)
- Electrodes: 1.4435 (316, 316L), Alloy C22
- Flange
  - EN 1092-1 (DIN2501): RSt37-2 (S235JRG2); Alloy C22; FE 410 WB
    (DN ≤ 300: with Al/Zn protective coating; DN ≥ 350 with protective lacquering)
  - ASME: A105
    (DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective lacquering)
  - AWWA (only Promag W): 1.0425 (with protective lacquering)
  - JIS: RSt37-2 (S235JRG2); HII; 1.0425
    (DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective lacquering)
  - AS 2129
    - (DN 25, 80, 100, 150 to 1200) A105 or RSt37-2 (S235JRG2)
    - (DN 50, 80, 350, 400, 500) A105 or St44-2 (S275JR)
      (DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective lacquering)
  - AS 4087: A105 or St44-2 (S275JR)
    (DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective lacquering)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435 (316, 316L) or Alloy C22

Material load diagram

The material load diagrams (pressure-temperature graphs) for the process connections are to be found in the "Technical Information" documents of the device in question:
List of supplementary documentation → 🖹 107.

Fitted electrodes

Promag D

- 2 measuring electrodes for signal detection

Promag E/L/P/W

- 2 measuring electrodes for signal detection
- 1 EPD electrode for empty pipe detection
- 1 reference electrode for potential equalization

Promag H

- 2 measuring electrodes for signal detection
- 1 EPD electrode for empty pipe detection (apart from DN 2 to 15)

Process connections

Promag D

Wafer version → without process connections

Promag E

Flange connection:
- EN 1092-1 (DIN 2501), DN ≤ 300 (12") form A, DN ≥ 350 (14") form B (Dimensions to DIN 2501, DN 65 PN 16 and DN 600 (24") PN 16 exclusively to EN 1092-1)
- ASME B16.5
- JIS B2220

Promag H

With O-ring:
- Flange EN (DIN), ASME, JIS
- External thread

With gasket seal:
- Weld nipple DIN 11850, ODT/SMS
- TriClamp L14 AM7
- Threaded joint DIN 11851, DIN 11864-1, SMS 1145
- Flange DIN 11864-2

Promag L

Flange connection:
- EN 1092-1 (DIN 2501)
  - DN ≤ 300 (12") = form A
  - DN ≥ 350 (14") = form B
- ASME B16.5
- AWWA C207
- AS

Promag P/W

Flange connections:
- EN 1092-1 (DIN 2501)
  - DN ≤ 300 = form A
  - DN ≥ 350 = flat face
  - DN 65 PN 16 and DN 600 PN 16 only as per EN 1092-1

- ASME
- AWWA (only Promag W)
- JIS
- AS

Surface roughness

All data relate to parts in contact with fluid.

- Liner → PFA: ≤ 0.4 µm (15 µin)
- Electrodes → 1.4435 (316, 316L), Alloy C22: 0.3 to 0.5 µm (12 to 20 µin)
- Process connection made of stainless-steel (Promag H):
  - with O-ring seal: ≤ 1.6 µm (63 µin)
  - with aseptic gasket seal: ≤ 0.8 µm (31.5 µin)
  - optional: ≤ 0.38 µm (15 µin)

10.1.11 Human interface

Display elements

- Liquid crystal display: unilluminated, two-line, 16 characters per line
- Display (operating mode) preconfigured: volume flow and totalizer status
- 1 totalizer

Note!
At ambient temperatures below −20 (−4 °F) the readability of the display may be impaired.

Operating elements

Local operation with three keys (⊟ ⊞ Ⓔ)

Remote operation

Operation via HART protocol and FieldCare

10.1.12 Certificates and approvals

CE mark

The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

C-tick mark

The measuring system meets the EMC requirements of the Australian Communications and Media Authority (ACMA)

Ex approval

Information about currently available Ex versions (ATEX, FM, CSA, IECEx, NEPSI etc.) can be supplied by your Endress+Hauser Sales Center on request. All explosion protection data are given in a separate documentation which is available upon request.

Sanitary compatibility

Promag D/E/L/P/W

No applicable approvals or certification

Promag H

- 3A authorization and EHEDG-certified
- Seals: in conformity with FDA (except Kalrez seals)

Drinking water approval

Promag D/L/W

- WRAS BS 6920
- ACS
- NSF 61
- KTW/W270

Promag E/H/P

No drinking water approval

Pressure Equipment Directive

Promag D/L

No pressure measuring device approval

Promag E/H/P/W

The devices can be ordered with or without a PED approval. If a device with a PED approval is required, this must be explicitly stated in the order. For devices with nominal diameters less than or equal to DN 25 (1"), this is neither possible nor necessary.

- With the PED/G1/x (x = category) marking on the sensor nameplate, Endress+Hauser confirms compliance with the "Essential Safety Requirements" specified in Annex I of the Pressure Equipment Directive 97/23/EC.
- Devices bearing this marking (PED) are suitable for the following types of medium: Media in Group 1 and 2 with a vapor pressure greater than, or smaller and equal to 0.5 bar (7.3 psi)
- Devices not bearing this marking (PED) are designed and manufactured according to good engineering practice. They meet the requirements of Art.3 Section 3 of the Pressure Equipment Directive 97/23/EC. The range of application is indicated in tables 6 to 9 in Annex II of the Pressure Equipment Directive.

Other standards and guidelines

- EN 60529:
  Degrees of protection by housing (IP code).
- EN 61010-1
  Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC/EN 61326
  Electromagnetic compatibility (EMC requirements)
- ASME/ISA-S82.01
  Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment - General Requirements. Pollution degree 2, Installation Category II.
- CAN/CSA-C22.2 (No. 1010.1-92)
  Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use. Pollution degree 2, Installation Category I.

10.1.13 Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser website: www.endress.com → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: www.endress.com/worldwide

Note!
Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

10.1.14 Accessories

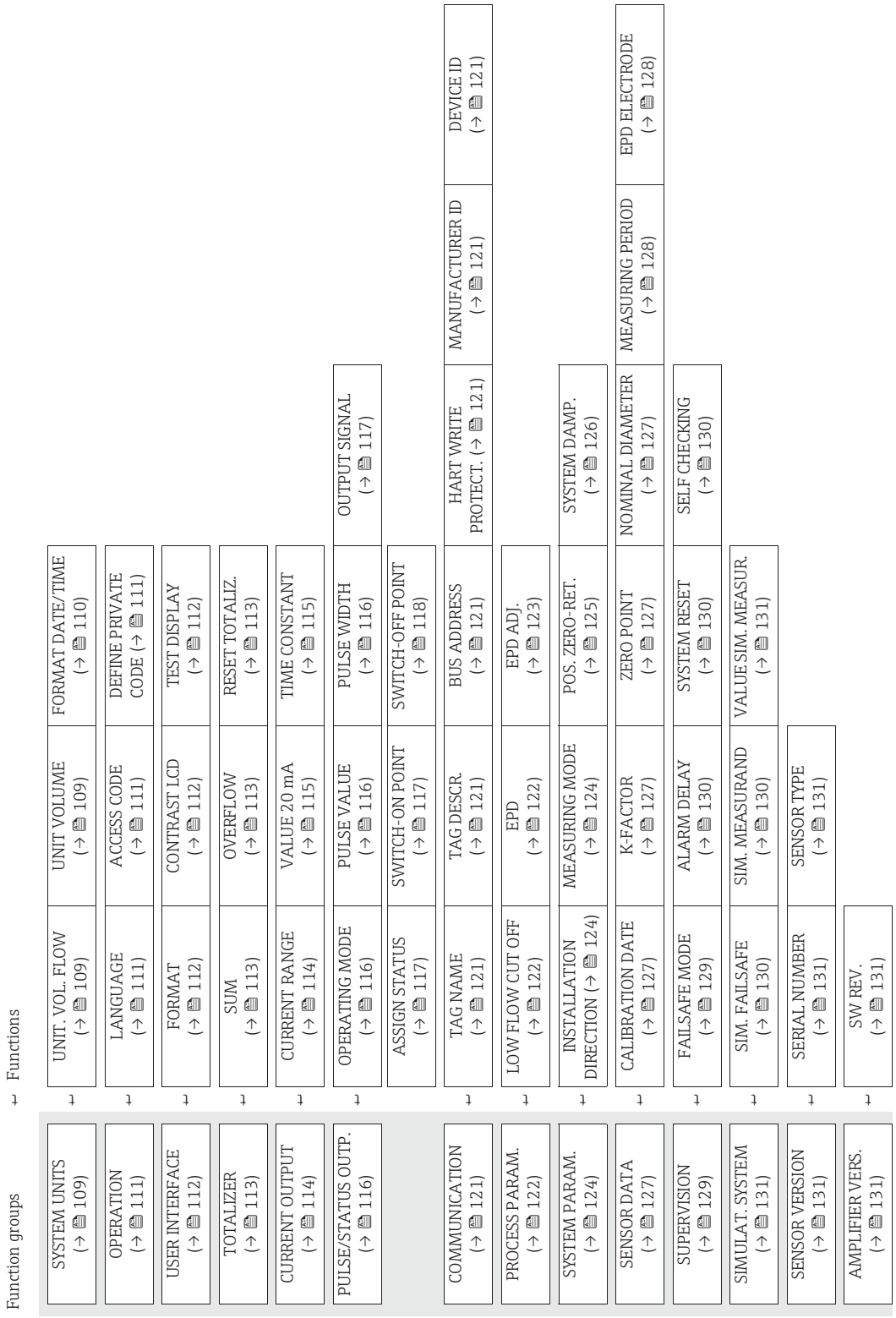
Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor.→ 70
Your Endress+Hauser service organization can provide detailed information on the specific order codes on request.

10.1.15 Documentation

- Flow measuring technology (FA00005D/06)
- Technical Information Promag 10D (TI00081D/06)
- Technical Information Promag 10E (TI01160D/06)
- Technical Information Promag 10H (TI00095D/06)
- Technical Information Promag 10L(TI00100D/06)
- Technical Information Promag 10P (TI00094D/06)
- Technical Information Promag 10W (TI00093D/06)

11 Appendix

11.1 Illustration of the function matrix



11.2 Group SYSTEM UNITS

Functional description SYSTEM UNITS	
Use this function group to select the unit required and displayed for the measured variable.	
UNIT VOLUME FLOW	Use this function to select the unit required and displayed for the volume flow. The unit you select here is also valid for: ▪ Volume flow display ▪ Current output ▪ Switch points (limit value for volume flow, flow direction) ▪ Low flow cut off Options: *Metric:* Cubic centimeter → cm^3/s; cm^3/min; cm^3/h; cm^3/day Cubic decimeter → dm^3/s; dm^3/min; dm^3/h; dm^3/day Cubic meter → m^3/s; m^3/min; m^3/h; m^3/day Milliliter → ml/s; ml/min; ml/h; ml/day Liter → l/s; l/min; l/h; l/day Hectoliter → hl/s; hl/min; hl/h; hl/day Megalith → Ml/s; Ml/min; Ml/h; Ml/day *US*: Cubic centimeter → cc/s; cc/min; cc/h; cc/day Acre foot → af/s; af/min; af/h; af/day Cubic foot → ft3/s; ft3/min; ft3/h; ft3/day Fluid ounce → oz f/s; oz f/min; oz f/h; oz f/day Gallon → gal/s; gal/min; gal/h; gal/day Kilo gallons → kgal/s; kgal/min; kgal/h; kgal/day Million gallons → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (normal fluids: 31.5 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (beer: 31.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 42.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (filling tanks: 55.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day *Imperial*: Gallon → gal/s; gal/min; gal/h; gal/day Mega gallon → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (beer: 36.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 34.97 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Factory setting: Depends on nominal diameter and country (dm^3/min to m^3/h or US-gal/min), corresponding to the full scale value unit factory setting → 🖹 132
UNIT VOLUME	Use this function to select the unit required and displayed for the volume. The unit you select here is also valid for: ▪ Totalizer status display ▪ Totalizer unit ▪ Pulse value (e.g. m^3/p) Options: *Metric* → cm^3; dm^3; m^3; ml; l; hl; Ml *US* → cc; af; ft3; oz f; gal; Mgal; bbl (normal fluids); bbl (beer); bbl (petrochemicals); bbl (filling tanks) *Imperial* → gal; Mgal; bbl (beer); bbl (petrochemicals) Factory setting: Depends on nominal diameter and country (dm^3 to m^3 or US-gal corresponding to the totalizer unit factory setting. → 🖹 132

Functional description SYSTEM UNITS	
FORMAT DATE/TIME	Use this function to select the format for the date and the time. The unit you select here is also valid for displaying the current calibration date (function CALIBRATION DATE on → 127 Options: DD.MM.YY 24H MM/DD/YY 12H A/P DD.MM.YY 12H A/P MM/DD/YY 24H Factory setting: DD.MM.YY 24H (SI units) MM/DD/YY 12H A/P (US units)

11.3 Group OPERATION

Functional description OPERATION	
LANGUAGE	Use this function to select the language for all texts, parameters and messages shown on the local display. Options: ENGLISH DEUTSCH FRANCAIS ESPANOL ITALIANO Factory setting: Depends on country, see factory setting → 🖹 132 ✎ Note! If you press the ⊕⊖keys simultaneously at startup, the language defaults to "ENGLISH".
ACCESS CODE	All data of the measuring system are protected against inadvertent change. Programming is disabled and the settings cannot be changed until a code is entered in this function. If you press the ℗ keys in any function, the measuring system automatically goes to this function and the prompt to enter the code appears on the display (when programming is disabled). You can activate programming by entering your private code (factory setting = 10, see also the subsequent DEFINE PRIVATE CODE function) User input: Max. 4-digit number: 0 to 9999 ✎ Note! ▪ The programming levels are disabled if you do not press the operating elements within 60 seconds following automatic return to the HOME position. ▪ You can also disable programming in this function by entering any number (other than the defined private code). ▪ The Endress+Hauser service organization can be of assistance if you mislay your personal code.
DEFINE PRIVATE CODE	Use this function to enter a personal code to enable programming. User input: 0 to 9999 (max. 4-digit number) Factory setting: 10 ✎ Note! ▪ This function only appears if the private code was entered in the ACCESS CODE function. ▪ Programming is always enabled with the code "0". ▪ Programming has to be enabled before this code can be changed. When programming is disabled this function is not available, thus preventing others from accessing your personal code.

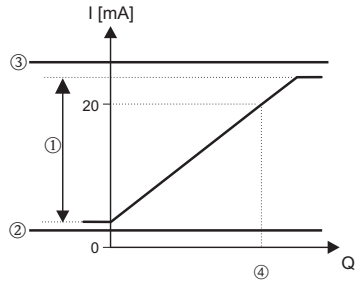
11.4 USER INTERFACE

Functional description USER INTERFACE	
FORMAT	Use this function to define the maximum number of places after the decimal point displayed for the reading in the main line. Options: XXXXX. XXXX.X XXX.XX XX.XXX X.XXXX Factory setting: X.XXXX ✎ Note! ▪ Note that this setting only affects the reading as it appears on the display, it has no influence on the accuracy of the system's calculations. ▪ The places after the decimal point as computed by the measuring device cannot always be displayed, depending on this setting and the engineering unit. In such instances an arrow appears on the display between the measuring value and the engineering unit (e.g. 1.2 → l/h), indicating that the measuring system is computing with more decimal places than can be shown on the display.
CONTRAST LCD	Use this function to optimize display contrast to suit local operating conditions. User input: 10 to 100% Factory setting: 50%
TEST DISPLAY	Use this function to test the operability of the local display and its pixels. Options: OFF ON Factory setting: OFF Test sequence: 1. Start the test by selecting ON. 2. All pixels of the main line and additional line are darkened for minimum 0.75 seconds. 3. The main line and additional line show an "8" in each field for minimum 0.75 seconds. 4. The main line and additional line show a "0" in each field for minimum 0.75 seconds. 5. The main line and additional line show nothing (blank display) for minimum 0.75 seconds. When the test completes the local display returns to its initial state and the setting changes to "OFF".

11.5 Group TOTALIZER

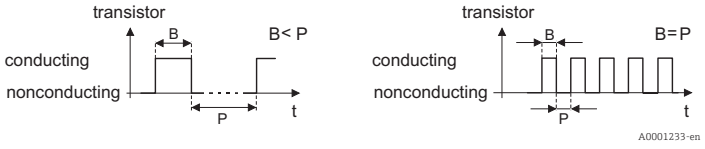
Functional description TOTALIZER	
SUM	The total for the totalizer's measured variable aggregated since measuring commenced appears on the display. This value can be positive or negative, depending on: ▪ Flow direction and/or ▪ Setting in the MEASURING MODE function → 🖹 124 Display: Max. 6-digit floating-point number, incl. sign and unit (e.g. 15467.4 m^3) ✎ Note! ▪ The totalizer's response to faults is defined in the central "FAILSAFE MODE" function → 🖹 129. ▪ The unit of the totalizer is defined in the UNIT VOLUME function → 🖹 109.
OVERFLOW	The total for the totalizer's overflow aggregated since measuring commenced appears on the display. Total flow quantity is represented by a floating-point number consisting of max. 7 digits. You can use this function to view higher numerical values (>9,999,999) as overflows. The effective quantity is thus the total of the OVERFLOW function plus the value displayed in the SUM function. Example: Reading for 2 overflows: 2 E7 dm^3 (= 20,000,000 dm^3) The value displayed in the function "SUM" = 196,845 dm^3 Effective total quantity = 20,196,845 dm^3 Display: Integer with exponent, including sign and unit, e.g. 2 E7 dm^3
RESET TOTALIZER	Use this function to reset the sum and the overflow of the totalizer to "zero" (= RESET). Options: NO YES Factory setting: NO

11.6 Group CURRENT OUTPUT

Functional description CURRENT OUTPUT	
Note! **The functions of the CURRENT OUTPUT group are only available if the "0" value was entered in the BUS ADDRESS function → 121.**	
CURRENT RANGE	Use this function to specify the current range. You can configure the current output either in accordance with the NAMUR recommendation (max. 20.5 mA) or for a maximum drive of 25 mA. Options: OFF 4-20 mA (25 mA) 4-20 mA (25 mA) HART 4-20 mA NAMUR 4-20 mA HART NAMUR 4-20 mA US 4-20 mA HART US Factory setting: 4-20 mA HART NAMUR Current range, work range and signal on alarm level  **A** | ① | ② | ③ OFF | 4 mA | - | - 4-20 mA (25 mA) | 4 - 24 mA | 2 | 25 4-20 mA (25 mA) HART | 4 - 24 mA | 2 | 25 4-20 mA NAMUR | 3,8 - 20,5 mA | 3,5 | 22,6 4-20 mA HART NAMUR | 3,8 - 20,5 mA | 3,5 | 22,6 4-20 mA US | 3,9 - 20,8 mA | 3,75 | 22,6 4-20 mA HART US | 3,9 - 20,8 mA | 3,75 | 22,6 A0005392 *A = Work range* *① = Work range* *② = Lower signal on alarm level* *③ = Upper signal on alarm level* *④ = Scaled full scale value* *Q = Flow* Note! ▪ If the measured value is outside the measuring range (defined in the VALUE 20 mA function → 115), a notice message is generated. ▪ The current output's response to faults is defined in the central FAILSAFE MODE function → 129.

Functional description CURRENT OUTPUT	
VALUE 20 mA	Use this function to assign the 20 mA current a full scale value. Positive and negative values are permitted. The required measuring range is defined by defining the VALUE 20 mA . In the SYMMETRY measuring mode → 🖹 124, the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the flow direction selected. User input: 5-digit floating-point number, with sign Factory setting: Depends on nominal diameter and country, [value] / [dm^3...m^3 or US-gal...US-Mgal] Corresponds to the factory setting for the full scale value → 🖹 132 ✎ Note! ▪ The appropriate unit is taken from the SYSTEM UNITS group → 🖹 109. ▪ The value for 4 mA always corresponds to the zero flow (0 [unit]). This value is fixed and cannot be edited.
TIME CONSTANT	Use this function to enter a time constant defining how the current output signal reacts to severely fluctuating measured variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). User input: Fixed-point number 0.01 to 100.00 s Factory setting: 1.00 s

11.7 Group PULSE/STATUS OUTPUT

Functional description PULSE/STATUS OUTPUT	
OPERATING MODE	Configuration of the output as a pulse or status output. The functions available in this function group vary, depending on which option you select here. Options: OFF PULSE STATUS Factory setting: PULSE
PULSE VALUE	✎ Note! This function is not available unless the PULSE setting was selected in the OPERATING MODE function. Use this function to define the flow at which a pulse is triggered. These pulses can be totaled by an external totalizer, and the total flow quantity since measuring started can be registered in this way. In the SYMMETRY measuring mode → 🖹 124, the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the positive flow direction. User input: 5-digit floating-point number, [unit] Factory setting: Depends on nominal diameter and country, [value] [dm^3...m^3 or US-gal] / pulse; Corresponds to the factory setting for the pulse value → 🖹 132 ✎ Note! The appropriate unit is taken from the SYSTEM UNITS group.
PULSE WIDTH	✎ Note! This function is not available unless the PULSE setting was selected in the OPERATING MODE function. Use this function to enter the maximum pulse width of the output pulses. User input: 5 to 2000 ms Factory setting: 100 ms Pulse output is always with the pulse width (B) entered in this function. The pauses (P) between the individual pulses are automatically configured. However, they must at least correspond to the pulse width (B = P).  *P = Intervals between the individual pulses* *B = Pulse width entered (the illustration applies to positive pulses)* ☝ Caution! Buffering (pulse memory) takes place if the number of pulses is too large to output the pulses with the selected pulse width (see PULSE VALUE function on → 🖹 116). The system error message RANGE PULSE is displayed if more pulses are in the pulse memory than can be output in 4 seconds. ✎ Note! ▪ When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.). ▪ The pulse output's response to faults is defined in the central FAILSAFE MODE function → 🖹 129.

Functional description PULSE/STATUS OUTPUT	
OUTPUT SIGNAL	Note! This function is not available unless the PULSE setting was selected in the OPERATING MODE function. Use this function to configure the output in such a way that it matches an external counter, for example. Depending on the application, you can select the direction of the pulses here. Options: PASSIVE - POSITIVE PASSIVE - NEGATIVE Factory setting: PASSIVE - NEGATIVE
ASSIGN STATUS OUTPUT	Note! This function is not available unless the STATUS setting was selected in the OPERATING MODE function. Configuration of the status output. Options: ON (operation) FAULT MESSAGE NOTICE MESSAGE FAULT MESSAGE or NOTICE MESSAGE EPD (empty pipe detection, only if active) FLOW DIRECTION VOLUME FLOW LIMIT VALUE Factory setting: FAULT MESSAGE Note! ▪ The behavior of the status output is a normally closed behavior, in other words the output is closed (trASMEstor conductive) when normal, error-free measuring is in progress. ▪ It is very important to read and comply with the information on the switching characteristics of the status output → 120.
SWITCH-ON POINT	Note! This function is not available unless LIMIT VALUE or FLOW DIRECTION was selected in the ASSIGN STATUS OUTPUT function. Use this function to assign a value to the switch-on point (status output pulls up). The value can be equal to, greater than or less than the switch-off point. Positive and negative values are permitted. User input: 5-digit floating-point number, [unit] Factory setting: 0 [unit] Note! ▪ The appropriate unit is taken from the SYSTEM UNITS group. ▪ Only the switch-on point is available for flow direction output (no switch-off point). If you enter a value not equal to the zero flow (e.g. 5), the difference between the zero flow and the value entered corresponds to half the switchover hysteresis.

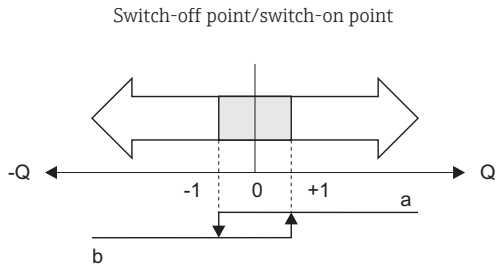
Functional description PULSE/STATUS OUTPUT	
SWITCH-OFF POINT	✎ Note! This function is not available unless LIMIT VALUE was selected in the ASSIGN STATUS OUTPUT function. Use this function to assign a value to the switch-off point (status output drops off). The value can be equal to, greater than or less than the switch-on point. Positive and negative values are permitted. User input: 5-digit floating-point number, [unit] Factory setting: 0 [unit] ✎ Note! ▪ The appropriate unit is taken from the SYSTEM UNITS group. ▪ If SYMMETRY is selected in the MEASURING MODE function and values with different signs are entered for the switch-on and switch-off points, the notice message "INPUT RANGE EXCEEDED" appears.

11.7.1 Information on the response of the status output

General

If you have configured the status output for "LIMIT VALUE" or "FLOW DIRECTION", you can configure the requisite switch points in the SWITCH-ON POINT and SWITCH-OFF POINT functions. When the measured variable in question reaches these predefined values, the status output switches as shown in the illustrations below.

Status output configured for flow direction



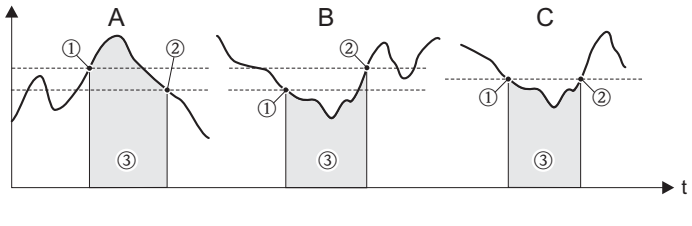
a = Status output conductive
b = Status output not conductive

The value you entered in the function SWITCH-ON POINT defines the switch point for the positive and negative directions of flow. If, for example, the switch point entered is = 1 m^3/h, the status output switches off at −1 m^3/h (not conductive) and switches on again at +1 m^3/h (conductive). Set the switch point to 0 if your process calls for direct switchover (no switching hysteresis). If low flow cut off is used, it is advisable to set hysteresis to a value greater than or equal to the low flow cut off rate.

Status output configured for limit value

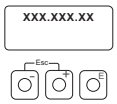
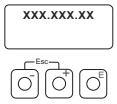
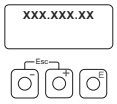
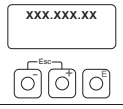
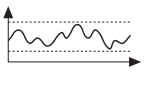
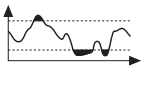
The status output switches as soon as the measured variable undershoots or overshoots a defined switch point.

Application: monitoring flow or process-related boundary conditions.



- A = Maximum safety:
  ① SWITCH-OFF POINT > ② SWITCH-ON POINT
- B = Minimum safety:
  ① SWITCH-OFF POINT < ② SWITCH-ON POINT
- C = Minimum safety:
  ① SWITCH-OFF POINT = ② SWITCH-ON POINT (this configuration should be avoided)
- ③ = Relay de-energized

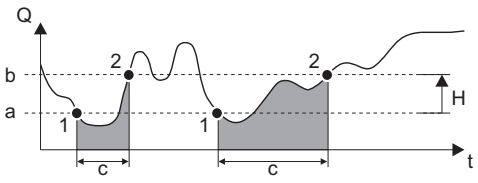
11.7.2 Switching behavior of the status output

Function	State	Open collector behavior (TrASMEstor)
ON (operation)	System in measuring mode 	conductive A0001237
	System not in measuring mode (power supply failed)	not conductive A0001239
Fault message	System OK 	conductive A0001237
	(System error or process error) fault → Response to error, outputs/inputs and totalizers	not conductive A0001239
Notice message	System OK 	conductive A0001237
	(System error or process error) Notice → Continuation of measuring	not conductive A0001239
Fault message or notice message	System OK 	conductive A0001237
	(System error or process error) Fault → Response to error or Notice → Continuation of measuring	not conductive A0001239
Empty pipe detection (EPD)	Measuring tube full	conductive A0001237
	Measuring tube partially filled / empty measuring tube	not conductive A0001239
Flow direction	Forwards A0001241	conductive A0001237
	Backwards A0001242	not conductive A0001239
Volume flow limit value	Limit value not overshot or undershot  A0001243	conductive A0001237
	Limit value overshot or undershot  A0001244	not conductive A0001239

11.8 Group COMMUNICATION

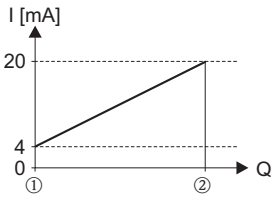
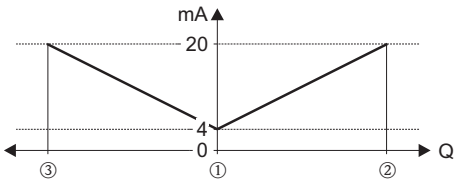
Functional description COMMUNICATION	
✎ **Note!** **The communication group is only visible if the HART option was selected in the CURRENT RANGE function.**	
TAG NAME	Use this function to enter a tag name for the measuring device. You can edit and read this tag name at the local display or via the HART protocol. User input: Max. 8-character text, permitted characters are: A-Z, 0-9, +,-, underscore, space, period Factory setting: "_ _ _ _ _ _ _ _" (no text)
TAG DESCRIPTION	Use this function to enter a tag description for the measuring device. You can edit and read this tag description at the local display or via the HART protocol. User input: Max. 16-character text, permitted characters are: A-Z, 0-9, +,-, underscore, space, period Factory setting: "_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _" (no text)
BUS ADDRESS	Use this function to define the address for the exchange of data with the HART protocol. User input: 0 to 15 Factory setting: 0 ✎ Note! Addresses 1 to 15: a constant 4 mA current is applied.
HART WRITE PROTECTION	Use this function to activate HART write protection. Options: OFF = function can be edited/read via the HART protocol ON = HART protocol write-protected (only readable) Factory setting: OFF
MANUFACTURER ID	Use this function to view the manufacturer ID in decimal numerical format. Display: – Endress+Hauser – 17 (≙ 11 hex) for Endress+Hauser
DEVICE ID	Use this function to view the device ID in hexadecimal numerical format. Display: 45 hex (≙ 69 dec) for Promag 10

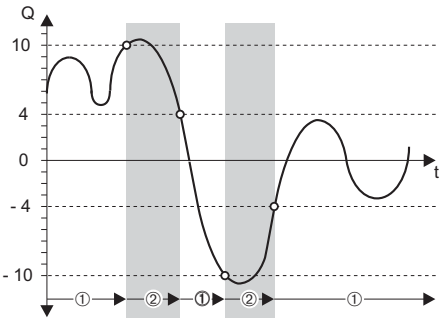
11.9 Group PROCESS PARAMETER

Functional description PROCESS PARAMETER	
SWITCH-ON POINT LOW FLOW CUT OFF	Use this function to enter the switch-on point for low flow cut off. Low flow cut off is active if the value entered is not equal to 0. The sign of the flow value is highlighted on the display to indicate that low flow cut off is active. User input: 5-digit floating-point number, [unit] Factory setting: Depends on nominal diameter and country, [value] / [dm^3...m^3 or US-gal] Corresponds to the factory setting for the low flow cut off → 🖹 132 ✎ Note! The appropriate unit is taken from the SYSTEM UNITS group. The switch-off point is specified as a positive hysteresis from the switch-on point with 50%.  A0001245 *Q* *Flow [volume/time]* *t* *Time* *H* *Hysteresis* *a* *SWITCH-ON POINT LOW FLOW CUT OFF = 200 dm^3/h* *b* *Low flow cut off switch-off point = 50%* *c* *Low flow cut off active* *1* *Low flow cut off is switched on at 200 dm^3/h* *2* *Low flow cut off is switched off at 300 dm^3/h*
EPD	Activating empty pipe detection (EPD). Options: OFF ON (empty pipe detection) Factory setting: OFF ✎ Note! ▪ The ON option is not available unless the sensor is fitted with an EPD electrode. ▪ The default setting for the EPD function when the device is delivered is OFF. The function must be activated as required. ▪ When delivered, the measuring device is calibrated with water (500 µS/cm). If the fluid differs from this conductivity, empty-pipe and full-pipe adjustment has to be performed on site. ▪ To activate the function (ON option), valid adjustment coefficients have to be available. ▪ The following error messages are displayed if the empty-pipe and full-pipe adjustment is incorrect: ▪ ADJUSTMENT FULL = EMPTY: the adjustment values for empty pipe and full pipe are identical. ▪ ADJUSTMENT NOT OK: adjustment is not possible as the fluid conductivity values are outside the permitted range. ▪ In cases of this nature you must repeat empty-pipe or full-pipe adjustment.

Functional description PROCESS PARAMETER	
EPD-MODE (continued)	Notes on empty pipe detection (EPD) ▪ Flow cannot be measured correctly unless the measuring tube is completely full. This status can be monitored at all times by means of the EPD. ▪ An empty or partially filled pipe is a process error. A default factory setting defines that a notice message is issued and that this process error does not have any effect on the outputs. ▪ The EPD process error can be output via the configurable status output. Response to partially filled pipe If the EPD is switched on and responds to a partially filled or empty pipe, the notice message "EMPTY PIPE" appears on the display and zero flow is indicated. If the pipe is partially empty and the EPD is not switched on, the response can vary in identically configured systems: ▪ Flow reading fluctuates ▪ Zero flow ▪ Excessively high flow values
EPD ADJUSTMENT	Use this function to activate adjustment for an empty or full measuring tube. Options: OFF EPD EMPTY PIPE ADJ. EPD FULL PIPE ADJUST Factory setting: OFF ✎ Note! An exact description of the procedure for an EPD empty-pipe/full-pipe adjustment is provided on → 🖹 68.

11.10 Group SYSTEM PARAMETER

Functional description SYSTEM PARAMETER	
INSTALLATION DIRECTION SENSOR	Use this function to reverse the sign of the flow quantity, if necessary. Options: FORWARDS (flow as indicated by the arrow) BACKWARDS (flow opposite to direction indicated by the arrow) Factory setting: FORWARDS ✎ Note! Ascertain the actual direction of fluid flow with reference to the direction indicated by the arrow on the sensor (nameplate).
MEASURING MODE	Use this function to select the measuring mode for all outputs and for the internal totalizer. Options: STANDARD SYMMETRY Factory setting: STANDARD The responses of the individual outputs and the internal totalizer in each of the measuring modes are described in detail on the following pages: Current output STANDARD Only the flow components for the selected flow direction are output, (positive or negative full scale value ② = flow direction). Flow components in the opposite direction are not taken into account (suppression). Example for current output:  A0001248 SYMMETRY The output signals of the current output are independent of the direction of flow (absolute amount of the measured variable). The "VALUE20mA" ③ (e.g. backflow) corresponds to the mirrored VALUE20mA ② (e.g. flow). Positive and negative flow components are taken into account. Example for current output:  A0001249 ✎ Note! The direction of flow can be output via the configurable status output.

Functional description SYSTEM PARAMETER	
MEASURING MODE (Contd)	Pulse output STANDARD Only flow components of the positive flow direction are output. Components in the opposite direction are not taken into account. SYMMETRY The absolute value of the positive and negative flow components is taken into account. Status output ✎ Note! The information is only applicable if LIMIT VALUE was selected in the function ASSIGN STATUS OUTPUT. STANDARD The status output signal switches at the defined switch points. SYMMETRY The status output signal switches at the defined switch points, irrespective of the sign. In other words, if you define a switch point with a positive sign, the status output signal switches as soon as the value is reached in the negative direction (negative sign), (see illustration). Example for the SYMMETRY measuring mode: Switch-on point: Q = 4 Switch-off point: Q = 10 ① = Status output switched on (conductive) ② = Status output switched off (nonconductive)  A0001247 Totalizer STANDARD Only positive flow components are output. Negative components are not taken into account. SYMMETRY The positive and negative flow components are balanced. In other words, net flow in the flow direction is registered.
POSITIVE ZERO RETURN	Use this function to interrupt evaluation of measured variables. This is necessary when a piping system is being cleaned, for example. This setting acts on all function and outputs of the measuring device. Options: OFF ON → Signal output is set to the "ZERO FLOW" value. Factory setting: OFF

Functional description SYSTEM PARAMETER	
SYSTEM DAMPING	Use this function to set the filter depth of the digital filter. This reduces the sensitivity of the measuring signal to interference peaks (e.g. high solids content, gas bubbles in the fluid, etc.). The system reaction time increases with the filter setting. User input: 0 to 4 Factory setting: 3 ✎ Note! ▪ The system damping acts on all functions and outputs of the measuring device. ▪ The higher the value set, the stronger the damping (higher response time).

11.11 Group SENSOR DATA

All sensor data (calibration factors, zero point and nominal diameter etc.) are set at the factory.

Caution!
Under normal circumstances you should not change the following parameter settings, because changes affect numerous functions of the entire measuring facility in general and the accuracy of the measuring system in particular. Therefore, the functions described below are provided with an additional prompt (with the code 10) once you enter your private code.

Functional description SENSOR DATA	
CALIBRATION DATE	Use this function to view the current calibration date and time for the sensor. User input: Calibration date and time. Factory setting: Calibration date and time of the current calibration. Note! The calibration date and time format is defined in the FORMAT DATE/TIME function, → 110 Selectable formats: DD.MM.YY 24H MM/DD/YY 12H A/P DD.MM.YY 12H A/P MM/DD/YY 24H
K-FACTOR	Use this function to display the current calibration factor (positive and negative flow direction) for the sensor. The calibration factor is determined and set at the factory. User input: 5-digit fixed-point number: 0.5000 to 2.0000 Factory setting: Depends on nominal diameter and calibration Note! This value is also provided on the sensor nameplate.
ZERO POINT	This function shows the current zero-point correction value for the sensor. Zero-point correction is determined and set at the factory. User input: Max. 4-digit number: -1000 to +1000 Factory setting: Depends on nominal diameter and calibration Note! This value is also provided on the sensor nameplate.
NOMINAL DIAMETER	This function shows the nominal diameter for the sensor. The nominal diameter depends on the size of the sensor and is set at the factory. Options: 2 to 2000 mm 1/12 to 78" Factory setting: Depends on the size of the sensor Note! This value is also provided on the sensor nameplate.

Functional description SENSOR DATA	
MEASURING PERIOD	Use this function to set the time for a full measuring period. The duration of the measuring period is calculated from the rise time of the magnetic field, the brief recovery time, the (automatically tracked) integration time and the empty pipe detection time. User input: 10 to 1000 ms Factory setting: Depends on nominal diameter
EPD ELECTRODE	Indicates whether the sensor is equipped with an EPD electrode. Display: YES NO Factory setting: YES → Electrode fitted as standard

11.12 Group SUPERVISION

Functional description SUPERVISION	
FAILSAFE MODE	The dictates of safety render it advisable to ensure that the device signal processing assumes a predefined state in the event of a fault. The setting you select here is valid for: ▪ Current output ▪ Pulse output ▪ Totalizer ✎ Note! This has no effect on the display. Options: MINIMUM VALUE MAXIMUM VALUE ACTUAL VALUE Factory setting: MINIMUM VALUE The response of the individual outputs and the totalizer is listed below. Current output: MINIMUM VALUE The current output adopts the value of the lower signal on alarm level (as defined in the CURRENT RANGE function → 🖹 114). MAXIMUM VALUE The current output is set to the upper value of the signal on alarm level. (The values in question can be found in the CURRENT RANGE function on → 🖹 114). ACTUAL VALUE Measured value output is based on the current flow measurement. The fault is ignored. Pulse output: MINIMUM or MAXIMUM VALUE Output is zero pulse ACTUAL VALUE Measured value output is based on the current flow measurement (fault is ignored). Totalizer: MINIMUM or MAXIMUM VALUE The totalizer is paused until the fault is rectified. ACTUAL VALUE The totalizer continues to count on the basis of the current flow value. The fault is ignored.

Functional description SUPERVISION	
ALARM DELAY	Use this function to define a time span in which the criteria for an error have to be satisfied without interruption before an error or notice message is generated. Depending on the setting and the type of error, this suppression acts on: ▪ Display ▪ Current output ▪ Pulse/status output User input: 0 to 100 s (in increments of one second) Factory setting: 0 s ☝ Caution! If this function is activated error and notice messages are delayed by the time corresponding to the setting before being forwarded to the higher-order controller (process controller, etc.). It is therefore imperative to check in advance in order to make sure whether a delay of this nature could affect the safety requirements of the process. If error and notice messages cannot be suppressed, a value of 0 seconds must be entered here.
SYSTEM RESET	Use this function to perform a reset of the measuring system. Options: NO RESTART SYSTEM (Restart without disconnecting main power) RESET DELIVERY (Restart without disconnecting main power, the saved settings of the delivery status (factory settings) are applied). Factory setting: NO
SELF CHECKING	Use this function to switch on and off the self-checking function of the electrode amplifier. When the function is switched on, the electrode signal circuit is checked against a reference voltage at 60-second intervals. If there is an impermissible deviation from the value, system error message #101 is output and displayed on the local display. Options: ON OFF Factory setting: OFF

11.13 Group SIMULATION SYSTEM

Functional description SIMULATION SYSTEM	
SIMULATION FAILSAFE MODE	Use this function to set all outputs and the totalizer to their defined failsafe modes, in order to check whether they respond correctly. During this time, the words "SIMULATION FAILSAFE MODE" appear on the display. Options: ON OFF Factory setting: OFF
SIMULATION MEASURAND	Use this function to set all outputs and the totalizer to their defined flow-response modes, in order to check whether they respond correctly. During this time, the words "SIMULATION MEASURAND" appear on the display. Options: OFF VOLUME FLOW Factory setting: OFF Note! ▪ The measuring device cannot be used for measuring while this simulation is in progress. ▪ The setting is not saved if the power supply fails.
VALUE SIMULATION MEASURAND	Note! This function is not available unless the SIMULATION MEASURAND function is active (= VOLUME FLOW). In this function, a freely selectable value (e.g. 12 m^3/s) is specified. This value is used to test downstream devices and the flowmeter itself. User input: 5-digit floating-point number [unit], with sign Factory setting: 0 [unit] Caution! The setting is not saved if the power supply fails. Note! The appropriate unit is taken from the SYSTEM UNITS group.

11.14 Group SENSOR VERSION

Functional description SENSOR VERSION	
SERIAL NUMBER	Use this function to view the serial number of the sensor.
SENSOR TYPE	Use this function to view the sensor type.

11.15 Group AMPLIFIER VERSION

Functional description AMPLIFIER VERSION	
SOFTWARE REVISION NUMBER	Use this function to view the software revision number of the electronics board.

11.16 Factory settings

11.16.1 SI units (not for USA and Canada)

Low flow cut off, full scale value, pulse value, totalizer

Nominal diameter		Low flow cut off		Full scale value current output		Pulse value		Totalizer
[mm]	[inch]	(approx. v = 0.04 m/s)		(approx. v = 2.5 m/s)		(approx. 2 pulses/s at v = 2.5 m/s)		
2	1/12"	0.01	dm³/min	0.5	dm³/min	0.005	dm³	dm³
4	1/8"	0.05	dm³/min	2	dm³/min	0.025	dm³	dm³
8	3/8"	0.1	dm³/min	8	dm³/min	0.10	dm³	dm³
15	½"	0.5	dm³/min	25	dm³/min	0.20	dm³	dm³
25	1"	1	dm³/min	75	dm³/min	0.50	dm³	dm³
32	1 ¼"	2	dm³/min	125	dm³/min	1.00	dm³	dm³
40	1 ½"	3	dm³/min	200	dm³/min	1.50	dm³	dm³
50	2"	5	dm³/min	300	dm³/min	2.50	dm³	dm³
65	2 ½"	8	dm³/min	500	dm³/min	5.00	dm³	dm³
80	3"	12	dm³/min	750	dm³/min	5.00	dm³	dm³
100	4"	20	dm³/min	1200	dm³/min	10.00	dm³	dm³
125	5"	30	dm³/min	1850	dm³/min	15.00	dm³	dm³
150	6"	2.5	m³/h	150	m³/h	0.025	m³	m³
200	8"	5.0	m³/h	300	m³/h	0.05	m³	m³
250	10"	7.5	m³/h	500	m³/h	0.05	m³	m³
300	12"	10	m³/h	750	m³/h	0.10	m³	m³
350	14"	15	m³/h	1000	m³/h	0.10	m³	m³
375	15"	20	m3/h	1200	m3/h	0.15	m3	m3
400	16"	20	m³/h	1200	m³/h	0.15	m³	m³
450	18"	25	m³/h	1500	m³/h	0.25	m³	m³
500	20"	30	m³/h	2000	m³/h	0.25	m³	m³
600	24"	40	m³/h	2500	m³/h	0.30	m³	m³
700	28"	50	m³/h	3500	m³/h	0.50	m³	m³
–	30"	60	m³/h	4000	m³/h	0.50	m³	m³
800	32"	75	m³/h	4500	m³/h	0.75	m³	m³
900	36"	100	m³/h	6000	m³/h	0.75	m³	m³
1000	40"	125	m³/h	7000	m³/h	1.00	m³	m³
–	42"	125	m³/h	8000	m³/h	1.00	m³	m³
1200	48"	150	m³/h	10000	m³/h	1.50	m³	m³
–	54"	200	m³/h	13000	m³/h	1.50	m³	m³
1400	–	225	m³/h	14000	m³/h	2.00	m³	m³
–	60"	250	m³/h	16000	m³/h	2.00	m³	m³
1600	–	300	m³/h	18000	m³/h	2.50	m³	m³
–	66"	325	m³/h	20500	m³/h	2.50	m³	m³
1800	72"	350	m³/h	23000	m³/h	3.00	m³	m³
–	78"	450	m³/h	28500	m³/h	3.50	m³	m³
2000	–	450	m³/h	28500	m³/h	3.50	m³	m³

Language

Country	Language
Austria	Deutsch
Belgium	English
Denmark	English
England	English
Finland	English
France	Francais
Germany	Deutsch
Holland	English
Hong Kong	English
International Instruments	English
Italy	Italiano
Japan	English
Malaysia	English
Norway	English
Singapore	English
South Africa	English
Spain	Espanol
Sweden	English
Switzerland	Deutsch
Thailand	English

11.16.2 US units (only for USA and Canada)

Low flow cut off, full scale value, pulse value, totalizer

Nominal diameter		Low flow cut off		Full scale value current output		Pulse value		Totalizer
[inch]	[mm]	(approx. v = 0.04 m/s)		(approx. v = 2.5 m/s)		(approx. 2 pulses/s at v = 2.5 m/s)		
1/12"	2	0.002	gal/min	0.1	gal/min	0.001	gal	gal
1/8"	4	0.008	gal/min	0.5	gal/min	0.005	gal	gal
3/8"	8	0.025	gal/min	2	gal/min	0.02	gal	gal
½"	15	0.10	gal/min	6	gal/min	0.05	gal	gal
1"	25	0.25	gal/min	18	gal/min	0.20	gal	gal
1 ¼"	32	0.50	gal/min	30	gal/min	0.20	gal	gal
1 ½"	40	0.75	gal/min	50	gal/min	0.50	gal	gal
2"	50	1.25	gal/min	75	gal/min	0.50	gal	gal
2 ½"	65	2.0	gal/min	130	gal/min	1	gal	gal
3"	80	2.5	gal/min	200	gal/min	2	gal	gal
4"	100	4.0	gal/min	300	gal/min	2	gal	gal
5"	125	7.0	gal/min	450	gal/min	5	gal	gal
6"	150	12	gal/min	600	gal/min	5	gal	gal
8"	200	15	gal/min	1200	gal/min	10	gal	gal
10"	250	30	gal/min	1500	gal/min	15	gal	gal
12"	300	45	gal/min	2400	gal/min	25	gal	gal
14"	350	60	gal/min	3600	gal/min	30	gal	gal
15"	375	60	gal/min	4800	gal/min	50	gal	gal
16"	400	60	gal/min	4800	gal/min	50	gal	gal
18"	450	90	gal/min	6000	gal/min	50	gal	gal
20"	500	120	gal/min	7500	gal/min	75	gal	gal
24"	600	180	gal/min	10500	gal/min	100	gal	gal
28"	700	210	gal/min	13500	gal/min	125	gal	gal
30"	–	270	gal/min	16500	gal/min	150	gal	gal
32"	800	300	gal/min	19500	gal/min	200	gal	gal
36"	900	360	gal/min	24000	gal/min	225	gal	gal
40"	1000	480	gal/min	30000	gal/min	250	gal	gal
42"	–	600	gal/min	33000	gal/min	250	gal	gal
48"	1200	600	gal/min	42000	gal/min	400	gal	gal
54"	–	1.3	Mgal/d	75	Mgal/d	0.0005	Mgal	Mgal
–	1400	1.3	Mgal/d	85	Mgal/d	0.0005	Mgal	Mgal
60"	–	1.3	Mgal/d	95	Mgal/d	0.0005	Mgal	Mgal
–	1600	1.7	Mgal/d	110	Mgal/d	0.0008	Mgal	Mgal
66"	–	2.2	Mgal/d	120	Mgal/d	0.0008	Mgal	Mgal
72"	1800	2.6	Mgal/d	140	Mgal/d	0.0008	Mgal	Mgal
78"	–	3.0	Mgal/d	175	Mgal/d	0.001	Mgal	Mgal
–	2000	3.0	Mgal/d	175	Mgal/d	0.001	Mgal	Mgal

Language

Country	Language
USA	English
Canada	English

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People for Process Automation

Heater, Forced Air, Ouellet, 4.8kW, OAC04804BL

180, 3rd Avenue, L'Islet, Quebec, G0R 2C0, CANADA
Tel.: (418) 247-3947, 1-800-463-7043 Fax: (418) 247-7801
www.ouellet.com

INSTRUCTIONS "OAC" Series

WARNING

When using electrical appliances, basic precautions should always be taken to reduce the risk of fire, electrical shock and injury, including the following.

Read carefully these instructions before installation, operation of the heater. Failure to adhere to the instructions could result in fire, electric shock, serious personal injury, and death or property damage. Review frequently for continuing safe operation and instruction of future users, if necessary.

IMPORTANT INSTRUCTIONS

1- Read all instructions before installing or using this heater.
2- This heater is hot when in use. To avoid burns, do not let bare skin touch hot surfaces. Keep combustible materials, like furniture, pillows, bedding, papers, clothes, and curtains at least 36 in. (915 mm) from the front of the heater.
3- Extreme caution is necessary when any heater is used by or near children or invalids and whenever the heater is left operating and unattended.
4- Do not operate any heater after it malfunctions. Disconnect power at service panel and have heater inspected by a reputable electrician before reusing.
5- Do not use outdoors.
6- Do not insert or allow foreign objects to enter any ventilation or exhaust opening as this may cause an electric shock or fire, or damage the heater.
7- Do not block air intakes or exhaust in any way whatsoever.
8- This heater has hot and arcing or sparking parts inside. Do not use it in areas where gasoline, paint, or flammable liquids are used or stored.
9- Use this heater only as described in this manual. Any other use not recommended by the manufacturer may cause fire, electric shock, or injury.
10- **AMERICAN VERSION ONLY:** Some models (up to 6000W maximum and 240V maximum) include a visual alarm to warn that parts of the heater are getting excessively hot. If the light turns on, immediately turn the heater off and inspect for any objects on or adjacent to the heater that may have blocked the airflow or otherwise caused high temperatures to have occured. If no obstruction is visible, the heater must be checked by a qualified person. **DO NOT OPERATE THE HEATER WHEN THE ALARM LIGHT IS ON.**
11- The thermostat should not be considered an infallible device in cases where maintaining a temperature is considered critical. Examples: Hazardous material storage, computer server room, etc. In these particular cases, it is imperative to add a monitoring system to avoid the consequences of a thermostat failure.

OPERATING INSTRUCTIONS

1- The heater must be properly installed before it is used.
2- Turn the power on at the circuit breaker panel.
3- Electronic thermostat: be sure to set it on the fan mode.
4- Built-in thermostat: to set thermostat at the desired temperature, follow these steps:
   - Set thermostat at maximum temperature (turn clockwise).
   - When the desired temperature is reached, turn the thermostat counter-clockwise slowly until you hear a click.
   - The thermostat will keep this room temperature.
5- Built-in thermostat with control knob, the setting can be adjusted with the knob supplied, located on the front cover.
6- Built-in tamperproof thermostat: the setting can be adjusted through the hole in the front cover with a small slotted screwdriver.
7- **AMERICAN VERSION ONLY**:
   Some models (up to 6000W maximum and 240V maximum) include a visual alarm to warn that parts of the heater are getting excessively hot. If the light turns on, immediately turn the heater off and inspect for any objects on or adjacent to the heater that may have blocked the airflow or otherwise caused high temperatures to have occured.
   DO NOT OPERATE THE HEATER WHEN THE ALARM LIGHT IS ON.

OPTIONS:

Fan switch:
This option allows the use of the fan in continuous or automatic mode.
The switch can be switched through the upper grille with a screwdriver.
Position ON: The fan runs continuously, with or without heating demand.
Position AUTO: The fan operates in automatic mode, only during a heating demand.

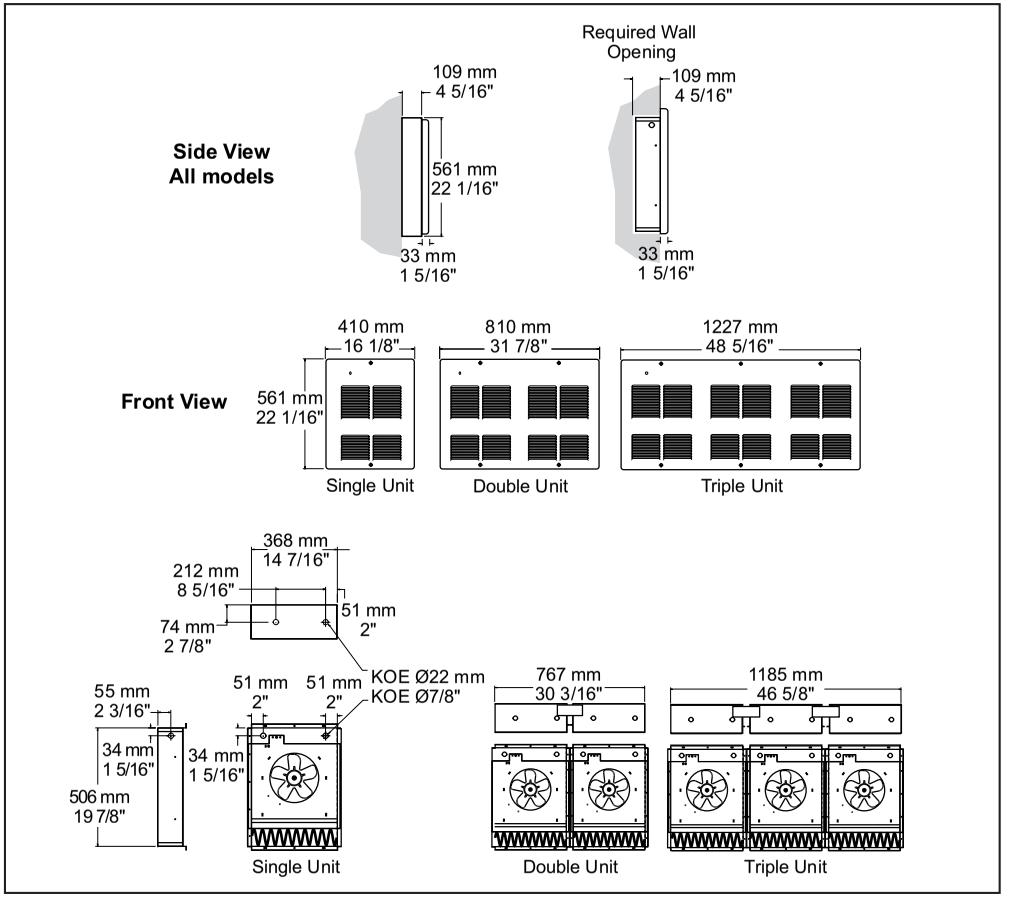
Heating switch:
This option allows the standby of the heating function of the heater.
The switch can be switched through the upper grille with a screwdriver.
Position ON: The heater is operating normally, depending of the heating demand from the thermostat.
Position STBY: The heater does not allow to heat the room, even with a heating demand from the thermostat.
However, the fan can be used for air circulation with the fan switch option, if applicable.

MAINTENANCE INSTRUCTIONS

1- Once a year, remove the front panel and use a vacuum cleaner to remove the dust accumulation inside the heater and through openings of the front panel.
2- Cleaning should be done while the heater is disconnected from the main service panel. Wait until the housing and heating element cool before performing maintenance.
3- Replace the front panel before energizing.
4- Any other servicing should be performed by a qualified technician.

WARRANTY

Please refer to the product sheet at www.ouellet.com.



SAVE THESE INSTRUCTIONS

INSTALLATION INSTRUCTIONS

RECESS MOUNTING:

1- Heater must be used with recess box.
2- Never install warm air outlet of heater less than 10 in. (250 mm) from floor or adjacent wall.
3- Provide a wall opening as:
   Depth : 4 5/16 in. (109 mm)
   Height : 19 7/8 in. (506 mm)
   Length : - Single unit : 14 7/16 in. (368 mm)
   - Double unit : 30 3/16 in. (767 mm)
   - Triple unit : 46 5/8 in. (1185 mm)
4- Remove the appropriate knock-out from the recess box for the electrical supply.
5- Attach firmly the recess box using provided screws. Make sure that the edge on each side of the recess box lean on the gypsum panel and not on the structural parts of the wall. See marking on the sides of the recess box.
6- Install the heater to the recess box and be sure that the heater is attach firmly with four (4) provided screws.
7- Connect the heater leads to the supply leads according to national and local codes. See wiring diagram in the front cover of the heater.
8- Make sure the fan rotates freely and that there is no foreign object in the heater.
9- Install the front cover using the provided screws. IMPORTANT: To insure that the front cover is not upside down, check if the logo is in the correct orientation.
10- To test the heater temporarily, set thermostat at maximum temperature.

SURFACE MOUNTING:

Model 4 in. (102 mm)

1- The surface box must be used with recess box.
2- Never install warm air outlet of heater less than 10 in. (250 mm) from floor or adjacent wall.
3- Locate the power supply leads behind the planned location of the heater (surface box).
4- Mount the surface box securely to the wall with provided screws. IMPORTANT: For a single surface box, there are two bracktets fixed at the top and bottom. Unfold the metal hooks to remove the brackets. Insert brackets in the surface box before continuing the installation. See illustration to install properly.
5- Follow instructions 4 to 10 as above for recess mounting.

SEMI-RECESSED MOUNTING:

Model 1 in. (25 mm) and Model 2 in. (51 mm)

1- The surface box must be used with recess box.
2- Never install warm air outlet of heater less than 10 in. (250 mm) from floor or adjacent wall.
3- Provide a wall opening as:
   Depth for 1 in. model : 3 5/16 in. (84 mm)
   Depth for 2 in. model : 2 5/16 in. (59 mm)
   Height : 19 7/8 in. (506 mm)
   Length : - Single unit : 14 7/16 in. (368 mm)
   - Double unit : 30 3/16 in. (767 mm)
   - Triple unit : 46 5/8 in. (1185 mm)
4- Locate the power supply leads behind the planned location of the heater (surface box).
5- Mount the surface box securely to the wall with provided screws. IMPORTANT: For a single surface box, model 2 in. (51 mm) there are two bracktets fixed at the top and bottom. Unfold the metal hooks to remove the brackets. Insert brackets in the surface box before continuing the installation. See illustration to install properly.
6- Follow instructions 4 to 10 as above for recess mounting.

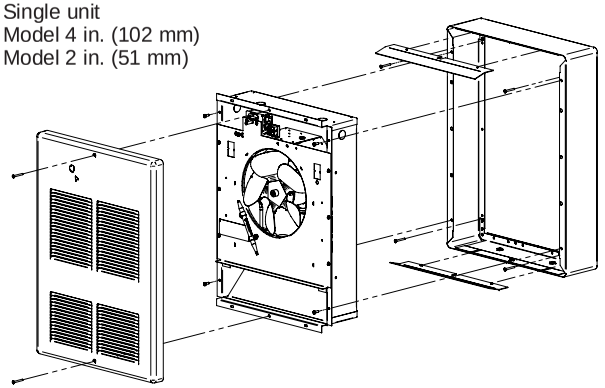
CAUTION:

High temperature, risk of fire, keep electrical cords, drapery, furnishings, and other combustibles at least 36 in. (915 mm) from the front of the heater. To reduce the risk of fire, do not store or use gasoline or other flammable vapors and liquids in the vicinity of the heater.

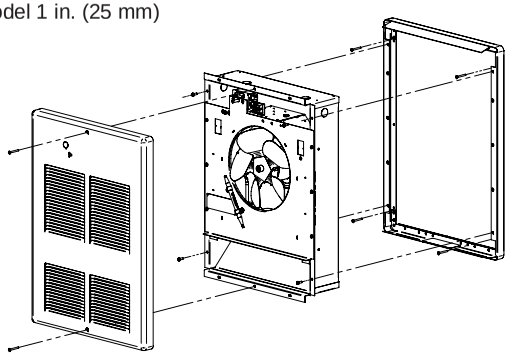
IMPORTANT

1- Do not obstruct front of heater for at least 48 in. (1220 mm).
2- Any remote thermostat or relay must be connected to the heater control terminal block.
3- Do not interrupt power supply to control this heater.

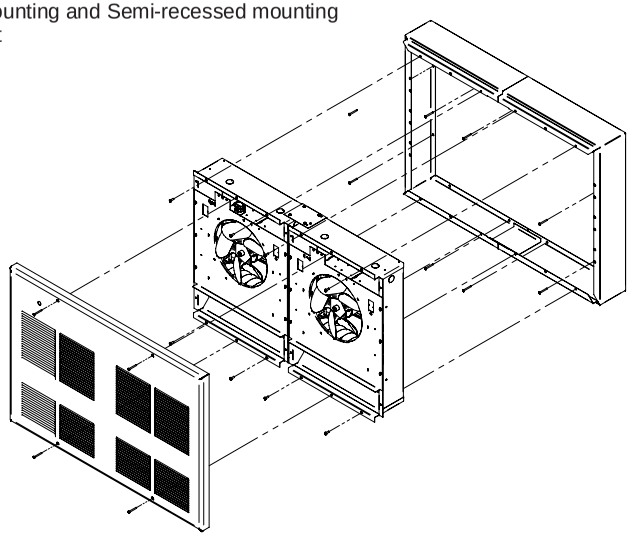
Surface mounting and Semi-recessed mounting
Single unit
Model 4 in. (102 mm)
Model 2 in. (51 mm)



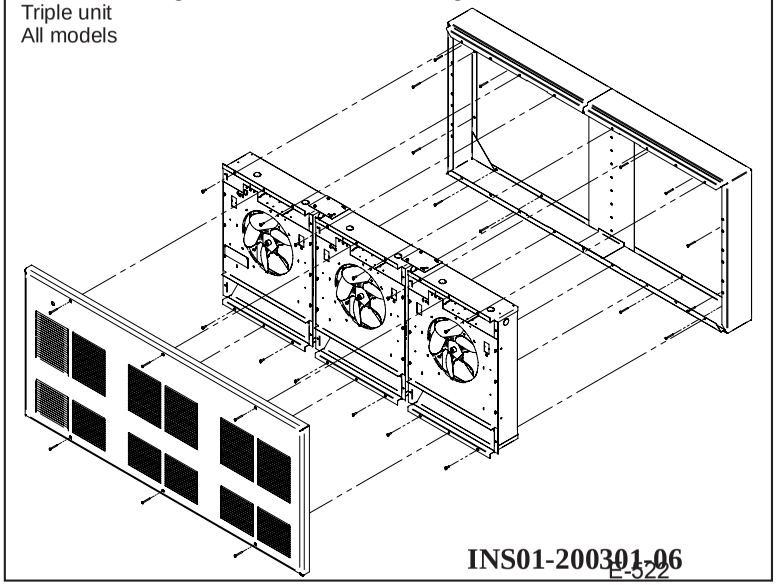
Semi-recessed mounting
Single unit
Model 1 in. (25 mm)



Surface mounting and Semi-recessed mounting
Double unit
All models

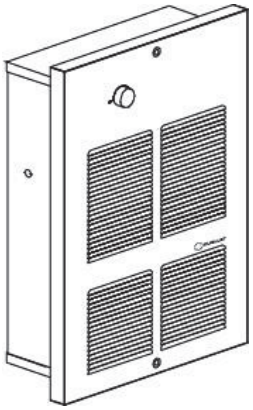


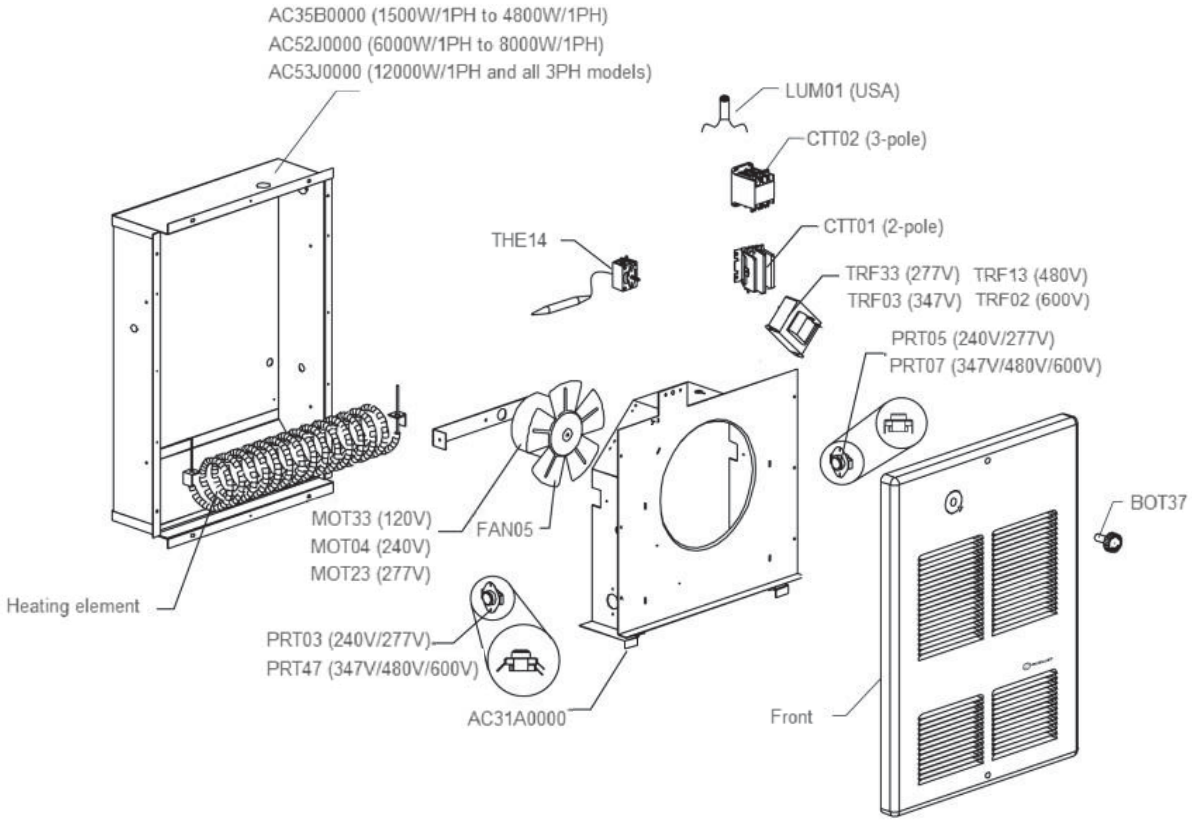
Surface mounting and Semi-recessed mounting
Triple unit
All models



OAC *series*

Commercial Wall Heater





Amp	Fusible *Fuse*	Porte fusible *Fuse holder*	
		Avant le 14 août 2013 *Before August 14, 2013*	After le 14 août 2013 *After August 14, 2013*
15	FUS02	FUS03	FUS07
30	FUS09	FUS07	FUS07

Watts (PH)	Devant *Front*
1500 (1) - 4000 (1)	AC07A000*
4800 (1)	AC29A000*
6000 (1) - 8000 (1)	AC11A000*
12000 (1) **	AC14A000*

* Couleurs sur mesure disponible sur demande. / Custom colors available upon request.
** 12000W/1PH et tous les modèles 3PH. / 12000W/1PH and all 3PH models.

Watts (PH)	Élément chauffant *Heating element*						
	120V	208V	240V	277V	347V	480V	600V
1500 (1)	ELO114	-	ELO71	ELU32	ELO66	ELU71	ELO67
2000 (1)	-	ELO72	ELO47	ELU20	ELO50	ELU24	ELO53
3000 (1)	-	-	ELO48	ELU21	ELO51	ELU25	ELO54
4000 (1)	-	ELO46	ELO49	ELU22	ELO52	ELU26	ELO55
4800 (1)	-	ELU30	ELU31	ELU33	ELO107	ELU58	ELO106
6000 (1)	-	-	ELO48	ELU21	ELO51	ELU25	ELO54
6000 (3)	-	ELO72	-	-	-	-	ELO53
8000 (1)	-	ELO46	ELO49	ELU22	ELO52	ELU26	ELO55
9000 (3)	-	ELO49	-	-	-	-	ELO54
12000 (1)	-	ELO46	ELO49	ELU22	ELO52	ELU26	ELO55
12000 (3)	-	ELO46	-	-	-	ELU26	ELO55

test

watts	volts	
	ELU26	

H-301/302H-401/402 H-501/502 H-503/504 - Heater, Immersion, Caloritech 6KW 460V 3ph

INC.
Tel.: (905) 829-4422
Fax: (905) 829-4430
Tel.: (705) 325-3473
Fax: (705) 325-2106
Tel.: (514) 334-3720
Fax: (514) 334-6491
Tel.: (716) 564-0010
Fax: (716) 564-0044

INSTALLATION AND MAINTENANCE INSTRUCTIONS IMMERSION HEATERS - TYPES CX & DX

1.0 INSTALLATION

1.1 Immersion heaters are designed for operation only while completely immersed in liquids. Never allow the heating elements to be exposed while energized or failure will result.

1.2 CAUTION: Use the heater only in liquids and at pressures for which it was designed. Normally copper sheath is recommended in water, steel or alloy sheath in oil, and the appropriate alloy sheath for heating chemical solutions. Check factory for recommendations.

1.3 In the case of flanged (and some screwplug type) heaters where a gasket seal is required, the gasket surface should be clean and dry before the heater is seated.

1.4 The terminals must be protected at all times from moisture or vapour. In hazardous locations, explosion resistant terminal housings must be used. In outdoor locations, moisture resistant housings are required.

1.5 Protect terminals of heating elements from drippings, condensation, fumes, spray or any other substance which could result in element contamination.

1.6 When melting solids by direct immersion, a surface vent should be provided to allow gases to escape. Operate the heater on $^1/_2$ voltage until melted material completely covers the heating elements. Heaters used for this purpose may require special design features. Check factory for recommendations.

2.0 WIRING AND CONTROL

2.1 Heaters must be wired by qualified personnel to electrical code requirements.

2.2 Check supply voltage for compliance with heater nameplate voltage.

2.3 A line voltage or pilot duty thermostat should be used to control the heater. The pilot duty thermostat must be used with a contactor and (if required) a transformer. Generally, heaters supplied with built-in thermostats will be factory prewired if suitable for line voltage operation. Integral thermostats not factory prewired are usually intended for pilot duty.

2.4 It is recommended that the control circuits be supplied from the isolated secondary windings of transformers obviating the need for two supply circuits, or as an alternative, that mechanical or electrical interlocking be provided so that both supplies must be disconnected before live parts can be made accessible.

2.5 If there is even the slightest possibility that the liquid level may fall below the elements, a level control switch or over-temperature sensing device affixed to the uppermost heating element is required. Check factory for recommendations.

2.6 Heaters with explosion resistant terminal housings must only be used in locations for which the heaters are certified.

a) Check heater nameplate information for approval code.

b) Never energize an explosion resistant heater unless the terminal housing cover is properly tightened.

c) An immersion heater for hazardous locations is approved for use only if an approved liquid level control is used to de-energize the heater under low liquid conditions.

3.0 START-UP INSPECTION

3.1 Check that all terminal connections are tight.

3.2 Heaters stored for prolonged periods may absorb moisture. Using a megger (insulation resistance tester) check the value of the insulation resistance to ground for each circuit. Initial readings of over 500,000 ohms to ground are normally acceptable. Should lower readings be observed, check factory for instructions.

4.0 MAINTENANCE

4.1 DISCONNECT POWER BEFORE SERVICING.

4.2 Remove the immersion heater periodically to inspect for corrosion, sludge built-up and for scale removal.

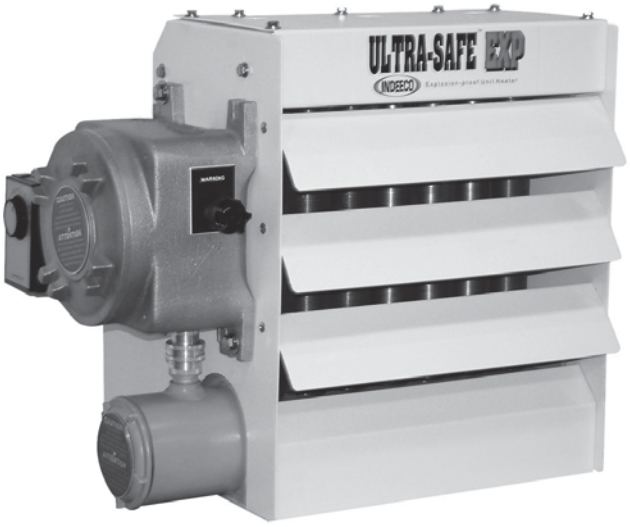
4.3 Periodically check electrical connections for tightness.

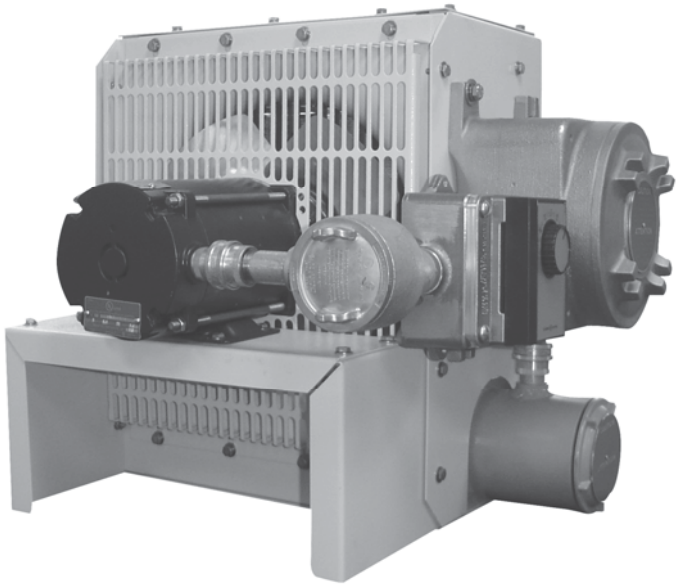
INDEECO

Owner's Manual

ULTRA-SAFE EXP Series

Electric Forced Air Heater for Hazardous Locations





This manual covers installation, maintenance and repair parts.

FM and CSA Approved for the following classified areas:
Class I, Divisions 1 & 2, Groups C & D
Class II, Divisions 1 & 2, Groups F & G
Operating Temperature Code T3C - 320°F (160°C)
Class I, Zones 1 & 2, Group IIB, T3 (FMUS & CSAUS only)
or
Class I, Divisions 1 & 2, Groups C & D
Class II, Divisions 1 & 2, Groups E, F & G
Operating Temperature Code T3C - 320ºF (160ºC)
Class I, Zones 1 & 2, Group IIB T3 (FMUS & CSAUS only)
See Data Plate for Specific Area Classification

For details on the particular hazardous environments having the potential for explosion, refer to Articles 500 through 516 of the National Electric Code, and/or Section 18 of the Canadian Electric Code, Part I.

C SA ® US

C FM US APPROVED

23-2199-83-1
E-526

WARNINGS

Installation and maintenance personnel should familiarize themselves with this manual and all the **WARNINGS** before installing or working on this heater to avoid potential hazardous conditions, severe property damage, personal injury or death.

1. To reduce the risk of ignition of hazardous atmospheres: Do not install where the operating temperature code limit exceeds the ignition temperature of the hazardous atmosphere.
2. Potentially lethal voltages are present. Be sure to lock the branch circuit disconnect switch in the OFF position and tag the circuit "Out for Maintenance" before working on this equipment.
3. Keep electrical enclosure covers tightly closed while in operation.
4. Hazard of Electric Shock. Heater must be grounded in accordance with the N.E.C. and/or C.E.C.
5. This heater should be installed by qualified personnel familiar with the National Electric Code and/or the Canadian Electrical Code requirements for hazardous locations. It is the responsibility of the installer to verify the safety and suitability of the installation.
6. Disassembly of the unit, for installation, is not required or authorized.
7. When connecting the room thermostat, be sure that the thermal cutouts remain connected in series with the controlling contactor. The unit must not operate without the thermal cutouts properly connected in the circuit.
8. Do not attempt to install a "Fan Only" switch on a standard unit heater and do not try to field modify a standard unit heater for this option. The heater must have been ordered for this option to have the necessary internal controls.
9. Replacement of electrical components should only be done by qualified personnel familiar with the requirements of maintaining electrical equipment in hazardous locations.
10. Replacement electrical components must be obtained from the factory in order to maintain the hazardous location rating.
11. The heat exchanger is a factory vacuum-sealed unit. Do not attempt to loosen or tighten any of the fill or drain plugs or attempt to operate the pressure relief valve. A loss of vacuum could cause nuisance tripping of the cutouts or high pressures which will cause the relief valve to actuate with an accompanying loss of liquid. Should leakage occur, remove unit from service and investigate cause.
12. The heat exchanger is filled with a mixture of water and inhibited propylene glycol. Contact with the fluid at operating temperatures may produce a burn hazard. The Material Safety Data sheets indicate that there is not a health hazard from coming in contact with the inhibited propylene glycol. Suggested first aid consists of flushing eyes with plenty of water and to wash off skin in flowing water or a shower.
13. Install and operate in an upright position only. Failure to comply will cause the overtemperature thermal cutouts to trip.
14. Installation minimum mounting clearances on nameplate must be maintained.
15. Use copper wire for supply connections according to size and rating on nameplate.
16. Do not attempt to override louver stops or operate unit with louvers fully closed.
17. "Warning Light", if supplied, will turn on if the high temperature thermal cutout opens. This could result if the heat exchanger is dirty, inlet air is obstructed, vacuum loss in heat exchanger, fan not turning or incorrect supply voltage. Disconnect power to unit before servicing.
18. Crackling noises within the heat exchanger at startup are normal.

WARRANTY WILL BE VOID IF INSTRUCTIONS ARE NOT FOLLOWED.

GENERAL

The air heaters are designed for comfort heating and should not be used in ambient temperatures exceeding 104ºF (40ºC). The units may be wall, pole or ceiling mounted. They utilize a hermetically sealed, liquid-to-air heat exchanger containing immersion type electric heating elements. A mixture of nontoxic propylene glycol and water is place in the heater core to act as a heat transfer fluid. The propylene glycol provides freeze damage protection to -49ºF (-45ºC). The unit is designed to give years of safe, trouble-free operation when properly installed and maintained.

INSTALLATION

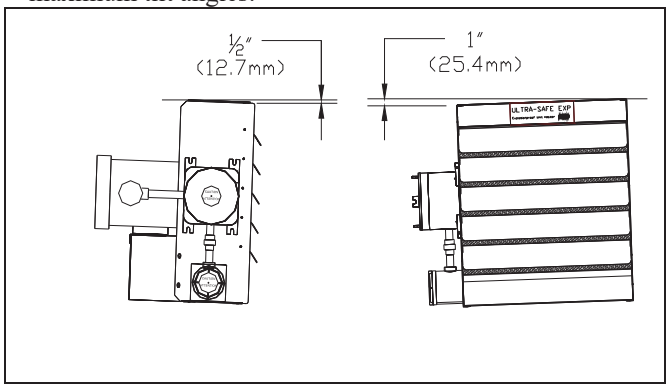
A. Site Selection:

The Heaters should not be mounted close to drapery or similar materials which could lay on the cabinet, or block the inlet or outlet of the heater. The heaters are intended for elevated mounting locations so that they blow warm air down to the floor area. A mounting height should be selected so that the heater is out of the way of possible moving equipment or personnel, yet low enough to deliver warm air to the selected area. See mechanical installation instructions for recommended installation heights.

B. Mechanical Installation:

Once an acceptable location has been determined, follow these instructions to complete the mechanical installation.

1. The Heaters are designed for use only while permanently mounted in an upright, level position. See figure below maximum tilt angles:



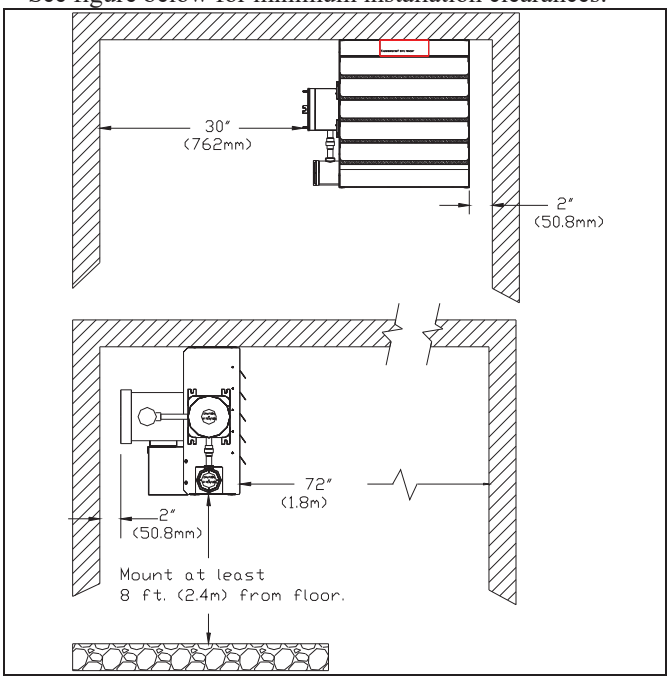
2. To ensure proper heating of floor surfaces, observe the following recommended maximum mounting heights (to bottom of heater):

Maximum Mounting Height from Floor:		
233-FA	233-FB	233-FC
9 ft.	10 ft.	13 ft.
(2.7m)	(3.0m)	(4.0m)

3. The supporting structure that the heater is attached to must have adequate strength to safely support the heater and be sufficient to keep the heater in its proper upright operating position. The maximum unit weights are:

MODEL	lbs	(kgs)
233-FA	150	68
233-FB	200	91
233-FC	250	114

4. See figure below for minimum installation clearances:



5. The heater may be suspended from overhead beams or mounted to a side wall or a 4" pipe using one of the approved mounting kits. Use of non-approved mounting kits voids all warranties, expressed or implied.
6. Wall mounting should be to structural steel. If the wall construction is plasterboard with wooden 2 X 4 framing or similar, it must be reinforced with angle iron or wooden cross braces.
7. Lock washers should be used on all mounting nuts and bolts to ensure they don't vibrate or work loose due to fan vibration or other vibration transmitted to the heater.

C. Electrical Installation:

Follow these instructions to complete the electrical installation:

1. External branch circuit protection is required. See nameplate ratings and follow Code recommendations.
2. Use only an approved explosion-proof means of wiring, such as mineral insulated cable or copper conductors in rigid conduit with conduit seals as required to make connection to the heater.
3. Follow the NEC and/or CEC and any local electrical and building codes related to the installation and intended use of the heater in an explosion-hazard area.
4. When doing any work on a heater, including the initial electrical connection, disconnect the electrical current at the main branch circuit switch, and lock the switch in the off (open) position and tag the circuit "Out for Maintenance" to prevent potential lethal shock hazards.
5. Confirm that the electrical power supply matches the nameplate voltage, phase, amperage and frequency rating of the heater to be connected.
6. Ensure conductors are of appropriate gauge size. The minimum gauge is stamped on the nameplate. Size all input conductors according to accepted standards consistent with the temperature rating of the wire being used. Use minimum 75°C rated wire.

7. Proper installation of the heater requires that an adequate grounding conductor be connected to the ground terminal. This terminal is painted green or marked with the letter "G" and is located on the inside of the control enclosure next to the power input opening.
8. Check and confirm all connections are securely fastened.
9. Before application of electrical power, check all connections to ensure compliance with the wiring diagram and any code requirements. Remove any foreign objects from the control boxes. Reinstall covers tightly.
10. On all 3-phase heaters, it is necessary to verify that the fan is rotating in the proper direction. If air delivery is not from the front of the heater, exchange any 2 input wires at the main contactor terminal located in the control enclosure.
11. The explosion-proof control box is designed with threaded joints and metal-to-metal contact at the lid or cover joint to prevent an explosion. Do not attempt to install gasket material of any type at these joints. A light coating of anti-seize compound is applied to the threads to prevent seizing.
12. See section titled "operation" before energizing the heater.

D. Field Installed Controls:

1. Power Disconnect Switch:
The NEC requires that a power disconnect switch be mounted within sight of the heater. The CEC or local codes may require a disconnect switch within sight of the heater. Refer to the electrical diagram and follow these steps:
   a.) The remote power disconnect switch must be an explosion-proof disconnect switch rated for the area classification.
   b.) The switch must be indicating and have a locked off position.
   c.) The switch must be rated for the nameplate voltage and current per the NEC, CEC and any local codes.
   d.) Follow steps 6 through 12 of the electrical installation instructions to complete the installation.

2. Room Thermostat:
Refer to the electrical wiring diagram and follow these steps:
   a.) Connect the remote thermostat across the leads marked "C" and "C1". The external thermostat will then be in series with the heater thermal high-limit switches and correct operation of the heater will result.
   b.) The wiring to the remote thermostat must be copper wire, 16 gauge minimum (for Class II) or 14 gauge minimum (Class I) and run in explosion-proof conduit with appropriate conduit seals installed per the NEC, CEC and any local codes.
   c.) Any room thermostat used with this heater must be of an explosion-proof type rated for the area classification, open on temperature rise, rated 250VAC, 75VA inductive capacity.
3. 'Fan Only' Switch:
Refer to the electrical wiring diagram and follow these steps:
   a.) Do not attempt to install a "Fan Only" switch on a standard unit heater and do not try to field modify a standard unit heater for this option. The heater must have been ordered for this option to have the necessary internal controls.
   b.) Connect the remote 'fan only' selector switch across the leads marked "C" and "F".
   c.) The wiring to the fan selector switch must be copper wire, 16 gauge minimum (for Class II) or 14 gauge minimum (for Class I) and run in explosion-proof conduit with appropriate conduit seals installed per the NEC, CEC and any local codes.
   d.) Any selector switch used with this heater must be an explosion-proof switch rated for the area classification, maintained 2 position selector switch rated for 250 VAC, 75 VA inductive.

OPERATION

The unit heater may be operated normally at ambient temperatures of 104°F (40°C) or less and at altitudes of 3,300 feet (1000m) or less in atmospheres containing less than 21% oxygen by volume, and as classified on the nameplate. All of these conditions must be met before attempting to operate the heater. The heater should never be operated in an oxygen-enriched atmosphere or at ambient temperatures above 104°F, (40°C). The heater may be operated at higher altitudes if the ambient temperatures are below 104°F, (40°C).

A. Initial Operation:

Check to make sure the mechanical and electrical installation is complete and that it is safe to operate the heater.

1.) Heater without built on or remotely mounted fan switch:
   a.) Set the temperature control thermostat to a setting above the current room temperature.
   b.) Energize the heater electrical supply circuit.
   c.) The heater and fan should come on and in 5 to 15 minutes reach a stable operating temperature. If the room temperature is high and the installation is above 3,300 feet, the unit heater may cycle on the thermal high limits of the motor or the heater.
   d.) Check out and report any unusual or questionable operating characteristics, such as noise, vibration, loss of fluid, etc. Note that crackling noises coming from the heat exchanger during warm up are normal.
   e.) Set the temperature control thermostat to the desired room temperature setting.
   f.) De-energize the heater electrical supply circuit until heater operation is required.
2.) Heater with fan switch:
   a.) Place the fan switch in the fan position.
   b.) Set the temperature control thermostat to a setting below the current room temperature.
   c.) Energize the heater electrical supply circuit.
   d.) The heater fan should come on but the heater should remain off.
   e.) Place the fan switch in the auto position.
   f.) The fan should go off.
   g.) Set the temperature control thermostat to a setting above the current room temperature.

h.) The fan and heater should operate. If the room temperature is high and the installation is above 3,300 feet (1000m), the unit heater may cycle on the thermal high limit cutouts of the motor or the heater.

i.) Check out and report any unusual or questionable operating characteristics, such as noise, vibration, loss of fluid, etc.
Note that crackling noises coming from the heat exchanger during warm up are normal.

j.) Set the fan switch and temperature control thermostat to the desired operating positions.

B. Normal Operation:

Prior to the start of the heating season, perform the electrical and mechanical steps outlined in the section titled "maintenance".

a.) Perform the Operation steps for the applicable temperature control option.

b.) Place all switches in their normal operating position and place the unit heater in service.

MAINTENANCE

Maintenance and repair must be performed by qualified personnel only.

A. Electrical:

1. Inspect all terminal connections, contactor and conductor insulation for damage, looseness, fraying, etc., as applicable. Tighten any loose terminals and replace or repair wire with damaged or deteriorated insulation. If contactor contacts are badly pitted, welded together, or burned, replace the contactor. Check all explosion-proof conduit for visible damage and tightness.
2. If reduced heat output is suspected, perform the mechanical checks. If low heat output is still suspected after completing the mechanical checks, verify the condition of the heating elements by using an amperage meter to check the current draw of each input line. All input lines should draw approximately equal current which should agree with nameplate rating. If they do not, one or more of the heating elements could be burned out and the heater/core assembly should be replaced.
3. The electric motor is permanently lubricated and thermally protected. Check for smooth and quiet running at all inspections. Replace motor if excessive bearing play is detected. Contact the factory for instructions.

B. Mechanical:

1. Never attempt to fill, drain or check the liquid level of the heat exchanger or check the action of the pressure relief valve. Contact the factory for instructions.
2. The explosion-proof control box is designed with threaded joints and metal-to-metal contact at the lid or cover joints to prevent an explosion. Do not attempt to install gasket material of any type at these joints. A light coating of anti-seize compound is applied to the threads to prevent seizing.
3. Annually check the tightness of all visible bolts and nuts, in particular the support structure bolts and nuts. Similarly check the motor mounting bolts and nuts.
4. Periodically, check the motor, fan and heater core fins for cleanliness. A dirty heat exchanger can cause the unit to over heat and cycle on the thermal cutouts. If the dirt is loose dust, clean with a vacuum or by air jet. If the dirt can't be vacuumed or blown off, use a warm water spray directed to the inlet side of the heat exchanger then to the outlet side. A soft bristled brush may be required to loosen stubborn deposits. Be careful not to bend the aluminum fins on the heat exchanger or the fan blade propeller. Allow unit to dry before re-energizing.
5. Check louvers for position tightness and equal angle settings. Check motor and fan for smooth running operation. Any unusual noise or vibration must be investigated and rectified.
6. Should there be any evidence of fluid leakage from the heater core, the heater should be repaired immediately. The heater will not operate properly with a low fluid level. Contact the factory for replacement core.

REPAIR AND REPLACEMENT

Maintenance and repair must be performed by qualified personnel only.

A. Replacing the Heat Exchanger Core:

The heat exchanger core is not field repairable. Contact factory for replacement.

1. Disconnect the heater electrical power supply, unwire and lower the heater from it's mounting location. Set heater face down on a table or on the floor.
2. Remove the cabinet bottom, cabinet top, wiring and heater enclosure covers.
3. Disconnect all heater wires from the contactor in the wiring enclosure. Disconnect the control wiring from thermal cutout.
4. Thread conduit into wiring enclosure to disconnect the heater terminal box.
5. With an assistant supporting the weight of the heat exchanger, remove the 3 heat exchanger mounting bolts. Carefully remove the heat exchanger out of the bottom of the cabinet.
6. Locate rating tag on the heat exchanger and verify that electrical ratings of the core to be installed match the electrical ratings on the heater nameplate.
7. To reinstall, slide the core through the bottom of the cabinet while an assistant lines up and installs the 3 heat exchanger mounting bolts.
8. Guide the heater lead wires back into the wiring enclosure.
9. Reconnect the heater lead wires to the contactor and the conduit.
10. Reattach the cabinet bottom and enclosure covers before mounting heater and energizing.

B. Replacing the Temperature High-Limit Cutouts:

1. Disconnect the heater electrical power supply and remove the heater enclosure cover.

2. Remove the wire barrier to expose the high limit cutout.
3. Disconnect the wires from the high limit cutout and mark their location.
4. Remove the two nuts used to attach the temperature high limit cutout.
5. Lift and remove the sheetmetal mounting plate.
6. Carefully lift and remove the temperature high limit cutout.
7. Use only factory supply parts for safe operation.
8. Lightly coat the new manual and automatic cutout bulbs with the supplied thermal transfer compound. This is critical for proper cutout operation.
9. Carefully slide the automatic cutout bulb into the **left** thermowell and the manual cutout bulb into the **right** thermowell.
10. Reinstall the sheetmetal plate. Note that the sheetmetal plate also acts as a stop to keep the cutout bulbs from backing out of the wells.
11. Carefully install the temperature high limit control to avoid putting kinks into the capillary.
12. Reattach the wires to the cutout and reinstall the wire barrier.
13. Ensure heater enclosure cover is in place before energizing heater.

C. Resetting the Manual Cutout:

All unit heaters contain a built-in manual reset thermal cutout with or without backup contactor.

1. Disconnect the heater electrical power supply and remove the heater enclosure cover.
2. Determine the reason for the manual reset thermal cutout actuating and rectify the situation. See section titled “maintenance”.
3. Reset the manual reset thermal cutout by pressing on the red stem in the center of the control.
4. Replace the heater enclosure cover securely.
5. Energize the heater electrical supply circuit.
6. The heater and fan should come on and in 5 to 15 minutes reach a stable operating temperature.
7. Check out and report any unusual or questionable operating characteristics, such as noise, vibration, loss of fluid, etc.
8. If heater operation appears normal, place the unit into normal operation.

D. Replacing the Fan Motor and Blade:

The fan motor is permanently lubricated and does not require any maintenance. If the fan motor is defective, a replacement must be obtained from the factory.

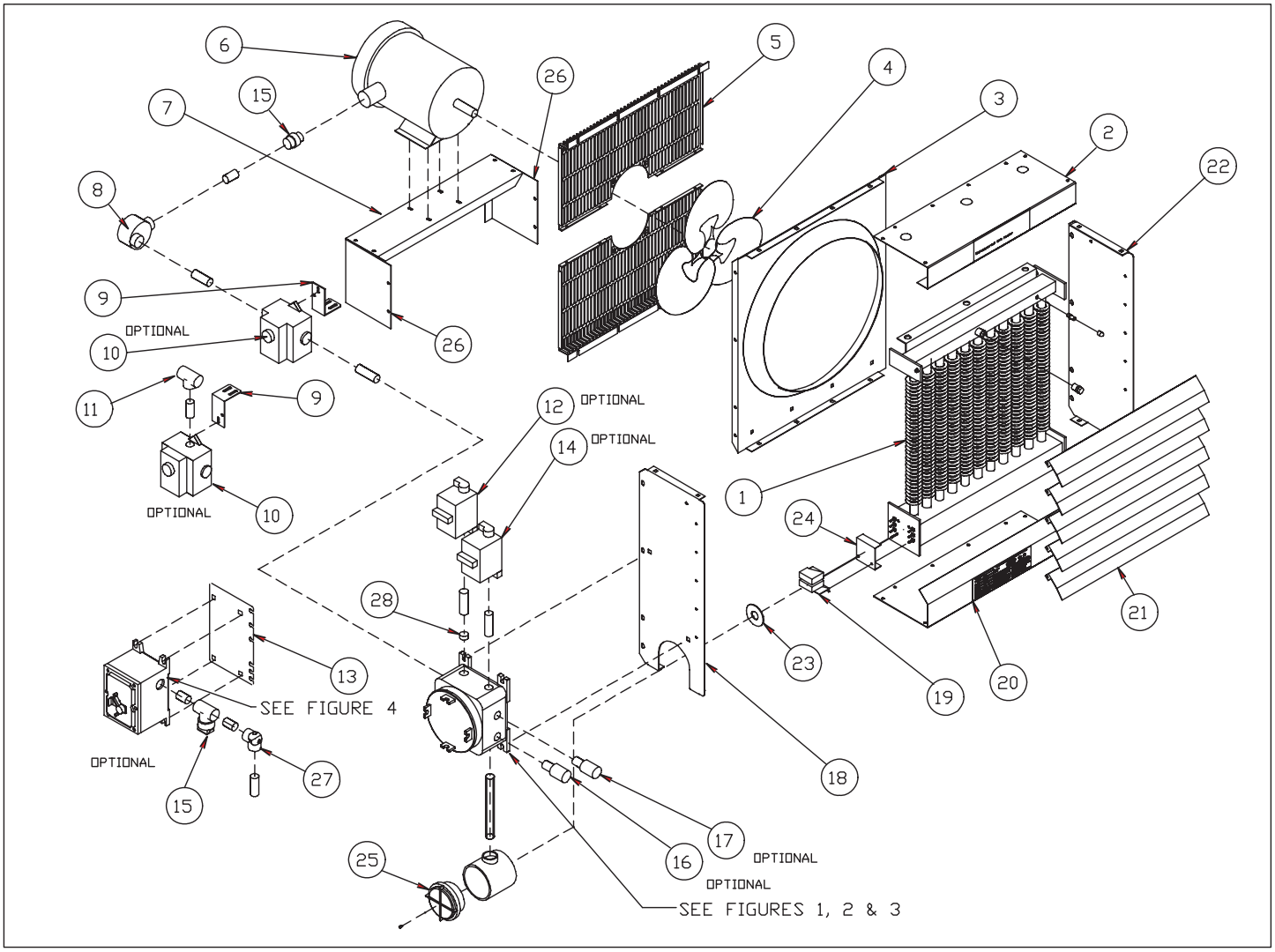
1. To replace the fan motor:
   a. Disconnect the heater electrical power supply.
   b. Disconnect the motor supply wires from the contactor in the wiring enclosure.
   c. Disassemble the conduit union located at the motor wiring hub.
   d. Remove top fan guard and motor mounting bolts.
   e. Lift motor out of heater assembly.
   f. Remove fan blade and conduit union from defective motor and install on new motor.
   g. Install new motor to heater using existing motor mounting hardware.
   h. Reinstall top fan guard and ensure that the fan blade rotates freely.
   i. Feed motor wires through conduit and into wiring enclosure.
   j. Reattach conduit union. Reconnect motor wires to contactor.
   k. Check fan rotation by momentarily energizing heater. Airflow should exit from front of heater cabinet. If rotation is incorrect, disconnect electrical power supply and reverse two of the motor lead wires at the contactor.
   l. Reattach wiring enclosure cover before placing heater back in service.

2. To replace the motor fan blade:
   a. Remove the top fan guard.
   b. Remove the four motor mounting bolts and disconnect the conduit union at the motor.
   c. Loosen the bolt that connects the fan blade to the motor shaft.
   d. Slide the motor back and tilt in order to remove the old blade & install a new one.
   e. Tighten the fan blade attachment bolt to the motor shaft.
   f. Reattach the motor conduit union and the four motor mounting bolts.
   g. Reinstall the top fan guard and ensure that the fan blade rotates freely.

REPLACEMENT PARTS

1. All replacements must be factory supplied to ensure safe heater operation.
2. Mark wires and refer to wiring diagram to ensure proper electrical connections.

Reference heater catalog number and item number in figures below when contacting factory for replacement parts. Contact factory for items not shown.



ITEM	DESCRIPTION
1	Heat Exchanger Core Assy.
2	Cabinet – Top
3	Fan Venturi
4	Fan Blade
5	Fan Guard
6	Fan Motor
7	Motor Support – Top
8	Motor Junction Box
9	Thermostat Support Bracket
10	Thermostat
11	Conduit Tee
12	Disconnect Switch – Small
13	Large Disconnect Support Bkt.
14	Fan Switch

ITEM	DESCRIPTION
15	Conduit Seal
16	Pilot Light – Bottom
17	Pilot Light – Top
18	Cabinet – Left Side
19	High Limit Cutout
20	Cabinet – Bottom
21	Cabinet - Louver
22	Cabinet – Right Side
23	High Limit Barrier
24	High Limit Mounting Bridge
25	Heater Enclosure Cover
26	Motor Support – Side
27	¾” Conduit Pull Elbow
28	Reducer Bushing

Select the Figure that corresponds to your heater.

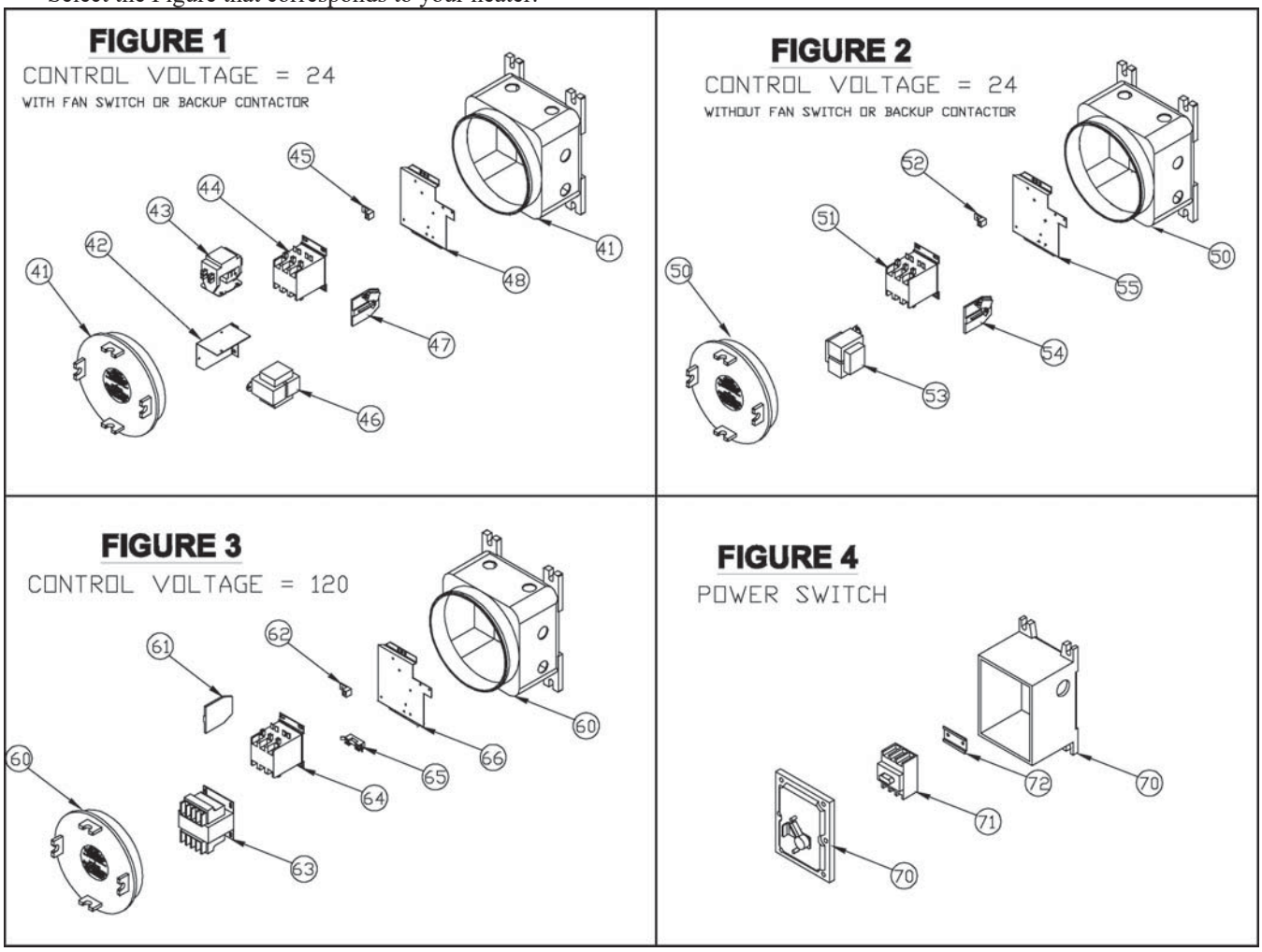


FIGURE 1:

ITEM	DESCRIPTION
41	Wiring Enclosure and Cover
42	Option Mounting Bridge
43	Option Contactor
44	Main Contactor
45	Ground Lug
46	Transformer
47	Auxiliary Contact
48	Main Mounting Bridge

FIGURE 2:

ITEM	DESCRIPTION
50	Wiring Enclosure and Cover
51	Main Contactor
52	Ground Lug
53	Transformer
54	Auxiliary Contact
55	Main Mounting Bridge

FIGURE 3:

ITEM	DESCRIPTION
60	Wiring Enclosure and Cover
61	Auxiliary Contact
62	Ground Lug
63	Transformer
64	Main Contactor
65	Transformer Fuse & Fuse Block
66	Main Mounting Bridge

FIGURE 4:

ITEM	DESCRIPTION
70	Switch Enclosure and Cover
71	Disconnect Switch
72	Disconnect Switch Track

Magelis
GTO HMI
User Manual

10/2014

EIO0000001133.03

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The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book

At a Glance

Document Scope

This manual describes how to use the HMIGTO panels.

Validity Note

This documentation is valid for Vijeo Designer 6.2 or higher.

The technical characteristics of the devices described in this document also appear online. To access this information online:

Step	Action
1	Go to the Schneider Electric home page *www.schneider-electric.com*.
2	In the **Search** box type the reference of a product or the name of a product range. ● Do not include blank spaces in the model number/product range. ● To get information on grouping similar modules, use asterisks (*).
3	If you entered a reference, go to the **Product Datasheets** search results and click on the reference that interests you. If you entered the name of a product range, go to the **Product Ranges** search results and click on the product range that interests you.
4	If more than one reference appears in the **Products** search results, click on the reference that interests you.
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.
6	To save or print a data sheet as a .pdf file, click **Download XXX product datasheet**.

The characteristics that are presented in this manual should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the manual and online information, use the online information as your reference.

Product Related Information

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

The application of this product requires expertise in the design and programming of control systems. Only persons with such expertise should be allowed to program, install, alter, and apply this product.

Follow all local and national safety standards.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Chapter 1
Overview

Overview

This chapter describes the panels and general topics such as package contents and standards.

What Is in This Chapter?

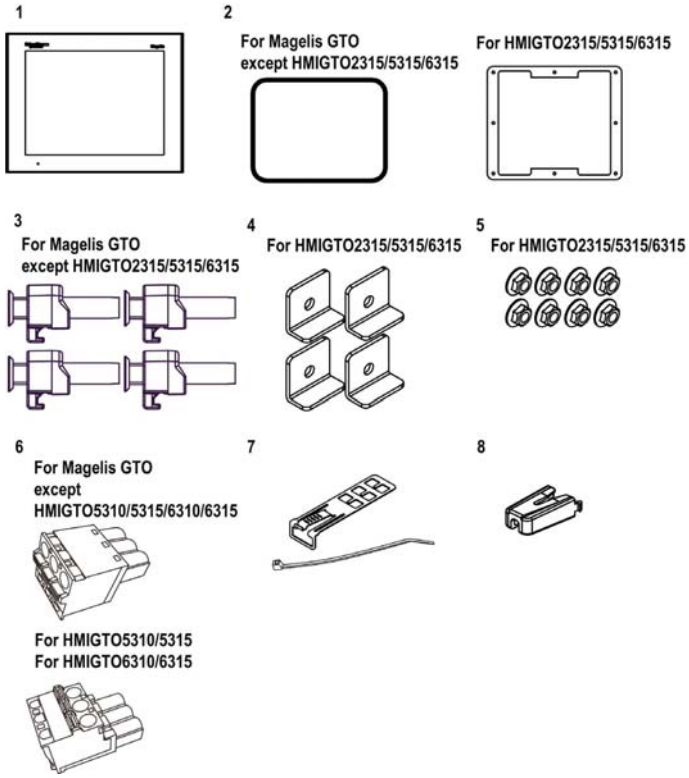
This chapter contains the following topics:

Topic	Page
HMIGTO Package Contents	10
Certifications and Standards	11
GTO Series of Panels	13

HMIGTO Package Contents

Overview

Verify all items listed here are present in your package:



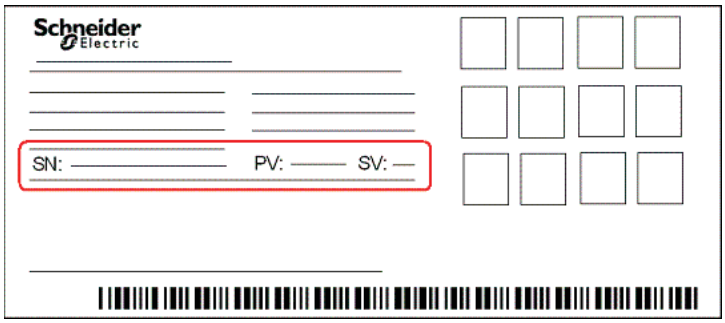
1 HMIGTO: 1
2 Installation gasket: 1 (attached to the panel)
3 Installation fasteners: 4 per set
4 Brackets: 4
5 M4 Hex Nuts: 8
6 DC power connector: 1[*1]
7 USB cable clamp Type A: 1 set (1 clip and 1 tie)
8 USB cable clamp mini-B: 1 (1 USB holder)
9 HMIGTO Quick Reference Guide: 1

This product has been carefully packed with special attention to quality. However, should you find anything damaged or missing, please contact your local distributor.

[*1] You can use the DC power connector for HMIGTO1300/1310/2300/2310/2315/3510/4310 to supply power to HMIGTO5310/5315/6310/6315. However the reverse is not possible. You cannot use the power connector for HMIGTO5310/5315/6310/6315 on HMIGTO1300/1310/2300/2310/2315/3510/4310.

Revision

You can identify the product version (PV), revision level (RL) and the software version (SV) from the unit product label.



Certifications and Standards

Introduction

Schneider Electric submitted this product for independent testing and qualification by third-party listing agencies. These agencies have certified this product as meeting the following standards.

Agency Certifications

The HMIGTO is manufactured in accordance with:

- Standard UL 508 and CSA C22.2 n°142 for Industrial Control Equipment
- Standard ANSI/ISA - 12.12.01 and CSA C22.2 n°213 for Electrical Equipment for Use in Class I, Division 2 Hazardous Locations
  NOTE:
- For use in Pollution Degree 2 environments.
- For use on a flat surface of a Type 1, Type 4X (Indoor Use Only) or Type 13 Enclosure.
- 24 Vdc input panel must be used with a Class 2 power supply.
- Suitable for use in Class I, Division 2 Groups A, B, C, and D Hazardous Locations.

- GOST certification.
  Please refer to product markings.
- ATEX certification by Technical Inspection Association.
  Please refer to product label.
- Merchant Navy rules. (Except Magelis GTOxxx5.)
  Products are designed to comply with Merchant Navy rules.
  Please refer to the Schneider Electric Web site for Merchant Navy rules installation guidelines.
- Standard EN1672-2 (Magelis GTOxxx5).
- FDA regulation 21 CFR 177 (Magelis GTOxxx5).

Refer to the Schneider Electric web site for installation guidelines.

For detailed information, contact your local distributor or see the catalog & marking on the product.

Hazardous Substances

The HMIGTO is a device for use in factory systems. When using the HMIGTO in a system, the system should comply with the following standards in regards to the installation environment and handling:

- WEEE, Directive 2002/96/EC
- RoHS, Directive 2011/65/EU
- RoHS China, Standard SJ/T 11363-2006

CE Markings

This product conforms to the necessary requirements of the following Directives for applying the CE label:

- 2006/95/EC Low Voltage Directive
- 2004/108/EC EMC Directive

This conformity is based on compliance with EN61000-6-4, EN61000-6-2

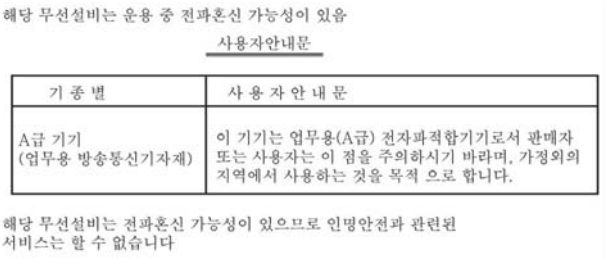
⚠ DANGER

POTENTIAL FOR EXPLOSION

- Verify that the power, input and output (I/O) wiring are in accordance with Class I, Division 2 wiring methods.
- Substitution of any component may impair suitability for Class I, Division 2.
- Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
- Securely lock externally connected units and each interface before turning on the power supply.
- Do not use, connect, or disconnect USB cable unless area is known to be non-hazardous.
- Do not disconnect while circuit is live or unless the area is known to be free of ignitable concentrations.
- Potential electrostatic charging hazard. Wipe the front panel of the terminal with a damp cloth before turning ON.

Failure to follow these instructions will result in death or serious injury.

KC Markings



해당 무선설비는 운용 중 전파혼신 가능성이 있음

사용자안내문

기 종 별	사 용 자 안 내 문
A급 기기 (업무용 방송통신기자재)	이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적 으로 합니다.

해당 무선설비는 전파혼신 가능성이 있으므로 인명안전과 관련된 서비스는 할 수 없습니다

GTO Series of Panels

Critical systems, alarms and handling Requirements

Critical alarm indicators and system functions require independent and redundant protection hardware and/or mechanical interlocks.

When you cycle power, wait at least 10 seconds before restoring the power to the panel after it has been turned off. Switching the power OFF and ON quickly can damage the panel.

In the event the screen cannot be properly read, for example, if the backlight is not functioning, it may be difficult or impossible to identify a function. Functions that may present a hazard if not immediately executed, such as a fuel shut-off, must be provided independently of the panel. The machine's control system design must take into account the possibility of the backlight no longer functioning and the operator being unable to control the machine or making mistakes in the control of the machine.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.
- The machine control system design must take into account the possibility of the backlight no longer functioning and the operator being unable to control the machine, or making errors in the control of the machine.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems" or their equivalent governing your particular location.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Do not use this equipment as the only means of control for critical system functions such as motor start/stop or power control.
- Do not use this equipment as the only notification device for critical alarms, such as device overheating or overcurrent.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Handling the LCD panel

The following characteristics are specific to the LCD panel and are considered normal behavior:

- LCD screen may show unevenness in the brightness of certain images or may appear different when seen from outside the specified viewing angle. Extended shadows, or crosstalk may also appear on the sides of screen images.
- LCD screen pixels may contain black and white colored spots and color display may seem to have changed.
- When the same image is displayed on the screen for a long period, an afterimage may appear when the image is changed.

NOTE: Change the screen image periodically and try not to display the same image for a long period of time.

⚠ CAUTION

SERIOUS EYE AND SKIN INJURY

The liquid in the LCD panel contains an irritant:
- Avoid direct skin contact with the liquid.
- Wear gloves when you handle a broken or leaking unit.
- Do not use sharp objects or tools in the vicinity of the LCD touch panel.
- Handle the LCD panel carefully to prevent puncture, bursting, or cracking of the panel material.

Failure to follow these instructions can result in injury or equipment damage.

If the panel is damaged and any liquid comes in contact with your skin, immediately rinse the area with running water for at least 15 minutes. If the liquid gets in your eyes, immediately rinse your eyes with running water for at least 15 minutes and consult a doctor.

Chapter 2
Device Connectivity

Introduction

This chapter presents the equipment you can connect to the panel.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
System Design	16
Accessories	21

System Design

Introduction

The following diagrams represent equipment you can connect to the panel.

	COM1	COM2
HMIGTO1300	RS-232C *(see page 16)*	RS-485 *(see page 19)*
HMIGTO1310	RS-232C / RS-485 *(see page 18)*	–
HMIGTO2300	RS-232C *(see page 16)*	RS-485 *(see page 19)*
HMIGTO2310	RS-232C *(see page 16)*	RS-485 *(see page 19)*
HMIGTO2315	RS-232C *(see page 16)*	RS-485 *(see page 19)*
HMIGTO3510	RS-232C *(see page 16)*	RS-485 *(see page 19)*
HMIGTO4310	RS-232C *(see page 16)*	RS-485 *(see page 19)*
HMIGTO5310	RS-232C *(see page 16)*	RS-485 *(see page 19)*
HMIGTO5315	RS-232C *(see page 16)*	RS-485 *(see page 19)*
HMIGTO6310	RS-232C *(see page 16)*	RS-485 *(see page 19)*
HMIGTO6315	RS-232C *(see page 16)*	RS-485 *(see page 19)*

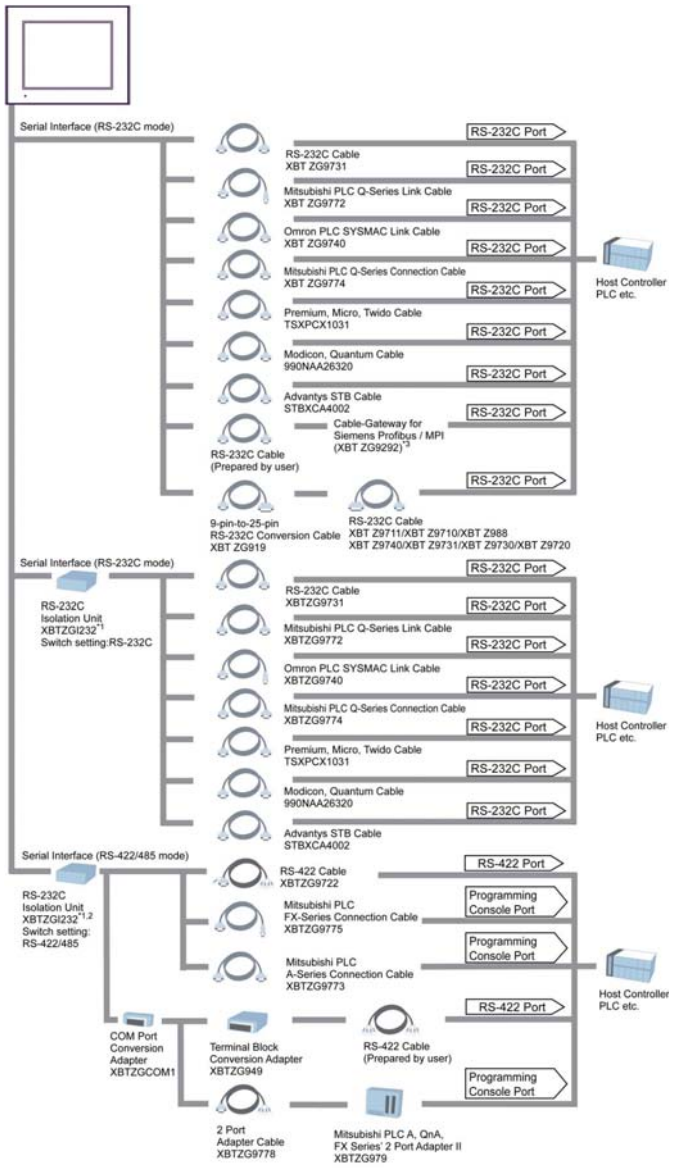
RUN Mode Peripherals - RS-232C

⚠ CAUTION

LOSS OF POWER

- Make sure all connections to the communication ports on the bottom and sides of the panel do not put excessive stress on the ports.
- Securely attach communication cables to the panel or cabinet.
- Use only D-Sub 9 pin cables with a locking system in good condition.

Failure to follow these instructions can result in injury or equipment damage.

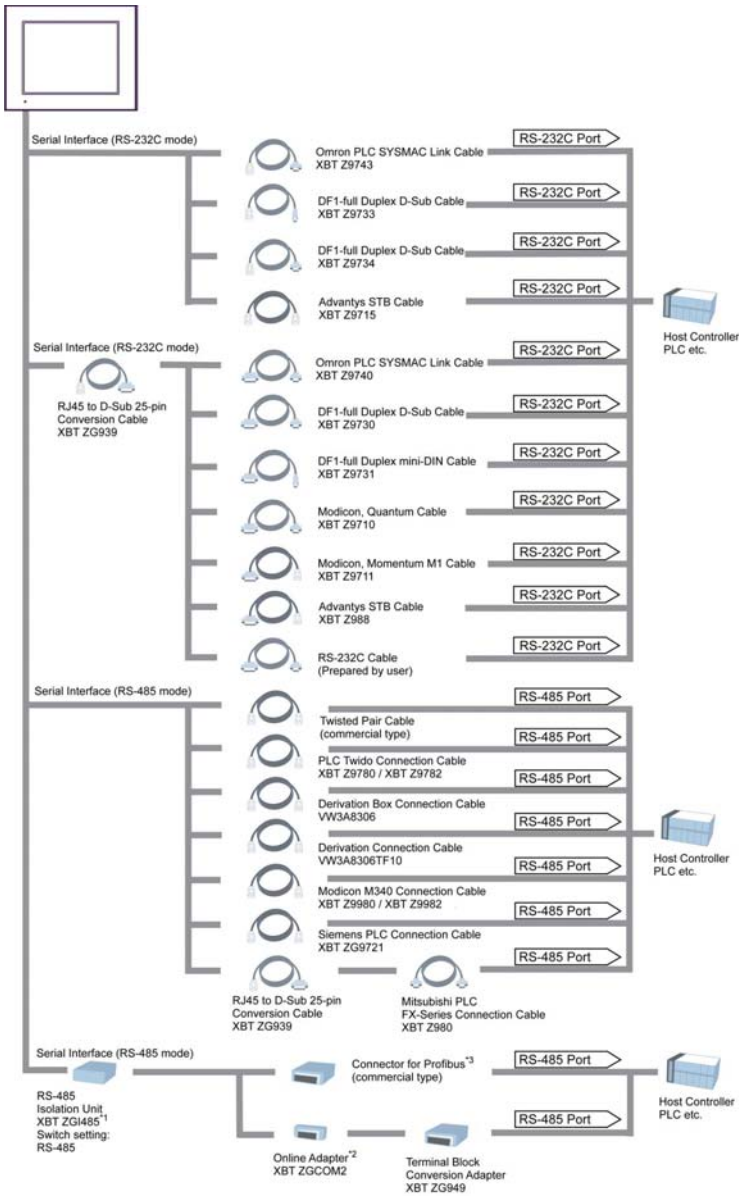


*1 When connecting the XBTZGI232, the COM port's pin 9 setting should be VCC. You can define COM port settings in Vijeo Designer or in the HMIGTO's offline menu.

*2 The RS-232C Isolation Unit works with only RS-422/485 (4 wire) communication.

*3 Cable-Gateway for Siemens Profibus / MPI (XBT ZG9292) is not supported by HMIGTO1310.

RUN Mode Peripherals - RS-232C / RS-485

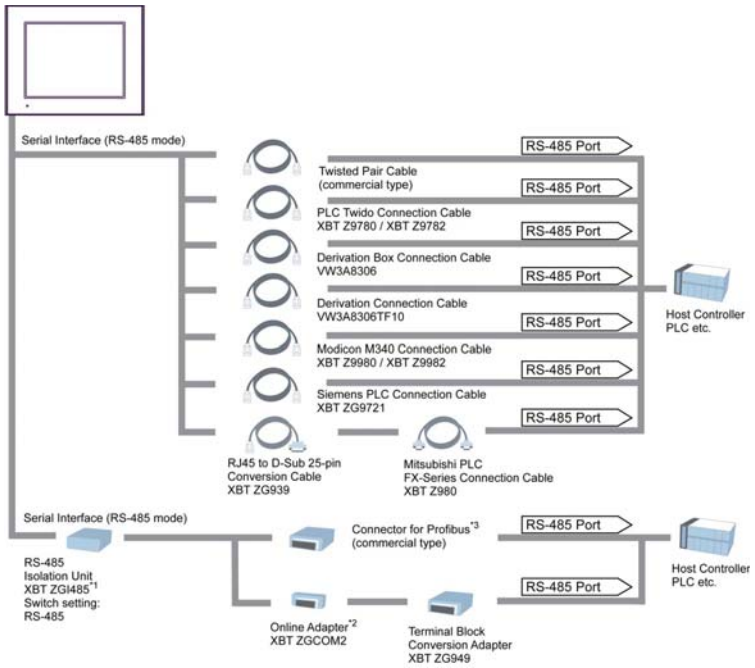


*1 Use the RS-485 Isolation Unit's USB port to supply power to itself. There is no need to set up a separate power supply.

*2 In 1:n, n:1, or n:m communication, you can use the online adapter as a terminal. (Use 1 unit in either communication setup.)

*3 The connector has a switch to control the terminal. Turn on the switch to enable communication.

RUN Mode Peripherals - RS-485

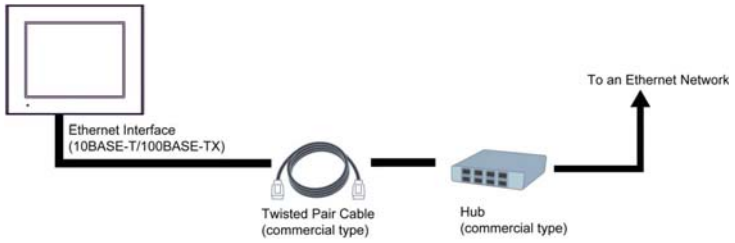


*1 Use the RS-485 Isolation Unit's USB port to supply power to itself. There is no need to set up a separate power supply.

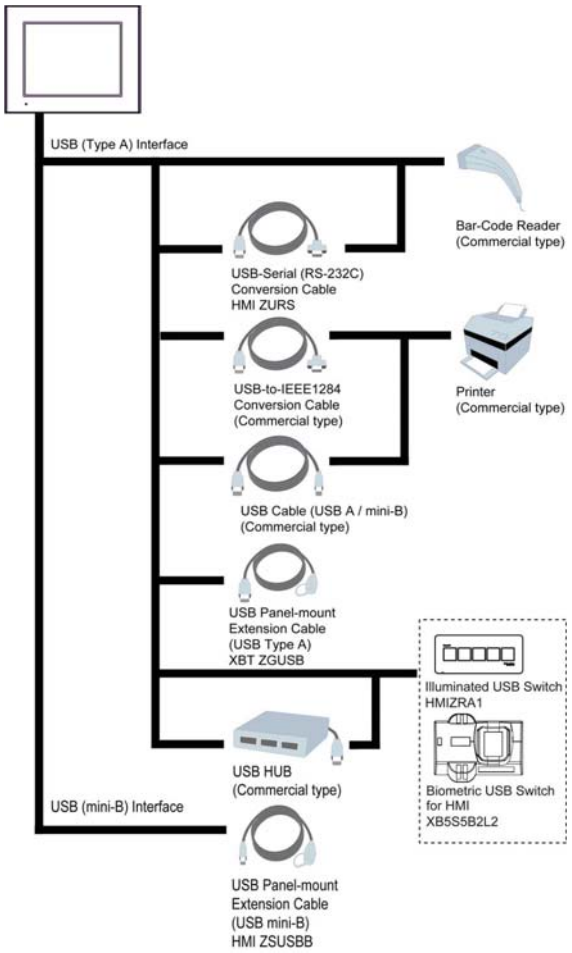
*2 In 1:n, n:1, or n:m communication, you can use the online adapter as a terminal. (Use 1 unit in either communication setup.)

*3 The connector has a switch to control the terminal. Turn on the switch to enable communication.

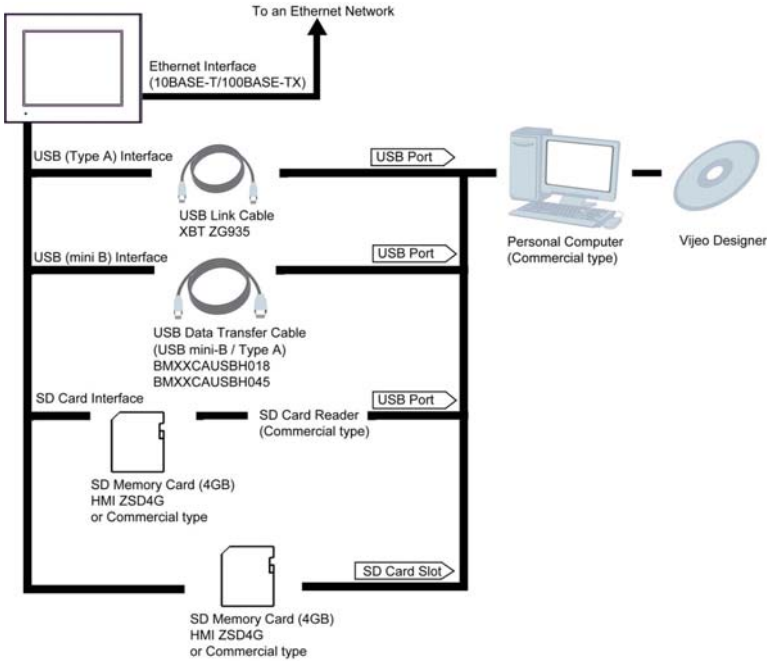
RUN Mode Peripherals - Ethernet Communication



RUN Mode Peripherals - USB Type A / mini-B Interface



Edit Mode Peripherals



Accessories

Serial Interface Items

Product Name	Product Number	Description
RS-232C Cable	XBT ZG9731	Connects a host controller to the panel. (RS-232C)
RS-422 Cable	XBT ZG9722	Connects a host controller to the panel. (RS-422)
Mitsubishi PLC Q-Series Link Cable	XBT ZG9772	Connects Mitsubishi PLC Q-Series (or other host controller) to the panel. (RS-232C)
Omron PLC SYSMAC Link Cable	XBT ZG9740 XBT Z9743 XBT Z9740	Connects Omron PLC SYSMAC Series unit (or other host controller) to the panel. (RS-232C)
Mitsubishi PLC A-Series Connection Cable	XBT ZG9773	Connects Mitsubishi PLC A or QnA Series programming console I/F to panel. (Simultaneous use of programming consoles is not possible.)
Mitsubishi PLC Q-Series Connection Cable	XBT ZG9774	Connects Mitsubishi PLC Q-Series programming console I/F to panel. (Simultaneous use of programming consoles is not possible.)
Mitsubishi PLC FX-Series Connection Cable	XBT ZG9775 XBT Z980	Connects Mitsubishi PLC FX-Series programming console I/F and panel. (Simultaneous use of programming consoles is not possible.)
Premium, Micro, Twido Cable	TSXPCX1031	Connects Premium, Micro, or Twido to the panel.
Modicon, Quantum Cable	990NAA26320 XBT Z9710	Connects Modicon or Quantum to the panel.
2 Port Adapter Cable	XBT ZG9778	Connects Mitsubishi PLC directly to the panel (D-sub 9 pin plug) using 2 port adapter II (RS-422).
Mitsubishi PLC A, QnA, FX Series 2 Port Adapter II	XBT ZG979	Enables simultaneous use of a panel and a Mitsubishi PLC A, QnA, or FX Series peripheral device.
Advantys STB Cable	STBXCA4002 XBT Z9715 XBT Z988	Connects Advantys STB to panel.
Terminal Block Conversion Adapter	XBT ZG949	Connects output from a panel's Serial Interface (D-sub 9 pin plug) directly with an RS-422 terminal block.
COM Port Conversion Adapter	XBT ZGCOM1	Connects optional RS-422 communication items to panel's COM1 port.
DF1-full Duplex D-Sub Cable	XBT Z9730 XBT Z9733 XBT Z9734	Connects DF1-full Duplex to HMIGTO.
DF1-full Duplex mini-DIN Cable	XBT Z9731 XBT Z9720	Connects DF1-full Duplex to HMIGTO.
Modicon, Momentum M1 Cable	XBT Z9711	Connects Modicon, Momentum M1 to HMIGTO.
PLC Twido Connection Cable	XBT Z9780 / XBT Z9782	Connects PLC Twido to HMIGTO.
Derivation Box Connection Cable	VW3A8306	Connects Derivation Box to HMIGTO.
Derivation Connection Cable	VW3A8306TF10	Connects Derivation to HMIGTO.
Modicon M340 Connection Cable	XBT Z9980 / XBT Z9982	Connects Modicon M340 to HMIGTO.
Siemens PLC Connection Cable	XBT ZG9721	Connects Siemens PLC to HMIGTO.
RS-232C Isolation Unit	XBT ZGI232	Connects a host controller to HMIGTO with isolation. (RS-232C and RS-422 are switchable.)
RS-485 Isolation Unit	XBT ZGI485	Connects a host controller to HMIGTO with isolation.
Cable-gateway for Siemens Profibus / MPI	XBT ZG9292	Connects Siemens Profibus / MPI units to HMIGTO.
RJ45 to D-Sub 25 pin Conversion Cable	XBT ZG939	Connects a RJ45 cable to HMIGTO (D-sub 9 pin plug).
9-pin to 25-pin RS-232C Conversion Cable	XBT ZG919	Connects a standard RS-232C cable (D-Sub 25-pin socket) to HMIGTO (D-sub 9 pin plug).
Online Adapter	XBT ZGCOM2	Terminal adapter for RS-485 communication.

USB Interface Items

Product Name	Product Number	Description
USB Transfer Cable	XBT ZG935	Downloads project data created with the software via the panel's USB I/F.
USB Front Cable	XBT ZGUSB	Extension cable attaching USB interface to front panel.
USB-Serial (RS-232C) Conversion Cable	HMIZURS	Cable for converting a panel's USB interface into a serial interface (RS-232C). Allows connection to modems*1 or bar code readers*1 that support RS-232C.
USB Transfer Cable (USB Type A/mini-B)	BMXXCAUSBH018 BMXXCAUSBH045	Cable for transferring screen data from a PC (USB Type A) to the panel (USB mini-B).
Remote USB port location for mini-USB	HMIZSUSBB XBT ZGUSBB	Extension cable that attaches to the USB (mini-B) interface on the front side of the operation panel.
Illuminated USB Switch	HMIZRA1	A unit of 5 illuminated switches with multiple color LED easily connected with HMIGTO via USB.
Biometric USB Switch for HMI	XB5S5B2L2	Fingerprint recognition unit easily connected with HMIGTO via USB.

Software

Product name	Description
Vijeo Designer (Version 6.1 or later)	Software you install on your computer to create project data for your HMIGTO.

SD Card Items

Product Name	Product Number	Description
SD Memory Card (4 GB)	HMIZSD4G	SD Memory Card (4 GB, CLASS4)

Option Items

Product Name	Product Number	Corresponding panel	Description
12.1-inch Screen Protection Sheet	XBT ZG66	HMIGTO6310/6315	Disposable, dirt-resistant sheet for the HMIGTO screen (5 sheets/set)
10.4-inch Screen Protection Sheet	XBT ZG65	HMIGTO5310/5315	
7.5-inch Screen Protection Sheet	XBT ZG64	HMIGTO4310	
7.0-inch Wide Screen Protection Sheet	XBT ZG63	HMIGTO3510	
5.7-inch Screen Protection Sheet	XBT ZG62	HMIGTO2300/2310/2315	
3.5-inch Screen Protection Sheet	XBT ZG60	HMIGTO1300/1310	
12.1-inch Environment Cover	XBT ZECOV6	HMIGTO6310	Disposable, environment cover for the HMIGTO screen (1 sheet/set)
10.4-inch Environment Cover	XBT ZECOV5	HMIGTO5310	
7.0/7.5-inch Environment Cover	XBT ZECOV4	HMIGTO3510/4310	
5.7-inch Environment Cover	XBT ZECOV2	HMIGTO2300/2310	
3.5-inch Environment Cover	XBT ZECOV1	HMIGTO1300/1310	

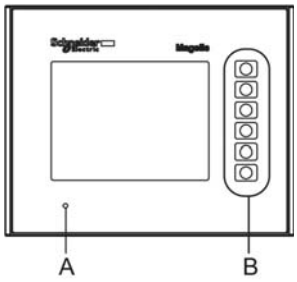
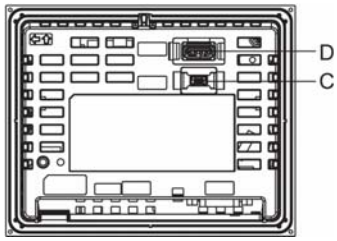
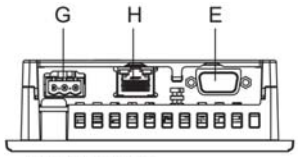
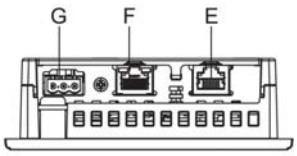
Maintenance Options

Product Name	Product Number	Corresponding panel	Description
Installation Fastener	HMI ZGFIX	HMIGTO except HMIGTO2315/5315/6315	Used to install the HMIGTO into a solid panel (4 pieces/set)
Installation System	HMI ZGFIX2	HMIGTO2315/5315/6315	Used to install the HMIGTO into a solid panel. Brackets (4 pieces/set) M4 Hex nuts (8 pieces/set)
12.1-inch Installation Gasket	HMI ZG56	HMIGTO6310	Provides dust and moisture resistance when HMIGTO is installed into a solid panel (1 piece)
	HMI ZG562	HMIGTO6315	
10.4-inch Installation Gasket	HMI ZG55	HMIGTO5310	
	HMI ZG552	HMIGTO5315	
7.0-inch Wide & 7.5-inch Installation Gasket	HMI ZG54	HMIGTO3510/4310	
5.7-inch Installation Gasket	HMI ZG52	HMIGTO2300/2310	
	HMI ZG522	HMIGTO2315	
3.5-inch Installation Gasket	HMI ZG51	HMIGTO1300/1310	
USB Clamp TypeA (1 port)	HMI ZGCLP1	Magelis GTO	Clamp to prevent disconnection of USB cable (USB/A, 1 port, 5 clamps/set)
USB Clamp mini-B (1 port)	HMI ZGCLP3	Magelis GTO	Clamp to prevent disconnection of USB cable (USB/mini-B, 1 port, 5 clamps/set)
DC Power Supply Connector	HMI ZGPWS	HMIGTO3510/4310 HMIGTO2300/2310/2315 HMIGTO1300/1310	Connector to connect DC power supply cables (5 pcs/set)
DC Power Supply Connector (Right-angle)	HMI ZGPWS2	HMIGTO6310/6315 HMIGTO5310/5315	Right-angle connector to connect DC power supply cables (5 pcs/set)
Battery for Memory Backup	HMI ZGBAT	HMIGTO (except HMIGTO1300/1310/2300)	Primary battery for memory and time data backup
Panel Cutout Adapter	XBT ZGGCO4	HMIGTO5310	Panel cutout adapter for mounting HMIGTO5310 in cutout for XBT GT5230.
Insert Label	HMI ZLYGO3	HMIGTO3510	Label insert for HMIGTO 7-inch Wide models.
	HMI ZLYGO1	HMIGTO1300/1310	Label insert for HMIGTO 3.5-inch models

Chapter 3
Parts Identification and Functions

Parts Identification and Functions

HMIGTO1300/1310 Parts Identification

Side	HMIGTO1300/1310
Front	
Rear	
Bottom	 HMIGTO1300  HMIGTO1310

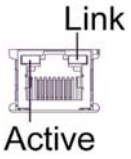
Part	Name	Description
A	Status LED	*1
B	Function Switches	Six switches (F1 to F6). You can define operations for these switches using Vijeo Designer.
C	USB (mini-B) Interface	Conforms to USB2.0 (mini-B) x 1. Communication Distance: 5 m (16.4 ft) or less.
D	USB (Type A) Interface	Conforms to USB2.0 (Type A) x 1. Power supply voltage: 5Vdc+/-5%. Output Current: 500 mA or less. Maximum communication distance: 5 m (16.4 ft).
E	Serial Interface (COM1)	HMIGTO1300: RS-232C Serial Interface. Connector: D-Sub 9 pin (plug) x 1. HMIGTO1310: RS-232C/485 Serial Interface. (You can switch the communication method via software.) Connector: Modular jack (RJ-45).

Part	Name	Description
F	Ethernet Interface*2	Ethernet transmission interface (10BASE-T/100BASE-TX) Connector: Modular jack (RJ-45) x 1. Ethernet Interface is not attached to HMIGTO1300.
G	Power Plug Connector	-
H	Serial Interface (COM2)	HMIGTO1300: RS-485 Serial Interface. Connector: Modular jack (RJ-45) x 1.

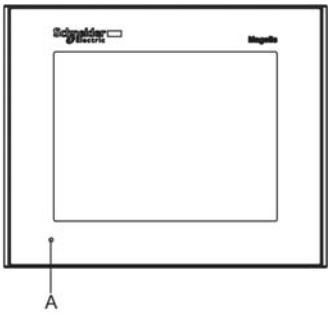
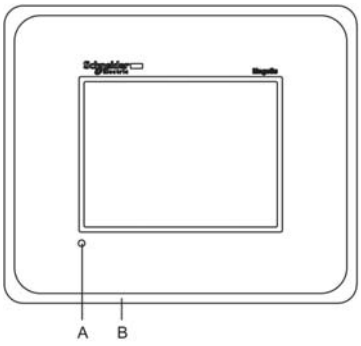
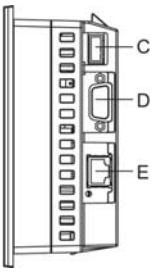
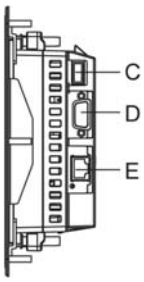
*1 Status LED operations are as shown below:

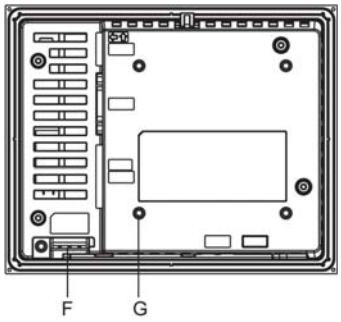
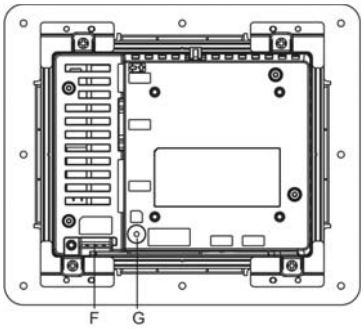
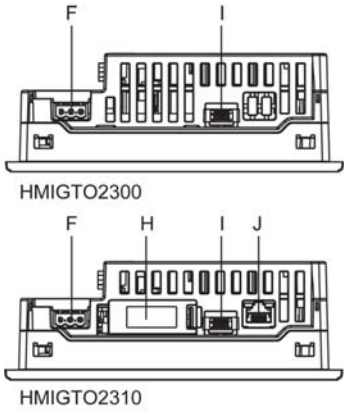
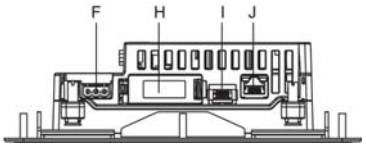
Color	Indicator	Description
Green	ON	Offline
		In operation
Orange	Flashing	Software starting up.
Red	ON	Power is turned ON.
-	OFF	Power is turned OFF.

*2 Ethernet LED operations are as shown below.

	Color	Indicator	Description
	Green (Active)	Flashing	Data transmission is occurring.
		OFF	No data transmission.
	Green (Link)	ON	Data transmission is available in 10BASE-T/100BASE-TX.
		OFF	No connection or subsequent transmission failure.

HMIGTO2300/2310/2315 Parts Identification

Side	HMIGTO2300/HMIGTO2310	HMIGTO2315
Front		
Right		

Side	HMIGTO2300/HMIGTO2310	HMIGTO2315
Rear		
Bottom		

Part	Name	Description
A	Status LED	*1
B	Stainless Steel Bezel	HMIGTO2315 only.
C	USB (Type A) Interface	Conforms to USB2.0 (Type A) x 1. Power supply voltage: 5Vdc+/-5%. Output Current: 500 mA or less. Maximum communication distance: 5 m (16.4 ft).
D	Serial Interface (COM1)	RS-232C Serial Interface. Connector: D-Sub 9 pin (plug) x 1.
E	Serial Interface (COM2)*2	RS-485 Serial Interface. Connector: Modular jack (RJ-45).
F	Power Plug Connector	-
G	SD Card Access LED *3	This lamp lights up when SD Card is inserted. For more information, refer to SD Card Insertion/Removal *(see page 131)*. **NOTE:** SD Card Access LED is not available on HMIGTO2300.
H	SD Card Interface Cover/Replacement Battery Insertion Cover	For information on how to open the cover, and insert or remove the SD Card, refer to SD Card Insertion / Removal *(see page 131)*. For information on how to open the cover and replace the battery, refer to Replacing the Primary Battery *(see page 146)*. **NOTE:** This cover is not on HMIGTO2300.
I	USB (mini-B) Interface	Conforms to USB2.0 (mini-B) x 1. Communication Distance: 5 m (16.4 ft) or less.
J	Ethernet Interface *4	Ethernet transmission interface (10BASE-T/100BASE-TX) Connector: Modular jack (RJ-45) x 1. **NOTE:** Ethernet Interface is not available on HMIGTO2300.

*1 Status LED operations are as shown below:

Color	Indicator	Description
Green	ON	Offline
		In operation
Orange	Flashing	Software starting up.
Red	ON	Power is turned ON.
-	OFF	Power is turned OFF.

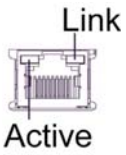
*2 COM2 LED operations are as shown below.

Color	Indicator	Description
Yellow	ON	Communication (sending or receiving data) is occurring.
	OFF	No communication.

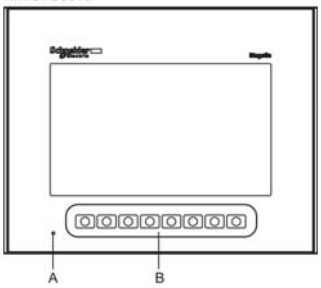
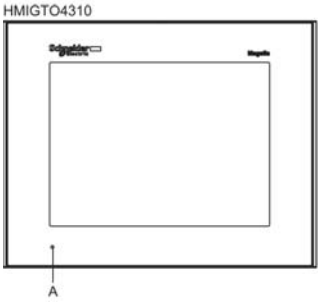
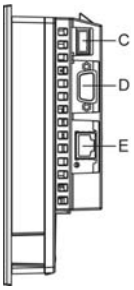
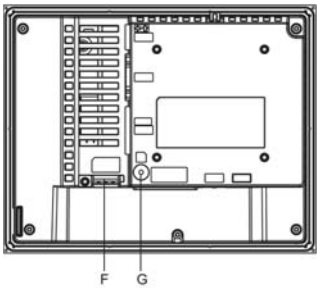
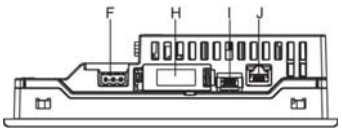
*3 SD Card Access LED operations are as shown below.

Color	Indicator	Description
Green (Active)	ON	The SD Card is inserted.
	OFF	The SD Card is not inserted or is not being accessed.

*4 Ethernet LED operations are as shown below.

	Color	Indicator	Description
	Green (Active)	Flashing	Data transmission is occurring.
		OFF	No data transmission.
	Green (Link)	ON	Data transmission is available in 10BASE-T/100BASE-TX.
		OFF	No connection or subsequent transmission failure.

HMIGTO3510/4310 Parts Identification

Side	HMIGTO3510/4310
Front	HMIGTO3510  HMIGTO4310 
Right	
Rear	
Bottom	

Part	Name	Description
A	Status LED	*1
B	Function Switches	HMIGTO3510 only. Eight switches (F1 to F8). You can define operations for these switches using Vijeo Designer.
C	USB (Type A) Interface	Conforms to USB2.0 (Type A) x 1. Power supply voltage: 5 Vdc+/-5%. Output Current: 500 mA or less. Maximum communication distance: 5 m (16.4 ft).
D	Serial Interface (COM1)	RS-232C Serial Interface. Connector: D-Sub 9 pin (plug) x 1.
E	Serial Interface (COM2)*2	RS-485 Serial Interface. Connector: Modular jack (RJ-45) x 1.
F	Power Plug Connector	-
G	SD Card Access LED *3	This lamp lights up when SD Card is inserted. For more information, refer to SD Card Insertion / Removal *(see page 131)*.
H	SD Card Interface Cover/Replacement Battery Insertion Cover	For information on how to open the cover, and insert or remove the SD Card, refer to SD Card Insertion / Removal *(see page 131)*. For information on how to open the cover and replace the battery, refer to Replacing the Primary Battery *(see page 146)*.
I	USB (mini-B) Interface	Conforms to USB2.0 (mini-B) x 1. Communication Distance: 5 m (16.4 ft) or less.
J	Ethernet Interface *4	Ethernet transmission interface (10BASE-T/100BASE-TX) Connector: Modular jack (RJ-45) x 1.

*1 Status LED operations are as shown below:

Color	Indicator	Description
Green	ON	Offline
		In operation
Orange	Flashing	Software starting up.
Red	ON	Power is turned ON.
-	OFF	Power is turned OFF.

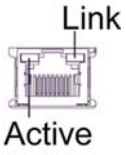
*2 COM2 LED operations are as shown below.

Color	Indicator	Description
Yellow	ON	Communication (sending or receiving data) is occurring.
	OFF	No communication.

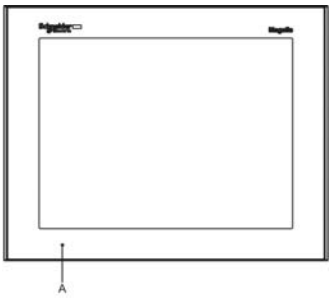
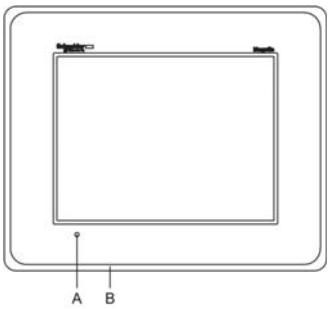
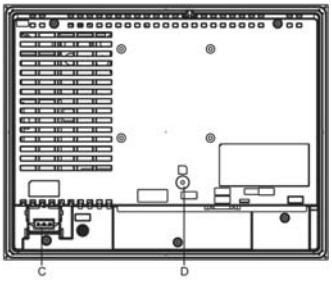
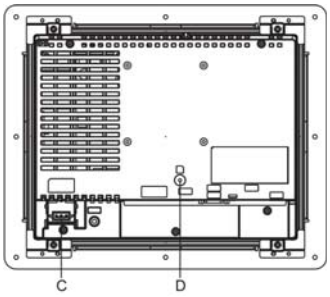
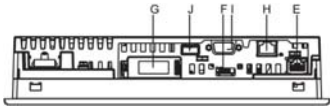
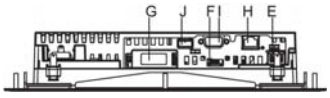
*3 SD Card Access LED operations are as shown below.

Color	Indicator	Description
Green (Active)	ON	The SD Card is inserted.
	OFF	The SD Card is not inserted or is not being accessed.

*4 Ethernet LED operations are as shown below.

	Color	Indicator	Description
	Green (Active)	Flashing	Data transmission is occurring.
		OFF	No data transmission.
	Green (Link)	ON	Data transmission is available in 10BASE-T/100BASE-TX.
		OFF	No connection or subsequent transmission failure.

HMIGTO5310/5315 Parts Identification

Side	HMIGTO5310	HMIGTO5315
Front		
Rear		
Bottom		

Part	Name	Description
A	Status LED	*1
B	Stainless Steel Bezel	HMIGTO5315 only.
C	Power Plug Connector	-
D	SD Card Access LED *2	This lamp lights up when SD Card is inserted. **NOTE:** Do not remove or insert the SD Card when the LED lamp is on. Doing so may damage data on the SD Card.
E	Ethernet Interface *3	Ethernet transmission interface (10BASE-T/100BASE-TX) Connector: Modular jack (RJ-45) x 1.
F	USB (mini-B) Interface	Conforms to USB2.0 (mini-B) x 1. Communication Distance: 5 m (16.4 ft) or less.
G	SD Card Interface Cover/Replacement Battery Insertion Cover	For information on how to open the cover, and insert or remove the SD Card, refer to SD Card Insertion/Removal *(see page 131)*. For information on how to open the cover and replace the battery, refer to Replacing the Primary Battery *(see page 146)*.
H	Serial Interface (COM2)*4	RS-485 Serial Interface. Connector: Modular jack (RJ-45).
I	Serial Interface (COM1)	RS-232C Serial Interface. Connector: D-Sub 9 pin (plug) x 1.
J	USB (Type A) Interface	Conforms to USB2.0 (Type A) x 1. Power supply voltage: 5Vdc+/-5%. Output Current: 500 mA or less. Maximum communication distance: 5 m (16.4 ft).

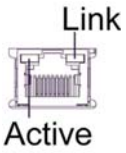
*1 Status LED operations are as shown below:

Color	Indicator	Description
Green	ON	Offline
		In operation
Orange	Flashing	Software starting up.
Red	ON	Power is turned ON.
-	OFF	Power is turned OFF.

*2 SD Card Access LED operations are as shown below.

Color	Indicator	Description
Green (Active)	ON	The SD Card is inserted.
	OFF	The SD Card is not inserted or is not being accessed.

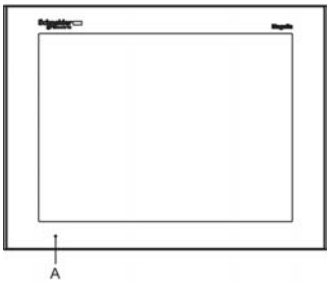
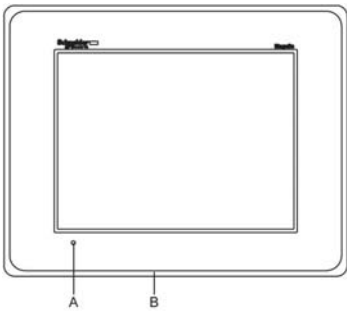
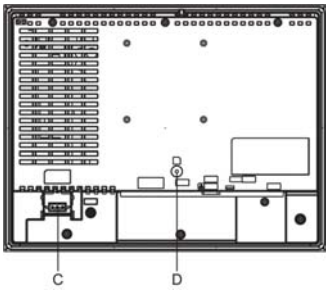
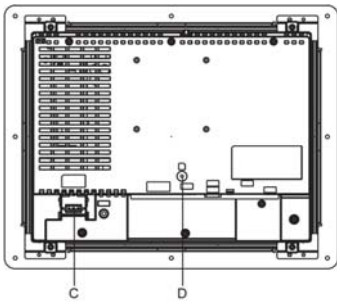
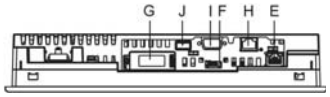
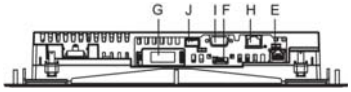
*3 Ethernet LED operations are as shown below.

	Color	Indicator	Description
	Green (Active)	Flashing	Data transmission is occurring.
		OFF	No data transmission.
	Green (Link)	ON	Data transmission is available in 10BASE-T/100BASE-TX.
		OFF	No connection or subsequent transmission failure.

*4 COM2 LED operations are as shown below.

Color	Indicator	Description
Yellow	ON	Communication (sending or receiving data) is occurring.
	OFF	No communication.

HMIGTO6310/6315 Parts Identification

Side	HMIGTO6310	HMIGTO6315
Front		
Rear		
Bottom		

Part	Name	Description
A	Status LED	*1
B	Stainless Steel Bezel	HMIGTO6315 only.
C	Power Plug Connector	-
D	SD Card Access LED *2	This lamp lights up when SD Card is inserted. **NOTE:** Do not remove or insert the SD Card when the LED lamp is on. Doing so may damage data on the SD Card.
E	Ethernet Interface *3	Ethernet transmission interface (10BASE-T/100BASE-TX) Connector: Modular jack (RJ-45) x 1.
F	USB (mini-B) Interface	Conforms to USB2.0 (mini-B) x 1. Communication Distance: 5 m (16.4 ft) or less.
G	SD Card Interface Cover/Replacement Battery Insertion Cover	For information on how to open the cover, and insert or remove the SD Card, refer to SD Card Insertion/Removal *(see page 131)*. For information on how to open the cover and replace the battery, refer to Replacing the Primary Battery *(see page 146)*.
H	Serial Interface (COM2)	RS-485 Serial Interface. Connector: Modular jack (RJ-45)
I	Serial Interface (COM1)	RS-232C Serial Interface. Connector: D-Sub 9 pin (plug) x 1.
J	USB (Type A) Interface	Conforms to USB2.0 (Type A) x 1. Power supply voltage: 5Vdc+/-5%. Output Current: 500 mA or less. Maximum communication distance: 5 m (16.4 ft).

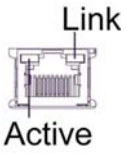
*1 Status LED operations are as shown below:

Color	Indicator	Description
Green	ON	Offline
		In operation
Orange	Flashing	Software starting up.
Red	ON	Power is turned ON.
-	OFF	Power is turned OFF.

*2 SD Card Access LED operations are as shown below.

Color	Indicator	Description
Green (Active)	ON	The SD Card is inserted.
	OFF	The SD Card is not inserted or is not being accessed.

*3 Ethernet LED operations are as shown below.

	Color	Indicator	Description
	Green (Active)	Flashing	Data transmission is occurring.
		OFF	No data transmission.
	Green (Link)	ON	Data transmission is available in 10BASE-T/100BASE-TX.
		OFF	No connection or subsequent transmission failure.

*4 COM2 LED operations are as shown below.

Color	Indicator	Description
Yellow	ON	Communication (sending or receiving data) is occurring.
	OFF	No communication.

Chapter 4
Specifications

Overview

This chapter presents the HMIGTO specifications.

What Is in This Chapter?

This chapter contains the following sections:

Section	Topic	Page
4.1	HMIGTO1300/1310	36
4.2	HMIGTO2300/2310/2315	50
4.3	HMIGTO3510/4310	68
4.4	HMIGTO5310/5315	84
4.5	HMIGTO6310/6315	101

Section 4.1
HMIGTO1300/1310

What Is in This Section?

This section contains the following topics:

Topic	Page
Electrical Specifications	37
Environmental Specifications	38
Structural Specifications	39
Display Specifications	40
Memory, Clock, Touch Panel and Function Switches	41
Interface Specifications	42
Specifications of Serial Interface COM1	43
Specifications of Serial Interface COM2	45
Dimensions	46

Electrical Specifications

Power Supply	Rated Input Voltage		24 Vdc
	Input Voltage Limits		19.2...28.8 Vdc
	Voltage Drop		2 ms or less
	Power Consumption		9.6 W or less
		When power is not supplied to external devices	5.2 W or less
		Backlight OFF (Standby Mode)	4.2 W or less
		Backlight Dimmed (Brightness: 20%)	4.3 W or less
	In-Rush Current		30 A or less
Voltage Endurance			1,000 Vac 20 mA for 1 minute (between charging and FG terminals)
Insulation Resistance			500 Vdc, 10 MΩ or more (between charging and FG terminals)

Environmental Specifications

Physical Environment	Surrounding Air Temperature	0...50 °C (32...122 °F)
	Storage Temperature	-20...60 °C (-4...140 °F)
	Surrounding Air and Storage Humidity	10%...90% RH (Non condensing, wet bulb temperature 39 °C [102.2 °F] or less)
	Dust	0.1 mg/m^3 (10^{-7} oz/ft^3) or less (non-conductive levels)
	Pollution Degree	For use in Pollution Degree 2 environment
	Corrosive Gases	Free of corrosive gases
	Atmospheric Pressure (Operating Altitude)	800...1,114 hPa (2,000 m [6,561 ft] or lower)
Mechanical Environment	Vibration Resistance	IEC/EN 61131-2 compliant 5...9 Hz Single amplitude 3.5 mm (0.14 in.) 9...150 Hz Fixed acceleration: 9.8 m/s^2 X, Y, Z directions for 10 cycles (approx. 100 min.)
	Concussion Resistance	IEC/EN 61131-2 compliant 147 m/s^2, X, Y, Z directions for 3 times
Electrical Environment	Noise immunity	Noise Voltage: 1,000 Vp-p Pulse Width: 1 µs Rise Time: 1 ns (via noise simulator)
	Electrostatic Discharge Immunity	Contact Discharge Method: 6 kV (IEC/EN 61000-4-2 Level 3)

Air quality requirements

Do not operate or store the panel where chemicals evaporate, or where chemicals are present in the air:

- Corrosive chemicals: Acids, alkalines, liquids containing salt.
- Flammable chemicals: Organic solvents.

⚠ CAUTION

INOPERATIVE EQUIPMENT

Do not allow water, liquids, metal, and wiring fragments to enter the panel case.

Failure to follow these instructions can result in injury or equipment damage.

Structural Specifications

Grounding	Functional grounding: Grounding resistance of 100Ω, 2mm^2 (AWG 14) or thicker wire, or your country's applicable standard. (Same for FG and SG terminals)
Cooling Method	Natural air circulation
Structure *1	IP65f NEMA #250 TYPE 4X/13 (on the front panel when properly installed in an enclosure)
External Dimensions	W132 x H106 x D42 mm (W5.2 x H4.17 x D1.65 in.)
Panel Cut Dimensions	W118.5 x H92.5 mm (W4.67 x H3.64 in.)*2 Panel thickness area: 1.6...5 mm (0.06...0.2 in)*3
Weight	0.4 kg (0.9 lb) or less (main unit only)

*1 The front face of the HMIGTO, installed in a solid panel, has been tested using conditions equivalent to the standards shown in the specification. Even though the HMIGTO's level of resistance is equivalent to these standards, oils that should have no effect on the HMIGTO can possibly harm the panel. This can occur in areas where either vaporized oils are present, or where low viscosity cutting oils are allowed to adhere to the panel for long periods of time. If the panel's front face protection sheet peels off, these conditions can lead to the ingress of oil into the panel and separate protection measures are suggested.

Also, if non-approved oils are present, they may cause deformation or corrosion of the front panel's plastic cover. Therefore, prior to installing the panel, be sure to confirm the type of conditions that will be present in the panel's operating environment. If the installation gasket is used for a long period of time, or if the panel and its gasket are removed from the panel, the original level of protection cannot be kept. To maintain the original protection level, be sure to replace the installation gasket regularly.

*2 For dimensional tolerance, everything +1/-0 mm (+0.04/-0 in.) and R in angle are below R3 (R0.12 in.)

*3 Even if the installation wall thickness is within the recommended range for the "Panel Cut Dimensions", depending on wall's material, size, and installation location of the panel and other devices, the installation wall could warp. To prevent warping, the installation surface may need to be strengthened.

The front face of the panel, installed in a solid panel, has been tested using conditions equivalent to the standards shown in the specification.

⚠ CAUTION

EQUIPMENT DAMAGE

Ensure that the panel is not in permanent and direct contact with oils.

Failure to follow these instructions can result in injury or equipment damage.

NOTICE

STORAGE AND OPERATION OUTSIDE OF SPECIFICATIONS

- Store the panel in areas where temperatures are within the panel's specifications.
- Do not restrict or block the panel's rear-face ventilation slots.

Failure to follow these instructions can result in equipment damage.

NOTICE

GASKET AGING

- Inspect the gasket periodically as required by your operating environment to keep the initial IP level.
- Change the gasket at least once a year, or as soon as scratches or dirt become visible.

Failure to follow these instructions can result in equipment damage.

Display Specifications

		HMIGTO1310	HMIGTO1300
Display Type		TFT Color LCD	
Display Size		3.5”	
Resolution		320 x 240 pixels (QVGA)	
Effective Display Area		W70.56 x H52.92 mm (W2.78 x H2.08 in.)	
Display Colors		65,536 colors (No blink) / 16,384 colors (Blink)	
Backlight		White LED (Not user replaceable. When replacement is required, contact your local distributor.)	
Backlight Service Life		50,000 hours or more (continuous operation at 25 °C [77 °F] before backlight brightness decreased to 50%)	
Brightness Control		16 levels (Adjusted with touch panel or software	
Language Fonts		ASCII: (Code page 850) Alphanumeric (including European characters) Chinese: (GB2312-80 codes) Simplified Chinese fonts Japanese (except for XBT GT1000 series): ANK 158, Kanji: 6,962 (JIS Standards 1 & 2) (including 607 non-kanji characters) Korean: (KSC5601 - 1992 codes) Hangul fonts Taiwanese: (Big 5 codes) Traditional Chinese fonts	
Character sizes		8 x 8, 8 x 16, 16 x 16 and 32 x 32 pixel fonts	
Font sizes		You can expand width up to 8 times, and expand height up to 8 times.*1	
Text	8 x 8 pixels	40 characters per row x 30 rows	
	8 x 16 pixels	40 characters per row x 15 rows	
	16 x 16 pixels	20 characters per row x 15 rows	
	32 x 32 pixels	10 characters per row x 7 rows	

*1 You can set up other font sizes using the software.

Memory, Clock, Touch Panel and Function Switches

Memory

	HMIGTO1310	HMIGTO1300
Application Memory *1	FLASH EPROM 96 MB	FLASH EPROM 64 MB
Application run DRAM	128 MB	128 MB
Data Backup	SRAM 512 KB (Rechargeable lithium battery for data backup)	SRAM 128 KB (Rechargeable lithium battery for data backup)

*1 Capacity available for user application.

NOTE:

- When the message "Battery level is low" is displayed, supply power to the panel and fully charge the battery. In 24 hours the battery charges to a level that allows backup operation. Completing a full charge requires about 120 hours (5 days).
- The lifetime of the rechargeable lithium battery is 10 years when the battery's ambient temperature is 40 °C (104 °F) or less, 4.1 years when the battery's ambient temperature is 50 °C (122 °F) or less, and 1.5 years when the battery's ambient temperature is 60 °C (140 °F) or less.
  When used for backup:
  Approximately 100 days with a fully charged battery.
  Approximately 6 days with a half-charged battery.

Clock

Clock Accuracy*1	±65 seconds/month (deviation at room temperature and power is OFF).

*1 Depending on the operating temperature and age of panel, the clock can deviate from -380 to +90 sec/month. For systems where this level of precision is insufficient, the user should monitor and make adjustments when required.

NOTE:

- When the message "Battery level is low" is displayed, supply power to the panel and fully charge the battery. In 24 hours the battery charges to a level that allows backup operation. Completing a full charge requires about 120 hours (5 days).
- The lifetime of the rechargeable lithium battery is 10 years when the battery's ambient temperature is 40 °C (104 °F) or less, 4.1 years when the battery's ambient temperature is 50 °C (122 °F) or less, and 1.5 years when the battery's ambient temperature is 60 °C (140 °F) or less.
  When used for backup:
  Approximately 100 days with a fully charged battery.
  Approximately 6 days with a half-charged battery.

Touch Panel

Touch Panel Type	Resistive Film (analog)
Touch Panel Resolution	1,024 x 1,024
Touch Panel Service Life	1 million times or more

Function Switches

Six switches (F1 to F6).

Interface Specifications

Serial Interface COM1

	HMIGTO1310	HMIGTO1300
Asynchronous Transmission	RS-232C / RS-485	RS-232C
Data Length	7 or 8 bits	
Stop Bit	1 or 2 bits	
Parity	None, odd or even	
Data Transmission Speed	2,400...115,200 bps, 187,500 bps (MPI)	2,400...115,200 bps
Connector	Modular jack (RJ-45)	D-Sub 9 pin (plug)

Serial Interface COM2

	HMIGTO1300
Asynchronous Transmission	RS-485
Data Length	7 or 8 bits
Stop Bit	1 or 2 bits
Parity	None, odd or even
Data Transmission Speed	2,400...115,200 bps, 187,500 bps (MPI)
Connector	Modular jack (RJ-45)

USB Interface

	USB (Type A) Interface	USB (mini-B) Interface
Connector	USB 2.0 (Type A) x 1	USB 2.0 (mini-B) x 1
Power Supply Voltage	5 Vdc ±5%	-
Maximum Current Supplied	500 mA	-
Maximum Transmission Distance	5 m (16.4 ft)	

Ethernet Interface

	HMIGTO1310
Ethernet (LAN)	IEEE802.3i / IEEE802.3u, 10BASE-T/100BASE-TX
Connector	Modular jack (RJ45) x 1

NOTE: HMIGTO1300 does not have an Ethernet interface.

Specifications of Serial Interface COM1

Introduction

⚠ CAUTION

LOSS OF POWER

- Make sure all connections to the communication ports on the bottom and sides of the panel do not put excessive stress on the ports.
- Securely attach communication cables to the panel or cabinet.
- Use only D-Sub 9 pin cables with a locking system in good condition.

Failure to follow these instructions can result in injury or equipment damage.

The serial port is not isolated. The SG (signal ground) and FG (frame ground) terminals are connected inside the panel.

⚠⚠ DANGER

ELECTRIC SHOCK

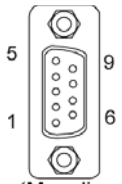
When using the SG terminal to connect an external device to the panel:

- Verify that a short-circuit loop is not created when you set up the system.
- For HMIGTO1300, connect the #5 SG terminal to remote equipment when the host (PLC) unit is not isolated. Connect the #5 SG terminal to a known reliable ground connection to reduce the risk of damaging the circuit.
- For HMIGTO1310, connect the #8 SG terminal to remote equipment when the host (PLC) unit is not isolated. Connect the #8 SG terminal to a known reliable ground connection to reduce the risk of damaging the circuit.

Failure to follow these instructions will result in death or serious injury.

Serial Interface COM1

HMIGTO1300: D-Sub 9 pin plug connector via an RS-232C cable.

Pin Connection	Pin No.	RS-232C		
		Signal Name	Direction	Meaning
 (Magelis GTO side)	1	CD	Input	Carrier Detect
	2	RD(RXD)	Input	Receive Data
	3	SD(TXD)	Output	Send Data
	4	ER(DTR)	Output	Data Terminal Ready
	5	SG	-	Signal Ground
	6	DR(DSR)	Input	Data Set Ready
	7	RS(RTS)	Output	Request to Send
	8	CS(CTS)	Input	Send possible
	9	CI(RI)/VCC	Input/–	Called Status Display +5V±5% Output 0.25A
	Shell	FG	–	Frame Ground (Common with SG)

You can switch pin #9 between RI and VCC via software.

NOTICE

EQUIPMENT DAMAGE

Use only the rated current.

Failure to follow these instructions can result in equipment damage.

Interfit bracket is #4-40 (UNC).

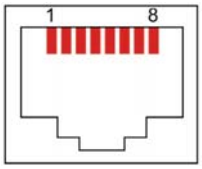
⚠ CAUTION

LOSS OF COMMUNICATION

- All connections to the communication ports must not put excessive stress on the ports.
- Securely attach communication cables to the panel wall or cabinet.
- Use only D-Sub 9 pin cables with a locking tab in good condition.

Failure to follow these instructions can result in injury or equipment damage.

HMIGTO1310: RJ-45 connector via an RS-232C or RS-485 cable.

Pin Connection	Pin No.	RS-232C/RS-485		
		Signal Name	Direction	Meaning
	1	RD(RXD)	Input	Receive Data (RS-232C)
	2	SD(TXD)	Output	Send Data (RS-232C)
	3	NC	–	–
	4	D1	Input/Output	Transfer Data (RS-485)
	5	D0	Input/Output	Transfer Data (RS-485)
	6	RS(RTS)	Output	Request to Send
	7	NC	–	–
	8	SG	–	Signal Ground
	Shell	FG	–	Frame Ground (Common with SG)

⚠ CAUTION

LOSS OF COMMUNICATION

- All connections to the communication ports must not put excessive stress on the ports.
- Securely attach communication cables to the panel wall or cabinet.
- Use only RJ45 with a locking tab in good condition.

Failure to follow these instructions can result in injury or equipment damage.

Specifications of Serial Interface COM2

Introduction

The serial port is not isolated. The SG (signal ground) and FG (frame ground) terminals are connected inside the panel.

⚠⚠ DANGER

ELECTRIC SHOCK

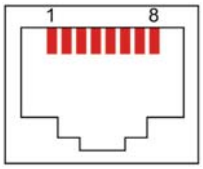
When using the SG terminal to connect an external device to the panel:
- Verify that a short-circuit loop is not created when you set up the system.
- Connect the #8 SG terminal to remote equipment when the host (PLC) unit is not isolated. Connect the #8 SG terminal to a known reliable ground connection to reduce the risk of damaging the circuit.

Failure to follow these instructions will result in death or serious injury.

Serial Interface COM2

HMIGTO1300: RJ-45 connector via an RS-485 cable

NOTE: When setting up RS-485 communication, the cable diagram for some equipment may require polarization on the terminal side. This terminal does not require any special setting as it handles polarization automatically.

Pin Connection	Pin No.	RS-485		
		Signal Name	Direction	Meaning
	1	NC	–	–
	2	NC	–	–
	3	NC	–	–
	4	Line A	Input/Output	Transfer Data (RS-485)
	5	Line B	Input/Output	Transfer Data (RS-485)
	6	RS(RTS)	Output	Request to Send
	7	NC	–	–
	8	SG	–	Signal Ground

⚠ CAUTION

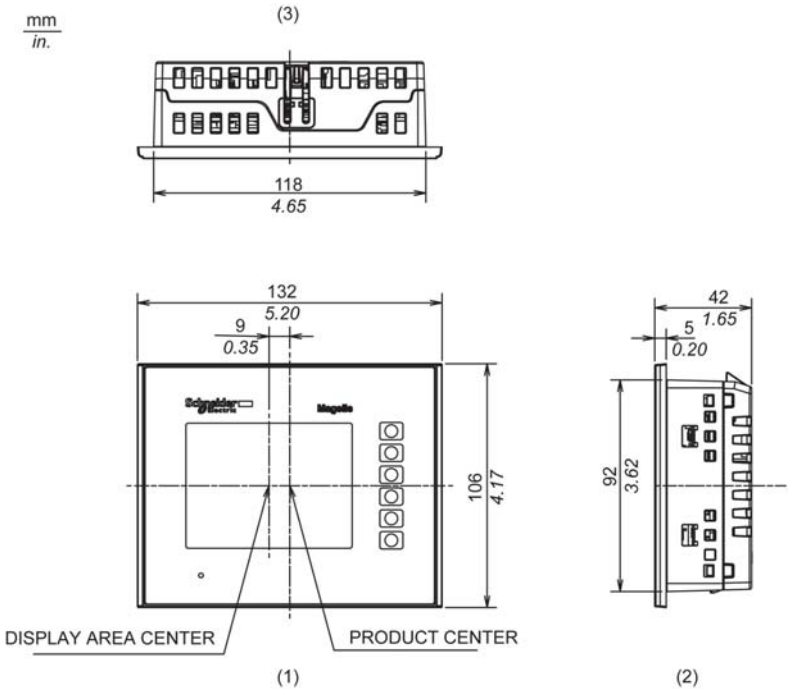
LOSS OF COMMUNICATION

- All connections to the communication ports must not put excessive stress on the ports.
- Securely attach communication cables to the panel wall or cabinet.
- Use only RJ45 with a locking tab in good condition.

Failure to follow these instructions can result in injury or equipment damage.

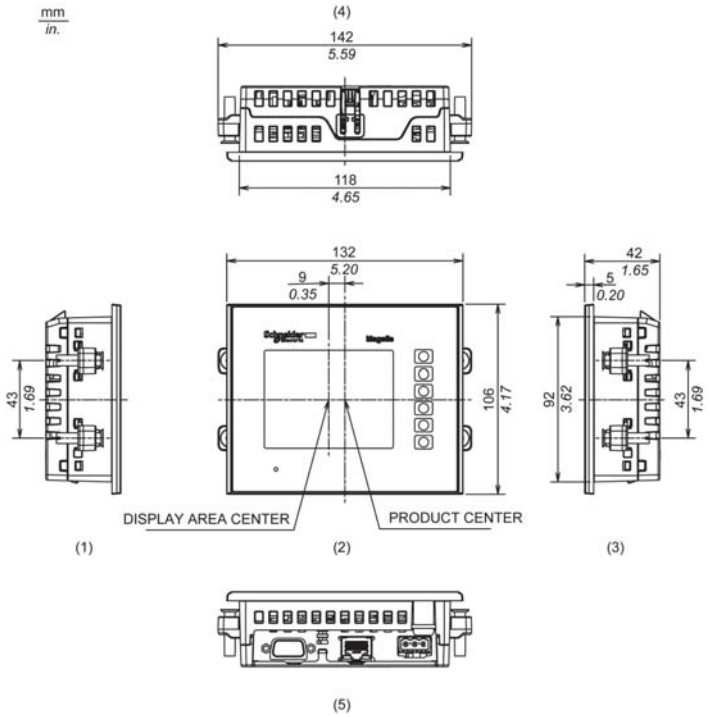
Dimensions

External Dimensions



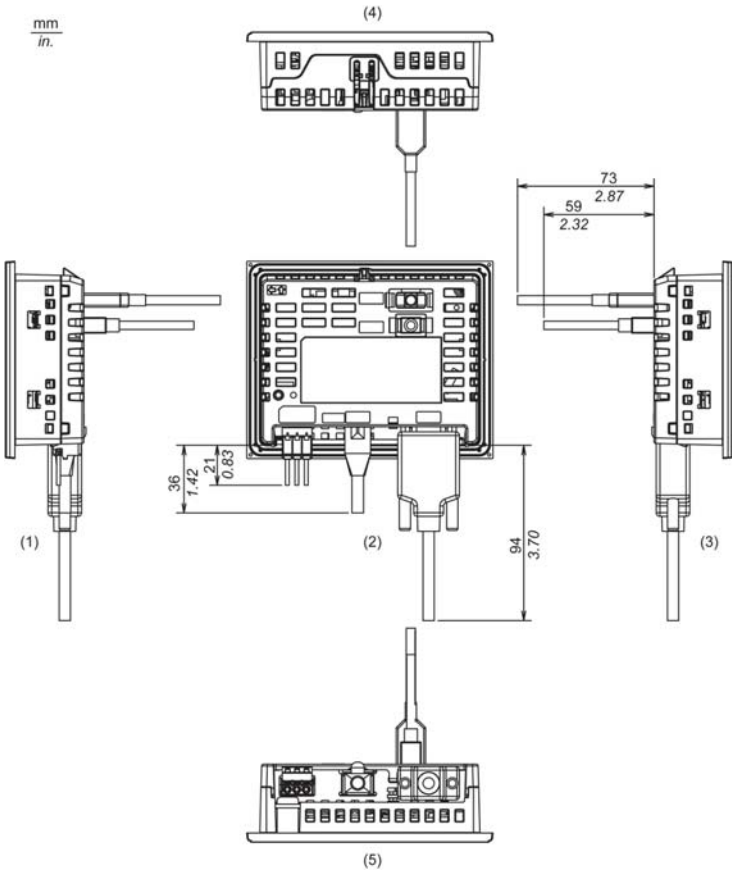
1 Front
2 Right Side
3 Top

Installation with Installation Fasteners



1 Left Side
2 Front
3 Right Side
4 Top
5 Bottom

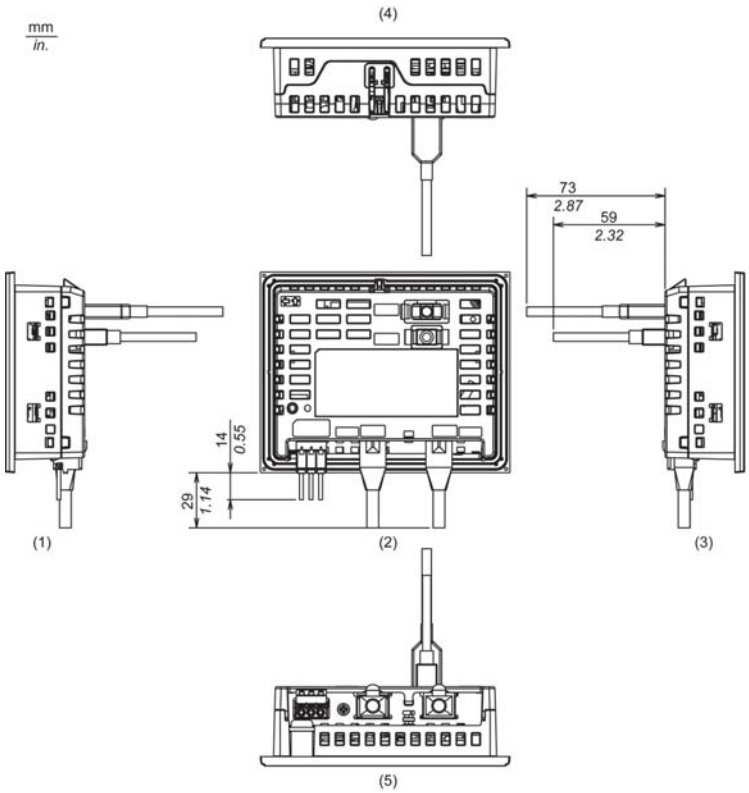
Dimensions with Cables: HMIGTO1300



1 Left Side
2 Rear
3 Right Side
4 Top
5 Bottom

NOTE: All the above values are designed with cable bending in mind. The dimensions given here are representative values depending on the type of connection cable in use. Therefore, these values are intended for reference only.

Dimensions with Cables: HMIGTO1310

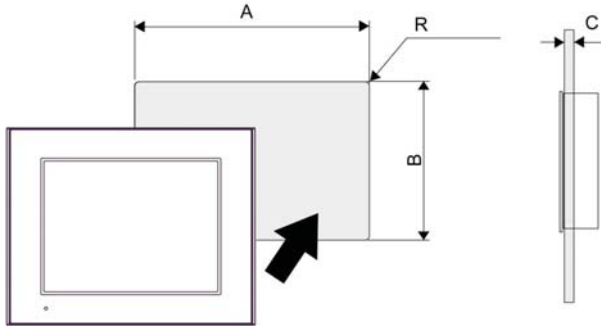


1 Left Side
2 Rear
3 Right Side
4 Top
5 Bottom

NOTE: All the above values are designed with cable bending in mind. The dimensions given here are representative values depending on the type of connection cable in use. Therefore, these values are intended for reference only.

Panel Cut Dimensions

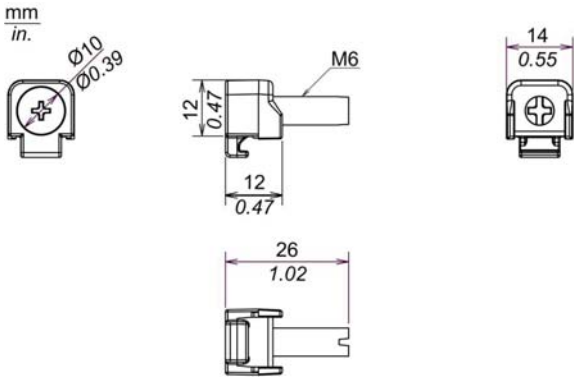
Create a panel cut and insert the panel into the opening from the front.



A	B	C	R
118.5 mm (+1, -0 mm) (4.67 in [+0.04, -0 in.])	92.5 mm (+1, -0 mm) (3.64 in. [+0.04, -0 in.])	1.6...5 mm (0.06...0.2 in)	3 mm (0.12 in.) maximum

NOTE: Before designing the panel cut, refer to Installation *(see page 120)*.

Installation Fastener Dimensions



Section 4.2
HMIGTO2300/2310/2315

What Is in This Section?

This section contains the following topics:

Topic	Page
Electrical Specifications	51
Environmental Specifications	52
Structural Specifications	53
Display Specifications	55
Memory, Clock, and Touch Panel	56
Interface Specifications	57
Specifications of Serial Interface COM1	58
Specifications of Serial Interface COM2	60
Dimensions	61

Electrical Specifications

Power Supply	Rated Input Voltage		24 Vdc
	Input Voltage Limits		19.2...28.8 Vdc
	Voltage Drop		5 ms or less
	Power Consumption		10.5 W or less
		When power is not supplied to external devices	6.5 W or less
		Backlight OFF (Standby Mode)	4.5 W or less
		Backlight Dimmed (Brightness: 20%)	5 W or less
	In-Rush Current		30 A or less
Voltage Endurance			1,000 Vac, 20 mA for 1 minute (between charging and FG terminals)
Insulation Resistance			500 Vdc, 10 MΩ or more (between charging and FG terminals)

Environmental Specifications

		HMIGTO2310 / HMIGTO2315	HMIGTO2300
Physical Environment	Surrounding Air Temperature	0...55 °C (32 °F...131 °F)	0...50 °C (32...122 °F)
	Storage Temperature	-20...60 °C (-4...140 °F)	
	Surrounding Air and Storage Humidity	10...90% RH (Non condensing, wet bulb temperature 39 °C [102.2 °F] or less)	
	Dust	0.1 mg/m^3 (10^{-7} oz/ft^3) or less (non-conductive levels)	
	Pollution Degree	For use in Pollution Degree 2 environment	
	Corrosive Gases	Free of corrosive gases	
	Atmospheric Pressure (Operating Altitude)	800...1,114 hPa (2,000 m [6,561 ft] or lower)	
Mechanical Environment	Vibration Resistance	IEC/EN 61131-2 compliant 5...9 Hz Single amplitude 3.5 mm (0.14 in.) 9...150 Hz Fixed acceleration: 9.8 m/s^2 X, Y, Z directions for 10 cycles (approx. 100 min)	
	Concussion Resistance	IEC/EN 61131-2 compliant 147 m/s^2, X, Y, Z directions for 3 times	
Electrical Environment	Noise Immunity	Noise Voltage: 1,000 Vp-p Pulse Width: 1 µs Rise Time: 1 ns	
	Electrostatic Discharge Immunity	Contact Discharge Method: 6 kV (IEC/EN 61000-4-2 Level 3)	

Air quality requirements

Do not operate or store the panel where chemicals evaporate, or where chemicals are present in the air:

- Corrosive chemicals: Acids, alkalines, liquids containing salt.
- Flammable chemicals: Organic solvents.

⚠ CAUTION

INOPERATIVE EQUIPMENT

Do not allow water, liquids, metal, and wiring fragments to enter the panel case.

Failure to follow these instructions can result in injury or equipment damage.

Structural Specifications

	HMIGTO2300/HMIGTO2310	HMIGTO2315
Grounding	Functional grounding: Grounding resistance of 100Ω, 2mm^2 (AWG 14) or thicker wire, or your country's applicable standard. (Same for FG and SG terminals)	
Cooling Method	Natural air circulation	
Structure[*1]	IP65f NEMA #250 TYPE 4X/13 (on the front panel when properly installed in an enclosure)	IP66k NEMA #250 TYPE 4X/13 (on the front panel when properly installed in an enclosure)[*2]
External Dimensions	W169.5 x H137 x D59.5 mm (W6.67 x H5.39 x D2.34 in.)	W213.5 x H181 x D59.5 mm (W8.41 x H7.13 x D2.34 in.)
Panel Cut Dimensions	W156 x H123.5 mm (W6.14 x H4.86 in.) [*3] Panel thickness area: 1.6...5 mm (0.06...0.2 in.) [*4]	W195 x H162.5 mm (W7.68 x H6.40 in.) [*3] Panel thickness area: 1.6...5 mm (0.06...0.2 in.) [*4]
Weight	0.8 kg (1.8 lbs) or less (main unit only)	1.2 kg (2.6 lbs) or less (main unit only)

NOTE: [*1] The front face of the HMIGTO, installed in a solid panel, has been tested using conditions equivalent to the standards shown in the specification. Even though the HMIGTO's level of resistance is equivalent to these standards, oils that should have no effect on the HMIGTO can possibly harm the panel. This can occur in areas where either vaporized oils are present, or where low viscosity cutting oils are allowed to adhere to the panel for long periods of time. If the panel's front face protection sheet peels off, these conditions can lead to the ingress of oil into the panel and separate protection measures are suggested.
Also, if non-approved oils are present, they may cause deformation or corrosion of the front panel's plastic cover. Therefore, prior to installing the panel, be sure to confirm the type of conditions that will be present in the panel's operating environment. If the installation gasket is used for a long period of time, or if the panel and its gasket are removed from the panel, the original level of protection cannot be kept. To maintain the original protection level, be sure to replace the installation gasket regularly.

[*2] When installing the HMIGTO in a panel, you may not be able to mount the HMIGTO flush with the panel. This occurs due to the thickness of the gasket. The difference in level between the HMIGTO and panel depends on how much the gasket is compressed.

NOTICE

EQUIPMENT DAMAGE

For food and beverage and pharmaceutical industries, when the HMIGTO is not flush with panel, use silicon to form a seal to prevent water, chemicals, or food from lodging into place. Otherwise, the panel face could leak.

Failure to follow these instructions can result in equipment damage.

[*3] For dimensional tolerance, everything +1/-0 mm (+0.04/-0 in.) and R in angle are below R3 (R0.12 in.)

[*4] Even if the installation wall thickness is within the recommended range for the "Panel Cut Dimensions", depending on wall's material, size, and installation location of the panel and other devices, the installation wall could warp. To prevent warping, the installation surface may need to be strengthened.

⚠ CAUTION

EQUIPMENT DAMAGE

Ensure that the panel is not in permanent and direct contact with oils.

Failure to follow these instructions can result in injury or equipment damage.

NOTICE

STORAGE AND OPERATION OUTSIDE OF SPECIFICATIONS

- Store the panel in areas where temperatures are within the panel's specifications.
- Do not restrict or block the panel's rear-face ventilation slots.

Failure to follow these instructions can result in equipment damage.

NOTICE

GASKET AGING

- Inspect the gasket periodically as required by your operating environment to keep the initial IP level.
- Change the gasket at least once a year, or as soon as scratches or dirt become visible.

Failure to follow these instructions can result in equipment damage.

Display Specifications

Display Type		TFT Color LCD
Display Size		5.7”
Resolution (pixels)		320 x 240 pixels (QVGA)
Effective Display Area		W115.2 x H86.4 mm (W4.54 x H3.40 in.)
Display Colors		65,536 colors (No blink) / 16,384 colors (Blink)
Backlight		White LED (Not user replaceable. When replacement is required, contact your local distributor.)
Backlight Service Life		50,000 hours or more (continuous operation at 25 °C [77 °F] before backlight decreases to 50%.)
Brightness Control		16 levels (Adjusted with touch panel or software)
Language Fonts		ASCII: (Code page 850) Alphanumeric (including European characters) Chinese: (GB2312-80 codes) Simplified Chinese fonts Japanese (except for XBT GT1000 series): ANK 158, Kanji: 6,962 (JIS Standards 1 & 2) (including 607 non-kanji characters) Korean: (KSC5601 - 1992 codes) Hangul fonts Taiwanese: (Big 5 codes) Traditional Chinese fonts
Character Sizes		8 x 8, 8 x 16, 16 x 16 and 32 x 32 pixel fonts
Font Sizes		You can expand the width up to 8 times, and expand the height up to 8 times.*1
Text	8 x 8 pixels	40 characters per row x 30 rows
	8 x 16 pixels	40 characters per row x 15 rows
	16 x 16 pixels	20 characters per row x 15 rows
	32 x 32 pixels	10 characters per row x 7 rows

*1 You can set up other font sizes using the software.

Memory, Clock, and Touch Panel

Memory

	HMIGTO2310 / HMIGTO2315	HMIGTO2300
Application Memory *1	FLASH EPROM 96 MB	FLASH EPROM 64 MB
Application run DRAM	128 MB	128 MB
Data Backup	SRAM 512 KB (Replaceable lithium battery for data backup)	SRAM 128 KB (Rechargeable lithium battery for data backup)

*1 Capacity available for user application.

NOTE:

- When the message "Battery level is low" is displayed on the HMIGTO2300, supply power to the panel and fully charge the battery. In 24 hours the battery charges to a level that allows backup operation. Completing a full charge requires about 120 hours (5 days).
- The lithium battery's lifetime is: 10 years when the battery's ambient temperature is 40 °C (104 °F) or less, 4.1 years when the battery's ambient temperature is 50 °C (122 °F) or less, and 1.5 years when the battery's ambient temperature is 60 °C (140 °F) or less.
  When used for backup:
  Approximately 100 days, with a fully charged battery.
  Approximately 6 days, with a half-charged battery.

Clock

Clock Accuracy*1	±65 seconds/month (deviation at room temperature and power is OFF).

*1 Depending on the operating temperature and age of panel, the clock can deviate from -380 to +90 sec/month. For systems where this level of precision is insufficient, the user should monitor and make adjustments when required.

NOTE:

- When the message "Battery level is low" is displayed on the HMIGTO2300, supply power to the panel and fully charge the battery. In 24 hours the battery charges to a level that allows backup operation. Completing a full charge requires about 120 hours (5 days).
- The lithium battery's lifetime is: 10 years when the battery's ambient temperature is 40 °C (104 °F) or less, 4.1 years when the battery's ambient temperature is 50 °C (122 °F) or less, and 1.5 years when the battery's ambient temperature is 60 °C (140 °F) or less.
  When used for backup:
  Approximately 100 days, with a fully charged battery.
  Approximately 6 days, with a half-charged battery.

Touch Panel

Touch Panel Type	Resistive Film (analog)
Touch Panel Resolution	1,024 x 1,024
Touch Panel Service Life	1 million times or more

Interface Specifications

Serial Interface COM1

Asynchronous Transmission	RS-232C
Data Length	7 or 8 bits
Stop Bit	1 or 2 bits
Parity	None, odd or even
Data Transmission Speed	2,400...115,200 bps
Connector	D-Sub 9 pin (plug)

Serial Interface COM2

Asynchronous Transmission	RS-485
Data Length	7 or 8 bits
Stop Bit	1 or 2 bits
Parity	None, odd or even
Data Transmission Speed	2,400...115,200 bps, 187,500 bps (MPI)
Connector	Modular jack (RJ-45)

USB Interface

	USB (Type A) Interface	**USB (mini-B) Interface**
Connector	USB 2.0 (Type A) x 1	USB 2.0 (mini-B) x 1
Power Supply Voltage	5 Vdc ±5%	-
Maximum Current Supplied	500 mA	-
Maximum Transmission Distance	5 m (16.4 ft)	

Ethernet Interface

	HMIGTO2310 / HMIGTO2315
Ethernet (LAN)	IEEE802.3i / IEEE802.3u, 10BASE-T/100BASE-TX
Connector	Modular jack (RJ45) x 1

SD Card Interface

HMIGTO2310/HMIGTO2315: SD Card slot x 1 (maximum 32 GB SD/SDHC Card)

NOTE: HMIGTO2300 does not have an SD Card interface.

Specifications of Serial Interface COM1

Introduction

⚠ CAUTION

LOSS OF POWER

- Make sure all connections to the communication ports on the bottom and sides of the panel do not put excessive stress on the ports.
- Securely attach communication cables to the panel or cabinet.
- Use only D-Sub 9 pin cables with a locking system in good condition.

Failure to follow these instructions can result in injury or equipment damage.

The serial port is not isolated. The SG (signal ground) and FG (frame ground) terminals are connected inside the panel.

⚠⚠ DANGER

ELECTRIC SHOCK

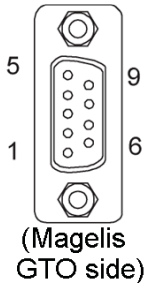
When using the SG terminal to connect an external device to the panel:

- Verify that a short-circuit loop is not created when you set up the system.
- Connect the #5 SG terminal to remote equipment when the host (PLC) unit is not isolated. Connect the #5 SG terminal to a known reliable ground connection to reduce the risk of damaging the circuit.

Failure to follow these instructions will result in death or serious injury.

Serial Interface COM1

HMIGTO2300 / HMIGTO2310/ HMIGTO2315: D-Sub 9 pin plug connector via an RS-232C cable.

Pin Connection	Pin No.	RS-232C		
		Signal Name	Direction	Meaning
 (Magelis GTO side)	1	CD	Input	Carrier Detect
	2	RD(RXD)	Input	Receive Data
	3	SD(TXD)	Output	Send Data
	4	ER(DTR)	Output	Data Terminal Ready
	5	SG	-	Signal Ground
	6	DR(DSR)	Input	Data Set Ready
	7	RS(RTS)	Output	Request to Send
	8	CS(CTS)	Input	Send possible
	9	CI(RI)/VCC	Input/–	Called Status Display +5V±5% Output 0.25A[*1]
	Shell	FG	–	Frame Ground (Common with SG)

NOTE: [*1] You can switch pin #9 between RI and VCC via software.

NOTICE

EQUIPMENT DAMAGE

Use only the rated current.

Failure to follow these instructions can result in equipment damage.

Interfit bracket is #4-40 (UNC).

⚠ CAUTION

LOSS OF COMMUNICATION

- All connections to the communication ports must not put excessive stress on the ports.
- Securely attach communication cables to the panel wall or cabinet.
- Use only D-Sub 9 pin cables with a locking tab in good condition.

Failure to follow these instructions can result in injury or equipment damage.

Specifications of Serial Interface COM2

Introduction

The serial port is not isolated. The SG (signal ground) and FG (frame ground) terminals are connected inside the panel.

⚠⚠ DANGER

ELECTRIC SHOCK

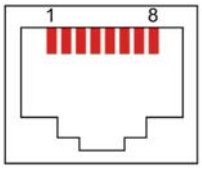
When using the SG terminal to connect an external device to the panel:
- Verify that a short-circuit loop is not created when you set up the system.
- Connect the #8 SG terminal to remote equipment when the host (PLC) unit is not isolated. Connect the #8 SG terminal to a known reliable ground connection to reduce the risk of damaging the circuit.

Failure to follow these instructions will result in death or serious injury.

Serial Interface COM2

HMIGTO2300 / HMIGTO2310/ HMIGTO2315: RJ45 connector via an RS-485 cable.

NOTE: When setting up RS-485 communication, the cable diagram for some equipment may require polarization on the terminal side. This terminal does not require any special setting as it handles polarization automatically.

Pin Connection	Pin No.	RS-422/RS-485		
		Signal Name	Direction	Meaning
	1	NC	-	-
	2	NC	-	-
	3	NC	-	-
	4	Line A	Input/Output	Transfer Data (RS-485)
	5	Line B	Input/Output	Transfer Data (RS-485)
	6	RS(RTS)	Output	Request To Send
	7	NC	-	-
	8	SG	-	Signal Ground

⚠ CAUTION

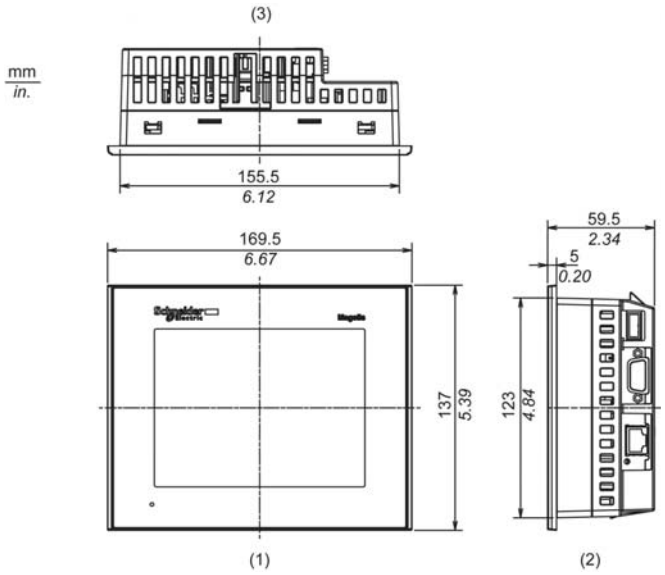
LOSS OF COMMUNICATION

- All connections to the communication ports must not put excessive stress on the ports.
- Securely attach communication cables to the panel wall or cabinet.
- Use only RJ45 with a locking tab in good condition.

Failure to follow these instructions can result in injury or equipment damage.

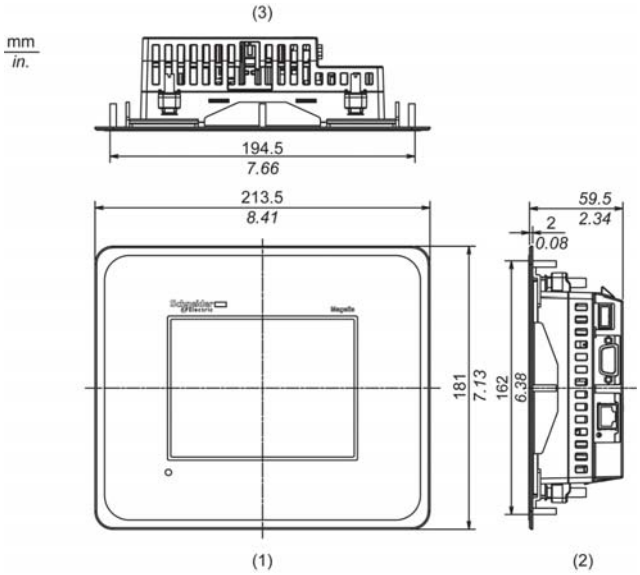
Dimensions

External Dimensions: HMIGTO2300/HMIGTO2310



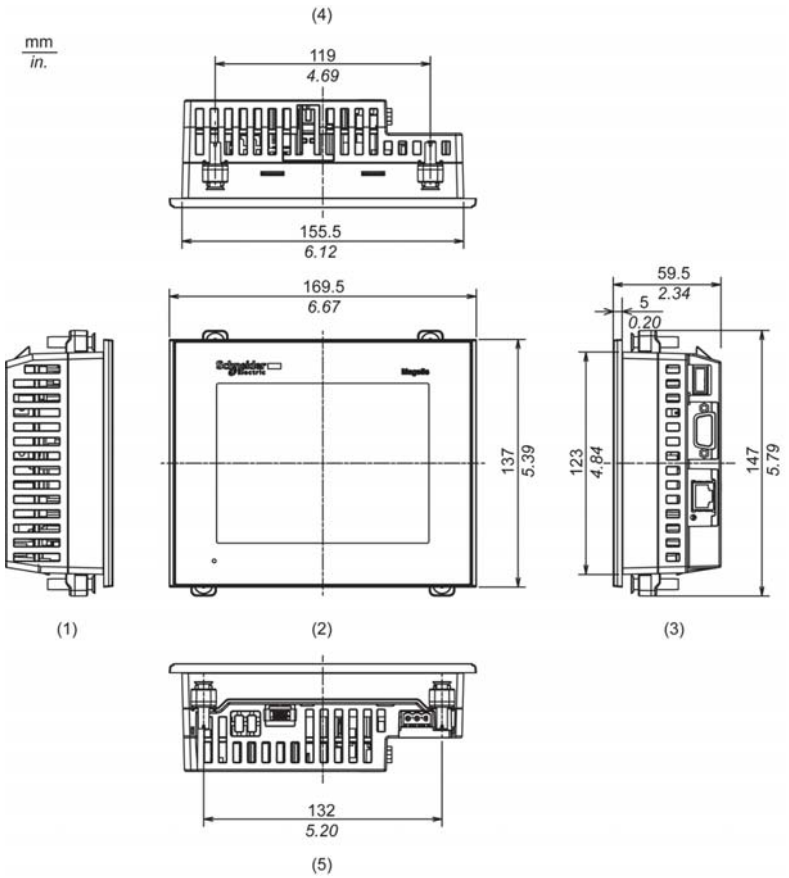
1 Front
2 Right Side
3 Top

External Dimensions: HMIGTO2315



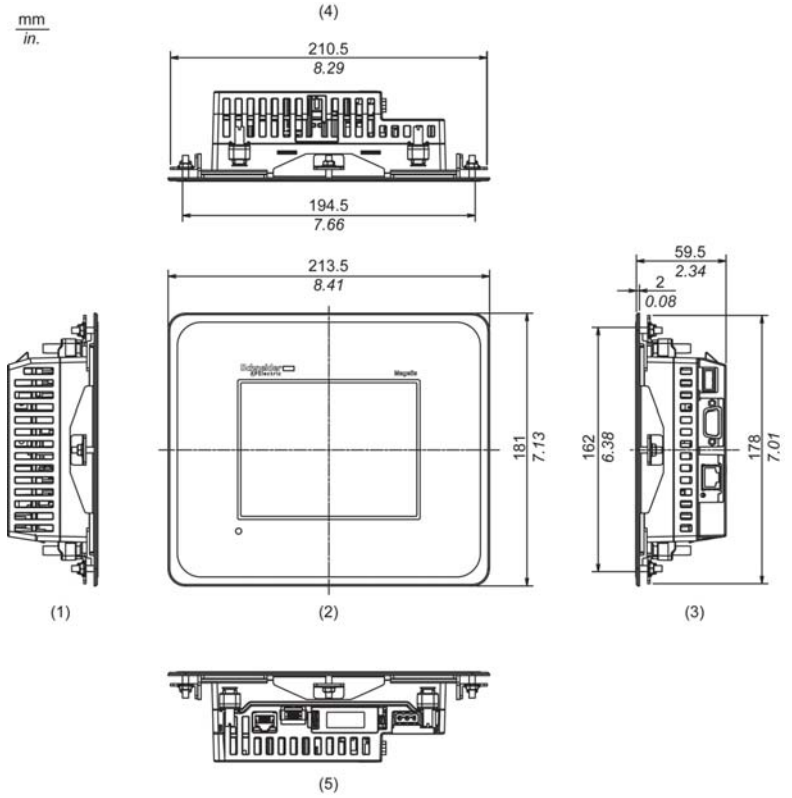
1 Front
2 Right Side
3 Top

Installation with Installation Fasteners: HMIGTO2300/HMIGTO2310



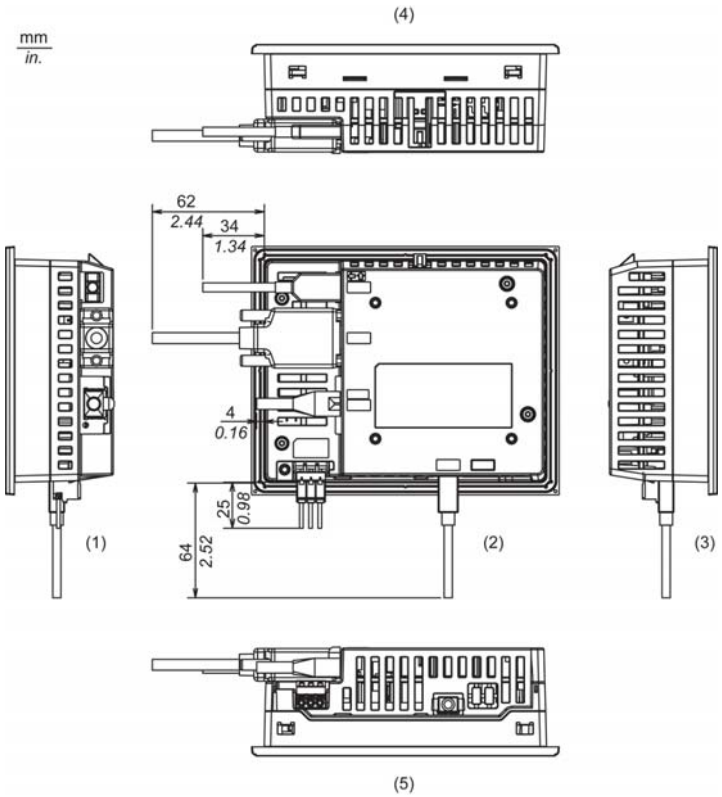
1 Left Side
2 Front
3 Right Side
4 Top
5 Bottom

Installation with Installation Fasteners: HMIGTO2315



1 Left Side
2 Front
3 Right Side
4 Top
5 Bottom

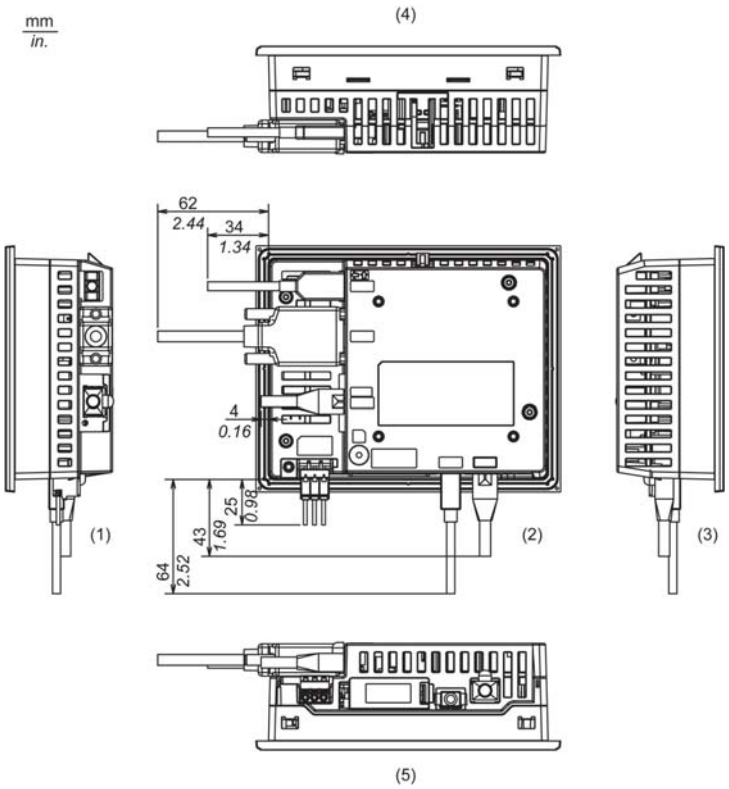
Dimensions with Cables: HMIGTO2300



1 Left Side
2 Rear
3 Right Side
4 Top
5 Bottom

NOTE: All the above values are designed with cable bending in mind. The dimensions given here are representative values depending on the type of connection cable in use. Therefore, these values are intended for reference only.

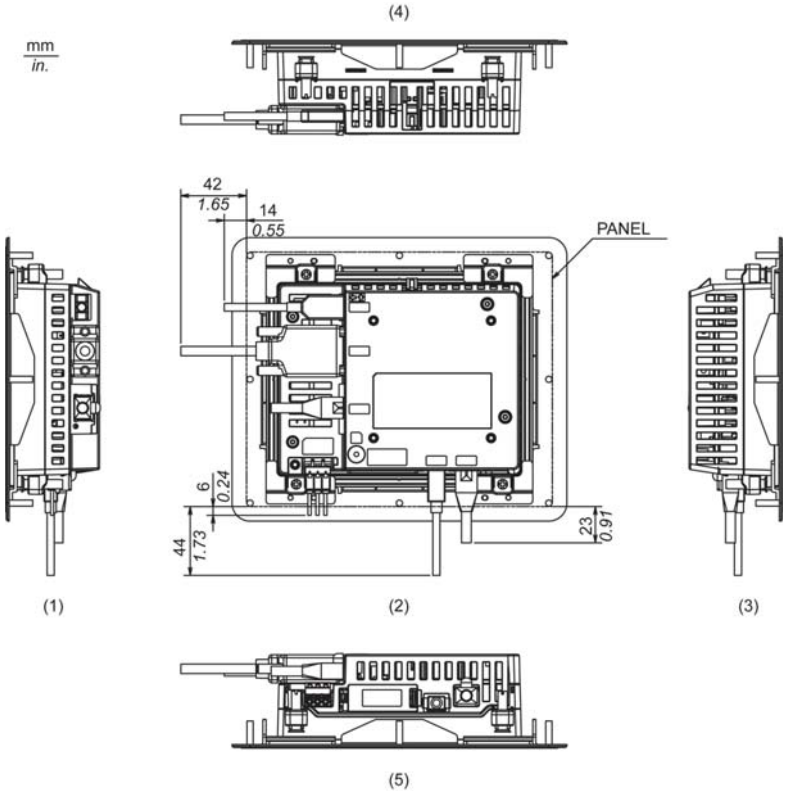
Dimensions with Cables: HMIGTO2310



1 Left Side
2 Rear
3 Right Side
4 Top
5 Bottom

NOTE: All the above values are designed with cable bending in mind. The dimensions given here are representative values depending on the type of connection cable in use. Therefore, these values are intended for reference only.

Dimensions with Cables: HMIGTO2315

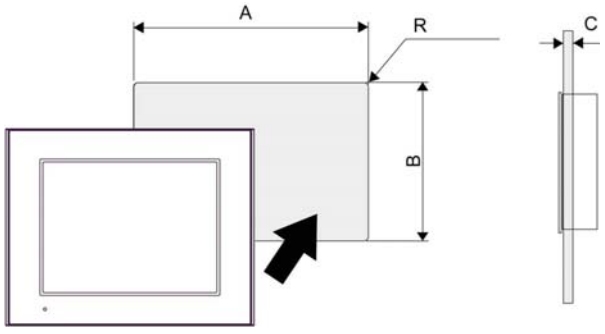


1 Left Side
2 Rear
3 Right Side
4 Top
5 Bottom

NOTE: All the above values are designed with cable bending in mind. The dimensions given here are representative values depending on the type of connection cable in use. Therefore, these values are intended for reference only.

Panel Cut Dimensions

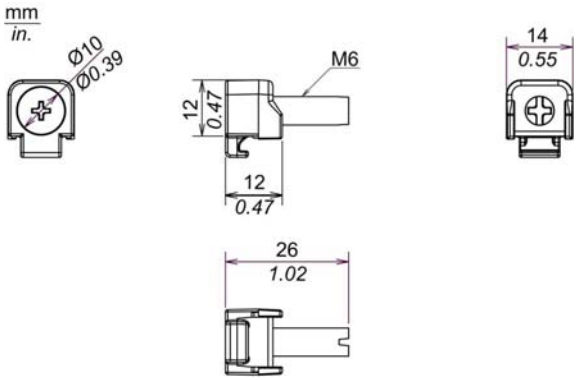
Create a panel cut and insert the panel into the opening from the front.



	A	B	C	R
HMIGTO2310 HMIGTO2300	156 mm (+1/-0) mm (6.14 in [+0.04, -0 in.])	123.5 mm (+1, -0 mm) (4.86 in [+0.04, -0 in.])	1.6...5 mm (0.06...0.2 in.)	3 mm (0.12 in.) maximum
HMIGTO2315	195 mm (+1/-0) mm (7.68 in [+0.04, -0in.])	162.5 mm (+1/-0) mm (6.40 in [+0.04, -0in.])		

NOTE: Before designing the panel cut, refer to Installation *(see page 120)*.

Installation Fastener Dimensions



Section 4.3
HMIGTO3510/4310

What Is in This Section?

This section contains the following topics:

Topic	Page
Electrical Specifications	69
Environmental Specifications	70
Structural Specifications	71
Display Specifications	72
Memory, Clock, Touch Panel, and Function Switches	73
Interface Specifications	74
Specifications of Serial Interface COM1	75
Specifications of Serial Interface COM2	77
Dimensions	78

Electrical Specifications

Power Supply	Rated Input Voltage		24 Vdc
	Input Voltage Limits		19.2...28.8 Vdc
	Voltage Drop		5 ms or less
	Power Consumption		12 W or less
		When power is not supplied to external devices	8 W or less
		Backlight OFF (Standby Mode)	5 W or less
		Backlight Dimmed (Brightness: 20%)	5.5 W or less
	In-Rush Current		30 A or less
Voltage Endurance			1,000 Vac, 20 mA for 1 minute (between charging and FG terminals)
Insulation Resistance			500 Vdc, 10 MΩ or more (between charging and FG terminals)

Environmental Specifications

		HMIGTO4310	HMIGTO3510
Physical Environment	Surrounding Air Temperature	0...55 °C (32...131 °F)	0...50 °C (32...122 °F)
	Storage Temperature	-20...60 °C (-4...140 °F)	
	Surrounding Air and Storage Humidity	10...90% RH (Non condensing, wet bulb temperature 39 °C [102.2 °F] or less)	
	Dust	0.1 mg/m^3 (10^{-7} oz/ft^3) or less (non-conductive levels)	
	Pollution Degree	For use in Pollution Degree 2 environment	
	Corrosive Gases	Free of corrosive gases	
	Atmospheric pressure (Operating Altitude)	800...1,114 hPa (2,000 m [6,561 ft] or lower)	
Mechanical Environment	Vibration Resistance	IEC/EN 61131-2 5...9 Hz Single amplitude 3.5 mm (0.14 in.) 9...150 Hz Fixed acceleration: 9.8 m/s^2 X, Y, Z directions for 10 cycles (approx. 100 min)	
	Concussion Resistance	IEC/EN 61131-2 compliant 147 m/s^2, X, Y, Z directions for 3 times	
Electrical Environment	Noise Immunity	Noise Voltage: 1,000 Vp-p Pulse Width: 1 µs Rise Time: 1 ns	
	Electrostatic Discharge Immunity	Contact Discharge Method: 6 kV (IEC/EN 61000-4-2 Level 3)	

Air quality requirements

Do not operate or store the panel where chemicals evaporate, or where chemicals are present in the air:

- Corrosive chemicals: Acids, alkalines, liquids containing salt.
- Flammable chemicals: Organic solvents.

⚠ CAUTION

INOPERATIVE EQUIPMENT

Do not allow water, liquids, metal, and wiring fragments to enter the panel case.

Failure to follow these instructions can result in injury or equipment damage.

Structural Specifications

Grounding	Functional grounding: Grounding resistance of 100 Ω, 2 mm^2 (AWG 14) or thicker wire, or your country's applicable standard. (Same for FG and SG terminals)
Cooling Method	Natural air circulation
Structure*1	IP65f NEMA #250 TYPE 4X/13 (on the front panel when properly installed in an enclosure)
External Dimensions	W218 x H173 x D60 mm (W8.58 x H6.81 x D2.36 in.)
Panel Cut Dimensions	W204.5 x H159.5 mm (W8.05 x H6.28 in.)*2 Panel thickness area: 1.6...5 mm (0.06...0.2 in.)*3
Weight	1.2 kg (2.6 lb) or less (main unit only)

NOTE: *1 The front face of the HMIGTO, installed in a solid panel, has been tested using conditions equivalent to the standards shown in the specification. Even though the HMIGTO's level of resistance is equivalent to these standards, oils that should have no effect on the HMIGTO can possibly harm the panel. This can occur in areas where either vaporized oils are present, or where low viscosity cutting oils are allowed to adhere to the panel for long periods of time. If the panel's front face protection sheet peels off, these conditions can lead to the ingress of oil into the panel and separate protection measures are suggested.
Also, if non-approved oils are present, they may cause deformation or corrosion of the front panel's plastic cover. Therefore, prior to installing the HMIGTO, be sure to confirm the type of conditions that will be present in the panel's operating environment. If the installation gasket is used for a long period of time, or if the HMIGTO and its gasket are removed from the panel, the original level of protection cannot be kept. To maintain the original protection level, be sure to replace the installation gasket regularly.

*2 For dimensional tolerance, everything +1/-0 mm (+0.04/-0 in.) and R in angle are below R3 (R0.12 in.)

*3 Even if the installation wall thickness is within the recommended range for the "Panel Cut Dimensions", depending on wall's material, size, and installation location of the panel and other devices, the installation wall could warp. To prevent warping, the installation surface may need to be strengthened.

⚠ CAUTION

EQUIPMENT DAMAGE

Ensure that the panel is not in permanent and direct contact with oils.

Failure to follow these instructions can result in injury or equipment damage.

NOTICE

STORAGE AND OPERATION OUTSIDE OF SPECIFICATIONS

- Store the panel in areas where temperatures are within the panel's specifications.
- Do not restrict or block the panel's rear-face ventilation slots.

Failure to follow these instructions can result in equipment damage.

NOTICE

GASKET AGING

- Inspect the gasket periodically as required by your operating environment to keep the initial IP level.
- Change the gasket at least once a year, or as soon as scratches or dirt become visible.

Failure to follow these instructions can result in equipment damage.

Display Specifications

		HMIGTO4310	HMIGTO3510
Display Type		TFT Color LCD	
Display Size		7.5”	7.0”
Resolution		640 x 480 pixels (VGA)	800 x 480 pixels (WVGA)
Effective Display Area		W153.7 x H115.8 mm (W6.05 x H4.56 in.)	W152.4 x H91.44 mm (W6.0 x H3.6 in.)
Display Colors		65,536 colors (No blink) / 16,384 colors Blink)	
Backlight		White LED (Not user replaceable. When replacement is required, contact your local distributor.)	
Backlight Service Life		50,000 hours or more (continuous operation at 25 °C [77 °F] before backlight brightness decreases to 50%)	
Brightness Control		16 levels (Adjusted with touch panel or software)	
Language Fonts		ASCII: (Code page 850) Alphanumeric (including European characters) Chinese: (GB2312-80 codes) Simplified Chinese fonts Japanese (except for XBT GT1000 series): ANK 158, Kanji: 6,962 (JIS Standards 1 & 2) (including 607 non-kanji characters) Korean: (KSC5601 - 1992 codes) Hangul fonts Taiwanese: (Big 5 codes) Traditional Chinese fonts	
Character sizes		8 x 8, 8 x 16, 16 x 16 and 32 x 32 pixel fonts	
Font sizes		You can expand the width up to 8 times, and expand the height up to 8 times.*1	
Text	8 x 8 pixels	80 characters per row x 60 rows	100 characters per row x 60 rows
	8 x 16 pixels	80 characters per row x 30 rows	100 characters per row x 30 rows
	16 x 16 pixels	40 characters per row x 30 rows	50 characters per row x 30 rows
	32 x 32 pixels	20 characters per row x 15 rows	25 characters per row x 15 rows

*1 You can set up other font sizes using the software.

Memory, Clock, Touch Panel, and Function Switches

Memory

	HMIGTO4310	HMIGTO3510
Application Memory *1	FLASH EPROM 96 MB	FLASH EPROM 96 MB
Application run DRAM	128 MB	128 MB
Data Backup	SRAM 512 KB (Replaceable lithium battery for data backup)	SRAM 128 KB (Replaceable lithium battery for data backup)

*1 Capacity available for user application.

NOTE:

- When the message "Battery level is low" is displayed, supply power to the panel and fully charge the battery.

Clock

Clock Accuracy*1	±65 seconds/month (deviation at room temperature and power is OFF).

*1 Depending on the operating temperature and age of panel, the clock can deviate from -380 to +90 sec/month. For systems where this level of precision is insufficient, the user should monitor and make adjustments when required.

Touch Panel

Touch Panel Type	Resistive Film (analog)
Touch Panel Resolution	1,024 x 1,024
Touch Panel Service Life	1 million times or more

Function Switches

HMIGTO3510: Eight switches (F1 to F8).

Interface Specifications

Serial Interface COM1

Asynchronous Transmission	RS-232C
Data Length	7 or 8 bits
Stop Bit	1 or 2 bits
Parity	None, odd or even
Data Transmission Speed	2,400...115,200 bps
Connector	D-Sub 9 pin (plug)

Serial Interface COM2

Asynchronous Transmission	RS-485
Data Length	7 or 8 bits
Stop Bit	1 or 2 bits
Parity	None, odd or even
Data Transmission Speed	2,400...115,200 bps, 187,500 bps (MPI)
Connector	Modular jack (RJ-45)

USB Interface

	USB (Type A) Interface	**USB (mini-B) Interface**
Connector	USB 2.0 (Type A) x 1	USB 2.0 (mini-B) x 1
Power Supply Voltage	5 Vdc ±5%	-
Maximum Current Supplied	500 mA	-
Maximum Transmission Distance	5 m (16.4 ft)	

Ethernet Interface

Ethernet (LAN)	IEEE802.3i / IEEE802.3u, 10BASE-T/100BASE-TX
Connector	Modular jack (RJ45) x 1

SD Card Interface

SD Card slot x 1 (maximum 32 GB SD/SDHC Card)

Specifications of Serial Interface COM1

Introduction

⚠ CAUTION

LOSS OF POWER

- Make sure all connections to the communication ports on the bottom and sides of the panel do not put excessive stress on the ports.
- Securely attach communication cables to the panel or cabinet.
- Use only D-Sub 9 pin cables with a locking system in good condition.

Failure to follow these instructions can result in injury or equipment damage.

The serial port is not isolated. The SG (signal ground) and FG (frame ground) terminals are connected inside the panel.

⚠⚠ DANGER

ELECTRIC SHOCK

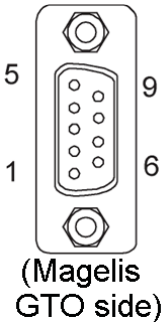
When using the SG terminal to connect an external device to the panel:

- Verify that a short-circuit loop is not created when you set up the system.
- Connect the #5 SG terminal to remote equipment when the host (PLC) unit is not isolated. Connect the #5 SG terminal to a known reliable ground connection to reduce the risk of damaging the circuit.

Failure to follow these instructions will result in death or serious injury.

Serial Interface COM1

HMIGTO3510 / HMIGTO4310: D-Sub 9 pin plug connector via an RS-232C cable.

Pin Connection	Pin No.	RS-232C		
		Signal Name	Direction	Meaning
 (Magelis GTO side)	1	CD	Input	Carrier Detect
	2	RD(RXD)	Input	Receive Data
	3	SD(TXD)	Output	Send Data
	4	ER(DTR)	Output	Data Terminal Ready
	5	SG	-	Signal Ground
	6	DR(DSR)	Input	Data Set Ready
	7	RS(RTS)	Output	Request to Send
	8	CS(CTS)	Input	Send possible
	9	CI(RI)/VCC	Input/–	Called Status Display +5V±5% Output 0.25A[*1]
	Shell	FG	–	Frame Ground (Common with SG)

NOTE: [*1] You can switch pin #9 between RI and VCC via software.

NOTICE

EQUIPMENT DAMAGE

Use only the rated current.

Failure to follow these instructions can result in equipment damage.

Interfit bracket is #4-40 (UNC).

⚠ CAUTION

LOSS OF COMMUNICATION

- All connections to the communication ports must not put excessive stress on the ports.
- Securely attach communication cables to the panel wall or cabinet.
- Use only D-Sub 9 pin cables with a locking tab in good condition.

Failure to follow these instructions can result in injury or equipment damage.

Specifications of Serial Interface COM2

Introduction

The serial port is not isolated. The SG (signal ground) and FG (frame ground) terminals are connected inside the panel.

⚠⚠ DANGER

ELECTRIC SHOCK

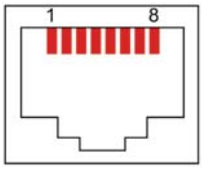
When using the SG terminal to connect an external device to the panel:
- Verify that a short-circuit loop is not created when you set up the system.
- Connect the #8 SG terminal to remote equipment when the host (PLC) unit is not isolated. Connect the #8 SG terminal to a known reliable ground connection to reduce the risk of damaging the circuit.

Failure to follow these instructions will result in death or serious injury.

Serial Interface COM2

HMIGTO3510 / HMIGTO4310: RJ45 connector via a RS-485 cable.

NOTE: When setting up RS-485 communication, the cable diagram for some equipment may require polarization on the terminal side. This terminal does not require any special setting as it handles polarization automatically.

Pin Connection	Pin No.	RS-485		
		Signal Name	Direction	Meaning
	1	NC	-	-
	2	NC	-	-
	3	NC	-	-
	4	Line A	Input/Output	Transfer Data (RS-485)
	5	Line B	Input/Output	Transfer Data (RS-485)
	6	RS(RTS)	Output	Request To Send
	7	NC	-	-
	8	SG	-	Signal Ground

⚠ CAUTION

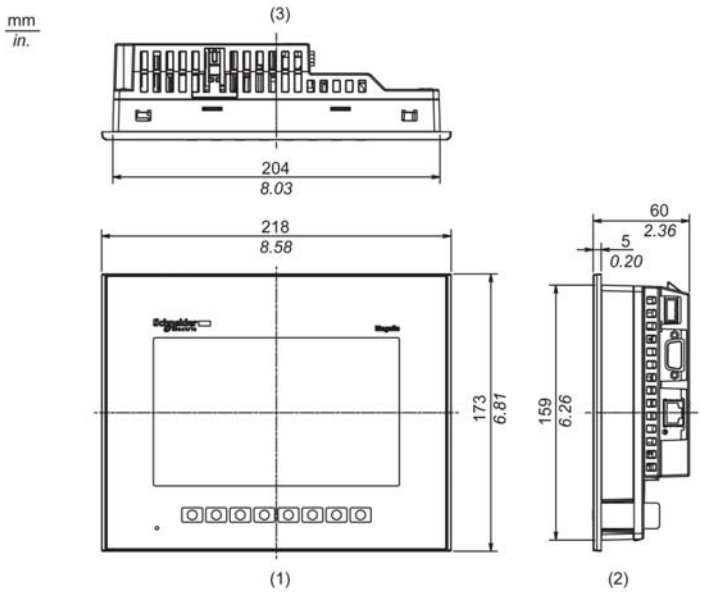
LOSS OF COMMUNICATION

- All connections to the communication ports must not put excessive stress on the ports.
- Securely attach communication cables to the panel wall or cabinet.
- Use only RJ45 with a locking tab in good condition.

Failure to follow these instructions can result in injury or equipment damage.

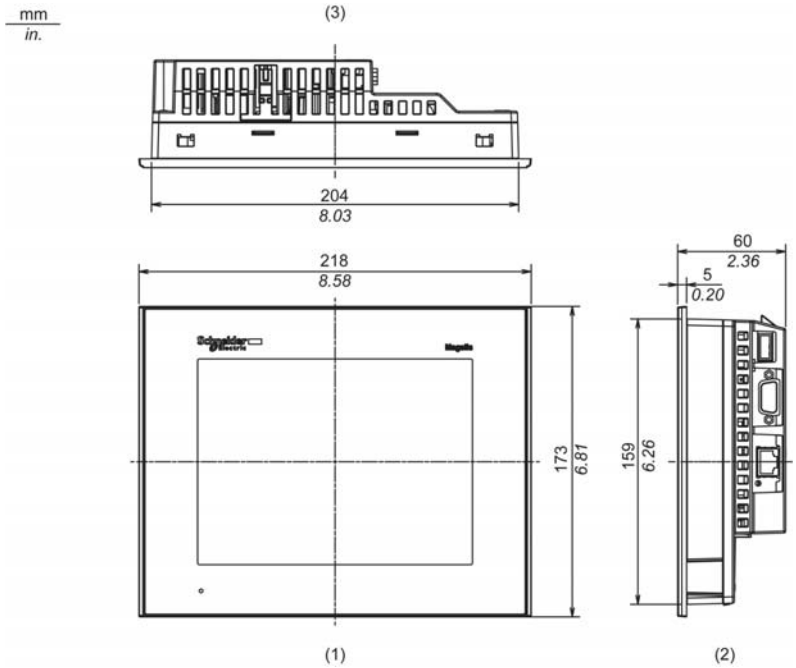
Dimensions

External Dimensions: HMIGTO3510



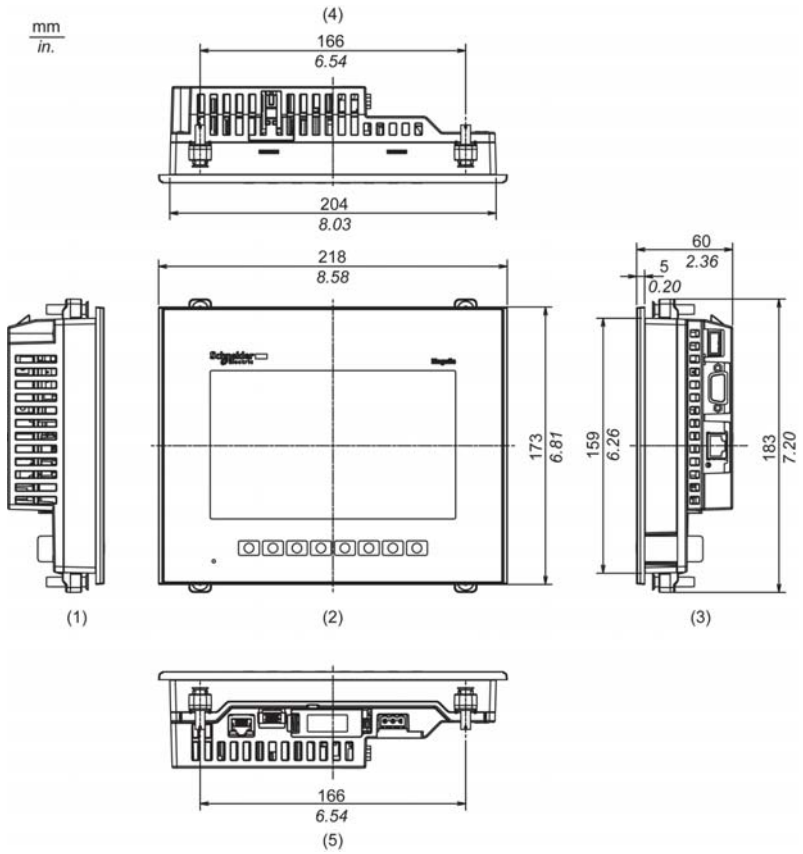
1 Front
2 Right Side
3 Top

External Dimensions: HMIGTO4310



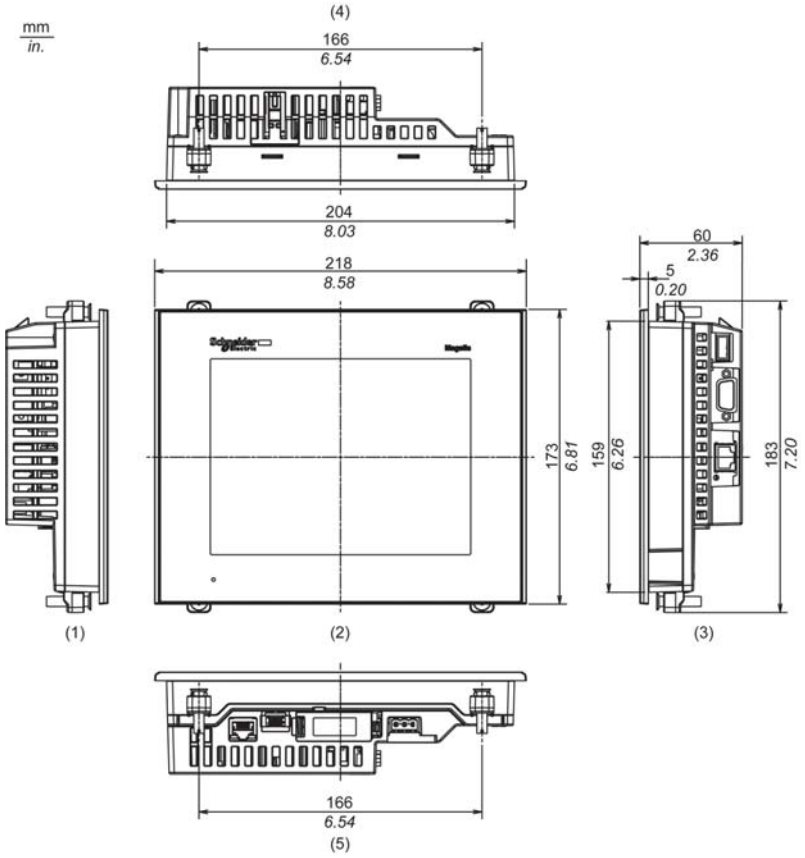
1 Front
2 Right Side
3 Top

Installation with Installation Fasteners: HMIGTO3510



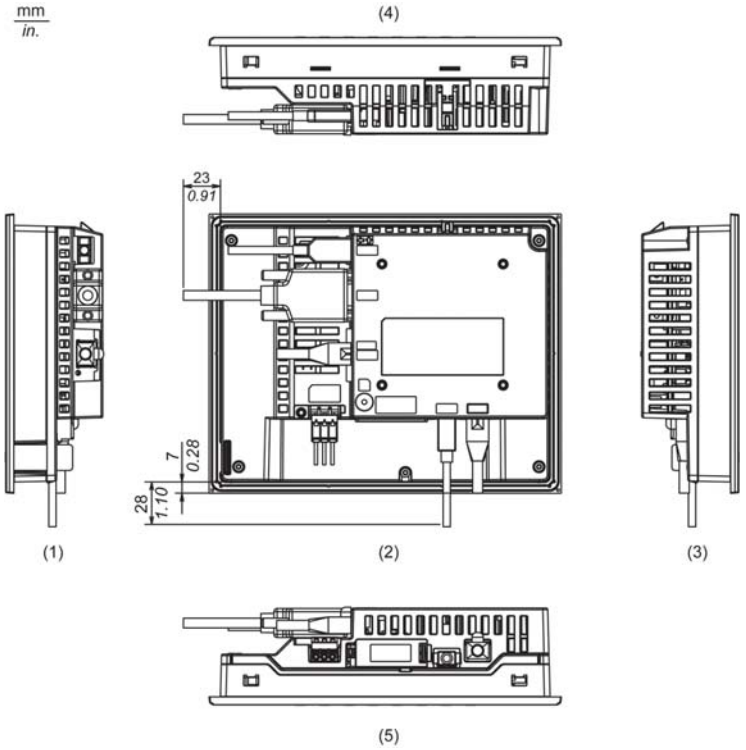
1 Left Side
2 Front
3 Right Side
4 Top
5 Bottom

Installation with Installation Fasteners: HMIGTO4310



1 Left Side
2 Front
3 Right Side
4 Top
5 Bottom

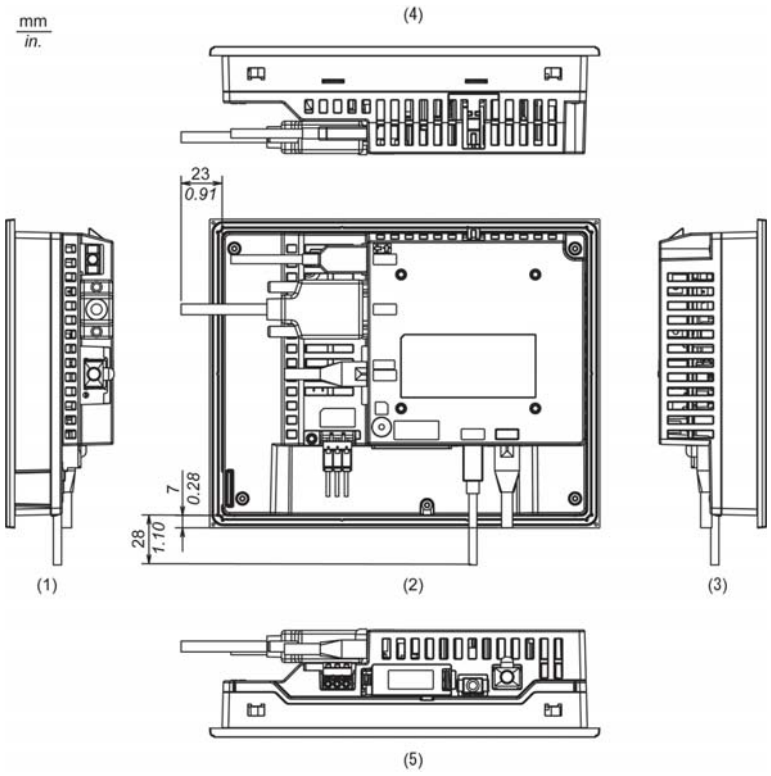
Dimensions with Cables: HMIGTO3510



1 Left Side
2 Rear
3 Right Side
4 Top
5 Bottom

NOTE: All the above values are designed with cable bending in mind. The dimensions given here are representative values depending on the type of connection cable in use. Therefore, these values are intended for reference only.

Dimensions with Cables: HMIGTO4310

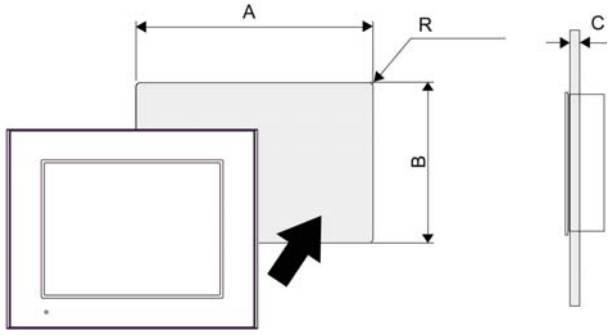


1 Left Side
2 Rear
3 Right Side
4 Top
5 Bottom

NOTE: All the above values are designed with cable bending in mind. The dimensions given here are representative values depending on the type of connection cable in use. Therefore, these values are intended for reference only.

Panel Cut Dimensions

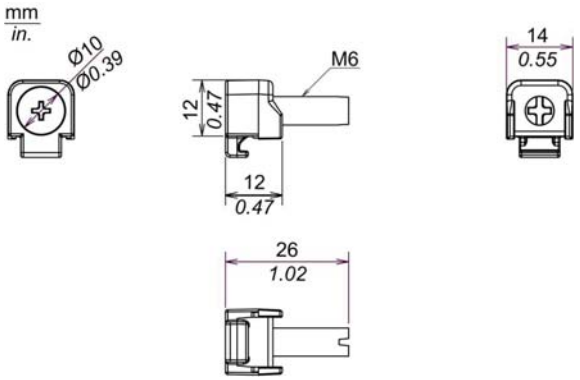
Create a panel cut and insert the panel into the opening from the front.



A	B	C	R
204.5 mm (+1, -0 mm) (8.05 in. [+0.04, -0 in.])	159.5 mm (+1, -0 mm) (6.28 in. [+0.04, -0 in.])	1.6...5 mm (0.06...0.2 in.)	3 mm (0.12 in.) maximum

NOTE: Before designing the panel cut, refer to Installation *(see page 120)*.

Installation Fastener Dimensions



Section 4.4
HMIGTO5310/5315

What Is in This Section?

This section contains the following topics:

Topic	Page
Electrical Specifications	85
Environmental Specifications	86
Structural Specifications	87
Display Specifications	89
Memory, Clock, and Touch Panel	90
Interface Specifications	91
Specifications of Serial Interface COM1	92
Specifications of Serial Interface COM2	94
Dimensions	95

Electrical Specifications

Power Supply	Rated Input Voltage		24 Vdc
	Input Voltage Limits		19.2...28.8 Vdc
	Voltage Drop		10 ms or less
	Power Consumption		17 W or less
		When power is not supplied to external devices	12 W or less
		Backlight OFF (Standby Mode)	7 W or less
		Backlight Dimmed (Brightness: 20%)	8 W or less
	In-Rush Current		30 A or less
Voltage Endurance			1500 Vac, 20 mA for 1 min. (between charging and FG terminals)
Insulation Resistance			500 Vdc, 10 MΩ or more (between charging and FG terminals)

Environmental Specifications

Physical Environment	Surrounding Air Temperature	0...55 °C (32...131 °F)
	Storage Temperature	-20...60 °C (-4...140 °F)
	Surrounding Air and Storage Humidity	10...90% RH (Non condensing, wet bulb temperature 39 °C [102.2 °F] or less)
	Dust	0.1 mg/m^3 (10^{-7} oz/ft^3) or less (non-conductive levels)
	Pollution Degree	For use in Pollution Degree 2 environment
	Corrosive Gases	Free of corrosive gases
	Atmospheric Pressure (Operating Altitude)	800...1,114 hPa (2,000 m [6,561 ft] or lower)
Mechanical Environment	Vibration Resistance	IEC/EN 61131-2 compliant 5...9 Hz Single amplitude 3.5 mm (0.14 in.) 9...150 Hz Fixed acceleration: 9.8 m/s^2 X, Y, Z directions for 10 cycles (approx. 100 min.)
	Concussion Resistance	IEC/EN 61131-2 compliant 147 m/s^2, X, Y, Z directions for 3 times
Electrical Environment	Noise Immunity	Noise Voltage: 1,000 Vp-p Pulse Width: 1 µs Rise Time: 1 ns
	Electrostatic Discharge Immunity	Contact Discharge Method: 6 kV (IEC/EN 61000-4-2 Level 3)

Air quality requirements

Do not operate or store the panel where chemicals evaporate, or where chemicals are present in the air:

- Corrosive chemicals: Acids, alkalines, liquids containing salt.
- Flammable chemicals: Organic solvents.

⚠ CAUTION

INOPERATIVE EQUIPMENT

Do not allow water, liquids, metal, and wiring fragments to enter the panel case.

Failure to follow these instructions can result in injury or equipment damage.

Structural Specifications

	HMIGTO5310	HMIGTO5315
Grounding	Functional grounding: Grounding resistance of 100Ω, 2mm^2 (AWG 14) or thicker wire, or your country's applicable standard. (Same for FG and SG terminals)	
Cooling Method	Natural air circulation	
Structure[*1]	IP65f NEMA #250 TYPE 4X/13 (on the front panel when properly installed in an enclosure)	IP66k NEMA #250 TYPE 4X/13 (on the front panel when properly installed in an enclosure)[*2]
External Dimensions	W272.5 x H214.5 x D57 mm (W10.73 x H8.44 x D2.24 in.)	W316.5 x H258.5 x D57 mm (W12.44 x H10.18 x D2.24 in.)
Panel Cut Dimensions	W259 x H201 mm (W10.2 x H7.91 in.)[*3] Panel thickness area: 1.6...5 mm (0.06...0.2 in.)[*4]	W298 x H240 mm (W11.73 x H9.45 in.)[*3] Panel thickness area: 1.6...5 mm (0.06...0.2 in.)[*4]
Weight	2.0 kg (4.4 lb) or less (main unit only)	2.5 kg (5.5 lb) or less (main unit only)

NOTE: [*1] The front face of the HMIGTO, installed in a solid panel, has been tested using conditions equivalent to the standards shown in the specification. Even though the HMIGTO's level of resistance is equivalent to these standards, oils that should have no effect on the HMIGTO can possibly harm the panel. This can occur in areas where either vaporized oils are present, or where low viscosity cutting oils are allowed to adhere to the panel for long periods of time. If the panel's front face protection sheet peels off, these conditions can lead to the ingress of oil into the panel and separate protection measures are suggested.
Also, if non-approved oils are present, they may cause deformation or corrosion of the front panel's plastic cover. Therefore, prior to installing the HMIGTO, be sure to confirm the type of conditions that will be present in the panel' operating environment. If the installation gasket is used for a long period of time, or if the HMIGTO and its gasket are removed from the panel, the original level of protection cannot be kept. To maintain the original protection level, be sure to replace the installation gasket regularly.
[*2] When installing the HMIGTO in a panel, you may not be able to mount the HMIGTO flush with the panel. This occurs due to the thickness of the gasket. The difference in level between the HMIGTO and panel depends on how much the gasket is compressed.

NOTICE

EQUIPMENT DAMAGE

For food and beverage and pharmaceutical industries, when the HMIGTO is not flush with panel, use silicon to form a seal to prevent water, chemicals, or food from lodging into place. Otherwise, the panel face could leak.

Failure to follow these instructions can result in equipment damage.

[*3] For dimensional tolerance, everything +1/-0 mm (+0.04/-0 in.) and R in angle are below R3 (R0.12 in.)

[*4] Even if the installation wall thickness is within the recommended range for the "Panel Cut Dimensions", depending on wall's material, size, and installation location of the panel and other devices, the installation wall could warp. To prevent warping, the installation surface may need to be strengthened.

⚠ CAUTION

EQUIPMENT DAMAGE

Ensure that the panel is not in permanent and direct contact with oils.

Failure to follow these instructions can result in injury or equipment damage.

NOTICE

STORAGE AND OPERATION OUTSIDE OF SPECIFICATIONS

- Store the panel in areas where temperatures are within the panel's specifications.
- Do not restrict or block the panel's rear-face ventilation slots.

Failure to follow these instructions can result in equipment damage.

NOTICE

GASKET AGING

- Inspect the gasket periodically as required by your operating environment to keep the initial IP level.
- Change the gasket at least once a year, or as soon as scratches or dirt become visible.

Failure to follow these instructions can result in equipment damage.

Display Specifications

Display Type		TFT Color LCD
Display Size		10.4”
Resolution		640 x 480 pixels (VGA)
Effective Display Area		W211.2 x H158.4 mm (8.31 x 6.24 in.)
Display Colors		65,536 colors (No blink) / 16,384 colors (Blink)
Backlight		White LED (Not user replaceable. When replacement is required, contract your local distributor.)
Backlight Service Life		50,000 hours or more (continuous operation at 25 °C [77 °F] before backlight brightness dimmed to 50%
Brightness Control		16 levels (Adjusted with the touch panel or software)
Language Fonts		ASCII: (Code page 850) Alphanumeric (including European characters) Chinese: (GB2312-80 codes) Simplified Chinese fonts Japanese: ANK 158, Kanji: 6,962 (JIS Standards 1 & 2) (including 607 non-kanji characters) Korean: (KSC5601 - 1992 codes) Hangul fonts Taiwanese: (Big 5 codes) Traditional Chinese fonts
Character Sizes		8 x 8, 8 x 16, 16 x 16 and 32 x 32 pixel fonts
Font Sizes		You can expand the width up to 8 times, and expand the height up to 8 times.*1
Text	8 x 8 pixels	80 characters per row x 60 rows
	8 x 16 pixels	80 characters per row x 30 rows
	16 x 16 pixels	40 characters per row x 30 rows
	32 x 32 pixels	20 characters per row x 15 rows

*1 You can set up other font sizes using the software.

Memory, Clock, and Touch Panel

Memory

Application Memory *1	FLASH EPROM 96 MB
Application run DRAM	128 MB
Data Backup	SRAM 512 KB (Replaceable lithium battery for data backup)

*1 Capacity available for user application.

NOTE:

- When the message "Battery level is low" is displayed, supply power to the panel and fully charge the battery.

Clock

Clock Accuracy*1	±65 seconds/month (deviation at room temperature and power is OFF).

*1 Depending on the operating temperature and age of panel, the clock can deviate from -380 to +90 sec/month. For systems where this level of precision is insufficient, the user should monitor and make adjustments when required.

Touch Panel

Touch Panel Type	Resistive Film (analog)
Touch Panel Resolution	1,024 x 1,024
Service Life	1 million times or more

Interface Specifications

Serial Interface COM1

Asynchronous Transmission	RS-232C
Data Length	7 or 8 bits
Stop Bit	1 or 2 bits
Parity	None, odd or even
Data Transmission Speed	2,400...115,200 bps
Connector	D-Sub 9 pin (plug)

Serial Interface COM2

Asynchronous Transmission	RS-485
Data Length	7 or 8 bits
Stop Bit	1 or 2 bits
Parity	None, odd or even
Data Transmission Speed	2,400...115,200 bps, 187,500 bps (MPI)
Connector	Modular jack (RJ-45)

USB Interface

	USB (Type A) Interface	**USB (mini-B) Interface**
Connector	USB 2.0 (Type A) x 1	USB 2.0 (mini-B) x 1
Power Supply Voltage	5 Vdc ±5%	-
Maximum Current Supplied	500 mA	-
Maximum Transmission Distance	5 m (16.4 ft)	

Ethernet Interface

Ethernet (LAN)	IEEE802.3i / IEEE802.3u, 10BASE-T/100BASE-TX
Connector	Modular jack (RJ45) x 1

SD Card Interface

SD Card slot x 1 (maximum 32 GB SD/SDHC Card)

Specifications of Serial Interface COM1

Introduction

⚠ CAUTION

LOSS OF POWER

- Make sure all connections to the communication ports on the bottom and sides of the panel do not put excessive stress on the ports.
- Securely attach communication cables to the panel or cabinet.
- Use only D-Sub 9 pin cables with a locking system in good condition.

Failure to follow these instructions can result in injury or equipment damage.

The serial port is not isolated. The SG (signal ground) and FG (frame ground) terminals are connected inside the panel.

⚠⚠ DANGER

ELECTRIC SHOCK

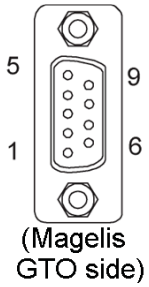
When using the SG terminal to connect an external device to the panel:

- Verify that a short-circuit loop is not created when you set up the system.
- Connect the #5 SG terminal to remote equipment when the host (PLC) unit is not isolated. Connect the #5 SG terminal to a known reliable ground connection to reduce the risk of damaging the circuit.

Failure to follow these instructions will result in death or serious injury.

Serial Interface COM1

HMIGTO5310 / HMIGTO5315: D-Sub 9 pin plug connector via an RS-232C cable.

Pin Connection	Pin No.	RS-232C		
		Signal Name	Direction	Meaning
 (Magelis GTO side)	1	CD	Input	Carrier Detect
	2	RD(RXD)	Input	Receive Data
	3	SD(TXD)	Output	Send Data
	4	ER(DTR)	Output	Data Terminal Ready
	5	SG	-	Signal Ground
	6	DR(DSR)	Input	Data Set Ready
	7	RS(RTS)	Output	Request to Send
	8	CS(CTS)	Input	Send possible
	9	CI(RI)/VCC	Input/–	Called Status Display +5V±5% Output 0.25A[*1]
	Shell	FG	–	Frame Ground (Common with SG)

NOTE: [*1] You can switch pin #9 between RI and VCC via software.

NOTICE

EQUIPMENT DAMAGE

Use only the rated current.

Failure to follow these instructions can result in equipment damage.

Interfit bracket is #4-40 (UNC).

⚠ CAUTION

LOSS OF COMMUNICATION

- All connections to the communication ports must not put excessive stress on the ports.
- Securely attach communication cables to the panel wall or cabinet.
- Use only D-Sub 9 pin cables with a locking tab in good condition.

Failure to follow these instructions can result in injury or equipment damage.

Specifications of Serial Interface COM2

Introduction

The serial port is not isolated. The SG (signal ground) and FG (frame ground) terminals are connected inside the panel.

⚠⚠ DANGER

ELECTRIC SHOCK

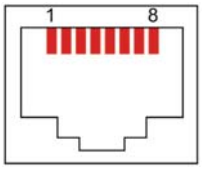
When using the SG terminal to connect an external device to the panel:
- Verify that a short-circuit loop is not created when you set up the system.
- Connect the #8 SG terminal to remote equipment when the host (PLC) unit is not isolated. Connect the #8 SG terminal to a known reliable ground connection to reduce the risk of damaging the circuit.

Failure to follow these instructions will result in death or serious injury.

Serial Interface COM2

HMIGTO5310 / HMIGTO5315: RJ45 connector via a RS-485 cable.

NOTE: When setting up RS-485 communication, the cable diagram for some equipment may require polarization on the terminal side. This terminal does not require any special setting as it handles polarization automatically.

Pin Connection	Pin No.	RS-485		
		Signal Name	Direction	Meaning
	1	NC	-	-
	2	NC	-	-
	3	NC	-	-
	4	Line A	Input/Output	Transfer Data (RS-485)
	5	Line B	Input/Output	Transfer Data (RS-485)
	6	RS(RTS)	Output	Request To Send
	7	NC	-	-
	8	SG	-	Signal Ground

⚠ CAUTION

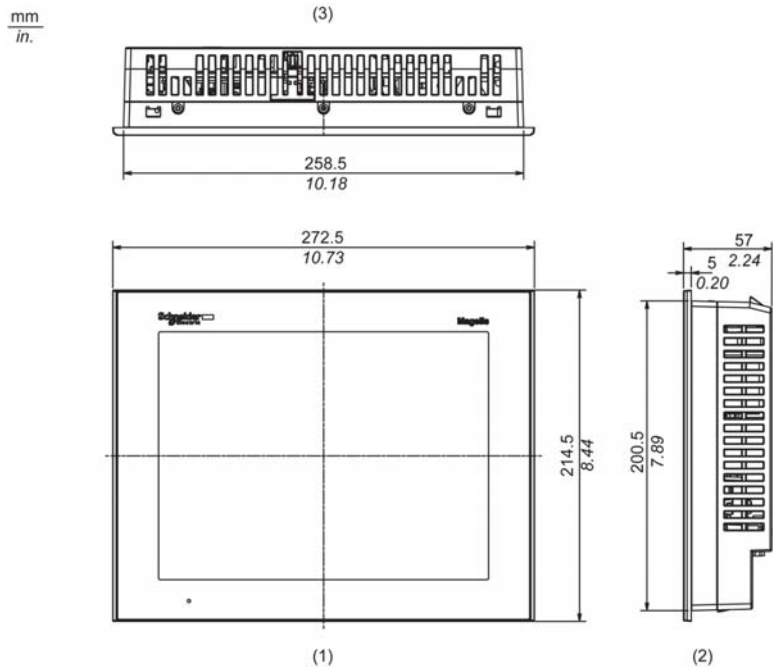
LOSS OF COMMUNICATION

- All connections to the communication ports must not put excessive stress on the ports.
- Securely attach communication cables to the panel wall or cabinet.
- Use only RJ45 with a locking tab in good condition.

Failure to follow these instructions can result in injury or equipment damage.

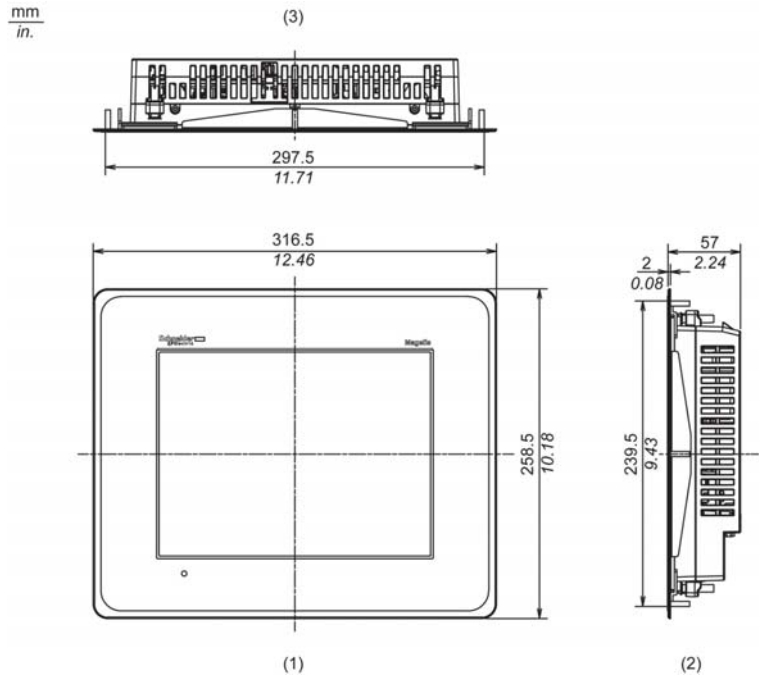
Dimensions

External Dimensions: HMIGTO5310



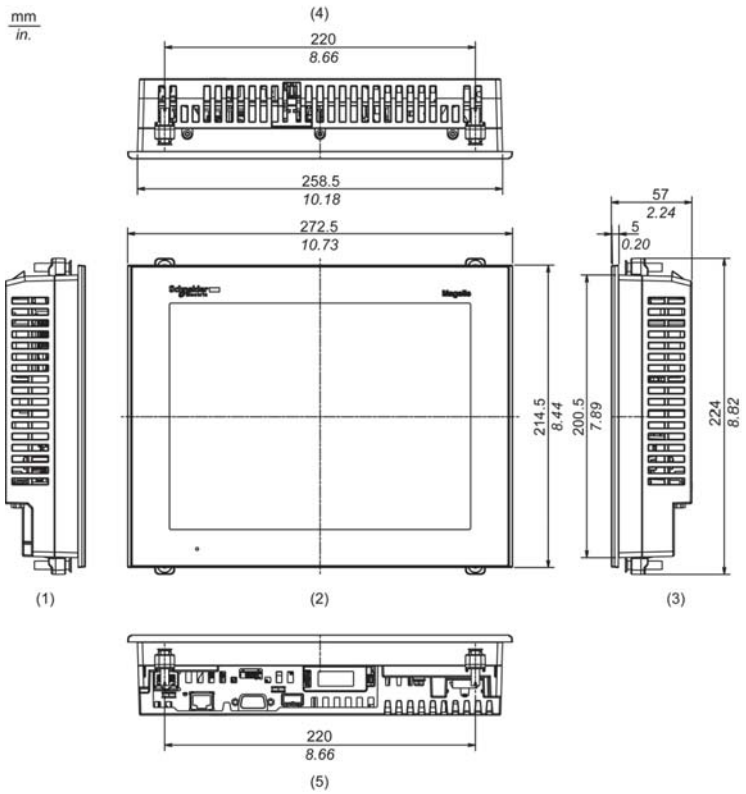
1 Front
2 Right Side
3 Top

External Dimensions: HMIGTO5315



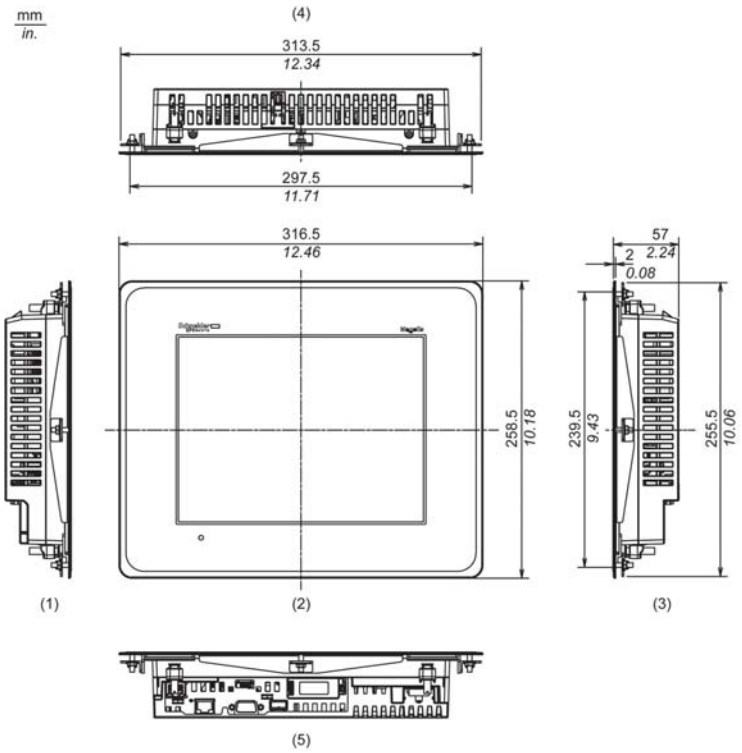
1 Front
2 Right Side
3 Top

Installation with Installation Fasteners: HMIGTO5310



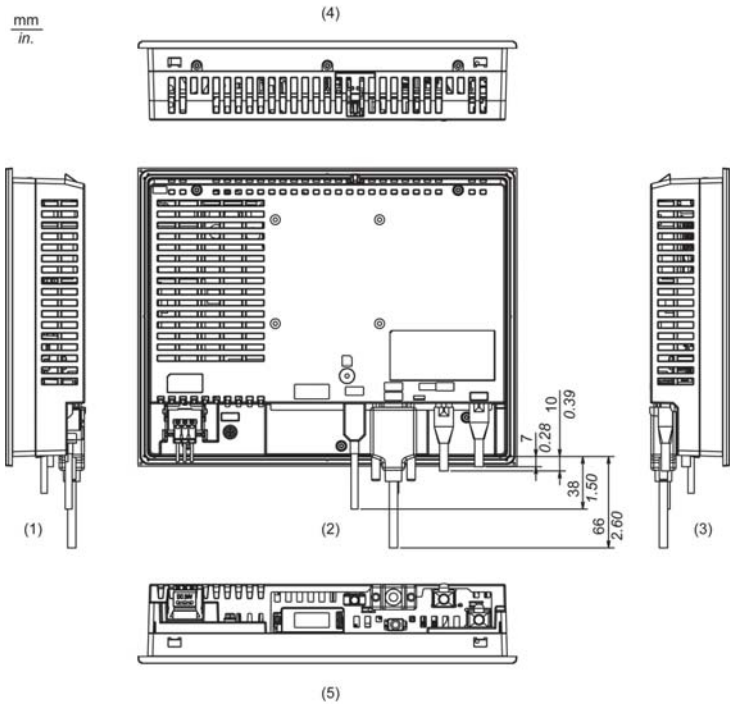
1 Left Side
2 Front
3 Right Side
4 Top
5 Bottom

Installation with Installation Fasteners: HMIGTO5315



1 Left Side
2 Front
3 Right Side
4 Top
5 Bottom

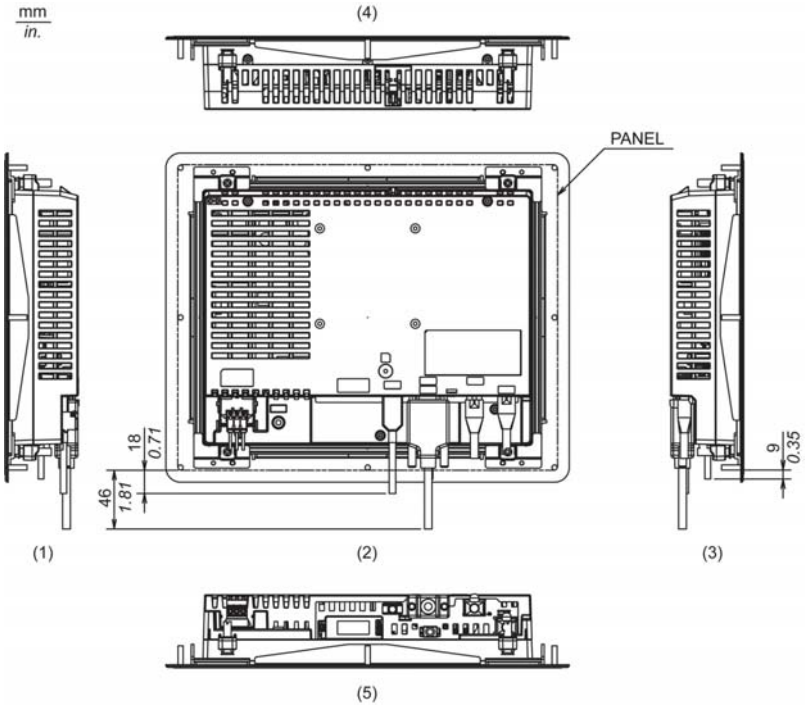
Dimensions with Cables: HMIGTO5310



1 Left Side
2 Rear
3 Right Side
4 Top
5 Bottom

NOTE: All the above values are designed with cable bending in mind. The dimensions given here are representative values depending on the type of connection cable in use. Therefore, these values are intended for reference only.

Dimensions with Cables: HMIGTO5315

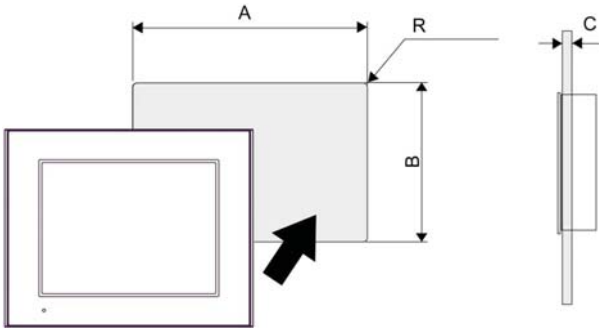


1 Left Side
2 Rear
3 Right Side
4 Top
5 Bottom

NOTE: All the above values are designed with cable bending in mind. The dimensions given here are representative values depending on the type of connection cable in use. Therefore, these values are intended for reference only.

Panel Cut Dimensions

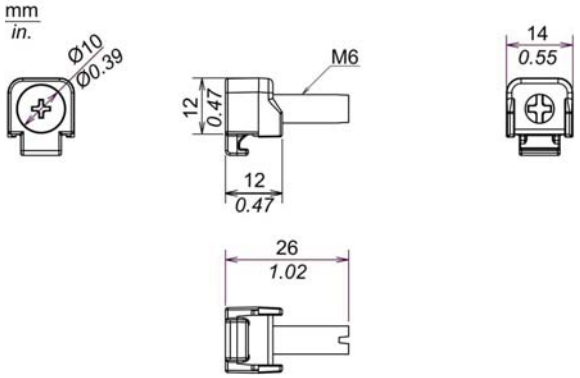
Create a panel cut and insert the panel into the opening from the front.



	A	B	C	R
HMIGTO5310	259 mm (+1, -0 mm) (10.2 in. [+0.04, -0 in.])	201 mm (+1, -0 mm) (7.91 in. [+0.04, -0 in.])	1.6...5 mm (0.06...0.2 in.)	3 mm (0.12 in.) maximum
HMIGTO5315	298 mm (+1, -0 mm) (11.73 in. [+0.04, -0 in.])	240 mm (+1, -0 mm) (9.45 in. [+0.04, -0 in.])		

NOTE: Before designing the panel cut, refer to Installation *(see page 120)*.

Installation Fastener Dimensions



Section 4.5
HMIGTO6310/6315

What Is in This Section?

This section contains the following topics:

Topic	Page
Electrical Specifications	102
Environmental Specifications	103
Structural Specifications	104
Display Specifications	106
Memory, Clock, and Touch Panel	107
Interface Specifications	108
Specifications of Serial Interface COM1	109
Specifications of Serial Interface COM2	111
Dimensions	112

Electrical Specifications

Power Supply	Rated Input Voltage		24 Vdc
	Input Voltage Limits		19.2...28.8 Vdc
	Voltage Drop		10 ms or less
	Power Consumption		17 W or less
		When power is not supplied to external devices	12 W or less
		Backlight OFF (Standby Mode)	7 W or less
		Backlight Dimmed (Brightness: 20%)	8 W or less
	In-Rush Current		30 A or less
Voltage Endurance			1,500 Vac, 20 mA for 1 minute (between charging and FG terminals)
Insulation Resistance			500 Vdc, 10 MΩ or more (between charging and FG terminals)

Environmental Specifications

Physical Environment	Surrounding Air Temperature	0...55 °C (32...131 °F)
	Storage Temperature	-20...60 °C (-4...140 °F)
	Surrounding Air and Storage Humidity	10...90% RH (Non condensing, wet bulb temperature 39 °C [102.2 °F] or less)
	Dust	0.1 mg/m^3 (10^{-7} oz/ft^3) or less (non-conductive levels)
	Pollution Degree	For use in Pollution Degree 2 environment
	Corrosive gases	Free of corrosive gases
	Atmospheric Pressure (Operating Altitude)	800...1,114 hPa (2,000 m [6,561 ft] or lower)
Mechanical Environment	Vibration Resistance	IEC/EN 61131-2 compliant 5...9 Hz Single amplitude 3.5 mm (0.14 in.) 9...150 Hz Fixed acceleration: 9.8 m/s^2 X, Y, Z directions for 10 cycles (approx.100 minute)
	Concussion Resistance	IEC/EN 61131-2 compliant 147 m/s^2, X, Y, Z directions for 3 times
Electrical Environment	Noise immunity	Noise Voltage: 1,000 Vp-p Pulse Width: 1 µs Rise Time: 1 ns
	Electrostatic Discharge Immunity	Contact Discharge Method: 6 kV (IEC/EN 61000-4-2 Level 3)

Air quality requirements

Do not operate or store the panel where chemicals evaporate, or where chemicals are present in the air:

- Corrosive chemicals: Acids, alkalines, liquids containing salt.
- Flammable chemicals: Organic solvents.

⚠ CAUTION

INOPERATIVE EQUIPMENT

Do not allow water, liquids, metal, and wiring fragments to enter the panel case.

Failure to follow these instructions can result in injury or equipment damage.

Structural Specifications

	HMIGTO6310	HMIGTO6315
Grounding	Functional grounding: Grounding resistance of 100 Ω, 2 mm^2 (AWG 14) or thicker wire, or your country's applicable standard. (Same for FG and SG terminals)	
Cooling Method	Natural air circulation	
Structure[*1]	IP65f NEMA #250 TYPE 4X/13 (on the front panel when properly installed in an enclosure)	IP66k NEMA #250 TYPE 4X/13 (on the front panel when properly installed in an enclosure)[*2]
External Dimensions	W315 x H241 x D56 mm (W12.4 x H9.49 x D2.2 in.)	W359 x H285 x D56 mm (W14.13 x H11.22 x D2.2 in.)
Panel Cut Dimensions	W301.5 x H227.5 mm (W11.87 x H8.96 in.)[*3] Panel thickness area: 1.6...5 mm (0.06...0.2 in.)[*4]	W340.5 x H266.5 mm (W13.41 x H10.49 in.)[*3] Panel thickness area: 1.6...5 mm (0.06...0.2 in.)[*4]
Weight	2.5 kg (5.5 lb) or less (main unit only)	3 kg (6.6 lb) or less (main unit only)

NOTE: [*1] The front face of the HMIGTO, installed in a solid panel, has been tested using conditions equivalent to the standards shown in the specification. Even though the HMIGTO's level of resistance is equivalent to these standards, oils that should have no effect on the HMIGTO can possibly harm the panel. This can occur in areas where either vaporized oils are present, or where low viscosity cutting oils are allowed to adhere to the panel for long periods of time. If the panel's front face protection sheet peels off, these conditions can lead to the ingress of oil into the panel and separate protection measures are suggested.

Also, if non-approved oils are present, they may cause deformation or corrosion of the front panel's plastic cover. Therefore, prior to installing the HMIGTO, be sure to confirm the type of conditions that will be present in the panel's operating environment. If the installation gasket is used for a long period of time, or if the HMIGTO and its gasket are removed from the panel, the original level of protection cannot be kept. To maintain the original protection level, be sure to replace the installation gasket regularly.

[*2] When installing the HMIGTO in a panel, you may not be able to mount the HMIGTO flush with the panel. This occurs due to the thickness of the gasket. The difference in level between the HMIGTO and panel depends on how much the gasket is compressed.

NOTICE

EQUIPMENT DAMAGE

For food and beverage and pharmaceutical industries, when the HMIGTO is not flush with panel, use silicon to form a seal to prevent water, chemicals, or food from lodging into place. Otherwise, the panel face could leak.

Failure to follow these instructions can result in equipment damage.

[*3] For dimensional tolerance, everything +1/-0 mm (+0.04/-0 in.) and R in angle are below R3 (R0.12in.)

[*4] Even if the installation wall thickness is within the recommended range for the "Panel Cut Dimensions", depending on wall's material, size, and installation location of the panel and other devices, the installation wall could warp. To prevent warping, the installation surface may need to be strengthened.

⚠ CAUTION

EQUIPMENT DAMAGE

Ensure that the panel is not in permanent and direct contact with oils.

Failure to follow these instructions can result in injury or equipment damage.

NOTICE

STORAGE AND OPERATION OUTSIDE OF SPECIFICATIONS

- Store the panel in areas where temperatures are within the panel's specifications.
- Do not restrict or block the panel's rear-face ventilation slots.

Failure to follow these instructions can result in equipment damage.

NOTICE

GASKET AGING

- Inspect the gasket periodically as required by your operating environment to keep the initial IP level.
- Change the gasket at least once a year, or as soon as scratches or dirt become visible.

Failure to follow these instructions can result in equipment damage.

Display Specifications

Display Type		TFT Color LCD
Display Size		12.1”
Resolution		800 x 600 pixels (SVGA)
Effective Display Area		W246.0 x H184.5 mm (W9.69 x H7.26 in.)
Display Colors		65,536 colors (No blink) / 16,384 colors (Blink)
Backlight		White LED (Not user replaceable. When replacement is required, contact your local distributor.)
Backlight Service Life		50,000 hours (continuous operation at at 25 °C [77 °F] before backlight brightness decreases to 50%)
Brightness Control		16 levels (Adjusted with touch panel or software)
Language Fonts		ASCII: (Code page 850) Alphanumeric (including European characters) Chinese: (GB2312-80 codes) Simplified Chinese fonts Japanese: ANK 158, Kanji: 6,962 (JIS Standards 1 & 2) (including 607 non-kanji characters) Korean: (KSC5601 - 1992 codes) Hangul fonts Taiwanese: (Big 5 codes) Traditional Chinese fonts
Character Sizes		8 x 8, 8 x 16, 16 x 16 and 32 x 32 pixel fonts
Text	8 x 8 pixels	100 characters per row x 75 rows
	8 x 16 pixels	100 characters per row x 37 rows
	16 x 16 pixels	50 characters per row x 37 rows
	32 x 32 pixels	25 characters per row x 18 rows

*1 You can set up other font sizes using the software.

Memory, Clock, and Touch Panel

Memory

Application Memory*1	FLASH EPROM96 MB
Application run DRAM	128 MB
Data Backup	SRAM 512 KB (Replaceable lithium battery for backup memory)

*1 Capacity available for user application.

NOTE:

- When the message "Battery level is low" is displayed, supply power to the panel and fully charge the battery.

Clock

Clock Accuracy*1	±65 seconds/month (deviation at room temperature and power is OFF).

*1 Depending on the operating temperature and age of the panel, the clock can deviate from -380 to +90 sec/month. For systems where this level of precision is insufficient, the user should monitor and make adjustments when required.

Touch Panel

Touch Panel Type	Resistive Film (analog)
Touch Panel Resolution	1,024 x 1,024
Touch Panel Service Life	1 million times or more

Interface Specifications

Serial Interface COM1

Asynchronous Transmission	RS-232C
Data Length	7 or 8 bits
Stop Bit	1 or 2 bits
Parity	None, odd or even
Data Transmission Speed	2,400...115,200 bps
Connector	D-Sub 9 pin (plug)

Serial Interface COM2

Asynchronous Transmission	RS-485
Data Length	7 or 8 bits
Stop Bit	1 or 2 bits
Parity	None, odd or even
Data Transmission Speed	2,400...115,200 bps, 187,500 bps (MPI)
Connector	Modular jack (RJ-45)

USB Interface

	USB (Type A) Interface	**USB (mini-B) Interface**
Connector	USB 2.0 (Type A) x 1	USB 2.0 (mini-B) x 1
Power Supply Voltage	5 Vdc ±5%	-
Maximum Current Supplied	500 mA	-
Maximum Transmission Distance	5 m (16.4 ft)	

Ethernet Interface

Ethernet (LAN)	IEEE802.3i / IEEE802.3u, 10BASE-T/100BASE-TX
Connector	Modular jack (RJ45) x 1

SD Card Interface

SD Card slot x 1 (maximum 32 GB SD/SDHC Card)

Specifications of Serial Interface COM1

Introduction

⚠ CAUTION

LOSS OF POWER

- Make sure all connections to the communication ports on the bottom and sides of the panel do not put excessive stress on the ports.
- Securely attach communication cables to the panel or cabinet.
- Use only D-Sub 9 pin cables with a locking system in good condition.

Failure to follow these instructions can result in injury or equipment damage.

The serial port is not isolated. The SG (signal ground) and FG (frame ground) terminals are connected inside the panel.

⚠⚠ DANGER

ELECTRIC SHOCK

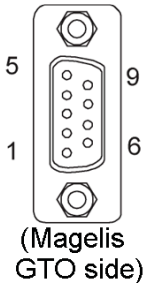
When using the SG terminal to connect an external device to the panel:

- Verify that a short-circuit loop is not created when you set up the system.
- Connect the #5 SG terminal to remote equipment when the host (PLC) unit is not isolated. Connect the #5 SG terminal to a known reliable ground connection to reduce the risk of damaging the circuit.

Failure to follow these instructions will result in death or serious injury.

Serial Interface COM1

HMIGTO6310 / HMIGTO6315: D-Sub 9 pin plug connector via an RS-232C cable.

Pin Connection	Pin No.	RS-232C		
		Signal Name	Direction	Meaning
 (Magelis GTO side)	1	CD	Input	Carrier Detect
	2	RD(RXD)	Input	Receive Data
	3	SD(TXD)	Output	Send Data
	4	ER(DTR)	Output	Data Terminal Ready
	5	SG	-	Signal Ground
	6	DR(DSR)	Input	Data Set Ready
	7	RS(RTS)	Output	Request to Send
	8	CS(CTS)	Input	Send possible
	9	CI(RI)/VCC	Input/–	Called Status Display +5V±5% Output 0.25A[*1]
	Shell	FG	–	Frame Ground (Common with SG)

NOTE: [*1] You can switch pin #9 between RI and VCC via software.

NOTICE

EQUIPMENT DAMAGE

Use only the rated current.

Failure to follow these instructions can result in equipment damage.

Interfit bracket is #4-40 (UNC).

⚠ CAUTION

LOSS OF COMMUNICATION

- All connections to the communication ports must not put excessive stress on the ports.
- Securely attach communication cables to the panel wall or cabinet.
- Use only D-Sub 9 pin cables with a locking tab in good condition.

Failure to follow these instructions can result in injury or equipment damage.

Specifications of Serial Interface COM2

Introduction

The serial port is not isolated. The SG (signal ground) and FG (frame ground) terminals are connected inside the panel.

⚠⚠ DANGER

ELECTRIC SHOCK

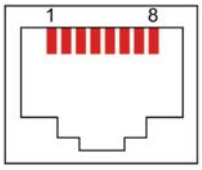
When using the SG terminal to connect an external device to the panel:
- Verify that a short-circuit loop is not created when you set up the system.
- Connect the #8 SG terminal to remote equipment when the host (PLC) unit is not isolated. Connect the #8 SG terminal to a known reliable ground connection to reduce the risk of damaging the circuit.

Failure to follow these instructions will result in death or serious injury.

Serial Interface COM2

HMIGTO6310 / HMIGTO6315: RJ45 connector via a RS-485 cable.

NOTE: When setting up RS-485 communication, the cable diagram for some equipment may require polarization on the terminal side. This terminal does not require any special setting as it handles polarization automatically.

Pin Connection	Pin No.	RS-485		
		Signal Name	Direction	Meaning
	1	NC	-	-
	2	NC	-	-
	3	NC	-	-
	4	Line A	Input/Output	Transfer Data (RS-485)
	5	Line B	Input/Output	Transfer Data (RS-485)
	6	RS(RTS)	Output	Request To Send
	7	NC	-	-
	8	SG	-	Signal Ground

⚠ CAUTION

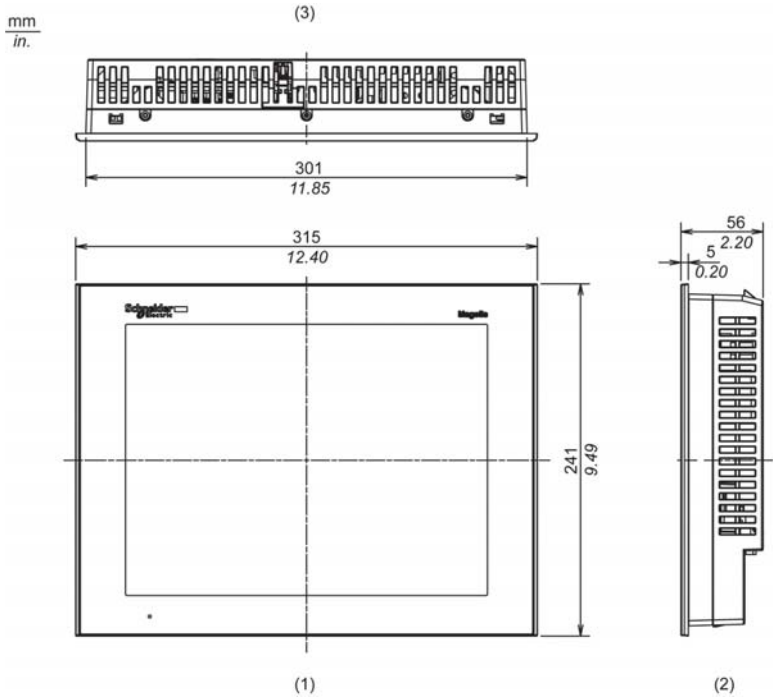
LOSS OF COMMUNICATION

- All connections to the communication ports must not put excessive stress on the ports.
- Securely attach communication cables to the panel wall or cabinet.
- Use only RJ45 with a locking tab in good condition.

Failure to follow these instructions can result in injury or equipment damage.

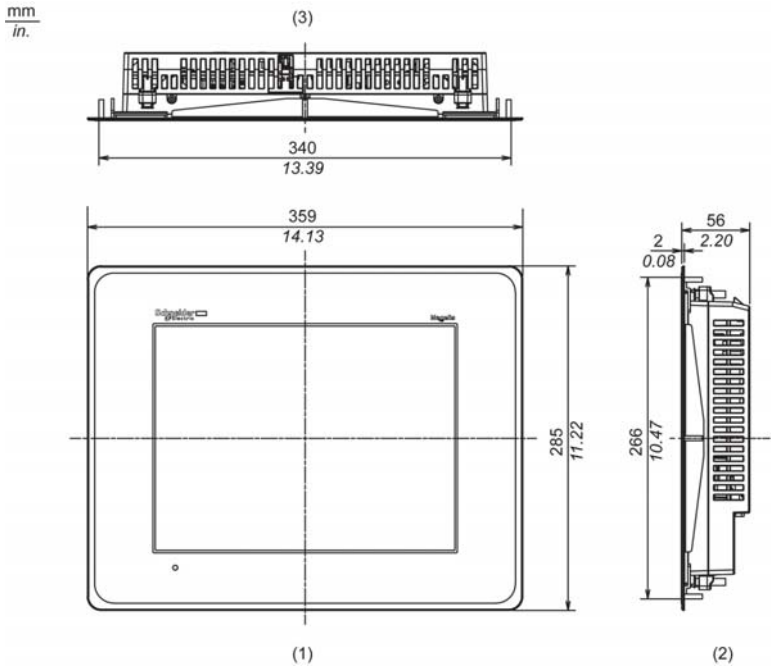
Dimensions

External Dimensions: HMIGTO6310



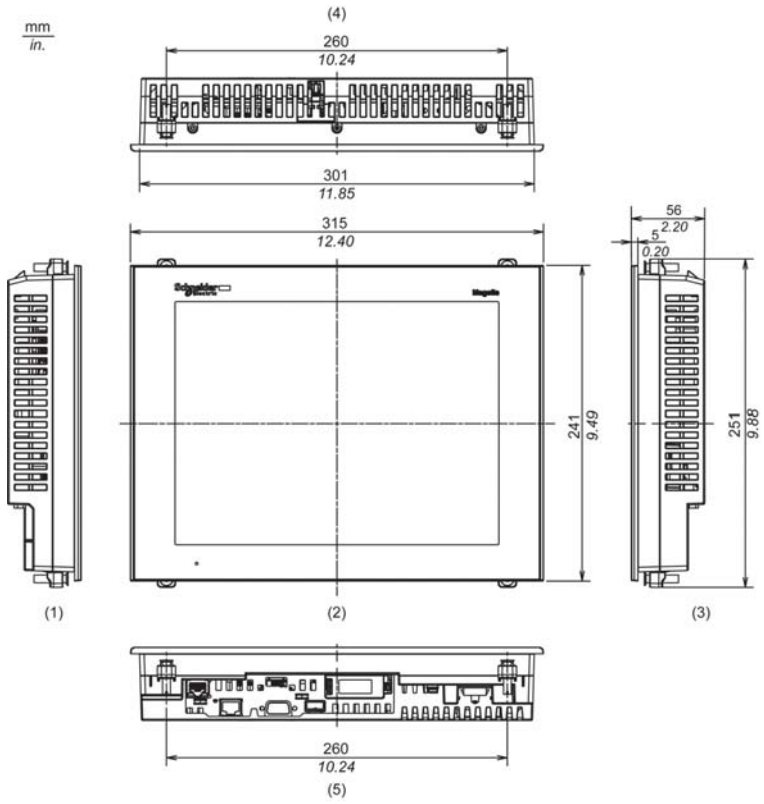
1 Front
2 Right Side
3 Top

External Dimensions: HMIGTO6315



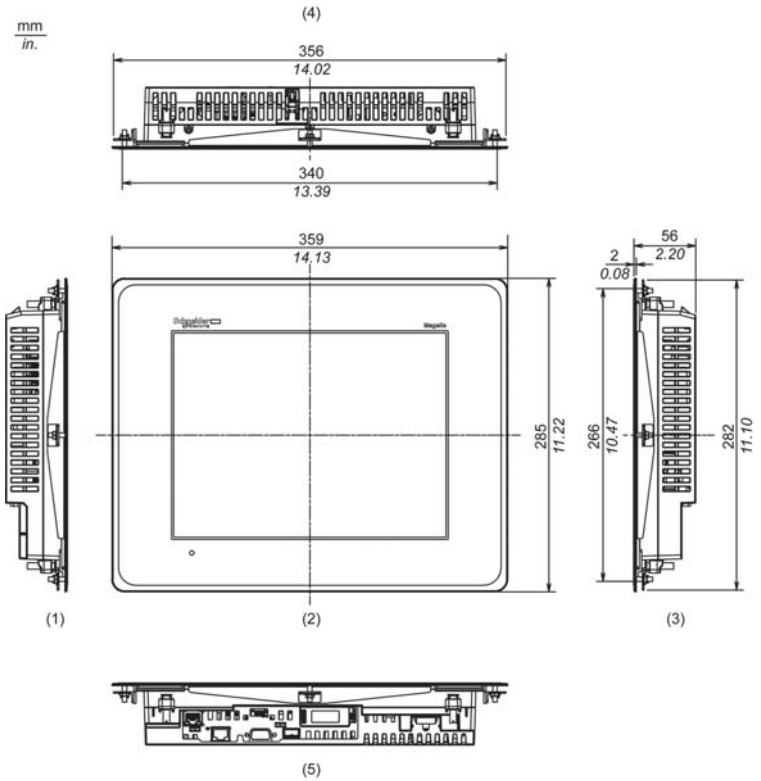
1 Front
2 Right Side
3 Top

Installation with Installation Fasteners: HMIGTO6310



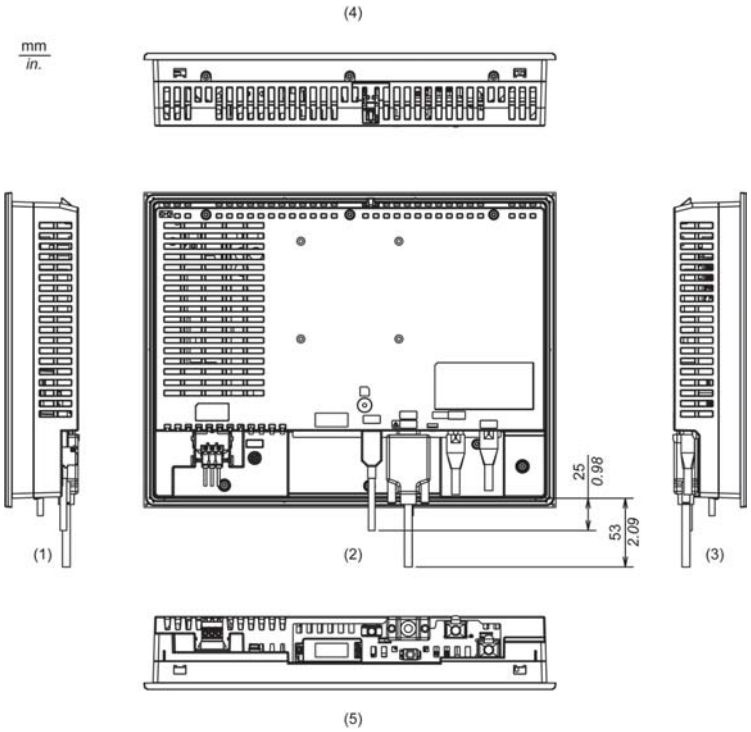
1 Left Side
2 Front
3 Right Side
4 Top
5 Bottom

Installation with Installation Fasteners: HMIGTO6315



1 Left Side
2 Front
3 Right Side
4 Top
5 Bottom

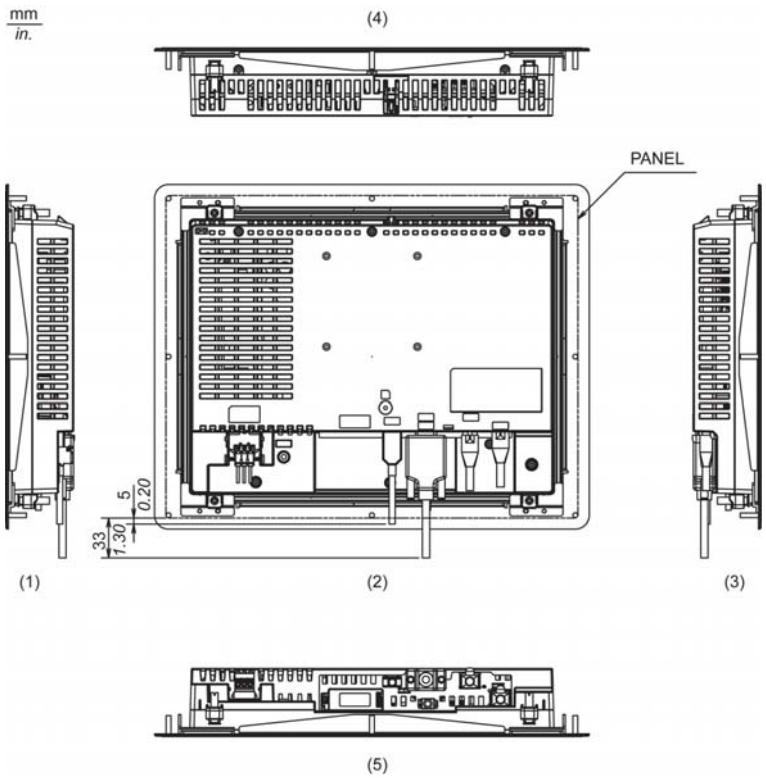
Dimensions with Cables: HMIGTO6310



1 Left Side
2 Rear
3 Right Side
4 Top
5 Bottom

NOTE: All the above values are designed with cable bending in mind. The dimensions given here are representative values depending on the type of connection cable in use. Therefore, these values are intended for reference only.

Dimensions with Cables: HMIGTO6315

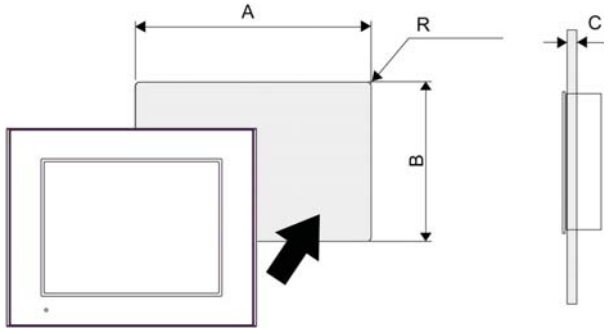


1 Left Side
2 Rear
3 Right Side
4 Top
5 Bottom

NOTE: All the above values are designed with cable bending in mind. The dimensions given here are representative values depending on the type of connection cable in use. Therefore, these values are intended for reference only.

Panel Cut Dimensions

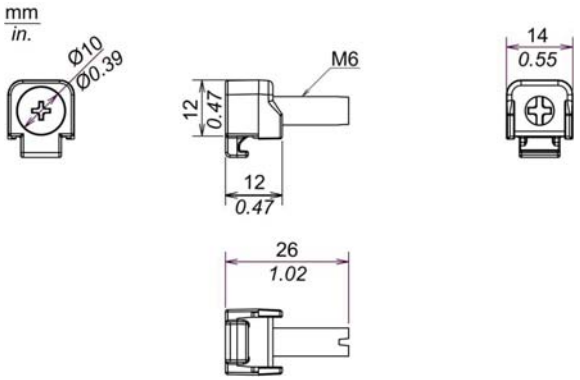
Create a panel cut and insert the panel into the opening from the front.



	A	B	C	R
HMIGTO6310	301.5 mm (+1, -0 mm) (11.87 [+0.04, -0 in.])	227.5 mm (+1, -0 mm) (8.96 in. [+0.04, -0 in.])	1.6...5 mm (0.06...0.2 in.)	3 mm (0.12 in.) maximum
HMIGTO6315	340.5 mm (+1, -0 mm) (13.41 [+0.04, -0 in.])	266.5 mm (+1, -0 mm) (10.49 in. [+0.04, -0 in.])		

NOTE: Before designing the panel cut, refer to Installation *(see page 120)*.

Installation Fastener Dimensions



Chapter 5
Installation and Wiring

What Is in This Chapter?

This chapter contains the following sections:

Section	Topic	Page
5.1	Installation	120
5.2	Wiring Principles	125
5.3	SD Card Insertion/Removal	131
5.4	USB Cable Clamp	136

Section 5.1
Installation

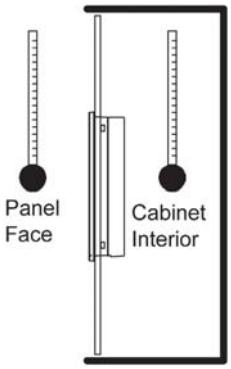
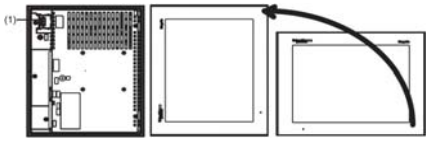
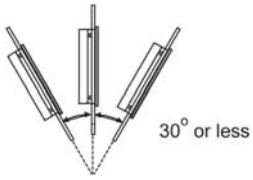
Installation Procedures

Introduction

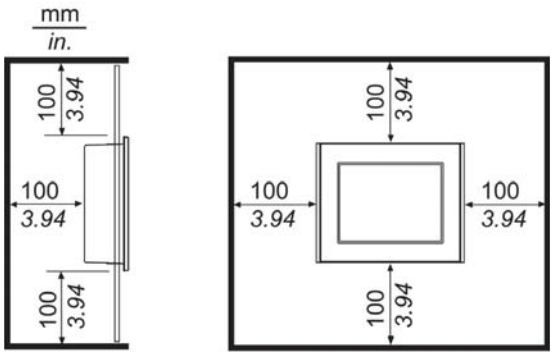
The installation fasteners are required when installing the panel.

Mount the panel in an enclosure that provides a clean, dry, robust and controlled environment. (HMIGTO except HMIGTO2315/HMIGTO5315/HMIGTO6315: IP65, Type 1, Type 4X [Indoor Use Only] or Type 13 Enclosure. HMIGTO2315/HMIGTO5315/HMIGTO6315: IP66k, Type 1, Type 4X [Indoor Use Only] or Type 13 Enclosure.)

Installation Requirements

Check that the installation wall or cabinet's surface is flat, in good condition and has no jagged edges. Metal reinforcing strips may be attached to the inside of the wall, near the panel-cut, to increase its rigidity.
Decide on the thickness of the enclosure wall, based on the level of strength required: 1.6...5 mm (0.06...0.2 in.).
Be sure that the surrounding air temperature and the ambient humidity are within their designated ranges. Surrounding air temperature: 0 to 50 °C (32 to 122 °F) or 0 to 55 °C (32 to 131 °F) (please see the Environment Specifications for your HMIGTO); ambient humidity: 10 to 90%RH; wet bulb temperature: maximum 39 °C [102 °F]. When installing the panel in a cabinet or enclosure, the surrounding air temperature is the cabinet's or enclosure's internal temperature. 
Be sure that heat from surrounding equipment does not cause the panel to exceed its standard operating temperature.
When mounting the panel vertically, ensure that the right side of the unit faces up. In other words, the power connector should be at the top.  **1** Power connector
When installing the panel in a slanted position, the panel face should not incline more than 30° . 
When installing the panel in a slanted position with an incline more than 30° , the ambient temperature must not exceed 40 °C (104 °F). You may need to use forced air cooling (fan, A/C) to ensure the ambient operating temperature is 40° C or less (104 °F or less).

For easier maintenance, operation and improved ventilation, install the panel at least 100 mm (3.94 in.) away from adjacent structures and other equipment as shown in the following illustration:



The holes on the rear of the panel (except HMIGTO1300/1310) do not correspond to VESA 75 mm standards. Do not attach the panel to a commercial-type VESA arm.

Panel Mounting Procedure: (except HMIGTO2315/HMIGTO5315/HMIGTO6315)

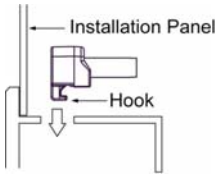
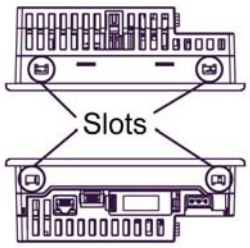
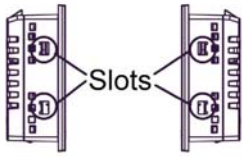
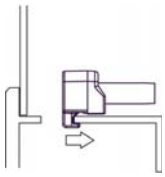
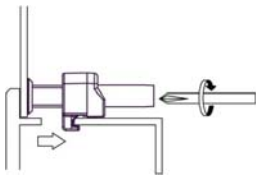
NOTICE

PANEL UNSTEADY WHEN UNSECURED

Keep HMIGTO stabilized in the panel-cut while you are installing or removing the screw fasteners.

Failure to follow these instructions can result in equipment damage.

Step	Action
1	Place the panel on a clean and level surface with the display facing downward.
2	Check that the panel's gasket is seated securely into the gasket's groove, which runs around the perimeter of the panel frame.
3	Cut a hole in the installation panel as defined by the HMIGTO's panel cutout dimensions. HMIGTO1300/HMIGTO1310 *(see page 48)* HMIGTO2300/HMIGTO2310 *(see page 66)* HMIGTO3510/HMIGTO4310 *(see page 82)* HMIGTO5310 *(see page 99)* HMIGTO6310 *(see page 116)*
4	Insert the HMIGTO into the panel-cut.

Step	Action
5	Insert the installation fasteners into the HMIGTO's insertion slots on the top and bottom sides (left and right sides for the HMIGTO1300/1310). Slide the fasteners to the back. If the fasteners are not correctly attached, the HMIGTO may shift or fall out.  HMIGTO2310  HMIGTO1310 
6	Insert each of the fasteners shown below. Make sure you pull the fastener back until it is flush with the rear of the attachment hole insert. 
7	Use a Phillips screwdriver to tighten each fastener screw and secure the panel in place. The necessary torque is 0.5 Nm (4.4 lb•in). 

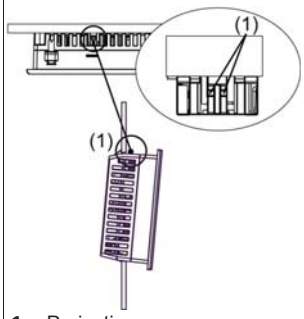
NOTICE

BROKEN ENCLOSURE

- Do not exert more than 0.5 Nm (4.4 lb•in) of torque when tightening the fastener's screws.
- Use on flat surface of a Type 1, Type 4X (Indoor Use Only) or Type 13 Enclosure.

Failure to follow these instructions can result in equipment damage.

Removal Procedure: (except HMIGTO2315/HMIGTO5315/HMIGTO6315)

Step	Action
1	Loosen the installation fasteners (4) from the HMIGTO.
2	Remove the HMIGTO slowly from the panel while pressing the projections on the top of the HMIGTO.  **1** Projections **NOTE:** ● You could damage the HMIGTO if you try and remove it without holding down the projections. ● Watch your fingers so they do not get caught when holding down the projections.

⚠ CAUTION

RISK OF INJURY

Do not drop the HMIGTO when you remove it from the panel.

- Hold the HMIGTO in place after removing the fasteners.
- Use both hands.

Failure to follow these instructions can result in injury or equipment damage.

HMIGTO2315/HMIGTO5315/HMIGTO6315 Panel Mounting Procedure

⚠ CAUTION

RISK OF INJURY

Do not drop the HMIGTO when you install or remove it from the panel.

- Hold the HMIGTO in place after removing the M4 Hex nuts and brackets.
- Use both hands.

Failure to follow these instructions can result in injury or equipment damage.

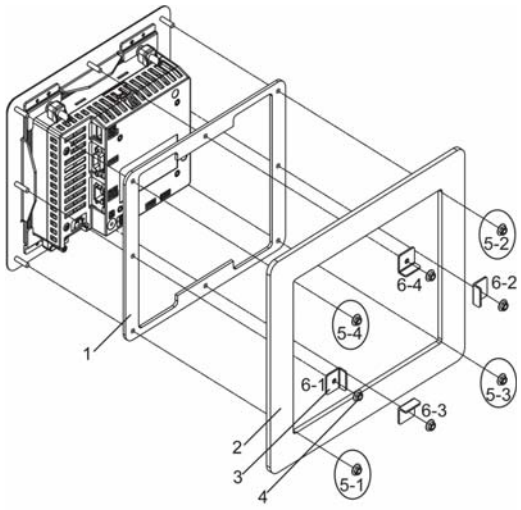
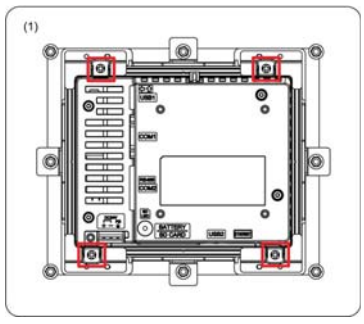
NOTICE

PANEL UNSTEADY WHEN UNSECURED

Keep panel stabilized in the panel-cut while you are installing or removing the M4 Hex nuts and brackets.

Failure to follow these instructions can result in equipment damage.

Step	Action
1	Place the panel on a clean and level surface with the display facing downward.
2	Confirm that the panel's gasket is seated properly on the rear of the panel.
3	Cut a hole in the panel as defined by the HMIGTO panel cutout dimensions. HMIGTO2315 *(see page 66)* HMIGTO5315 *(see page 99)* HMIGTO6315 *(see page 116)*

Step	Action
4	Insert the HMIGTO into the panel-cut.  **1** Gasket **2** Panel **3** Brackets **4** M4 Hex Nut **5** Please read Step 5. **6** Please read Step 6.
5	Tighten the four corners of the rear of the panel with the M4 Hex nuts, in the order shown in the example in Step 4. Use an M4 box-type screwdriver to tighten each M4 Hex nut and secure the panel in place. The necessary torque is 0.5 Nm (4.4 lb•in). If the M4 Hex nuts are not correctly attached, the panel may shift or fall out.
6	Attach the bracket onto the screws in the middle between the M4 Hex nuts in the order shown in the example in Step 4. Use an M4 box-type screwdriver to tighten each M4 Hex nut and secure the panel in place. The necessary torque is 0.5 Nm (4.4 lb•in). If the M4 Hex nuts are not correctly attached, the panel may shift or fall out.
7	Tighten all the M4 Hex nuts again. The necessary torque is 0.5 Nm (4.4 lb•in). **NOTE:** Do not loosen the installation fasteners, marked with red squares below.  **1** Panel

NOTICE

BROKEN ENCLOSURE

- Do not exert more than 0.5 Nm (4.4 lb•in) of torque when tightening the M4 Hex nuts.
- Use on flat surface of a Type 1, Type 4X (Indoor Use Only) or Type 13 Enclosure.

Failure to follow these instructions can result in equipment damage.

Section 5.2
Wiring Principles

Overview

This section presents the HMIGTO wiring principles.

What Is in This Section?

This section contains the following topics:

Topic	Page
Connecting the Power Cord	126
Connecting the Power Supply	128
Grounding	130

Connecting the Power Cord

⚠ WARNING

EXCESSIVE ELECTROMAGNETIC INTERFERENCE

- When the functional ground (FG) terminal is connected, be sure the wire is grounded. Not grounding the HMIGTO can result in excessive Electromagnetic Interference (EMI). Grounding is required to meet EMC level immunity.
- Remove power before wiring the HMIGTO's power terminals.
- The DC model uses only 24 Vdc power. Using any other level of power can damage both the power supply and the HMIGTO.
- Since the HMIGTO is not equipped with a power switch, be sure to connect a power switch to the power supply.
- Be sure to ground the HMIGTO's FG terminal.
- Replace and secure all elements of the system before applying power to the HMIGTO.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

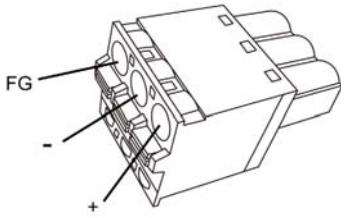
NOTE: The shield ground (SG) and FG terminals are connected internally in the panel.

DC Power Cord Preparation

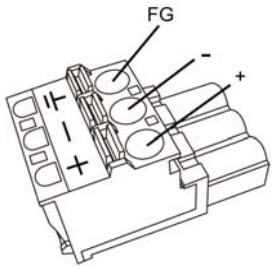
- Make sure the ground wire is either the same or heavier gauge than the power wires.
- Do not use aluminum wires in the power supply's power cord.
- If the ends of the individual wires are not twisted correctly, the wires may create a short circuit.
- Wherever possible, use wires that are 0.75 to 2.5 mm^2 (AWG 18 - 13) for the power cord, and twist the wire ends before attaching the terminals.
- The conductor type is solid or stranded wire.
- Field wiring terminal marking for wire type (75 °C [167 °F] copper conductors only).

DC Power Supply Connector (Plug) Specifications: Spring Clamp Terminal Blocks

HMIGTO1300/1310 / HMIGTO2300/2310/2315 / HMIGTO3510/4310

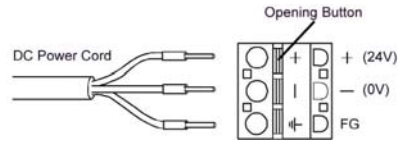
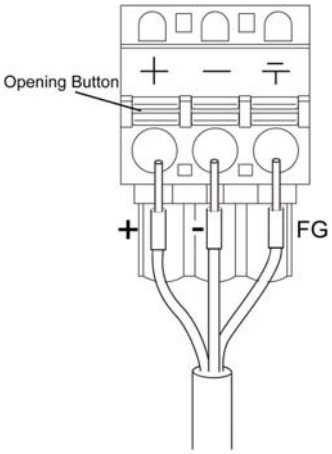


HMIGTO5310/5315 / HMIGTO6310/6315



Connection	Wire
+	24 Vdc
-	0 Vdc
FG	Grounded terminal connected to the panel chassis.

How to connect the DC Power Cord

Step	Action
1	Confirm the power cord is not connected to the power supply.
2	Check the rated voltage and remove the “DC24V” sticker on the DC power supply connector.
3	Remove 10 mm (0.39 in.) of the vinyl membrane off the ends of the power cord wires.
4	If using stranded wire, twist the ends. Tinning the ends with solder reduces risk of fraying and ensures good electrical transfer.
5	Push the Opening button with a small and flat screwdriver to open the desired pin hole.
6	Insert each pin terminal into its corresponding hole. Release the Opening button to clamp the pin in place. HMIGTO1300/1310 / HMIGTO2300/2310/2315 / HMIGTO3510/4310  HMIGTO5310/5315 / HMIGTO6310/6315 
7	After inserting all three pins, insert the power plug into the power connector on the panel.

NOTE:

- Do not solder the wire directly to the power receptacle pin.
- To prevent the possibility of a terminal short, use a pin terminal that has an insulating sleeve.
- You can connect the DC power supply connector for HMIGTO1300/1310, HMIGTO2300/2310/2315, or HMIGTO3510/4310 to HMIGTO5310/5315 or HMIGTO6310/6315 units. However, the reverse is not possible. You cannot connect the DC power supply connector for HMIGTO5310/5315 or HMIGTO6310/6315 to HMIGTO1300/1310, HMIGTO2300/2310/2315, or HMIGTO3510/4310 units.

Connecting the Power Supply

Precautions

- You must use a 24 Vdc input unit with a Class 2 power supply.
- To increase the electromagnetic noise resistance, make sure you twist the ends of the power cord wires before connecting them to the power plug.
- The panel's power supply cord should not be bundled with or kept close to main circuit lines (high voltage, high current), or input/output signal lines.
- Connect a lightning surge absorber to handle power surges.
- To reduce electromagnetic noise, make the power cord as short as possible.

⚠ WARNING

SHORT CIRCUIT, FIRE, OR UNINTENDED EQUIPMENT OPERATION

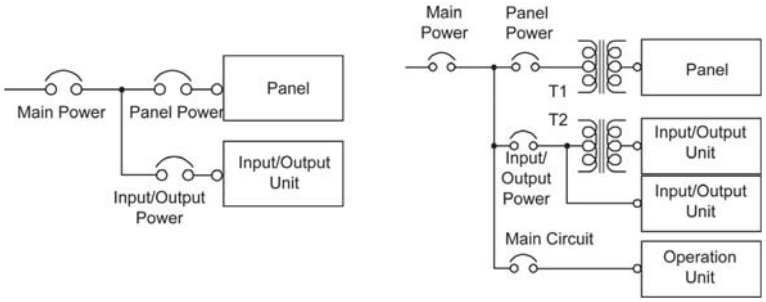
Avoid excessive force on the power cable to prevent accidental disconnection

- Securely attach power cables to the HMIGTO or cabinet.
- Use the designated torque to tighten the unit terminal block screws.
- Install and fasten the HMIGTO on installation panel or cabinet prior to connecting power supply and communication lines.

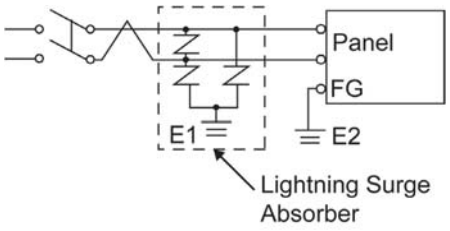
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Power Supply Connections

When supplying power to the panel, separate the input/output and power lines, as shown.

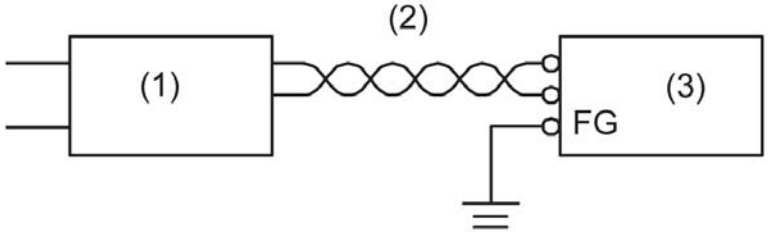


NOTE:
The following shows a lightning surge absorber connection:



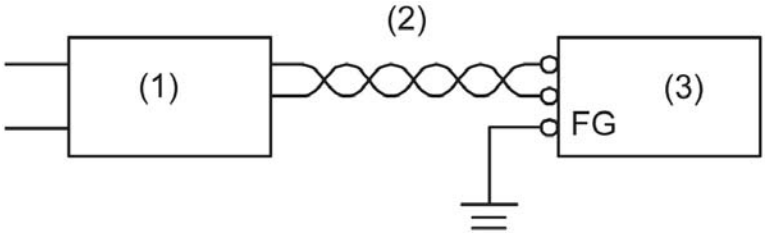
- Ground the surge absorber (E1) separately from the panel (E2).
- Select a surge absorber that has a maximum circuit voltage greater than that of the peak voltage of the power supply.

If the supplied voltage exceeds the panel range, connect a constant voltage transformer.



1 Constant voltage transformer
2 Twisted-pair cord
3 panel

Select a power supply low in noise for between the line and ground. If there is an excess amount of noise, connect an insulating transformer.



1 Insulating transformer
2 Twisted-pair cord
3 panel

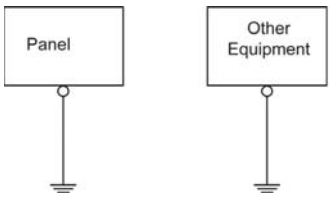
NOTE: Use constant voltage and insulating transformers with capacities exceeding the Power Consumption value.

Grounding

Exclusive Grounding

When supplying power to the panel, separate the input/output and power lines as shown below.

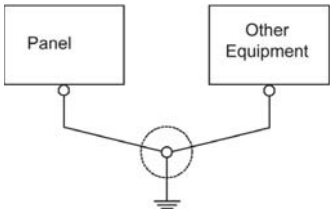
Connect the frame ground (FG) terminal on the power plug to an exclusive ground.



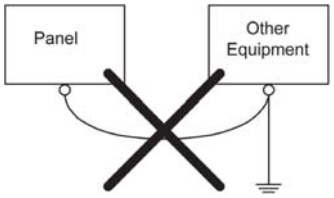
Precautions

Electromagnetic Interference (EMI) can be created if the devices are improperly grounded. EMI can cause loss of communication. Do not use common grounding, except for the authorized configuration described below. If exclusive grounding is not possible, use a common grounding point.

Correct grounding



Incorrect grounding



- Check that the grounding resistance is 100 Ω or less.[*1]
- The FG wire should have a cross sectional area greater than 2 mm^2 (AWG 14) [(1)]. Create the connection point as close to the panel as possible, and make the wire as short as possible. When using a long grounding wire, replace the thin wire with a thicker wire, and place it in a duct.
- FG and SG terminals are internally connected in the panel. When connecting an external device to the panel using the SG terminal, check that you do not create a short-circuit loop when you set up the system.

[*1] Observe local codes and standards. Ensure the ground connection has a resistance of 100 Ω and that the ground wire has a cross-section of at least 2 mm^2 or AWG 14.

Section 5.3
SD Card Insertion/Removal

What Is in This Section?

This section contains the following topics:

Topic	Page
Introduction	132
Inserting the SD Card	133
Removing the SD Card	134
SD Card Data Backup	135

Introduction

NOTICE

LOSS OF DATA

When using the HMIGTO and a SD Card, observe the following to avoid losing valuable data:

- Since accidental data loss can occur at any time, back up HMIGTO screen and SD Card data regularly. Once HMIGTO data is lost, it cannot be recovered.
- While a SD Card is accessed, do not turn OFF or reset the HMIGTO, and do not insert or remove the SD Card. Doing so could damage the SD Card, or corrupt its data.
- Before using the SD Card, familiarize yourself with the SD Card's front and rear face orientation, as well as the position of the SD Card connectors. If the SD Card is not positioned correctly when inserted into the HMIGTO, the card's internal data and HMIGTO could become damaged.

Failure to follow these instructions can result in equipment damage.

NOTICE

LOSS OF DATA

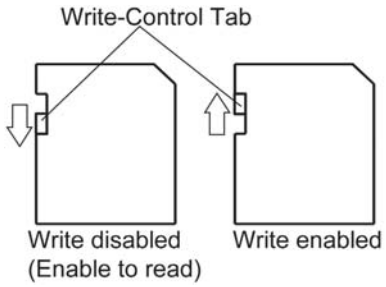
When handling the SD Card, follow the instructions below to prevent internal data on the SD Card from being destroyed or a SD Card malfunction from occurring:

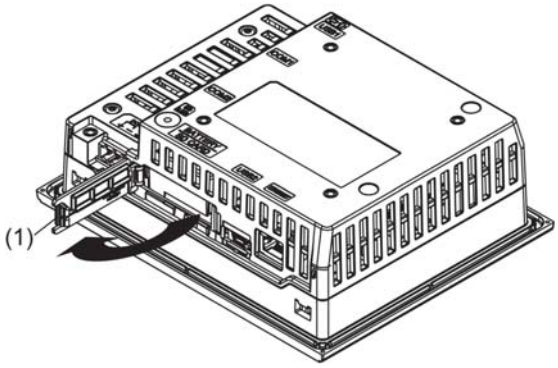
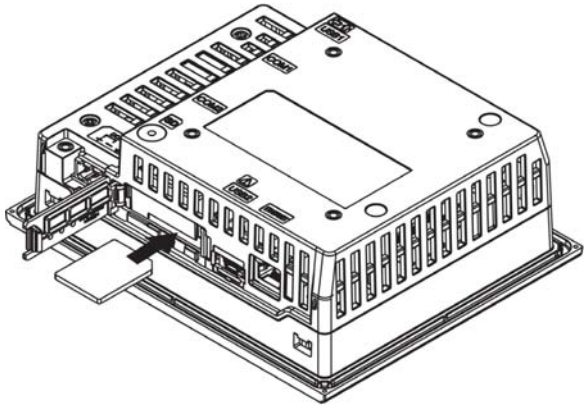
- Avoid storing the SD Card where there is static electricity or electromagnetic waves.
- Avoid storing the SD Card in direct sunlight, near a heater, or other locations where high temperatures can occur.
- Do not bend the SD Card.
- Do not drop or strike the SD Card against another object.
- Keep the SD Card dry.
- Do not touch the SD Card connectors.
- Do not disassemble or modify the SD Card.
- Use only SD Cards formatted using FAT or FAT32. The HMIGTO does not recognize NTFS formatted SD Cards. Format the SD Card on your computer using FAT or FAT32.

Failure to follow these instructions can result in equipment damage.

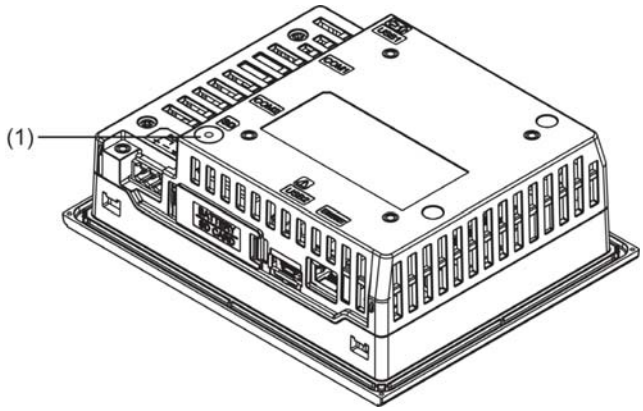
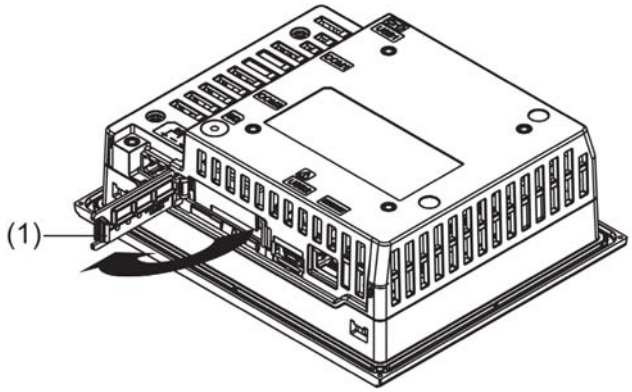
Inserting the SD Card

NOTE: As shown in the image below (example on the left-hand side), you can set the Write-Control Tab to prevent write operations to the SD Card. Push the tab up, as shown in the example on the right-hand side, to release the lock and enable writing to the SD Card. Before using a commercial-type SD Card, read the manufacturer's instructions.



Step	Action
1	Pull on the tab and open the SD Card cover.  **1** Tab
2	Insert the SD Card into the SD Card interface, and push until you hear it "click". 
3	Close the SD Card cover.

Removing the SD Card

Step	Action
1	Make sure the SD Card Access LED is off.  **1** SD Card Access LED
2	Push down the tab on the SD Card cover, then pull open the cover.  **1** Tab
3	Push the SD Card once to release, and pull out the card. After removing the card, close the cover. **NOTE:** After using the SD Card, store the SD Card in its case or other safe location.

SD Card Data Backup

To make your backups, you can either insert the SD Card directly into the SD Card interface on your computer, or use a commercially available SD Card reader.

Section 5.4
USB Cable Clamp

Overview

This section presents the USB cable clamp.

What Is in This Section?

This section contains the following topics:

Topic	Page
USB Cable Clamp for USB (Type A)	137
USB Holder for USB (mini-B)	139

USB Cable Clamp for USB (Type A)

Introduction

When using a USB device, attaching a USB cable clamp to the USB interface to prevent the USB cable from being disconnected.

⚠ DANGER

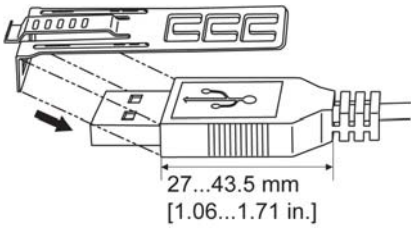
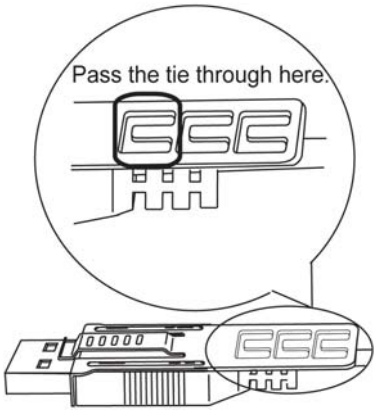
POTENTIAL FOR EXPLOSION

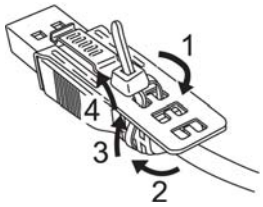
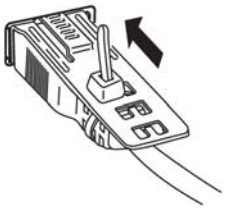
- Verify the power, input, and output (I/O) wiring are in accordance with Class I, Division 2 wiring methods.
- Substitution of any components may impair suitability for Class I, Division 2.
- Confirm that the USB cable has been fixed with the USB cable clamp before using the USB interface.
- Remove power before attaching or detaching any connectors to or from the unit.

Failure to follow these instructions will result in death or serious injury.

Attaching the USB Cable Clamp

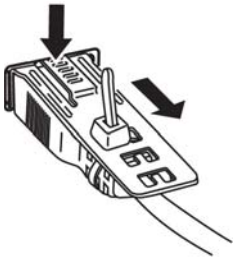
NOTE: Watch your fingers. The edge of the clip is sharp.

Step	Action
1	Mount the clip to the USB mark connector shell so that it overlaps. The clip matches the 27 to 43.5 mm [1.06 to 1.71 in.] length of the USB connector. 
2	Align the clip and the USB cable connector shell. Adjust the position of the holes where the clip is attached. To ensure stability, select the clip-hole position that is closest to the base of the connector shell. 

Step	Action
3	As shown, pass the tie through the clip hole. Next, turn the tie and pass it through the head so that the USB cable can pass through the center of the tie loop. The clip is now attached to the USB cable.  **NOTE:** ● Check the direction of the head beforehand. Make sure the USB cable is through the center of the tie loop and that the tie can pass through the head. ● You can substitute the tie provided with commercially available ties with a width of 4.8 mm [0.19 in.] and thickness of 1.3 mm [0.05 in.].
4	While pressing the grip on the clip, insert the cable from step 3 all the way into the USB host interface. Make sure that the clip tab is secured to the USB cable attached to the HMIGTO. 

Removing the USB Cable

Remove the USB cable while pushing the grip section of the clip.



USB Holder for USB (mini-B)

Introduction

When using a USB device, you can attach a USB holder to the USB (mini-B) interface to prevent the USB cable from being disconnected.

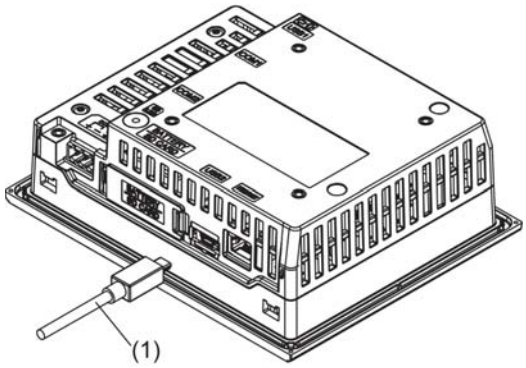
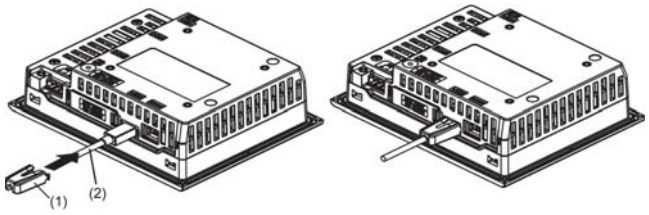
⚠ DANGER

POTENTIAL FOR EXPLOSION

- Verify the power, input, and output (I/O) wiring are in accordance with Class I, Division 2 wiring methods.
- Substitution of any components may impair suitability for Class I, Division 2.
- Confirm that the USB cable has been fixed with the USB cable clamp before using the USB interface.
- Remove power before attaching or detaching any connectors to or from the unit.

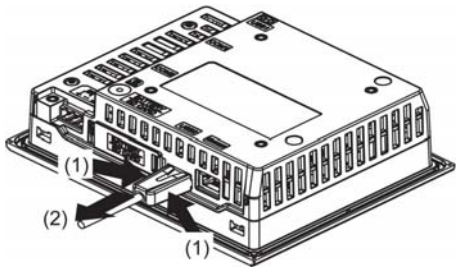
Failure to follow these instructions will result in death or serious injury.

Attaching the USB Holder

Step	Action
1	Insert the USB cable into the USB (mini-B) interface.  **1** USB cable
2	Attach the USB holder to fix the USB cable in place. Insert the USB holder into the USB (mini-B) interface.  **1** USB holder **2** USB cable

Removing the USB Holder

Remove the USB holder by pressing the tabs from the sides.



1 USB holder
2 USB cable

Chapter 6
Maintenance

Overview

This chapter explains how to maintain your panel.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Regular Cleaning	142
Replacing the Installation Gasket	143
Periodic Check Points	145
Replacing the Primary Battery	146

Regular Cleaning

Cleaning the display

NOTICE
EQUIPMENT DAMAGE ● Power off the panel before cleaning it. ● Do not use hard or pointed objects to operate the touch panel as you may damage the panel surface. ● Do not use paint thinner, organic solvents, or a strong acid compound to clean the unit. **Failure to follow these instructions can result in equipment damage.**

When the surface or the frame of the display gets dirty, soak a soft cloth in water with a neutral detergent, wring the cloth tightly and wipe the display.

Replacing the Installation Gasket

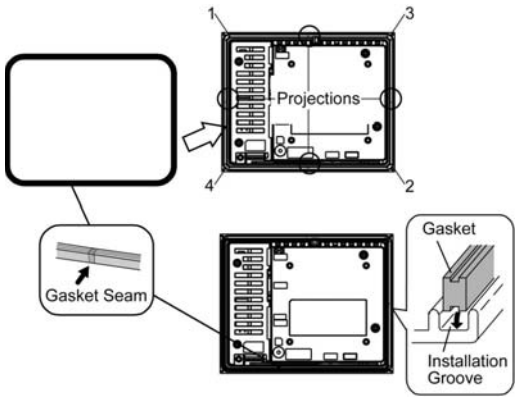
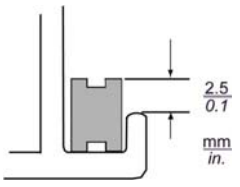
Overview

The installation gasket provides protection against dust and moisture.

NOTICE
GASKET AGING ● Inspect the gasket periodically as required by your operating environment to keep the initial IP level. ● Change the gasket at least once a year, or as soon as scratches or dirt become visible. **Failure to follow these instructions can result in equipment damage.**

Installing the Installation Gasket

NOTE: For instructions on how to install the installation gasket when using HMIGTO2315/HMIGTO5315/HMIGTO6315, see HMIGTO2315/HMIGTO5315/HMIGTO6315 Panel Mounting Procedure *(see page 123)*.

Stage	Description
1	Place the panel on a flat, level surface, with the display face pointing down.
2	Remove the gasket from the panel.
3	Attach the new gasket to the panel. Position the gasket in the installation groove so that the gasket seam is at the bottom of the panel. First, insert the gasket into the 4 corners, in the order shown in the image below. Then, insert the rest of the gasket into the installation groove. **NOTE:** ● The center of the panel bezel's installation groove is ribbed. Make sure you insert the gasket all the way in without catching the ribbed sections. ● When using a tool to insert the gasket, make sure the tool does not catch the rubber gasket and cause a tear. 
4	The upper surface of the gasket should protrude approximately 2.0 mm (0.06 in.) from the groove. Check the gasket is inserted correctly before installing the HMIGTO into a panel. 

The gasket must be inserted correctly into the groove for IP65f moisture resistance for the panel. (IP66k moisture resistance for HMIGTO2315/HMIGTO5315/HMIGTO6315.)

⚠ CAUTION

EQUIPMENT DAMAGE

- Since the gasket is flexible but not elastic, be careful not to stretch it unnecessarily.
- Make sure the gasket seam is not inserted into any of the panel corners.
- Insert the gasket in the installation groove

Failure to follow these instructions can result in injury or equipment damage.

Periodic Check Points

Operation Environment

- Is the operating temperature within the allowable range? Refer to Environmental Specifications *(see page 38)*, *(see page 52)*, *(see page 70)*, *(see page 86)*, *(see page 103)*.
- Is the operating humidity within the specified range? (10%RH to 90%RH, dry bulb temperature of 39 °C [102.2 °F] or less)
- Is the operating atmosphere free of corrosive gasses?

When the HMIGTO is inside a panel, the ambient environment refers to the interior of the panel.

Electrical Specifications

Is the input voltage appropriate?

- 100 Vac to 240 Vac 50/60 Hz
- 19.2 Vdc to 28.8 Vdc

Related Items

- Are all power cords and cables connected properly? Are there any loose cables?
- Are all mounting brackets holding the unit securely?
- Are there scratches or traces of dirt on the installation gasket?

Replacing the Primary Battery

Introduction

The replacement battery HMI ZGBAT (sold separately) for the primary battery in the HMIGTO is available from Schneider Electric.

NOTE: The HMIGTO1300/1310 and HMIGTO2300 are not equipped with a primary battery.

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Follow the procedures step by step to replace the battery correctly and safely.
- Before replacing the battery, turn OFF the HMIGTO's power.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

EXPLOSION, FIRE, OR CHEMICAL HAZARD

- Use only the replacement battery HMI ZGBAT manufactured by Schneider Electric.
- Do not cause a short circuit.
- Recycle or properly dispose of used batteries.

Failure to follow these instructions will result in death or serious injury.

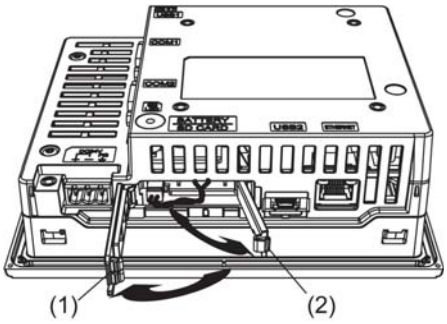
NOTICE

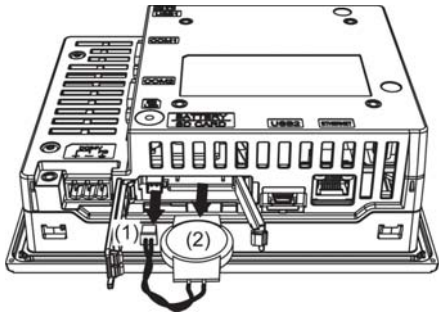
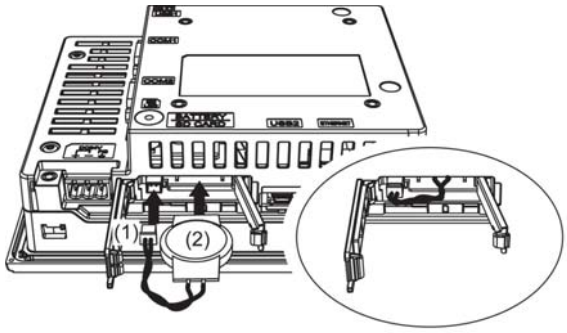
LOSS OF DATA

The primary battery is non-rechargeable, and is used for data backup of memory and the internal clock. If the primary battery is depleted, the backup data is lost. One month before the primary battery is completely depleted, a message will appear to indicate it is time to replace the primary battery.

- Replace the battery within one month after the message appears. Otherwise, backup data may be lost.
- Complete replacing the battery within ten minutes of shutting down the HMIGTO.
- The primary battery replacement time (within a month after the message appears) is only a guideline. When backup SRAM data and clock data is lost after the message appears, Schneider Electric does not perform data recovery/retrieval. Schneider Electric does not accept any responsibility for the loss of data.
- Replace the primary battery regularly every five years after you purchase the HMIGTO.

Failure to follow these instructions can result in equipment damage.

Step	Action
1	Disconnect the power supply from the HMIGTO.
2	Touch the housing or ground connection (not the power supply) to discharge any electrostatic charge from your body.
3	Open the SD Card Interface Cover by pressing its tab. Next, open the Replacement Battery Insertion Cover by pressing its tab.  **1** SD Card Interface Cover / Tab **2** Replacement Battery Insertion Cover / Tab

Step	Action
4	Remove the primary battery and connector.  **1** Connector **2** Primary battery
5	Attach the new primary battery and connector. 
6	First close the replacement battery cover, then close the SD Card Interface Cover. **NOTE:** Make sure the cables are inserted completely inside the enclosure. Otherwise, you can damage the cables when you close the cover.
7	Reconnect the power supply to the HMIGTO.

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LS	19279	Switch, Level, Mech Float, Narrow Angle, N.C., YEL	N/C, Yellow float
LS	M1343	Switch, Level, Mech Float, Narrow Angle, N.O., Blue	Tilt Float Level Switch w 40' cable
LS-101/2/3	19279	Switch, Level, Mech Float, Narrow Angle, N.C., YEL	N/C, Yellow float
LSHH-101.102/103 LSHH-301 LSHH-401 LSHH-501 LSHH-502 LSHH-601/602	19279	Switch, Level, Mech Float, Narrow Angle, N.C., YEL	N/C, Yellow float
LSLL-301/401/501/502	M1108	Switch, Level, Mech Float, Wide Angle, N.O., Red	13A, SPST, N/O, Red

Form 237
Sheet P/N 7801165
Rev. D

Warrick®
Series M Mechanical Tilt Float Switch
Installation and Operation Bulletin

Specifications

Cord	16 gauge, 2 or 3 conductor SJOW, Oil Resistant CPE
Contact Rating	13 amp @ 120/240 VAC, 1/2hp
Contact Design	SPST, Normally Open or Normally Closed, Common with N.O. & N.C. (Form C)
Temperature Rating	32°F (0°C) to 194°F (90°C) Dry and 140°F (60°C) Water Resistant
Overall Weight	1.0 lbs. (not including weight)
Tether Method	Tie-wrap nylon, weight: 2.5 lbs.
Approvals	U.L. Recognized, CSA Certified

Installation

Tether Tie-Wrap (Fig 1)
Attach cord, using a tie-wrap, to a stationary structure. This is known as the tether point, it will determine the pumping range. The farther the float is placed from the tether point, the greater the pumping range. The minimum distance that the float should be placed from the tether point is 3 inches.

Tether-Weight (Fig 2)
Place tension-brand over the cord before installation. Place the weight at the desired position and secure with the tension-band. This position will determine the pumping range. The farther the float is placed from the tether point, the greater the pumping range. The minimum distance that the float should be placed from the tether point is 3 inches.

Determine tether point using charts below as a reference

Notes:
1. To Prevent Motor Burnout - In a pumpdown application make sure the turn-off level is at least 2 inches above the intake of the submersible pump.

2. Securing Tether Points - Make sure levels are correct and that floats are free from any obstructions before securing tether points.

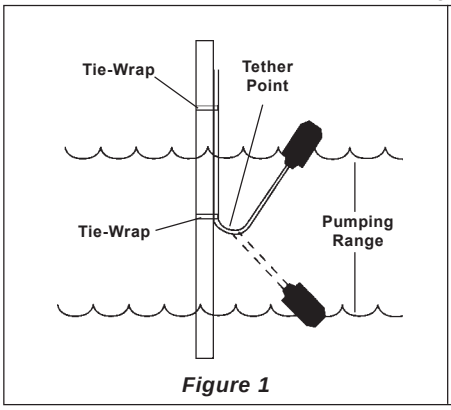


Figure 1

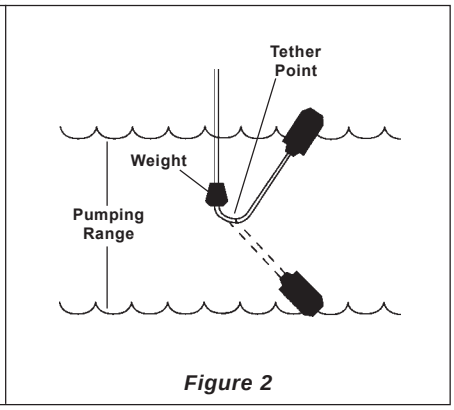
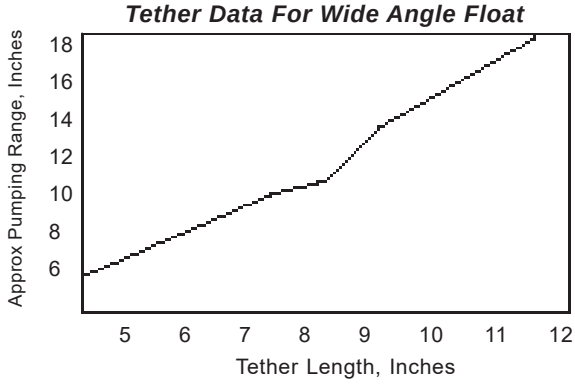
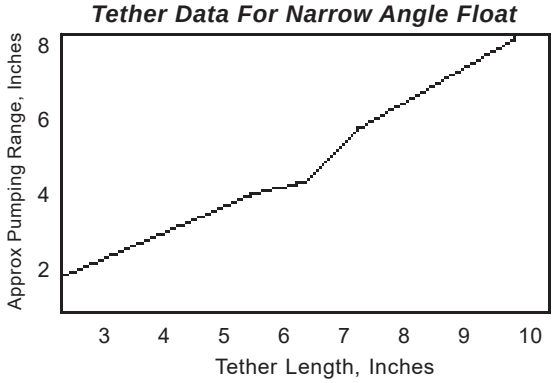


Figure 2

Tether Data For Wide Angle Float

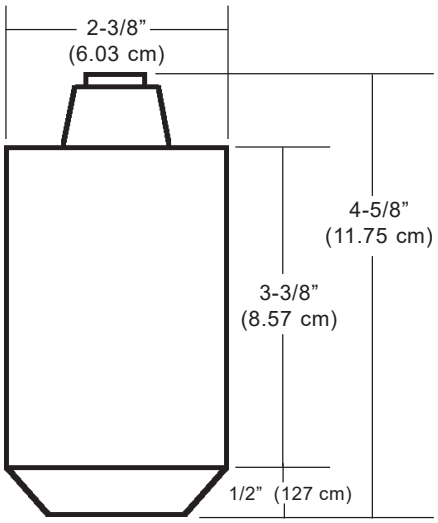


Tether Data For Narrow Angle Float

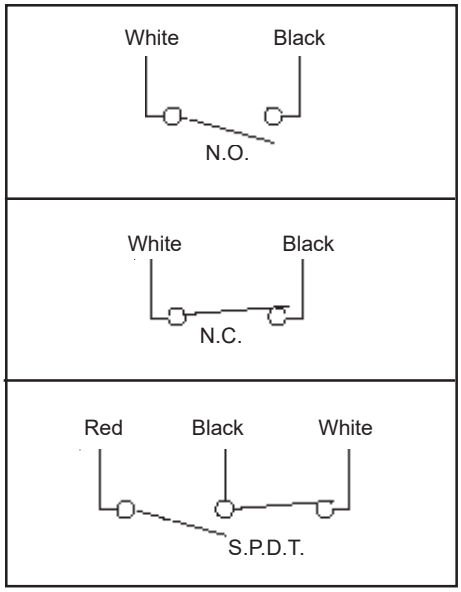


Notes:
1. Narrow angle pumping range is approximately 2 In. to 8 In.
2. Wide angle pumping range is approximately 5 In. to 18 In.

Dimensions



Contact Configurations



Important Points:

- Gems products must be maintained and installed in strict accordance with the National Electrical Code and the applicable Gems Product Instruction Bulletin that covers installation, operation and proper maintenance. Failure to observe this information may result in serious injury or damages.
- For hazardous area applications involving such things as, but not limited to, ignitable mixtures, combustible dust and flammable materials, use an appropriate explosionproof enclosure or intrinsically safe interface device.
- Please adhere to the pressure and temperature limitations shown throughout this catalog for our level and flow sensors. These limitations must not be exceeded. These pressures and temperatures take into consideration possible system surge pressures/temperatures and their frequencies.
- Selection of materials for compatibility with the media is critical to the life and operation of Gems products. Take care in the proper selection of materials of construction, testing is required.
- NSF-approved sensors are made of materials approved for potable water applica tions according to Standard 61.
- Stainless steel is generally regarded as safe by NSF and FDA.
- Life expectancy of switch contacts varies with application. Contact Gems if life cycle testing is required.
- Ambient temperature changes do affect switch set points, since the gravity of a liquid can vary with temperature.
- Our sensors have been designed to resist shock and vibration. However, shock and vibration should be minimized.
- Filter liquid media containing particulate and/or debris to ensure the proper operation of our products.
- Electrical entries and mounting points in an enclosed tank may require liquid/vapor sealing.
- Our sensors must not be field-repaired.
- Physical damage sustained by product may render it unserviceable.

Return Policy

Returns are accepted on stock items up to 30 days from date of order. You must contact our Returns Department for a Return Authorization (RA) number. Return the goods - freight prepaid - in the original container and include original packing slip. C. O. D. returns are not accepted. Gems reserves the right to apply restocking charges.

Tel: 860-793-4357
Fax: 860-793-4563

Gems Sensors Inc.
One Cowles Road
Plainville, CT 06062-1198
Tel: 860-793-4579
Fax: 860-793-4580

LSHH - Switch, Level, Almeg, Vertical, ATB3-48B
LSHH-7901 - "LSLL-301/401/ 501/502"M1108Switch, Level, Mech Float, Wide Angle, N.O., Red13A, SPST, N/O, Red
Switch, Level, Almeg, Vertical, ATB3-48B

ATB 3 and ATS3 Series Spec Sheet
Level Switch - Small Size - Heavy Duty

The ATB3 is designed for high or low level alarm or switch point applications in rugged situations similar to oil tank reservoirs or industry vessels that require a more robust level switch. Notice the larger brass one piece machined hex to get a wrench on - this model also has an optional brass set screw locking collar in place of the clip.

Internal reed switch selection is the same Almeg quality standard but we've beefed up the external part as well as fully encapsulated the reed switch to maintain a complete moisture free environment. The leads are wire wrapped (not clipped) soldered and heat shrink sealed to the reed switch before encapsulating.

The TRUE closed cell Buna float will not swell or take on moisture - even if cut or drilled. It is designed like a tight bee hive or honey comb construction.

100% of our controls are tested before shipping.

The ATB3 is available in a single order or OEM applications.

LT-301/501 - Transmitter, Pressure, KPSI 750 series 0-10ft H20Part Number 750S14D4A004.334000.000B10015B

KPSI®

Level Transducers

KPSI® User's Manual

18th Edition

February 2010

E-688

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Our Company

Pressure Systems is an ISO9001:2000 certified U.S. manufacturer of submersible and non-submersible (above ground) pressure transducers for environmental, industrial and municipal applications. Our KPSI™ Level and Pressure Transducers have been specified in thousands of projects throughout the United States, Canada and Europe by geologists, system integrators, national engineering firms and a variety of government agencies. Typical applications include, but are not limited to, pump control, tank level monitoring, sewage lift station operation, reservoirs, weirs, flumes, site remediation, watershed management, storm water/well monitoring, pump/pipeline pressures and compressor pressures.

Website and E-Mail

You may visit our website at www.PressureSystems.com to look at our latest new product releases, application notes, product certifications and specifications, as well as Intrinsic Safety control installation drawings. E-mail your questions and comments to us: sales@PressureSystems.com.

E-commerce

Orders may be placed on-line by visiting our e-commerce site *(www.LEVELandPRESSURE.com)* or by contacting the factory or local representative.

Applicable Products

This manual provides information applicable to the use of the following KPSI Level and Pressure Transducers:

Please note: Series 500 and Series 550 (waterMONITOR) have separate manuals.

Level Transducers (Submersible)
Series 700/710/720/730/735
Series 320/330/335/340
Series 300DS
Series 705
Series 750

Pressure Transducers (Non-submersible)
Series 27/28/30

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1.0 Product Description

General Characteristics

KPSI™ Level and Pressure Transducers use isolated-diaphragm sensors that are specifically designed for use with hostile fluids and gases. These sensors utilize a silicon pressure cell that has been fitted into a stainless steel or titanium package with an integral, compliant stainless steel or titanium barrier diaphragm. This sensor assembly is housed in a rugged 316 stainless steel or titanium case which provides for a variety of level ranges from 2.3 ft (0.75 m) H_2O through 4614 ft (1408 m) H_2O and pressure inputs from 0-1 (7 kPa) through 0-15000 psi (103 mPa). Our devices feature internal signal conditioning. Standard outputs are 4-20 mA and VDC.

All units containing active electronic components have surge and reverse polarity protection. For ease of use in the field, our transducers are permanently laser engraved with our logo and name, wiring information, part number (P/N), serial number (S/N), date of manufacture (DOM), range, excitation and output. Transducers are offered in diameters of 1.0 (25 mm) and 0.75 inches (19 mm).

Care and Handling

Our transducers are designed for rugged use. However, they need protection from over pressure and sharp impact. When lowering them into a liquid, penetrate the surface slowly and only to the depth necessary. Avoid dropping the unit from above the surface. Clean all transducers by rinsing them in a mild detergent. Direct probing of the diaphragm or attempts to remove protective screens will damage the sensor, voiding the warranty.

Calibration

All transducers are shipped with calibration information unique to each transducer. Make sure you keep each calibration report. However, should you misplace your calibration sheet, you can contact the factory and request a duplicate. All KPSI™ Transducer calibrations are traceable to the National Institute of Standards and Technology (NIST).

Approvals

Most of our products have UL and FM certification for intrinsic safety. Their respective installation control drawings can be downloaded from our website. Several of our product lines also carry ABS approval. Most products are CE compliant to EN 61326-1:2006 and EN 61326-2-3:2006. CE compliant units are labeled accordingly.

2.0 Product Accessories and Options

Nose Caps

There are several different user-installable nose caps for the 700, 710, 720, 730, 735 submersible level transducers. The ported nose cap (Delrin) with #8-32UNC-2B threaded hole is best used where weights are required and for those installations where users may encounter sharp, protruding objects. The open-face nose cap which allows maximum contact with the liquid media is ideal for wastewater and "greasy" applications where clogging of the sensor is a concern. The piezometer nose cap allows the unit to be buried in saturated soil without damage to the sensor diaphragm. The 1/4" male NPT pressure nose cap is not only useful for calibration purposes but also allows the device to be used as a submersible or above ground pressure transducer.

810 SuperDry™ Vent Filter or 815 Aneroid Bellows

All submersible transducers with vented gauge format are supplied with a protective barrier that guards against moisture buildup in the cable vent tube. The 810 SuperDry™ vent filter is installed free of charge and is guaranteed to operate maintenance free for one year. We also offer the 815 Aneroid Bellows as a maintenance free option that can be used on submersibles with accuracies of: ±1%, ±0.5%, or ±0.25% FSO. These barriers ensure reliable operation and long life as they protect sensitive electronic components from mildew and prevent the formation of a liquid column in the vent tube. Any such liquid column directly affects calibration of the transducer.

Sacrificial Anodes

Our sacrificial anodes are made from a special zinc alloy formulated to guarantee continued effectiveness over long periods. Because the anodes are 95% galvanic, they will not corrode unless there is an electrolytic demand. The anode maintains a high driving potential throughout its 12 month life, is self-sluffing and always exposes new zinc for the best possible protection. For those applications where cable buoyancy is a problem, the sacrificial anode can be substituted for hanging weights.

Sacrificial Anodes provide cathodic protection against galvanic corrosion for our submersible pressure transducers. Galvanic corrosion occurs when dissimilar metals are placed in contact with an electrolyte. This condition causes a potential difference to exist between the two metals, causing electron flow between them. Corrosion of the less corrosion-resistant metal is increased and attack of the more resistant metal is decreased. The 820 Sacrificial Anode is clamped to the exterior of a one-inch bore submersible transducer. We also offer a 1" diameter pencil anode, the 825, that attaches to the nose cap of either a 3/4" or 1" bore submersible transducer.

Absolute/Sealed Gage Transducer

The sealed gage option for submersible transducers eliminates the need for a vent filter. The standard output of a sealed gauge transducer is 4 mA at 14.70 psia. Before ordering a sealed gauge transducer, the customer should determine the altitude (above sea level) of the installation and inform PSI's Customer Service of this value before order entry. During manufacture, the output of the transducer will be adjusted to compensate for the altitude difference, if applicable.

Polyurethane & ETFE Jacketed Cable

Most installations of our submersible level transducers connect our polyurethane or ETFE cable to a junction box. From this junction box (P/N 840), users typically run their own cable to the required instrumentation. Polyurethane-jacketed cable is used for most applications while ETFE material is recommended for more aggressive environments.

Specifications for our standard polyurethane and ETFE jacketed cable are as follows:

Specifications	Standard Submersible Cable	Standard Non-Submersible Cable
Weight	0.05 lbs/ft (0.07 kg/m)	0.025 lbs/ft (0.035 kg/m)
Min. OD	0.28" (7.10 mm)	0.189" (4.8 mm)
Max OD	0.31" (7.87 mm)	0.19" (4.9 mm)
Conductors	4 - 22 AWG	22 AWG
Insulation Conductors Outer jacket	PVC Polyurethane or ETFE	Color coded PVC
Shield	36 gauge spiral tinned copper wire foil shield with drain wire	Aluminum/polyester foil facing outward
Vent Tube	Polyethylene, .060" ID (1.52 mm)	Drain wire 7/32 tinned copper

- **Chemical resistance of polyurethane:** Potable Water, Wastewater, Borax, Butane, Animal Fat, Carbonic Acid, Citric Acid, Cod Liver Oil, Corn Oil, Glycerin, Glycol, Mineral Oils, Potassium Nitrate, Potassium Sulfate, Silicone Oils, Stoddard Solvent, Tannic Acid (10), Tartaric Acid, Turbine Oil.

- **Chemical resistance of ETFE:** Acetic Acid (Glacial), Acetic Anhydride, Acetone, Aluminum Chloride, Anti-Freeze, Bromine, Calcium Chloride, Calcium Hydroxide, Chlorine, Copper Chloride, Ferrous Chloride, Hydrochloric Acid, Ketones, Lacquer Thinners, Sulfuric Acid.

The vented cable termination end is specially prepared at the factory to eliminate the potential for moisture migration. Where the lead wires emerge from under the jacket, there's potting material and a shrink tube "boot", every effort should be made to leave this feature intact. Should the cable be longer than needed for the installation, it is recommended that the excess length be accommodated in a service loop and that the potted end of the cable **NOT** be shortened.

The cable attached to this instrument is specifically engineered for submersible applications. The polyurethane outer jacket provides long term reliability under most conditions. The cable should be handled carefully, however, as the jacket may be subject to cutting should it be "raked" over extremely sharp edges. To guard against water incursion should an inadvertent minor cut occur, we have incorporated an exclusive "water block" feature immediately beneath the jacket. The cable is fully shielded, with the shield connected to the metal housing at the transducer end and terminated in a drain wire at the termination or user end. The shield should always be terminated to a good earth ground, unless the transducer is installed in an area where galvanic corrosion is known to be a serious problem.

Lightning Protection

Lightning and surge protection for VDC, SDI-12 and 4-20 mA output are available. This is achieved through the use of 2 protectors, one is integral to the transducer housing and one is provided for the outside line located at the surface and grounded to a DIN-Rail. Please remember this option must be factory installed at the time of order entry or as a factory upgrade. **This option cannot be installed in the field.** Lightning protection is also available for unit only. Contact customer service for details.

Featuring quick response and low clamping voltages, these devices protect against fast rising voltage transients as well as severe current surges associated with lightning discharges up to 20,000 amperes. Following a surge, the protector automatically restores the line to normal operation and awaits the next surge without having to reset a breaker or replace a fuse. The power supply needs to be limited to 150 mA to avoid lock up of the gas tube after a suppression event. **Transducers installed with this option have a lifetime warranty *against damage due to voltage surge***.

Please note: When using the lightning protection option on 4-20 mA products, users should take into account the additional series resistance of this option when selecting the loop power supply. This option will increase total loop resistance by 88 Ohms.

½" Male NPT Conduit Fitting

Submersible level transducers can be attached to a rigid conduit and the cable run through the conduit. To achieve this, all of our submersible transducers can be fitted with an optional ½" NPT male conduit fitting (specify "Electrical Connection Option 4" when ordering) where the cable exits the transducer. This fitting can be mated to a standard rigid conduit.

Electrical Outputs

We offer the industry standard 0-5 VDC and 4-20 mA outputs. In addition we also offer a variety of voltage output ranges.

Reverse Signal Output

For some applications, it is important to know how far the water is from the top of the tank or the surface of the ground. If specified by the customer, our factory can set the transducer so that zero pressure reads full scale electrical output and maximum pressure reads zero electrical output.

Temperature Output

A temperature output option is available for most transducers having 4-20 mA pressure output. The temperature sensor requires an excitation of 9-28 VDC and is calibrated for a temperature range of -20 to 60ºC with an accuracy of ±4ºC.

Output Option 6 (4-20mA output for -20 to 60ºC) (mA Reading x 5) - 40 = Temperature ºC

Example:	Reading is 20mA	(20 x 5) - 40 = 60ºC
	Reading is 12mA	(12 x 5) - 40 = 20ºC
	Reading is 4mA	(4 x 5) - 40 = -20ºC

Cable Hanger

We can supply an optional cable hanger (P/N 12-90-0931) to help end users secure the cable. The cable hanger can be positioned anywhere on the cable by pushing the ends together. Once positioned, the cable hanger expands and provides a snug grip on the cable.

When mounting the transducer in a well casing, the cable hanger can be secured to a hook on the well plate or an eye bolt may be attached to the side of the well casing. The cable hanger loop is then secured to the eye bolt by using any number of types of fasteners. A similar technique can be used when working in stilling wells for surface water level measurement. In this case, the loop-end of the cable hanger can be attached directly to a screw or bolt bored into the still well shelf.

Submersible Cable Splicing Kit

Our field-installable cable splice kit (P/N 830) allows you to splice polyurethane and ETFE submersible cable. It is most commonly used for well applications where the more expensive ETFE cable is required for suspension in corrosive media where the liquid level is fairly shallow, but the well is hundreds of feet in depth. It is also used in emergency situations where cable must be spliced together to get an application up and running.

3.0 Installation & Maintenance Tips

General Installation Procedures

The following is important installation and preventive maintenance information. Our Customer Service or Applications Engineering Support staff can provide additional instruction.

1. **Transducer Anchors:** Most users either suspend our submersible transducers in stilling wells or attach them to rigid conduit. This is done to prevent damage to the transducer from shock caused by water turbulence. It is not advisable to tie your transducer to a pump or to piping, as any problem with the transducer could require that the pump be pulled from the installation. This could prove to be *very expensive*. (Please refer to the Cable Anchoring Schemes drawing in **Appendix A**.)

   Some applications use our optional bracket (P/N 49-06-00PC) to clamp the transducer to a fixed object (i.e., wall, ladder, step) or require the unit to be suspended without any protective still well or attachment device. In all installations, care should be taken to ensure no damage occurs to the cable.

2. **Transducer Submersion:** Damage to submersible cable is one of the most frequent causes of transducer failure. Lower your transducer into the liquid slowly, making sure the cable does not drag over sharp edges and only to the depth necessary. Avoid dropping the unit from the surface. This does not apply to Series 27, 28, and 30 transducers.

3. **SuperDry™ Vent Filter (Desiccant) or Aneroid Bellows Installation** (For submersible transducers vented gage pressure format only) ***Always*** install a desiccant vent filter or aneroid bellows immediately after transducer installation**.** Failure to use one or the other could result in premature failure of the transducer; which would not be covered by warranty. If you use a desiccant filter, you should establish a regular maintenance schedule. You should change your vent filter when it is 75% spent (pink color). Replacement filters are available at a nominal cost from the factory. Do not remove the old vent filter until a new one is available. The most common failure mode of our transducers is moisture and corrosion damage due to lack of use or maintenance of the vent filter. This will allow air into the desiccant filter and allows the transducer to properly vent with changes in barometric pressure.

   To install/replace either the aneroid bellows or the vent filter, simply unplug the old unit from the vent tube and plug the 0.062" x 1" stainless steel connector tube (supplied with each filter or bellows) into the vent tube. (Installation and mounting instructions are supplied with each aneroid bellows and vent filter.) The diagram on page 16 shows typical vent filter and aneroid bellows hookups.

4. **Cable Protection** An inexpensive way to protect the cable from damage is to order the submersible pressure transducer with a ½" conduit attachment. Connect an inexpensive flexible 5/8" garden hose to the ½" conduit fitting with an equally inexpensive female PVC ½" NPT x 3/4" NHT swivel fitting, available at your local hardware store

5. **Bending of Cable** Our polyurethane and ETFE jacketed cables are quite flexible. Care needs to be taken to ensure that when bending the cable to suit your installation you do not crimp the vent tube inside the cable. Consequently, do not bend the cable more than a radius of 1 inch.

6. **Cable Compression** Many users require a compression fitting to secure our ETFE and polyurethane jacketed cable as it enters a junction box. Care needs to be taken that you do not over-tighten the fitting so as to damage the cable.

7. **4-20 mA Wiring** When connecting a 2-wire 4-20 mA transducer to a typical power supply and mA meter, verify that the meter has an input impedance of at least 10 Ohms. If you are unsure of the input impedance, then a 10 Ohm resistor may be placed in series with the meter and transducer. Connect the + (red) lead of the transducer to the + terminal of the power supply. If the 10 Ohm resistor is required, connect it to the - (black) lead of the transducer. Use a short length of 22 AWG or heavier wire to connect the + terminal of the meter to the resistor (if it is required) or the - (black) wire of the transducer. Connect the - terminal of the meter to the - terminal of the power supply with a length of 22 AWG or heavier wire. Connect the drain wire from the transducer to a good earth ground. (See **Appendix**, page **14** for wiring diagram.) Please refer to "**Maximum Cable Lengths and Minimum Supply Voltage**" in **Appendix C**, page **22** to verify minimum loop supply voltage requirements.

8. **VDC Wiring** To connect a 3 wire VDC output transducer to a typical power supply and the voltmeter, connect the - terminal of the power supply to the - input terminal of the meter with a length of 22 AWG or heavier wire. Connect the - excitation (black) lead of the transducer to the - input terminal of the meter. Connect the + input terminal of the meter to the signal lead (white) of the transducer. Connect the + terminal of the power supply to the + lead (red) of the transducer. Connect the drain wire to a good earth ground. (See **Appendix A**, **page 14**.)

9. **The Model 750** comes standard with a field removable diaphragm protector (one-inch or 25 mm standoff). The diaphragm protector can easily be taken off by removing six (6) fasteners located on the bottom of the unit.

10. **Sealed-Gage Transducer Configured For Altitude Above Sea Level** Since sealed-gauge transducers are normally calibrated at sea level, there may be considerable error induced when used at a higher elevation. If the transducer was calibrated without taking into consideration the difference in atmospheric pressure at sea level and the higher elevation, an offset error will occur. In order to eliminate error due to this difference, the customer must identify the elevation where the transducer will be installed. The nominal atmospheric pressure at the location is calculated and the transducer will be ranged accordingly. Not all KPSI Transducers are available in a sealed pressure format. Please refer to the appropriate datasheet for availability.

11. **Position Sensitivity** The transducer should be installed so that the diaphragm located behind the nose cap is oriented in a vertical position, otherwise the unit could exhibit an offset.

General Maintenance Tips for Submersible Transducers

1. **Desiccant Maintenance**

If you use a desiccant vent filter, you should establish a regular maintenance schedule. You should change your vent filter when it is 75% spent (pink color). Replacement filters are available at a nominal cost from the factory. Do not remove the old vent filter until a new one is available. Remember that Pressure Systems' improved 810 SuperDry™ Vent Filter are designed to be effective for at least one year before requiring replacement.

2. **Clogged Nose Piece or Dirty Diaphragm**

Either of these conditions could result in erroneous readings from your transducer.

Your transducer may be cleaned in accordance with the procedures listed in step 4, below.

3. **Cleaning your transducer**

Materials required:

- Plastic bowls 8-12 inches (200-300 mm) in diameter and 4-6 inches (100 - 150 mm) deep
- Supply of clean, lint-free cleaning rags
- 32 ounce bottle of "The Works-Tub and Shower Cleaner" (a mild detergent) manufactured by Lime-O-Sol Company in Ashley, IN 46705 and available locally through Wal-Mart, K-Mart, Target, and Ace Hardware stores at $2 to $4 per bottle

Preparation: Prior to cleaning your pressure transducer, ensure that all procedures have been followed in the proper cleaning of the cable and transducer to remove any hazardous materials. The vent filter (or bellows) must be properly attached. The cable should be coiled to ensure ease of handling and it must be protected against the possibility of accidental abrasion and/or penetration of the cable jacket by sharp objects. A lead length of 1 to 1 ½ feet (0.3 - 0.45 m) of cable from the transducer should be allowed to facilitate handling during cleaning. The protective covering (or similar protective device) that is shipped with each transducer should be attached to the transducer at all times. It should only be removed prior to installation or cleaning.

Your work surface needs to be clean and free of clutter and large enough to accommodate all materials required in addition to the transducer and cable. Fill one of the bowls with fresh water, one with a mild detergent mixed with water and the last with 16 ounces (0.45 kg) of "The Works".

Cleaning:

Step 1: Holding the cable 6 inches (150 mm) from the transducer, immerse the unit in the bowl containing the mild detergent and stir for 20-30 seconds. Remove and rinse in the bowl containing the fresh water, using the same stirring motion used in the mild detergent. Rinse and wipe dry.

Step 2: Holding the body of the transducer with one hand so that you are looking at the retaining screen protecting the sensor, carefully remove the sensor nose piece by simply unscrewing it from the transducer body. *Do not touch the sensor diaphragm with your finger or any other object. Also, do not try to dry the inside portion of the transducer, as you risk damaging the pressure sensor*.

Step 3: Place the transducer in a vertical position with the sensing end facing downward in the bowl containing "The Works" solution for approximately 15-20 seconds. Rinse in the bowl containing clean water and wipe dry the external casing only. Place the protective screen in the same solution for 15-20 seconds, rinse and wipe dry.

Step 4: Holding the transducer in a vertical position so that you can see the face of the sensor, screw the protective nose piece back into place.

4. Cleaning the Lightning Protection Data Line Protector

4.0 Warranty and Product Return Procedure

Any transducer/transmitter that is less than 2 years old (see DOM) which does not meet the product's specifications and exhibits **no obvious physical damage to the housing, sensor, or cable (cuts),** will be replaced under warranty.

Units 2-3 years old: Units that fall within this age group and exhibit no obvious physical damage to the housing, sensor, or cable (cuts), may be replaced at a discounted list price.

Units greater than 3 years old: Units that fall within this age group are not replaced under warranty.

Merchandise Return Procedures

Contact the **Applications Support Group** or the **Customer Service Department** at Pressure Systems if your transducer is not operating properly. Our staff is available for troubleshooting at **(757) 865-1243** or toll free at **1-800-328-3665** during normal working hours, Eastern time. If your transducer or accessory needs to be returned to Pressure Systems, obtain a *Returned Merchandise Authorization* (RMA) from the Customer Service Department prior to shipment. Be prepared to supply the following information when requesting the RMA:

- Part number
- Serial number
- Complete description of problems/symptoms
- **Bill To** and **Ship To** address
- Purchase order number (not required for warranty repairs)
- Customer contact and telephone number

The above information, including the RMA number, must be on the customer's shipping documents that accompany the equipment to be repaired. Pressure Systems also requests that the outside of the shipping container be labeled with the RMA number to assist in tracking the repairs. All equipment should be sent to the following address:

ATTN: KPSI TRANSDUCER REPAIR DEPARTMENT (7-digit RMA number)
Pressure Systems, Inc.
34 Research Drive
Hampton, Virginia 23666

Prior to returning to Pressure Systems, the transducer and cable must be cleaned per instructions provided on the cleaning certificate supplied when the transducer was delivered. The certificate can also be found on Pressure Systems website:

www.PressureSystems.com/cleaning.html

The completed certificate must accompany the transducer when shipped to Pressure Systems. If the transducer has been used in media other than potable water, PSI customer service must be notified at the same time an RMA number is requested. PSI reserves the right to reject any shipment deemed to be unsanitary or environmentally unsafe to handle. If these guidelines are not met, the package will be sent back unopened and at the customer's expense. ***Please***

include the attached vent filter or aneroid bellow with each returned vented gage submersible transducer.

Pressure Systems will return warranty items prepaid via UPS GROUND. If the customer desires another method of return shipment, Pressure Systems will prepay and add the shipping charges to the repair bill.

Incoming freight charges are the customer's responsibility. The customer is also responsible for shipping charges to and from Pressure Systems for all equipment not under warranty.

Once the return is received, it typically takes 5-10 working days for the technician to make a fault determination.

A cable reconnect fee will be charged when the customer requests a different length of cable.

Restocking Policy

Pressure Systems does allow standard products to be returned for credit in the event it is no longer required, providing the products are in new and unused condition. A restocking fee will be assessed depending on the model type and variety.

A **25% restocking fee** applies to the following models, providing they are vented-gage reference format and [pressure ranges above 3 psig (20 kPa) and below 100 psig (690 kPa)].

27	320	700	710
28	342	705	720
Display Meters - all models			750

A **50% restocking fee** applies to the following models. This also applies to all other models with sealed-gage and absolute pressure formats as well as vented-gage reference formats with [pressure ranges below 3 psig (20 kPa) and above 100 psig (690 kPa)].

30	335
300DS	730
330	735

NOTE: Expedite premiums and shipping charges are non-refundable.

Please consult the individual manuals for the Series 500 and Series 550 (waterMONITOR) for the restocking policy.

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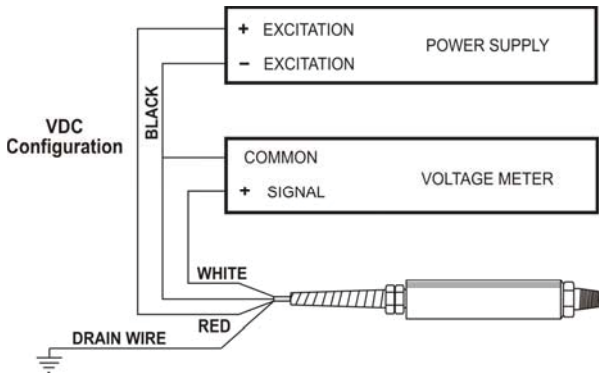
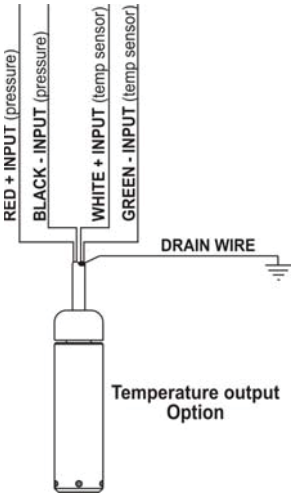
Appendix A

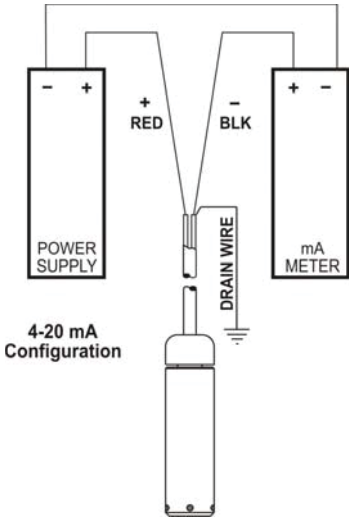
Drawings and Diagrams

Wiring Diagram VDC, mA, and Temp Output 14
Cable Anchoring Schemes 15
Reference Connection Schemes 16
Submersible Cable Termination 17

Wiring Diagram VDC, mA, and Temp Output





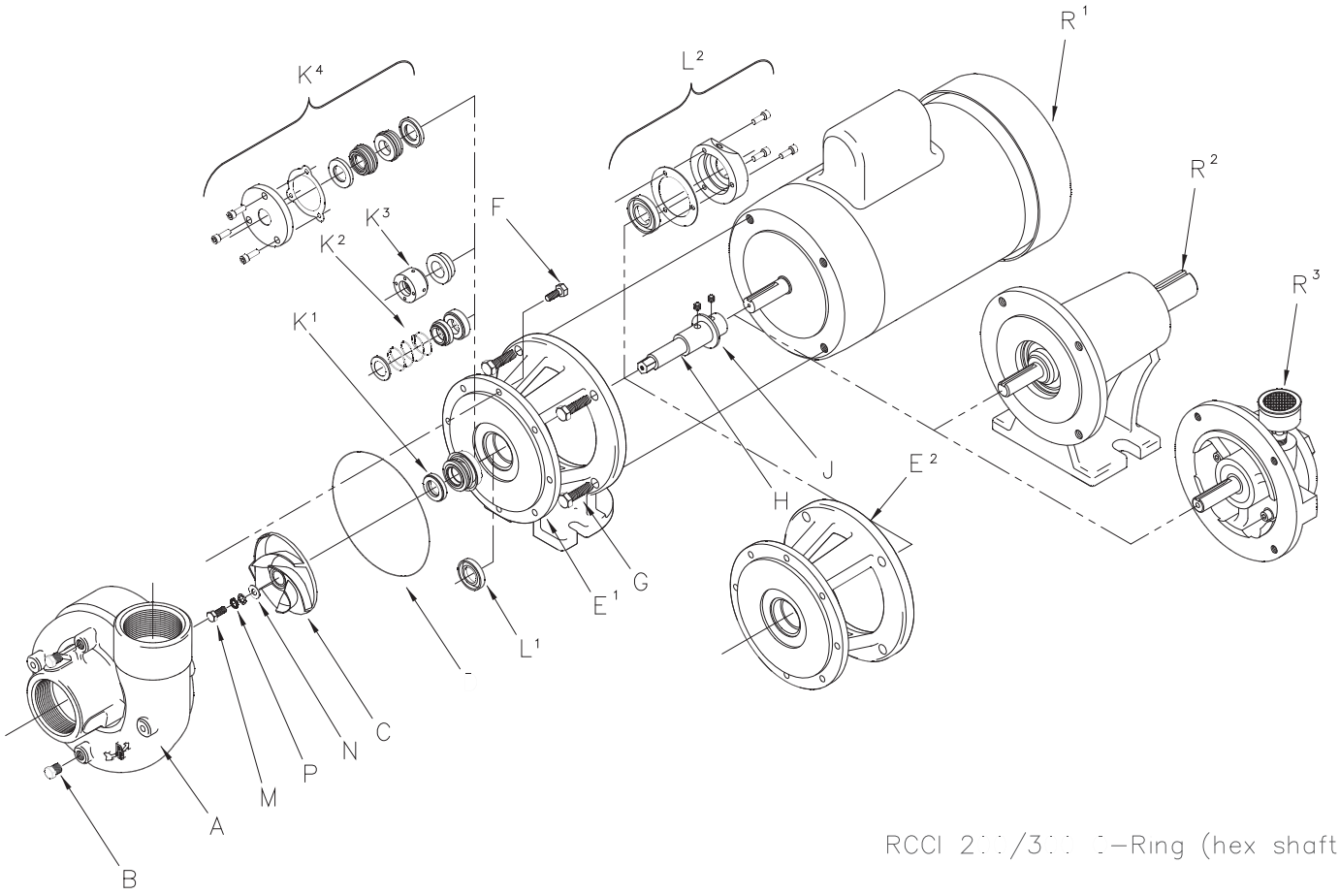


Notes:

1. These diagrams depict typical installations. Refer to your power supply and instrumentation Manufacturer for the specifics of your application.

PRICE® PUMP CO.

RCCI_P.dwg rev. C



RCCI 2::/3:: :-Ring (hex shaft)

Price® Pump C:.
21775 Eighth Street East * Sonoma, CA 95476-0329 * (707) 938-8441 * Fax (707) 938-0764

PRICE CENTRIFUGAL PUMP CAUTIONS & WARNINGS

- **CAUTION:** Price Pump centrifugal pumps must be operated above minimum flow rate to avoid damage.
- **CAUTION:** All Price Pump centrifugal pumps require the suction to be flooded.
- **CAUTION:** It is recommended that all piping connections to the pump be flexible.
- **WARNNING:** Verify chemical compatibility of the pump materials of construction with the fluid being pumped.
- **WARNNING:** Price centrifugal pumps are not designed for use in sanitary or food applications.
- **CAUTION:** Use only Price Pump original equipment factory replacement parts.
- **WARNNING:** Price pump fluid temperature limits must be observed. Maximum operating temperature is 300°F.
- **CAUTION:** The pump should be thoroughly flushed and drained before disassembly.
- **CAUTION:** For larger pump motor units, weight may exceed 65 1bs. (30 kg).

CAUTION: Maximum working pressure for seals:

- Type 6 Seal **75 PSI** (5.2 bar)
- Type 6A Seal **75 PSI** (5.2 bar)
- Type 8 Seal **325 PSI** (22.4 bar)
- Type 9 Seal **350 PSI** (24.1 bar)
- Type 21 Seal **150 PSI** (10.3 bar)
- Type 2106 Seal **150 PSI** (10.3 bar)

CAUTION: Maximum solid size by pump

- HP75 / MS50 **0.030"** (0.76mm)
- SP150 **0.060"** (1.50mm)
- LT25 **0.120"** (3.05mm)
- F50/75/95 **0.150"** (3.81mm)
- OH75 **0.150"** (3.81mm)
- CD100/150 **0.150"** (3.81mm)
- CL150 **0.150"** (3.81mm)
- RC200/300 **0.380"** (9.60mm)
- XJ-JB100 **0.120"** (3.05mm)
- XJ-JB150 **0.250"** (6.40mm)
- XJ-JB200 **0.440"** (11.2mm)
- XL-XT100 **0.120"** (3.05mm)
- XL-XT150 **0.250"** (6.40mm)
- XL-XT200 **0.440"** (11.2mm)

- HP75 / MS50 **0.5 GPM** (1.9 LPM)
- SP150 **10 GPM** (38 LPM)
- LT25 **0.5 GPM** (1.9 LPM)
- F50/75/95 **5.0 GPM** (19 LPM)
- OH75 **7.0 GPM** (26 LPM)
- CD100 **12 GPM** (45 LPM)
- CD150 **25 GPM** (94 LPM)
- CL150 **40 GPM** (150 LPM)
- RC200 **10 GPM** (38 LPM)
- RC300 **50 GPM** (189 LPM)
- XJ-JB150 **20 GPM** (75 LPM)
- XJ-JB150 **40 GPM** (150 LPM)
- XJ-JB200 **90 GPM** (340 LPM)
- XL-XT100 **10 GPM** (38 LPM)
- XL-XT150 **35 GPM** (132 LPM)
- XL-XT200 **50 GPM** (189 LPM)

GENERAL TERMS OF SALE FOR PRODUCTS

1. GENERAL

A. Seller's price is based on these sales terms and conditions. The agreement and inclusion of other or amended terms in this contract will result in a change (including increase) in Seller's pric e (as may be contained in any price books or quotations) to reflect such other or amended terms . This contract shall represent the final, complete and exclusive statement of the agreement between the parties and may not be modified, supplemented, explained or waived by parole evidence, any Terms and Conditions contained in Buyer's purchase order or request for quotation, any course of dealings between the parties, Seller's performance or delivery, or in any other way. The Terms and Conditions of this contr act may only be modified or waived in a written document signed by an Officer of Seller. These terms are intended to cover all activity of Seller and Buyer hereunder, including sales and use of products, parts and work and all related matters (references t o products include parts and references to work include construction, installation and start -up). Any reference by Seller to Buyer's specifications and similar requirements are only to describe the products and work covered hereby and no warranties or oth er terms therein shall have any force of effect. Any information provided by Seller including, but not limited to, suggestions as to specific equipment does not imply any guarantee of specific suitability and/or material compatibility in a particular appl ication, since many factors outside the control of Seller may affect the suitability of products in a particular application. Catalogs, circulars, similar pamphlets and information contained on websites of the Seller are issued for general information pur poses only and shall not be deemed to modify the provisions hereof.

B. The agreement formed hereby and the language herein shall be construed and enforced under the Uniform Commercial Code as in effect in the State of California on the date hereof.

2. TAXES

Any sales, use or other similar type taxes imposed on this sale or on this transaction and/or any import or export duties or fees as may be assessed or imposed on or as a result of deliveries under this transaction are not included in the price . Such taxes shall be billed separately to the Buyer. Seller will accept a valid exemption certificate from the Buyer if applicable; however, if an exemption certificate previously accepted is not recognized by the governmental taxing authority involved and the Seller is required to pay the tax covered by such exemption certificate. Buyer agrees to promptly reimburse Seller for the taxes paid.

3. PERFORMANCE, INSPECTION AND ACCEPTANCE

A. Unless Seller specifically assumes installation, construction or start-up responsibility, all products shall be finally inspected and accepted within thirty (30) days after arrival at point of delivery. Where seller has responsibility for installation, construction or start -up all work shall be finally inspected and accepted with thirty (30) days after completion of the applicable work by Seller. All claims whatsoever by Buyer, (including claims for shortages) except only those provided for under the WARRANTY AND LIMITATION OF LIABILITY and PATENTS Clauses, hereof, must be asserted in writing by Buyer within said thirty (30) day period or they are waived. If this contract involves partial performance, all such claims must be asserted within said thirty - (30) day period for each partial performance. There shall be n o revocation of acceptance. Rejection may be only for defects substantially impairing the value of products or work and Buyer's remedy for lesser defects shall be those provided for under the WARRANTY AND LIMITATION OF LIABILITY Clause.

B. Seller shall not be responsible for non -performance or for delays in performance occasioned by any causes beyond Seller's reasonable control, including, by way of example and not limitation, to labor difficulties, delays of vendors or carriers, fires, governmental act ions, or shortages of material, components, labor, or manufacturing facilities. Any delays so occasioned shall affect a corresponding extension of Seller's performance dates, which are, in any event, understood to be approximate. IN NO EVENT SHALL BUYER BE ENTITLED TO INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR LATE PERFORMANCE OR FOR A FAILURE TO PERFORM. Seller reserves the right to make partial shipments and to ship products, parts or work which may be completed prior to the scheduled performance date.

C. In the event that Seller has agreed to mount motors, turbines, gears, or other products which are not manufactured by Seller and which are not an integral part of Seller's manufactured product, and a delay in the delivery of such products to Seller occ urs that will cause a delay in Seller's performance date, Seller reserves the right to ship its product upon completion of manufacture and to refund an equitable portion of the amount originally included in the purchase price for mounting without incurring liability for non -performance.

D. Seller reserves to itself the right to change its specifications, drawings and standards if such changes will not impair the performance of its products, and parts, and further those products , and parts, will meet any of Buyer's specifications and other specific product requirements which are a part of this agreement. Seller is a global supplier of products and utilizes parts and products obtained worldwide, and Seller's products supplied under this contract shall be s ubject to Seller's sole determination as to all manufacturing, sourcing, assembly and supply unless otherwise specifically agreed in writing.

E. The manufacture and inspection of products and parts shall be to Seller's Engineering and Quality Assurance st andards, plus such other inspections or tests of documentation as are specifically agreed to by Seller. Requirements for any additional inspection, tests, documentation, or Buyer witness of manufacture, test, and/or inspection shall be subject to addition al charges.

4. TITLE AND RISK OF LOSS

Title and risk of loss shall pass to buyer upon delivery of products at the designated "Ex Works" as defined by Incoterms, unless other wise agreed by the parties.

5. EROSION AND CORROSION

It is specifically unde rstood that products and parts sold hereunder are not warranted for operation with erosive or corrosive fluids or for operation with any fluid or under any operating condition in variance with the specifications of this contract . No product or part shall b e deemed to be defective by reason of failure to resist erosive or corrosive action of any fluid and Buyer shall have no claim whatsoever against Seller therefore. No product shall be deemed defective by reason of any effect on Seller's products of the ac tion or results (such as vibration) of any goods or system (such as piping) not supplied by Seller.

6. BUYER'S RESPONSIBILITY

The design specifications of the equipment require the operation of the equipment within certain parameters and m ay call for the use of speed controls, safety devices, set points or other control devices to insure that the operation remains within design parameters. Buyer agrees and understands that the equipment must be operated and maintained within design specific ations and operated within the specifications of the contract, irrespective of whether controls or devices are otherwise required.

7. WARRANTY AND LIMITATION OF LIABILITY.

A. Seller warrants only that its product and parts, when shipped, will be free fr om defects in materials and workmanship. All claims for defective products or parts under this warranty must be made in writing immediately upon discovery and, in any event, within two (2) years of shipment by seller and all claims for defective work must be made in writing immediately upon discovery. Defective items must be held for Seller's inspection and returned to the sellers' point of original shipment upon request.

ANY UNAUTHORIZED DISSASSEMBLY, ALTERATION OF OR TAMPERING WITH ANY PRODUCT OR COMPONENT MAY "VOID" THE WARRANTY, IN THAT SUCH ACTION WILL RESULT IN SELLER BEING RELEASED AND RELIEVED FROM ITS OBLIGATIONS UNDER THIS WARRANTY AND FOR ANY FURTHER COSTS OR ACTIONS UNDER CLAUSE 7.C, FOLLOWING, AND THE BUYER ASSUMING SOLE RESPONSIBILITY FOR THE COSTS AND RESULTS OF SUCH ACTION.

THE FOREGOING IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES WHATSOEVER, EXPRESS, IMPLIED AND STATUTORY, INCLUDING WITHOUT LIMITATION, THE IMPLIED, WARRANTIES OF MERCHANTABILITY AND FITNESS.

B. ANY PRODUCT (S) SOLD HEREU NDER WHICH ARE NOT MANUFACTURED BY SELLER ARE NOT WARRANTED BY SELLER and shall be covered only by the express warranty, if any, of the manufacturer thereof. With respect to products and parts not manufactured by Seller, Seller's only obligation shall be to assign to Buyer, to the extent possible, whatever warranty Seller obtains from the manufacturer.

C. Upon Buyer's submission of a claim as provided above and its substantiation, Seller shall at its option either (i) repair or replace its product, part o r work at the original place of shipment, or (ii) refund an equitable portion of the purchase price.

D. THE FOREGOING IS SELLER'S ONLY OBLIGATION AND BUYER'S EXCLUSIVE REMEDY FOR BREACH OF WARRANTY AND, EXCEPT FOR THE REMEDIES PERMITTED UNDER THE PERFORMANCE, INSPECTION AND ACCEPTANCE AND THE PATENTS CLAUSES HEREOF, THE FOREGOING IS BUYER EXCLUSIVE REMEDY AGAINST SELLER FOR ALL CLAIMS ARISING HEREUNDER OR RELATING HERETO WHETHER SUCH CLAIMS ARE BASED ON BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE OR S TRICT LIABILITY) , INDEMNITY OR OTHER THEORIES. BUYER'S FAILURE TO SUBMIT A CLAIM AS PROVIDED ABOVE SHALL SPECIFICALLY WAIVE ALL CLAIMS FOR DAMAGES OR OTHER RELIEF, INCLUDING BUT NOT LIMITED TO CLAIMS BASED ON LATENT DEFECTS. IN NO EVENT SHALL BUYER BE EN TITLED TO INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, NOR FOR DAMAGES FOR LOSS OF USE, LOST PROFITS OR REVENUE, INTEREST, LOST GOODWILL, WORK OR PRODUCTION STOPPAGE, IMPAIRMENT OF OTHER GOODS, INCREASED EXPENSES OF OPERATION, OR THE COST OF PURCHASING REPLACEMENT POWER OR OTHER SERVICES BECAUSE OF SERVICE INTERRUPTIONS. FURTHERMORE, IN NO EVENT SHALL SELLER'S TOTAL LIABILITY FOR DAMAGES OF BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS OR PARTS MANUFACTURED BY SELLER AND UPON WHICH SUCH LIABIL ITY IS BASED. ANY ACTION ARISING HEREUNDER RELATED HERETO, WHETHER BASED ON BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE) OR OTHER THEORIES, MUST BE COMMENCED WITHIN ONE (1) YEAR AFTER THE CAUSE OF ACTION ACCRUES OR IT SHALL BE BARRED.

8. PURCHASER'S R EPRESENTATIONS & WARRANTIES

Purchaser represents and warranties that the products(s) covered by this contract shall not be used in or in connection with a nuclear facility or application. The parties agree that this representation and warranty is material and is being relied on by seller. This provision may be modified in a separate writing signed by an officer of Price Pump Co.

9. PATENTS

Seller agrees to assume the defense of any suit for infringement of any patents brought against Buyer to the extent of such suit charges infringement of an apparatus or product claim by Seller's product in and of itself, provided (i) said product is built entirely to Seller's design, (ii) Buyer notifies Seller in writing of the filing of such suit within ten (10) days a fter the service of process thereof, and (iii) Seller is given complete control of the defense of such suit, including the right to defend, settle and make changes in the product for the purpose of avoiding infringement of any process or method claims. Pr ovided however, Seller will not defend any suit for infringement of a claimed patent where such alleged infringement is the result of following specific instruction furnished by Seller.

10. EXTENT OF SUPPLY

Only products as listed in Seller's proposal are included in this agreement. It must not be assumed that Seller has included anything beyond same.

11. MANUFACTURING SOURCES

To maintain delivery schedules, Seller reserves the right to have all or any part of the Buyer's order manufactured at an y of Sellers', sellers' licensees or sub contractors' plants, globally.

12. TERMS OF PAYMENT

Net 30 days from date of invoice .

13. ARBITRATION

In the event a dispute arises between the parties relating to or arising out of this agreement, the parties agree to attempt to have their senior management amicably settle the matter. In the event that the matter cannot be settled, the parties shall submit all disputes relating to this Agreement (whether contract, tort, products liability or otherwise) to bind ing Arbitration before a panel of arbitrators under the Commercial Dispute Resolution Procedures of the American Arbitration Association. Each party shall appoint an arbitrator and the third shall be selected in accordance with the rules of the American A rbitration Association. Judgment upon the award may be entered in any court having jurisdiction. The parties shall cooperate in providing reasonable disclosure of relevant documents. Each party shall bear its own expenses, and the costs and fees of the ar bitration shall be borne as allocated by the Arbitrator.

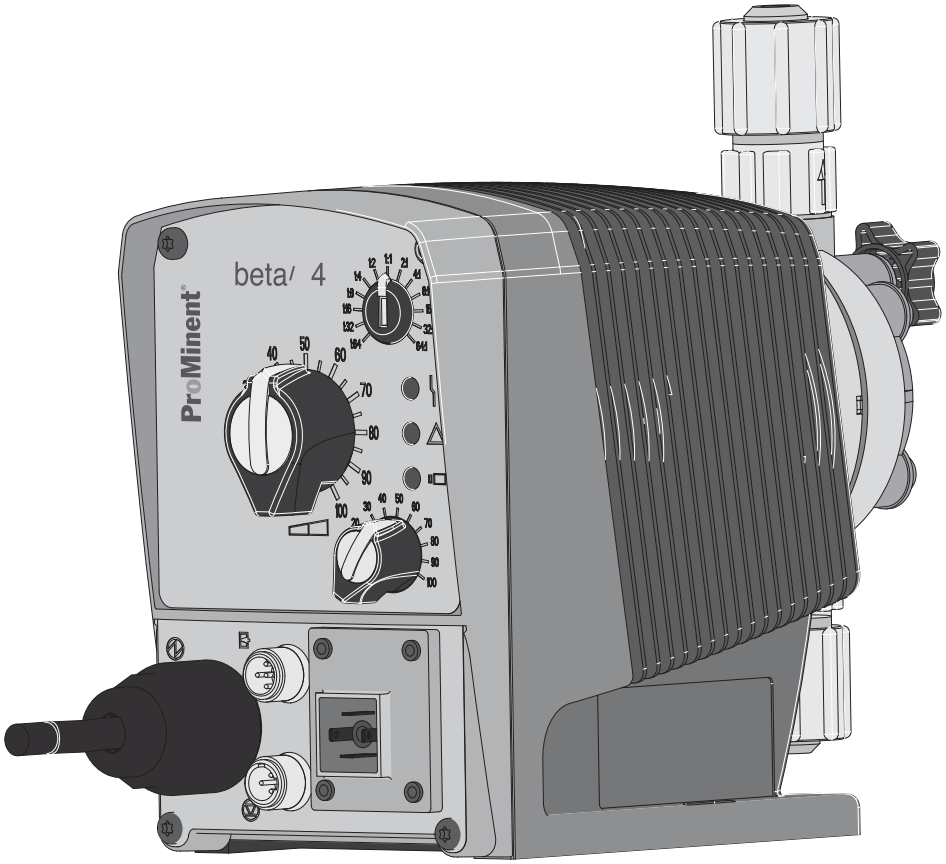
P-6101,2,3 - Beta - BT4b - BT4B0708PVT2000UD010A01Flow: 1.88GPH / 7.10L/HPressure: 102PSI / 07BAR"

Operating instructions

Solenoid Metering Pump

Beta® b BT4b and BT5b

EN



Please carefully read these operating instructions before use. · Do not discard.
The operator shall be liable for any damage caused by installation or operating errors.
The latest version of the operating instructions are available on our homepage.

Supplementary information

Fig. 1: Please read!

Read the following supplementary information in its entirety! You will benefit more from using the operating instructions should you already know this information.

The following are highlighted separately in the document:

- Enumerated lists

→ Instructions

⇨ Outcome of the instructions

↳ *'State the identity code and serial number' on page 2*: Links to points in this chapter

- refer to ... : References to points in this document or another document

[Keys]

Information

This provides important information relating to the correct operation of the unit or is intended to make your work easier.

Safety Information

Safety information is identified by pictograms - see Safety Chapter.

Validity

These operating instructions conform to current EU regulations applicable at the time of publication.

State the identity code and serial number

Please state identity code and serial number, which you can find on the nameplate when you contact us or order spare parts. This enables us to clearly identify the unit type and material versions.

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1 Identity code

Product range Beta b							
BT4b	Type	Capacity					
		bar	l/h				
	1000	10	0.74				
	1601	16	1.10				
	1602	16	2.20				
	1604	16	3.60				
	0708	7	7.10				
	0413	4	12.30				
	0220	2	19.00				
BT5b							
	2504	25	2.90				
	1008	10	6.80				
	0713	7	11.00				
	0420	4	17.10				
	0232	2	32.00				
		Material of dosing head/valves					
		PP	Polypropylene/PVDF. With the self-bleeding version (SEK): polypropylene/polypropylene				
		NP	Clear acrylic/PVDF. With the self-bleeding version (SEK): Clear acrylic/PVC				
		PV	PVDF/PVDF				
		TT	PTFE/PTFE				
		SS	Stainless steel 1.4404/1.4404				
			Material of seals/diaphragm				
			T	PTFE/PTFE coated			
			E	EPDM/PTFE coated, only for PP and NP self-bleeding (SEK)			
			B	FPM-B/PTFE coated, only for PP and NP self-bleeding (SEK)			
			W	Diaphragm additionally with FPM coating for media containing silicate			
				Dosing head design			
				0	without bleed valve, without valve spring only for NP, TT, SS and type 0232		
				1	without bleed valve, with valve spring only for NP, TT, SS and type 0232		
				2	with bleed valve, without valve spring only for PP, PV, NP not for type 0232		
				3	with bleed valve, with valve spring only for PP, PV, NP not for type 0232		
				4	version for higher-viscous media only for PVT, type 1604, 2504, 0708, 1008, 0413, 0713, 0220, 0420		
				7	self-bleeding (SER) only for PV/NP, not for types 1000, 1601 and 0232		
				9	self-bleeding (SEK) only for PP/NP, not for types 1000 and 0232		
					Hydraulic connector		
					0	Standard connection in line with technical data	
					5	Connector for 12/6 tube, discharge side only	
					9	Connector for 10/4 tube, discharge side only	

Product range Beta b																				
						Design														
						0	Standard													
							Logo													
							0	with ProMinent logo												
								Electrical connections												
								U	100 ... 230 V ± 10%, 50/60 Hz*											
									Cable and plug											
									A	2 m European										
									B	2 m Swiss										
									C	2 m Australian										
									D	2 m USA										
									1	2 m open end										
										Relay										
										0	No relay									
										1	fault indicating relay (NC) (change-over relay)									
										3	fault indicating relay (NO) (change-over relay)									
										4	as 1 + pacing relay, (ONE each)									
										5	as 3 + pacing relay, (ONE each)									
											Accessories									
											0	without accessories								
											1	with foot and injection valve, 2 m PVC suction line, 5 m PE metering line								
												Control type								
												0	no lock							
												1	with lock: manual operation locked when external cable plugged in							
												H	External without PCS stop							
													Control version							
													0	Standard						
													A	External analogue 0...20 mA / 4...20 mA						
														Options						
														00	no options					

2 About this pump

Properties of the device

This solenoid metering pump Beta b is equipped with all adjustment and activation functions for modern water treatment and the dosing of chemicals. It has pulse step-up and pulse step-down compared with the preceding model. This enables it to adapt more precisely to external signal generators. The result is the simpler and more precise adjustment of chemical consumption to the actual need. It also has a 10 percent increase in efficiency and energy efficiency over the preceding model. The Beta b can be simply adjusted during operation.

3 Safety Chapter

Identification of safety notes

The following signal words are used in these operating instructions to denote different severities of danger:

Signal word	Meaning
WARNING	Denotes a possibly dangerous situation. If this is disregarded, you are in a life-threatening situation and this can result in serious injuries.
CAUTION	Denotes a possibly dangerous situation. If this is disregarded, it could result in slight or minor injuries or material damage.

Warning signs denoting different types of danger

The following warning signs are used in these operating instructions to denote different types of danger:

Warning signs	Type of danger
	Warning – automatic start-up.
	Warning – high-voltage.
	Warning – danger zone.

Intended Use

- Only use the pump to meter liquid feed chemicals.
- Only use the pump after it has been correctly installed and started up in accordance with the technical data and specifications contained in the operating instructions.
- Observe the general limitations with regard to viscosity limits, chemical resistance and density - see also ProMinent resistance list in the Product Catalogue or at www.prominent.com!
- All other uses or modifications are prohibited.
- The pump is not intended for the metering of gaseous media and solids.
- The pump is not intended for the metering of flammable media without implementing suitable protective measures.
- The pump is not intended for the metering of explosive media.
- The pump is not intended for operation in areas at risk from explosion.
- The pump is not intended for exterior applications without the implementation of suitable protective measures.
- The pump should only be operated by trained and authorised personnel, see the following "Qualifications" table.
- You are obliged to observe the information contained in the operating instructions at the different phases of the unit's service life.

Safety Information

WARNING!

Warning about personal and material damage

The pump can start to pump, as soon as it is connected to the mains voltage.

– Install an emergency cut-off switch in the pump power supply line or integrate the pump in the emergency cut-off management of the system.

WARNING!

Danger of electric shock

A mains voltage may exist inside the pump housing.

– If the pump housing has been damaged, you must disconnect it from the mains immediately. It may only be returned to service after an authorised repair.

WARNING!

Warning of dangerous or unknown feed chemical

Should a dangerous or unknown feed chemical be used: It may escape from the hydraulic components when working on the pump.

– Take appropriate protective measures before working on the pump (e.g. safety glasses, safety gloves, ...). Observe the safety data sheet for the feed chemical.
– Drain and flush the liquid end before working on the pump.

WARNING!

Fire danger

When pumping inflammable media the operator must take suitable safety precautions.

WARNING!

Danger from hazardous substances!

Possible consequence: Fatal or very serious injuries.

Please ensure when handling hazardous substances that you have read the latest safety data sheets provided by the manufacture of the hazardous substance. The actions required are described in the safety data sheet. Check the safety data sheet regularly and replace, if necessary, as the hazard potential of a substance can be re-evaluated at any time based on new findings.

The system operator is responsible for ensuring that these safety data sheets are available and that they are kept up to date, as well as for producing an associated hazard assessment for the workstations affected.

CAUTION!

Warning of feed chemical spraying around

Feed chemical can spray out of the hydraulic components if they are manipulated or opened due to pressure in the liquid end and adjacent parts of the system.

– Disconnect the pump from the mains power supply and ensure that it cannot be switched on again by unauthorised persons.
– Depressurise the system before commencing any work on hydraulic parts.

CAUTION!

Warning of feed chemical spraying around

The metering pump can generate a multiple of its rated pressure. Hydraulic parts can rupture if a discharge line is blocked.

– Correctly install a relief valve in the discharge line downstream of the metering pump.

CAUTION!

Warning of feed chemical spraying around

An unsuitable feed chemical can damage the wetted parts of the pump.

– Take into account the resistance of the wetted materials when selecting the feed chemical - see the ProMinent Product Catalogue or visit our homepage.

CAUTION!

Danger of injury to personnel and material damage

The use of untested third party components can result in injury to personnel and material damage.

– Only fit parts to metering pumps that have been tested and recommended by ProMinent.

CAUTION!

Danger from incorrectly operated or inadequately maintained pumps

Danger can arise from a poorly accessible pump due to incorrect operation and poor maintenance.

– Ensure that the pump is accessible at all times.
– Adhere to the maintenance intervals.

CAUTION!

Danger from incorrect metering

Should a different liquid end size be fitted, this will change the metering behaviour of the pump.

– Have the pump reprogrammed in the works.

CAUTION!

Warning against illegal operation

Observe the regulations that apply where the device is installed.

Fixed separating protective equipment

- Dosing head
- Housing
- Hood (houses the control elements)

The dosing head may only be removed by the customer in accordance with the "Repair" chapter.

The housing and the hood may only be removed by ProMinent customer service department.

Information in the event of an emergency

In an emergency, either pull out the mains plug, turn the multifunctional switch to "Stop" or press the Emergency Stop switch installed on the customer's side or disconnect the pump from the mains power supply in line with the emergency shut-down management guidelines for your system!

If feed chemical escapes, additionally ensure that the hydraulic system around the pump is at atmospheric pressure. Adhere to the safety data sheet for the feed chemical.

Qualification of personnel

Task	Qualification
Storage, transport, unpacking	Instructed person
Assembly	Technical personnel, service
Planning the hydraulic installation	Qualified personnel who have a thorough knowledge of metering pumps
Hydraulic installation	Technical personnel, service
Installation, electrical	Electrical technician
Operation	Instructed person
Maintenance, repair	Technical personnel, service
Decommissioning, disposal	Technical personnel, service
Troubleshooting	Technical personnel, electrical technician, instructed person, service

Explanation of the table:

Qualified personnel

A qualified employee is deemed to be a person who is able to assess the tasks assigned to him and recognise possible dangers based on his/her technical training, knowledge and experience, as well as knowledge of pertinent regulations.

Note:

A qualification of equal validity to a technical qualification can also be gained by several years of employment in the relevant field of work.

Electrical technician

An electrical technician is able to complete work on electrical systems and recognise and avoid possible dangers independently based on his/her technical training and experience, as well as knowledge of pertinent standards and regulations.

The electrical technician should be specifically trained for the working environment in which he is employed and know the relevant standards and regulations.

An electrical technician must comply with the provisions of the applicable statutory directives on accident prevention.

Instructed person

An instructed person is deemed to be a person who has been instructed and, if required, trained in the tasks assigned to him/her and possible dangers that could result from improper behaviour, as well as having been instructed in the required protective equipment and protective measures.

Service

The Service department refers to service technicians, who have received proven training and have been authorised by ProMinent to work on the system.

Sound pressure level

Sound pressure level LpA < 70 dB according to EN ISO 20361

at maximum stroke length, maximum stroke rate, maximum back pressure (water)

4 Storage, Transport and Unpacking

Safety Information

WARNING!

The transporting of pumps which have been used with radioactive feed chemicals is forbidden!

They will also not be accepted by ProMinent!

WARNING!

Only return metering pumps for repair in a cleaned state and with a flushed liquid end - refer to "Decommissioning!

Only return metering pumps with a completed Decontamination Declaration form. The Decontamination Declaration constitutes an integral part of an inspection / repair order. A unit can only be inspected or repaired when a Declaration of Decontamination Form is submitted that has been completed correctly and in full by an authorised and qualified person on behalf of the pump operator.

The "Decontamination Declaration Form" can be found on our homepage.

CAUTION!

Danger of material damage

The device can be damaged by incorrect or improper storage or transportation!

- The unit should only be stored or transported in a well packaged state - preferably in its original packaging.
- The packaged unit should also only be stored or transported in accordance with the stipulated storage conditions.
- The packaged unit should be protected from moisture and the ingress of chemicals.

Ambient conditions

Data	Value	Unit
Minimum storage and transport temperature	-20	°C
Maximum storage and transport temperature	+60	°C
Maximum air humidity *	95	% rel. humidity

* non-condensing

Scope of delivery

Compare the delivery note with the scope of delivery:

- Metering pump with mains cable
- Connector kit for hose/pipe connection (optional)
- Product-specific operating instructions with EC Declaration of Conformity
- Optional accessories

5 Overview of Equipment and Control Elements

5.1 Overview of Equipment

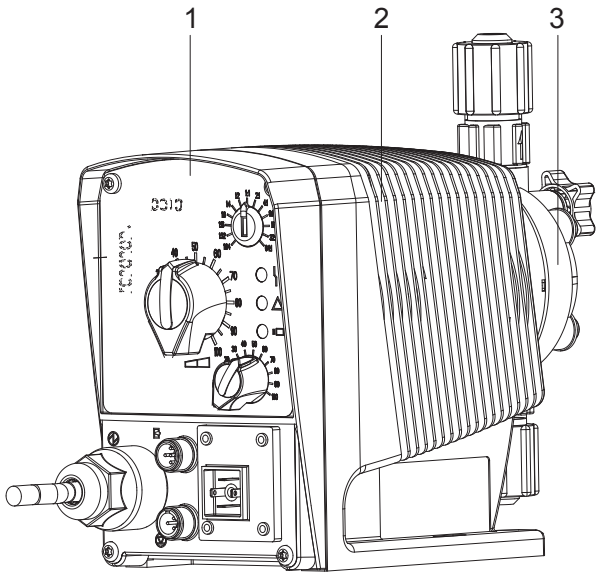


Fig. 2: Complete overview

1 Control unit
2 Drive unit
3 Liquid end

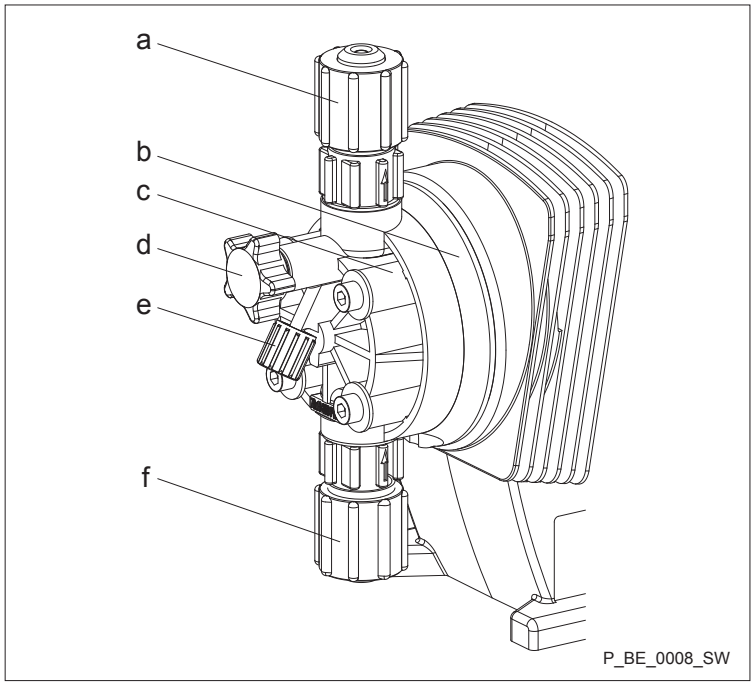
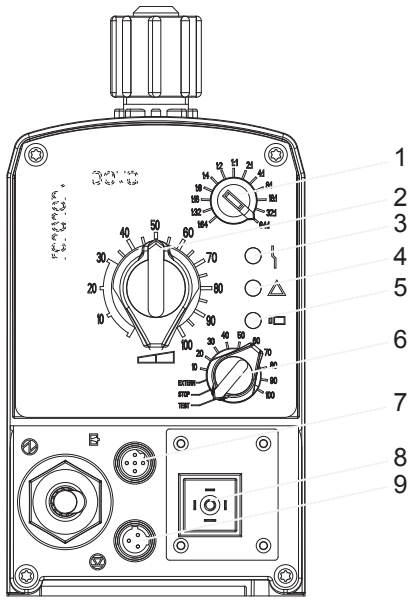


Fig. 3: Overview of liquid end (PV)

a Discharge valve
b Backplate
c Dosing head
d Bleed valve
e Bypass hose sleeve
f Suction valve

5.2 Control Elements



P_BE_0011_SW

Fig. 4

1 Pulse control switch
2 Stroke Length Adjustment Button
3 Fault indicator (red)
4 Warning indicator (yellow)
5 Operating indicator (green)
6 Multifunctional Switch
7 "External control" terminal
8 Relay connection (optional)
9 "Level switch" terminal

5.2.1 Pulse control switch

In **"External Contact" operating mode**, the pulse control switch either triggers a series of strokes or steps down an incoming series of contacts by a single contact (at the "external control" terminal).

In **"External Analogue" operating mode**, the stroke rate can be controlled by an mA signal via the pulse control switch. To do so, the multifunctional switch has to be turned to "Extern".

5.2.2 Stroke Length Adjustment Button

The stroke length adjustment button can be used to adjust the stroke length.

5.2.3 Multifunctional Switch

The multifunctional switch can be used to set the following functions, operating modes and stroke rate.

The operating modes that can be set are:

- Test (priming function)
- Stop (optionally missing)
- Extern (Contact)
- External (analogue, optional)
- Manual (setting stroke rate in 10% increments)

5.2.4 Functional and Fault Indicators

Fault indicator (red)

The fault indicator lights up if the fluid level in the dosing tank falls below the second switching point of the level switch (20 mm residual filling level in the dosing tank).

The fault indicator lights up if the current falls below 3.8 mA (only with 4...20 mA) or exceeds 23 mA in "External Analogue" operating mode.

This LED flashes in the event of an undefined operating status.

Warning indicator (yellow)

The warning indicator lights up if the fluid level in the dosing tank falls below the first switching point of the level switch.

Operating indicator (green)

The operating indicator lights up if the pump is ready for operation and there are no fault or warning alerts. It goes out quickly as soon as the pump has performed a stroke.

5.2.5 "External control" terminal

The "external control" terminal is a five-pole panel terminal.

It enables the following functions and operating modes to be used:

- Pause
- External contact
- External Analogue (optional)
- Auxiliary frequency (external frequency changer)

The two- and four-pole cables used to date can continue to be used. The "Auxiliary frequency" function can, however, only be used with a five-pole cable.

5.2.6 "Level switch" terminal

A 2-stage level switch with pre-warning and end switch-off can be connected.

6 Functional description

6.1 Liquid End

The dosing process is performed as follows: The diaphragm is pressed into the dosing head; the pressure in the dosing head closes the suction valve and the feed chemical flows through the discharge valve out of the dosing head. The diaphragm is now drawn out of the dosing head; the discharge valve closes due to the negative pressure in the dosing head and fresh feed chemical flows through the suction valve into the dosing head. One cycle is completed.

6.2 Drive Unit

The diaphragm is driven by an electromagnet, which is controlled by an electronic controller.

6.3 Capacity

The capacity is determined by the stroke length and the stroke rate.

The stroke length is adjusted by the stroke length adjustment knob within a range of 0 ... 100 %. A stroke length of between 30 ... 100 % (SEK type: 50 ... 100 %) is recommended to achieve the specified reproducibility!

Data	Value	Unit
Recommended stroke length, standard type	30 ... 100	%
Recommended stroke length, SEK type	50 ... 100	%

The stroke rate can be set within a range of 10 ... 100 % using the multifunctional switch.

6.4 Self-Bleeding

Self-bleeding liquid ends (SEK types) are capable of independent priming when a discharge line is connected and diverting existent air pockets via a bypass. During operation they are also capable of conveying away gases which are produced, independently of the operating pressure in the system. It is also possible to dose precisely in a depressurised state due to the integral back pressure valve.

6.5 Operating modes

The operating modes are selected by means of the multifunctional switch.

"Manual" operating mode

As soon as the stroke rate has been set by the multifunctional switch, the pump finds itself in "Manual" operating mode. 100% corresponds to 180 strokes/min.

"External contact" operating mode

The "External Contact" operating mode is described below in the "Operation" and "Installation, Electrical" chapters.

"External Analogue" operating mode

The "External Analogue" operating mode is described below in the "Operation" and "Installation, Electrical" chapters.

6.6 Functions

The functions are described below in the "Operation" chapter.

6.7 Relay

The pump has two connecting options.

Fault indicating relay option

The relay can switch a connected power circuit (e.g. for an alarm horn) in the event of warnings or fault messages (e.g. warning levels).

The relay can be retrofitted with the retrofit kit via a knock-out opening in the pump foot - refer to "Retrofitting relays".

Fault indicating and pacing relay option

This combined relay can generate a contact with each stroke via its pacing relay in addition to its function as a fault indicating relay.

The relay can be retrofitted with the retrofit kit via a knock-out opening in the pump foot - refer to "Retrofitting relays".

6.8 Hierarchy of Operating Modes, Functions and Fault Statuses

The different operating modes, functions and fault statuses have a different effect on if and how the pump reacts.

The following list shows the order:

1. - Test (priming)
2. - Fault, Stop, Pause
3. - Auxiliary frequency (external frequency changeover)
4. - Manual, Extern Contact

Comments:

re 1 - "Priming" can take place in any mode of the pump (providing it is functioning).

re 2 - "Fault", "Stop" und "Pause" stop everything apart from "Priming".

re 3 - The stroke rate of "Auxiliary frequency" always has priority over the stroke rate specified by an operating mode in 4.

7 Assembly

– *Compare the dimensions on the dimension sheet with those of the pump.*

WARNING!

Danger of electric shock

If water or other electrically conducting liquids penetrate into the drive housing, in any other manner than via the pump's suction connection, an electric shock may occur.

– Position the pump so that it cannot be flooded.

CAUTION!

Danger from incorrectly operated or inadequately maintained pumps

Danger can arise from a poorly accessible pump due to incorrect operation and poor maintenance.

– Ensure that the pump is accessible at all times.
– Adhere to the maintenance intervals.

Capacity too low

The liquid end valves can be disturbed by vibrations.

– *Secure the metering pump so that no vibrations can occur.*

Capacity too low

If the valves of the liquid end are not vertical, they cannot close correctly.

– *Suction and discharge valves must stand vertically upwards (for self-bleeding liquid end, the bleed valve).*

Mount the metering pump with the pump foot on a horizontal, level and load-bearing supporting surface.

8 Installation, hydraulic

Safety Information

CAUTION!

Warning of feed chemical spraying around

An unsuitable feed chemical can damage the wetted parts of the pump.

– Take into account the resistance of the wetted materials when selecting the feed chemical - see the ProMinent Product Catalogue or visit our homepage.

CAUTION!

Warning of feed chemical spraying around

Pumps which are not fully installed hydraulically can pump feed chemical from the outlet opening of the discharge valve as soon as they are connected to the mains power supply.

– First install the pump hydraulically, then electrically.
– In the event that you have failed to do so, turn the multi-functional switch to *[Stop]* (if fitted) or press an On / Off switch or Emergency Stop switch on site.

CAUTION!

Warning of feed chemical spraying around

Feed chemical can spray out of the hydraulic components if they are manipulated or opened due to pressure in the liquid end and adjacent parts of the system.

– Disconnect the pump from the mains power supply and ensure that it cannot be switched on again by unauthorised persons.
– Depressurise the system before commencing any work on hydraulic parts.

CAUTION!

Danger from rupturing hydraulic components

Peak loads during the dosing stroke can cause the maximum permissible operating pressure of the system and pump to be exceeded.

– The discharge lines are to be properly designed.

CAUTION!

Danger of personnel injury and material damage

The use of untested third party parts can result in personnel injuries and material damage.

– Only fit parts to metering pumps, which have been tested and recommended by ProMinent.

8.1 Installing hose lines

8.1.1 Installation of Metering Pumps Without Bleed Valve

Safety Information

CAUTION!

Warning of feed chemical spraying around

The pipes can loosen or rupture if they are not installed correctly.

- Route all hose lines so they are free from mechanical stresses and kinks.
- Only use original hoses with the specified hose dimensions and wall thicknesses.
- Only use clamp rings and hose nozzles that are intended for the hose diameter in question to ensure the long service life of the connections.

CAUTION!

Danger from rupturing hydraulic components

Hydraulic components can rupture if the maximum permissible operating pressure is exceeded.

- Always adhere to the maximum permissible operating pressure of all hydraulic components - please refer to the product-specific operating instructions and system documentation.
- Never allow the metering pump to run against a closed shut-off device.
- Install a relief valve.

CAUTION!

Hazardous feed chemicals can escape

Hazardous or extremely aggressive feed chemicals can leak out when using conventional bleeding procedures with metering pumps.

- Install a bleed line with return line into the storage tank.

CAUTION!

Hazardous feed chemicals can escape

Hazardous or extremely aggressive feed chemicals can leak out in the event that the metering pump is removed from the installation.

- Install a shut-off valve on the metering pump's pressure and discharge sides.

CAUTION!

Uncontrolled flow of feed chemical

Feed chemical can press through a stopped metering pump if there is back pressure.

- Use an injection valve or a vacuum breaker.

CAUTION!

Uncontrolled flow of feed chemical

Feed chemicals can leak through the metering pump in an uncontrolled manner in the event of excessive priming pressure.

– Do not exceed the maximum permissible priming pressure for the metering pump.

Align the pipes so that the metering pump and the liquid end can be removed from the side if necessary.

Installing hose lines - PP, NP, PV, TT designs

1. Cut off the ends of the hoses at right angles.
2. Pull the union nut (2) and clamp ring (3) over the hose (1) - see figure Fig. 5.
3. Push the hose end (1) up to the stop over the nozzle (4) and widen, if necessary.

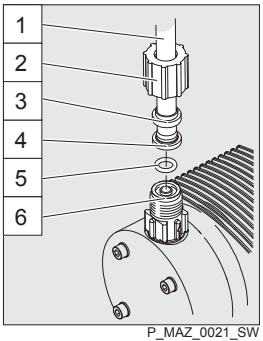
Ensure that the O-ring and flat seal (5) is properly fitted to the valve (6).

Never re-use used PTFE seals. An installation sealed in this way is not watertight.

This type of seal is permanently distorted when subjected to pressure.

In order to enable it to be distinguished from the EPDM flat seal, the FPM flat seal PV design has a dot.

4. Place the hose (1) with the nozzle (4) onto the valve (6).
5. Clamp the hose connector: Tighten the union nut (2) while simultaneously pressing on the hose (1).
6. Re-tighten the hose connector: Pull on the hose (1) briefly, which is fastened to the dosing head and then tighten the union nut (2) once more.

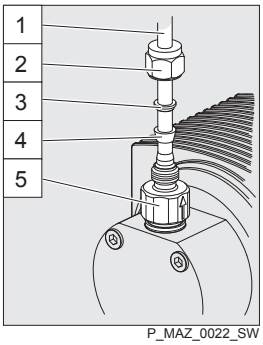


1 Hose
2 Union nut
3 Clamp ring
4 Nozzle
5 O-ring or flat seal
6 Valve

Fig. 5: PP, NP, PV and TT designs

Installing stainless steel pipe - SS design

1. Pull the union nut (2) and clamp rings (3, 4) over the pipe (1) with approx. 10 mm overhang - see *'Installing stainless steel pipe - SS design' on page 23*.
2. Insert the pipe (1) up to the stop in the valve (5).
3. Tighten the union nut (2).



1 pipe
2 Union nut
3 Rear clamp ring
4 Front clamp ring
5 Valve

Fig. 6: SS design

Installing hose lines - SS design

CAUTION!

Warning of feed chemical spraying around

Connections can come loose in the event that hose lines are installed incorrectly on stainless steel valves.

– Only use PE or PTFE hose lines.
– In addition, insert a stainless steel support insert into the hose line.

8.1.2 Installation of Metering Pumps With Bleed Valve

Safety Information

CAUTION!

– All the installation and safety notes for metering pumps without bleed valves also apply.

Installation of the return line

A return line is also connected in addition to the suction and discharge line.

1. Attach the hose line to the return hose nozzle or to the liquid end bleed valve. PVC hose, soft, 6x4 mm is recommended.
2. Feed the free end of the return line back to the storage tank.
3. Shorten the return line so that it is not immersed in the feed chemical in the storage tank.

8.1.3 Installation of Metering Pumps With Self-bleeding (SEK Type)

Safety Information

CAUTION!

- All of the installation and safety notes for metering pumps without self-bleeding also apply.
- Do not exceed the maximum values for priming lift, priming pressure and viscosity of the feed chemical.
- Do not allow the suction side line cross-section to exceed the line cross-section on the suction valve.

Information about priming pressure

- *Make sure that the priming pressure on the suction end is at least equal to the return line pressure.*
- *Priming pressure in the return line restricts the bleeding function.*
- *However, operation with priming pressure in the return line and the suction end at atmospheric pressure is possible.*

Installation of the return line

A return line is also connected in addition to the suction and discharge line.

- *The return line is connected to the vertical valve on the upper side of the liquid end. It is factory-labelled with a red sleeve - see ‘Installation of the return line’ on page 24.*
- *The discharge line is connected to the horizontal valve.*

1. Attach the hose line to the return hose nozzle or to the liquid end bleed valve. PVC hose, soft, 6x4 mm is recommended.
2. Feed the free end of the return line back to the storage tank.
3. SEK only: Insert the return line into the anti-kink device on the bleed valve and screw it in place until the anti-kink device engages.

The anti-kink device prevents the return line from kinking, avoiding the risk of self-bleeding failure.

4. Shorten the return line so that it is not immersed in the feed chemical in the storage tank.

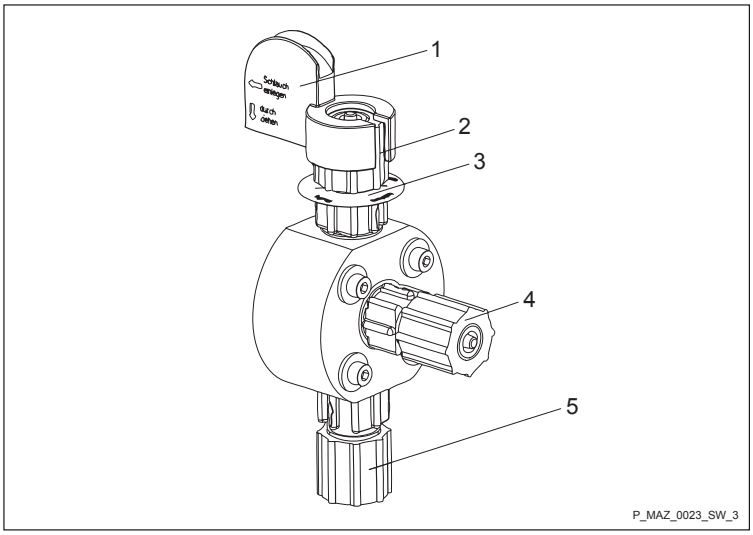


Fig. 7: SEK liquid end

1 Anti-kink device
2 Bleed valve for the return line into the storage tank, 6/4 mm
3 Red sleeve
4 Discharge valve for discharge line to the injection point, 6/4 - 12/9 mm
5 Suction valve for suction line in the storage tank, 6/4 - 12/9 mm

8.1.4 Basic installation notes

Safety notes

CAUTION!

Danger resulting from rupturing hydraulic components

Hydraulic components can rupture if the maximum permissible operating pressure is exceeded.

– Never allow the metering pump to run against a closed shut-off device.
– With metering pumps without integral relief valve: Install a relief valve in the discharge line.

CAUTION!

Hazardous feed chemicals can escape

With hazardous feed chemicals: Hazardous feed chemical can leak out when using conventional bleeding procedures with metering pumps.

– Install a bleed line with a return into the storage tank.

→ Shorten the return line so that it does not dip into the feed chemical in the storage tank.

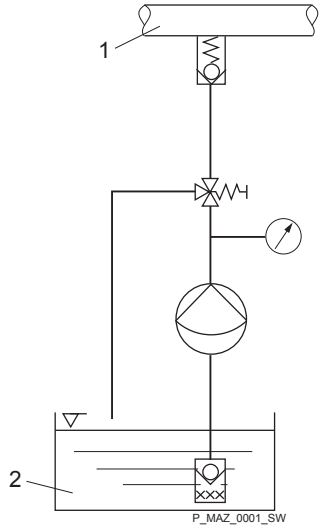


Fig. 8: Standard installation

1 Main line
2 Storage tank

Legend for hydraulic diagram

Symbol	Explanation	Symbol	Explanation
	Metering pump		Foot valve with filter meshes
	Injection valve		Level switch
	Multifunctional valve		Manometer

9 Electrical Installation

WARNING!

Danger of electric shock

A mains voltage may exist inside the device.

– Before any work, disconnect the device's mains cable from the mains.

WARNING!

Risk of electric shock

This pump is supplied with a grounding conductor and a grounding-type attachment plug.

– To reduce the risk of electric shock, ensure that it is connected only to a proper grounding-type receptacle.

WARNING!

Risk of electric shock

In the event of an electrical accident, the pump must be quickly disconnected from the mains.

– Install an emergency cut-off switch in the pump power supply line or
– Integrate the pump in the emergency cut-off management of the system and inform personnel of the isolating option.

WARNING!

Danger of electric shock

A mains voltage may exist inside the pump housing.

– If the pump housing has been damaged, you must disconnect it from the mains immediately. It may only be returned to service after an authorised repair.

CAUTION!

Material damage possible due to power surges

Should the pump be connected to the mains power supply in parallel to inductive consumers (such as solenoid valves, motors), inductive power surges can damage the controller when it is switched off.

– Provide the pump with its own contacts and supply with voltage via a contactor relay or relay.

Personnel: ■ Electrician

→ Install the pump in line with best working practice and in accordance with the operating instructions and applicable regulations.

9.1 Supply voltage connector

WARNING!

Unexpected startup is possible

As soon as the pump is connected to the mains, the pump may start pumping and consequently feed chemical may escape.

– Prevent dangerous feed chemicals from escaping.
– If you have not successfully prevented this, immediately press the *[STOP/START]* key or disconnect the pump from mains, e.g. via an emergency cu-off switch.

CAUTION!

If the pump is integrated into a system: Design the system so that potential hazardous situations are avoided by pumps starting up automatically subsequent to unintended power interruptions.

CAUTION!

Provide an option to disconnect the pump without Emergency Stop switch from the mains power supply.

9.1.1 Mains voltage

Parallel connection to inductive consumers

Should the pump be connected to the mains in parallel to inductive consumers (e.g. solenoid valves, motor), the pump must be electrically isolated when these consumers are switched off.

- Supply the pumps with voltage via a contactor relay or relay using separate contacts for the pump.
- If this is not possible then connect a varistor (part no. 710912) or an RC member, 0.22 µF / 220 Ω in parallel.

Interference suppression aids

Product	Part no.
Varistor:	710912
RC Gate, 0.22 µF / 220 Ω:	710802

9.2 Supply voltage connector - low voltage

WARNING!

Danger of electric shock

– For safety reasons, the low voltage pumps must be operated using only protective low voltage (SELV in accordance with EN 60335-1).

CAUTION!

Supply voltages that are too high destroy the pump.

– Do not connect the low voltage pump to voltages > 30 V.

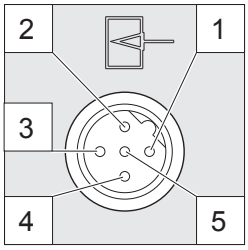
- *The pump will generate a fault ("switch-off threshold for supply") in the event that the supply voltage to the pump is insufficient to ensure reliable function. The pump will recommence operation as soon as the supply voltage is restored.*
- *The fault indicator flashes additionally if the supply voltage is interrupted during a stroke, ("threshold for stroke abort"). Aborted strokes are not counted by the stroke counter. In doing so, the pump's electronic controller periodically checks the supply voltage ("wait time after stroke abort": 10 min). The pump will recommence operation if the supply voltage is sufficient.*
- *The pump's electrical system will shut down completely in the event that the supply voltage undershoots another threshold. The pump will come out of standby mode and recommence operation as soon as sufficient supply voltage is restored.*
- *The programmed thresholds apply to standard lead-acid batteries. ProMinent can match these to customer requirements.*
- *Use short large-diameter power leads in order to minimise faults. Use batteries with low internal resistance.*
- *If the pump is connected with incorrect polarity, it will not run because the polarity protection does not allow any current to flow.*

9.3 Description of the Terminals

9.3.1 "External control" terminal

The "external control" socket is a five-pin panel socket. It is compatible with two- and four-pole cables.

The "Auxiliary rate" function can only be used with a five conductor cable.



P_BE_0014_SW

Fig. 9: Pump assignment

Electrical interface for pin 1 "Pause" - pin 2 "External contact" - pin 5 "Auxiliary frequency"

Data	Value	Unit
Voltage with open contacts	5	V
Input resistance	10	kΩ
Max. pulse frequency	25	pulse/s
Min. pulse duration	20	ms
Min. pause between pulses	3	ms

Control via:

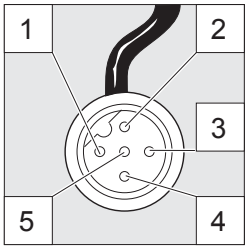
- potential-free contact (load: 0.5 mA at 5 V) or
- Semiconductor switch (residual voltage < 0.7 V)

Electrical interface for pin 3 "mA input" (with identity code characteristic "Control version": A - "External Analogue")

Data	Value	Unit
Input apparent ohmic resistance, approx.	120	Ω

Behaviour of the pump

At **approx. 0.1 mA (4.1 mA)** the metering pump makes its **first metering stroke**.
At **approx. 19.9 mA** the pump moves to continuous operation at **180 strokes / min** .
With current signals **above 23 mA**, the red fault indicator lights up, the pump stops and any fault indicating relay fitted switches (a **fault** is pending).
Only with 4...20 mA: With current signals **below 3.8 mA**, the red fault indicator lights up, the pump stops and any fault indicating relay fitted switches (**Fault** for example with a cable break).



P_BE_0015_SW

Fig. 10: Cable assignment

Pin	Function	5-wire cable	2-wire cable
1	Pause	brown	bridged at pin 4
2	External contact	white	brown
3	mA input*	blue	-
4	Earth GND	black	white
5	Auxiliary frequency	grey	-

* with identity code characteristic "Control version": A - "External Analogue"

Refer to the functional description for the hierarchy of functions and operating modes.

"Pause" function

The pump does not work if:

- the cable is connected and pin 1 and pin 4 are open.

The pump works if:

- the cable is connected and pin 1 and pin 4 are connected.
- no cable is connected.

"External contact" operating mode

The pump performs one or more strokes if:

- Pin 2 and pin 4 are connected to each other for at least 20 ms. At the same time, pin 1 and pin 4 must also be connected to each other.

"External Analogue" operating mode

- The metering pump makes its first metering stroke at approx. 0.1 mA (4.1 mA) and enters into continuous operation at approx. 19.9 mA.

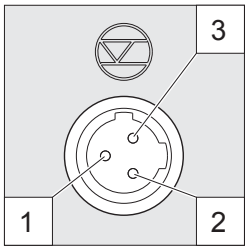
"Auxiliary frequency" operating mode

The pump works at a pre-set stroke rate if:

- Pin 5 and pin 4 are connected to each other. At the same time, pin 1 and pin 4 must also be connected to each other. The auxiliary frequency is factory-preset to the maximum stroke rate.

9.3.2 "Level switch" terminal

There is a connecting option for a 2-stage level switch with pre-warning and limit stop.



P_BE_0016_SW

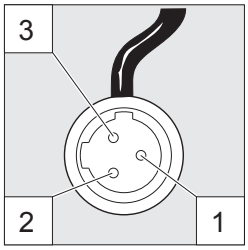
Fig. 11: Pump assignment

Electrical interface

Data	Value	Unit
Voltage with open contacts	5	V
Input resistance	10	kΩ

Control via:

- potential-free contact (load: 0.5 mA at 5 V) or
- Semiconductor switch (residual voltage < 0.7 V)



P_BE_0017_SW

Fig. 12: Cable assignment

Pin	Function	3-wire cable
1	Earth GND	black
2	Minimum pre-warning	blue
3	Minimum limit stop	brown

9.4 Relay

9.4.1 Relay functions

Beta b BT4b/BT5b

Identity code	Description	Type	Maximum voltage	Maximum current	Behaviour of relay type when retrofitting, as standard
0	no relay	-	-	-	-
1	Fault indicating relay	NC changeover contact	230 V	8 A	X
3	Fault indicating relay	NO changeover contact	230 V	8 A	-
4	Fault indicating relay	N/O	24 V	100 mA	X
	Pacing relay	N/O	24 V	100 mA	-
5	Fault indicating relay	N/O	24 V	100 mA	-
	Pacing relay	N/O	24 V	100 mA	-

Relay type switches in the event of...

Relay type	level Warning	level low	Calibrated stroke length Error	Processor Error
Fault indicating relay:	X	X	X	X

9.4.2 "Fault indicating relay" output (identity code 1 + 3)

A fault indicating relay can optionally be ordered. It is used to emit a signal when there is a fault with the pump and for the "Liquid level low, 1st stage" warning message and "Liquid level low 2nd stage" fault message.

A cut-off relay works when there are fault alerts from the pump and in the event of the "Liquid level low 2nd stage" alert.

The fault indicating relay can be retrofitted and is operational once attached to the relay board - refer to the "Operating Instructions for Retrofitting Relays for Beta b and delta".

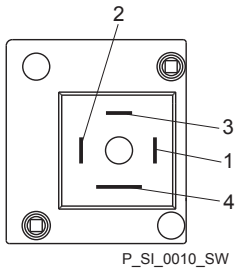


Fig. 13: Pump assignment

Electrical interface

Data	Value	Unit
Maximum contact load at 230 V and 50/60 Hz:	8	A
Minimum mechanical lifespan:	200,000	switching operations

Identity code 1 + 3

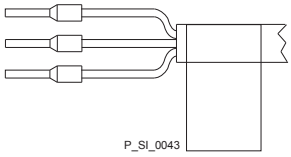


Fig. 14: Cable assignment

Pin assignment

To pin	VDE cable	Contact	CSA cable
1	white	NO (normally open)	white
2	green	NC (normally closed)	red
4	brown	C (common)	black

9.4.3 "Fault indicating relay" + "Pacing relay" output (identity code 4 + 5)

A fault indicating / pacing relay can optionally be ordered. The pacing output is electrically-isolated by means of an optocoupler with a semiconductor switch. The second switch is a relay.

The fault indicating /pacing relay can be retrofitted and is operational once attached to the relay board - refer to the "Operating Instructions for Retrofitting Relays for Beta b and delta".

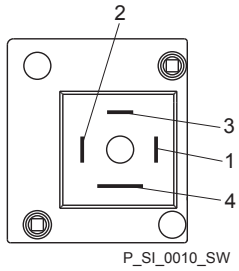


Fig. 15: Pump assignment

Electrical interface

for fault indicating relays:

Data	Value	Unit
Maximum contact load at 24 V and 50/60 Hz:	8	A
Minimum mechanical lifespan:	200,000	switching operations

for semiconductor switch pacing relay:

Data	Value	Unit
Residual voltage max. at I_c = 1 mA	0.4	V
Maximum current	100	mA
Maximum voltage	24	VDC
Pacing pulse duration, approx.	100	ms

Identity code 4 + 5

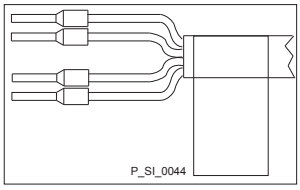


Fig. 16: Cable assignment

Pin assignment

To pin	VDE cable	Contact	Relay
1	yellow	NO (normally open)	Fault indicating relay
4	green	C (common)	Fault indicating relay
3	white	NO (normally open)	Pacing relay
2	brown	C (common)	Pacing relay

10 Start up

WARNING!

Dangerous reactions are possible due to contact of feed chemical with water

The feed chemical can mix and react in the liquid end with water remaining after testing in the factory.

- Read the safety data sheet on the feed chemical.
- Blast the liquid end with compressed air.
- Flush the liquid end with a suitable medium through the suction connector.

WARNING!

Fire hazard with flammable media

Only with combustible media: These may start to burn when combined with oxygen.

- During filling and draining of the liquid end, an expert must ensure that feed chemical does not come into contact with oxygen.

CAUTION!

Danger with dangerous feed chemicals

Contact with the feed chemical is possible provided the following handling instructions are adhered to.

- If the feed chemical is dangerous, take appropriate safety precautions when carrying out the following handling instructions.
- Adhere to the feed chemical safety data sheet.

CAUTION!

Warning of feed chemical spraying around

An unsuitable feed chemical can damage the parts of the pump that come into contact with the chemical.

- Take into account the resistance of the materials that will come into contact with the medium when selecting the feed chemical - refer to the ProMinent® Resistance List in the Product Catalogue or at www.prominent.com.

- *Reliable metering cannot be guaranteed after the metering pump has been idle for some time, as the feed chemical can crystallise in the valves and on the diaphragm. Regularly check the valves and diaphragm.*
- *Only adjust the stroke length when the pump is running.*
- *The metering pump should prime at 100% stroke length, as the priming lift depends on the stroke volume when the liquid end is empty. If the metering pump has to prime at a smaller stroke length and is not priming, reduce the priming lift (i.e. briefly lift up the storage tank with the feed chemical).*
- *SEK-type only: The suction lift corresponds to the priming lift, as some gas always remains in the liquid end with gaseous media.*

Starting up the metering pump

1. Fill the liquid end - *'Filling the liquid end' on page 35*.
2. Check the pump connectors and connections for leak-tightness.
3. Check the suction valve and discharge valve for leak-tightness and tighten if necessary.
4. Check the liquid end for leak-tightness and tighten the screws on the dosing head if necessary - see below for starting torque.
5. Only with bleed valve: Check whether the bleed valve is closed.
6. Start up the relief valve in the system in line with its operating instructions.
7. Start up the system.
8. After 24 hours of operation: Tighten the screws on the dosing head - see below for tightening torque.

Tightening torque

Data	Value	Unit
Tightening torque for screws:	4.5 ... 5.0	Nm

Draining the liquid end

With feed chemicals that should not come into contact with water.

1. Turn the pump so that the pressure connector is facing downwards.
2. Allow water to flow out of the liquid end.
3. Flush the suction connector from above with a suitable medium or blast with compressed air.

Filling the liquid end

With liquid ends without bleed valve:

1. Connect the suction line to the liquid end but not yet to the discharge line.
2. If fitted: Close the shut-off valve on the discharge side.
3. Connect a short, transparent section of hose to the discharge valve.
4. Switch on the metering pump and allow to work at maximum stroke length and stroke rate until some feed chemical becomes visible in the short section of hose.
   ⇨ The liquid end has been filled completely without bubbles.
5. Switch off the metering pump.
6. Connect the discharge line to the liquid end.
   ⇨ The metering pump is ready for operation.

With liquid ends with bleed valves (not SEK):

1. Connect the suction and discharge line to the liquid end.
2. Connect the return line.
3. Open the bleed valve by turning the star-shaped handle in a counter-clockwise direction.
   ⇨ You can now use the return line to bleed the pump.
4. Switch on the metering pump and allow to work at maximum stroke length and stroke rate until some feed chemical becomes visible in the return or discharge line.
   ⇨ The liquid end has been filled completely without bubbles.
5. Switch off the metering pump.
6. Close the bleed valve.
   ⇨ The metering pump is ready for operation.

With self-bleeding metering pumps (SEK type):

- *The return line is connected to the vertical valve on the top of the liquid end. It is labelled with a red sleeve ex-works.*
- *The discharge line is connected to the horizontal valve.*

1. Switch on the metering pump and allow to work at maximum stroke length and stroke rate until some feed chemical becomes visible in the return or discharge line.
   ⇨ The liquid end has been filled completely without bubbles.
2. Switch off the metering pump.
   ⇨ The metering pump is ready for operation.

Setting the precise dosage

Stroke length and stroke rate

- *Select as large a stroke length as possible with gaseous feed chemicals.*
- *Select as high a stroke rate as possible for good mixing.*
- *Do not set the stroke length to less than 30 % for precise metering using quantity-proportional metering.*

11 Operation

WARNING!

Fire hazard with flammable media

Only with combustible media: These may start to burn when combined with oxygen.

– During filling and draining of the liquid end, an expert must ensure that feed chemical does not come into contact with oxygen.

WARNING!

Danger of electric shock

Incompletely installed electrical options can allow moisture into the inside of the housing.

– Knock-out openings in the pump housing must be equipped with matching modules or be sealed in a leak-tight manner.

WARNING!

Danger of electric shock

A mains voltage may exist inside the pump housing.

– If the pump housing has been damaged, you must disconnect it from the mains immediately. It may only be returned to service after an authorised repair.

11.1 Manual

Personnel: ■ Instructed personnel

11.1.1 Capacity

The capacity is determined by the stroke length and the stroke rate.

The stroke length is adjusted by the stroke length adjustment knob within a range of 0 ... 100 %. A stroke length of between 30 ... 100 % (SEK type: 50 ... 100 %) is recommended to achieve the specified reproducibility!

Data	Value	Unit
Recommended stroke length, standard type	30 ... 100	%
Recommended stroke length, SEK type	50 ... 100	%

The stroke rate can be set within a range of 10 ... 100 % using the multi-functional switch.

11.1.2 Functions

The pump has the following functions:

"Pause" function

The pump can be remotely stopped via the "External Control" terminal. The "Pause" function only works via the "External Control" terminal.

"Stop" function (optional)

The pumps can be stopped by turning the multifunctional switch to "Stop" without disconnecting it from the mains power supply.

"Priming" function

Priming (transient conveyance at maximum frequency) can be provided by turning the multifunctional switch to "Test".

"Level switch" function

Information about the liquid/powder level in the feed chemical container is reported to the pump. To do so, a two-stage level switch must be fitted; it is connected to the "Level switch" terminal.

"Auxiliary rate" function

Enables switching of a stroke rate via the "External control" jack. This auxiliary rate has priority over the operating mode stroke rate settings . In the standard version, the "Auxiliary frequency" function is programmed to 100 % stroke rate.

11.1.3 External contact

"Extern" operating mode:

In the Extern Contact operating mode, either a series of strokes can be triggered or an inbound series of contacts can be stepped down via the pulse control switch by a single contact on the "External control" terminal. To do so, the multifunctional switch has to be turned to "Extern".

Explanation of the stepped-down values:

Settable values	Incoming contacts	Strokes performed
1:1	1	1
1:2	2	1
1:4	4	1
1:8	8	1
1:16	16	1
1:32	32	1
1:64	64	1

Explanation of stepped-up values:

Settable values	Incoming contacts	Strokes performed
1:1	1	1
2:1	1	2
4:1	1	4
8:1	1	8
16:1	1	16
32:1	1	32
64:1	1	64

11.1.4 External analog

"External Analogue" operating mode

In "External Analogue" operating mode, the stroke rate can be controlled by an mA signal via the pulse control switch. To do so, the multifunctional switch has to be turned to "Extern".

In the same way, a single contact via the pulse control switch at the "external control" terminal can either be used to trigger a series of strokes or to step down an incoming series of contacts. To do so, the multifunctional switch has to be turned to "Extern".

Explanation of the stepped-down values:

Settable values	Incoming contacts	Strokes performed
such as "External Analogue"	such as "External Analogue"	such as "External Analogue"
...	...	...
01:16	16	1
01:32	32	1
0-20 mA	-	corresponding to the mA signal

Explanation of stepped-up values:

Settable values	Incoming contacts	Strokes performed
such as "External Analogue"	such as "External Analogue"	such as "External Analogue"
...	...	...
16:1	1	16
32:1	1	32
4-20 mA	-	corresponding to the mA signal

11.2 Remote operation

There is an option to control the pump remotely via a signal cable - refer to your system documentation and to "Electrical Installation".

12 Maintenance

WARNING!

It is mandatory that you read the safety information and specifications in the "Storage, Transport and Unpacking" chapter prior to shipping the pump.

WARNING!

Fire hazard with flammable media

Only with combustible media: These may start to burn when combined with oxygen.

– During filling and draining of the liquid end, an expert must ensure that feed chemical does not come into contact with oxygen.

CAUTION!

Warning of feed chemical spraying around

Feed chemical can spray out of the hydraulic components if they are manipulated or opened due to pressure in the liquid end and adjacent parts of the system.

– Disconnect the pump from the mains power supply and ensure that it cannot be switched on again by unauthorised persons.
– Depressurise the system before commencing any work on hydraulic parts.

Third party spare parts for the pumps may lead to problems when pumping.

– *Use only original spare parts.*
– *Use the correct spare parts kits. In the event of doubt, refer to the exploded views and ordering information in the appendix.*

Standard liquid ends:

Interval	Maintenance work	Personnel
Quarterly*	■ Check the metering diaphragm for damage** - refer to "Repair". ■ Check that the hydraulic lines are fixed firmly to the liquid end. ■ Check that the suction valve and discharge valve are fitted tightly. ■ Check the tightness of the entire liquid end - particularly around the leakage hole - refer to *'Standard liquid ends:' on page 40*! ■ Check that the flow is correct: Allow the pump to prime briefly - turn the multifunctional switch briefly to "Test" ■ Check that the electrical connections are intact. ■ Check the integrity of the housing. ■ Check that the dosing head screws are tight.	Technical personnel

* Under normal loading (approx. 30 % of continuous operation)

Under heavy loading (e.g. continuous operation): Shorter intervals.

** Check the diaphragm frequently with feed chemicals that put particular pressure on the diaphragm, e.g. those containing abrasive additives.

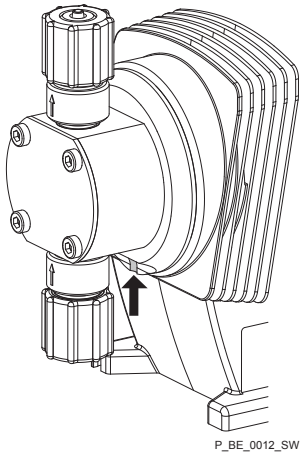


Fig. 17: Leakage hole

Liquid ends with bleed valve:

Interval	Maintenance work
Quarterly*	In addition: ■ Check that the bypass line is fixed firmly to the liquid end ■ Check that the bleed valve is tight. ■ Check the discharge and bypass line for kinks ■ Check that the bleed valve is operating correctly.

* Under normal loading (approx. 30 % of continuous operation)

Under heavy loading (e.g. continuous operation): Shorter intervals.

Tightening torque

Data	Value	Unit
Tightening torque for screws:	4.5 ... 5.0	Nm

13 Repairs

Safety Information

WARNING!

Danger of electric shock

Unauthorised repairs inside the pump can result in an electric shock.

For this reason, only allow a ProMinent branch or representative to perform repair inside the pump, in particular the following:

– Replacement of damaged mains connection lines
– Replacement of fuses
– Replacement of electronic control

WARNING!

Fire hazard with flammable media

Only with combustible media: These may start to burn when combined with oxygen.

– During filling and draining of the liquid end, an expert must ensure that feed chemical does not come into contact with oxygen.

WARNING!

It is mandatory that you read the safety information and specifications in the "Storage, Transport and Unpacking" chapter prior to shipping the pump.

WARNING!

Contact with the feed chemical

Parts that come into contact with the feed chemical are exposed and touched during repair work.

– Protect yourself against the feed chemical in case it is hazardous. Read the safety data sheet on the feed chemical.

CAUTION!

Warning of feed chemical spraying around

Feed chemical can spray out of the hydraulic components if they are manipulated or opened due to pressure in the liquid end and adjacent parts of the system.

– Disconnect the pump from the mains power supply and ensure that it cannot be switched on again by unauthorised persons.
– Depressurise the system before commencing any work on hydraulic parts.

Repairs that may be carried out by qualified technical personnel, in accordance with the operating instructions:

- Cleaning valves
- Replacing the diaphragm

All other repairs: Contact the responsible ProMinent branch!

13.1 Cleaning valves

Warning of faulty operation

Refer to the exploded drawings in the appendix when working on the unit.

Cleaning a discharge valve or a suction valve on types (PP, PV, NP) 1000, 1601, 1602, 1604, 2504

Warning of faulty operation

- *Discharge and suction valves differ from each other! Only take them apart one after each other, so that you do not confuse the components!*
- *Only use new components which fit your valve - both in terms of shape and chemical resistance!*
- *Recalibrate the pump after replacing a valve!*
- *Using an Allen key or similar, insert it into the smaller hole of the discharge connector and push the valve inserts out of it.*

A suction valve is constructed in almost the same way as a discharge valve.

Please note, however, that:

- the two valve inserts are identical here
- There is an additional spacer between the valve inserts.
- There is a shaped seal in the dosing head instead of an O-ring.
- The flow direction of the suction connector is the opposite to that of the discharge connector.

Cleaning a discharge valve or a suction valve on types (PP, PV, NP) 0708, 1008, 0220, 0420, 0413, 0713, 0232

Warning of faulty operation

- *Discharge and suction valves differ from each other! Only take them apart one after each other, so that you do not confuse the components!*
- *Only use new components which fit your valve - both in terms of shape and chemical resistance!*
- *With the PVT material version, the ball seat is integrated in the dosing head and so has to be cleaned separately!*
- *On the PVT material version, the discharge valve is a double ball valve!*
- *Using an Allen key or similar, insert it into the smaller hole of the discharge connector and push the valve inserts out of it.*

A suction valve is constructed in almost the same way as a discharge valve.

Please note, however, that:

- The flow direction of the suction connector is the opposite to that of the discharge connector.

13.2 Replacing the diaphragm

WARNING!
A little feed chemical may have accumulated behind the diaphragm in the backplate following a leak - depending on the design!

– Take this feed chemical into consideration when you are planning a repair - especially if it is hazardous!

- If necessary take protective measures.
- Adhere to the material safety data sheet for the feed chemical.
- Ensure that the system is at atmospheric pressure.

1. Empty the liquid end (turn the liquid end upside down and allow the feed chemical to run out; flush out with a suitable medium; flush the liquid end thoroughly when using hazardous feed chemicals!)
2. Turn the stroke adjustment dial as far as 0% stroke length when the pump is running (the drive axle is then difficult to turn).
3. Switch off the pump.
4. Unscrew the hydraulic connectors on the discharge and suction side.
5. With PP types with bleed valve: Firstly remove the bleed valve (grip), then lift off the cover of the liquid end with a screw driver.
6. Remove the screws (1).
7. Loosen the dosing head (2) and the backplate (4) from the pump housing (6) - but only loosen!
8. Hold the pump housing (6) with one hand and clamp the diaphragm (3) with the other hand between the dosing head (2) and the backplate (4).
9. Loosen the diaphragm (3) from the drive axle with a gentle backwards turn of the dosing head (2), diaphragm (3) and backplate (4) in an anticlockwise direction.
10. Unscrew the diaphragm (3) completely from the drive axle.
11. Remove the backplate (4) from the pump housing (6).
12. Check the condition of the safety diaphragm (5) and replace if necessary.
13. Push the safety diaphragm (5) onto the drive axle only until it lies flush with the pump housing (6) and no further!
14. Tentatively screw the new diaphragm (3) onto the drive axle until it can go no further.

    ⇨ The diaphragm (3) is now sitting at the stop of the thread.
15. Should this not work, remove dirt or swarf from the threads and screw the diaphragm (3) onto the drive axle correctly this time.

Ensure that the diaphragm is screwed exactly onto the drive axle otherwise the pump will subsequently not meter accurately!

16. Unscrew the diaphragm (3) again.
17. Place the backplate (4) on the pump housing (6).

CAUTION!
Leakage may become apparent at a later stage.
– Make sure that the leakage hole points downwards when the pump is installed later - please refer to !
– Place the backplate (4) immediately into the correct position on the pump housing (6)! Do not twist the backplate on the pump housing to prevent the safety diaphragm (5) becoming warped!

18. Place the diaphragm (3) into the backplate (4).

CAUTION!
Leakage may become apparent at a later stage.
– Do not over-tighten the diaphragm (3) in the following step!
– Ensure that the backplate (4) remains in its position so that the safety diaphragm does not become warped!

19. Hold the backplate (4) firmly and screw the diaphragm (3) in a clockwise direction until it is sitting tightly (the twisting resistance of the return spring can be felt).

20. Set the stroke length to 100%.

21. Place the dosing head (2) with the screws (1) onto the diaphragm (3) and the backplate (4) - ensure that the suction connector points downwards when the pump is in its subsequent fitting position.

22. Gently tighten the screws (1) and then tighten them diagonally. See below for the tightening torque.

23. With PP types with bleed valve: Allow the cover of the liquid end to rest in the dosing head, then press the grip on the bleed valve into the dosing head.

CAUTION!
Leakage possible
– Check the tightening torque of the screws after 24 hours of operation!
– With PP and PV dosing heads, check the tightening torque again after three months!

Tightening torque

Data	Value	Unit
Tightening torque for screws:	4.5 ... 5.0	Nm

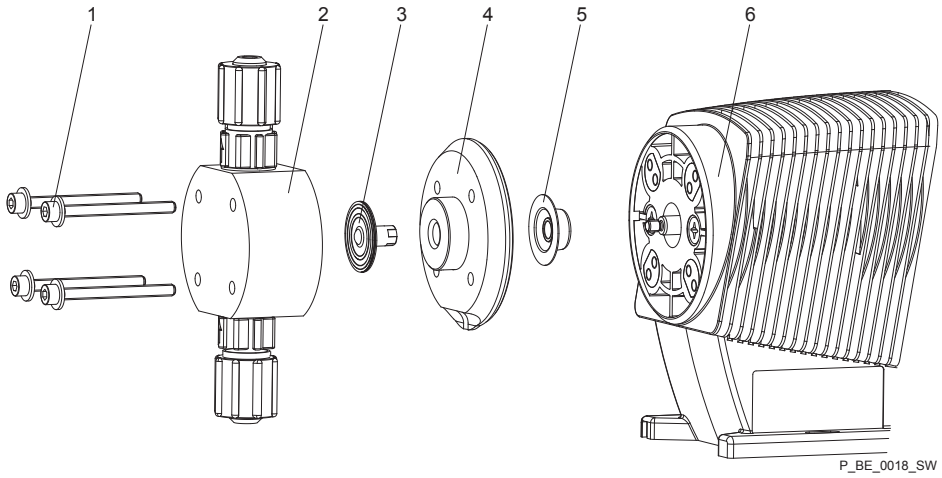


Fig. 18: Partially exploded view of liquid end

14 Troubleshooting

Safety Information

WARNING!

Warning of dangerous or unknown feed chemical

Should a dangerous or unknown feed chemical be used: It may escape from the hydraulic components when working on the pump.

– Take appropriate protective measures before working on the pump (e.g. safety glasses, safety gloves, ...). Observe the safety data sheet for the feed chemical.
– Drain and flush the liquid end before working on the pump.

WARNING!

Fire hazard with flammable media

Only with combustible media: These may start to burn when combined with oxygen.

– During filling and draining of the liquid end, an expert must ensure that feed chemical does not come into contact with oxygen.

CAUTION!

Warning of feed chemical spraying around

Feed chemical can spray out of the hydraulic components if they are manipulated or opened due to pressure in the liquid end and adjacent parts of the system.

– Disconnect the pump from the mains power supply and ensure that it cannot be switched on again by unauthorised persons.
– Depressurise the system before commencing any work on hydraulic parts.

14.1 Faults without a fault message

Fault description	Cause	Remedy	Personnel
Pump does not prime in spite of full stroke motion and bleeding.	Minor crystalline deposits on the ball seat due to the valves drying out.	Take the suction hose out of the storage tank and thoroughly flush out the liquid end.	Technical personnel
	Serious crystalline deposits on the ball seat due to the valves drying out.	Dismantle the valves and clean them - refer to "Repair"	Technical personnel
Fluid is escaping from the backplate.	The screws in the dosing head are too loose.	Tighten the screws in the dosing head crosswise - refer to "Repair" for tightening torque.	Instructed personnel
	The diaphragm is not leak-tight.	Replace the diaphragm - refer to "Repair".	Technical personnel
Green LED display (operating indicator) does not light up.	The wrong mains voltage or no mains voltage is connected.	Connect the pump correctly to the specified mains voltage - according to the specification on the nameplate	Electrician

14.2 Fault messages

Fault description	Cause	Remedy	Personnel
Red LED indicator (fault indicator) lights up and the pump stops	The fluid level in the storage tank has reached "Liquid level low 2nd stage".	Fill the storage tank.	Instructed personnel
	The pump is in "External Analogue" operating mode and the control current has risen above 23 mA (fault signal).	Clear the cause of the fault on the pump.	
	The pump is in "External Analogue" operating mode, set to "4-20 mA" and the control current has fallen below 4 mA.	Clear the cause of the low control current (e.g. cable break).	
	The multifunctional switch is not turned to "Extern" but an external cable is connected and the pump has the identity code feature "Control type" - "1" "with lock".	Either turn the multifunctional switch to "Extern" or remove the Extern cable from the pump	Technical personnel

14.3 Warning messages

Fault description	Cause	Remedy	Personnel
Yellow LED indicator (warning indicator) lights up	The fluid level in the storage tank has reached "Liquid level low 1st stage".	Fill the storage tank.	Instructed personnel

14.4 All Other Faults

Please contact the responsible ProMinent branch or representative!

15 Decommissioning

Decommissioning

WARNING!

Danger from chemical residues

There is normally chemical residue in the liquid end and on the housing after operation. This chemical residue could be hazardous to people.

- It is mandatory that the safety notes in the "Storage, Transport and Unpacking" chapter are read before shipping or transport.
- Thoroughly clean the liquid end and the housing of chemicals and dirt. Adhere to the material safety data sheet for the feed chemical.

WARNING!

Warning of dangerous or unknown feed chemical

Should a dangerous or unknown feed chemical be used: It may escape from the hydraulic components when working on the pump.

- Take appropriate protective measures before working on the pump (e.g. safety glasses, safety gloves, ...). Observe the safety data sheet for the feed chemical.
- Drain and flush the liquid end before working on the pump.

WARNING!

Fire hazard with flammable media

Only with combustible media: These may start to burn when combined with oxygen.

- During filling and draining of the liquid end, an expert must ensure that feed chemical does not come into contact with oxygen.

CAUTION!

Warning of feed chemical spraying around

Feed chemical can spray out of the hydraulic components if they are manipulated or opened due to pressure in the liquid end and adjacent parts of the system.

- Disconnect the pump from the mains power supply and ensure that it cannot be switched on again by unauthorised persons.
- Depressurise the system before commencing any work on hydraulic parts.

Danger of damage to the device

Take into account the information in the "Storage, Transport and Unpacking" chapter if the system is decommissioned for a temporary period.

1. Disconnect the pump from the mains/power supply.
2. Drain the liquid end by turning the pump upside down and allowing the feed chemical to run out.

3. Flush the liquid end with a suitable medium; flush the dosing head thoroughly when using hazardous feed chemicals!

Disposal

CAUTION!

Environmental hazard due to electronic waste

There are electronic components in the pump, which can have a toxic effect on the environment.

– Separate the electronic components from the remaining parts.
– Note the pertinent regulations currently applicable in your country!

16 Technical data

16.1 Performance data

Beta b operating at 180 strokes/minute and 100% stroke length

Type	Minimum pump capacity at maximum back pressure			Minimum pump capacity at medium back pressure			Connection size outside Ø x inside Ø	Suction lift*	Priming lift**	Maximum priming pressure on suction side
	bar	l/h	ml/stroke	bar	l/h	ml/stroke	mm	m WS	m WS	bar
Beta b										
1000	10	0.74	0.069	5.0	0.82	0.076	6x4	6.0	1.8	8
0700	7	0.8	0.074	3.5	0.88	0.074	6x4	6.0	1.8	8
0400	4	0.84	0.078	2.0	0.92	0.078	6x4	6.0	1.8	8
2001	20	0.96	0.089	10	1.5	0.13	6x3	6.0	2.0	8
1601	16	1.1	0.10	8.0	1.40	0.13	6x4	6.0	2.0	8
1001	10	1.3	0.12	5.0	1.5	0.14	6x4	6.0	2.0	8
0701	7	1.4	0.13	3.5	1.7	0.14	6x4	6.0	2.0	8
0401	4	1.5	0.14	2.0	2.0	0.18	6x4	6.0	2.0	8
2002	20	1.7	0.16	10	2.8	0.26	6x3	6.0	2.5	5.5
1602	16	2.2	0.20	8.0	2.5	0.24	6x4	6.0	2.5	5.5
1002	10	2.4	0.22	5.0	2.8	0.26	6x4	6.0	2.5	5.5
0702	7	2.6	0.24	3.5	3.1	0.29	6x4	6.0	2.5	5.5
0402	4	2.8	0.26	2.0	3.6	0.36	6x4	6.0	2.5	5.5
1604	16	3.6	0.33	8.0	4.3	0.40	6x4	5.0	3.0	3
1004	10	3.9	0.36	5.0	4.7	0.44	6x4	5.0	3.0	3
0704	7	4.2	0.39	3.5	5.1	0.47	6x4	5.0	3.0	3
0404	4	4.5	0.42	2.0	5.6	0.52	6x4	5.0	3.0	3
0708	7	7.1	0.66	3.5	8.4	0.78	8x5	4.0	2.0	2
0408	4	8.3	0.77	2	10.0	0.93	8x5	4.0	2.0	2
0413	4	12.3	1.14	2.0	14.2	1.31	8x5	3.0	2.5	1.5
0220	2	19.0	1.76	1.0	20.9	1.94	12x9	2.0	2.0	1
2504	25	2.9	0.27	12.5	3.7	0.34	8x4[1]	4.0	3.0	3
1605	16	4.1	0.38	8.0	4.9	0.45	8x5	4.0	3.0	3
1008	10	6.8	0.63	5.0	8.3	0.76	8x5	3.0	3.0	2
0713	7	11.0	1.02	3.5	13.1	1.21	8x5	3.0	3.0	1.5
0420	4	17.1	1.58	2.0	19.1	1.77	12x9	3.0	3.0	1
0232	2	32.0	2.96	1.0	36.2	3.35	12x9	2.0	2.0	0.8
Beta b Metering pumps with self-bleeding dosing head SEK* **										
1601	16	0.59	0.055	8.0	0.80	0.072	6x4	6.0	2.0	0.5
1001	10	0.72	0.067	5.0	0.60	0.08	6x4	6.0	2.0	0.5
0701	7	0.84	0.078	3.5	1.12	0.10	6x4	6.0	2.0	0.5

Type	Minimum pump capacity at maximum back pressure			Minimum pump capacity at medium back pressure			Connection size outside Ø x inside Ø	Suction lift*	Priming lift**	Maximum priming pressure on suction side
	bar	l/h	ml/ stroke	bar	l/h	ml/ stroke	mm	m WS	m WS	bar
0401	4	0.9	0.083	2.0	1.2	0.11	6x4	6.0	2.0	0.5
2002	20	0.78	0.07	10.0	1.8	0.17	6x4	6.0	2.5	0.5
1602	16	1.40	0.13	8.0	1.70	0.16	6x4	6.0	2.5	0.5
1002	10	1.7	0.16	5.0	2.0	0.18	6x4	6.0	2.5	0.5
0702	7	1.8	0.17	3.5	2.2	0.20	6x4	6.0	2.5	0.5
0402	4	2.1	0.19	2.0	2.5	0.23	6x4	6.0	2.5	0.5
1604	16	2.7	0.25	8.0	3.6	0.33	6x4	6.0	3.0	0.5
1004	10	3.3	0.30	5.0	3.9	0.36	6x4	6.0	3.0	0.5
0704	7	3.6	0.33	3.5	4.0	0.37	6x4	6.0	3.0	0.5
0404	4	3.9	0.36	2.0	4.2	0.39	6x4	6.0	3.0	0.5
0708	7	6.60	0.61	3.5	7.50	0.69	8x5	6.0	2.0	0.5
0408	4	7.5	0.64	2.0	8.1	0.77	8x5	6.0	2.0	0.5
0413	4	10.8	1.0	2.0	12.6	1.17	8x5	6.0	2.5	0.5
0220	2	16.2	1.5	1.0	18.0	1.67	12x9	6.0	2.0	0.5
1008	10	6.3	0.58	5.0	7.5	0.69	8x5	6.0	3.0	0.5
0713	7	10.5	0.97	3.5	12.3	1.14	8x5	6.0	2.5	0.5
0420	4	15.6	1.44	2.0	17.4	1.61	12x9	6.0	2.5	0.5
Beta b metering pumps with self-bleeding dosing head SER**										
1002	10	1.40	0.13	8.0	1.70	0.174	6x4	6.0	1.8	0.5
1004	10	2.7	0.25	8.0	3.6	0.33	6x4	6.0	1.8	0.5
0708	7	6.60	0.61	3.5	7.50	0.69	8x5	6.0	1.8	0.5
0413	4	10.8	1.0	2.0	12.6	1.17	8x5	6.0	1.8	0.5
0220	2	16.2	1.5	1.0	18.0	1.67	12x9	6.0	2.0	0.5
1008	10	6.3	0.58	5.0	7.5	0.69	8x5	6.0	1.8	0.5
0713	7	10.5	0.97	3.5	12.3	1.14	8x5	6.0	1.8	0.5
0420	4	15.6	1.44	2.0	17.4	1.61	12x9	6.0	1.8	0.5

* - Suction lift with a filled suction line and filled liquid end. With self-bleeding dosing head with air in the suction line.

** - Priming lift with clean and moist valves. Priming lift at 100% stroke length and free outlet or opened bleed valve.

*** - The given performance data constitutes guaranteed minimum values, calculated using water as the medium at room temperature. The bypass connection with a self-bleeding dosing head SEK is 6x4 mm.

*** - The given performance data constitutes guaranteed minimum values, calculated using water as the medium at room temperature.

[1] - The connector width is 6 mm on SST material versions.

Beta b Metering pumps with dosing heads for higher-viscosity media (HV) have a 10-20% lower capacity and are not self-priming. Connection G 3/4-DN 10 with hose nozzle d16-DN10.

16.2 Accuracy

16.2.1 Standard Liquid End

Data	Value	Unit
Capacity range of the series	-5 ... +10	% *
Reproducibility	±2	% **

* - at max. stroke length and max. operating pressure for all material versions

** - at constant conditions and min. 30 % stroke length

16.2.2 Self-Bleeding Liquid End

As the self-bleeding liquid end is used with outgassing media and when operating with air bubbles, no dosing accuracy or reproducibility can be provided.

The recommended minimum stroke length with self-bleeding dosing pumps is 50 %.

16.3 Viscosity

The liquid ends are suitable for the following viscosity ranges:

Version	Range	Unit
standard	0 ... 200	mPas
With valve springs	200 ... 500	mPas
Self-bleeding (SEK)	0 ... 50	mPas
HV (highly viscous)	500 ... 3000*	mPas

* Only when the installation is correctly adjusted

16.4 Material Data

Standard liquid ends

Version	Dosing head	Suction/Discharge connector	Seals	Valve balls
PPE	Polypropylene	Polypropylene	EPDM	Ceramic
PPB	Polypropylene	Polypropylene	FPM	Ceramic
PPT	Polypropylene	PVDF	PTFE	Ceramic
NPE	Acrylic glass	PVC	EPDM	Ceramic
NPB	Acrylic glass	PVC	FPM	Ceramic
NPT	Acrylic glass	PVDF	PTFE	Ceramic
PVT	PVDF	PVDF	PTFE	Ceramic
TTT	PTFE with carbon	PTFE with carbon	PTFE	Ceramic
SST	Stainless steel 1.4404	Stainless steel 1.4404	PTFE	Ceramic

Only the self-bleeding version in PPE, PPB, NPE and NPB material models with a valve spring made of hastealloy C and a valve insert made of PVDF. Diaphragm with a PTFE coating.

FPM = fluororubber

Pump

Housing parts: polyphenyl ether (PPE with fibreglass)

16.5 Electrical data

Version: 100 - 230 V ±10 %, 50/60 Hz, Beta b BT4b

Data	Value	Unit
Nominal power, approx.	6.4 ... 16.5	W
Current I eff	0.65 ... 0.1	A
Peak current	4.2 ...1.3	A
Switch on peak current, (within approx. 50 ms falling)	15	A
Fuse*	0.8	AT

Version: 100 - 230 V ±10 %, 50/60 Hz, Beta b BT5b

Data	Value	Unit
Nominal power, approx.	20 ... 25	W
Current I eff	0.9 ... 0.3	A
Peak current	5.9 ... 2.3	A
Switch on peak current, (within approx. 50 ms falling)	15	A
Fuse*	0.8	AT

* Fuses must have VDE, UL and CSA certification. E.G. type 19195 manufactured by Wickmann in compliance with IEC Publ. 127 - 2/3.

Power consumption

Type	Perform-ance	Type	Perform-ance	Type	Perform-ance
	W		W		W
1000	7.6	1602	12.2	0408	12.7
0700	6.4	1002	10.6	0413	16.5
0400	5.7	0702	9.3	0220	16.5
2001	10.5	0402	7.9	2504	21.2
1601	10.0	1604	16.5	1008	20.3
1001	8.3	1004	12.7	0713	21.2
0701	7.5	0704	11.1	0420	21.2
0401	6.9	0404	9.5	0232	24.9
2002	13.5	0708	16.5		

Design: 12 - 24 VDC# -8/+24 %, identity code M

Parameter	Beta b BT4b
Nominal power, approx.	17.4 W.
Nominal current (averaged at 180 H/min)	3.9 ... 1.9 A.
Peak current	15.6... 8.7 A.
closed current (no stroke)	32 ... 24 mA.
Fuse*	5 AT

SELV in accordance with EN 60335-1

* 5 AT, 5x20 mm, order no. 712028

The pump only works if the polarity is correct.

Design: 24 VDC# -15/+24 %, identity code N

Parameter	Beta b BT5b
Nominal power, approx.	24.4 W.
Nominal current (averaged at 180 H/min)	2.5 A.
Peak current	11.7 A.
Closed current (no stroke)	24 mA.
Fuse*	5 AT

SELV in accordance with EN 60335-1

* 5 AT, 5x20 mm, order no. 712028

The pump only works if the polarity is correct.

16.6 Temperatures

Pump, fully assembled

Data	Value	Unit
Storage and transport temperature:	-10 ... +50	°C
Ambient temperature in operation (power end/drive and control):	-10 ... +45	°C

Liquid end, long-term*

Maximum temperature, liquid end

Material version	Value	Unit
PP	50	°C
NP	40	°C
PV	50	°C
TT	50	°C
SS	50	°C

* long term at max. operating pressure, dependent on the ambient temperature and the feed chemical temperature

Minimum temperature, liquid end

Minimum temperature, liquid end

Material version	Value	Unit
All	-10	°C

Liquid end, short-term*

Maximum temperature, liquid end

Material version	Value	Unit
PPT	100	°C
NPT	60	°C
PVT	120	°C
TTT	120	°C
SST	120	°C

* Temp. max., for 15 min at max. 2 bar, dependent on the ambient and feed chemical temperatures

16.7 Climate

Data	Value	Unit
Maximum air humidity *:	95	% rel. humidity

* non-condensing

Exposure in a humid and alternating climate:

FW 24 according to DIN 50016

16.8 Degree of Protection and Safety Requirements

Degree of protection

Protection against accidental contact and humidity:

IP 65 according to DIN EN 60529

Safety requirements

Degree of protection:

1 - mains power connection with protective earth conductor

16.9 Compatibility

Some hydraulic parts of the Beta® b are identical to those of the Beta® a, gamma/ L and delta®.

There is most compatibility with pumps of the Beta® a, gamma/ L and delta® series with the following components and accessories:

- Signal cable gamma/Vario 2-, 4- and 5-wire for the "Extern" function
- Level switch 2-stage (gamma / Vario / Beta®)
- Dosing line cross-sections
- Standard gamma connector kit
- Chemical feed container
- Overall height (distance between the suction and discharge connector)
- Same use of accessories, such as back pressure valves, multifunctional valves, dosing monitor and flushing equipment

16.10 Sound pressure level

Sound pressure level

Sound pressure level LpA < 70 dB according to EN ISO 20361

at maximum stroke length, maximum stroke rate, maximum back pressure (water)

16.11 Shipping weight

Shipping weight of Beta b types - in kg

Material	BT4b						BT5b		
	1000, 0700, 0400	2001, 1601, 1001, 0701, 0401	2002, 1602, 1002, 0702, 0402	1604, 1004, 0704, 0404	0708, 0408, 0413	0220	2504, 1008, 0713	0420	0232
PP, NP, PV, TT	2.5	2.9	2.9	3.1	3.1	3.3	4.5	4.7	5.1
SS	3.0	3.6	3.6	3.9	3.9	4.4	5.3	5.8	6.6

17 Dimensional drawings

- *Compare the dimensions on the dimensional drawing and pump.*
- *All dimensions are in mm.*

Dimensional drawing Beta b, material version PP

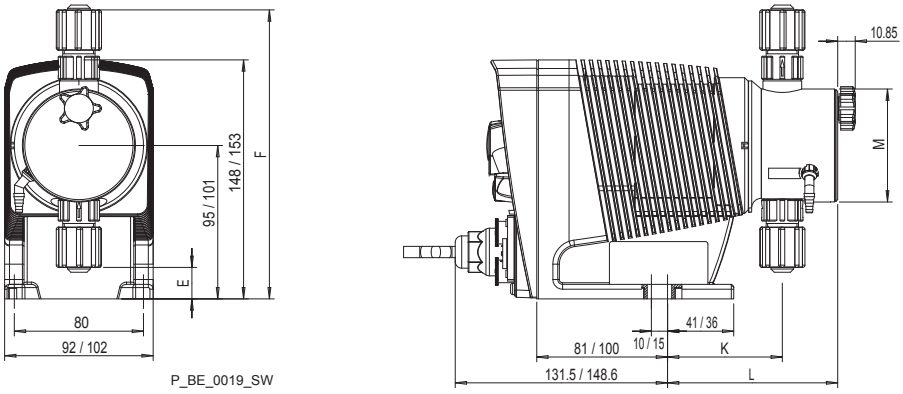


Fig. 19: Dimension drawing Beta b BT4b/BT5b, material version PP - dimensions in mm

	1000 - 1604	0708 - 0220	1008 - 0420	0232
E	19.5	7	14	1.5
F	179	186.5	191.5	200.5
K	71	77.5	74	77.5
L	105.5	111	107.5	94.5
M	Ø 70	Ø 90	Ø 90	Ø 110

Dimensional drawing Beta b, material version PP

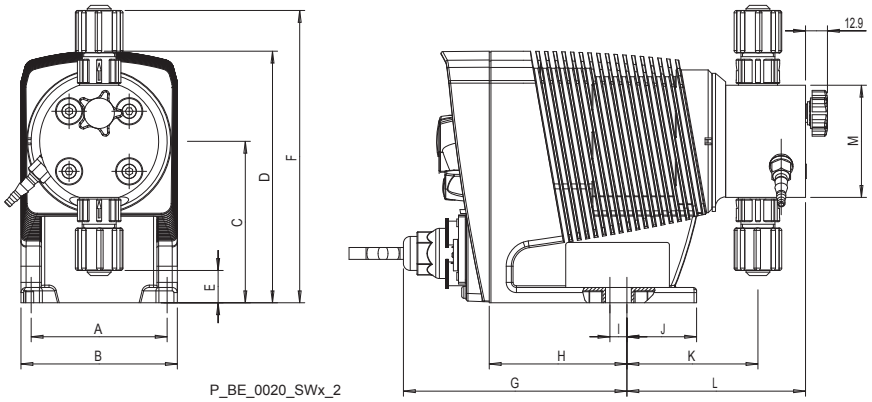


Fig. 20: Dimension drawing Beta b BT4b/BT5b, material version PP - dimensions in mm

	1000 - 1604	0708 - 0220	2504	1008 - 0420	0232
A	80	80	80	80	80
B	92	92	102	102	102
C	95	95	101	101	101
D	148	148	153	153	153
E	19	7.2	24.6	14	3.2
F	172	182.8	178.4	188	198.8
G	131.5	131.5	148.6	148.6	148.6
H	81	81	100	100	100
I	10	10	15	15	15
J	41	41	36	36	36
K	77	77.5	77.1	74.1	76
L	105	105.5	105.1	102.1	104.5
M	Ø 70	Ø 90	Ø 70	Ø 90	Ø 110

Dimensional drawing Beta b, material version PP and NP SEK

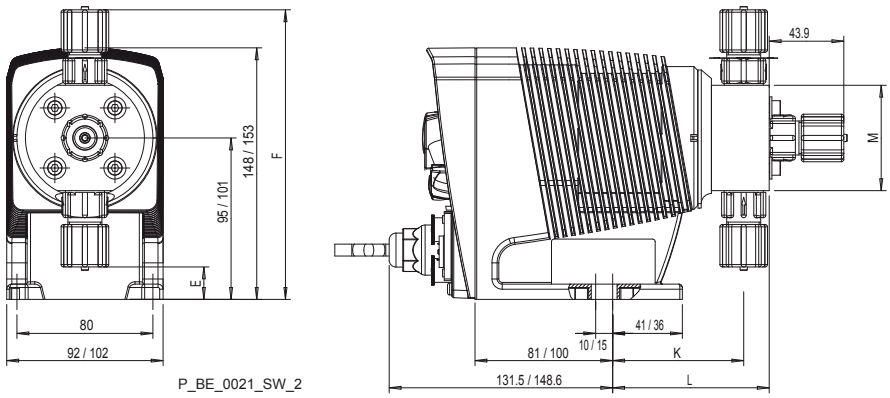


Fig. 21: Dimensional drawing Beta b BT4b/BT5b, material versions PP and NP with self-bleeding dosing head SEK - dimensions in mm

	1604	0708 - 0220	1008 - 0232
E	19	7.5	13.6
F	170.5	182.5	188.4
K	77	74	74
L	92	105.5	89
M	Ø 70	Ø 90	Ø 90

Dimensional drawing Beta b, material version PV

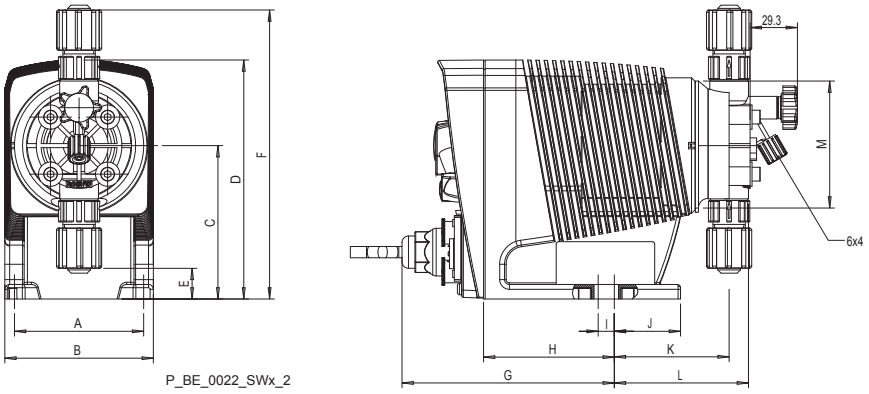


Fig. 22: Dimension drawing Beta b BT4b/BT5b, material version PV - dimensions in mm

	1604	0708 - 0220	1008 - 0420	0232
A	80	80	80	80
B	92	92	102	102
C	95	95	101	101
D	148	148	153	153
E	19	8.1	14.1	3.2
F	179	185.5	191.5	199
G	131.5	131.5	148.5	148.5
H	81	81	100	100
I	10	10	15	15
J	41	41	36	36
K	71	73	73	76
L	83	90	90	93
M	Ø 70	Ø 90	Ø 90	Ø 110

Dimensional drawing Beta b, material version PV HV

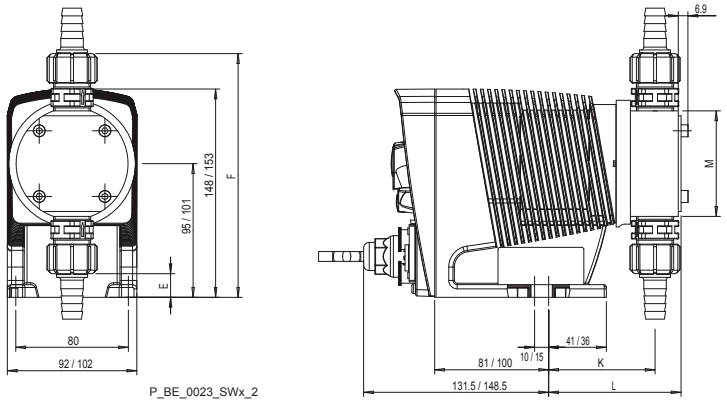


Fig. 23: Dimensional drawing Beta b BT4b/BT5b, material version PV for highly viscous feed chemicals - dimensions in mm

	1604	0708 - 0413	0220	1008 - 0713	0420
E	17	13	13	22.8	19
F	173	177	177	179.2	183
K	75.5	77	77	75.5	78.5
L	94	95	95	94	96.5
M	Ø 70	Ø 80	Ø 85	Ø 85	Ø 85

Dimensional drawing Beta b, material version TT

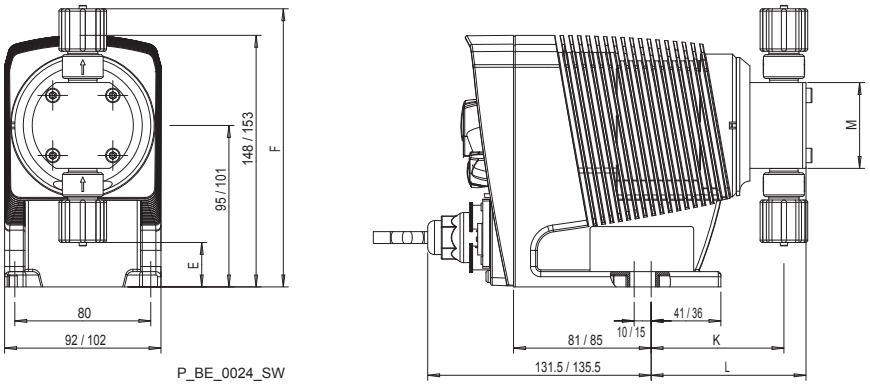


Fig. 24: Dimension drawing Beta b BT4b/BT5b, material version TT - dimensions in mm

	1000 - 1601	1602 - 1604	0708 - 0220	1008 - 0420	0232
E	26.2	21.3	-13.2	-7.2	-14.2
F	163.7	168.8	202.7	208.7	215.7
K	78	72	77	77.1	78
L	91	86	94	94	97
M	Ø 60	Ø 70	Ø 85	Ø 85	Ø 100

Dimensional drawing Beta b, material version SS

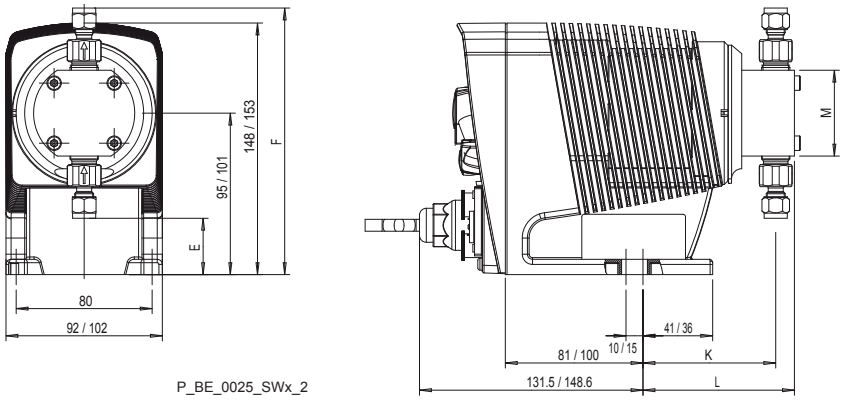


Fig. 25: Dimensional drawing Beta b BT4b/BT5b, material version SS - dimensions in mm

	1000 - 1601	1602 - 1604	0708 - 0220	2504	1008 - 0420	0232
E	33.2	24.4	-7.8	31.7	-1.8	-8
F	156.9	165.6	197.3	170.4	203.3	210
K	78	75	82	72	77	78
L	89	87	97	84	92	95
M	Ø 60	Ø 70	Ø 85	Ø 70	Ø 85	Ø 110

18 Diagrams for setting the metering capacity

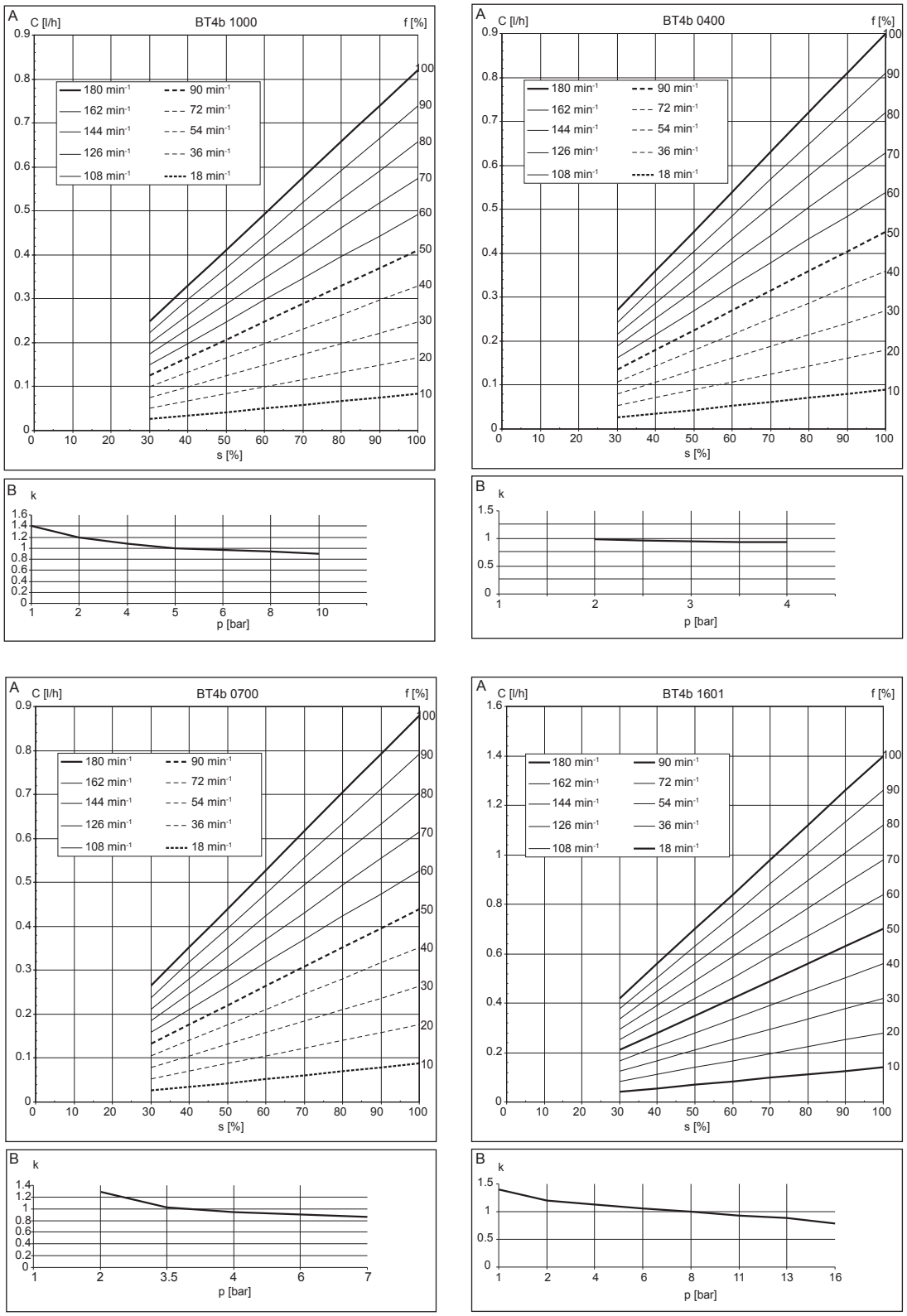


Fig. 26: A) Metering capacity C for medium back pressure dependent on the stroke length s for different stroke rates f. B) Corresponding correction factors k dependent on back pressure p.

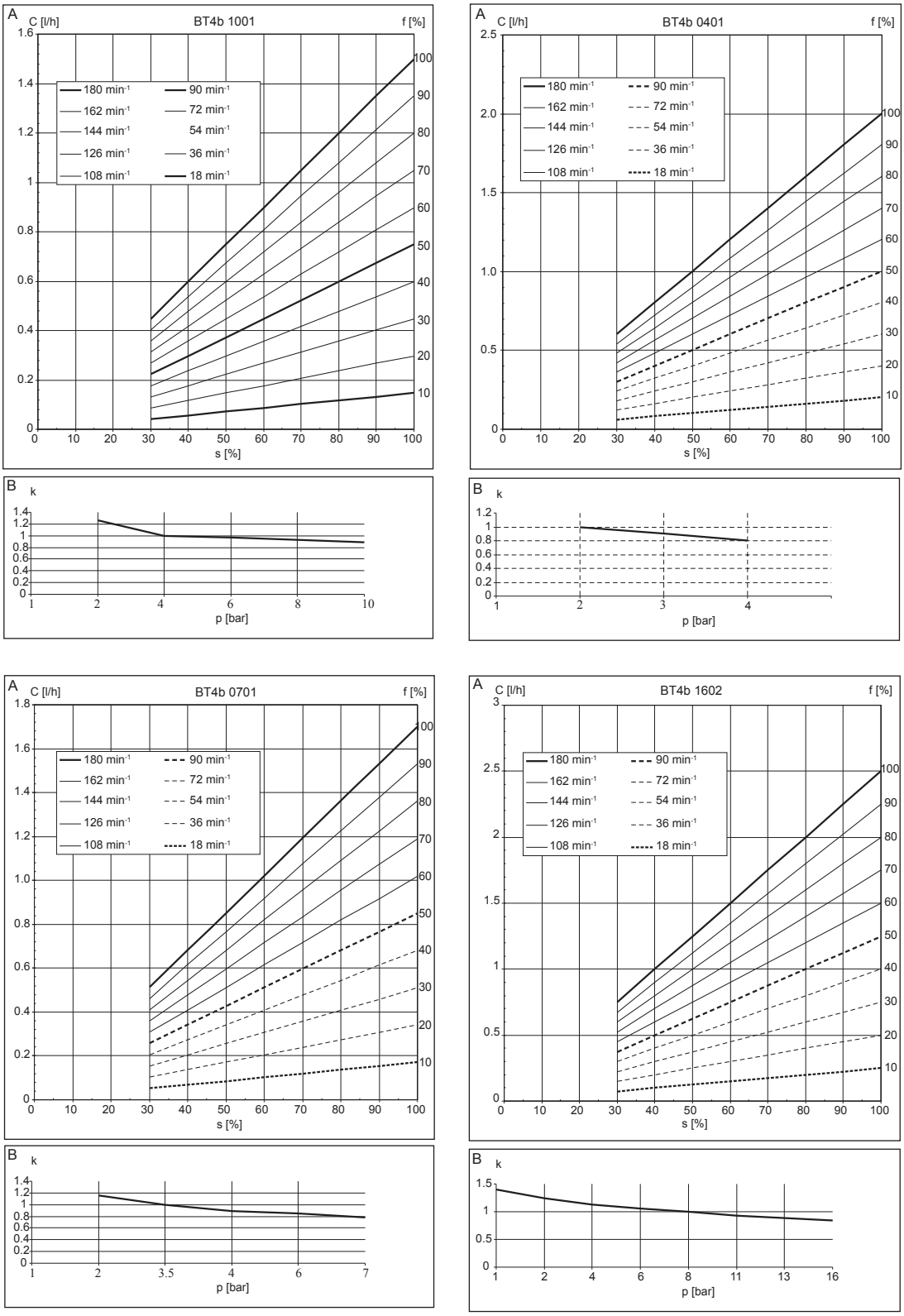


Fig. 27: A) Metering capacity C for medium back pressure dependent on the stroke length s for different stroke rates f. B) Corresponding correction factors k dependent on back pressure p.

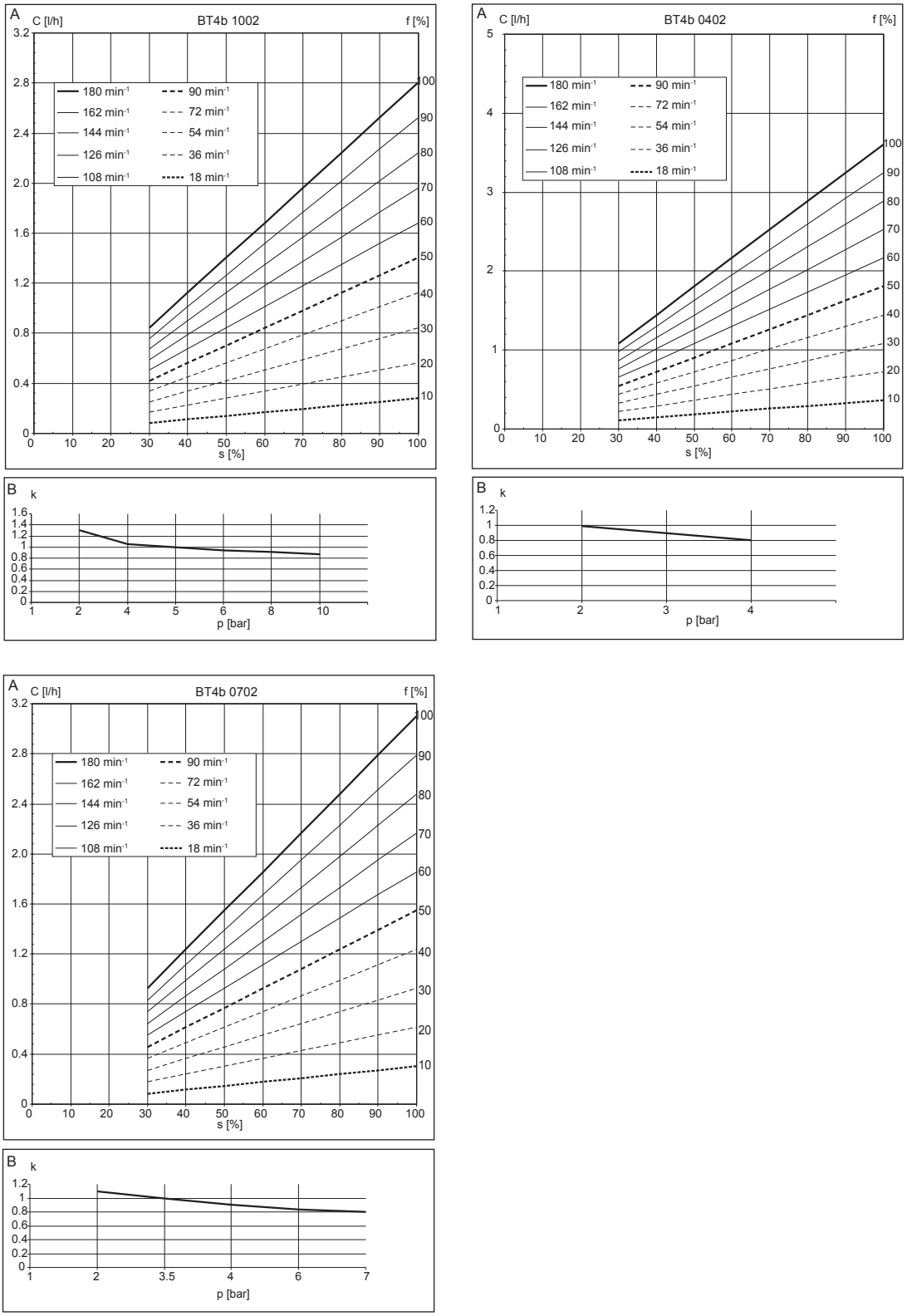


Fig. 28: A) Metering capacity C for medium back pressure dependent on the stroke length s for different stroke rates f. B) Corresponding correction factors k dependent on back pressure p.

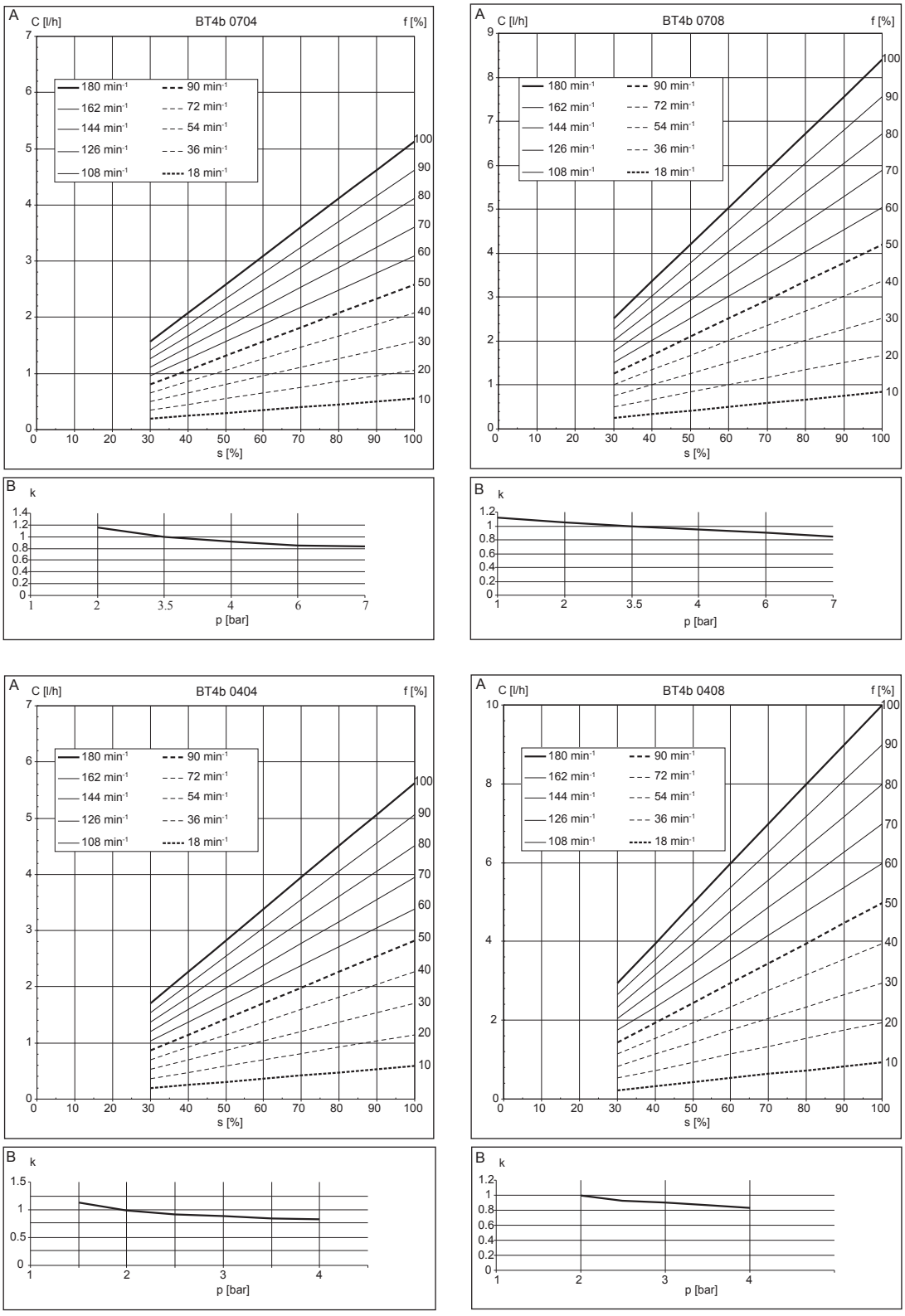


Fig. 29: A) Metering capacity C for medium back pressure dependent on the stroke length s for different stroke rates f. B) Corresponding correction factors k dependent on back pressure p.

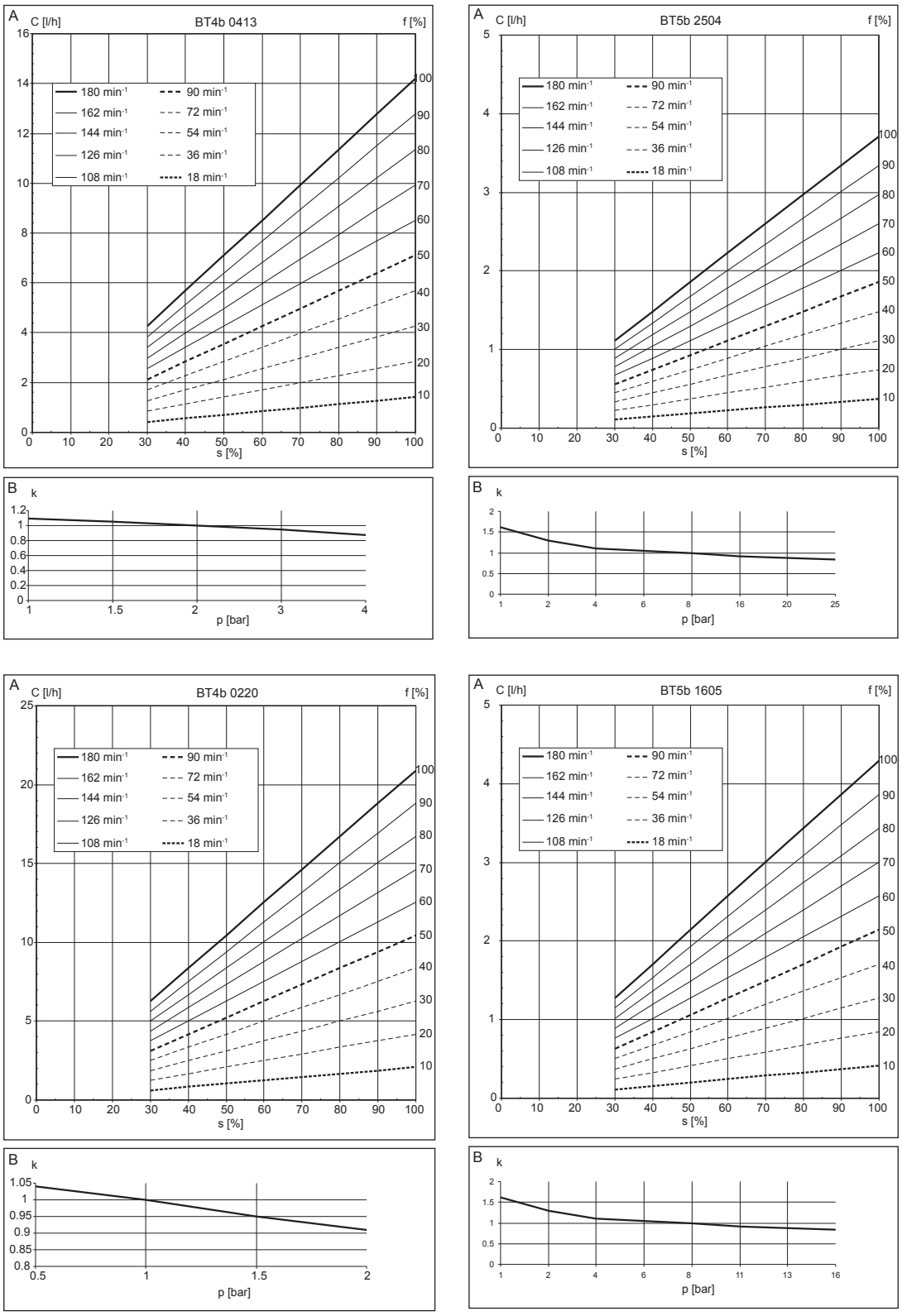


Fig. 30: A) Metering capacity C for medium back pressure dependent on the stroke length s for different stroke rates f. B) Corresponding correction factors k dependent on back pressure p.

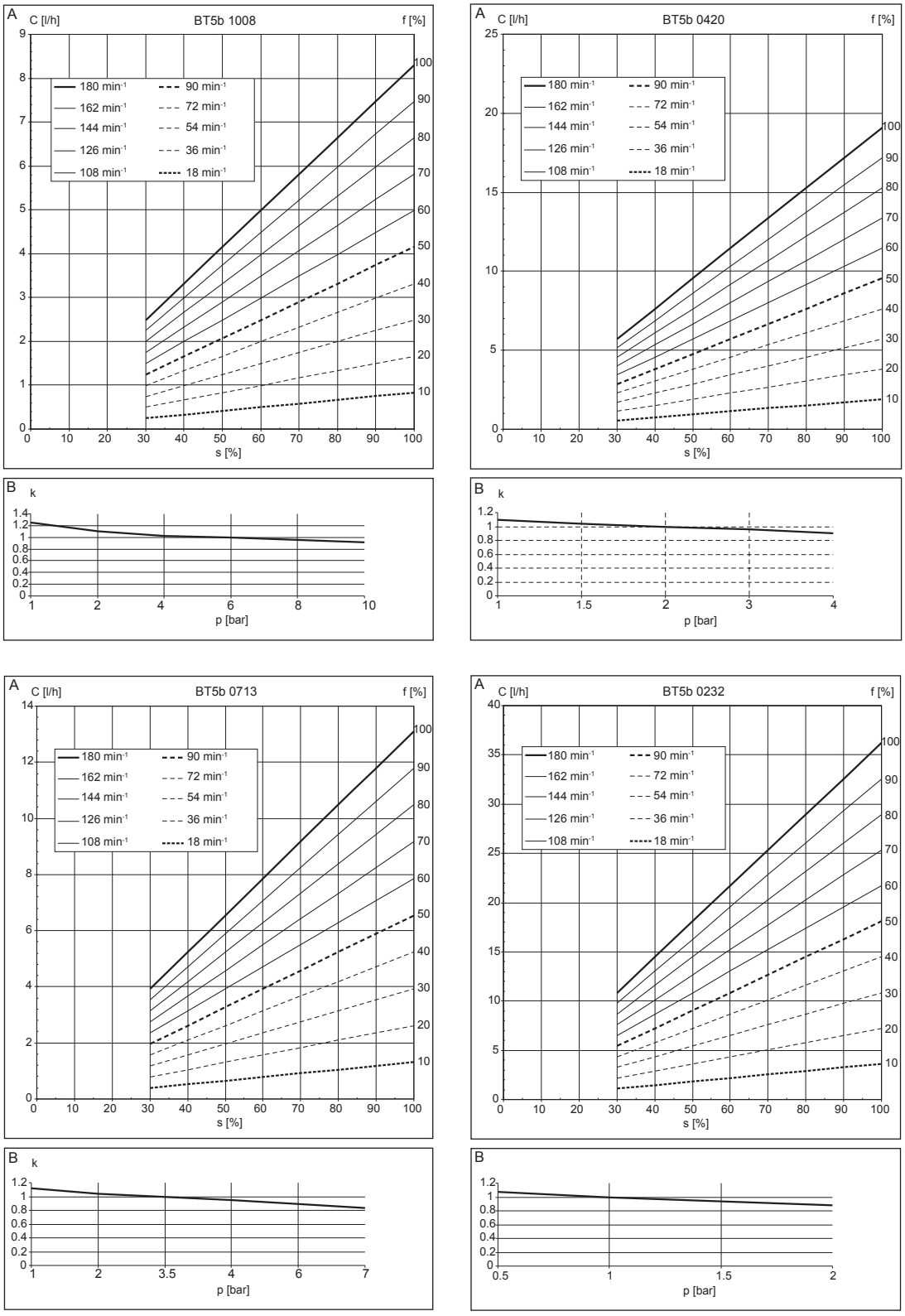


Fig. 31: A) Metering capacity C for medium back pressure dependent on the stroke length s for different stroke rates f. B) Corresponding correction factors k dependent on back pressure p.

19 Exploded Views of Liquid Ends

Liquid end Beta® 1000 - 1604 PP with bleed valve

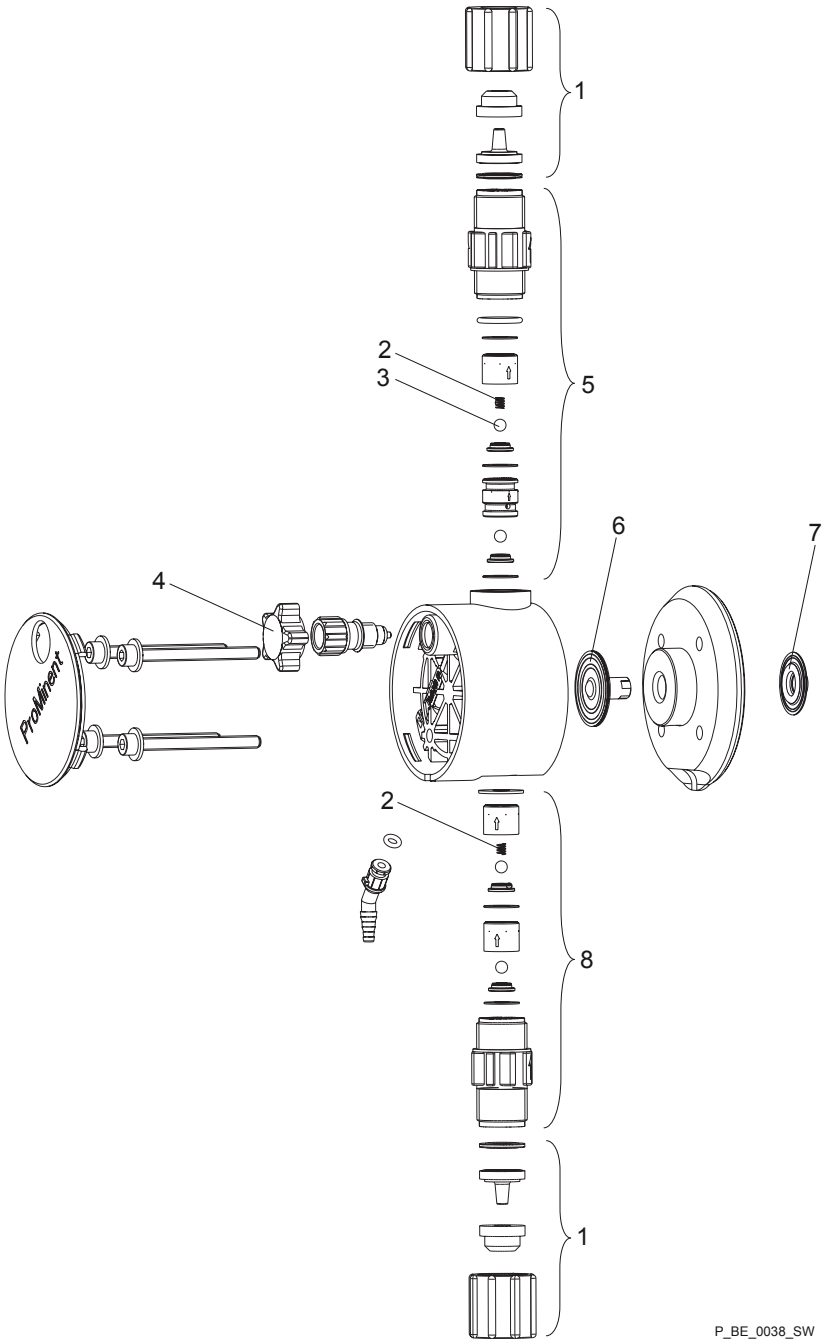


Fig. 32

Item	Description	Type 1000	Type 1601	Type 1602	Type 1604
1	Connector kit 6/4 PVT	1023246	1023246	1023246	1023246
3	4 Valve balls	404201	404201	404201	404201
4	Bleed valve	1021662	1021662	1021662	1021662

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 1000	Type 1601	Type 1602	Type 1604
5	Discharge valve, compl. 4.7-2 PVT	1023127	1023127	1023127	1023127
6	Diaphragm	1000244	1000245	1000246	1034612
7	Safety diaphragm	1006061	1006061	1006061	1006061
8	Suction valve, compl. 4.7-2 PVT	1023128	1023128	1023128	1023128

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 0708 (1008) - 0220 (0420) PP with bleed valve

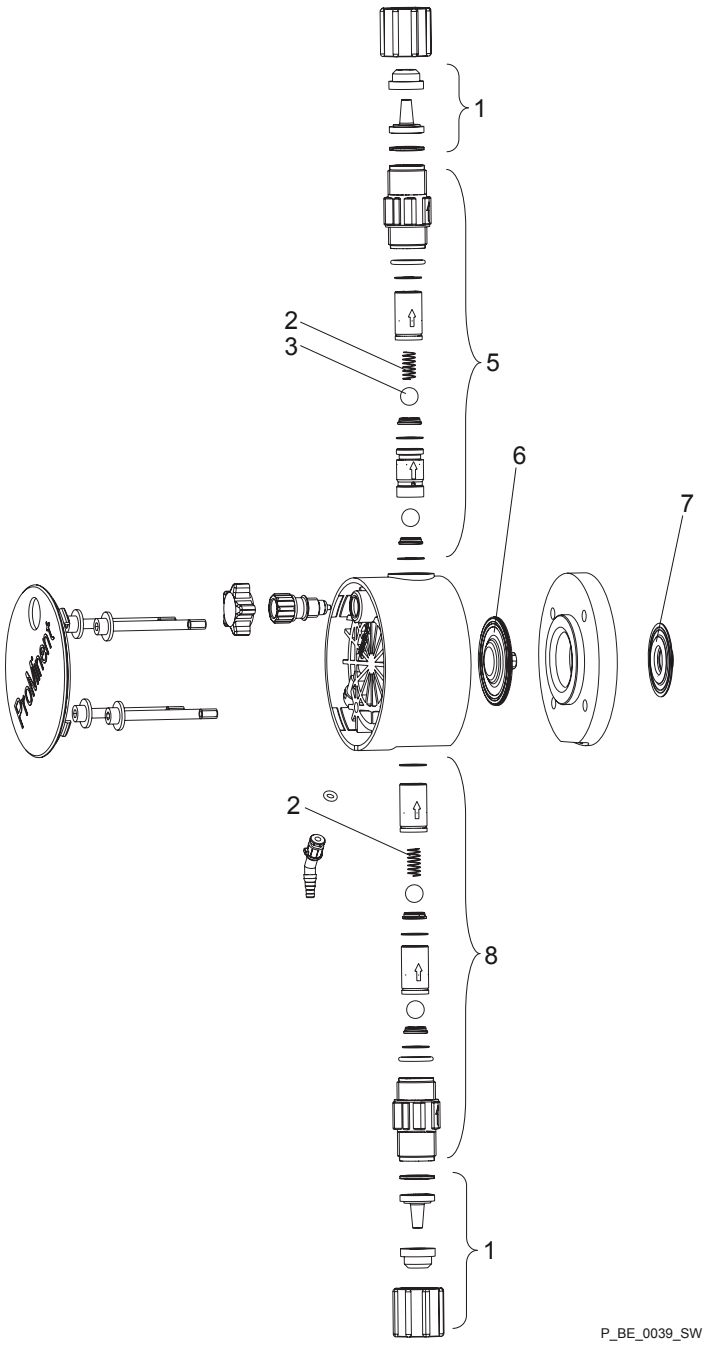


Fig. 33

Item	Description	Type 0708 (1008)	Type 0413 (0713)	Type 0220 (0420)
1	Connector kit 8/5 PVT	1023247	1023247	1023247
3	4 Valve balls	404281	404281	404281
4	Bleed valve	1021662	1021662	1021662
5	Discharge valve, compl. 9.2-2 PVT	1023125	1023125	1023125

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 0708 (1008)	Type 0413 (0713)	Type 0220 (0420)
6	Diaphragm	1000248	1000249	1000250
7	Safety diaphragm	1006061	1006061	1006061
8	Suction valve, compl. 9.2-2 PVT	1023126	1023126	1023126

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 0232 PP without bleed valve

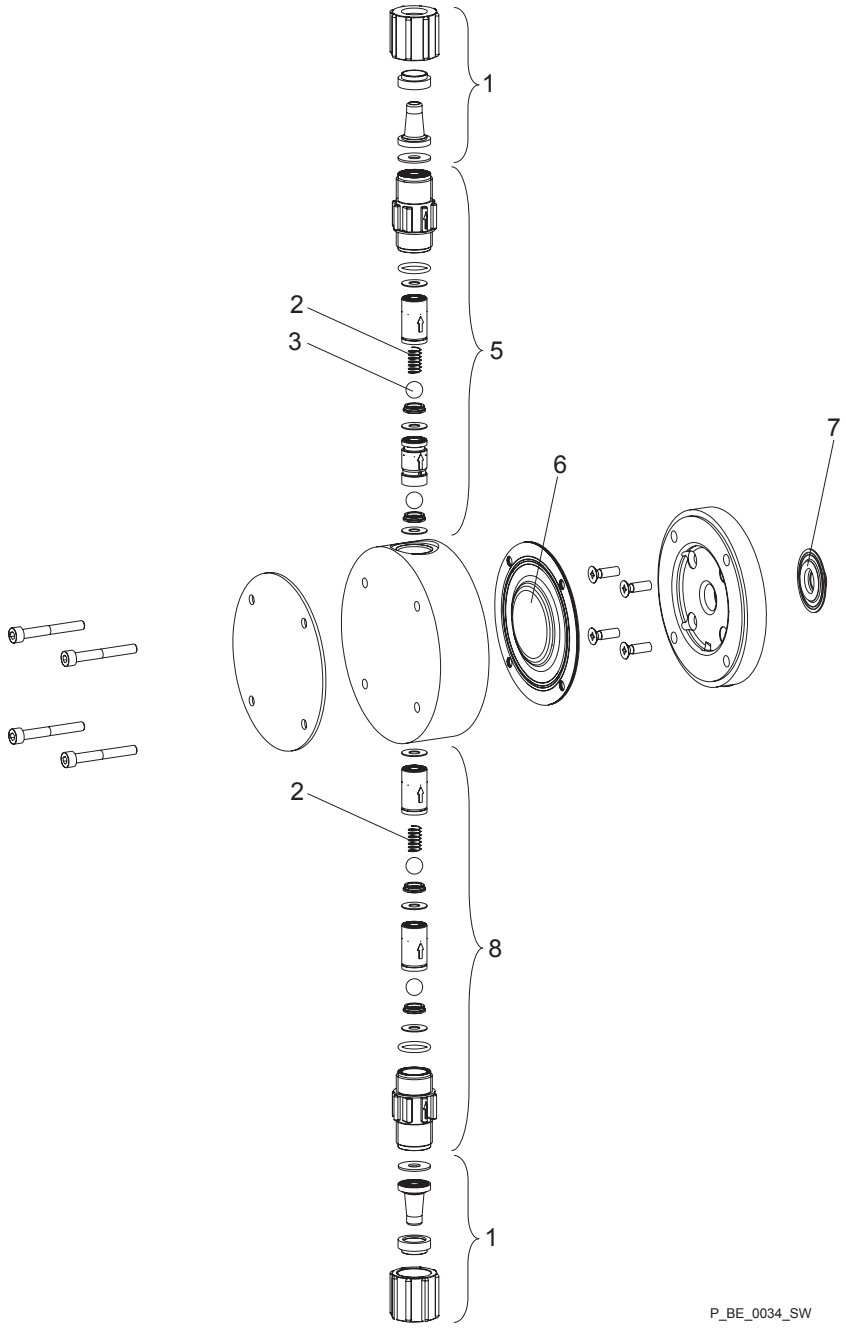


Fig. 34

Item	Description	Type 0232
1	Connector kit 12/9 PVT	1023248
3	4 Valve balls	404281
5	Discharge valve, compl. 9.2-2 PVT	1023125
6	Diaphragm	1000251

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 0232
7	Safety diaphragm	1006061
8	Suction valve, compl. 9.2-2 PVT	1023126

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 1000 - 1604 NP with and without bleed valve

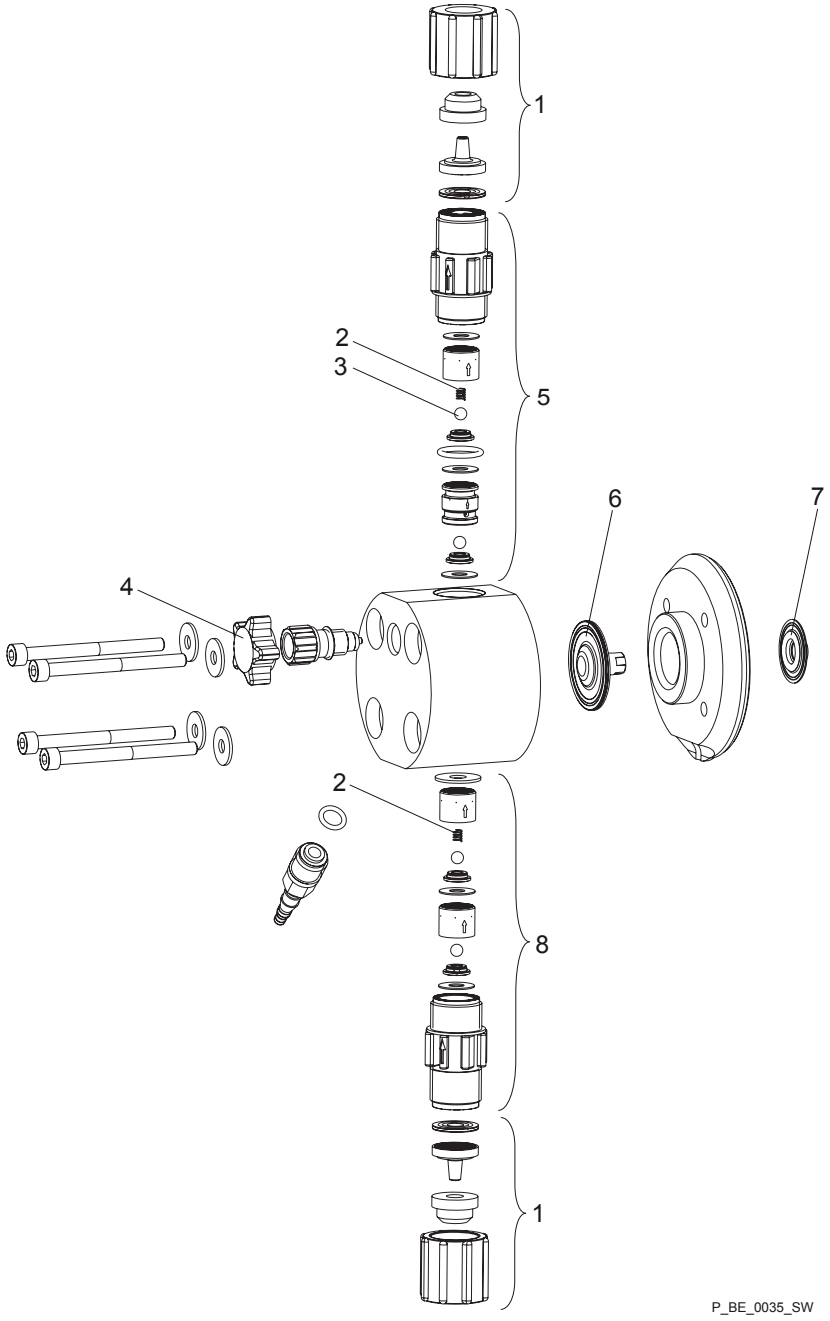


Fig. 35

Item	Description	Type 1000	Type 1601	Type 1602	Type 1604
1	Connector kit 6/4 PVT	1023246	1023246	1023246	1023246
3	4 Valve balls	404201	404201	404201	404201
4	Bleed valve	1021662	1021662	1021662	1021662
5	Discharge valve, compl. 4.7-2 PVT	1023127	1023127	1023127	1023127

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 1000	Type 1601	Type 1602	Type 1604
6	Diaphragm	1000244	1000245	1000246	1034612
7	Safety diaphragm	1006061	1006061	1006061	1006061
8	Suction valve, compl. 4.7-2 PVT	1023128	1023128	1023128	1023128

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 0708 (1008) - 0220 (0420) NP with and without bleed valve

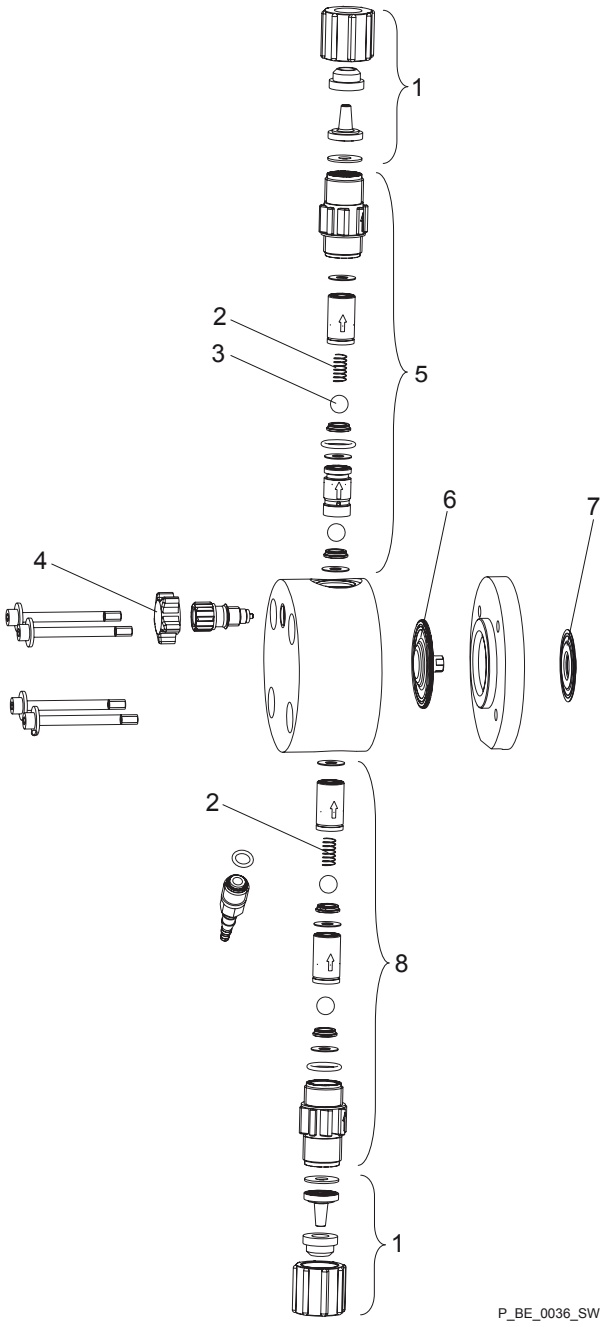


Fig. 36

Item	Description	Type 0708 (1008)	Type 0413 (0713)	Type 0220 (0420)
1	Connector kit 8/5 PVT	1023247	1023247	1023247
3	4 Valve balls	404281	404281	404281
4	Bleed valve	1021662	1021662	1021662
5	Discharge valve, compl. 9.2-2 PVT	1023125	1023125	1023125

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 0708 (1008)	Type 0413 (0713)	Type 0220 (0420)
6	Diaphragm	1000248	1000249	1000250
7	Safety diaphragm	1006061	1006061	1006061
8	Suction valve, compl. 9.2-2 PVT	1023126	1023126	1023126

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 0232 NP with and without bleed valve

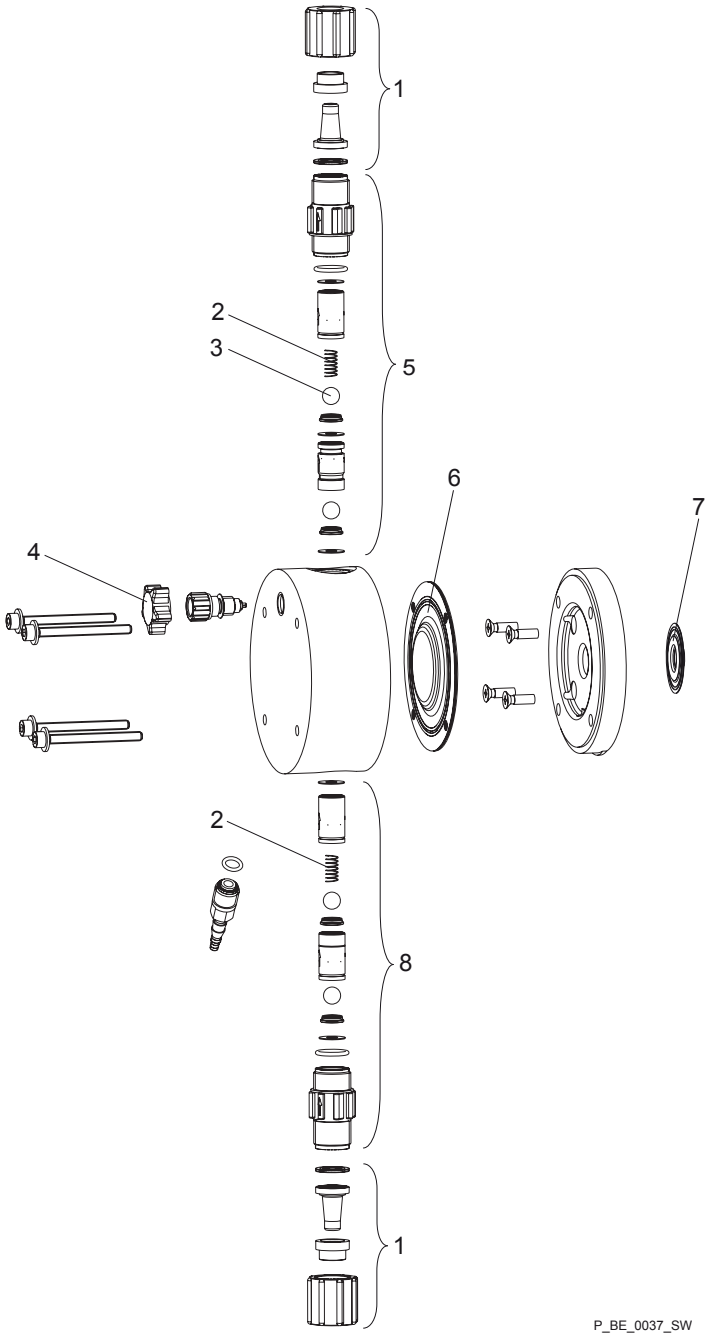


Fig. 37

Item	Description	Type 0232
1	Connector kit 12/9 PVT	1023248
3	4 Valve balls	404281
5	Discharge valve, compl. 9.2-2 PVT	1023125
6	Diaphragm	1000251

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 0232
7	Safety diaphragm	1006061
8	Suction valve, compl. 9.2-2 PVT	1023126

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 1000 - 1604 PV with bleed valve

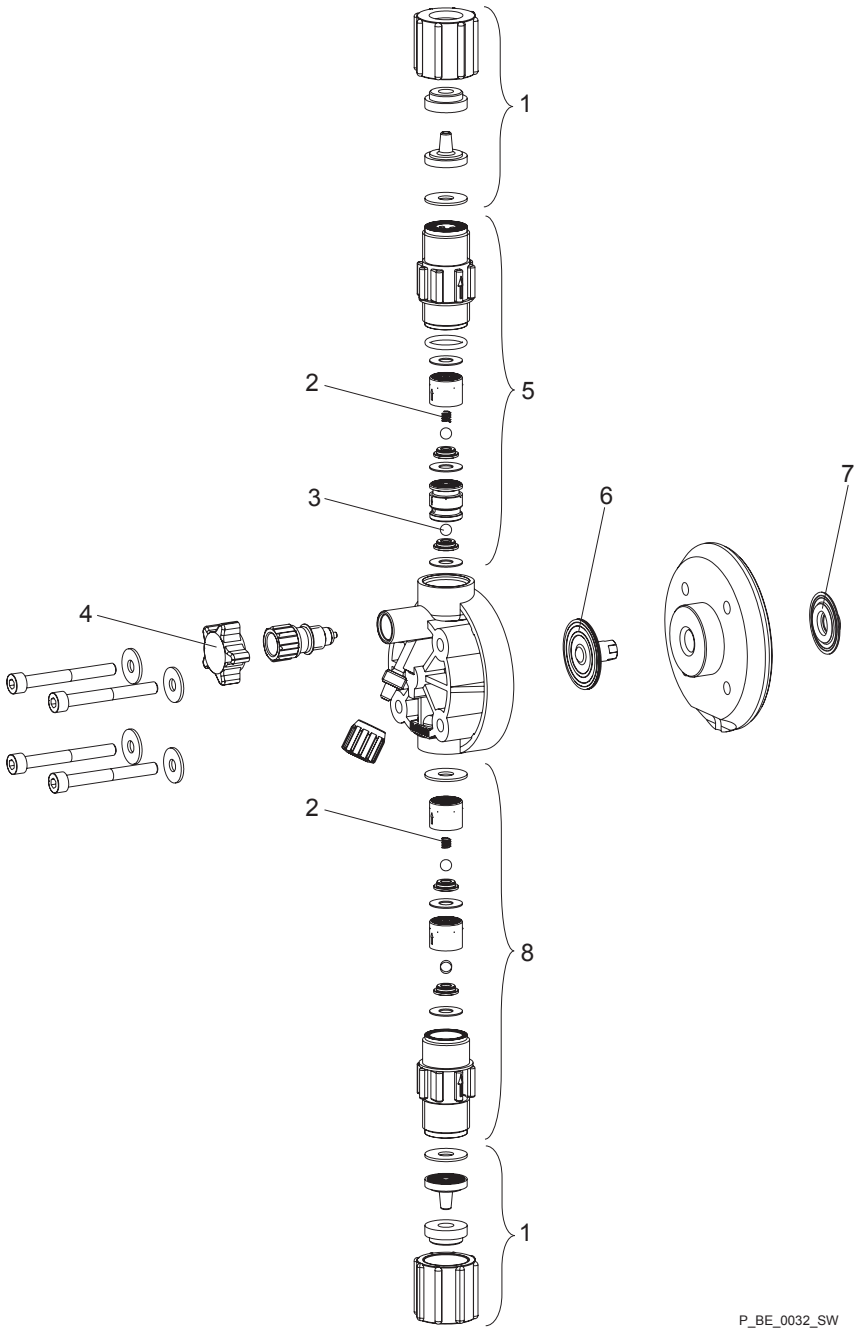


Fig. 38

Item	Description	Type 1000	Type 1601	Type 1602	Type 1604
1	Connector kit 6/4 PVT	1035660	1035660	1035660	1035660
3	4 Valve balls	404201	404201	404201	404201
4	Bleed valve	1021662	1021662	1021662	1021662
5	Discharge valve, compl. 4.7-2 PVT	1023127	1023127	1023127	1023127

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 1000	Type 1601	Type 1602	Type 1604
6	Diaphragm	1000244	1000245	1000246	1034612
7	Safety diaphragm	1006061	1006061	1006061	1006061
8	Suction valve, compl. 4.7-2 PVT	1023128	1023128	1023128	1023128

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 0708 (1008) - 0220 (0420) PV with bleed valve

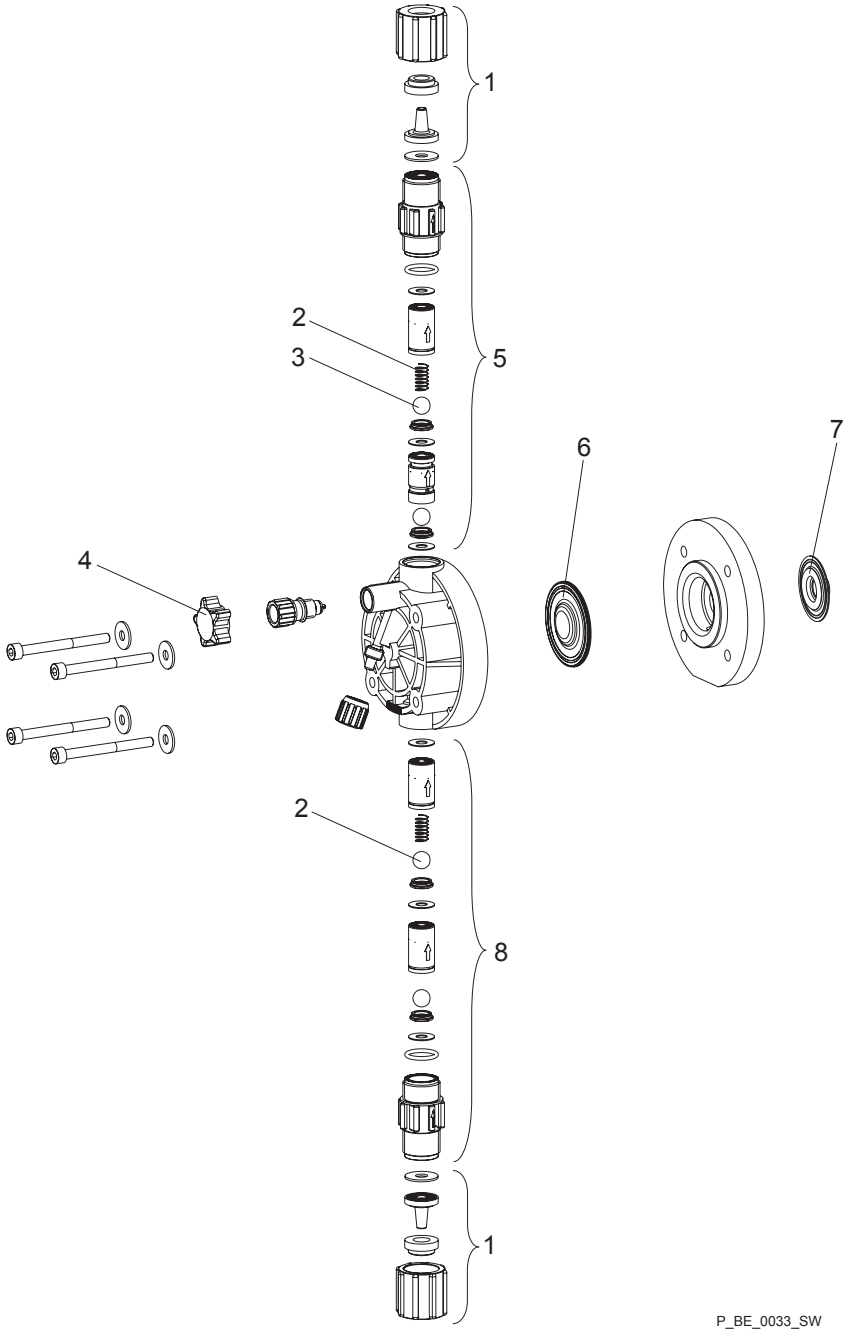


Fig. 39

Item	Description	Type 0708 (1008)	Type 0413 (0713)	Type 0220 (0420)
1	Connector kit 8/5 PVT (0220/0420: 12/9)	1035661	1035661	1035659
3	4 Valve balls	404281	404281	404281
4	Bleed valve	1021662	1021662	1021662
5	Discharge valve, compl. 9.2-2 PVT	1023125	1023125	1023125

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 0708 (1008)	Type 0413 (0713)	Type 0220 (0420)
6	Diaphragm	1000248	1000249	1000250
7	Safety diaphragm	1006061	1006061	1006061
8	Suction valve, compl. 9.2-2 PVT	1023126	1023126	1023126

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 0232 PV without bleed valve

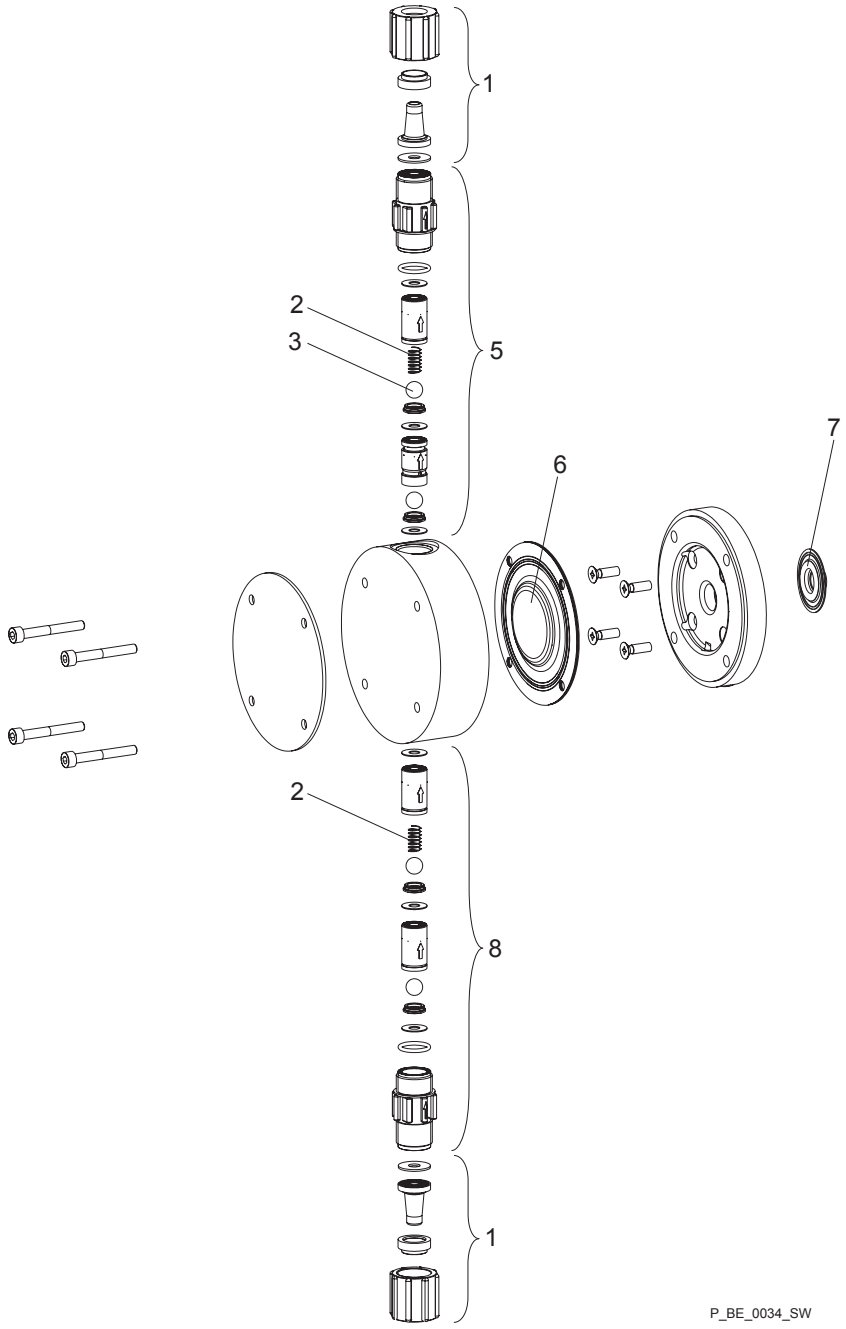


Fig. 40

Item	Description	Type 0232
1	Connector kit 12/9 FVD PVT	1035659
3	4 Valve balls	404281
5	Discharge valve, compl. 9.2-2 PVT	1023125
6	Diaphragm	1000251

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 0232
7	Safety diaphragm	1006061
8	Suction valve, compl. 9.2-2 PVT	1023126

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 1604 - 0220 (0420) PV
HV, for highly viscous feed chemicals

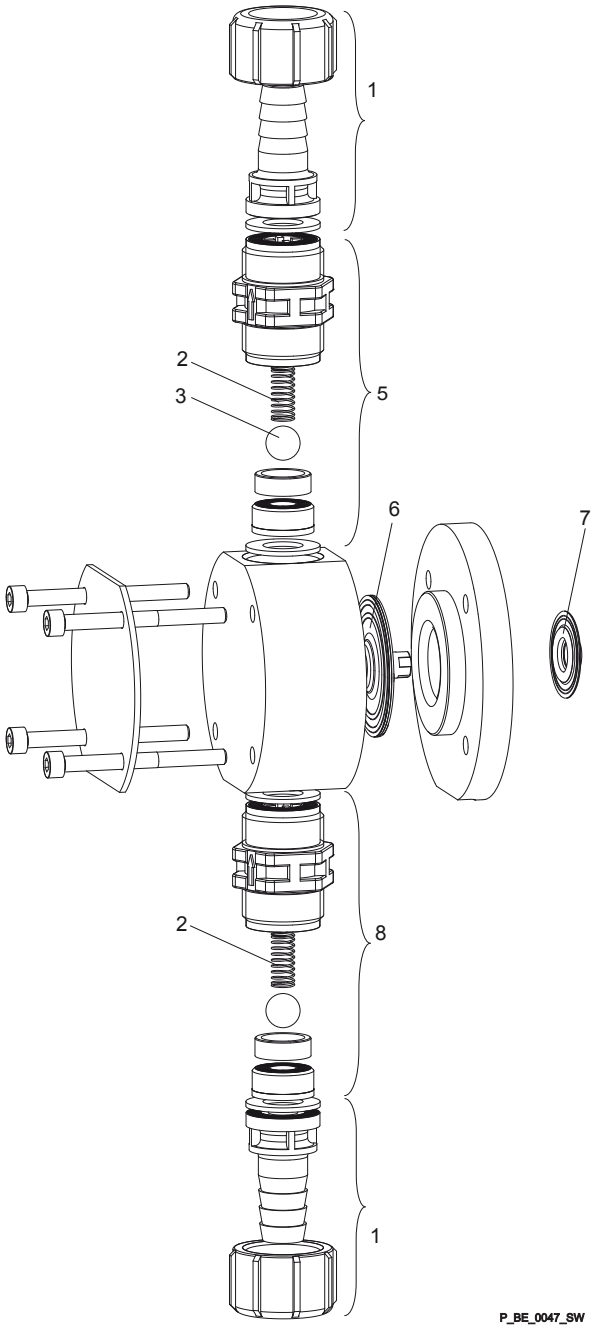


Fig. 41

Item	Description	Type 1604	Type 0708	Type 0413	Type 0220
1	Connector kit DN10 HV with PVT tube nozzle	1017405	1017405	1017405	1017405
3	4 Valve balls	404277	404277	404277	404277
6	Diaphragm	1006061	1006061	1006061	1006061
7	Safety diaphragm	1027414	1027414	1027414	1027414
The positions listed are included in the spare parts kit. Technical changes reserved.					

Liquid end Beta® 1000 - 1604 TT

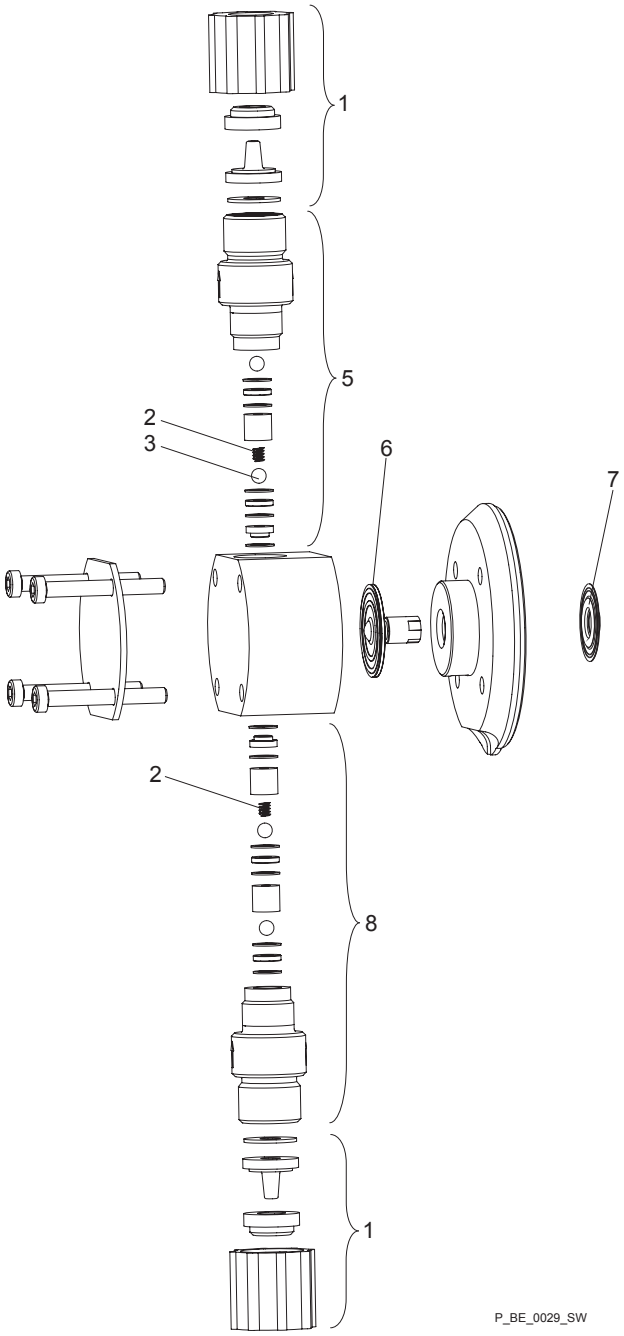


Fig. 42

Item	Description	Type 1000	Type 1601	Type 1602	Type 1604
1	Connector kit 6/4 TTT	817201	817201	817201	817201
3	4 Valve balls	404201	404201	404201	404201
5	Discharge valve, compl. 4.7-2 TTT	809406	809406	809406	809406
6	Diaphragm	1000244	1000245	1000246	1034612

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 1000	Type 1601	Type 1602	Type 1604
7	Safety diaphragm	1006061	1006061	1006061	1006061
8	Suction valve, compl. 4.7-2 TTT	809407	809407	809407	809407

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 0708 (1008) - 0220 (0420) TT

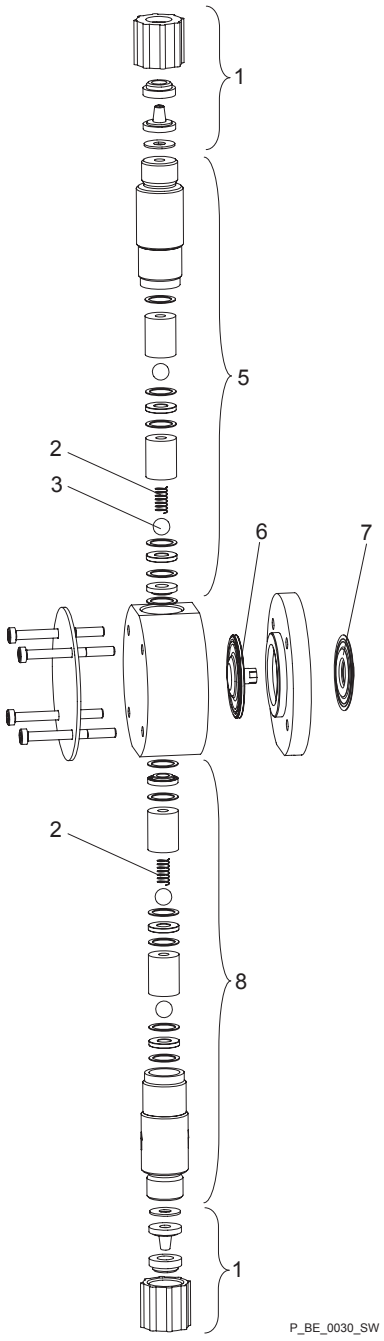


Fig. 43

Item	Description	Type 0708 (1008)	Type 0413 (0713)	Type 0220 (0420)
1	Connector kit 8/5 TTT	817204	817204	817204
3	4 Valve balls	404281	404281	404281
5	Discharge valve, compl. 9.2-2 TTT	809444	809444	809444
6	Diaphragm	1000248	1000249	1000250

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 0708 (1008)	Type 0413 (0713)	Type 0220 (0420)
7	Safety diaphragm	1006061	1006061	1006061
8	Suction valve, compl. 9.2-2 TTT	809445	809445	809445

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 0232 TT

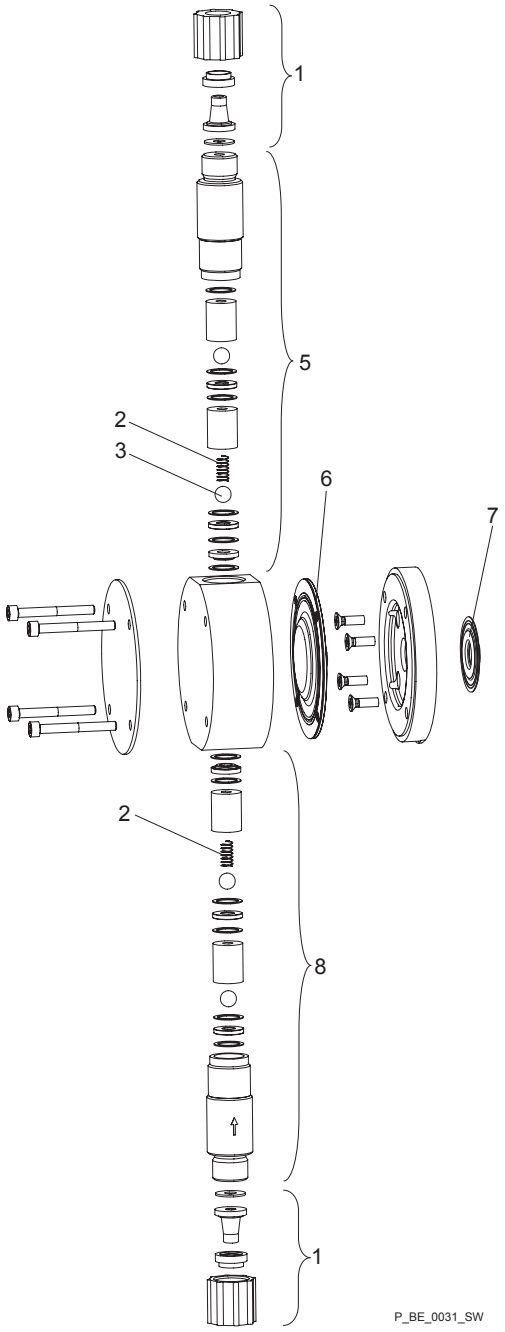


Fig. 44

Item	Description	Type 0232
1	Connector kit 12/9 TTT	817202
3	4 Valve balls	404281
5	Discharge valve compl. TTT	809444
6	Diaphragm	1000251

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 0232
7	Safety diaphragm	1006061
8	Suction valve compl. TTT	809445

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 1000 - 1604 SS

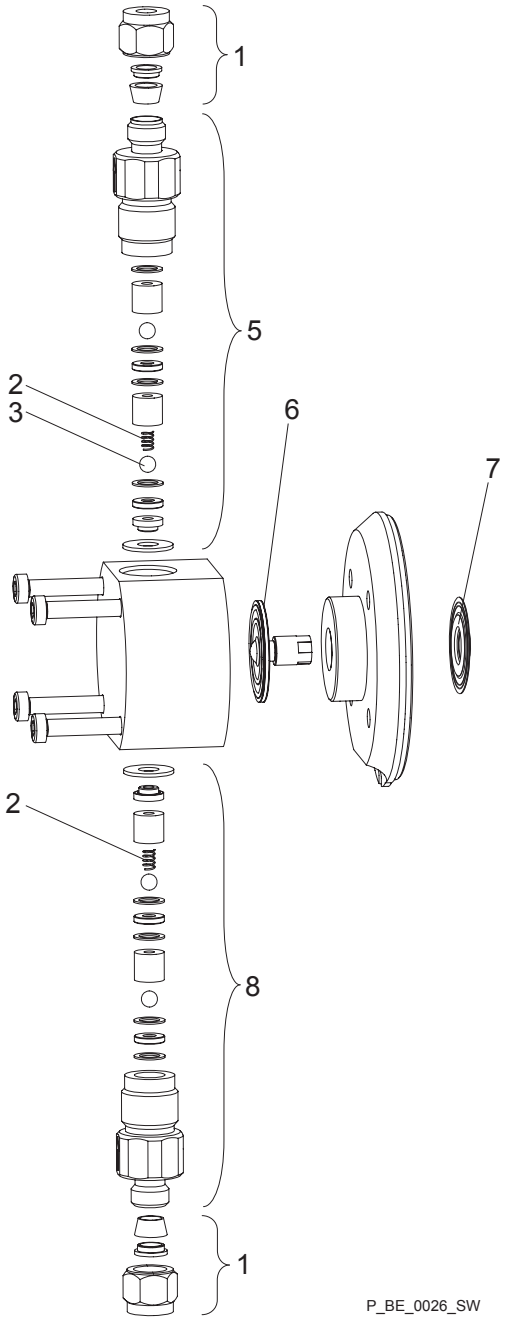


Fig. 45

Item	Description	Type 1000	Type 1601	Type 1602	Type 1604
1	Connector kit 6 mm SS	104233	104233	104233	104233
3	4 Valve balls	404201	404201	404201	404201
5	Discharge valve compl. 6 mm SST	809418	809418	809418	809418
6	Diaphragm	1000244	1000245	1000246	1034612

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 1000	Type 1601	Type 1602	Type 1604
7	Safety diaphragm	1006061	1006061	1006061	1006061
8	Suction valve compl. 6 mm SST	809419	809419	809419	809419

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 0708 (1008) - 0220 (0420) SS

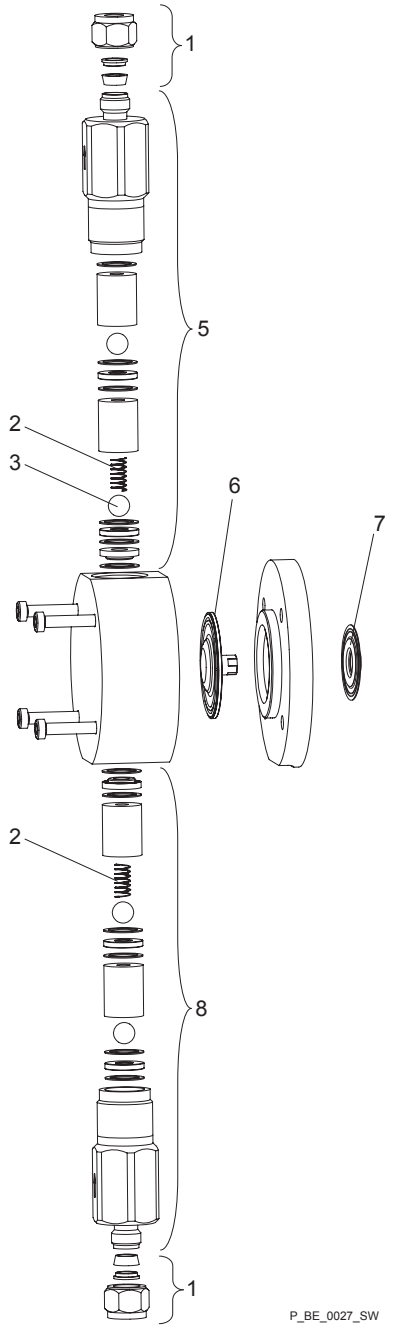


Fig. 46

Item	Description	Type 0708 (1008)	Type 0413 (0713)	Type 0220 (0420)
1	Connector kit SS	104237	104237	104245
3	4 Valve balls	404281	404281	404281
5	Discharge valve compl. SST	809494	809494	809446
6	Diaphragm	1000248	1000248	1000250

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 0708 (1008)	Type 0413 (0713)	Type 0220 (0420)
7	Safety diaphragm	1006061	1006061	1006061
8	Suction valve compl. SST	809495	809495	809447

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 0232 SS

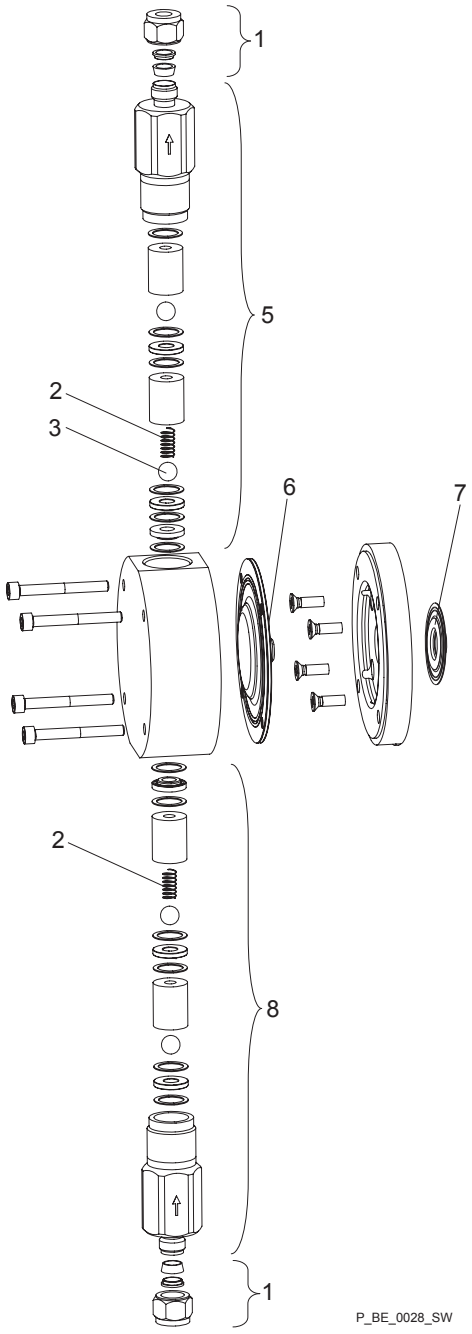


Fig. 47

Item	Description	Type 0232
1	Connector kit 12 mm SS	104245
3	4 Valve balls	404281
5	Discharge valve compl. 12 mm SST	809446
6	Diaphragm	1000251

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Item	Description	Type 0232
7	Safety diaphragm	1006061
8	Suction valve compl. 12 mm SST	809447

Spring (item 2) is a special accessory. The positions listed are included in the spare parts kit. Technical changes reserved.

Liquid end Beta® 1601 - 1604 PP SEK and 1601 - 1604 NP SEK, self-bleeding

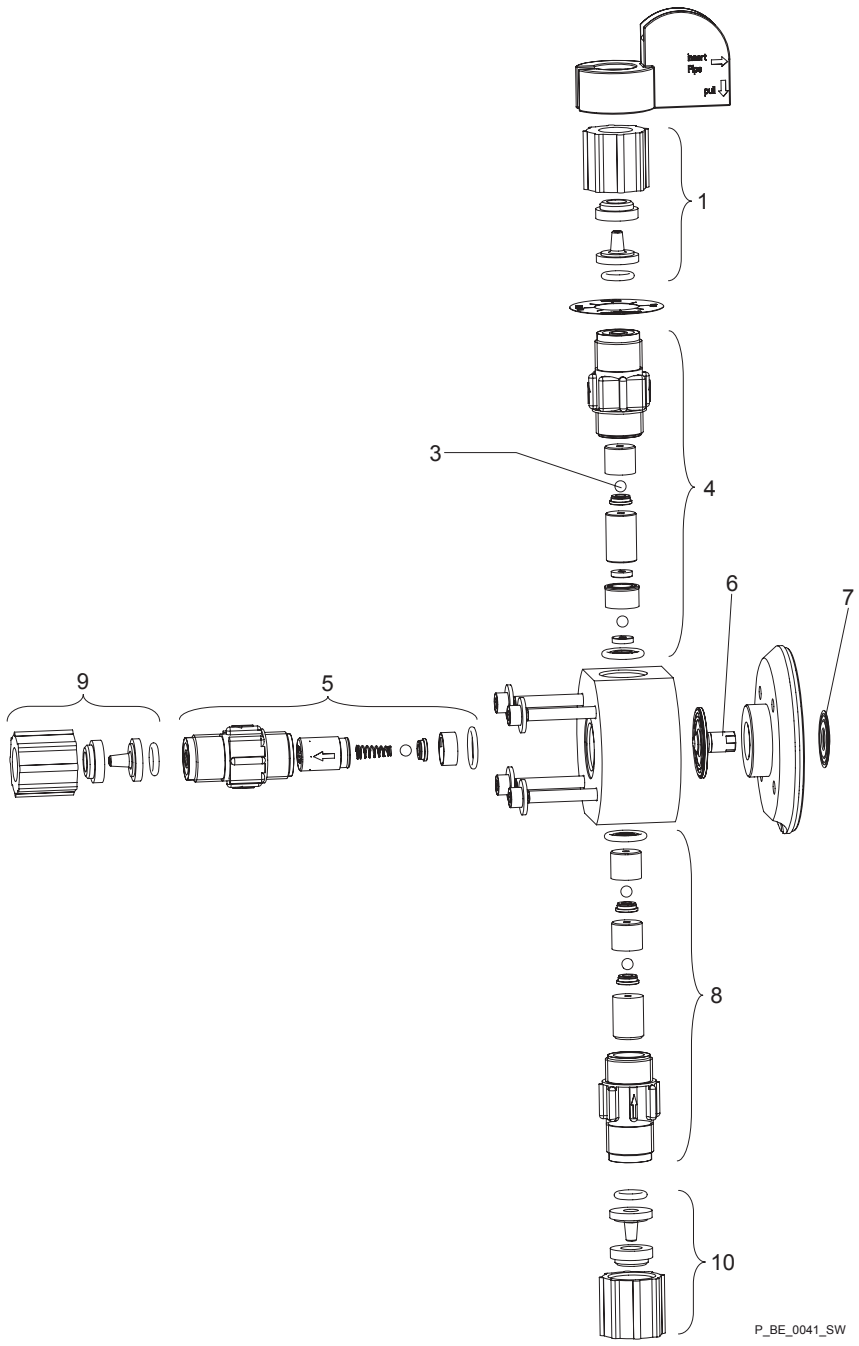


Fig. 48

Item	Part	Material version	Part no.
1, 9, 10	Connector kit 6/4	PPE	817160
1, 9, 10	Connector kit 6/4	PPB	817173
1, 9, 10	Connector kit 6/4	PCE	791161
1, 9, 10	Connector kit 6/4	PCB	817165
9, 10	Connector kit 8/5	PPE	817161
9, 10	Connector kit 8/5	PPB	817174

Item	Part	Material version	Part no.
9, 10	Connector kit 8/5	PCE	792058
9, 10	Connector kit 8/5	PCB	817066
9	With 2504: Connector kit 8/4	PCB	1035844
10	With 2504: Connector kit 6/4	PCE	791161
10	With 2504: Connector kit 6/4	PCB	817065
3	4 Valve balls		404201
4	Bleed valve	PPE	1001063
4	Bleed valve	PPB	1001062
4	Bleed valve	PCE	1001061
4	Bleed valve	PCB	1001060
5	Discharge valve compl.	PPE	1001067
5	Discharge valve compl.	PPB	1001066
5	Discharge valve compl.	PCE	1001065
5	Discharge valve compl.	PCB	1001064
6	Diaphragm 1601		1000245
6	Diaphragm 1602		1000246
6	Diaphragm 1604		1034612
7	Safety diaphragm		1006061
8	Suction valve compl.	PPE	792644
8	Suction valve compl.	PPB	792646
8	Suction valve compl.	PCE	792119
8	Suction valve compl.	PCB	792026

Spare parts kits for type:	Material version	Part no.
1601	PPE	1001756
1602	PPE	1001757
1604 with spring	PPE	1035335
1604 without spring	PPE	1035339
1601	PPB	1001762
1602	PPB	1001763
1604 with spring	PPB	1035336
1604 without spring	PPB	1035340
1601	NPE	1001660
1602	NPE	1001661

Spare parts kits for type:	Material version	Part no.
1604 without spring	NPE	1035337
1604 with spring	NPE	1035333
1601	NPB	1001666
1602	NPB	1001667
1604 without spring	NPB	1035338
1604 with spring	NPB	1035334

Sealing sets	Material	Part no.
1 Sealing set	EPDM	1001674
1 Sealing set	FPM	1001672

The positions listed are included in the spare parts kit.

Technical changes reserved.

Liquid end Beta® 0708 (1008) - 0220 (0420) PP / NP SEK, self-bleeding

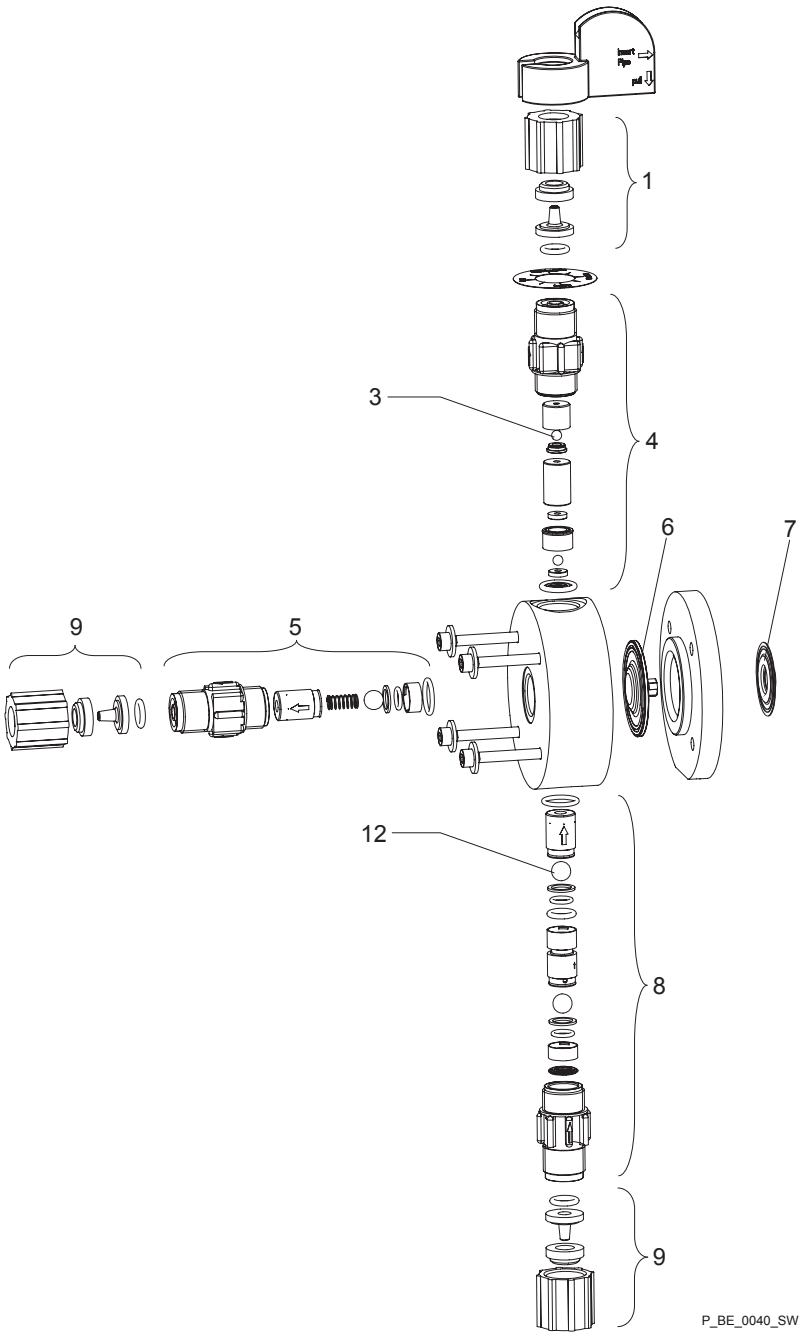


Fig. 49

Item	Part	Material version	Part no.
1	Connector kit 6/4	PPE	817160
1	Connector kit 6/4	PPB	817173
1	Connector kit 6/4	PCE	791161
1	Connector kit 6/4	PCB	817165
9	Connector kit 8/5	PPE	817161
9	Connector kit 8/5	PPB	817174

Item	Part	Material version	Part no.
9	Connector kit 8/5	PCE	792058
9	Connector kit 8/5	PCB	817066
9	Connector kit 12/9	PPE	817162
9	Connector kit 12/9	PPB	817175
9	Connector kit 12/9	PCE	790577
9	Connector kit 12/9	PCB	817067
3	4 Valve balls		404201
4	Bleed valve	PPE	1001063
4	Bleed valve	PPB	1001062
4	Bleed valve	PCE	1001061
4	Bleed valve	PCB	1001060
5	Discharge valve compl.	PPE	1001071
5	Discharge valve compl.	PPB	1001070
5	Discharge valve compl.	PCE	1001069
5	Discharge valve compl.	PCB	1001068
6	Diaphragm 0708		1000248
6	Diaphragm 0413		1000249
6	Diaphragm 0220		1000250
7	Safety diaphragm		1006061
8	Suction valve compl.	PPE	1001437
8	Suction valve compl.	PPB	1001436
8	Suction valve compl.	PCE	1001435
8	Suction valve compl.	PCB	1001434

Spare parts kits for type:	Material version	Part no.
0708 (1008)	PPE	1001759
0413 (0713)	PPE	1001760
0220 (0420)	PPE	1001761
0708 (1008)	PPB	1001765
0413 (0713)	PPB	1001766
0220 (0420)	PPB	1001767
0708 (1008)	NPE	1001663
0413 (0713)	NPE	1001664
0220 (0420)	NPE	1001665
0708 (1008)	NPB	1001669
0413 (0713)	NPB	1001670
0220 (0420)	NPB	1001671

Sealing sets	Material	Part no.
1 Sealing set	EPDM	1001674
1 Sealing set	FPM	1001672

The positions listed are included in the spare parts kit.

Technical changes reserved.

20 Further order information

Spare parts kits for SEK types

The information is given in the corresponding exploded views.

Spare parts kits for SER types

Type	NPT7 / PVT7
1602	1047830
1604	1047858
0708 (1008)	1047832
0413 (0713)	1047833
0220 (0420)	1047837

Spare parts kits for other types

Type	PP, NP, PV	TT	SS	HV types
1000	1023107	1001737	1001729	-
1601	1023108	1001738	1001730	-
1602	1023109	1001739	1001731	-
1604 (2504)	1035332	1035330	1035331	1035342
0708 (1008)	1023111	1001741	1001733	1019067
0413 (0713)	1023112	1001742	1001734	1019069
0220 (0420)	1023113	1001754	1001735	1019070
0232	1024124	1001755	1001736	-

Sealing sets for SEK types

The information is given in the corresponding exploded views.

Sealing sets for other types

Type	PP, NP	PV	TT, SS
1000, 1601, 1602, 1604	1023130	1023130	483907 *
0708 (1008) 0413 (0713) 0220 (0420)	1023129	1023129	483975
0232	1023129	1023129	483975
All HV types	-	1019364	-
* 11-part			

Relay retrofit kit for Beta® b

Name	Part no.
Fault indicating relay for Beta® b	1029309
Fault indicating and pacing relay for Beta® b	1029310

Interference suppression aids

Product	Part no.
Varistor:	710912
RC Gate, 0.22 µF / 220 Ω:	710802

Further sources of information

Further information on spare parts, accessories and options can be found in:

- the exploded drawings
- the identity code
- under www.prominent.com
- the ProMinent product catalogue

21 EC Declaration of Conformity for Machinery

In accordance with DIRECTIVE 2006/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, Appendix I, BASIC HEALTH AND SAFETY REQUIREMENTS, section 1.7.4.2. C.

We,

- ProMinent GmbH
- Im Schuhmachergewann 5 - 11
- D - 69123 Heidelberg,

hereby declare that the product specified in the following, complies with the relevant basic health and safety requirements of the EC Directive, on the basis of its functional concept and design and in the version distributed by us. Any modification to the product not approved by us will invalidate this declaration.

Extract from the EC Declaration of Conformity

Designation of the product:	Metering pump, product range Beta/4 and Beta/5
Product type:	BT4b _ _ _ _ _ _ _ _ _ _ _ U BT5b _ _ _ _ _ _ _ _ _ _ _ U
Serial number:	see nameplate on the device
Relevant EC directives:	Machinery Directive (2006/42/EC) EMC Directive (2004/108/EC) Compliance with the protection targets of the Low Voltage Directive 2006/95/EC according to Appendix I, No. 1.5.1 of the Machinery Directive 2006/42/EC RoHS Directive (2011/65/EU)
Harmonised standards applied, in particular:	EN 809: 2010 EN ISO 12100: 2010 EN 61010-1: 2010 EN 61000-6-2: 2005 EN 61000-6-3: 2011 EN 50581: 2013
Place, Date:	Heidelberg, 22.07.2014

You will find the EC Declaration of Conformity to download on our homepage.

22 EC Declaration of Conformity for Machinery

In accordance with DIRECTIVE 2006/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, Appendix I, BASIC HEALTH AND SAFETY REQUIREMENTS, section 1.7.4.2. C.

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Extract from the EC Declaration of Conformity

Designation of the product:	Metering pump, product range Beta/4 and Beta/5
Product type:	BT4b _ _ _ _ _ _ _ _ _ _ _ M BT4b _ _ _ _ _ _ _ _ _ _ _ N BT5b _ _ _ _ _ _ _ _ _ _ _ N
Serial number:	see nameplate on the device
Relevant EC directives:	EC Machinery Directive (2006/42/EC) EC EMC Directive (2004/108/EC) EU RoHS Directive (2011/65/EU)
Harmonised standards applied, in particular:	EN 809: 2010 EN ISO 12100: 2010 EN 61010-1: 2010 EN 61000-6-2: 2005 EN 61000-6-3: 2011 EN 50581: 2013
Place, Date:	Heidelberg, 22.07.2014

You will find the EC Declaration of Conformity on our homepage.

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ProMinent GmbH
Im Schuhmachergewann 5-11
D-69123 Heidelberg
Telephone: +49 6221 842-0
Fax: +49 6221 842-419
Email: info@prominent.com
Internet: www.prominent.com

Heidelberg, 6, en_GB

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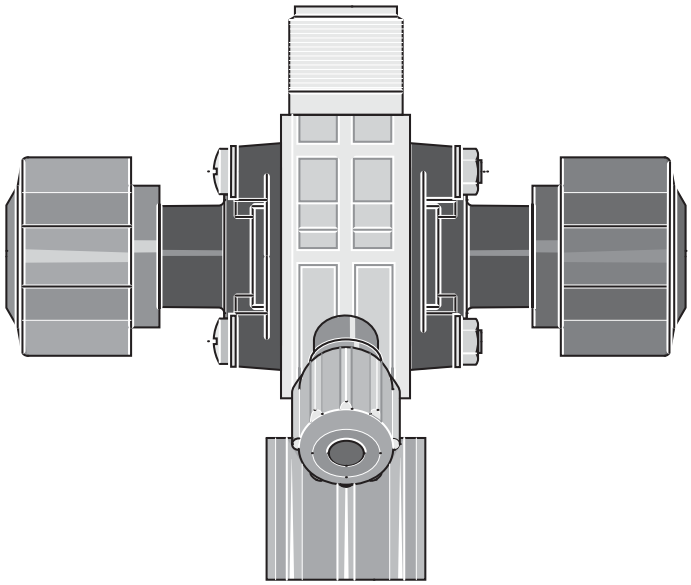
P-610x - Pump, Metering, Parts, Multi-function ValvePVDF, 87PSIG Size 2

Betriebsanleitung / Operating Instructions
Mode d'emploi / Instrucciones de servicio

ProMinent® Mehrfunktionsventil
ProMinent® Multi-Function Valve
Vanne multifonctions ProMinent®
Válvula multifuncional ProMinent®

D/GB/F/E



Teile Nr./Part No.: 987629 **ProMinent Dosiertechnik GmbH · 69123 Heidelberg · Germany** BA MAZ 623 10/04 G/GB/F/E

(D) Betriebsanleitung in Deutsch
von Seite 4 bis 8

(GB) Operating Instructions in English
from page 9 to page 14

(F) Mode d'emploi en français
de la page 15 à la page 20

(E) Instrucciones de servicio en español
de página 21 hasta página 26

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ProMinent Dosiertechnik GmbH
Im Schuhmachergewann 5-11
69123 Heidelberg · Germany

Telefon: 06221 842-0
Fax: 06221 842-617

info@prominent.com
www.prominent.com

Technische Änderungen vorbehalten.

Betriebsanleitung bitte zuerst vollständig durchlesen. Nicht wegwerfen! Bei Schäden durch Bedienungsfehler erlischt die Garantie!

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2	**Funktionsbeschreibung**	4
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1 Aufbau

Die Funktionen des Mehrfunktionsventils werden durch je eine federbelastete Membran erzeugt. Es ist je ein Entlastungsmechanismus für die Druckhalte-Funktion und für die Überdruckfunktion vorgesehen.

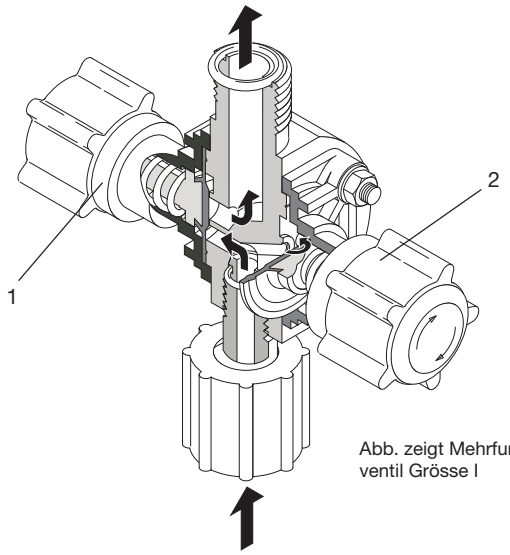


Abb. zeigt Mehrfunktionsventil Grösse I

2 Funktionsbeschreibung

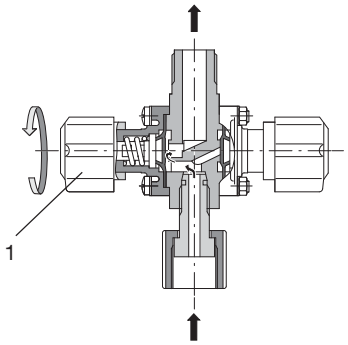
Funktionen

- Erzeugung eines definierten Gegendruckes bei Dosierung gegen freien Auslauf.
  Das Aufheben dieser Funktion erfolgt durch Drehen am schwarzen Drehknopf im Uhrzeigersinn (1).
- Verhindern von Durchhebern aus dem Vorratsgebinde bei Unterdruck an der Dosierstelle.
  Das Aufheben dieser Funktion erfolgt durch Drehen am schwarzen Drehknopf im Uhrzeigersinn (1).

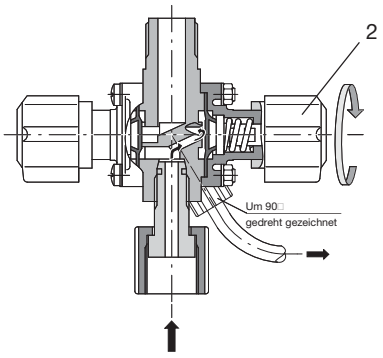
ACHTUNG

- **Multifunktionsventile sind keine absolut dicht schließende Absperrorgane.**

Wenn absolut kein Dosiermedium zur Dosierstelle gelangen darf, so ist ein zusätzliches Absperrorgan saugseitig der Pumpe vorzusehen.



- Ansaughilfe bei der Inbetriebnahme der Pumpe gegen Druck. Das Lösen der Druckleitung ist nicht erforderlich. Dies erfolgt durch Drehen am roten Drehknopf (2).



ACHTUNG

- **An der Dosierstelle muß ein Rückschlagventil installiert werden, da bei der Betätigung des Ventils der gesamte Inhalt der Anlage über den Bypass zurückfließen kann.**

- Entlastung der Dosierleitung bei Stillstand der Anlage (z.B. Reparatur). Dies erfolgt durch Drehen am roten Drehknopf (2).
- Überströmventil zum Schutz der Anlage gegen unzulässigen Überdruck, der von der Dosierpumpe verursacht wird. Rückführung über eine Bypassleitung. Diese Funktion erfolgt automatisch.

3 Bestimmungsgemäßer Gebrauch

Bestimmungsgemäßer Gebrauch

Schutz der Dosierleitung vor unzulässigem Überdruck, der durch die Dosierpumpe erzeugt wird, wenn ein in der Dosierleitung befindlicher Absperrhahn geschlossen wird.

- Das Multifunktionsventil darf nicht verwendet werden zum Schutz der Dosierleitung vor unzulässigem Überdruck, der andere Ursachen hat als der von der Dosierpumpe erzeugte Druck.
- Das Ventil darf **nicht** als Absperrorgan verwendet werden.

4 Montage / Installation

Sicherheitsanforderung, Sicherheitshinweise

ACHTUNG

- **Bei druckbeaufschlagten Systemen muss an der Dosierstelle ein Rückschlagventil installiert sein, da sonst bei Betätigung des Ventils der gesamte Inhalt der Anlage über den Bypass zurückfließen kann.**
- **Die Bypassleitung muß immer angeschlossen sein, da es beim Betrieb des Ventils nahe der Überdruckfunktion zu einem minimalen Überströmen in die Bypassleitung kommen kann.**
- **Multifunktionsventile sind keine absolut dicht schließenden Absperrorgane!**

Montagebeschreibung mechanisch/hydraulisch

Das Mehrfunktionsventil wird direkt auf den Druckanschluß der Pumpe aufgeschraubt. Das Ventil kann um 360□gedreht und ausgerichtet werden.

Abgangsseitig wird mittels Anschlußset bzw. GF-Verschraubung die Dosierleitung bzw. Dosierschlauch befestigt. Werkseitig ist in der O-Ringnut am Abgang ein EPDM O-Ring eingelegt. Für Anwendungen, bei denen EPDM nicht beständig ist, wird die Montage eines Viton® B O-Rings empfohlen. Dieser O-Ring (bräunlich) ist dem Ventil beigelegt.

Die Bypassleitung wird in den Vorratsbehälter zurückgeführt. Befestigung über Schlauchtülle und Überwurfmutter.

5 Betrieb / Bedienung

ACHTUNG

- **Die Bypassleitung muß immer angeschlossen sein, da es beim Betrieb des Ventils nahe der Überdruckfunktion zu einem minimalen Überströmen in die Bypassleitung kommen kann.**
- **Multifunktionsventile sind keine absolut dicht schließenden Absperrorgane!**

Bedienung und Einstellung Ansaughilfe

Durch Drehen des roten Drehknopfes (2) in Pfeilrichtung (Uhrzeigersinn) wird der Weg zum Bypass frei. Das Medium fließt in den Vorratsbehälter zurück.

HINWEIS

- **Dabei wird auch die Druckleitung teilweise entlastet und es kann Flüssigkeit am Bypass austreten.**

Die ProMinent Dosierpumpe ist jetzt auf „Ansaugen" zu stellen (s. hierzu auch Betriebsanleitung der Pumpe), bis Flüssigkeit in der Bypassleitung sichtbar wird.

Die Pumpe hat angesaugt und kann in Betrieb genommen werden. Nach dem Loslassen des roten Drehknopfes (2) geht dieser selbständig in die Ausgangsstellung zurück.

Entlastung der Druckleitung

Durch Herausdrehen des roten Drehknopfes (2) und des schwarzen Drehknopfes (1) im Uhrzeigersinn wird der Weg von der Druckleitung zum Bypass frei. Wird nur der rote Drehknopf (2) betätigt, so fällt der Druck in der Leitung auf ca. 1,5 bar ab.

Die beiden Knöpfe müssen solange herausgedreht bleiben, bis keine Flüssigkeit mehr an der Bypassöffnung austritt bzw. keine Flüssigkeit mehr in den Vorratsbehälter zurückfließt. Die Dosierleitung ist jetzt druckentlastet. Nach dem Loslassen der beiden Drehknöpfe, drehen sich beide wieder selbständig in ihre Ausgangsstellung zurück.

6 Technische Daten / Bestellhinweise

Mediumberührte Werkstoffe

Ventilkörper	PVDF
Membrane	PTFE-beschichtet
Dichtungen	Viton® oder EPDM
Adapter bei Größe III	PVC

Viton® ist ein eingetragenes Warenzeichen von DuPont Dow Elastomers.

Typ	Best. Nr.	Überström-Öffnungsdruck*	Anschluß-größe	Bypass-Anschluß
Größe I	792011.9	16 bar	6-12 mm	6/4 mm
Größe I	791715.6	10 bar	6-12 mm	6/4 mm
Größe I	1005745	6 bar	6-12 mm	6/4 mm
Größe II	792203.4	10 bar	6-12 mm	12/9 mm
Größe II	740427.0	6 bar	6-12 mm	12/9 mm
Größe III	792215.6	10 bar	DN 10	12/9 mm

* Der hier angegebene Überström-Öffnungsdruck ist der Druck, bei dem das Ventil zu öffnen beginnt. Je nach Pumpentyp kann der Druck bis zum vollständigen Öffnen des Ventils um bis zu 50 % höher liegen.

Einsatzbereich

Größe I	CONCEPT, Pneumados und Beta® 4: alle Typen gamma/ L: Typ 1000, 1601, 1602, 1005, 0708, 0413, 0220 und 1605
Größe II	alle Typen unter Größe I Beta® 5: Typ 1008, 0713, 0420 und 0232 gamma/ L: Typ 1008, 0713, 0420 und 0232
Größe III	Sigma/ 1 mit Anschlussgewinde DN 10

Technische Änderungen vorbehalten.

Please completely read through these operating instructions. Do not discard! The warranty shall be invalidated by damage caused by operating errors!

		Page
1	Design	10
2	Functional Description	10
3	Use for Intended Purpose	12
4	Mounting / Installation	12
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6	Technical Data / Ordering Notes	14

1 Design

Each of the functions of the multi-function valve is produced by a spring-loaded diaphragm. The valve features a pressure relief mechanism for both the pressure retaining function as well as for the pressure relief function.

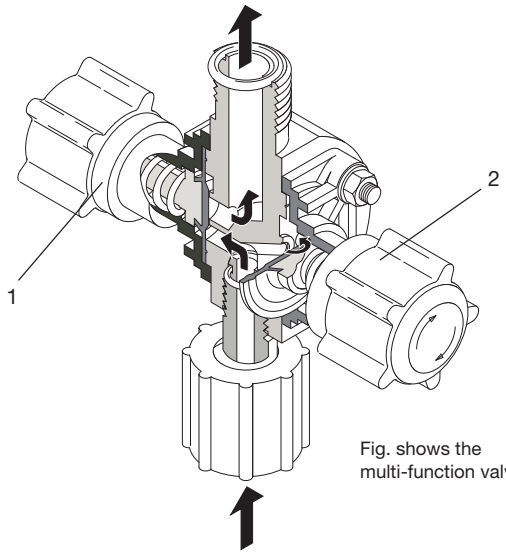


Fig. shows the multi-function valve, Size I

2 Functional Description

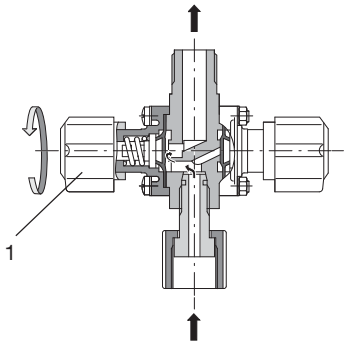
Functions

- Producing a defined backpressure for metering with respect to free outlet.
  Turn the black rotary knob clockwise (1) to disable this function.
- Prevents lift-through from the supply vessel in the case of vacuum at the metering point.
  Turn the black rotary knob clockwise (1) to disable this function.

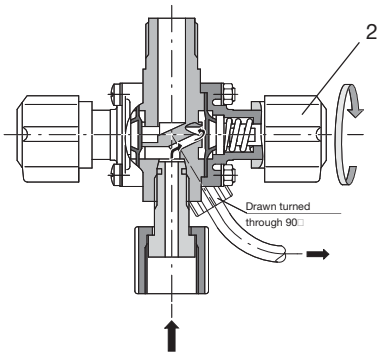
IMPORTANT

- **Multi-function valves are not intended to act as fully sealing stop taps.**

If it is imperative that no metering chemical reaches the metering point, fit an additional stop cock to the suction side of the pump.



- Intake aid to prevent pressure when starting up pumps. It is not necessary to release the delivery line.
  Turn the red rotary knob (2) for this purpose.



IMPORTANT

- **A non-return valve must be installed at the metering point since the entire content of the system can flow via the bypass when the valve is operated.**

- Depressurizing the metering line when the relevant system is at a standstill (e.g. repairs). Turn the red rotary knob (2) for this purpose.
- Overflow valve to protect the system from impermissible overpressure caused by the metering pump. Return flow via a bypass line. This function operates automatically.

3 Use for Intended Purpose

Use for Intended Purpose

To protect the metering line from impermissible overpressure caused by the metering pump when a stop cock valve is connected in the metering line.

- The multi-function valve may not be used to protect the discharge line from inadmissible excess pressure caused by anything other than the pressure generated by the metering pump.
- The valve must **not** be used as a shut-off.

4 Mounting / Installation

Safety Requirements, Notes on Safety

IMPORTANT

- **Pressurised systems must have a non-return valve fitted at the metering point because the entire contents of the system can flow back via the bypass when the valve is operated.**
- **The bypass line must always be connected since minimum overflow into the bypass line can occur during operation of the valve close to the pressure relief function.**
- **Multi-function valves are not intended to act as fully sealing stop taps!**

Mounting Description, Mechanical/Hydraulic

The multi-function valve is screwed directly on to the pressure connection of the pump. The valve can be turned and aligned through 360□.

The metering line or metering hose is secured on the outlet end by means of a connection set or GF screw fitting. An EPDM O-ring is fitted at the factory in the O-ring groove at the outlet. For applications in which EPDM is not suitable, it is advisable to fit a Viton B O-ring. This O-ring (brown) is supplied together with the valve.

The bypass line is routed into the supply vessel. It is secured by means of a hose grommet and union nut.

5 Operation

IMPORTANT

- **The bypass line must always be connected since minimum overflow into the bypass line can occur during operation of the valve close to the pressure relief function.**
- **Multi-function valves are not intended to act as fully sealing stop taps!**

Operation and Setting Intake Aid

Turn the red rotary knob (2) in the direction of the arrow (clockwise) to open the way to the bypass. The medium flows back into the supply tank.

NOTE

- **In this case, the delivery line is partly depressurized and liquid can flow out of the bypass.**

The ProMinent metering pump must now be set to “intake“ (refer to pump operating instructions) until liquid can be seen in the bypass line.

The pump is now primed and ready for use. After being released, the red rotary knob (2) reverts of its own accord back to its initial position.

Depressurizing the Delivery Line

The passage from the delivery line to the bypass is cleared by turning the red rotary knob (2) and the black rotary knob (1). The pressure drops in the line to approx. 1.5 bar if only the red rotary knob (2) is turned.

Both knobs must remain unscrewed until no more liquid flows out of the bypass line or no more liquid flows back into the supply tank. The metering line is now depressurized. Once released, both rotary knobs turn of their own accord back to their initial position.

6 Technical Data / Ordering Notes

Materials in Contact with Medium

Valve housing	PVDF
Diaphragm	PTFE-coated
Seals	Viton® or EPDM
Adapter for size III	PVC

Viton® is a registered trademark of DuPont Dow Elastomers.

Type	Order No.	Overflow opening pressure*	Connection size	Bypass connection
Size I	792011.9	16 bar	6-12 mm	6/4 mm
Size I	791715.6	10 bar	6-12 mm	6/4 mm
Size I	1005745	6 bar	6-12 mm	6/4 mm
Size II	792203.4	10 bar	6-12 mm	12/9 mm
Size II	740427.0	6 bar	6-12 mm	12/9 mm
Size III	792215.6	10 bar	DN 10	12/9 mm

* The overflow opening pressure stated here is the pressure at which the valve starts to open. Depending on the pump type, the pressure may be higher up to 50 % until complete opening of the valve.

Operating range

Size I	CONCEPT, Pneumados and Beta® 4: all types gamma/ L: type 1000, 1601, 1602, 1005, 0708, 0413, 0220 and 1605
Size II	all types below size I Beta® 5: type 1008, 0713, 0420 and 0232 gamma/ L: type 1008, 0713, 0420 and 0232
Size III	Sigma/ 1 with threaded connection DN 10

Subject to technical modifications.

Veuillez lire en premier lieu entièrement ce mode d'emploi. Ne surtout pas le jeter ! En cas de dommages occasionnés par des erreurs d'utilisation, il y a automatiquement perte du droit de garantie !

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5	Mise en service	19
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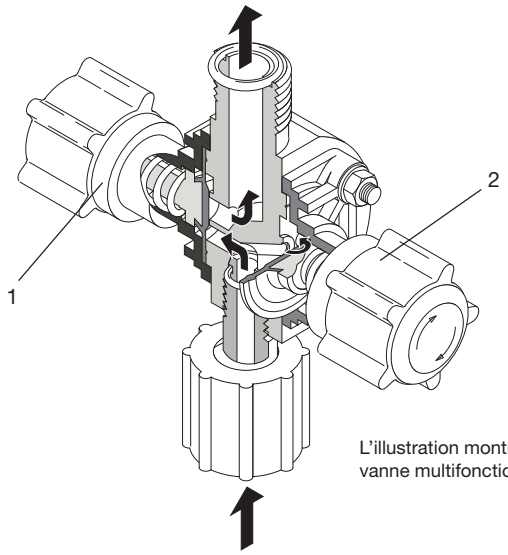
1 Structure

Les fonctionnalités de la vanne multifonctions sont générées à chaque fois par une membrane équipée d'un ressort. Un mécanisme de décharge est prévu pour la fonction de maintien en pression et pour la fonction de surpression.



L'illustration montre une vanne multifonctions taille I

2 Description fonctionnelle

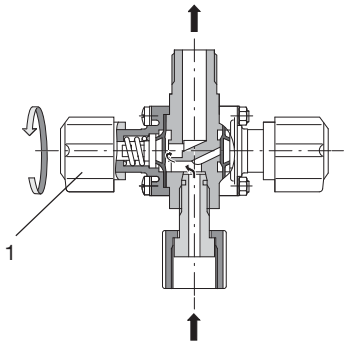
Fonctionnalités

- Génération d'une contre-pression définie pour un dosage contre une sortie libre.
  Cette fonction peut être arrêtée en tournant le bouton rotatif noir en sens horaire (1).
- Eviter les coups de siphon du réservoir en présence d'un vide au point de dosage.
  Cette fonction peut être arrêtée en tournant le bouton rotatif noir en sens horaire (1).

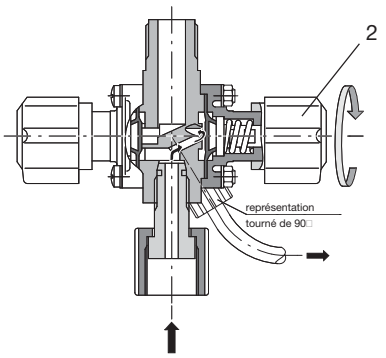
ATTENTION

- **Les vannes multifonctions ne sont pas des organes d'arrêt à fermeture absolument étanche.**

Si aucune quantité de fluide ne doit parvenir au point de dosage, il faut prévoir un organe d'arrêt supplémentaire côté aspiration de la pompe.



- Dispositif auxiliaire d'aspiration pour la mise en service de la pompe contre pression. Pas besoin de desserrer le tuyau de refoulement.
  Tourner à cet effet le bouton rotatif rouge (2).



ATTENTION

- **Un clapet anti-retour doit être installé au point de dosage étant donné qu'en actionnant la vanne, le contenu total de l'installation est susceptible de recouler via la dérivation.**

- Décharge de la conduite de dosage à l'arrêt de l'installation (réparation par exemple). Tourner à cet effet le bouton rotatif rouge (2).
- Soupape de décharge pour protéger l'installation contre une surpression inadmissible provoquée par la pompe doseuse. Retour via une conduite de dérivation (bypass). Cette fonction s'exécute automatiquement.

3 Utilisation conforme

Utilisation conforme

Protection de la conduite de dosage contre une surpression non autorisée, générée par la pompe doseuse après la fermeture d'un robinet d'arrêt monté dans la conduite de dosage.

- La vanne multifonctions ne doit pas être utilisée pour la protection de la conduite de dosage contre une surpression inadmissible ayant d'autres causes que la pression générée par la pompe doseuse.
- La vanne **ne doit pas** être utilisée en tant qu'organe d'arrêt.

4 Montage / Installation

Exigences concernant la sécurité, consignes de sécurité

ATTENTION

- **Lors d'injection dans un système sous pression, un clapet anti-retour doit être installé au point de dosage sinon un retour de flux est susceptible d'être refoulé via le bypass de la vanne multifonctions lorsque celle-ci est actionnée.**
- **La conduite de bypass doit toujours être raccordée. Lorsque la pression d'exploitation de la pompe est proche de la pression de décharge de la vanne, il se peut qu'un peu de produit s'écoule du raccord de bypass.**
- **Les vannes multifonctions ne sont pas des organes d'arrêt à fermeture absolument étanche.**

Description du montage de l'installation mécanique/hydraulique

La vanne multifonctions se visse directement sur le raccord de refoulement de la pompe. La vanne peut être tournée et alignée de 360□.

Côté sortie, il convient de fixer le tuyau ou resp. la conduite de dosage au moyen du lot de raccordement ou via un raccord vissé GF. Un joint torique en EPDM est posé départ usine dans la rainure du joint torique en sortie. En cas d'utilisations pour lesquelles l'EPDM ne serait pas résistant, nous recommandons le montage d'un joint torique en Viton B. Ce joint torique (brunâtre) est joint à la vanne.

La conduite de dérivation est ramenée dans le réservoir. Elle est fixée par un embout de tuyau flexible et un écrou-raccord.

5 Mise en service / Commande

ATTENTION

- **La conduite bypass doit toujours être raccordée étant donné qu'en cas d'exploitation de la vanne à proximité de la fonction de surpression, un débordement minimal est susceptible de se produire dans la conduite de dérivation.**
- **Les vannes multifonctions ne sont pas des organes d'arrêt à fermeture absolument étanche.**

Commande et réglage
Dispositif auxiliaire d'aspiration

Tourner le bouton rotatif rouge (2) dans le sens de la flèche (sens horaire) pour dégager la voie vers le (bypass). Le milieu s'écoule de nouveau dans le réservoir.

REMARQUE

- **Ce faisant, la conduite de refoulement est partiellement déchargée et du liquide peut sortir du bypass.**

Dès à présent, commuter la pompe doseuse ProMinent® sur „Amorçage" (voir à cet effet également le mode d'emploi de la pompe), jusqu'à ce que du liquide devienne visible dans la conduite de dérivation.

La pompe s'est amorcée et peut être mise en service. En laissant revenir le bouton rotatif rouge (2), celui-ci reprend automatiquement sa position d'origine.

Décharge de la conduite de refoulement

En sortant le bouton rotatif rouge (2) et le bouton rotatif noir (1) par rotation dans le sens des aiguilles d'une montre, le parcours allant de la conduite de refoulement vers le bypass est libéré. En actionnant uniquement le bouton rotatif rouge (2), la pression dans la conduite tombe à 1,5 bar environ.

Les deux boutons doivent demeurer tournés jusqu'à ce que plus aucun liquide ne sorte de l'ouverture du bypass ou que plus aucun liquide ne soit refoulé dans le réservoir. La conduite de dosage est maintenant hors pression. En relâchant les deux boutons rotatifs, ceux-ci se remettent à tourner automatiquement sur leur position d'origine.

6 Caractéristiques techniques / Remarques concernant la commande

Matériaux en contact avec le milieu

Corps de la vanne	PVDF
Membranes	revêtues de PTFE
Joints	Viton® ou EPDM
Adapteur taille III	PVC

Viton® est une marque déposée de DuPont Dow Elastomers.

Type	Nº de commande	Pression d'ouverture de décharge*	Grandeur de raccordement	Raccord bypass
taille I	792011.9	16 bar	6-12 mm	6/4 mm
taille I	791715.6	10 bar	6-12 mm	6/4 mm
taille I	1005745	6 bar	6-12 mm	6/4 mm
taille II	792203.4	10 bar	6-12 mm	12/9 mm
taille II	740427.0	6 bar	6-12 mm	12/9 mm
taille III	792215.6	10 bar	DN 10	12/9 mm

* La pression d'ouverture de décharge indiquée ici constitue la pression à laquelle la vanne commence à s'ouvrir. En fonction du type de pompe, la pression jusqu'à l'ouverture complète de la vanne peut être jusqu'à 50 % plus élevée.

Domaine d'utilisation

taille I	CONCEPT, Pneumados et Beta® 4: tous types gamma/ L: type 1000, 1601, 1602, 1005, 0708, 0413, 0220 et 1605
taille II	tous types inférieurs à la taille I Beta® 5: type 1008, 0713, 0420 et 0232 gamma/ L: type 1008, 0713, 0420 et 0232
taille III	Sigma/ 1 avec taraudage de raccordement DN 10

Sous réserve de modifications.

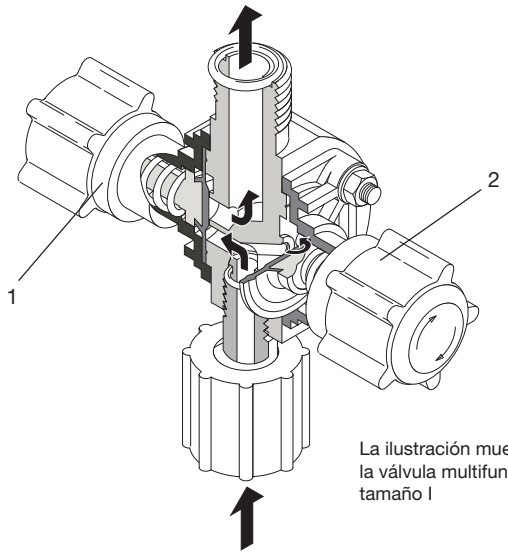
Le rogamos lea primeramente en su totalidad las instrucciones de servicio. No las tire. En caso de daños ocasionados por error en el manejo del equipo, desaparece la garantía.

Página

1	Principio de funcionamiento	22
2	Características funcionales	22
3	Uso conforme a los fines previstos	24
4	Montaje / Instalación	24
5	Operación / Manejo	25
6	Características técnicas / Instrucciones para el pedido	26

1 Principio de funcionamiento

Las funciones de la válvula multifuncional son generadas, en cada caso, por una membrana sometida a la presión de un muelle. Están previstos un mecanismo de descarga para la función de mantenimiento de la presión y otro para la de sobrepresión.



La ilustración muestra la válvula multifuncional tamaño I

2 Características funcionales

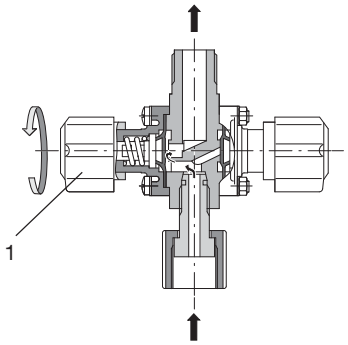
Funciones

- Generar una contrapresión definida en la dosificación a salida libre.
  La supresión de esta función se realiza girando el botón giratorio negro en sentido horario (1).
- Evitar el "efecto sifón" desde el depósito dosificador en caso de presión negativa en el punto de dosificación.
  La supresión de esta función se realiza girando el botón giratorio negro en sentido horario (1).

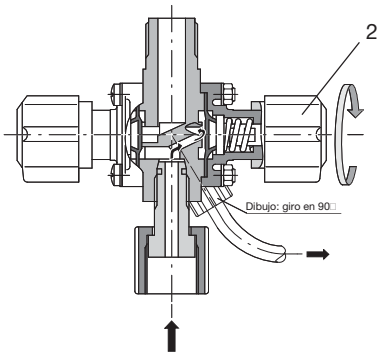
ATENCIÓN

- **Las valvulas multifuncionales no son órganos de cierre absolutamente herméticos.**

Si no debe llegar absolutamente ningún medio de dosificación al punto de dosificación debe instalarse un órgano de cierre adicional en el lado de aspiración de la bomba.



- Ayudar en la aspiración en la puesta en servicio de la bomba contra presión. No es necesario aflojar el tubo de presión. Esto se realiza girando el botón giratorio rojo (2).



ATENCIÓN

- **En el punto de dosificación se debe instalar una válvula de retención, ya que al operar la válvula, todo el contenido de la instalación puede refluir a través de la derivación.**

- Descargar el tubo de dosificación cuando la instalación esté parada (p.ej. por motivos de reparación). Esto se realiza girando el botón giratorio rojo (2).
- Válvula de seguridad para proteger la instalación contra sobrepresiones inadmisibles generadas por la bomba dosificadora. Retorno a través de un tubo de derivación. Esta función es automática.

3 Uso conforme a los fines previstos

Uso conforme a los fines previstos

Protección del tubo dosificador contra sobrepresiones inadmisibles generadas por la bomba dosificadora al cerrar una llave de retención ubicada en el tubo dosificador.

- La válvula multifuncional no debe utilizarse para protección de la tubería de dosificación contra sobrepresión indebida, que tiene otras causas que la presión generada por la bomba dosificadora.
- La válvula **no** debe ser empleada como órgano de cierre.

4 Montaje / Instalación

Requisitos e indicaciones de seguridad

ATENCIÓN

- **En sistemas presurizados debe estar instalada una válvula antirretorno en los puntos de dosificación, ya que de lo contrario, al operarse la válvula todo el contenido de la instalación puede refluir a través de la derivación.**
- **El tubo de derivación debe mantenerse siempre conectado, ya que al operar la válvula cerca de la función de sobre-presión es posible que rebase una pequeña cantidad de líquido hacia el tubo de derivación.**
- **Las válvulas multifuncionales no son órganos de cierre absolutamente herméticos.**

Descripción del montaje mecánico / hidráulico

La válvula multifuncional se enrosca directamente en la conexión de presión de la bomba. La válvula tiene un giro de 360□y puede orientarse según conveniencia.

En el lado de salida, se fija el tubo o conducto dosificador mediante un juego de conexiones o bien la unión roscada GF. En la ranura anular en O del lado de salida, viene colocada de fábrica una junta toroidal de EPDM. Para las aplicaciones en las que el EPDM no sea resistente a los líquidos utilizados, se recomienda el montaje de una junta toroidal de Viton B. Esta junta toroidal (de color marrón) viene adjunta a la válvula.

El tubo de derivación se lleva nuevamente al depósito dosificador. Fijarlo mediante boquilla portatubo y tuerca de racor.

5 Operación / Manejo

ATENCIÓN

- **El tubo de derivación debe mantenerse siempre conectado, ya que al operar la válvula cerca de la función de sobre-presión es posible que rebase una pequeña cantidad de líquido hacia el tubo de derivación.**
- **Las válvulas multifuncionales no son órganos de cierre absolutamente herméticos.**

Operación y puesta a punto
Ayuda en la aspiración

Mediante giro del botón giratorio rojo (2) en la dirección de la flecha (sentido horario) queda libre la vía al bypass. El líquido a dosificar retorna al depósito dosificador.

NOTA

- **Se produce una descarga parcial del tubo de presión, por lo que puede salir líquido en la derivación.**

La bomba dosificadora ProMinent debe ponerse entonces en "aspirar" (véase tambièn al respecto las instrucciones de servicio de la bomba), hasta que aparezca líquido en el tubo de derivación.

La bomba ha aspirado y puede ser puesta en marcha. Al soltar el botón giratorio rojo (2), éste retorna automáticamente a la posición inicial.

Descarga del tubo de presión

Girando hacia fuera el botón giratorio rojo (2) y el botón giratorio negro (1) en el sentido de las agujas del reloj, queda libre el recorrido de la tubería de impulsión hasta el bypass. Si sólo es accionado el botón giratorio rojo (2), la presión en la tubería bajará hasta 1,5 bar, aproximadamente.

Ambos mandos deben permanecer en esa posición hasta que ya no salga líquido por el orificio de derivación ni que retorne líquido al depósito dosificador. El tubo de dosificación está entonces descargado de presión. Al soltar los dos mandos giratorios, éstos retornan automáticamente a su posición inicial.

6 Características técnicas / Instrucciones para el pedido

Materiales empleados para los elementos en contacto con el líquido a dosificar

Cuerpo de válvula	PVDF
Membrana	revestida de Teflón
Juntas	Viton® o EPDM
Pieza de ajuste para tamaño III	PVC

Viton® es una marca registrada de DuPont Dow Elastomers.

Tipo	No. de ref.	Presión de apertura de rebose*	Tamaño de conexión	Conexión de derivación
Tamaño I	792011.9	16 bar	6-12 mm	6/4 mm
Tamaño I	791715.6	10 bar	6-12 mm	6/4 mm
Tamaño I	1005745	6 bar	6-12 mm	6/4 mm
Tamaño II	792203.4	10 bar	6-12 mm	12/9 mm
Tamaño II	740427.0	6 bar	6-12 mm	12/9 mm
Tamaño III	792215.6	10 bar	DN 10	12/9 mm

* La presión de apertura de rebose indicada aquí es la presión a la que empieza a abrirse la válvula. Según el tipo de bomba, la presión hasta la apertura total de la válvula puede ser hasta el 50 % mayor.

Aplicaciones

Tamaño I	CONCEPT, Pneumados y Beta® 4: todos los tipos gamma/ L: tipo 1000, 1601, 1602, 1005, 0708, 0413, 0220 y 1605
Tamaño II	todos los tipos bajo tamaño I Beta® 5: tipo 1008, 0713, 0420 y 0232 gamma/ L: tipo 1008, 0713, 0420 y 0232
Tamaño III	Sigma/ 1 con rosca de unión DN 10

Sujeto a modificaciones técnicas.

Anschriften- und Liefernachweise durch den Hersteller /
Addresses and delivery through manufacturer /
Adresses et liste des fournisseurs fournies par le constructeuer /
Para informarse de las direcciones de los distribuidores, dirigirse al fabricante:

ProMinent Dosiertechnik GmbH
Im Schuhmachergewann 5-11 · 69123 Heidelberg
Germany
Tel.: +49 6221 842-0
Fax: +49 6221 842-419
info@prominent.com · www.prominent.com

P-701/702	12026	Motor, Teco, 1hp, 1800rpm, 143T	208-230/460V, 3ph, CSA/UR

TECO Westinghouse

OPERATION & MAINTENANCE MANUAL FOR THREE PHASE INDUCTION MOTORS

TECO-Westinghouse Motor Company
5100 North IH-35
Round Rock, Tx. 78681

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1. INTRODUCTION

This and the following instruction address the more common situations encountered in motor installation, operation and maintenance. For the TWMC motor warranty to be and to remain in effect, the motor must be installed and operated in strict accordance with the outline drawing, motor nameplates and these instructions and must not be altered or modified in any unauthorized manner.

During the installation and operation of motors in heavy industrial applications there is a danger of live electrical parts and rotating parts. Therefore to prevent injury and/or damage the basic planning work for installation, transportation, assembly, operation, etc... needs to be done and checked by authorized and competent personnel only.

Since these instructions cannot cover every eventuality of installation, operation and maintenance, the following points should be considered and checked.

- The technical data and information on permissible use such as assembly, connection, ambient and operating conditions given in the related catalogue, operating instructions, nameplates and other production documentation.
- The general erection and safety regulations.
- The local and plant-specific specifications and requirements.
- The proper use of transport, lifting devices and tools.
- The use of personal protective equipment.

Following indications should be observed when reading these instructions.

Safety instructions are marked as follows:

Warning of electric hazards for personnel.

Warning of dangers for personnel.

ATTENTION!
Warning of damage for the motor or installation.

2. ACCEPTING, INSPECTION, STORAGE, TRANSPORTATION

Inspection upon receipt
Check to following points upon receipt:

- Are the nameplate ratings identical with what you ordered?
- Are dimensions and color in compliance with your specifications?
- Are the nameplate ratings for space heater, thermal protector, temperature detector, etc. identical with what you ordered?
- Is there any damage?
- Are all accessories and accompanying instruction manuals in good order?
- Please ensure that the arrow head indicator really indicates direction of rotation.
- If there are any specific requirements, please ensure they are in conformity with your specifications.

2.1 Storage
When motors are not in operation, the following precautionary measures should be undertaken to assure best performance.

2.2 Place
(a) High and dry, well ventilated without direct sun, dust or corrosive gas.
(b) Not located near to a boiler or freezer.
(c) Entirely free form vibration and easy for movements.
(d) Motors should be put on pallets to prevent moisture.

2.3 Moisture prevention
Since moisture can be very detrimental to electrical components, the motor temperature should be maintained about 3ºC above the dew point temperature by providing either external or internal heat. If the motor is equipped with space heaters, they should be energized at the voltage shown by the space heater nameplate attached to the motor. Incandescent light bulbs can be placed within the motor to provide heat. However, if used, they must not be allowed to come in contact with any parts of the motor because of the concentrated hot spot that could result.

2.4
Even during storage, the insulation resistance should be kept above the specified values.
(a) For measurement of insulation resistance and acceptable standard values, please refer to measures stated in 3.1.2 “Measurement of insulation resistance”.
(b) Insulation resistance test should be performed once every three months.

2.5

If the motor is not in operation for a long period (one week and above) after installation or has been in operation but stopped for a period of time, the following precautions must be taken.

(a) Protect the motor as measures stated in 2.2.3.
(b) Insulation resistance test should be performed as stated in 2.2.4.

2.6 Bearing protection

(a) If the motor has been provided with a shaft shipping brace to prevent shaft movement during transit, it must be removed before operating the motor. It is very important that this brace be re-installed exactly as it was originally, before the motor is moved form storage or any time when the motor is being transported. This prevents axial rotor movement that might damage the bearings.
(b) Motors equipped with sleeve bearings are shipped from the factory with the bearing oil reservoirs drained. In storage, the oil reservoirs should be properly filled to the center of the oil level gauge with a good grade of rust inhibiting oil. To keep the bearing journals well oiled and to prevent rusting, the motor shaft should be rotated several revolutions about every month ensuring the shaft does not come to rest in its original position. While the shaft is rotating, it should be pushed to both extremes of the endplay.
(c) Motors with anti-friction bearings are properly lubricated with the correct grade of grease at the factory and no further greasing is required in storage. The shaft should be rotated several revolutions about every month to maintain proper distribution of the grease within the bearings.
(d) Tilt-pad bearings are a type of sleeve bearing used in special design applications. Due to the nature of this bearing, a loose oil ring for delivering lubricant cannot be provided. Therefore, during the storage internal, oil must be periodically manually introduced into the pads and housing to prevent the occurrence of oxidation of the precision machined components.
    (1) Remove the pipe plug from the bearing cap located above the tilt-bearing shell.
    (2) Pour in approximately one cup of oil every month and rotate the shaft a few revolutions about every two (2) weeks.
    (3) For long periods of storage, the oil that accumulates in the housing should be removed.

ATTENTION!
Care should be taken to keep parts such as fitting surfaces, key, shaft extension and axial central hole from any collision with foreign matter. Grease should also be generously applied to prevent rusting.

2.7 Transportation

To keep the rotating parts of motors from moving, thus preventing damage and scratching during transportation, they should be held securely with a locking device. Remove all transit clamps before operating the motor. It is very important that this device be reinstalled exactly as it was originally, before the motor is moved from storage or any time when the motor is being transported. The vertical mounting type motors should be transported in the vertical position.

Do not use the hoisting hook/eyebolts to lift more that the motor itself. They are designed to support the motor only. Make sure the hoisting hook is correctly attached to the eyebolt(s)/lug(s) are fully screwed in before hoisting. Also note such parts as fan cover, ventilation box, bracket, slip-ring, etc. may have their own hoisting lugs which can only carry their own weight. Nothing extra should be attached while hoisting.
Do not twist the steel wires and make sure the eyebolts have been firmly screwed and the sling angle is correct.

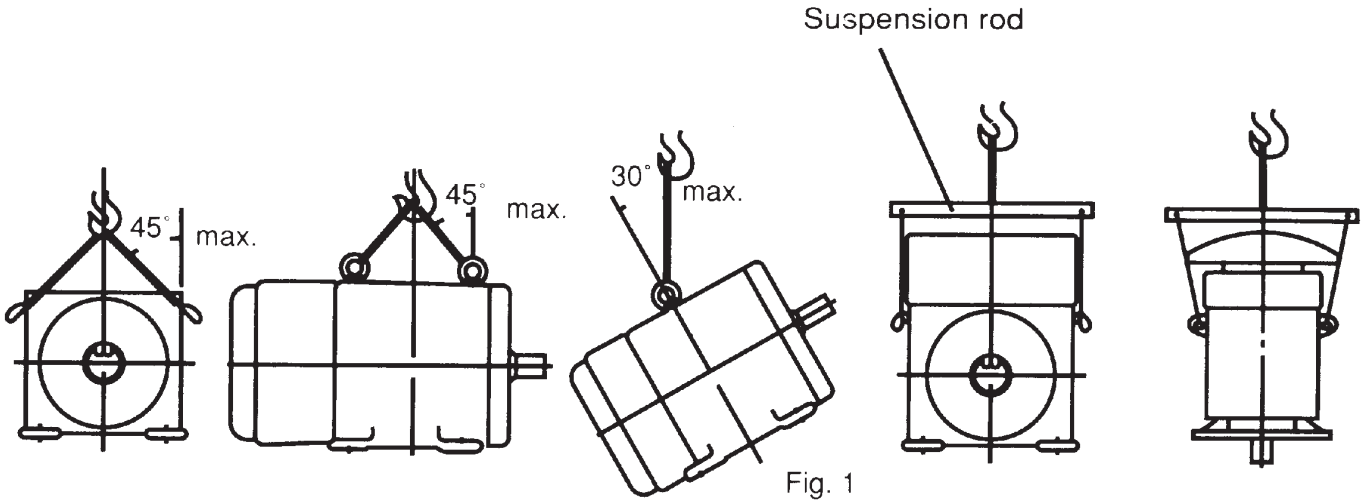


Fig. 1

3 INSTALLATION

Site and environment for motor installation

3.1.1

Standard environment and site conditions for the installation of motors are usually set as follows:

(a) Ambient temperature: -10~40ºC
(b) Humidity: Relative humidity below 90%RH for totally enclosed types, and below 80%RH for semi-enclosed types.
(c) Elevation: below 1000 meters or 3300 feet.
(d) Harmful gases, liquids, dusts, high moisture should be absent.
(e) Foundations should be strong and free of vibration.

If there are any special environmental conditions, please inform TWMC prior o ordering.

3.1.2 Ventilation and space

(a) Installation area should be well ventilated.
(b) The installation space should be large enough to facilitate heat dissipation and maintenance.

3.2 Foundation

3.2.1

Use rigid and solid sole plate or common bed as foundation.
For best motor performance, it is advisable to use a sole plate or common bed, particularly when using a shaft coupling.

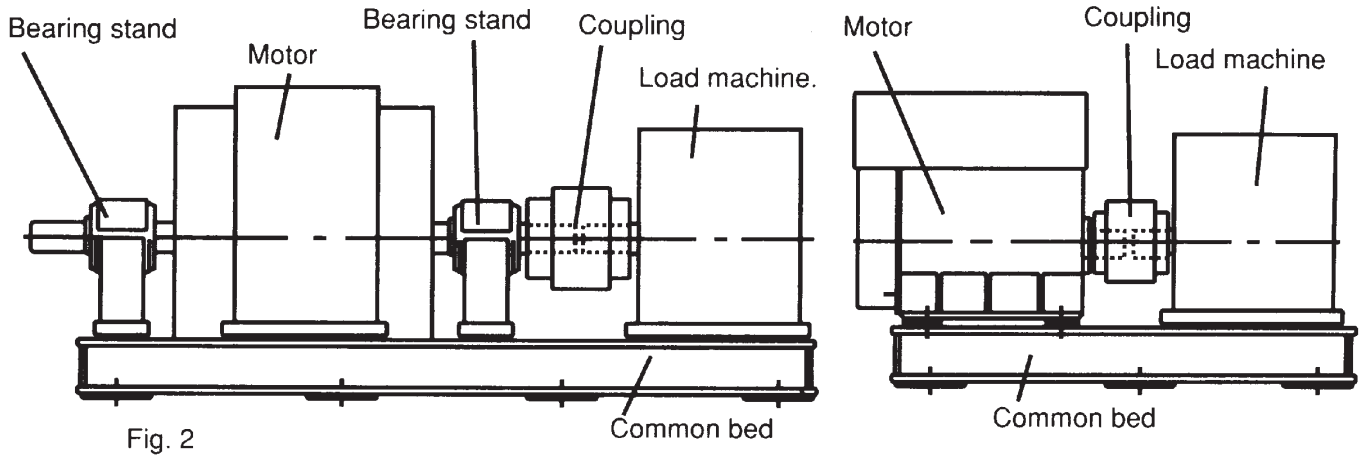


Fig. 2

3.2.2 Installation

(a) Select an appropriate foundation surface for the sole plate or common bed, which will be, considered the ultimate level.
(b) Align the position of the common bed with reference to that level.
(c) Align the level accuracy at least at four points such as bearing mounting, shaft extension etc. The accuracy should be within 0.04mm or .0015 inches
(d) Sole plate or common bed should be embedded in concrete foundation as illustrated in Fig. 3. Stiff pads should also be installed beneath the wedges, which are welded together at various spots about 400-500mm (15.75-19.70 inches) apart etc., to enable the foundation to carry evenly the weight of the whole motor.
(e) The base should be sturdy and rigid to keep it flat and level.
(f) Make sure the mortar and concrete are completely dry, and the precision of the level is acceptable, and then set the motor on the mounting foundation.
(g) Accurately install shaft couplings, belt sheaves etc., then weld the wedges solid to prevent untoward change in position.

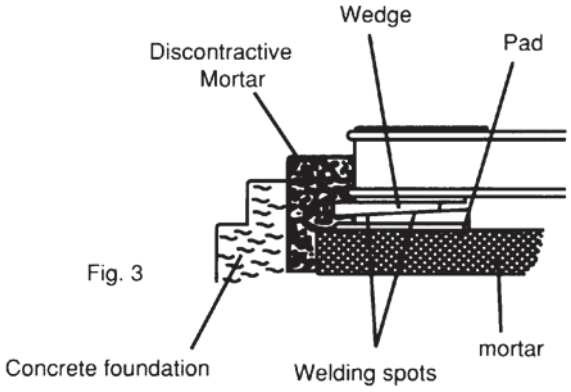


Fig. 3

3.2.3 The foundation of vertical induction motors: (Also the foundation of pump)

(a) Foundation of motor/pump must be rigid and secure to provide adequate support. There must be no vibration, twisting, misalignment etc. due to inadequate foundations.
(b) A massive concrete foundation is preferred in order to minimize vibration. Rigidity and stability are enhanced by prop plate and foundation bolt. As shown in Fig. 4.

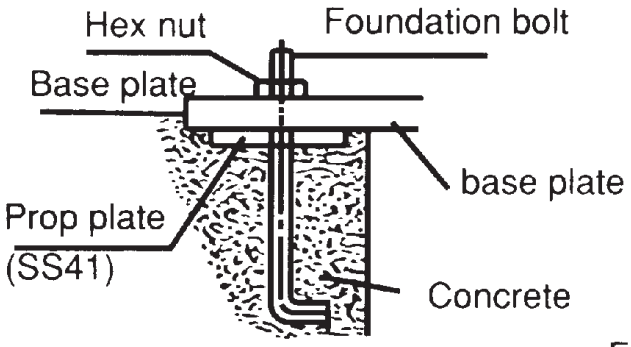


Fig. 4

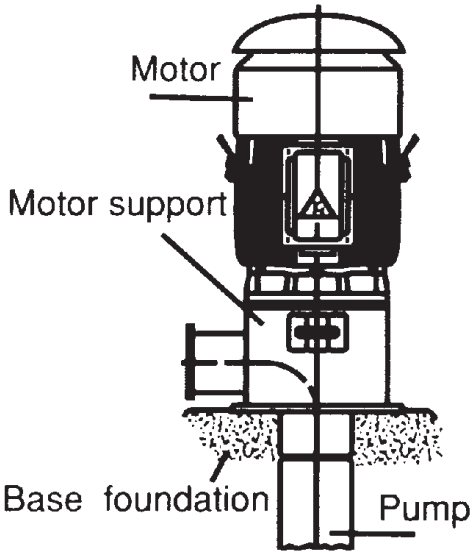


Fig. 5

3.2.4 Installation of vertical motors:

(a) All mounting surfaces must be clean and level.
(b) Foundation must be leveled at least at 4 points and guaranteed to be below 0.04mm (.0015 in.) flat and level.
(c) Make sure the mortar and concrete are completely dry, and the precision of the level is acceptable, and then set the motor on the mounting foundation.
(d) Accurately install shaft couplings.

3.3 Installation of shaft coupling

ATTENTION!
Motors must always be accurately aligned, and this applies especially where they are directly coupled.
Incorrect alignment can lead to bearing failure, vibration and even shaft fracture. As soon as bearing failure or vibration is detected, the alignment should be checked.

3.3.1

Field application of a coupling to the motor shaft should follow the procedures recommended by the coupling manufacturer. The motor shaft extension must not be subjected to either extreme heat or cold during coupling installation.

ATTENTION!
Basically, the coupling should be heated and pushed onto the shaft extension with slight axial force. Do not hammer coupling to prevent bearing damage.

3.3.2

Although the sleeve bearings are equipped with thrust faces, these are intended only to provide momentary axial restraint of rotor movement either during start-up or when operating the motor disconnected from the driven equipment. They must not be operated under a constant thrust load unless they were originally designed for this condition.

Motors with either sleeve or anti-friction bearings are suitable for connection to the driven load through a flexible coupling. Coupling solidly to the load is not acceptable. With sleeve bearings, the flexible coupling should be of the limited end float type to prevent the possibility of any end thrust from load being transmitted to the motor bearings, which could cause bearing damage. The recommended limits of end float are as follows:

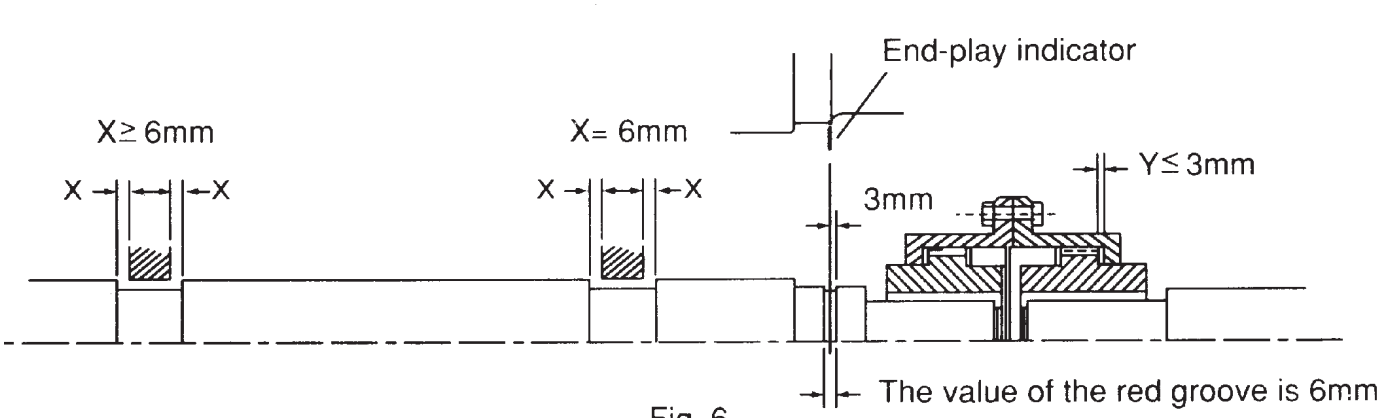


Fig. 6

(a) When the motor is in operation after installation, be sure that the end-play indicator is within the 6mm (.236 in.) of the groove on the shaft or aligned to the shaft shoulder immediately outboard of the drive-end bearing to assure there is low friction between shaft and bearing.

(b) Unless otherwise specified, the designed end-play value X of the groove for TWMC motors in general is within 6mm (.236 in.) as illustrated in Fig. 6. In essence, the endplay indicator is adjusted to point at the center of the groove or the drive-end shaft shoulder; thus X equals to 6±1mm or so, and the endplay value (Y) of the couplings should equal or be smaller than 3mm (.118 in.).

(c) If the desired value Y is grater than 3mmm (.118 in.) caused for instance by a thrust load and/or load machine with large end-play, please inform TWMC prior to entering an order.

3.3.3

In aligning the motor (and rotor) axially with the driven equipment, consideration should be given not only to the endplay indicator position but also to axial shaft expansion and increase in shaft centerline height due to thermal effects. In general, the axial shaft growth for motors can be disregarded since neither bearing is fixed and any shaft growth due to temperature increase will produce an elongation away from the coupling.

Shaft height growth (change in shaft centerline elevation) for TEFC machines can be calculated as follows:

$$\Delta=(0.0005\text{”}) \times (\text{motor foot to shaft £ dimension})$$

For non-TEFC machines, divide the number by 2.

3.3.4

It is desirable, in normal operation that the motor operates on its magnetic center, so that no axial force is exerted on the coupling.

The motor shaft and the driven shaft should be aligned within the following tolerances in both angular and parallel alignment:

Unit: mm

TIR	Range of rotating speed	Solid coupling	Flexible coupling
C	2500 rpm and above	0.03	0.03
	Below 2500 rpm	0.04	0.05
A	2500 rpm and above	0.03	0.03
	Below 2500 rpm	0.03	0.04

Angular misalignment is the amount by which the centerlines of driver and driven shafts are skewed. It can be measured using a dial indicator set up as shown in Fig. 7. The couplings are rotated together through 360 degrees so that the indicator does not measure runout of the coupling hub face. The shafts should be forced against either the in or out extreme of their end float while being rotated.

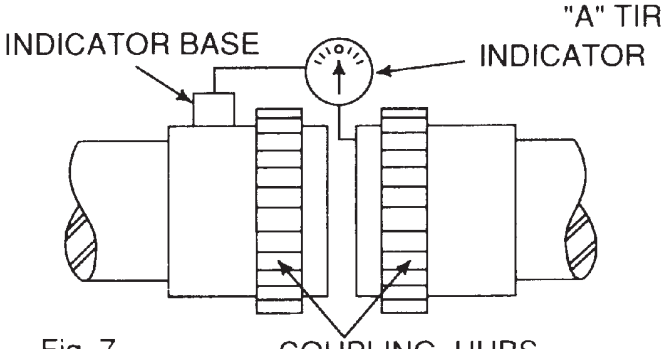


Fig. 7

TIR=Total indicator reading (by dial indicator)

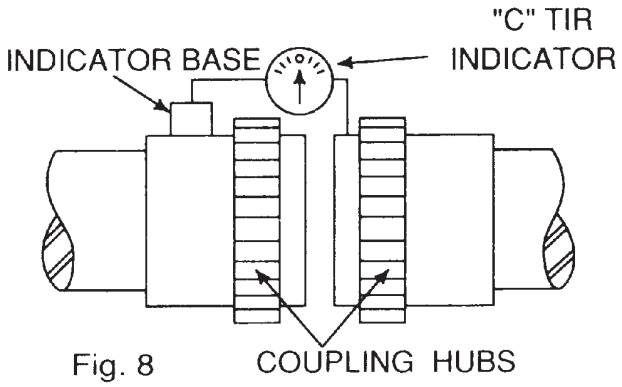


Fig. 8

Parallel misalignment is the amount by which the centerlines of the driver and driven shafts are out of parallel. It can be measured using a dial indicator set up as shown in Fig. 8. Again, the couplings are rotated together through 360 degrees so that the indicator does not measure runout of the coupling hub outside diameter.

3.3.5

After the motor has been properly aligned with the driven equipment and the hold-down bolts have been installed and tightened, for motors with fabricated frames, at least two dowel pins should be installed in two diagonally opposite motor feet.

3.3.6 Installation of shaft coupling: (Vertical hollow shaft motor only)

Bolted Coupling as shown in Fig. 9

(a) Bearings are provided to absorb some upward shaft thrust when the coupling is fitted.
(b) The coupling is fastened with bolts.
(c) This coupling type is not auto-release type.

Note: Standard high thrust motors can absorb momentary up-thrust load up to 30% of the standard down thrust load. If the up-thrust is long in duration (over 10 Seconds) and/or exceeds 30% of the standard high thrust rating, special design arrangements are required and standard motor is not suitable.

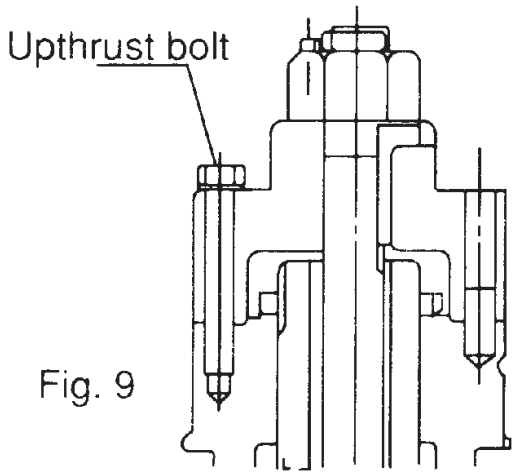


Fig. 9

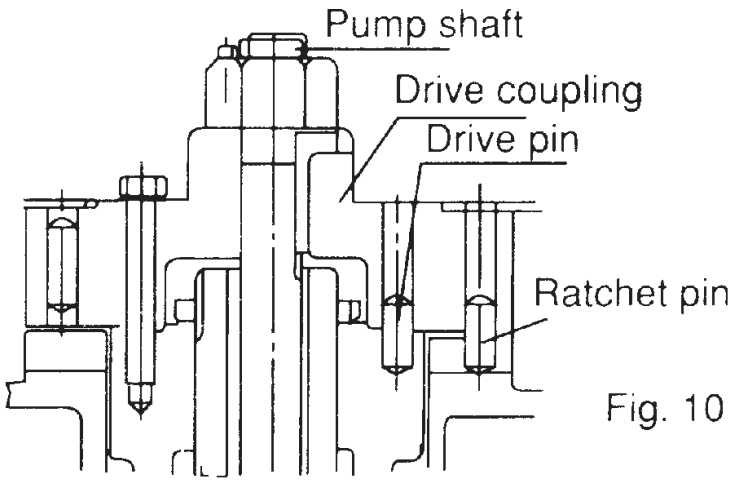


Fig. 10

3.3.7 Non-reverse ratchet/coupling, as Fig. 10 (If necessary)

The non-reverse coupling is also a bolted type and,

(a) It prevents the pump and motor from rotating in the reverse direction.
(b) It also prevents damage form over speeding and damage to pump shaft and bearings.
(c) The ratchet pins are lifted by the ratchet teeth and are held clear by centrifugal force and friction as the motor comes up to speed.
(d) When power is removed, speed decreases, and the pins fall. At the instant of reversal, a pin will catch in a ratchet tooth and prevent backward rotation.
(e) When installing the non-reverse coupling, do not use lubricant. Lubricant will interfere with proper operation. The top half of the coupling should seat solidly on the lower half and the pins should touch the bottom of the pockets between the teeth in the plate.
(f) As with the bolted coupling, the up-thrust capabilities are 30% of the standard high thrust rating for down thrust.

ATTENTION!
Do not apply non-reverse ratchets on applications in which the pump reversal time from shutdown (the instant the stop button is pressed) to zero speed is less than one second.

3.4 Installation for belt drive

In general, power transmission though direct flexible coupling is appropriate for large motors. Such motors are not suitable for belt, chain or gear connection unless specially designed for such service. However, for small and medium motors of which outputs within the ranges shown on table below, it is acceptable to use belt transmission as indicated. Beyond these ranges, do not apply belt sheaves unless specially designed.

3.4.1

The diameter ratio between conveyance sheaves should not be greater than 5 to 1 for flat belts, and 8 to 1 for V-belts. It is also advisable to limit the belt velocity to under 35m/sec (115 ft/sec) to limit belt abrasion and vibration. The smaller the outer diameter of the V-belt sheave, the greater the shaft bending stress will be. If the bending stress is in excess of the shaft fatigue stress, the shaft may break. Therefore, please inform TWMC when you have decided the size of the sheaves and the length of the belts upon ordering.

ATTENTION!
Place the sheave and belt as close as possible to the motor body (it is advisable to make x as shown in Fig. 11 equal to 0) to reduce the bending moment and improve shaft life.

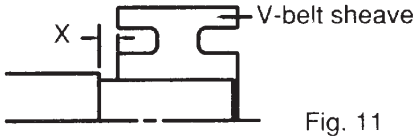


Fig. 11

3.4.2 Table of belt-sheave application for general electric motors

Output (KW/HP)			V-Belt Sheave							
			Conventional V-Belts				Narrow V-Belts			
4P	6P	8P	V-Belt Type	Number Of Belts	Min. PCD (mm)	Max Width (mm)	V-Belt Type	Number Of Belts	Min. PCD (mm)	Max Width (mm)
11/15	-	-	B	4	160	82	3V	4	125	48
-	11/15	-	B	5	170	101	3V	5	140	59
-	-	11/15	B	5	190	101	3V	6	160	69
15/20	-	-	B	5	170	101	3V	6	125	69
-	15/20	-	B	5	224	101	3V	6	160	69
-	-	15/20	C	4	224	111	5V	3	180	60
18.5/25	-	-	B	5	200	101	3V	6	140	69
-	18.5/25	-	C	4	224	111	5V	3	180	60
-	-	18.5/25	C	5	224	136	5V	4	180	78
22/30	-	-	B	5	224	101	5V	6	160	69
-	22/30	-	C	5	224	136	3V	4	180	78
-	-	22/30	C	5	250	136	5V	4	200	78
30/40	-	-	C	5	224	136	5V	4	180	78
-	30/40	-	C	5	265	136	5V	4	224	78
-	-	30/40	C	6	265	162	5V	5	224	95
37/50	-	-	C	6	224	162	5V	4	200	78
-	37/50	-	C	6	265	162	5V	4	224	78
-	-	37/50	C	7	280	187	5V	5	250	95
45/60	-	-	C	6	265	162	5V	4	224	78
-	45/60	-	C	7	280	187	5V	5	224	95
-	-	45/60	C	7	315	187	5V	6	250	113
55/75	-	-	C	7	265	187	5V	5	224	95
-	55/75	-	C	8	300	213	5V	6	250	113
-	-	55/75	D	5	355	196	5V	6	280	113
75/100	-	-	C	8	315	213	5V	6	250	113
-	75/100	-	D	6	355	233	5V	6	315	113
-	-	75/100	D	6	400	233	5V	6	355	113
-	90/120	-	D	6	400	233	5V	6	355	113
-	-	90/120	D	6	425	233	8V	4	355	124
-	110/150	-	D	7	400	270	8V	4	355	124
-	132/175	110/150	D	7	450	270	8V	4	400	124
-	160/200	132/175	D	9	450	344	8V	4	450	124

3.5 Conveyance with chain or gear

3.5.1

Make sure the loading capacity of shaft and bearings is appropriate for the size and installation position (overhung) of chain and gear. If necessary, please contact us to ensure the shaft and bearings will meet your requirements.

3.5.2
Pay close attention to ensure the parallelism of shafts.

3.5.3
The teeth of couplings should be correctly and precisely matched; the force conveyance centers should lie on the same line.

3.5.4
There should be no skip, jumping, vibration or unusual noises.

ATTENTION!
Do not hammer the conveyance devices such as couplings, belt sheaves, chain wheels, gears etc. onto the shaft. Those shaft fitments should be fitted and removed only by means of suitable devices. Heat shrinking may be a better alternative to avoid damaging bearings and components.

The exposed rotating parts should be covered to prevent accidents.

3.6 Electrical connections
All interconnecting wiring for controls and grounding should be in strict accordance with local requirements such as the USA National Electrical Code and UK IEE wiring regulations. Wiring of motor and control, overload protection and grounding should follow the instructions of connection diagrams attached to the motor.

3.6.1 Power
The rated conditions of operation for the motor are as shown on the nameplate. Within the limits, given below, of voltage and frequency variation from the nameplate values, the motor will continue to operate but with performance characteristics that may differ from those at rated conditions:

±10% of rated voltage
±5% of rated frequency
±10% combined voltage and frequency variation so long as frequency variation is no more than ±5% of rated.

Operating the motor at voltages and frequencies outside of the above limits can result in both unsatisfactory motor performance and damage to or failure of the motor.

3.6.2
The main lead box furnished with the motor has been sized to provide adequate space for the make-up of the connections between the motor lead cables and the incoming power cables.

The bolted joints between the motor lead and the power cables must be made and insulated in a workman-like manner following the best trade practices.

3.6.3
Either fabricated motors or fan cooled cast frame, motors are all provided with grounding pads or bolts.

The motor must be grounded by proper connection to the electrical system ground.

3.6.4

The rotation direction of the motor will be as shown by either a nameplate on the motor or the outline drawing. The required phase rotation of the incoming power for this motor rotation may also be stated. If either is unknown, the correct sequence can be determined in the following manner: While the motor is uncoupled from the load, start the motor and observe the direction of rotation. Allow the motor to achieve full speed before disconnecting it from the power source. Refer to the operation section of these instructions for information concerning initial start-up. If resulting rotation is incorrect, it can be reversed by interchanging any two (2) incoming cables.

3.6.5 Auxiliary devices

Auxiliary devices such as resistance temperature detectors, thermocouples, thermoguards, etc., will generally terminate on terminal blocks located in the auxiliary terminal box on the motor. Other devices may terminate in their own enclosures elsewhere on the motor. Such information can be obtained by referring to the outline drawing. Information regarding terminal designation and the connection of auxiliary devices can be obtained from auxiliary drawings or attached nameplates.

If the motor is provided with internal space heaters, the incoming voltage supplied to them must be exactly as shown by either a nameplate on the motor or the outline drawing for proper heater operation.

Caution must be exercised anytime contact is made with the incoming space heater circuit as space heater voltage is often automatically applied when the motor is shutdown.

4. OPERATION

4.1 Examination before start

4.1.1

When motors are installed in good manner, ensure the wiring is according to the diagram. Also, the following points should be noted:

(a) Make sure all wiring is correct.
(b) Ensure the sizes of cable wires are appropriate and all connections are well made for the currents they will carry.
(c) Ensure all connections are properly insulated for the voltage and temperature they will experience.
(d) Ensure the capacity of fuses, switches, magnetic switches and thermo relays etc. are appropriate and the contactors are in good condition.
(e) Make sure the frame and terminal box are grounded.
(f) Make sure that the starting method is correct.
(g) Make sure switches and starters are set at their right positions.
(h) Motor heaters must be switched off when the motor is running.

4.1.2 Measurement of insulation resistance

During and immediately after measuring, the terminals must not be touched as they may carry residual dangerous voltages. Furthermore, if power cables are connected, make sure that the power supplies are clearly disconnected and there are no moving parts.

(a) For rated voltage below 1000V, measured with a 500VDC megger.
(b) For rated voltage above 1000V, measured with a 1000VDC megger.
(c) In accordance with IEEE 43, clause 9.3, the following formula should be applied:

$$R \geq \left(\frac{\text{Rated voltage (v)}}{1000} + 1 \right) \times 10(M\Omega)$$

(d) On a new winding, where the contaminant causing low insulation resistance is generally moisture, drying the winding through the proper application of heat will normally increase the insulation resistance to an acceptable level. The following are several accepted methods for applying heat to the winding:
   (1) If the motor is equipped with space heaters, they can be energized to heat the winding.
   (2) Direct current (as from a welder) can be passed through the winding. The total current should not exceed approximately 50% of rated full load current. If the motor has only three leads, two must be connected together to form one circuit through the winding. In this case, one phase will carry the fully applied current and each of the others, one-half each. If the motor has six leads (3 mains and 3 neutrals), the three phases should be connected into one series circuit.

Ensure there is adequate guarding so live parts cannot be touched.

   (3) Heated air can either blown directly into the motor or into a temporary enclosure surrounding the motor. The source of heated air should preferably be electrical as opposed to fueled (such as kerosene) where a malfunction of the fuel burner could result in carbon entering the motor.

ATTENTION!
Caution must be exercised, when heating the motor with any source of heat other than self contained space heaters, to raise the winding temperature at a gradual rate to allow any entrapped moisture to vaporize and escape without rupturing the insulation. The entire heating cycle should extend over 15-20 hours.

Insulation resistance measurements can be made while the winding is being heated. However, they must be corrected to 40ºC for evaluation since the actual insulation resistance will decrease with increasing temperature. As an approximation for a new winding, the insulation resistance will approximately halve for each 10ºC increase in insulation temperature above the dew point temperature.

(e) Should the resistance fail to attain the specified value even after drying, careful examination should be undertaken to eliminate all other possible causes, if any.

4.1.3 Power Source

(a) Ensure the capacity of the power source is sufficient.
(b) Ensure the supply voltage and frequency ratings are identical to those on the nameplate.
(c) Voltage variation should be confined to within ±10% of the rated value and the phase to phase voltages should be balanced.

4.1.4 Bearing lubrication

(a) For sleeve bearing motors, the oil reservoir must be filled with oil to the correct level. On self-lubricated bearings, the standstill oil level will be at the center of the oil gauge. The proper oil is a rust and oxidation inhibited, turbine grade oil. Refer to the lubrication nameplate for the recommended viscosity.

(b) Motors, which are supplied with provision for flood lubrication, have an inlet orifice to meter the oil flow to the bearing. Refer to the outline drawing for these values. If the supply pressure does not match that stated on the outline, the orifice size must be adjusted to produce the specified flow rate. The drain adapter (also provided) has a weir plate fixed to the inside of the pipe to permit the establishment of the proper oil level. This weir plate must be located at the bottom of the pipe and must be parallel to the plane of the motor feet. To ensure optimum flow, the drain line should be vented to the atmosphere.

Oil inlet temperature:	Normal below 50ºC
	Alarm 60ºC
	Trip 65ºC

(c) If the motor is in storage for over three (3) months, refilling of some new oil should be undertaken before operation to prevent bearing damage due to dry friction. The oil level should be kept at the center of the oil gauge. If necessary, drain some oil after refilling.

(d) Motors that have been designed with anti-friction bearings for use with an oil mist lubrication system have been packed at the factory with a small amount of grease for short test runs. Continuous running should not be considered unless the oil mist system is installed and operating.

(e) Grease lubricant type

(1) The bearings have been well greased at the factory before delivery. However, regreasing is required if a significant period has elapsed between manufacture and use or in storage

(2) All motors with ZZ bearings will have SHELL Alvania R3 (*Lithium base grease*). All motors with open bearings will have Polyrex EM (polyurea base grease).

4.1.5 Cooling water for the cooler on water-cooled motors

Make sure the quality, volume and inlet temperature of cooling water for the motors are normal before the machine is in operation.

Water: General tower water or industrial water.	
Volume: Please see outline drawing	
Inlet temperature:	Normal below 30ºC
	Alarm 35ºC
	Trip 40ºC

ATTENTION!
Make sure all locks, which fasten the movable parts of the motors during transportation, are dismantled and the shaft can rotate freely.

ATTENTION!
Ensure there is no foreign matter or tools inside the motors before starting motors.

4.1.6
Make sure the transmission system, including belts, screws, bolts, nuts and set pins are in good condition.

The keys fitted to the shaft extensions are held by plastic tape only to prevent them from falling out during transportation or handling. The shaft key shall be removed to avoid flying out, when the motor is operated prior to the couplings etc. being fitted to the shaft extension.

4.1.7
Make sure the items above are examined. Test the motor running with or without load. Record and check according to "Maintenance" at 15-minute intervals during the first three hours of operation. Then regular examinations should take place at longer intervals. If all goes well the motor can be classified as "in good order".

4.2 Starting operation

4.2.1 Starting load
Initially run the motor unloaded prior to coupling to other machines. Unless otherwise specified, a motor usually starts with light load, which is then gradually increased, proportional to the square of the speed and at last reaches 100% load at full load speed.

4.2.2 Starting
Too frequent starts can be harmful to the motors. The following restrictions should be observed:

(a) Motor can be restarted should the initial start fail. Two starts are generally permissible when the motor is cold.
(b) Motor can be started only once when it is at normal running temperature.
(c) Should additional starts be necessary beyond the conditions stated above, the following restrictions should be noted:
    (1) Let the motor cool down for 60 minutes before restarting, fully loaded.
    (2) Let the motor cool down for 30 minutes before restarting, unloaded.
    (3) Two inching starts can be regarded as one normal start.

ATTENTION!
If the motor rotor fails to start turning within one or two seconds, shut off the power supply immediately.
Investigate thoroughly and take corrective action before attempting a restart.

Possible reasons for not starting are:
(1) Too low a voltage at the motor terminals.
(2) The load is too much for the rotor to accelerate.
(3) The load is frozen up mechanically.
(4) All electrical connections have not been made.
(5) Single-phase power has been applied.
(6) Any combination of the above.

4.2.3 Rotating direction

(a) Most TWMC motors are bi-directional. However, when some special types, such as high speed 2-Pole, certain large capacity motors, those with a non-reversing ratchet etc., should rotate in one direction, please ensure the rotation is in conformity with the directional arrow-mark shown on the attached nameplate.

(b) To reverse a bi-directional motor, cut the power and wait until the motor stops. Then interchange any two of the three phases.

4.2.4 Power source, Voltage, Current

(a) Ensure the voltage and frequency of the power source are identical to the ratings shown on the nameplate.

(b) Voltage variation should be confined to within ±10% of the rating and the three phase voltages should be in full balance

(c) Ensure the motor phase currents, when without load, are within ±5% of the average values.

4.2.5

Frequency variation should be confined to within ±5% of the rating. The aggregate variation of voltage and frequency should be confined to within ±10% of the absolute value of the ratings.

Starting time and unusual noises

ATTENTION!
Starting time is longer for the motors with large inertia. However, if starting time is longer than usual or if there is difficulty in starting, or there is abnormal noise, do not run the motor and refer to TWMC Service representative.

4.2.6 Sleeve bearing oil rings (sleeve bearing types only)

As the oil ring is used to carry lubricant to sleeve bearings, frequently check to ensure the oil ring is in motion.

4.2.7 Bearing temperature rise

Following the initial start-up, the bearing temperatures should be closely monitored. The rate of rise in bearing temperature is more indicative of impending trouble than is the actual temperature.

ATTENTION!
If the rate of rise in temperature is excessive or if the motor exhibits excessive vibration or noise, it should be shut down immediately and a thorough investigation made as to the cause before it is operated again.

If the bearing temperature rise and motor operation appear to be normal, operation should continue until the bearing temperature stabilizes.

Recommended limits on bearing temperature are as follows:

Sleeve Bearings	**Total measured temperature**
● By permanently installed detector	90ºC
● By temporary detector on top of the bearing sleeve near the oil ring	85ºC

Anti-Friction Bearings	Total measured temperature
● By permanently installed detector	100ºC
● By temporary detector measuring the outside of the bearing housing	95ºC

ATTENTION! (For sleeve bearing)

(1) It must be noted that when operating flood lubricated sleeve bearings without outside lubrication supplied, the bearing temperature must not be allowed to exceed 85ºC total temperature

(2) Under normal condition, for the self-lube bearing, the rate of temperature rise should be from 11 to 14ºC for the first ten (10) minutes after starting up and approximately 22ºC at thirty (30) minutes. The rate of bearing temperature rise is a function of the natural ventilation and operating conditions.

(3) When the rate of bearing temperature rise is less than 1ºC per half-hour, the bearing temperature is considered to be stabilized.

(4) If the total bearing temperature exceeds 95ºC, the motor should be shut down immediately.

Noise and Vibration

ATTENTION!
Any abnormal noise or vibration should be immediately investigated and corrected. Increased vibration can be indicative of a change in balance due to mechanical failure of a rotor part, a stator winding problem or a change in motor alignment.

5. MAINTENANCE

5.1 Major points in regular inspections and maintenance.

For safety, maintenance and repairs must only be carried out by properly trained personnel.

Some testing, such as insulation resistance, usually requires the motor to be stopped and isolated from power supplie(s).

Routine inspection and maintenance are usually performed by looking, listening, smelling and simple meters.

High temperature may arise under operating conditions on the motor surfaces, so that touching should be prevented or avoided. Keep away from moving and live parts. Unless deemed necessary, do not remove guards whilst assessing the motor.

Timely replacement of worn parts can assure longevity and prevent breakdown.

Routine inspection and regular inspection and maintenance are important in preventing breakdown and lengthening service life.

Owing to the varied time and circumstances, motors are used, it is difficult to set the items and periods for regular inspection and maintenance. However, as a guide it is recommended to be performed periodically according to factory maintenance program. Generally, the inspection scope determined by the following factors:

(a) Ambient temperature.
(b) Starting and stopping frequency.
(c) Troublesome parts usually affecting motor functions.
(d) Easily abraded parts.
(e) The important position of motor in the operational system of a factory should be duly recognized. Therefore, its health and wellbeing should be fully protected especially when it is operating in severe conditions.

5.2 Motor windings:

(a) Measurement of insulation resistance and standards to determine quality of insulation resistance, please refer to measures stated in 3.1.2 “Measurement of insulation resistance”.
(b) Inspection of coil-ends:
  (1) Grease and dust accumulated on coils may cause insulation deterioration and poor cooling effect.
  (2) Moisture must not accumulate. Keep coils warm when motor is not in use if moisture can be seen.
  (3) Discoloring. This is mainly caused by overheating.
(c) Ensure no untoward change of wedges from original position.
(d) Ensure the binding at the coil end is in its normal position.

5.3 Clean the interior of the motor:

(a) After a motor is in operation for some time, accumulation of dust, carbon powder and grease etc., on the inside is unavoidable, and may cause damage. Regular cleaning and examination is necessary to assure top performance.
(b) Points to note during cleaning:
  (1) If using compressed air or blower:
    (a) Compressed air should be free of moisture.
    (b) Maintain air pressure at 4 kg/cm², since high pressure can cause damage to coils.
  (2) Vacuum
    Vacuum cleaning can be used, both before and after other methods of cleaning, to remove loose dirt and debris. It is a very effective way to remove loose surface contamination from the winding without scattering. Vacuum cleaning tools should be non-metallic to avoid any damage to thee winding insulation
  (3) Wiping
    Surface contamination on the winding can be removed by wiping using a soft, lint-free wiping material. If the contamination is oily, the wiping material can be moistened (not dripping wet) with a safety type petroleum solvent. In hazardous locations, a solvent such as inhibited methyl chloroform may be used, but must be used sparingly and immediately removed. While this solvent is non-flammable under ordinary conditions, it is toxic and proper health and safety precautions should be followed while using it.

ATTENTION!
Solvents of nay type should never be used on windings provided with abrasion protection. Abrasion protection is a gray, rubber-like coating applied to the winding end-turns.

Adequate ventilation must always be provided in any area where solvents are being used to avoid the danger of fire, explosion or health hazards. In confined areas (such as pits) each operator should be provided with an airline respirator, a hose mask or a self-contained breathing apparatus. Operators should wear goggles, aprons and suitable gloves. Solvents and their vapors should never be exposed to open flames or sparks and should always be stored in approved safety containers.

(4) Keep core ducts completely clean. The difference in temperature rise could be around 10°C before and after cleaning

5.4 Clean the exterior of the motor:

(a) On open ventilated motors, screens and louvers over the inlet air openings should not be allowed to accumulate any build-up of dirt, lint, etc. that could restrict free air movement.

ATTENTION!
Screens and louvers should never be cleaned or disturbed while the motor is in operation because any dislodged dirt or debris can be drawn directly into the motor.

(b) If the motor is equipped with air filters, they should be replaced (disposable type) or cleaned and reconditioned (permanent type) at a frequency that is dictated by conditions. It is better to replace or recondition filters too often than not often enough.

(c) Totally enclosed air to air cooled and totally enclosed fan cooled motors require special cleaning considerations. The external fan must be cleaned thoroughly since any dirt build-up not removed can lead to unbalance and vibration. All of the tubes of the air-to-air heat exchanger should be cleaned using a suitable tube brush having synthetic fiber bristles (not wire of any type).

5.5 Maintenance of anti-friction bearings

5.5.1 Frequency of re-lubrication:

The life of grease varies greatly as a result of types of model, revolution speed, temperature, operational conditions etc. It is, therefore, impossible to be precise about replenishment intervals. However, for normal direct coupling transmission, the periods shown as Table 1 may be used as a guide.

Remarks:

(a) The periods shown in Table 1 should be halved where bearings are used for belt drive and/or in dirty or high ambient temperature or high humidity environments.

(b) Please refer to the lubrication nameplate, if attached to the motor.

(c) For bearing numbers outside the range of Table 1, please contact TWMC

(d) If the periods referred to in Table 1 for drive-end bearing and opposite drive-end are different, for the convenience of maintenance operation, please take the shorter one the required grease replenishment period of these bearings.

5.5.1 Kinds of grease:

All motors with ZZ bearings will have SHELL Alvania R3 (lithium base grease). All motors with open bearings will have Polyrex EM (polyurea base grease).
Certain T-frame models will utilize special grease and will be noted on the lubrication nameplate. Please us identical grease or its equivalents when maintaining lubrication schedule.

ATTENTION!
Do not mix different kinds of grease.
Mixing grease with different type of thickeners may destroy its composition and physical properties. Even if the thickeners are of the same type, possible differences in the additive may cause detrimental effects.

5.5.2 Grease quantity

The amount of grease per replenishment depends on the type, size and construction of the bearings. The maximum amount of one replenishment for each bearing is shown in Table 2.

5.5.3 Re-greasing

If re-lubrication is to be performed when the motor is running, stay clear of rotating parts.

It is advisable to re-grease when the motor is running to allow the new grease to be evenly distributed inside the bearing.
Before re-greasing, the inlet fitting should be thoroughly cleaned to prevent any accumulated dirt from being carried into the bearing with the new grease. The outlet of grease drainage should be opened to allow the proper venting of old grease.

Use a grease gun to pump grease through grease nipple into the bearings. After re-greasing, operate the motor for 10-30 minutes to allow any excess grease to vent out.

TABLE 1.

Bearing Number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM	3000 RPM	3600 RPM
62XX 63XX 72XX 73XX	6210										
	12									2000 Hrs.	
	13										
	14									1000 Hrs.	
	15										
	16									720 Hrs.	
	17							2000 Hrs.			
	18			3000 Hrs.							
	20										
	22										
	24							1500 Hrs.			
	26										
	28					2000 Hrs.		1000 Hrs.			
	30										
	32							500 Hrs.			
	34					1500 Hrs.					
	36										
	38			2000 Hrs.		1000 Hrs.					

Bearing Number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM
NU2XX NU3XX	NU214								
	15							2000 Hrs.	
	16								
	17								
	18			3000 Hrs.				1500 Hrs.	
	20								
	22							1000 Hrs.	
	24								
	26					2000 Hrs.			
	28							500 Hrs.	
	30								
	32								
	34			2000 Hrs.		1000 Hrs.			
	36								
	38	2000 Hrs.							
	40								
	44			1000 Hrs.					
	48	1000 Hrs.							

Bearing Number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM
222XX 223XX	22220							300 Hrs.	
	22								
	24		1000 Hrs.			500 Hrs.			
	26								
	28								
	30					300 Hrs.			
	32			500 Hrs.					
	34								
	36								
	38	500 Hrs.							
	40			300 Hrs.					
	44								
	48	300 Hrs.							

TABLE 2.

Bearing No.		Amount of replenishment
62XX 72XX NU2XX 2222XX	6210	30 g
	6212	40
	6213	50
	6214	50
	6215	60
	6216	60
	6217	80
	6218	80
	6220	100
	6222	120
	6224	120
	6226	140
	6228	160
	6230	180
	6232	200
	6234	250
	6236	300
	6238	350
	6240	400
	6244	450
	6248	500

Bearing No.		Amount of replenishment
63XX 73XX NU223XX 223XX	6310	40 g
	6312	60
	6313	80
	6314	80
	6315	100
	6316	100
	6317	120
	6318	120
	6320	160
	6322	220
	6324	270
	6326	300
	6328	400
	6330	450
	6332	500
	6334	600
	6336	700
	6338	800
	6340	900
	6344	900
	6348	900

*Fill new grease until it overflows and the old grease is entirely replaced.

5.5.4 Oil re-lubrication (For oil lubrication types only)

Maintain proper lubrication by checking the oil level periodically and adding oil when necessary. Because of the initial clearing action of the bearing and the expansion of the oil as it comes up to operating temperature, the oil level will be higher after the motor has been in operation for a while than it is with the motor at standstill.

Overfilling should be avoided not only because of the possibility that expansion may force the oil over the oil sleeve and on to the rotor, but also because too high an operating oil level prevents the bearing form clearing itself of excess oil. The resultant churning can cause extra loss, high temperatures, and oxidized oil. If, during operation, the oil level goes above the maximum shown on the sight gauge, drain enough oil to bring the level back within the recommended operating range. **Do not permit the operating level to fall below the minimum shown on the gauge.**

ATTENTION!
Should it ever become necessary to add excessive amount of make-up oil, investigate immediately for oil leaks.

Change the oil at regular intervals. The time between oil changes depends upon the severity of operating conditions and, hence, must be determined by the motor user. Two or three changes a year is typical, but special conditions, such as high ambient temperature, may require more frequent changes. Avoid operating the motor with oxidized oil.

Use only good grade, oxidation-corrosion-inhibited turbine oils produced by reputable oil companies.

The viscosity of the oil to be used depends upon the type and size of the bearings, its load and speed, the ambient temperature, and the amount and temperature of the cooling water (if used)). The lubrication nameplate or instructions with each motor specifies the viscosity range of oil suitable for average conditions. The usual oil viscosity range of oil suitable for average conditions. The usual oil viscosity recommendations are summarized in Table 3. Operation in ambient temperatures that are near or below freezing may require preheating the oil or the use of special oil. Whenever the motor is disassembled for general cleaning and reconditioning, the bearing housing may be washed out with a suitable cleaning solvent. Be sure that the oil-metering hole is clear, and then dry the housing thoroughly before re-assembly, and ensure all traces of cleaning solvent have been removed.

TABLE 3 Oil Viscosity**

Bearing function and location	Bearing Type	Oil Viscosity - SSU	
		@ 100°F	@ 200°F
Thrust Bearing	72XX, 73XX Angular contact ball And/or (62XX, 63XX)	150	45
	Spherical roller	300	53
	Plate (Kingsbury Type)	300	53

**Remark: When a lubrication nameplate attached to the motor, use lubrication oil it stipulates.

5.5.5 Cleaning and installation of bearings

(a) Apply the proper amount of grease to the disassembled parts of the bearing after they have been thoroughly cleaned with high quality cleaning oil. Then protect them from contamination before and during assembly.

(b) Bearing installation

ATTENTION!
Before installing the bearings, make sure that the shaft mounted parts inside the bearings are in place before installation.

Since the bearing is a high precision component, it is important to avoid ingression of dust and foreign matter, and hammering during cleaning and installation. Use extreme care and insure clean conditions during installation and assembly.

ATTENTION!
The best way for bearing installation is heat shrinking. Knocking and hammering during installation should be avoided absolutely.

The bearing should be heated in a bath of clean oil at a temperature of approximately 80°C. After warming, slide the bearings in place quickly and nimbly so that it has not shrunk before being fully in position.
Grease the bearing after the temperature returns to normal, and then reassemble the motor.

5.6 Maintenance of sleeve bearings

5.6.1 Daily inspections

(a) Ensure the volume and quality of lubrication oil are in compliance with specifications.

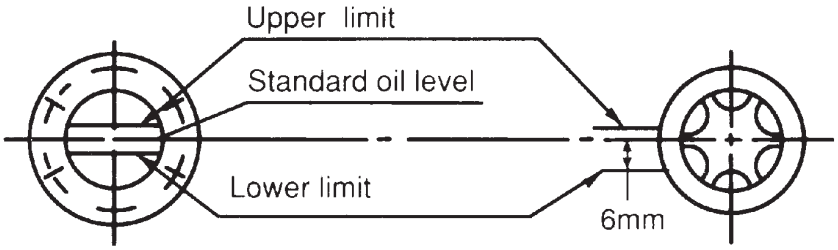


Fig. 12

(b) Ensure there is motion of the oil ring and it is not clamped.

(c) The indicator of the shaft endplay should be restricted within the specified range of the red groove of the shaft or the ±3mm (.118 in.) range of the drive-end shaft shoulder, or the bearing may be damaged.

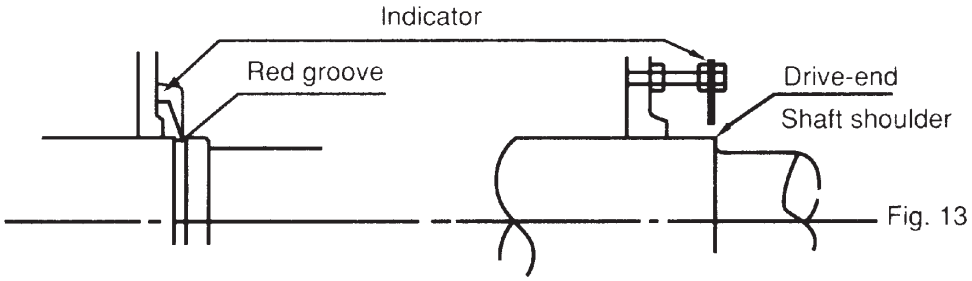


Fig. 13

5.6.2 Regular examination

(a) Periodical change of oil

The oil reservoirs of self (not flood) lubricated bearings should be drained and refilled about every six (6) months. More frequent changes may be needed on high speed (3600 rpm) motors or if severe oil discoloration or contamination occurs. In conditions where contamination does occur, it may be advisable to flush the reservoir with kerosene to remove any sediment before new oil is added. Proper care must be taken to thoroughly drain the reservoir of the flushing material before refilling with the new oil.

Refill the reservoir to the center of oil sight glass with a rust and oxidation inhibited turbine grade oil. Refer to the outline and lubrication nameplate for the correct viscosity.

(b) Quantity of lubrication oil

Please refer to the lubrication nameplate for oil quantity.

(c) Oil viscosity

(d)

ISO	Equivalents	Viscosity (SUS/100°F)
VG32	Esso Teresso 32	150
VG46	Esso Teresso 46	200
VG68	Esso Teresso 68	300

5.6.3 Disassembly

Prior to disassembling, ensure the power supplies are disconnected and there are no moving parts.

The bearing sleeve is of the spherically seated, self-aligning type. The opposite drive end bearing is normally insulated for larger motors (or when specified). On some motors, the insulation is bonded to the spherical seat of the bearing housing.

ATTENTION!
Extreme care must be exercised in removing the bearing sleeve from the insulated support to avoid damaging this insulation.

The following is the recommended procedure for removing the bearing sleeve:

(a) Remove the oil drain plug in the housing bottom and drain the oil sump.

(b) Remove all instrumentation sensors that are in contact with the bearing sleeve. These would include resistance temperature detectors, thermocouples, thermometers, etc..

(c) Remove the socket head bolts holding the bearing cap and the inner air seal. The end cover plate must also be removed if the non-drive end bearing is being disassembled. Remove the bearing cap and top half of the inner air seal. Place them on a clean, dry surface to avoid damage to the parting surfaces.

(d) Remove the top half of the bearing sleeve using suitable eyebolts in the tapped holes provided. Lift the bearing top straight up and avoid any contact with the shoulders of the shaft journals that might damage the thrust faces of the bearing. Place on a clean, dry surface taking care to prevent damage to either the parting surfaces or the locating pins that are captive n the top bearing half.

(e) Remove the screws at the partings in the oil ring and dismantle the ring by gently tapping the dowel pin ends with a soft face mallet. Remove the ring halves and immediately reassemble them to avoid any mix up I parts or damage to the surfaces at the partings.

(f) Pull up on the garter spring surrounding the floating labyrinth seal and carefully slip out the top half. Rotate the garter spring until the lock is visible. Twist counter-clockwise to disengage the lock, remove the garter spring then rotate the lower half of the seal out of the groove in the bearing housing. Note the condition of these floating labyrinth seals. If they are cracked or chipped, they must be replaced. Do not attempt to reuse a damaged seal.

(g) To remove the bottom bearing half, the shaft must be raised a slight amount to relieve pressure on the bearing. On the drive end, this can be done by jacking or lifting on the shaft extension. Protect the shaft. On the non-drive, jacing or lifting can be done using bolts threaded into the tapped holes provided in the shaft end.

(h) Roll the bottom bearing half to the top of the shaft journal and then lift it using suitable eyebolts threaded into the holes provided. Again avoid any contact with the shaft shoulders that could damage the bearing thrust faces. Place the lower bearing half on a clean, dry surface to protect the parting surfaces.

Use extreme care when rolling out the lower bearing half. Keep the hands and fingers well clear of any position where they might be caught by the bearing half if it were accidentally released and rotated back to its bottom position. Serious personal injury could result.

(i) Protect the shaft journal by wrapping it with clean, heavy paper or cardboard.

5.6.4 Re-assembly

Bearing re-assembly is basically a reverse of the disassembly procedures outlined above, with the following suggestions:

(a) The interior of the bearing housing should be cleaned and then flushed with clean oil or kerosene.

(b) The bearing halves and the shaft journal should be wiped clean using lint-free cloth soaked with clean oil.

(c) All parts should be carefully inspected for nicks, scratches, etc., in any contract surfaces. Such imperfections should be removed by an appropriate method such as stoning, scraping, filling, etc., followed by thorough cleaning.

(d) Before installing the floating labyrinth seal halves, observe their condition. Do not attempt to use a cracked or chipped seal. The bottom half seal has a set of drilled holes in its side face. These must be place at the bottom toward the inside of the bearing so that accumulating oil may drain back into the housing.

(e) Put a bead of Curil-T around the seal half O.D.'s on both sides adjacent to the garter spring groove. This will prevent oil by-passing the seal around its outside.

(f) Place the bottom seal half on top of the shaft and roll it into position. Install the top half and insert the garter spring pulling up on both ends to permit engaging the lock. Run a bead of Curil-T around the O.D's on both sides adjacent to the garter spring groove on this half also.

(g) Carefully reassemble the two oil ring halves. Inspect the dowel pins for burrs and straightness and make any corrections required. Do not force the ring halves together. Excessive force may alter the roundness or flatness of the oil ring which can change its oil delivery performance.

(h) Some of the pipe plugs in the housing are metric thread type. These are identified as those, which have a copper, lead, or similar material washer. If these plugs are removed,

be careful not to lose the washers. Before re-assembly, inspect the washers and replace them as required.

(i) Before installing the bearing cap, observe the position of the floating labyrinth seal. The "tab" must be on top to engage the pocket. Failure to position the seal properly will result in damage when the cap is assembled.

ATTENTION!
(1) Curil-T is the only approved compound for use in the assembly of the bearings on this motor. Other products may harden and impede the operation.
(2) During the re-assembly of the bearing parts, a thin layer of Curil-T should be applied to all gaskets and machined interface surfaces. This suggestion does not apply to the machined surfaces of the bearing liner halves.
(3) When seating the bearing shell, apply a thin layer of lube oil at the spherical surface of the liner. Slowly roll the lower bearing liner into the bearing housing making sure that the splinted surface of the liner and the housing are flush. Gradually lower the shaft onto the bearing. The weight of he shaft will help rotate the bearing liner so that the babbitt surface of the liner will match the slope of the journal. Sometimes it is required to use a rubber mallet to tap lightly on the bearing housing while slowly rolling the shaft to help this seating operation.

5.7 Maintenance of slip ring (For Wound Rotor Motors only)

Ensure motor is disconnected from power supplies and there are no accessible moving parts before maintenance operation.

5.7.1 Adjustment of carbon brush

(a) Brush pressure for normal operation:
- Electro-graphite brush…..0.2~0.25 kg/cm²

When frequent vibrations are evident or the brush is small (area below 0.5 cm²), the pressure should be greater than as shown.

(b) Adjustment of brush pressure:
The brush pressure should be adjusted to keep normal operation as it wears.
- The brush pressure may be reduced after use, so it is necessary to re-adjust. For adjustment, please turn adjusting screw, pressure adjusting pin or pressure adjusting plate as shown in Fig. 14 to obtain the correct tension (=0.23 x brush cross sectional area in cm²) ±10% kg.

(c) Brush pressure need not be adjusted if constant force spring is used as shown in Fig. 15 and Fig. 16.

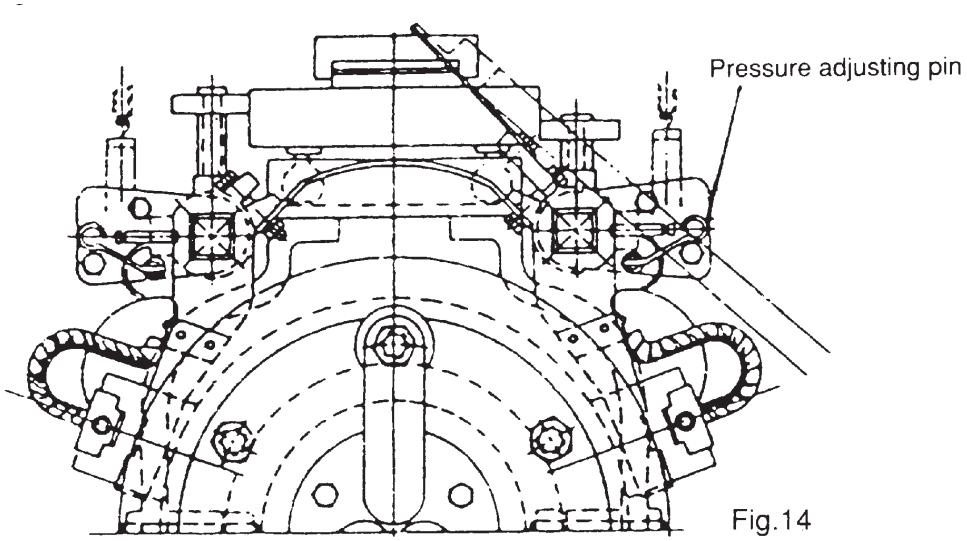


Fig.14

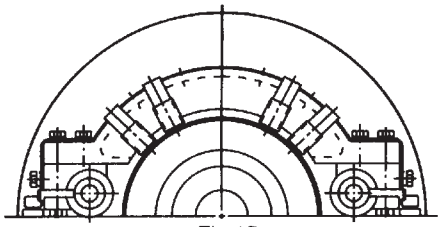


Fig.15

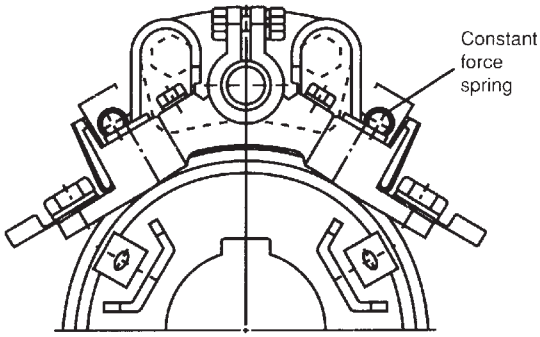


Fig.16

5.7.2 Brush replacement

The carbon brush is a part of the equipment which is easily worn away, replace it after it is worn to ½ ~ ¾ of original size.

(a) Brush material

The brush material is important to the performance of the motor. Only the most appropriate materials are chosen by TWMC, and are listed on the nameplate of the motor. It is important to know this when you replace the brush, so a recommended type is used.

(b) Dimensions

Brush, holder and gap between them, please refer to CNS 2322 C4051 or JIS C2802.

ATTENTION!
The gap between a brush and it holder is important for good performance and safety of the motor.

(c) Adjustment of new brushes (Shown in Fig. 17)

(1) Polish the new brush with a file until is assumes the appropriate contour of the slip ring which it touches.

(2) Place sand-paper (JIS R6252 No. 40…50) on the slip ring with the abrasive face of the paper against the brush to induce a closer contact by rubbing against each other.
(3) Repeat item 2 with fine sand –paper (JIS R6252 No. 100 to 200) until the contact surface between brush and slip ring exceeds 80%.
(4) Finally, clean the contaminated slip ring and brush with clean cloth or compressed air.

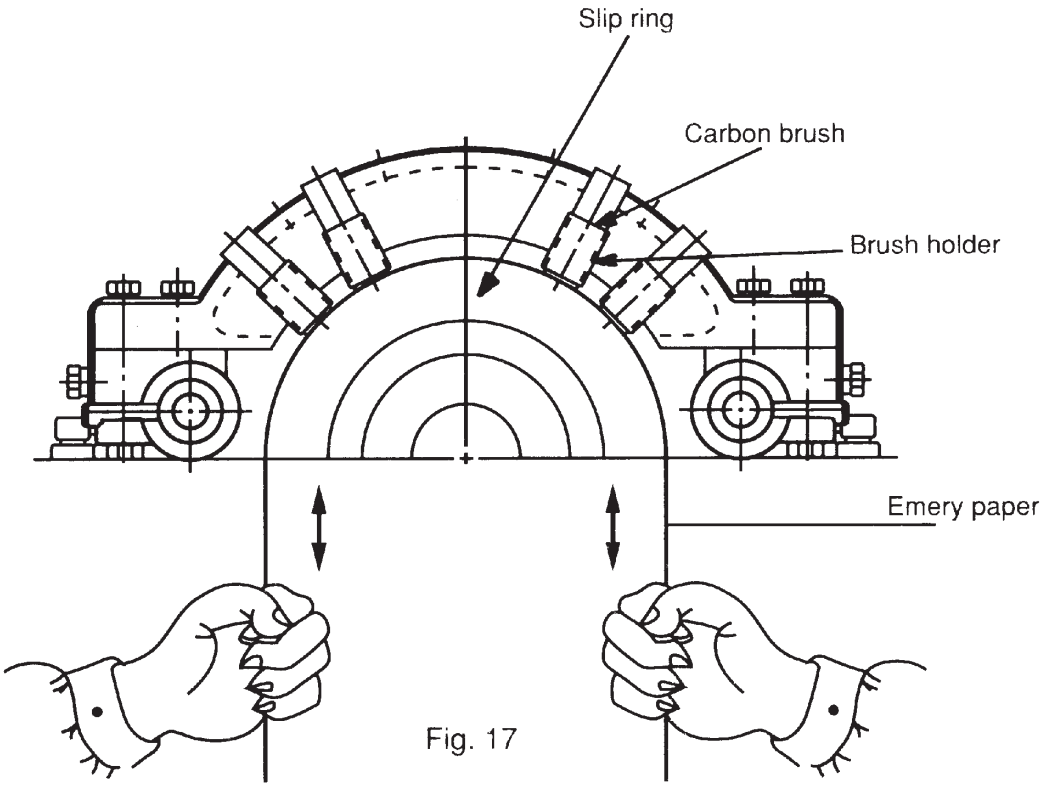


Fig. 17

5.8 Maintenance of non-reverse ratchet mechanism (For Vertical high Thrust Motor only)

5.8.1

In the pump piping system, a check valve and a stop valve should be installed in the discharge line. The check valve, placed between the pump and the stop valve, is to protect the pump from reverse flow and excessive backpressure. The stop valve is used in priming, starting and when shutting down the pump. It is advisable to close the stop valve before stopping the pump. This is especially important when the pump is operated against a high static head.

TWMC vertical high thrust motors are equipped with non-reverse ratchet (N.R.R.) mechanism only when requested by the pump manufacturer. Typical construction of the N.R.R. mechanism is shown as Fig 18 below.

The N.R.R. mechanism keeps the pump and motor from rotating in the reverse direction. Thus prevents damage from over-speeding and damage to water-lubricated pump shaft bearings

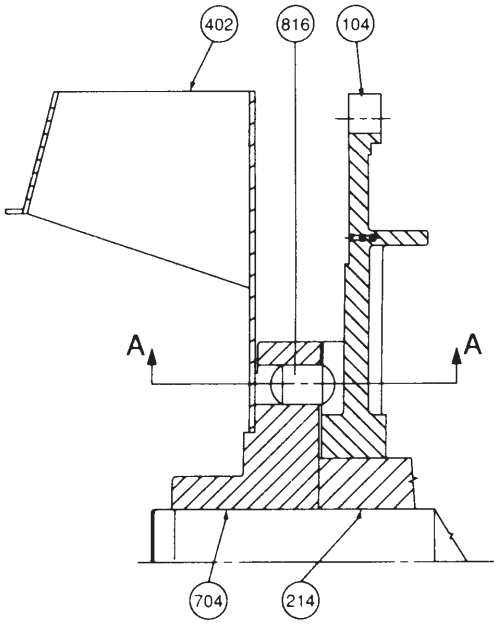
when, on shutdown, the falling water column tends to drive the pump in the reverse direction. In normal operation, the ratchet pins are lifted by the ratchet teeth and are held clear by centrifugal force and friction as the motor comes up to speed. When power is removed, the speed decreases and the pins fall. At the instant of reversal, a pin will catch in a ratchet tooth and prevent backward rotation.

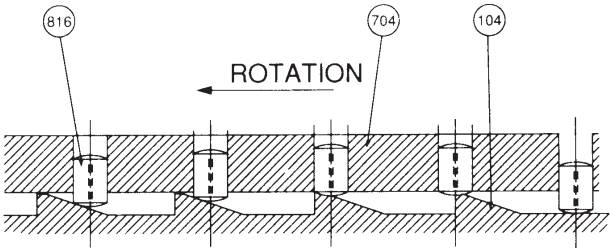
5.8.2

The service life of ratchet pins depends not only on the reverse shock load between the pin and ratchet tooth when pump stopped but also the frequency of pump starting and stopping while in service. Provided that the pins are deformed due to this reverse shock load, then the up and down motion of the ratchet pins could be sluggish or jammed and that unusual noises shall arise.

The recommended replacement period for these ratchet pins is every three (3) years. If the reverse shock load is greater than 30% of motor rated torque or the starting frequency is more than twice per day, then the replacement period should be halved.

ATTENTION!
The check valve and stop valve in the discharge line should be regularly inspected and maintained to assure the normal function of these valves. This is important to protect the pump and motor from damage and increase the service life of the N.R.R. mechanism.





SECTION A-A

ITEM	NAME
104	RATCHET
214	BEARING SEAT
402	EXTERNAL FAN
704	RATCHET PIN CARRIER
816	RATCHET PIN

Fig. 18

6. FAULT FINDING AND RECOGNITION

Kinds of Breakdown	Symptoms	Possible Causes	Remedies
Fail to start without load	Motionless and soundless	Power-off	Consult power company
		Switch-off	Switch-on
		No fuse	Install fuse
		Broken wiring	Check wiring and repair
		Broken lead	Check wiring and repair
		Broken windings	Check windings and repair
	Fuse blowing. (Automatic switch trips off, slow start with electromagnetic noise)	Short circuit of circuit switches	Check circuit switches and replace
		Incorrect wiring	Check wiring according to nameplate
		Poor contact at terminal	Lock tightly
		Windings grounded	Factory repair
		Broken windings	Factory repair
		Poor contact of circuit switches	Check and repair
		Broken wiring	Check and repair
		Poor contact of starting switches	Check and repair
		Short circuit of starting switches	Check and repair
		Incorrect connections of starting switches	Connect according to nameplate
Loading after start	Fuse blowing. Fail to restart due to trip-off of automatic switch	Insufficient capacity of fuse	Replace fuse if wiring permits
		Overload	Lighten load
		High load at low voltage	Check circuit capacity and reduce load
	Overheating motor	Overload or intermittent overload	Lighten load
		Under-voltage	Check circuit capacity and power source
		Over-voltage	Check power source
		Ventilation duct clogged	Remove the foreign matter in the duct
		Ambient temperature exceeds 40°C	Correct insulation class to B or F, or lower ambient temperature
		Friction between rotor and stator	Factory repair
		Fuse blown (Single-phase rotating)	Install the specified fuse
		Poor contact of circuit switches	Check and repair
		Poor contact of circuit starting switches	Check and repair
		Unbalance three-phase voltage	Check circuit or consult power company

Kinds of Breakdown	Symptoms	Possible Causes	Remedies
Loading after start	Speed falls sharply	Voltage drop	Check circuit and powers source
		Sudden overload	Check machine
		Single-phase rotating	Check circuit and repair
	Switch overheat	Insufficient capacity of switch	Replace switch
		High load	Lighten load
	Bearing over-heating	High belt tension	Adjust belt tension
		Slack belt tension	Adjust belt tension
		Misalignment between motor and machine shafts	Re-align
		Over speed of bearing outer-ring	Adjust bracket
		High bearing noise	Replace the damaged bearing
Noise	Electromagnetic noise induced by electricity	Occurrence from its first operation	May be normal
		Sudden sharp noise and smoking	Short circuit of windings should be repaired at the factory
	Bearing noise	Noise of low shishi or Thru-Thru	May be normal
		Kala-Kala as a result of poor lubrication	Grease
		Kulo-Kulo as a result of poor lubrication	Clean bearing and grease
		Sa-Sa or larger noise	Replace the damaged bearing
	Mechanical noise caused by machinery	Loose belt sheave	Adjust key and lock the screw
		Loose coupling or skip	Adjust the position of couplings, lock key and screw
		Loose screw on fan cover	Lock fan cover screw tightly
		Fan rubbing	Adjust fan position
		Rubbing as a result of ingression of foreign matter	Clean motor interior and ventilation ducts
		Wind noise	Noise induced by air flowing through ventilation ducts
		Induced by conveyance machine	Repair machine
Vibration	Electromagnetic vibration	Short circuit of winding	Factory repair
		Open circuit of rotor	Factory repair
	Mechanical vibration	Unbalanced rotor	Factory repair
		Unbalanced fan	Factory repair
		Broken fan blade	Replace fan
		Unsymmetric centers between belt sheaves	Align central points
		Central points of couplings do not lie on the same level	Adjust the central points of couplings to the same level
		Improper mounting installation	Lock the mounting screws
		Motor mounting bed is not strong enough	Reinforce mounting bed

Remarks:

(1) Circuit switches: These include knife switches, electromagnetic switches, fuse and other connection switches etc.

(2) Starting switches: These include Delta-Star starters, compensate starters, reactance starters, resistor starters, starting controller's etc.

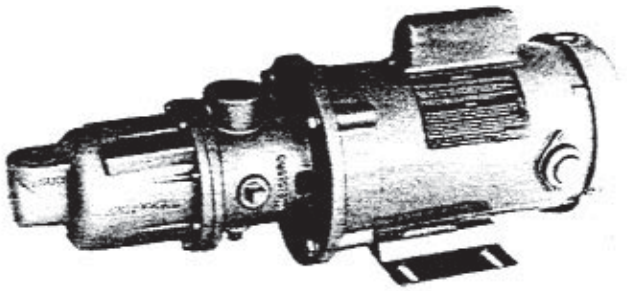
MOYNO

Always the Right Solution™

SERVICE MANUAL
MOYNO® 500 PUMPS
300 SERIES MOTORIZED
331, 332, 333, AND 344 MODELS

DESIGN FEATURES

Housing:	Cast iron/316 SS
Pump Rotor:	Chrome plated AISI 416 stainless steel/Chrome plated 316 stainless steel
Pump Stator:	NBR (Nitrile)
Seal:	Mechanical (carbon/ceramic)
Motor Shaft:	AISI 416 stainless steel/ANSI 316 stainless steel
Motor:	1/2 HP, 60 Hertz, 1725 rpm, totally enclosed, fan cooled (TEFC) C-Faced, 1 phase 115/230V or 3 phase 230/460V (other motor options available; consult sales representative)



Note: Alternate elastomers available. Refer to Repair/Conversion kit numbers pages 3 and 4.

INSTALLATION

Mounting Position. Pump may be mounted in any position. When mounting vertically, it is necessary to keep bearings above seals to prevent possible seal leakage into bearings.

Pre-Wetting. Prior to connecting pump, wet pump elements and mechanical seal by adding fluid to be pumped into suction and discharge ports. Turn pump over several times in a clockwise direction to work fluid into pump elements.

Piping. Piping to pump should be self-supporting to avoid excessive strain on pump housings. See Table 1 for suction and discharge port sizes of each pump model. Use pipe "dope" or tape to facilitate disassembly and to provide seal on pipe connections.

Electrical. Follow the wiring diagram on the motor nameplate or inside the terminal box for the proper connections. The wiring should be direct and conform to local electrical codes. Check power connections for proper voltage. Voltage variations must not exceed ±10% of nameplate voltage. Motor is provided with internal automatic overload protection.

To prevent damage to pump, pump rotation must be clockwise when facing pump from motor end.

OPERATION

Self-Priming. With wetted pumping elements, the pump is capable of 25 feet of suction lift with pipe size equal to port size. Be sure suction lines are air tight or pump will not self prime. Self-priming capabilities will vary due to fluid viscosity.

DO NOT RUN DRY. Unit depends on liquid pumped for lubrication. For proper lubrication, flow rate should be at least 10% of rated capacity.

Pressure and Temperature Limits. See Table 1 for maximum discharge pressure of each model. Unit is suitable for service at temperatures shown in Table 2.

Storage. Always drain pump for extended storage periods by removing bottom drain plug in pump body.

Caution: Suction pressure should never be greater than discharge pressure.

Table 1. Pump Data

Pump Model	Suction Port (NPT)	Discharge Port (NPT)	Voltage Rating (VAC)	Discharge Pressure (psig)
331	3/4	3/4	See Motor Name Plate For Voltage Ratings	150
332	3/4	3/4	See Motor Name Plate For Voltage Ratings	100
333	3/4	3/4	See Motor Name Plate For Voltage Ratings	50
344	3/4	3/4	See Motor Name Plate For Voltage Ratings	†30

†With 3/4 HP motor, pressure is 40 psig.

Table 2. Temperature Limits

Elastomer	Temperature Limits
*NBR	10°-160°F
*EPDM	10°-210°F
*FPM	10°-240°F

*NBR = Nitrile
EPDM = Ethylene-Propylene-Diene Terpolymer
FPM = Fluoroelastomer

TROUBLESHOOTING

WARNING: Before making adjustments, disconnect power source and thoroughly bleed pressure from system prior to disassembly. Failure to do so could lead to electric shock or serious bodily harm.

Failure To Pump.

1. Motor will not start: Check power supply. Voltage must be ± 10% of nameplate rating when motor is in locked rotor condition. Check for faulty capacitor on 1 phase Models.
2. Motor runs and thermally kicks out: Check for excessive discharge pressure. Check for defective centrifugal switch on 1 phase Models. Increase ventilation to motor. Do not use less than #14 wire size.
3. Stator torn; possible excessive pressure: Replace stator, check pressure at discharge port.
4. Flexible joint broken; possible excessive pressure:

   Replace joint, check pressure at discharge port.
5. Wrong rotation (3 phase only): Rotation must be clockwise when facing pump from motor end. Reverse the connections of any two line leads to the motor.
6. Excessive suction lift or vacuum.

Pump Overloads.

1. Excessive discharge pressure: Check pressure at discharge port for maximum ratings given in Table 1.
2. Fluid viscosity too high: Limit fluid viscosity to 100 CP or 500 SSU.

Noisy Operation.

1. Excessive suction lift or vacuum: Maximum suction lift is 25 feet for water.
2. Suction line too small: Check pipe size. Be sure lines are free from obstructions.
3. Pump Cavitates: Pump speed is 1725 rpm. Viscosity of fluid should not exceed 100 CP or 500 SSU.
4. Flexible joint worn: Replace joint. Check pressure at discharge port.
5. Insufficient mounting: Mount to be secure to a firm base. Vibration induced noise can be reduced by using mount pads and short sections of hose on suction and discharge ports.

Seal Leakage.

1. Leakage at startup: If leakage is slight, allow pump to run several hours to let faces run in.
2. Persistent seal leakage: Faces may be cracked from freezing or thermal shock. Replace seal.

Pump Will Not Prime.

1. Air leak on suction side: Check pipe connections.

PUMP DISASSEMBLY

WARNING: Before disassembling pump, disconnect power source and thoroughly bleed pressure from system. Failure to do so could result in electric shock or serious bodily harm.

1. Remove suction and discharge piping. Drain pump body by removing drain plug (261B).
2. Remove screws (112) holding suction housing (2) to discharge housing (1). Remove suction housing (2) and stator (21).
3. Remove rotor (22) from flexible joint (24) by turning counterclockwise (RH thread). On pinned, 3 phase models, remove rotor pin (45) with suitable punch.
4. Flexible joint (24) can be removed from motor shaft by using a 3/16 allen wrench in end of joint and turning counterclockwise. On 3 phase motors, remove motor pin (46) with suitable punch, then remove joint:
5. Slide mechanical seal (69) off motor shaft.
6. Remove discharge housing (1) from adaptor flange (12) by removing screws (1 12B).
7. Carefully pry seal seat out of discharge housing (1). If any parts of mechanical seal are worn or broken, the complete seal assembly should be replaced. Seal components are matched parts and are not interchangeable.
8. Remove adapter flange (12) from motor (70) by removing screws (112A).
9. Remove slinger ring (77).

PUMP ASSEMBLY

1. Install slinger ring (77).
2. Attach adaptor flange (12) to motor housing using screws (112A).
3. Attach discharge housing (1) to adaptor flange (12) using screws (1128). Be sure to center seal bore on shaft.
4. Install mechanical seal (69) in discharge housing (1) using the following procedure:
   a. Clean and oil sealing faces using clean oil (not grease).

Caution: Do not use oil on EPDM parts. Substitute glycerin or soap and water.

   b. Oil outer surfaces of the seal seat, and push assembly over the motor shaft and into the discharge housing (1) seating it firmly and squarely.
   c. After cleaning and oiling the shaft, slide the seal body along the motor shaft until it meets the seal seat.
   d. Install seal spring and spring retainer on shaft.
5. Thread flexible joint (24) into motor shaft in a clockwise direction (RH thread). Tighten with 3/16 allen wrench. On 3 phase models, install motor pin (46).
6. Thread rotor (22) onto flexible joint (24) in a clockwise direction (RH thread). On 3 phase models, install rotor pin (45).
7. Slide stator (21) on rotor (22). On 331 & 332 models, insert rounded end of stator ring (135) into end of stator prior to installing stator on rotor.
8. Secure stator (21) and suction housing (2) to discharge housing (1) using screws (112).
9. Lubricate rotor and stator by filling Suction housing and discharge housing with fluid to be pumped.
10. Connect Suction and discharge piping and power source.

PARTS LIST

To determine part numbers for all parts except standard motors, enter table with item number from pump illustration. Then locate part number under applicable model number (first three digits). Parts listed down the center are applicable to all pump models. To determine part numbers for standard motor (item 70), enter table at item 70 with the last two digits of model number: motor description and part number are on that line.

Item No.	Description	Pump Model Numbers			
		331	332	333	344
1	Discharge Housing	Cast Iron 350-1016-000/Stainless Steel 350-1016-007			
2	Suction Housing	Cast Iron 330-1064-002/Stainless Steel 330-1911-002			
*21	Stator	340-3501-120	340-3502-120	340-3503-120	340-3504-120
*22	Rotor (Threaded) 416 S5	320-2729-000	330-0906-000	320-1394-000	320-1841-000
*22	Rotor (Pinned) 416 SS	320-2729-004	320-4559-004	320-1584-002	320-1569-002
24	Flexible Joint (Threaded)	Carbon Steel 320-1511-000/Stainless Steel 320-3759-000			
240	Flexible Joint (Pinned)	Carbon Steel 320-1612-000/Stainless Steel 320-4415-000			
*45	Shaft Pin (2 req.)	320-4069-002			
*69	Mechanical Seal	320-2424-000			
70	Standard Motor				
	-59 1PH TEFC 1750 RPM	330-4529-000			
	-60 3PH TEFC 1750 RPM, Pin	330-4528-100			
	-52 1PH TEFC 1750 RPM	330-4529-1 00			
	-50 3PH TEFC 1750 RPM	330-4528-003			
77	Slinger Ring	320-6382-000			
112	Screw, Cap (8 req.)	Carbon Steel 619-1430-103 (10-24 x 5/8)/Stainless Steel 619-1432-120 (10-24 x 3/4)			
112A	Screw, Hex Hd (4 req.)	Carbon Steel 619-1530-161 (3/8-16 x 1)/Stainless Steel 320-6715-005 (3/8-16 x 1)			
135	Stator Ring	Carbon Steel 320-7812-000 /Stainless Steel 362-1774-000			
215	Lock Washer (8 req.)	320-6464-000			
215A	Lock Washer (4 req.)	Carbon Steel 623-0010-411/Stainless Steel 320-6717-002			
261	Pipe Plug, 1/4 NPT	Carbon Steel 610-0120-021/Stainless Steel 610-0420-020			
	Rotor (Threaded) 316 SS	320-2933-000	320-2942-000	320-2936-000	320-2934-000
	Rotor (Pinned) 316 SS	320-2933-002			

*Recommended spare parts.
Used on 3 phase models.

REPAIR/CONVERSION KIT NUMBERS

Item No.	Description	All 331 Models (Threaded Only)			All 332 Models (Threaded Only)		
		NBR	EPDM	FPM	NBR	EPDM	FPM
—	Kit No.	311-9026-000	311-9025-000	311-9054-000	311-9027-000	311-9038-000	311-9055-000
21	• Stator	340-3501-120	340-3501-320	340-3501-520	340-3502-120	340-3502-320	340-3502-520
24	• Joint	*320-1511-000	320-6367-000	320-4670-000	*320-1511-000	320-6367-000	320-4670-000
69	• Seal	320-2424-000	320-6379-000	320-6501-000	320-2424-000	320-6379-000	320-6501-000
		All 333 Models (Threaded Only)			All 344 Models (Threaded Only)		
Item No.	Description	NBR	EPDM	FPM	NBR	EPDM	FPM
—	Kit No.	311-9029-000	311-9028-000	311-9056-000	311-9031-000	311-9030-000	311-9057-000
21	• Stator	340-3503-120	340-3503-320	340-3503-520	340-3504-120	340-3504-320	340-3504-520
24	• Joint	*320-1511-000	320-6367-000	320-4670-000	*320-1511-000	320-6367-000	320-4670-000
69	• Seal	320-2424-000	320-6379-000	320-6501-000	320-2424-000	320-6379-000	320-6501-000

NBR = Nitrile
EPDM = Ethylene-Propylene-Diene Terpolymer
FPM = Fluoroelastomer
*Carbon steel joint, for 316 SS joint use 320-3759-000.

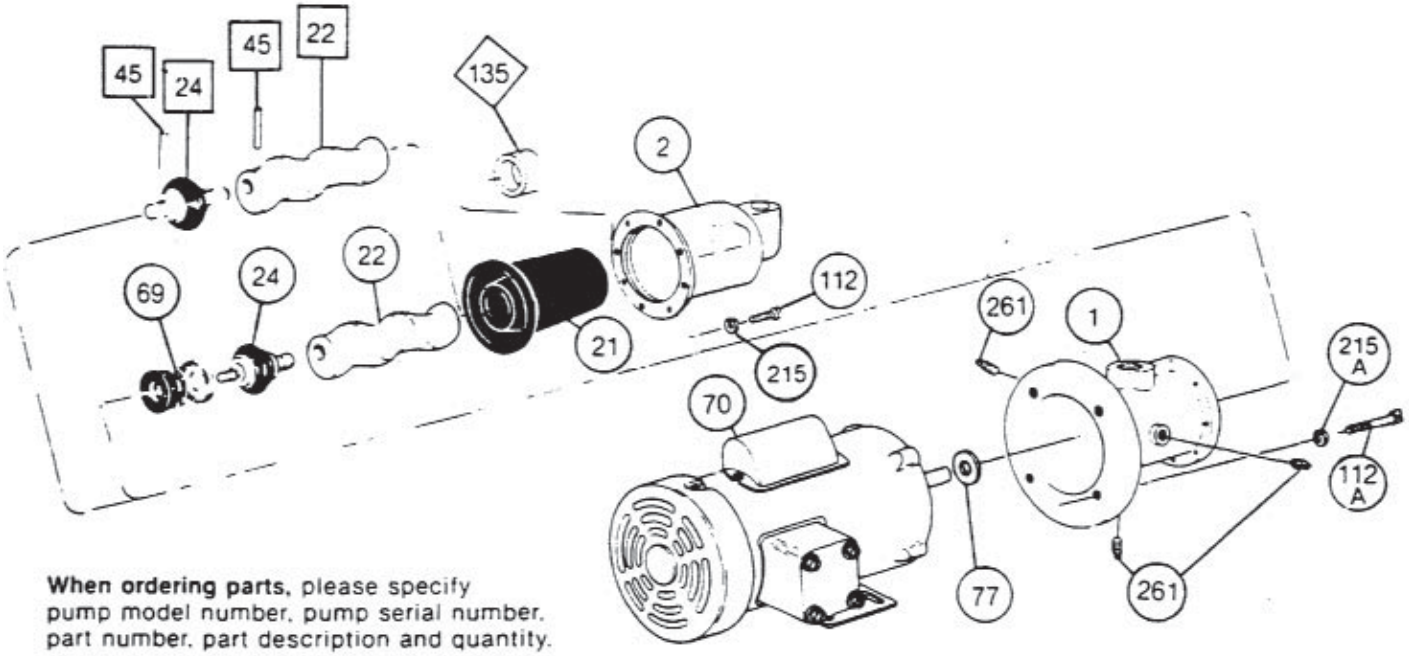
REPAIR/CONVERSION KIT NUMBERS (CONT.)

		All 331 Models (Pinned Only)			All 332 Models (Pinned Only)		
Item No.	**Description**	**NBR**	**EPDM**	**FPM**	**NBR**	**EPDM**	**FPM**
–	Kit No.	311-9104-000	311-9108-000	311-9112-000	311-9105-000	311-9109-000	311-9113-000
21	• Stator	340-3501-120	340-3501-320	340-3501-520	340-3502-120	340-3502-320	340-3502-520
24	• Joint	*320-1612-000	320-6973-000	320-6984-000	*320-1612-000	320-6973-000	320-6984-000
69	• Seal	320-2424.000	320-6379-000	320-6501-000	320-2424-000	320-6379-000	320-6501-000
45	• Pin (2 req.)	320-4069-002			320-4069-002		
		All 333 Models (Pinned Only)			**All 344 Models (Pinned Only)**		
Item No.	**Description**	**NBR**	**EPDM**	**FPM**	**NBR**	**EPDM**	**FPM**
–	• Kit No.	311-9106-000	311-9110-000	311-9114-000	311-9107-000	311-9111~000	311-9115-000
21	• Stator	340-3503-120	340-3503-320	340-3503-520	340-3504-120	340-3504-320	340-3504-520
24	• Joint	*320-1612-000	320-6973-000	320-6984-000	*320-1612-000	320-6973-000	320-6984-000
69	• Seal	320-2424-000	320-6379-000	320-6501-000	320-2424-000	320-6379-000	320-6501-000
45	Pin (2 req.)	320-4069-002			320-4069-002		

ABRASION RESISTANT SEALS

Elastomer	All 331 – 334 Models
NBR	320-6460-000
EPDM	320-6502-000
FPM	320-6503-000

NBR = Nitrile
EPDM = Ethylene-Propylene-Diene Terpolymer
FPM = Fluoroelastomer
*Carbon steel joint, for 316 SS joint use 320-4415-000.



When ordering parts, please specify pump model number, pump serial number, part number, part description and quantity.

◇ Used only on 331 & 332 Models.

□ Used on 3 Phase Models

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Product information presented here reflects conditions at time of publication. Consult factory regarding discrepancies or inconsistencies.

ZOELLER® PUMP COMPANY

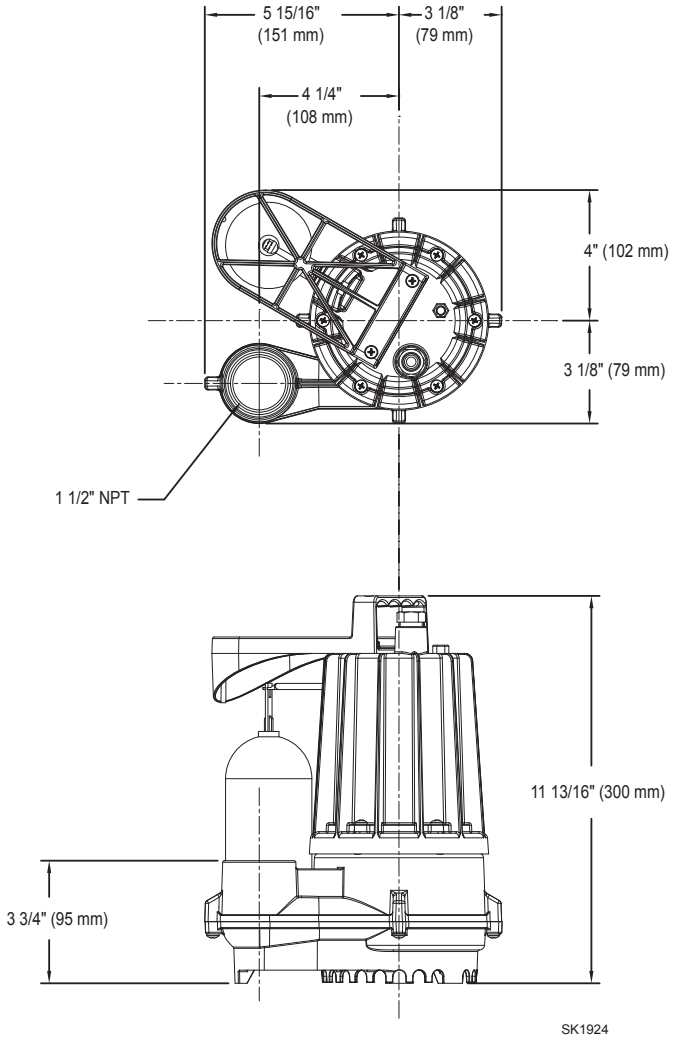
Zoeller Family of Water Solutions™

SECTION: 2.15.030
FM2780
0315
Supersedes
0114

TECHNICAL DATA SHEET
AQUA-MATE SERIES
Model 72 Submersible Dewatering Pump

PRODUCT SPECIFICATIONS

MOTOR	Horse Power	3/10
	Voltage	115
	Phase	1 Ph
	Hertz	60 Hz
	RPM	3400
	Type	Permanent split capacitor
	Insulation	Class B
	Amps	3.1
PUMP	Operation	Automatic or nonautomatic
	Auto On/Off Points	7-3/8" (18.7 cm) / 3-5/8" (9.2 cm)
	Discharge Size	1-1/2" NPT
	Solids Handling	3/8" (9 mm) spherical solids
	Cord Length	9' (3 m) standard
	Cord Type	UL listed, 3-wire, grounded plug
	Max. Head	18' (5.5 m)
	Max. Flow Rate	38 GPM (144 LPM)
	Max. Operating Temp.	110° F (43° C)
	Cooling	Oil free
	Motor Protection	Auto reset thermal overload
MATERIALS	Motor Housing	Engineered plastic
	Pump Housing	Engineered plastic
	Base	Engineered plastic
	Upper Bearing	Ball bearing
	Lower Bearing	Ball bearing
	Mechanical Seals	Carbon and ceramic
	Impeller Type	Non-clogging vortex
	Impeller	Engineered plastic
	Hardware	Stainless steel
	Motor Shaft	410 stainless steel
	Gasket	Buna-N o-ring



NOTE: See model comparison chart for specific details.

Certified to CSA Standard 227875

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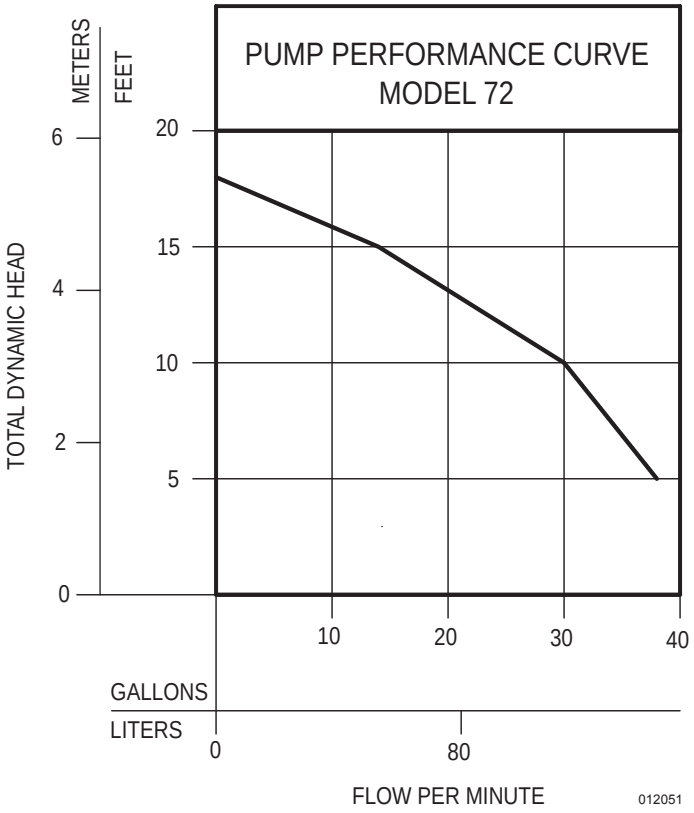
TOTAL DYNAMIC HEAD FLOW PER MINUTE

MODEL		72	
Feet	Meters	Gal.	Liters
5	1.5	38	144
10	3.0	30	114
15	4.6	14	53
Shut-off Head:		18 ft. (5.5 m)	



Model	MODEL COMPARISON										
	Seal	Mode	Volts	Ph	Amps	HP	Hz	Lbs	Kg	Simplex	Duplex
M72	Single	Auto	115	1	3.1	3/10	60	9.5	4.3	1	3
N72	Single	Non	115	1	3.1	3/10	60	9.5	4.3	2	2 & 3
BN72	Single	Non	115	1	3.1	3/10	60	9.5	4.3	*	---

* Single piggyback switch included.

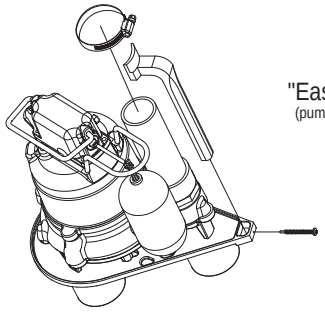
SELECTION GUIDE

1. Integral float-operated mechanical switch, no external control required.
2. Single piggyback variable level float switch or double piggyback variable level float switch. Refer to FM0477.
3. See FM0477 for a residential alternator system.

OPTIONAL PUMP STAND P/N 10-2421

- Reduces potential clogging by debris
- Replaces rocks or bricks under the pump
- Made of durable, noncorrosive ABS
- Raises pump 2" (5 cm) off bottom of basin
- Provides the ability to raise intake by adding sections of 1½" or 2" (DN40 or DN50) PVC piping
- Attaches securely to pump
- Accommodates sump, dewatering and effluent applications

NOTE: Make sure float is free from obstruction.



"Easy assembly"
(pump & discharge pipe not included.)

⚠ CAUTION All installation of controls, protection devices and wiring should be done by a qualified licensed electrician. All electrical and safety codes should be followed including the most recent National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA).

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Notice to installing contractor: Instructions must remain with installation.

Your Peace of Mind is Our Top Priority®

SECTION: 6.10.002
FM2676
1011
Supersedes
New

Product information presented here reflects conditions at time of publication. Consult factory regarding discrepancies or inconsistencies.

Zoeller Family of Water Solutions™

MAIL TO: P.O. BOX 16347 • Louisville, KY 40256-0347
SHIP TO: 3649 Cane Run Road • Louisville, KY 40211-1961
(502) 778-2731 • 1 (800) 928-PUMP • FAX (502) 774-3624

visit our web site: www.zoeller.com

NOTICE: VENT HOLE FOR CHECK VALVE SEE #3 IN CAUTION SECTION BELOW AND #4 ON PAGE 3

INSTALLATION INSTRUCTIONS
RECOMMENDED MODELS

DATE INSTALLED:
MODEL NUMBER:

P/N 151797

EFFLUENT*/SUMP/DEWATERING	SEWAGE
49 / 53 / 57 Series, 98 Series	264 Series
137 Series, 151 / 152 / 153 Series	266 / 267 / 268 Series

PREINSTALLATION CHECKLIST - ALL INSTALLATIONS

1. Inspect your pump. Occasionally, products are damaged during shipment. If the unit is damaged, contact your dealer before using. DO NOT remove the test plugs in the cover nor the motor housing.
2. Carefully read the literature provided to familiarize yourself with specific details regarding installation and use. These materials should be retained for future reference.

▲ WARNING — SEE BELOW FOR LIST OF WARNINGS

1. Make certain that the receptacle is within the reach of the pump's power supply cord. DO NOT USE AN EXTENSION CORD. Extension cords that are too long or too light do not deliver sufficient voltage to the pump motor. But, more important, they could present a safety hazard if the insulation were to become damaged or the connection end were to fall into the sump.
2. Make sure the pump electrical supply circuit is equipped with fuses or circuit breakers of proper capacity. A separate branch circuit is recommended, sized according to the "National Electrical Code" for the current shown on the pump nameplate.
3. Testing for ground. As a safety measure, each electrical outlet should be checked for ground using an Underwriters Laboratory Listed circuit analyzer which will indicate if the power, neutral and ground wires are correctly connected to your outlet. If they are not, call a qualified licensed electrician.
4. For Added Safety. Pumping and other equipment with a 3-prong grounded plug must be connected to a 3-prong grounded receptacle. For added safety the receptacle may be protected with a ground-fault circuit interrupter. When a pump needs to be connected in a watertight junction box, the plug can be removed and spliced to the supply cable with proper grounding. For added safety this circuit may be protected by a ground-fault circuit interrupter. The complete installation must comply with the National Electrical Code and all applicable local codes and ordinances.
5. FOR YOUR PROTECTION, ALWAYS DISCONNECT PUMP FROM ITS POWER SOURCE BEFORE HANDLING. Single phase pumps are supplied with a 3-prong grounded plug to help protect you against the possibility of electrical shock. DO NOT UNDER ANY CIRCUMSTANCES REMOVE THE GROUND PIN. The 3-prong plug must be inserted into a mating 3-prong grounded receptacle. If the installation does not have such a receptacle, it must be changed to the proper type, wired and grounded in accordance with the National Electrical Code and all applicable local codes and ordinances. Three phase pumps require motor starting devices with motor overload protection. See FM0486 for duplex installations.
6. The tank is to be vented in accordance with local plumbing code. Pumps must be installed in accordance with the National Electrical Code and all applicable local codes and ordinances. Pumps are not to be installed in locations classified as hazardous in accordance with National Electrical Code, ANSI/NFPA 70.
7. "Risk of electrical shock" Do not remove power supply cord and strain relief or connect conduit directly to the pump.
8. Installation and servicing of electrical circuits and hardware should be performed by a qualified licensed electrician.
9. Pump installation and servicing should be performed by a qualified person.
10. Risk of electric shock - These pumps have not been investigated for use in swimming pool and marine areas.
11. According to the state of California (Prop 65), this product contains chemicals known to the state of California to cause cancer and birth defects or other reproductive harm.

▲ CAUTION — SEE BELOW FOR LIST OF CAUTIONS

1. Check to be sure your power source is capable of handling the voltage requirements of the motor, as indicated on the pump name plate.
2. The installation of automatic pumps with variable level float switches or nonautomatic pumps using auxiliary variable level float switches is the responsibility of the installing party and care should be taken that the tethered float switch will not hang up on the pump apparatus or pit peculiarities and is secured so that the pump will shut off. It is recommended to use rigid piping and fittings and the pit be 18" or larger in diameter.
3. Information - vent hole purpose. It is necessary that all submersible sump, effluent, and sewage pumps capable of handling various sizes of solid waste be of the bottom intake design to reduce clogging and seal failures. If a check valve is incorporated in the installation, a vent hole (approx. 3/16") must be drilled in the discharge pipe below the check valve and pit cover to purge the unit of trapped air. Trapped air is caused by agitation and/or a dry basin. Vent hole should be checked periodically for clogging. The 53 / 57, and 98 Series pumps have a vent located in the pump housing opposite the float, adjacent to a housing lug, but an additional vent hole is recommended. The vent hole on a High Head application may cause too much turbulence. You may not want to drill one. If you choose not to drill a vent hole, be sure the pump case and impeller is covered with liquid before connecting the pipe to the check valve and no inlet carries air to the pump intake. NOTE: THE HOLE MUST ALSO BE BELOW THE BASIN COVER AND CLEANED PERIODICALLY. Water stream will be visible from this hole during pump run periods.
4. Pump should be checked frequently for debris and/or build up which may interfere with the float "on" or "off" position. Repair and service should be performed by Zoeller Pump Company Authorized Service Station only.
5. Dewatering and effluent sump pumps are not designed for use in pits handling raw sewage.
6. Maximum operating temperature for standard model pumps must not exceed 130°F (54°C).
7. Pump models 266, 267, 268, and 137 must be operated in an upright position. Do not attempt to start pump when tilted or laying on its side.
8. Do not operate a pump in an application where the Total Dynamic Head is less than the minimum Total Dynamic Head listed on the Pump Performance Curves.

NOTE: Pumps with the "UL" mark and pumps with the "US" mark are tested to UL Standard UL778. CSA Certified pumps are certified to CSA Standard C22.2 No. 108.

REFER TO WARRANTY ON PAGE 2.

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E-1131

Limited Warranty

Manufacturer warrants, to the purchaser and subsequent owner during the warranty period, every new product to be free from defects in material and workmanship under normal use and service, when properly used and maintained, for a period of three years from the date of original manufacture. Parts that fail within the warranty period, that inspections determine to be defective in material or workmanship, will be repaired, replaced or remanufactured at Manufacturer's option, provided however, that by so doing we will not be obligated to replace an entire assembly, the entire mechanism or the complete unit. No allowance will be made for shipping charges, damages, labor or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to and there shall be no warranty for any material or product that has been disassembled without prior approval of Manufacturer, subjected to misuse, misapplication, neglect, alteration, accident or act of God; that has not been installed, operated or maintained in accordance with Manufacturer's installation instructions; that has been exposed to outside substances including but not limited to the following: sand, gravel, cement, mud, tar, hydrocarbons, hydrocarbon derivatives (oil, gasoline, solvents, etc.), or other abrasive or corrosive substances, wash towels or feminine sanitary products, etc. in all pumping applications. The warranty set out in the paragraph above is in lieu of all other warranties expressed or implied; and we do not authorize any representative or other person to assume for us any other liability in connection with our products.

Contact Manufacturer at, 3649 Cane Run Road, Louisville, Kentucky 40211, Attention: Customer Service Department to obtain any needed repair or replacement of part(s) or additional information pertaining to our warranty.

MANUFACTURER EXPRESSLY DISCLAIMS LIABILITY FOR SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES OR BREACH OF EXPRESSED OR IMPLIED WARRANTY; AND ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE AND OF MERCHANTABILITY SHALL BE LIMITED TO THE DURATION OF THE EXPRESSED WARRANTY.

Some states do not allow limitations on the duration of an implied warranty, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

EASY DO'S & DON'T'S FOR INSTALLING A SUMP PUMP

1. DO read thoroughly all installation material provided with the pump.
2. DO inspect pump for any visible damage caused by shipping. Contact dealer if pump appears to be damaged.
3. DO clean all debris from the sump. Be sure that the pump will have a hard, flat surface beneath it. DO NOT install on sand, gravel or dirt.
4. DO be sure that the sump is large enough to allow proper clearance for the level control switch(es) to operate properly.
5. DO Always Disconnect Pump From Power Source Before Handling.
   DO always connect to a separately protected and properly grounded circuit.
   DO NOT ever cut, splice, or damage power cord (Only splice in a watertight junction box).
   DO NOT carry or lift pump by its power cord.
   DO NOT use an extension cord with a sump pump.
6. DO install a check valve and a union in the discharge line.
   DO NOT use a discharge pipe smaller than the pump discharge.
7. DO NOT use a sump pump as a trench or excavation pump, or for pumping sewage, gasoline, or other hazardous liquids.
8. DO test pump immediately after installation to be sure that the system is working properly.
9. DO cover sump with an adequate sump cover.
10. DO review all applicable local and national codes and verify that the installation conforms to each of them.
11. DO consult manufacturer for clarifications or questions.
12. DO consider a two pump system with an alarm where an installation may become overloaded or primary pump failure would result in property damages.
13. DO consider a D.C. Backup System where a sump or dewatering pump is necessary for the prevention of property damages from flooding due to A.C. power disruptions, mechanical or electrical problems or system overloading.
14. DO inspect and test system for proper operations at least every three months.

SERVICE CHECKLIST

▲ WARNING ELECTRICAL PRECAUTIONS- Before servicing a pump, always shut off the main power breaker and then unplug the pump - making sure you are wearing insulated protective sole shoes and not standing in water. Under flooded conditions, contact your local electric company or a qualified licensed electrician for disconnecting electrical service prior to pump removal.

▲ WARNING Submersible pumps contain oils which becomes pressurized and hot under operating conditions - allow 2½ hours after disconnecting before attempting service.

CONDITION	COMMON CAUSES
A. Pump will not start or run.	Check fuse, low voltage, overload open, open or incorrect wiring, open switch, impeller or seal bound mechanically, defective capacitor or relay when used, motor or wiring shorted. Float assembly held down. Switch defective, damaged, or out of adjustment.
B. Motor overheats and trips overload or blows fuse.	Incorrect voltage, negative head (discharge open lower than normal) impeller or seal bound mechanically, defective capacitor or relay, motor shorted.
C. Pump starts and stops too often.	Float tight on rod, check valve stuck or none installed in long distance line, overload open, level switch(s) defective, sump pit too small.
D. Pump will not shut off.	Debris under float assembly, float or float rod bound by pit sides or other, switch defective, damaged or out of adjustment.
E. Pump operates but delivers little or no water.	Check strainer housing, discharge pipe, or if check valve is used vent hole must be clear. Discharge head exceeds pump capacity. Low or incorrect voltage. Incorrect motor rotation. Capacitor defective. Incoming water containing air or causing air to enter pumping chamber.
F. Drop in head and/or capacity after a period of use.	Increased pipe friction, clogged line or check valve. Abrasive material and adverse chemicals could possibly deteriorate impeller and pump housing. Check line. Remove base and inspect.

If the above checklist does not uncover the problem, consult the factory - Do not attempt to service or otherwise disassemble pump. Service must be performed by Zoeller Authorized Service Stations. Go to www.zoellerpumps.com/servicestations **to find the Authorized Service Station in your area.**

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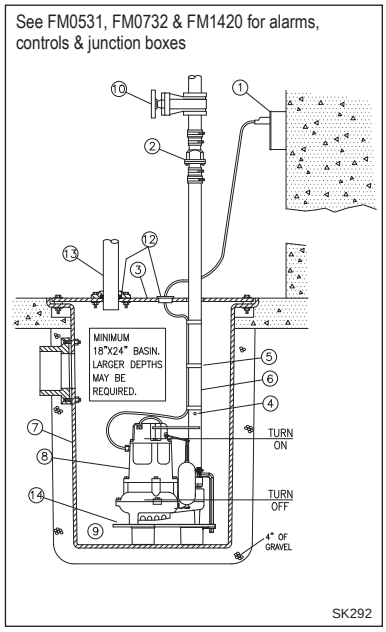
RECOMMENDED INSTALLATION FOR ALL APPLICATIONS

(1) Electrical wiring and protection must be in accordance with National Electrical Code and any other applicable state and local electrical requirements.
(2) Install proper Zoeller unicheck (combination union and check valve), preferably just above the basin to allow easy removal of the pump for cleaning or repair. On sewage, effluent or dewatering, if high head or below cover installation is required use 30-0164 on 1½" pipe, 30-0152 on 2" pipe and 30-0160 on 3" pipe. See (4) below.
(3) All installations require a basin cover to prevent debris from falling into the basin and to prevent accidental injury.
(4) When a Unicheck is installed, drill a 3/16" dia. hole in the discharge pipe even with the top of the pump. *NOTE: THE HOLE MUST ALSO BE BELOW THE BASIN COVER AND CLEANED PERIODICALLY.* (High Head unit see #3 under "Caution" on front page). Water stream will be visible from this hole during pump run periods.
(5) Securely tape or clamp power cord to discharge pipe, clear of the float mechanism(s).
(6) Use full-size discharge pipe.
(7) Basin must be in accordance with applicable codes and specifications.
(8) Pump must be level and float mechanism(s) clear of sides of basin before starting pump.
(9) Basin must be clean and free of debris after installation.
(10) Gate Valve or Ball Valve to be supplied by installer and installed according to any and all codes.
(11) Locate float switches as shown in sketches. The best place for the "off" point is above the motor housing and positioned 180° from the inlet. Never put "off" point below discharge on pump (Sewage & Effluent only). *NOTE: FOR AUTOMATIC PUMPS, USE DEWATERING INSTALLATION SKETCH.*
(12) Gas tight seals required to contain gases and odors.
(13) Vent gases and odors to the atmosphere through vent pipe (Sewage & Dewatering only).
(14) Install Zoeller Pump Stand (Model 10-2421) under pump to provide a settling basin. (Effluent & Dewatering only.)

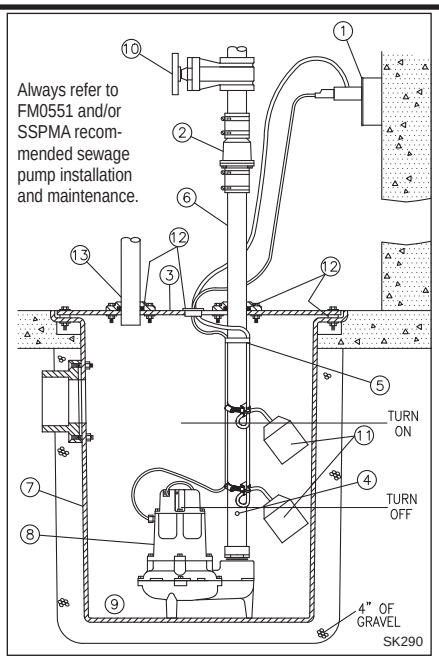
For Effluent Only:

(15) Wire pump to power through a Zoeller watertight junction box or watertight splice. ***NOTE: Watertight enclosure is a must in damp areas. See No. 8 on front page of FM0732.***
(16) Refer to SSPMA Effluent Sizing Manual for determining "on" - "off" switches.
(17) Septic tank risers must be used for easy pump and filter access.

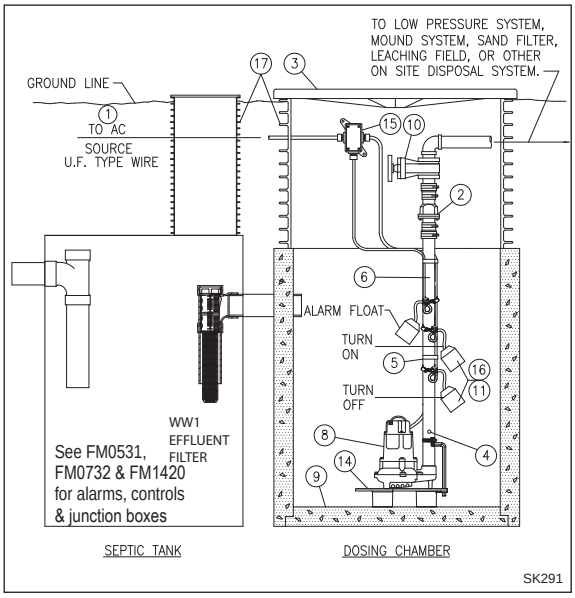
NOTE: Double seal pumps offer extra protection from damage caused by seal failure.



TYPICAL DEWATERING INSTALLATION



TYPICAL SEWAGE INSTALLATION



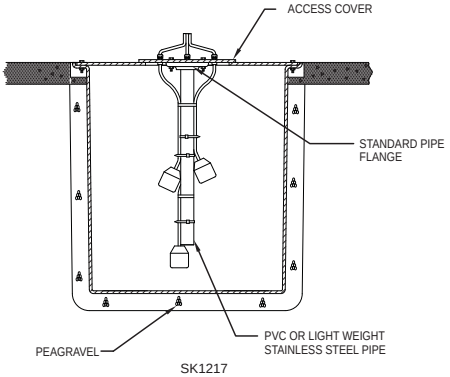
TYPICAL EFFLUENT INSTALLATION

All installations must comply with all applicable electrical and plumbing codes, including, but not limited to, National Electrical Code, local, regional, and/or state plumbing codes, etc. Not intended for use in hazardous locations.

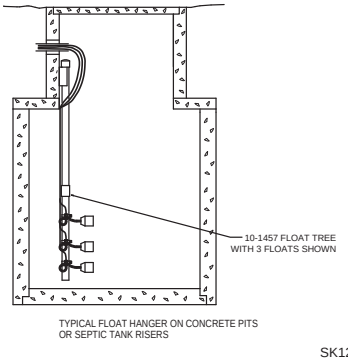
SUGGESTED METHODS OF FLOAT INSTALLATION

On some installations it may be desirable to install an independent hanger for the level control switches to avoid possible hang ups on the pumps, piping, valves, etc. Float hangers are available from Zoeller Company on Catalog Sheet FM0526 or can be fabricated from standard pipe and fittings.

TYPICAL FLOAT HANGER ON STEEL COVER PITS



TYPICAL FLOAT HANGER ON CONCRETE PITS OR SEPTIC TANK RISERS



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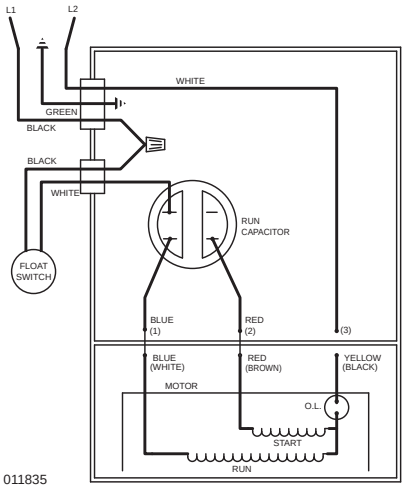
WD & WH MODEL INSTALLATION



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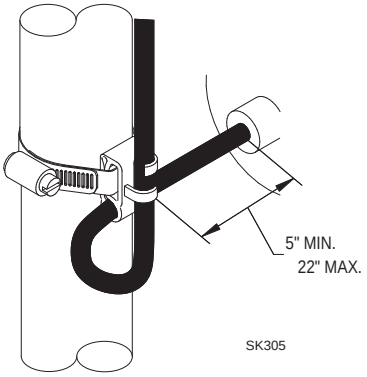
WIRING DIAGRAM FOR MODELS
WD - 230V, 1 Ph, 60 Hz.
WH - 200/208V, 1 Ph, 60 Hz.

Determining Pumping Range in Inches (1 inch - 2.5 cm)

Tether Length	5 min.	10	15	20	22 max.
Pumping Range	9	13.5	18	22	24

Use only as a guide. Due to weight of cable, pumping range above horizontal is not equal to pumping range below horizontal. Ranges are based on testing in nonturbulent conditions. Range may vary due to water temperature and cord shape. As tether length increases, so does the variance of the pumping range.

Models WD & WH are fully automatic. A float switch is included and factory wired in the pump circuit to provide automatic operation once the float switch is secured properly to the outlet pipe. Use the diagram above to secure the float switch properly and obtain the proper tether to customize the on-off cycle to each application.



20 AMP SWITCH (WD & WH MODELS)

Note: Failure to keep within proper tether limits may prevent reliable switch operation.

Note: Cable must be mounted in horizontal position.

SINGLE PHASE WIRING INSTRUCTIONS

▲ WARNING FOR YOUR PROTECTION, ALWAYS DISCONNECT PUMP FROM ITS POWER SOURCE BEFORE HANDLING. Single phase pumps are supplied with a 3-prong grounded plug to help protect you against the possibility of electrical shock. DO NOT UNDER ANY CIRCUMSTANCES REMOVE THE GROUND PIN. The 3-prong plug must be inserted into a mating 3-prong grounded receptacle. If the installation does not have such a receptacle, it must be changed to the proper type, wired and grounded in accordance with the National Electrical Code and all applicable local codes and ordinances.

▲ WARNING "Risk of electrical shock" Do not remove power supply cord and strain relief or connect conduit directly to the pump.

▲ WARNING Installation and checking of electrical circuits and hardware should be performed by a qualified licensed electrician.

▲ WARNING Units supplied without a plug (single and three phase) and single phase nonautomatic units with a 20 amp plug must have a motor control and liquid level control provided at time of installation. The control device should have suitable voltage, ampere, frequency, grounding and horsepower rating for the pump to which it is connected.

THREE PHASE WIRING INSTRUCTIONS

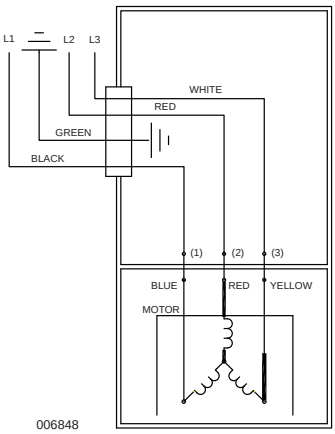
▲ WARNING FOR YOUR PROTECTION, ALWAYS DISCONNECT PUMP FROM ITS POWER SOURCE BEFORE HANDLING.

To automatically operate a nonautomatic three phase pump, a control panel is required. Follow the instructions provided with the panel to wire the system. For automatic three phase pumps see automatic 3 phase wiring diagram located to the far right.

Before installing a pump, check the pump rotation to ensure that wiring has been connected properly to power source, and that the green lead of power cord (See wiring diagram), is connected to a valid ground. Momentarily energize the pump, observing the directions of kick back due to starting torque. Rotation is correct if kick back is in the opposite direction of rotation arrow on the pump casing. If rotation is not correct, switching of any two power leads other than ground, should provide the proper rotation.

All three phase pumps require motor starting devices with motor overload protection. See FM0486 for duplex installations. Pumps must be installed in accordance with the National Electrical Code and all applicable local codes and ordinances. Pumps are not to be installed in locations classified as hazardous in accordance with National Electrical Code, ANSI/NFPA 70.

NONAUTOMATIC 3 PHASE



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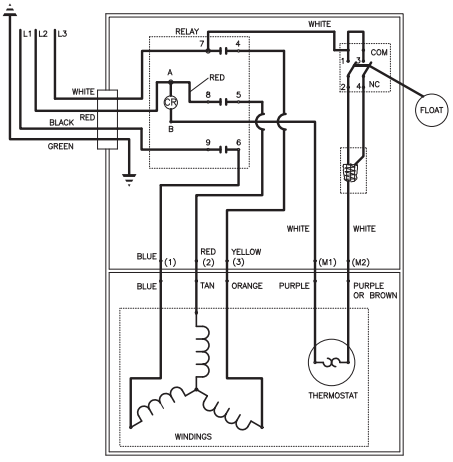
AUTOMATIC 3 PHASE



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IMPORTANT NOTICE: Some insurance policies, both commercial and residential, extend coverage for damages incurred by product failure. You will need to have possession of the product to support your claim in most cases. Zoeller Pump Co. will exchange the unit or refund the original purchase price once the claim is settled with the insurer in the case where you need to retain possession of the product to support a damage claim you submit to your insurance company.

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Aviso al contratista instalador: Las instrucciones deberán permanecer con la instalación.

FM2676S

Su Tranquilidad es Nuestra Prioridad®

La siguiente información sobre este producto refleja las condiciones existentes en la fecha de publicación. Se debe consultar a la fábrica cualquier discrepancia o inconsistencia que existiera.

Zoeller Family of Water Solutions™

ENVIAR CORRESPONDENCIA A: P. O. Box 16347 • Louisville, KY 40256-0347 USA
ENVIAR A: 3649 Cane Run Road • Louisville KY, 40211-1961 USA
+1 (502) 778-2731 • *Fax: +1* (502) 774-3624

Visite nuestro sitio web: www.zoeller.com

FECHA DE INSTALACIÓN:
NÚMERO DE MODELO:

INSTRUCCIONES DE INSTALACIÓN
MODELOS RECOMENDADOS

AVISO: AGUJERO DE VENTILACIÓN PARA LA VÁLVULA DE RETENCIÓN, VEA EL NRO. 3 EN LA SECCIÓN DE PRECAUCIONES A CONTINUACIÓN Y EL NRO. 4 EN LA PÁGINA 3.

EFLUENTES*/SUMIDERO/ACHIQUE	AGUAS CLOACALES
49 / 53 / 57 Series, 98 Series	264 Series
137 Series, 151 / 152 / 153 Series	266 / 267 / 268 Series

LISTA DE VERIFICACIÓN DE PRE-INSTALACIÓN - TODAS LAS INSTALACIONES

1. Inspeccione su bomba. Ocasionalmente, los productos se dañan durante el envío. Si la unidad está dañada, comuníquese con su vendedor antes de usarla. NO quite los tapones de prueba de la cubierta ni del cárter del motor.
2. Lea cuidadosamente toda la literatura provista para familiarizarse con los detalles específicos relacionados con la instalación y uso. Estos materiales deberán guardarse para referencia futura.

▲ ADVERTENCIA

VER ABAJO LA LISTA DE ADVERTENCIAS

1. Asegúrese de que el tomacorriente esté al alcance del cable de alimentación eléctrica de la bomba. NO USE UN CABLE DE EXTENSIÓN. Los cables de extensión que son demasiado largos o livianos no suministran voltaje suficiente al motor de la bomba. Más importante aún, presentan un peligro a la seguridad si el aislante se daña o el extremo de conexión cae dentro del sumidero.
2. Asegúrese de que el circuito de alimentación eléctrica de la bomba esté equipado con fusibles o interruptores de circuito de capacidad adecuada. Se recomienda un circuito auxiliar, del tamaño de acuerdo al "Código Eléctrico Nacional" para la corriente que se muestra en la etiqueta de nombre de la bomba.
3. Prueba de puesta a tierra. Como medida de seguridad, cada tomacorriente debe verificarse para puesta a tierra usando un analizador de circuitos aprobado por el Underwriters Laboratory, el cual indicará si los alambres de energía, neutrales y de puesta a tierra están conectados correctamente a su tomacorriente. Si no lo están, llame a un técnico electricista calificado.
4. Para mayor seguridad. El equipo de bombeo y otro equipo eléctrico con enchufes de 3 patillas deben conectarse a un tomacorriente para 3 patillas con puesta a tierra. Para mayor seguridad, el tomacorriente puede estar protegido con un interruptor de circuito de falla a tierra. Cuando una bomba necesita ser conectada a una caja de conexión hermética, el enchufe puede ser retirado y empalmado al cable de alimentación eléctrica propiamente conectado a tierra. Para mayor seguridad, este circuito puede ser protegido mediante un interruptor de circuito de falla a tierra. La instalación completa deberá cumplir con el Código Eléctrico Nacional y todas las ordenanzas y códigos locales aplicables.
5. PARA SU PROTECCIÓN, SIEMPRE DESCONECTE LA BOMBA DE LA FUENTE DE ALIMENTACIÓN ELÉCTRICA ANTES DE MANIPULARLA. Las bombas monofásicas se suministran con enchufes de 3 patillas con puesta a tierra para ayudar a protegerle contra la posibilidad de choque eléctrico. NO RETIRE BAJO NINGUNA CIRCUNSTANCIA LA CLAVIJA DE PUESTA A TIERRA. Los enchufes de 3 patillas se deben introducir en un tomacorriente para 3 patillas apropiado. Si la instalación no posee un tomacorriente de este tipo, se debe cambiar por uno apropiado, cableado y con puesta a tierra de acuerdo al Código Eléctrico Nacional y a todas las ordenanzas y códigos locales aplicables. Las bombas trifásicas requieren dispositivos de arranque del motor con protección contra sobrecarga. Vea FM0486 para instalaciones duplex.
6. El tanque se debe ventilar conforme a los códigos de plomería locales. Las bombas se deben instalar conforme al Código Eléctrico Nacional y a todos los códigos y ordenanzas locales que correspondan. Las bombas no se deben instalar en sitios peligrosos conforme a la clasificación del Código Eléctrico Nacional, ANSI/NFPA 70.
7. "Riesgo de choque eléctrico". No quite el cable de alimentación eléctrica ni el dispositivo de alivio de tensión y no conecte un conductor directamente a la bomba.
8. La instalación y verificación de los circuitos eléctricos y del equipo deberán llevarse a cabo por un técnico electricista calificado.
9. La instalación y verificación de la bomba deberá llevarse a cabo por una persona calificada.
10. Riesgo de choque eléctrico – No se ha investigado el uso de estas bombas en áreas marinas y en piscinas.
11. Este producto contiene sustancias químicas que de acuerdo al estado de California pueden causar cáncer y defectos congénitos u otros daños a la salud reproductiva.

REFIÉRASE A LA GARANTÍA EN LA PÁGINA 2.

▲ PRECAUCIÓN

VER ABAJO LA LISTA DE PRECAUCIONES

1. Asegúrese de que la fuente de energía eléctrica sea capaz de manejar los requisitos de voltaje del motor, según se indica en la etiqueta de nombre de la bomba.
2. La instalación de bombas automáticas con interruptores de flotador de nivel variable o las bombas no automáticas que usan interruptores de flotador de nivel variable auxiliares es responsabilidad del instalador y deberá verificarse que el interruptor de flotador atado no se enganchará en el aparato de la bomba ni en las peculiaridades del foso y que está fijado de manera que permita la parada de la bomba. Se recomienda usar tubería y empalmes rígidos y que el foso tenga 45 cm (18 pulg.) o más de diámetro.
3. Información - Objetivo del agujero de ventilación. Es necesario que todas las bombas sumer-gibles de sumidero, efluentes y de aguas cloacales capaces de manejar residuos sólidos de varios tamaños tengan la entrada en la parte inferior para reducir el atascamiento y las fallas del sello. Si se incorpora a la instalación una válvula de retención, deberá perforarse un agujero de ventilación [de aprox. 5 mm (3/16 pulg.)] en la tubería de descarga debajo de la válvula de retención y de la tapa del foso a fin de purgar la unidad del aire atrapado. La causa de aire atrapado puede ser agitación y/o un estanque seco. Deberá revisarse periódicamente el agujero de ventilación para verificar que no esté atascado. Las bombas de las series 53, 57 ó 98 poseen una ventilación ubicada en la caja de la bomba del lado opuesto al flotador, junto a una aleta de la caja. Sin embargo, se recomienda un agujero de ventilación adicional. Un agujero de ventilación en una aplicación de carga elevada podría causar demasiada turbulencia. Es posible que usted prefiera no perforar uno. Si decide no perforar un agujero de ventilación, asegúrese de que la caja de la bomba y el impulsor estén cubiertos de líquido antes de conectar la tubería a la válvula de retención y que no haya ningún tipo de entrada de aire en la vía de entrada de la bomba. NOTA: EL AGUJERO TAMBIÉN DEBERÁ ESTAR POR DEBAJO DE LA TAPA DEL SUMIDERO Y SE DEBERÁ LIMPIARLO PERIÓDICAMENTE. Se verá un chorro de agua saliendo del agujero durante los períodos de bombeo.
4. Se debe revisar la bomba frecuentemente para asegurarse de que no hay escombros y/o acumulación que pueda interferir con la posición "on" (encendido) o "off" (apagado) del flotador. La reparación y servicio deberá hacerse solamente por personal de una Estación de servicio autorizada por Zoeller Pump Company.
5. Las bombas de achique y de efluentes no se diseñan para uso en fosos con aguas cloacales crudas.
6. La temperatura de funcionamiento máxima para bombas de modelo estándar no debe superar 54°C (130°F).
7. Las bombas modelos 266, 267, 268, y 137 se deben operar en posición vertical. No intente encender la bomba cuando esté inclinada o apoyada sobre uno de sus lados.
8. No opere la bomba en una aplicación donde la carga dinámica total sea menor que la carga dinámica total mínima que se indica en la Curva de rendimiento de la bomba.

AVISO: Las bombas con la marca "UL" y "US" han sido probadas de acuerdo al estándar UL778. Las bombas "aprobadas por CSA" están certificadas de acuerdo al estándar CSA C22.2 No. 108.

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E-1135

GARANTÍA LIMITADA

El Fabricante garantiza, al comprador y el propietario subsiguiente durante el período de garantía, que cada producto nuevo está libre de defectos en materiales y mano de obra bajo condiciones de uso y servicio normales, cuando se usa y mantiene correctamente, durante un período de tres años a partir de la fecha de fabricación original del producto. Las partes que fallen durante el período de garantía, un año a partir de la fecha de compra por parte del usuario final, lo que ocurra primero, cuyas inspecciones determinen que presentan defectos en materiales o mano de obra, serán reparadas, reemplazadas o remanufacturadas a opción del Fabricante, con la condición sin embargo de que por hacerlo no estemos en la obligación de reemplazar un ensamblaje completo, el mecanismo entero o la unidad completa. No se dará concesión alguna por costos de envío, daños, mano de obra u otros cargos que pudieran surgir por falla, reparación o reemplazo del producto.

Esta garantía no aplica a y no se ofrecerá garantía alguna por ningún material o producto que haya sido desarmado sin aprobación previa del Fabricante, o que haya sido sometido a uso indebido, aplicación indebida, negligencia, alteración, accidente o acto fortuito; que no haya sido instalado, usado o mantenido según las instrucciones de instalación del Fabricante; que haya sido expuesto a sustancias foráneas que incluyen pero no se limitan a lo siguiente: arena, grava, cemento, lodo, alquitrán, hidrocarburos, derivados de hidrocarburos (aceite, gasolina, solventes, etc.), u otras sustancias abrasivas o corrosivas, toallas para lavar o productos sanitarios femeninos, etc. en todas las aplicaciones de bombeo. La garantía presentada en el párrafo anterior deja sin efecto cualquier otra garantía expresa o implícita; y no autorizamos a ningún representante u otra persona para que asuma por nosotros ninguna otra responsabilidad con respecto a nuestros productos.

Comuníquese con el Fabricante en 3649 Cane Run Road, Louisville, KY 40211 EE.UU., Attention: Customer Service Department, para obtener cualquier reparación necesaria o reemplazo de partes o información adicional sobre nuestra garantía.

EL FABRICANTE EXPRESAMENTE RECHAZA RESPONSABILIDAD POR DAÑOS ESPECIALES, EMERGENTES O INCIDENTALES O POR INCUMPLIMIENTO DE LA GARANTÍA EXPRESA O IMPLÍCITA; Y CUALQUIER GARANTÍA IMPLÍCITA DE IDONEIDAD PARA UN FIN PARTICULAR Y DE COMERCIALIZACIÓN SE LIMITARÁ A LA DURACIÓN DE LA GARANTÍA EXPRESA.

Algunos estados no permiten limitaciones en la duración de una garantía implícita, de forma que la limitación anterior podría no aplicar a usted. Algunos estados no permiten la exclusión o limitación de daños incidentales o emergentes, de forma que la limitación o exclusión anterior podría no aplicar a usted.

Esta garantía le otorga a usted derechos legales específicos y podría tener otros derechos que varían de un estado a otro.

LO QUE DEBE Y NO DEBE HACER PARA INSTALAR UNA BOMBA DE SUMIDERO

1. LEA completamente todo el material sobre la instalación provisto con la bomba.
2. INSPECCIONE la bomba para ver si hay cualquier daño visible causado durante el envío. Comuníquese con el vendedor si la bomba está dañada.
3. RETIRE todos los escombros del sumidero. Asegúrese de que la bomba se apoyará sobre una superficie dura, plana y estable. NO LA INSTALE sobre arena, grava o tierra.
4. ASEGÚRESE de que el sumidero sea suficientemente grande para permitir el funcionamiento correcto de los interruptores de control de nivel.
5. SIEMPRE desconecte la bomba de la fuente de alimentación eléctrica antes de manipularla.
   SIEMPRE conecte la bomba a un circuito protegido separadamente y con puesta a tierra adecuado.
   JAMÁS corte, empalme o dañe el cable de alimentación eléctrica. (Empalme únicamente cuando hay una caja de conexión hermética.)
   JAMÁS transporte o levante la bomba por su cable de alimentación eléctrica.
   JAMÁS use un cable de extensión con una bomba de sumidero.
6. INSTALE una válvula de retención y una unión en la tubería de descarga.
   JAMÁS use una tubería de descarga de menor tamaño que la descarga de la bomba.
7. JAMÁS use una bomba de sumidero como una bomba excavadora o para zanjas, ni para bombear aguas cloacales, gasolina u otros líquidos peligrosos.
8. PRUEBE la bomba inmediatamente después de su instalación para asegurarse de que el sistema funciona correctamente.
9. CUBRA el foso con una tapa adecuada para sumidero.
10. EXAMINE todos los códigos nacionales y locales aplicables y verifique que la instalación esté de acuerdo a cada uno de ellos.
11. CONSULTE con el fabricante si necesita aclaraciones o tiene preguntas.
12. CONSIDERE un sistema de dos bombas con alarma en donde la instalación puede sobrecargarse o la falla de una bomba primaria causaría daños a la propiedad.
13. CONSIDERE un sistema de apoyo de CD en donde una bomba de achique o sumidero es necesaria para prevenir daños a la propiedad debido a inundación causada por interrupciones en el suministro de energía eléctrica, problemas mecánicos o eléctricos, o sobrecarga del sistema.
14. INSPECCIONE y pruebe el funcionamiento del sistema por lo menos cada 3 meses.

LISTA DE VERIFICACIÓN DE SERVICIO

▲ ADVERTENCIA PRECAUCIONES ELÉCTRICAS - Antes de proporcionar algún servicio a la bomba, desactive siempre el interruptor principal de suministro de energía eléctrica y desenchufe la bomba. Asegúrese de usar zapatos protectores con suelas aislantes y de no estar parado en el agua. Bajo condiciones de inundación, llame a su compañía eléctrica local o a un técnico electricista calificado para desconectar el servicio eléctrico antes de quitar la bomba.

▲ ADVERTENCIA Las bombas sumergibles contienen aceites que se presurizan y calientan bajo condiciones operativas.
Deje que pasen 2½ horas después de apagarla antes de proceder con el servicio.

CONDICIÓN		CAUSAS COMUNES
A.	La bomba no arranca o no funciona.	Verifique el fusible, voltaje bajo, protección contra sobrecarga abierta, cableado abierto o incorrecto, interruptor abierto, impulsor o sello trabado mecánicamente, capacitor o relé defectuoso, motor o cableado eléctrico en corto circuito. Conjunto del flotador enganchado. Interruptor defectuoso, dañado o fuera de punto.
B.	El motor se sobrecalienta y activa la protección contra sobrecarga o desconecta el fusible.	Voltaje incorrecto, carga negativa (descarga abierta menos de lo normal), impulsor o sello trabado mecánicamente, capacitor o relé defectuoso, motor en corto circuito.
C.	La bomba se encienda y se apaga muy a menudo.	El flotador está apretado en la varilla, la válvula de retención está atascada o no hay una instalada en una línea de larga distancia, protección contra sobrecarga abierta, interruptores defectuosos, foso del sumidero demasiado pequeño.
D.	La bomba no se apaga.	Hay escombros debajo del conjunto del flotador, el flotador o la varilla del flotador están trabados por los lados del foso u otros, interruptor defectuoso, dañado o fuera de punto.
E.	La bomba funciona pero sin o con poca agua.	Verifique la caja del filtro y la tubería de descarga, o si se usa una válvula de retención, el agujero de ventilación debe estar abierto. La carga de descarga excede la capacidad de la bomba. Voltaje bajo o incorrecto. Rotación incorrecta del motor. Capacitor defectuoso. El agua de entrada contiene aire o hace que el aire entre en la bomba.
F.	Caída en la carga y/o capacidad después de un período de uso.	Aumento de fricción en la tubería, línea o válvula de retención atascada. Material abrasivo o productos químicos adversos podrían haber deteriorado el impulsor o el cárter de la bomba. Revise la línea. Quite la base e inspeccione.

Si la lista de verificación arriba mencionada no revela el problema, consulte con la fábrica. No intente proporcionar algún servicio o desarmar la bomba. Las Estaciones de servicio autorizadas por Zoeller deberán proporcionar dicho servicio.
Visite el sitio www.zoellerpumps.com/servicestations para encontrar la estación de servicio autorizada para su zona.

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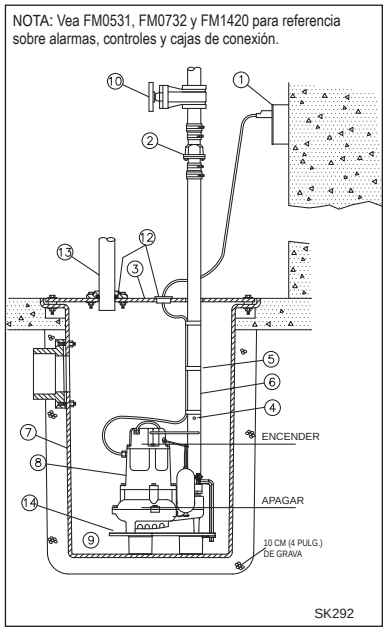
INSTALACIÓN RECOMENDADA PARA TODAS LAS APLICACIONES

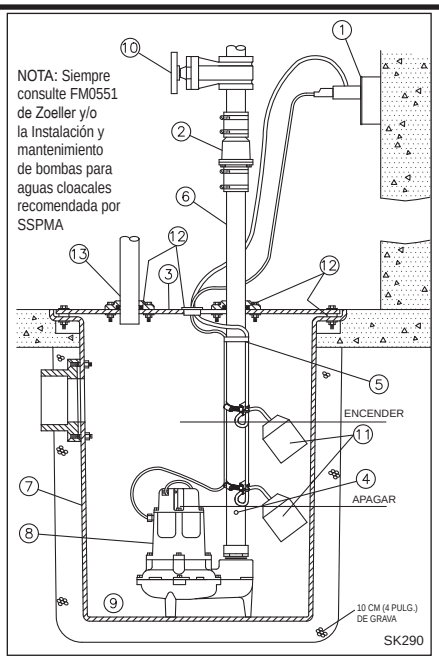
1. El cableado y la protección eléctrica deben estar de acuerdo con el Código Eléctrico Nacional y todos los otros requisitos eléctricos locales y estatales aplicables.
2. Instale el "Unicheck" (combinación de unión y válvula de retención) apropiado de Zoeller, luego arriba del estanque para que se pueda quitar fácilmente la bomba para su limpieza o reparación. Si los sistemas para aguas cloacales, efluentes o achique requieren instalación de carga elevada o por debajo de la tapa, use 30-0164 en tubería de 38 mm (1½ pulg.), 30-0152 en tubería de 51 mm (2 pulg.) y 30-0160 en tubería de 76 mm (3 pulg.). Vea el número 4 más abajo.
3. Todas las instalaciones requieren una tapa para prevenir que escombros caigan dentro del estanque y prevenir lesiones accidentales.
4. Cuando instale un "Unicheck", perfore un agujero de 5 mm (3/16 pulg.) de diámetro en la tubería de descarga al mismo nivel de la parte superior de la bomba. NOTA: EL AGUJERO TAMBIÉN DEBERÁ ESTAR POR DEBAJO DE LA TAPA DEL ESTANQUE Y SE DEBE LIMPIARLO PERIÓDICAMENTE. (Para unidades de carga elevada, ver el número 3 de la lista de "Precauciones" en la página 1.) Se verá un chorro de agua saliendo del agujero durante los períodos de bombeo.
5. Fije firmemente el cable de alimentación eléctrica al tubo de descarga con cinta o abrazadera.
6. Use tubería de descarga de tamaño completo.
7. El estanque debe estar de acuerdo con los códigos y las especificaciones aplicables.
8. La bomba debe estar nivelada y el mecanismo del flotador libre de los lados del estanque antes de encender la bomba.
9. El estanque debe estar limpio y libre de escombros después de la instalación.
10. El instalador deberá suministrar una válvula de paso directo o una válvula de bola y instalarla de acuerdo con cualesquiera y todos los códigos.
11. La ubicación de los interruptores de flotador es como se muestra en el esquema a la izquierda. El punto "off" (apagado) debe estar por encima del cárter del motor y a 180° de la entrada. NOTA: PARA BOMBAS AUTOMATICAS, UTILICE EL ESQUEMA PARA LA INSTALACION PARA ACHIQUE MÁS ABAJO.
12. Los sellos herméticos contra gases son necesarios en todas las instalaciones de aguas cloacales a fin de contener los gases y olores.
13. Ventile los gases y olores a la atmósfera a través del tubo de ventilación. (sólo para cloaca y achique).
14. Instale el soporte para bomba Zoeller (Modelo 10-2421) debajo de la bomba para proporcionar un sumidero de decantación (sólo para efluente y achique).

Para efluente solamente:

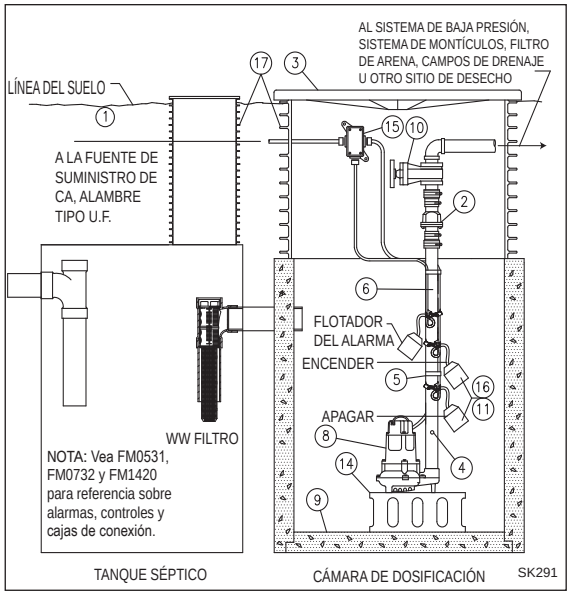
15. La conexión del cableado de la bomba a la fuente de alimentación eléctrica debe hacerse a través de una caja de conexión hermética Zoeller o un empalme hermético. NOTA: La caja hermética es obligatoria en áreas húmedas. Vea FM0732. Vea el número 8 en la página 1.
16. Consulte el Manual sobre tamaños de efluentes del SSPMA para determinar la posición de los interruptores "on-off" (encendido-apagado).
17. Se debe usar tubos verticales en el tanque séptico para tener fácil acceso a la bomba y al filtro.
    NOTA: Las bombas de sello doble ofrecen protección adicional contra los daños causados por falla del sello.



INSTALACIÓN TÍPICA PARA ACHIQUE



INSTALACIÓN TÍPICA PARA AGUAS CLOACALES



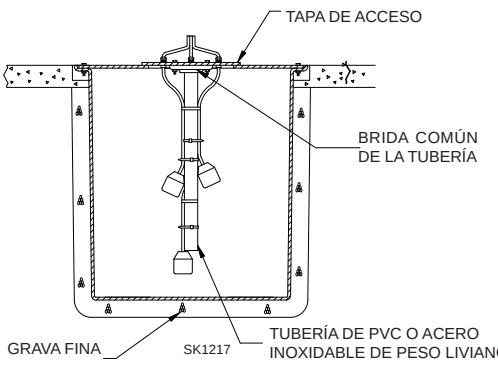
INSTALACIÓN TÍPICA PARA EFLUENTES

Todas las instalaciones deben cumplir con todos los códigos eléctricos y de instalación sanitaria aplicables, incluyendo, pero sin limitarse al Código Eléctrico Nacional, los códigos locales, regionales y/o los códigos estatales de instalación sanitaria, etc. No se debe usar las instalaciones en lugares peligrosos.

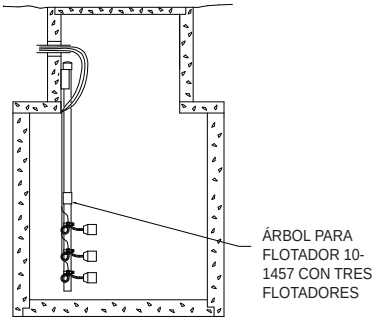
MÉTODOS SUGERIDOS PARA LA INSTALACIÓN DEL FLOTADOR

En algunas instalaciones es deseable instalar un soporte colgante independiente para los interruptores de control de nivel para evitar posibles enganches en las bombas, tubería, válvulas, etc. Los soportes colgantes del flotador se pueden comprar de Zoeller Company según la Hoja de catálogo FM0526, o fabricarse de tubería y empalmes comunes.

SOPORTE COLGANTE PARA FLOTADOR TÍPICO EN FOSOS CON TAPA DE ACERO



SOPORTE COLGANTE PARA FLOTADOR TÍPICO EN FOSOS DE CONCRETO O TUBOS VERTICALES PARA TANQUES SÉPTICOS



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INSTRUCCIONES PARA LA INSTALACIÓN DE LOS MODELOS WD Y WH

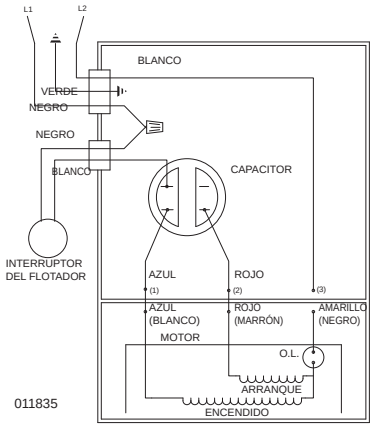


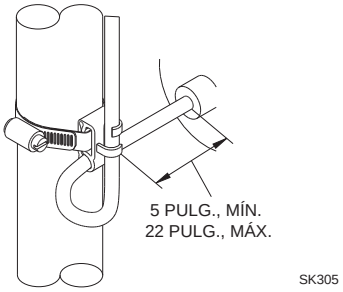
DIAGRAMA DE CABLEADO PARA LOS MODELOS:
WD-230V, 1 FASE, 60 CICLOS
WH-200/208V, 1 FASE, 60 CICLOS

Determinación del rango de bombeo en pulgadas
(1 pulg. = 2,5 cm)

Longitud de la atadura	5	10	15	20	22
	mín.				máx.
Rango de bombeo	9	13.5	18	22	24

Usar solamente como guía. Debido al peso del cable, el rango de bombeo sobre la horizontal no es igual al rango de bombeo debajo de la horizontal. Los rangos se basan en pruebas en condiciones no turbulentas. El rango puede variar debido a la temperatura del agua y a la forma del cable. A medida que aumenta la longitud de la atadura, también aumenta la variación en el rango de bombeo.

Los modelos WD y WH son completamente automáticos. Se incluye un interruptor de flotador con cableado de fábrica en el circuito de la bomba para proveer una operación automática una vez que el interruptor de flotador se haya atado correctamente a la tubería de salida. Use el diagrama de arriba para asegurar correctamente el interruptor de flotador y obtener la atadura apropiada para adecuar el ciclo de encendido-apagado a cada aplicación.



INTERRUPTOR DE 20 AMPERIOS
(MODELOS WD Y WH)

Nota: No tener en cuenta los límites adecuados de la atadura podría alterar el funcionamiento seguro del interruptor.
Nota: El cable debe ser instalado en posición horizontal.

INSTRUCCIONES PARA EL CABLEADO MONOFÁSICO

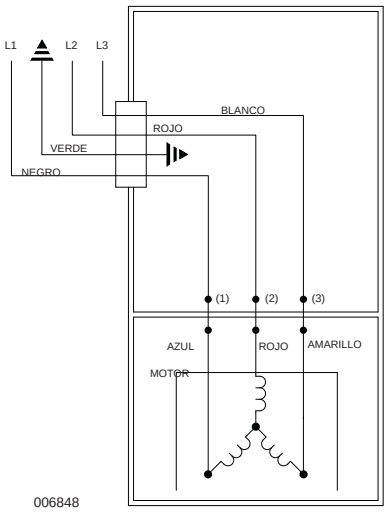
▲ ADVERTENCIA PARA SU PROTECCIÓN, SIEMPRE DESCONECTE LA BOMBA DE LA FUENTE DE ALIMENTACIÓN ELÉCTRICA ANTES DE MANIPULARLA. Las bombas monofásicas se suministran con enchufes de 3 patillas con puesta a tierra para ayudar a protegerle contra la posibilidad de choque eléctrico. NO RETIRE BAJO NINGUNA CIRCUNSTANCIA LA CLAVIJA DE PUESTA A TIERRA. Los enchufes de 3 patillas se deben introducir en un tomacorriente para 3 patillas apropiado. Si la instalación no posee un tomacorriente de este tipo, se debe cambiar por uno apropiado, cableado y con puesta a tierra de acuerdo al Código Eléctrico Nacional y a todas las ordenanzas y códigos locales aplicables.

▲ ADVERTENCIA "Riesgo de choque eléctrico". No quite el cable de alimentación eléctrica ni el dispositivo de alivio de tensión y no conecte un conductor directamente a la bomba.

▲ ADVERTENCIA La instalación y verificación de los circuitos eléctricos y del equipo deberán llevarse a cabo por un técnico electricista calificado.

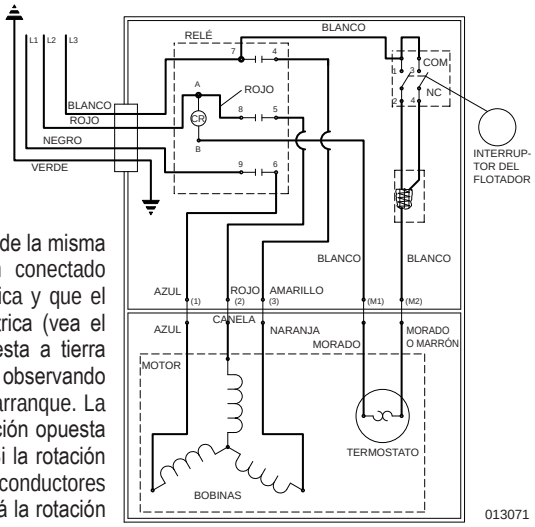
▲ ADVERTENCIA A las unidades que se suministran sin enchufe (monofásico y trifásico) y a las unidades monofásicas no automáticas que poseen un enchufe de 20 amperios se les debe conectar un control de motor y un control de nivel de líquidos durante la instalación. Los niveles de voltaje, amperaje, frecuencia, puesta a tierra y potencia del dispositivo de control deben ser apropiados para la bomba a la cual se conecta.

INSTRUCCIONES PARA EL CABLEADO TRIFÁSICO



Las bombas trifásicas no son automáticas. Para operarlas automáticamente se requiere un panel de control. Siga las instrucciones provistas con el panel para completar el cableado del sistema. Para bombas trifásicas automáticas, ver el diagrama de cableado para bombas trifásicas automáticas a la derecha.

Antes de instalar una bomba, verifique la rotación de la misma para asegurarse de que los cables se hayan conectado correctamente a la fuente de alimentación eléctrica y que el conductor verde del cable de alimentación eléctrica (vea el diagrama de cableado) está conectado con puesta a tierra adecuada. Active momentáneamente la bomba, observando la dirección del retroceso debido a la torsión de arranque. La rotación es correcta si el retroceso está en dirección opuesta a la flecha de rotación en la caja de la bomba. Si la rotación no es correcta, cambiar dos de cualquiera de los conductores eléctricos, excepto el con puesta a tierra, proveerá la rotación apropiada.



Todas las bombas trifásicas requieren dispositivos de arranque del motor con protección contra sobrecarga. Vea FM0514 para instalaciones simplex o FM0486 para instalaciones duplex. Las bombas se deben instalar de acuerdo al Código Eléctrico Nacional y a todas las ordenanzas y códigos locales aplicables. Las bombas no se deben instalar en sitios clasificados como peligrosos según el Código Eléctrico Nacional ANSI/NFPA 70.

▲ ADVERTENCIA PARA SU PROTECCIÓN, SIEMPRE DESCONECTE LA BOMBA DE LA FUENTE DE ALIMENTACIÓN ELÉCTRICA ANTES DE MANIPULARLA.

AVISO IMPORTANTE: Ciertas pólizas de seguro, tanto comerciales como residenciales, extienden la cobertura a los daños causados por la falla del producto. En la mayoría de los casos, usted deberá conservar el producto para respaldar su reclamo. Zoeller Pump Co. reemplazará la unidad o reembolsará el precio de compra original una vez que la compañía de seguros liquide el reclamo, en el caso de que usted necesite conservar el producto para respaldar un reclamo por daños que le haya presentado a su compañía de seguros.

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E-1138

Avis à l'installateur - Les instructions doivent rester avec l'installation.

FM2676F

Que vous dormiez en paix est notre priorité®

Les renseignements présentés ici reflètent les conditions au moment de la publication. Consulter l'usine en cas de contradiction ou d'inconsistance.

Zoeller Family of Water Solutions™

ADRESSE POSTALE : P.O. BOX 16437 • Louisville, KY 40256-0347 USA
ADRESSE PHYSIQUE : 3649 Cane Run Road • Louisville, KY 40211-1961 USA
TÉL : +1 (502)778-2731 • FAX +1 (502) 774-3624

www.zoeller.com

AVIS : TROU D'ÉVENT POUR LE CLAPET DE SÉCURITÉ VOIR N° 3 CI-DESSOUS ET N° 4 PAGE 3.

DATE D'INSTALLATION :
NUMÉRO DE MODÈLE :

INSTRUCTIONS D'INSTALLATION
MODÈLES RECOMMANDÉS

EFFLUENTS* / PUISARD / ASSÈCHEMENT	ÉGOUT
Série 49 / 53 / 57	Série 264
Série 137, Série 151 / 152 / 153	Série 266 / 267 / 268

LISTE DE VÉRIFICATIONS AVANT L'INSTALLATION - TOUTES LES INSTALLATIONS

1. Inspecter la pompe. De temps en temps, la pompe est endommagée en cours d'expédition. Si la pompe est endommagée, contacter le distributeur avant de l'utiliser. NE PAS enlever les bouchons test du couvercle ni du compartiment moteur.
2. Il faut lire attentivement tous les documents fournis pour se familiariser avec les détails spécifiques de l'installation et de l'utilisation. Il faut conserver ces documents pour pouvoir les consulter ultérieurement.

⚠ AVERTISSEMENT — **VOIR PLUS BAS POUR LA LISTE DES AVERTISSEMENTS**

1. Il faut vérifier que la prise est à portée du cordon d'alimentation de la pompe. NE PAS UTILISER DE RALLONGE. Les rallonges trop longues ou de trop faible capacité ne fournissent pas la tension nécessaire au moteur de la pompe, mais, encore plus important, elles peuvent être dangereuses si l'isolant est endommagé ou si l'extrémité avec le branchement tombe dans un endroit humide ou mouillé.
2. **Vérifier que le circuit d'alimentation de la pompe est équipé de fusibles ou de disjoncteurs de capacité appropriée.** Il est recommandé d'installer un circuit indépendant de capacité suffisante, conforme aux codes électriques nationaux pour la capacité indiquée sur la plaque d'identification de la pompe.
3. **Vérification de la mise à la terre.** Pour des raisons de sécurité, il faut vérifier la terre de chaque prise électrique en utilisant un analyseur de circuit sur la liste d'Underwriters Laboratory qui indique si les fils de phase, de neutre et de terre de la prise sont branchés correctement. S'ils ne sont pas branchés correctement, appeler un électricien agréé qualifié.
4. Pour des raisons de sécurité, les pompes et autre équipement équipés d'un fil à trois broches, avec mise à la terre, doivent être branchés sur une prise à trois broches. Pour des raisons de sécurité, la prise doit être protégée par un disjoncteur différentiel. Quand la pompe est branchée dans un boîtier de branchement étanche, il est possible d'enlever la fiche et de faire le branchement directement sur l'alimentation avec mise à la terre appropriée. Pour des raisons de sécurité, ce circuit peut être protégé par un disjoncteur différentiel. L'installation doit être conforme au code national d'électricité et tous les règlements locaux.
5. POUR DES RAISONS DE SÉCURITÉ, IL FAUT TOUJOURS DÉBRANCHER L'ALIMENTATION DE LA POMPE AVANT DE LA MANIPULER. Les pompes monophasées sont équipées d'un cordon avec fiche à trois broches de mise à terre pour protéger contre les électrocutions. IL NE FAUT JAMAIS ENLEVER LA BROCHE DE MISE À TERRE. Il faut brancher la fiche à trois broches dans une prise à trois broches de mise à terre. Si le circuit n'est pas équipé d'une telle prise, il faut en installer une en respectant le code national d'électricité et toute la législation et réglementation locales en vigueur. Les pompes triphasées doivent être équipées d'un dispositif de mise en marche avec protection thermique du moteur. Consulter la norme FM0486 pour les installations duplex.
6. La ventilation du réservoir doit être conforme au code de plomberie local. Les pompes doivent être installées conformément au code national d'électricité et à toute la législation et réglementation locales en vigueur. Les pompes ne doivent pas être installées dans des endroits classifiés à risque, conformément à la norme ANSI/NFPA 70 du Code national américain de l'électricité.
7. Risque d'électrocution. Ne pas enlever le cordon d'alimentation ni le distributeur de tension mécanique, ni brancher le conduit directement à la pompe.
8. L'installation et la vérification de l'équipement électrique doivent être faites par un électricien qualifié.
9. L'installation et la vérification de la pompe doivent être faites par une personne qualifiée.
10. Risque d'électrocution. L'usage de ce type de pompe dans une piscine de natation et des zones marines n'a pas été étudié.
11. Ce produit contient des produits chimiques dont l'état de la Californie a déterminer comme étant la cause de cancer et de déficiences à la naissance ou autres dommages reproductifs.

⚠ MISE EN GARDE — **VOIR PLUS BAS POUR LA LISTE DES MISES EN GARDE**

1. Vérifier que le circuit d'alimentation a une capacité suffisante pour alimenter le moteur, comme indiqué sur la pompe ou sur la plaque d'identification de l'appareil.
2. L'installateur est responsable de l'installation des pompes automatiques avec des interrupteurs à niveau variable ou des pompes non-automatiques utilisant des interrupteurs auxiliaires à niveau variable et il doit s'assurer que l'interrupteur à flotteur est installé fermement pour qu'il n'accroche pas à la pompe ni au puits pour permettre l'arrêt de la pompe. Il est recommandé d'utiliser du tuyau et des raccords rigides et le puits doit avoir un diamètre supérieur à 45 cm (18").
3. Renseignements sur le trou d'évent. Il est nécessaire que la pompe submersible, les pompes à effluents et d'égout capables de passer des solides de différentes tailles aient leur alimentation à la base pour réduire le colmatage et la défaillance des joints. Si l'installation comprend un clapet de sécurité, il faut percer un trou d'évent d'environ 5 mm (3/16") dans le tuyau de refoulement au-dessous du clapet de sécurité et le couvercle pour purger l'air de l'appareil. L'air emprisonné est causé par l'agitation et / ou un puits sec. Il faut vérifier périodiquement que le trou d'évent n'est pas colmaté. Les carters de pompe de la série 53 / 57 et 98 sont équipés d'un trou d'évent à l'opposé du flotteur, près du goujon du carter, du goujon du carter, mais un trou d'évent est recommandé. Le trou d'évent de l'application à une hauteur de refoulement dynamique élevée peut causer une turbulence trop élevée. Il peut être désirable de ne pas le percer. S'il est décidé de ne pas percer de trou d'évent, il faut s'assurer que le carter et le rotor de la pompe sont couverts de liquide avant de brancher le tuyau sur le clapet anti-retour et qu'aucune conduite d'aspiration n'amène de l'air à l'admission de la pompe. REMARQUE - LE TROU DOIT AUSSI ÊTRE AU-DESSOUS DU COUVERCLE DU PUITS ET IL FAUT LE NETTOYER RÉGULIÈREMENT. Un jet d'eau sera visible de cette orifice durant les périodes de fonctionnement de la pompe.
4. Il faut vérifier fréquemment qu'il n'y a pas de débris ni d'accumulation pouvant interférer avec le déplacement du flotteur de marche / arrêt. Les réparations ne doivent être faites que par un centre de réparation agréé par Zoeller Pump Company.
5. Les pompes d'assèchement mécanique et d'effluents sont conçues pour pompage d'eau usée non traitée dans un puits.
6. La température de fonctionnement maximale d'une pompe standard ne peut pas être plus de 54°C (130°F).
7. Il faut utiliser les pompes modèles 266, 267, et 137 en position verticale. Il ne faut pas essayer de mettre la pompe en marche quand elle est inclinée ou couchée sur le côté.
8. Il ne faut pas faire fonctionner la pompe dans une application où la hauteur de refoulement dynamique est inférieure à la hauteur de refoulement dynamique minimale donnée dans les courbes de refoulement et de capacité.

REMARQUE - Les pompes avec annotations "UL" et "US" sont vérifiées d'après la norme UL778. Les pompes certifiées CSA sont vérifiées d'après la norme C22.2 no 108.

SE RÉFÉRER À LA GARANTIE EN PAGE 2.

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GARANTIE LIMITÉE

Le fabricant garantit à l'acheteur et au propriétaire ultérieur pendant la période de garantie, tout produit neuf contre tout vice de matériel et de main-d'œuvre, en utilisation normale et quand utilisé et entretenu correctement, pendant une période de 3 ans de la date de fabrication initiale. Les pièces devenant défectueuses pendant la période de garantie, et que des inspections prouvent contenir des vices de fabrication ou de main-d'œuvre, seront réparées, remplacées ou rénovées au choix du Fabricant, à condition qu'en faisant cela nous ne soyons pas obligés de remplacer l'ensemble, le mécanisme complet ou l'appareil complet. Aucune provision n'est faite pour les frais d'expédition, les dégâts, la main-d'œuvre ni d'autres frais causés par la défaillance, la réparation ou le remplacement du produit.

Cette garantie ne s'applique pas et ne couvre aucun matériel ou produit qui a été démonté sans l'autorisation préalable du Fabricant, soumis à un usage abusif, des applications incorrectes, de la négligence, des modifications, des accidents ou un cas de force majeure ; qui n'a pas été installé, utilisé ou entretenu selon les instructions d'installation du Fabricant; qui a été exposé, y compris, mais non de façon limitative, à du sable, des gravillons, du ciment, de la boue, du goudron, des hydrocarbures ou des dérivés d'hydrocarbures (huile, essence, solvants, etc.) ou à d'autres produits abrasifs ou corrosifs, serviettes ou produits d'hygiène féminine etc., dans toutes les applications de pompage. La garantie mentionnée ci-dessus remplace toutes les autres garanties expresses ou implicites et nous n'autorisons aucun représentant ou autre personne à accepter la responsabilité en notre nom pour nos produits.
Prendre contact avec le Fabricant, 3649 Cane Run Road, Louisville, KY 40211, à l'attention du Service à la Clientèle, pour obtenir des réparations, des pièces de remplacement ou des renseignements supplémentaires concernant la garantie.

LE FABRICANT REFUSE EXPRESSÉMENT TOUTE RESPONSABILITÉ POUR LES DÉGÂTS SPÉCIAUX, INDIRECTS OU SECONDAIRES OU POUR LES RUPTURES DE GARANTIE EXPRESSES OU IMPLICITES; ET TOUTE GARANTIE IMPLICITE D'APPLICABILITÉ À UNE UTILISATION SPÉCIFIQUE OU DE COMMERCIALITÉ EST LIMITÉE À LA DURÉE DE LA GARANTIE EXPRESSE.

Certaines provinces ne permettent pas les limitations de la durée de la garantie implicite et il est possible que cette limitation ne s'applique pas. Certaines provinces ne permettent pas l'exclusion ou la limitation des dégâts secondaires ou indirects, et il est possible que cette limitation ou exclusion ne s'applique pas.

Cette garantie vous donne des droits spécifiques reconnus par la loi et vous pouvez également avoir d'autres droits qui varient d'une province à l'autre.

CONSEILS POUR L'INSTALLATION D'UNE POMPE DE PUISARD

1. IL FAUT lire toutes les instructions d'installation fournies avec la pompe.
2. IL FAUT vérifier que les appareils n'ont pas été endommagés en cours d'expédition. Contacter le distributeur si la pompe a été endommagée.
3. IL FAUT nettoyer tous les débris dans le puisard. Vérifier qu'il y a une surface dure et plate à l'emplacement désiré pour la pompe. NE PAS installer la pompe sur du sable, du gravier ou de la terre.
4. IL FAUT vérifier que le puisard est assez large pour avoir de l'espace suffisant pour le bon fonctionnement des interrupteurs de commande de niveau.
5. IL FAUT toujours débrancher l'alimentation de la pompe avant de la manipuler.
   IL FAUT toujours brancher la pompe sur un circuit séparé mis à la terre.
   IL NE FAUT JAMAIS couper, faire une épissure ou endommager un cordon d'alimentation. (Pour faire une raccordement, il faut utiliser un boîtier de raccordement étanche.
   IL NE FAUT PAS utiliser le cordon d'alimentation pour transporter ou soulever la pompe.
   IL NE FAUT PAS utiliser de rallonge pour une pompe de puisard.
6. IL FAUT installer un clapet de sécurité et un raccord sur la conduite de refoulement. IL NE FAUT PAS utiliser une conduite de refoulement de diamètre inférieur à celui du refoulement de la pompe.
7. IL NE FAUT PAS utiliser une pompe de puisard comme pompe de tranchée ou d'excavation, ou pour pomper des égouts, de l'essence ou tout autre liquide dangereux.
8. IL FAUT essayer la pompe immédiatement après l'installation pour être certain que le système fonctionne correctement.
9. IL FAUT recouvrir la pompe de puisard d'un couvercle de puisard approprié.
10. IL FAUT étudier tous les codes locaux et nationaux applicables et vérifier que l'installation est conforme.
11. IL FAUT consulter le fabricant pour obtenir des clarifications ou des réponses aux questions.
12. IL FAUT considérer un système à deux pompes avec une alarme quand l'installation peut être surchargée ou si une défaillance de la pompe primaire causait des dégâts importants.
13. IL FAUT considérer un système de secours en courant alternatif quand une pompe de puisard ou d'séchage mécanique est nécessaire pour éviter des dégâts matériels en cas d'inondation à la suite d'une panne d'alimentation secteur, de problème mécanique ou électrique ou de surcharge du système.
14. IL FAUT inspecter le système et vérifier son fonctionnement au moins tous les trois mois.

LISTE DE VÉRIFICATIONS POUR L'ENTRETIEN

AVERTISSEMENT PRÉCAUTIONS AVEC LE SYSTÈME ÉLECTRIQUE – Avant de réparer la pompe, il faut toujours ouvrir le circuit et débrancher la pompe, en prenant soin de porter des chaussures à semelle isolante et de ne pas se tenir dans l'eau. En cas d'inondation, contacter la compagnie d'électricité ou un électricien agréé pour couper l'alimentation avant de déposer la pompe.

AVERTISSEMENT Les pompes submersibles contiennent de l'huile qui peut être sous pression ou devenir chaude en cours de fonctionnement. Attendre 2 heures et demi après l'avoir débranchée avant de travailler sur la pompe.

CONDITION	CAUSES FRÉQUENTES
A. La pompe ne démarre pas ou ne fonctionne pas.	Vérifier que le fusible est en bon état, que la tension est normale, que le circuit n'est pas surchargé et que le câblage est correct, que l'interrupteur n'est pas ouvert, que le rotor ou le joint n'est pas bloqué, que le condensateur ou le relais n'est pas défectueux, si installé, qu'il n'y a pas de court-circuit dans le moteur ou le bobinage. Flotteur bloqué en position basse. Interrupteur défectueux, endommagé ou mal réglé.
B. Le moteur surchauffe et déclenche le disjoncteur ou la sécurité thermique.	Mauvaise tension, hauteur de refoulement négative (refoulement ouvert au-dessous de la normale), blocage mécanique du rotor ou du joint, moteur court-circuité.
C. La pompe se met en marche et s'arrête trop fréquemment.	Flotteur grippé sur la tige, clapet de sécurité coincé ou pas de clapet installé sur une conduite longue, clapet de sécurité ouvert, interrupteurs de niveau défectueux, puits trop petit.
D. La pompe ne s'arrête pas.	Débris sous le flotteur, flotteur ou tige du flotteur coincé contre la paroi du puits, interrupteur défectueux, endommagé ou mal réglé.
E. La pompe fonctionne mais son débit est faible ou non existant.	Vérifier le carter de crépine, le tuyau de refoulement ou, si un clapet de sécurité est installé, le trou d'évent. La hauteur de refoulement est supérieure à la capacité de la pompe. Mauvaise tension. Mauvaise direction de rotation de la pompe. Condensateur défectueux. L'eau d'alimentation contient de l'air ou provoque l'entrée d'air dans la chambre de la pompe.
F. Baisse de capacité ou de hauteur de refoulement après une période d'utilisation.	Augmentation de la friction dans le tuyau de refoulement, tuyau ou clapet de sécurité colmaté. Des produits abrasifs ou des produits chimiques peuvent détériorer le rotor et le carter de pompe. Inspecter la conduite. Déposer la base et inspecter.

Si les vérifications ci-dessus ne résolvent le problème, consulter l'usine. Ne pas essayer de réparer ou de démonter la pompe. Toutes les réparations doivent être faites par un centre de réparation agréé par Zoeller. Visitez le site Web www.zoellerpumps.com/servicestations pour trouver le centre de service agréé le plus proche.

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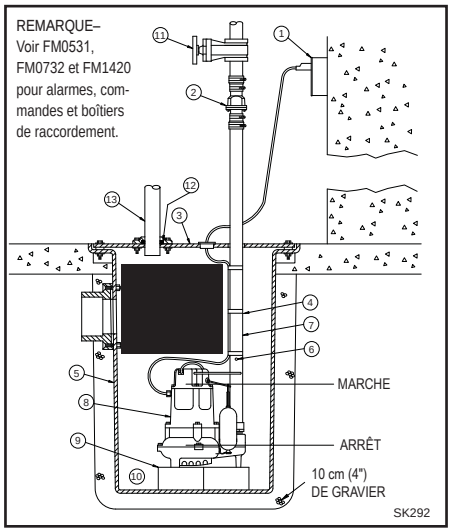
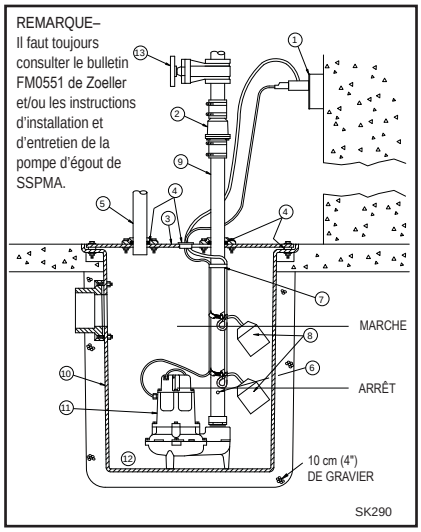
INSTALLATION RECOMMANDÉE POUR TOUTES APPLICATIONS

(1) Les circuits et les protections électriques doivent être conformes aux normes des codes électriques nationaux, provinciaux et locaux.
(2) Installer un Unicheck (raccord / clapet de sécurité combiné) de Zoeller approprié, de préférence juste au-dessus du puits pour permettre la dépose de la pompe pour le nettoyage ou les réparations. Pour les égouts, les effluents ou les eaux d'assèchement mécanique, utiliser le modèle 30-0164 avec des tuyaux de 1-1/2" (38 mm), modèle 30-0152 avec des tuyaux de 2" (51 mm) et le modèle 30-0160 avec des tuyaux de 3" (76 mm) s'il faut une grande hauteur de refoulement ou en cas d'installation sous un couvercle. Voir (4) ci-dessous.
(3) Tous les puits doivent avoir un couvercle pour empêcher les débris d'y tomber et éviter les chutes accidentelles.
(4) Quand un Unicheck est installé, percer un trou de 5 mm (3/16") dans le tuyau de refoulement, de niveau avec le dessus de la pompe. Les pompes de la série 50 et 90 ont un trou d'évent intégré. REMARQUE – LE TROU DOIT AUSSI ÊTRE AU-DESSOUS DU COUVERCLE DU PUITS ET IL FAUT LE NETTOYER RÉGULIÈREMENT (pompes à hauteur de refoulement élevée, voir n° 3 de la première page « MISE EN GARDE »). Un jet d'eau sera visible de cette orifice durant les périodes de fonctionnement de la pompe.
(5) Attacher fermement le cordon d'alimentation électrique sur le tuyau de refoulement en utilisant du chatterton ou des colliers.
(6) Utiliser un tuyau de refoulement de pleines dimensions.
(7) Le puits doit être conforme à tous les règlements applicables.
(8) Avant la mise en service, la pompe doit être de niveau et le mécanisme du flotteur ne doit pas toucher les bords du puits.
(9) Après l'installation, le puits doit être propre et ne doit pas contenir de débris.
(10) L'installateur doit fournir la vanne d'arrêt et l'installer en respectant tous les codes.
(11) Identifier les interrupteurs à flotteur indiqués dans les illustrations. Le point d'arrêt doit être au-dessus du carter du moteur et à 180° de l'admission. Le point d'arrêt ne se doit trouver jamais au-dessous du refoulement de la pompe (uniquement pour les systèmes d'eaux usées et d'effluent). REMARQUE - pour les pompes automatiques, utiliser le schéma d'installation pour l'assèchement ci-dessous.
(12) Pour éviter la propagation des gaz et des odeurs, toutes les installations doivent avoir des joints étanches.
(13) Les gaz et les odeurs sont évacués à l'atmosphère au moyen d'un tuyau d'évent. (uniquement pour les systèmes d'eaux usées et d'assèchement).
(14) Installer la base de pompe Zoeller (modèle 10-2421) sous la pompe pour formir un bassin de décantation (uniquement pour les systèmes d'effluent et d'assèchement). ***Uniquement pour les systèmes d'effluent :***
(15) Brancher l'alimentation de la pompe par l'intermédiaire d'un boîtier étanche Zoeller ou d'une épissure étanche. ***REMARQUE – Le boîtier étanche est une nécessité absolue dans un milieu humide. Voir le n° 8 à la première page de FM0732.***
(16) Consulter le manuel de dimensions pour les égouts de SSPMA afin de déterminer le modèle d'interrupteur de marche / arrêt à utiliser.
(17) Un accès à la fosse septique doit être prévu pour l'entretien du filtre et de la pompe.

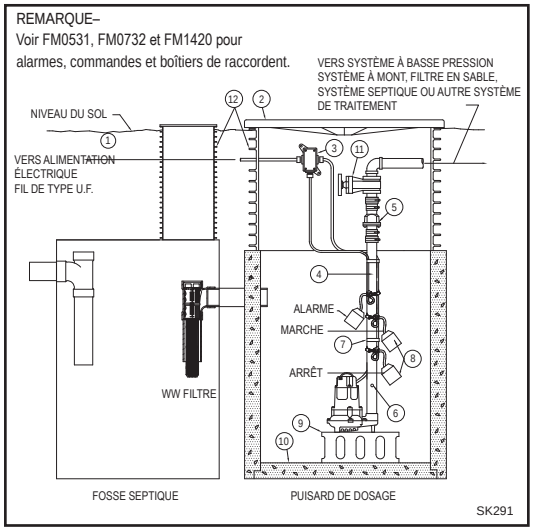
REMARQUE – Les pompes à joint double offrent une protection supplémentaire contre les dommages causés par la défaillance du joint.



INSTALLATION TYPIQUE
POUR L'ASSÈCHEMENT MÉCANIQUE



INSTALLATION TYPIQUE
POUR ÉGOUT

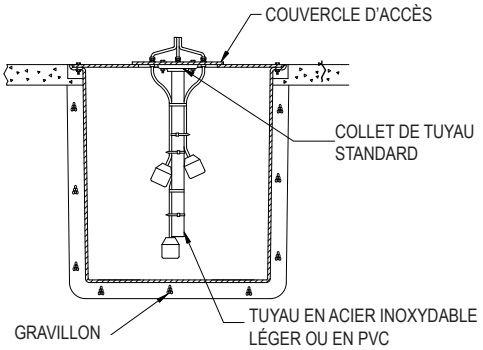


INSTALLATION TYPIQUE
POUR LES EFFLUENTS

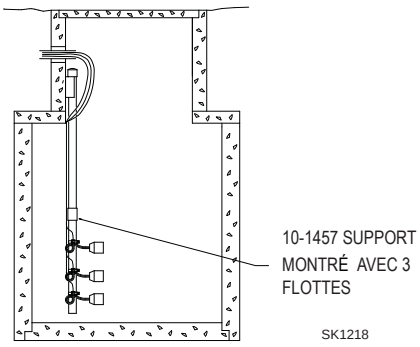
Toutes les installations doivent être conformes aux codes électriques et de plomberie applicables, y compris, mais pas limité aux codes électriques nationaux, locaux, régionaux et aux codes de plomberie provinciaux. Pas conçu pour utilisation dans les endroits dangereux.

MÉTHODES SUGGÉRÉES POUR L'INSTALLATION DU FLOTTEUR

Pour certaines installations, il peut être nécessaire d'installer un support indépendant pour les interrupteurs de commande de niveau pour éviter des accrochages possibles sur la pompe, la tuyauterie, les vannes, etc. Il est possible de fabriquer les supports de flotteur en utilisant des tuyaux et des raccords standard pour faciliter la dépose en cas de réparation. Les supports de flottes sont disponible chez Zoeller tel que décrit au feuillet FM0526 ou peuvent être fabriqué avec de la tuyauterie et des raccords standard.



SUPPORT TYPIQUE DE FLOTTEUR POUR COUVERCLE DE PUITS EN ACIER



SUPPORT DE FLOTTES TYPIQUE POUR PUISARD EN BÉTON OU POUR PUIT D' ACCÉS DE FOSSE SEPTIQUE

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Installation des modèles WD et WH

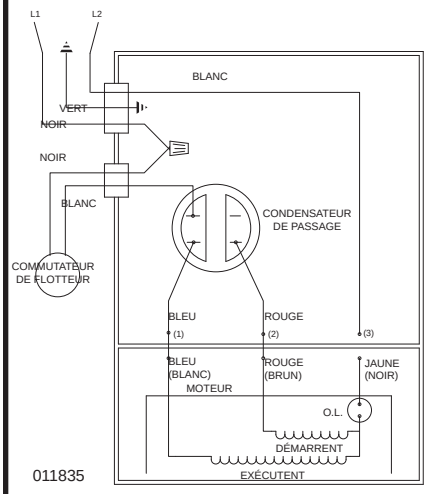
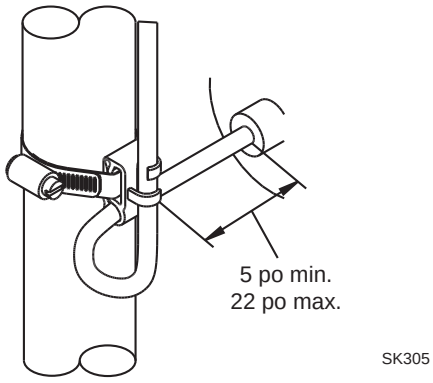


SCHÉMA ÉLECTRIQUE POUR LES MODÈLES
WD - 230 V, monophasé, 60 Hz
WH - 200/208, monophasé, 60 Hz

Définition de la plage de pompage en pouces (1 pouce = 2,5 cm)

Longueur du bras d'attache	5 min.	10	15	20	22 max.
Plage de pompage	9	13.5	18	22	24

Ce tableau ne doit être utilisé que comme guide. À cause du poids du câble, la plage de pompage au-dessus de l'horizontale n'est pas égale à la plage de pompage au-dessous de l'horizontale. Les plages sont basées sur des essais sans turbulence. La plage peut varier en fonction de la température de l'eau et de la forme du cordon. Plus le bras est long, plus les variations de plage de pompage sont importantes.



Interrupteur 20 amps (modèles WD et WH)

Les modèles WD et WH sont entièrement automatiques. Un interrupteur à flotteur est inclus et branché dans le circuit de la pompe pour permettre le fonctionnement automatique après avoir installé l'interrupteur à flotteur correctement sur le tuyau de refoulement. Il faut utiliser le schéma ci-dessus pour attacher correctement l'interrupteur à flotteur et obtenir un bras approprié pour modifier le cycle de marche-arrêt pour chaque application.

Remarque – L'interrupteur risque de mal fonctionner si le câble d'attache n'est pas maintenu dans les limites appropriées.

Remarque – Le câble doit être installé horizontalement.

Instructions de branchement monophasé

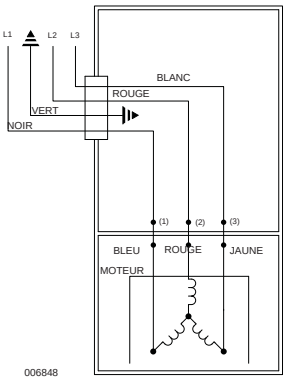
AVERTISSEMENT POUR DES RAISONS DE SÉCURITÉ, IL FAUT TOUJOURS DÉBRANCHER L'ALIMENTATION ÉLECTRIQUE DE LA POMPE AVANT L'INTERVENTION. Les pompes monophasées sont fournies avec une fiche à trois broches pour aider à protéger contre les risques d'électrocution. IL NE FAUT JAMAIS ENLEVER LA BROCHE DE TERRE. La fiche à trois broches doit être branchée dans une prise à trois alvéoles correspondantes. Si le circuit d'alimentation n'a pas une telle prise, il faut installer une prise du type approprié, branchée et mise à la terre selon le code national de l'électricité et tous les codes et règlements locaux appropriés.

AVERTISSEMENT « Risque d'électrocution ». Il ne faut pas enlever le cordon d'alimentation et le serre-câble ni brancher directement la pompe. L'installation et la vérification des circuits électriques et de la quincaillerie doivent être faites par un électricien qualifié.

AVERTISSEMENT Les unités non équipées d'une fiche (monophasée et triphasée) et les unités non automatiques monophasées à fiche de 20 ampères doivent être dotées d'une commande de moteur et d'un régulateur de niveau de liquide lors de l'installation. La tension, l'intensité, la fréquence, la mise à la terre et la puissance du dispositif de commande doivent s'accorder à la pompe sur lequel il est branché.

Instructions de branchement triphasé

Pompe non-automatique triphasée

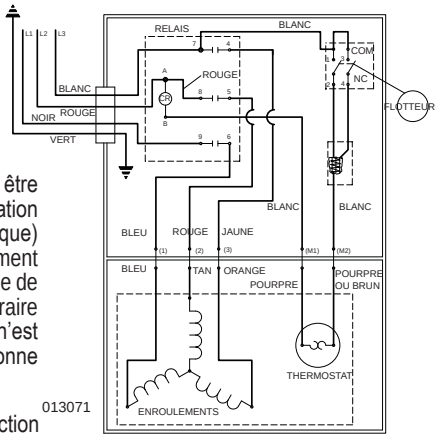


Les pompes triphasées ne sont pas automatiques. Pour qu'elles fonctionnent automatiquement, il faut installer un panneau de commande. Pour brancher le système, suivre les instructions fournies avec le panneau de commande. Pour trois phases automatique les pompes voient le diagramme de câblage automatique de 3 phases situé vers le droit.

Avant d'installer la pompe, vérifier la rotation de la pompe pour être certain que les fils ont été branchés correctement sur l'alimentation et que le fil vert du cordon d'alimentation (voir schéma électrique) est branché sur une bonne terre. Mettre la pompe momentanément sous tension et observer la direction du retour causé par le couple de démarrage. La rotation est correcte si le retour est en sense contraire à la flèche de rotation dans le carter de la pompe. Si la rotation n'est pas correcte, inverser deux des fils de phase pour obtenir la bonne direction de rotation.

Toutes les pompes triphasées doivent être équipées d'un dispositif de démarrage, avec dispositif de protection contre la surcharge. Voir FM0486 pour les installations duplex. La pompe doit être branchée conformément au code national de l'électricité et tous les codes et règlements locaux appropriés. Il ne faut pas installer les pompes dans un endroit classé dangereux conformément au code national de l'électricité, ANSI/NFPA 70.

Pompe automatique triphasée



AVERTISSEMENT POUR DES RAISONS DE SÉCURITÉ, IL FAUT TOUJOURS DÉBRANCHER L'ALIMENTATION ÉLECTRIQUE DE LA POMPE AVANT L'INTERVENTION.

REMARQUE IMPORTANTE. – Certaines polices d'assurance commerciales et résidentielles couvrent les dommages résultant d'une défaillance du **produit. Dans la plupart des cas, vous devez être en possession du produit pour déposer une réclamation. Zoeller Pump Co. s'engage à remplacer l'appareil ou à rembourser le prix d'achat original après que l'assureur aura réglé la réclamation dans un cas où vous êtes tenu d'être en possession du produit pour documenter une réclamation soumise à votre assureur.**

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Product information presented here reflects conditions at time of publication. Consult factory regarding discrepancies or inconsistencies.

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REPLACEMENT PARTS LIST FOR MODELS:

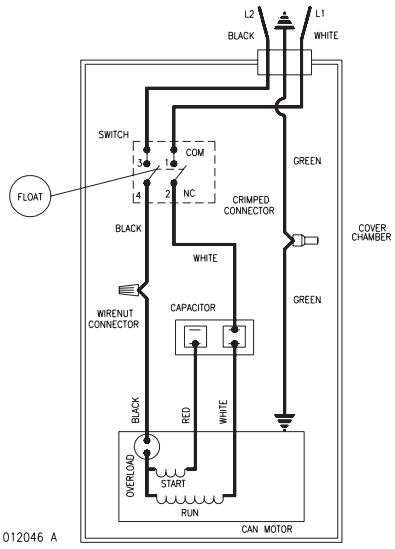
M72 AUTOMATIC 115V
N72 NONAUTOMATIC 115V
M76 AUTOMATIC 115V
N76 NONAUTOMATIC 115V

Consult factory for all other models

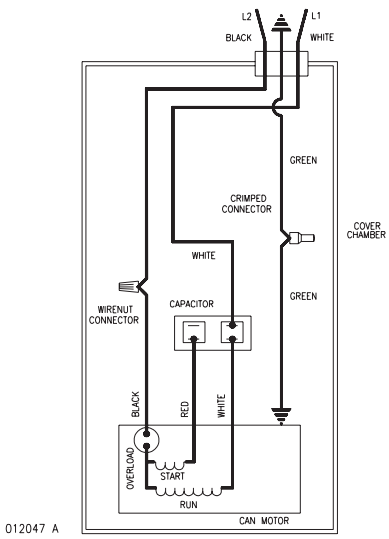
TO ORDER REPLACEMENT PARTS:

PLEASE FURNISH THE FOLLOWING INFORMATION:

- Model Number.
- Part Number of Pump.
- Part Number and Description of part.



WIRING DIAGRAM FOR MODEL
M72
7/99 THRU CURRENT



WIRING DIAGRAM FOR MODEL
N72
7/99 THRU CURRENT

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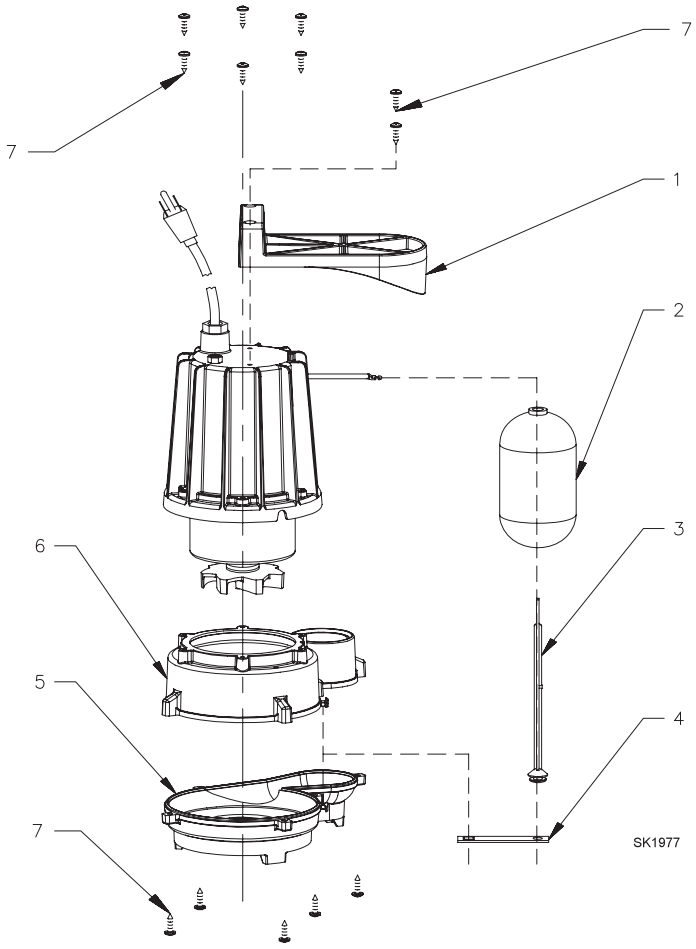
REPLACEMENT PARTS LIST FOR MODELS: "M72", "N72", "M76" and "N76".

MODEL: M72			Rev. A
REF. NO.	DESCRIPTION	QTY	7/99 thru Current
1	Guard/Handle	1	012029
2	Float-Polypropylene	1	034019
3	Float-Rod	1	054062
4	Guide	1	012043
5	Base	1	012028
6	Pump Housing	1	012027
7	Screw	13	012042

MODEL: N72			Rev. A
REF. NO.	DESCRIPTION	QTY	7/99 thru Current
1	Handle	1	012030
2	N/A	N/A	N/A
3	N/A	N/A	N/A
4	N/A	N/A	N/A
5	Base	1	012028
6	Pump Housing	1	012027
7	Screw	13	012042



MODEL: M76			Rev. A
REF. NO.	DESCRIPTION	QTY	02/00 thru Current
1	Guard/Handle	1	012029
2	Float-Polypropylene	1	034019
3	Float-Rod	1	002524
4	Guide	1	012043
5	Base	1	012028
6	Pump Housing	1	012048
7	Screw	13	012042

MODEL: N76			Rev. A
REF. NO.	DESCRIPTION	QTY	02/00 thru Current
1	Handle	1	012030
2	N/A	N/A	N/A
3	N/A	N/A	N/A
4	N/A	N/A	N/A
5	Base	1	012028
6	Pump Housing	1	012048
7	Screw	13	012042

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Assembly and operating instructions

DULCOMETER®, Compact Controller
Measured variable: pH / ORP

PH-501 - Transmitter, pH, Prominent Dulcometer pH or ORP4-20mA output, 7781499

EN

Please carefully read these operating instructions before use. · Do not discard.
The operator shall be liable for any damage caused by installation or operating errors.
The latest version of the operating instructions are available on our homepage.

Part no.: 986214
E-1145
BA DM 207 08/15 EN

General non-discriminatory approach

In order to make it easier to read, this document uses the male form in grammatical structures but with an implied neutral sense. It is aimed equally at both men and women. We kindly ask female readers for their understanding in this simplification of the text.

Supplementary information

Please read the supplementary information in its entirety.

Information

This provides important information relating to the correct operation of the unit or is intended to make your work easier.

Safety Information

The safety information includes detailed descriptions of the hazardous situation, see
↳ *Chapter 2.1 'Explanation of the safety information' on page 8*

The following symbols are used to highlight instructions, links, lists, results and other elements in this document:

More symbols

Symbol	Description
1. ▶	Action, step by step
⇨	Outcome of an action
↳	Links to elements or sections of these instructions or other applicable documents
■	List without set order
[Button]	Display element (e.g. indicators) Operating element (e.g. button, switch)
'Display /GUI'	Screen elements (e.g. buttons, assignment of function keys)
`CODE`	Presentation of software elements and/or texts

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1 Identity code

DCCa	DULCOMETER® Compact,								
	Mounting type								
	E	Spare part units							
	W	Wall/pipe mounting IP 67							
	S	With fitting kit for control panel mounting IP 54							
		Design							
		00	With ProMinent® logo						
		E1	Spare part unit, controller housing lower part (processor/PCB), fully assembled						
		E2	Spare part unit, controller housing top part (processor/PCB), fully assembled						
			Operating voltage						
			6	90 … 253 V, 48/63 Hz					
				Measured variable					
				C0	Free chlorine				
				NG	pH/ORP (switchable)				
				L3	Conductive conductivity (designation: COND_C)				
				L6	Inductive conductivity (designation: COND_I)				
					Hardware extension				
					0	None			
					Approvals				
					01	CE (Standard)			
						Certificates			
						0	None		
							Operating instructions language		
							EN	German	KR	Korean

DCCa	DULCOMETER® Compact,									
							EN	English	LT	Lithuanian
							ES	Spanish	LV	Latvian
							IT	Italian	NL	Dutch
							FR	French	PL	Polish
							FI	Finish	PT	Portuguese
							BG	Bulgarian	RO	Romanian
							ZH	Chinese	SV	Swedish
							CZ	Czech	SK	Slovakian
							EL	Greek	SL	Slovenian
							HU	Hungarian	RU	Russian
							YES	Japanese	TH	Thai

2 Introduction

Data and functions

These operating instructions describe the technical data and functions of the DULCOMETER® Compact Controller, measured variable pH / ORP.

2.1 Explanation of the safety information

Introduction

These operating instructions provide information on the technical data and functions of the product. These operating instructions provide detailed safety information and are provided as clear step-by-step instructions.

The safety information and notes are categorised according to the following scheme. A number of different symbols are used to denote different situations. The symbols shown here serve only as examples.

DANGER!

Nature and source of the danger

Consequence: Fatal or very serious injuries.

Measure to be taken to avoid this danger

Danger!

– Denotes an immediate threatening danger. If this is disregarded, it will result in fatal or very serious injuries.

WARNING!

Nature and source of the danger

Possible consequence: Fatal or very serious injuries.

Measure to be taken to avoid this danger

Warning!

– Denotes a possibly hazardous situation. If this is disregarded, it could result in fatal or very serious injuries.

CAUTION!

Nature and source of the danger

Possible consequence: Slight or minor injuries, material damage.

Measure to be taken to avoid this danger

Caution!

– Denotes a possibly hazardous situation. If this is disregarded, it could result in slight or minor injuries. May also be used as a warning about material damage.

NOTICE!

Nature and source of the danger

Damage to the product or its surroundings

Measure to be taken to avoid this danger

Note!

– Denotes a possibly damaging situation. If this is disregarded, the product or an object in its vicinity could be damaged.

Type of information

Hints on use and additional information

Source of the information, additional measures

Information!

– *Denotes hints on use and other useful information. It does not indicate a hazardous or damaging situation.*

2.2 Users' qualifications

WARNING!

Danger of injury with inadequately qualified personnel!

The operator of the plant / device is responsible for ensuring that the qualifications are fulfilled.

If inadequately qualified personnel work on the unit or loiter in the hazard zone of the unit, this could result in dangers that could cause serious injuries and material damage.

– All work on the unit should therefore only be conducted by qualified personnel.
– Unqualified personnel should be kept away from the hazard zone

Training	Definition
Instructed personnel	An instructed person is deemed to be a person who has been instructed and, if required, trained in the tasks assigned to him/her and possible dangers that could result from improper behaviour, as well as having been instructed in the required protective equipment and protective measures.
Trained user	A trained user is a person who fulfils the requirements made of an instructed person and who has also received additional training specific to the system from ProMinent or another authorised distribution partner.
Trained qualified personnel	A qualified employee is deemed to be a person who is able to assess the tasks assigned to him and recognize possible hazards based on his/her training, knowledge and experience, as well as knowledge of pertinent regulations. The assessment of a person's technical training can also be based on several years of work in the relevant field.

Training	Definition
Electrician	Electricians are deemed to be people, who are able to complete work on electrical systems and recognize and avoid possible hazards independently based on his/her technical training and experience, as well as knowledge of pertinent standards and regulations. Electricians should be specifically trained for the working environment in which the are employed and know the relevant standards and regulations. Electricians must comply with the provisions of the applicable statutory directives on accident prevention.
Customer Service department	Customer Service department refers to service technicians, who have received proven training and have been authorised by ProMinent to work on the system.

Note for the system operator

The pertinent accident prevention regulations, as well as all other generally acknowledged safety regulations, must be adhered to!

3 Safety and responsibility

3.1 General Safety Information

WARNING!

Live parts!

Possible consequence: Fatal or very serious injuries

- Measure: Disconnect the mains power supply prior to opening the housing
- De-energise damaged, defective or manipulated units by disconnecting the mains plug

WARNING!

Unauthorised access!

Possible consequence: Fatal or very serious injuries

- Measure: Ensure that there can be no unauthorised access to the unit

WARNING!

Operating errors!

Possible consequence: Fatal or very serious injuries

- The unit should only be operated by adequately qualified and technically expert personnel
- Please also observe the operating instructions for controllers and fittings and any other component groups, such as sensors, measuring water pumps ...
- The operator is responsible for ensuring that personnel are qualified

CAUTION!

Electronic malfunctions

Possible consequence: Material damage to destruction of the unit

- The mains connection cable and data cable should not be laid together with cables that are prone to interference
- Measure: Take appropriate interference suppression measures

NOTICE!

Correct and proper use

Damage to the product or its surroundings

- The unit is not intended to measure or regulate gaseous or solid media
- The unit may only be used in accordance with the technical details and specifications provided in these operating instructions and in the operating instructions for the individual components

NOTICE!

Correct sensor operation / Run-in time

Damage to the product or its surroundings

- Correct measuring and dosing is only possible if the sensor is working perfectly
- It is imperative that the run-in times of the sensors are adhered to
- The run-in times should be allowed for when planning initial operation
- It may take a whole working day to run-in the sensor
- Please read the operating instructions for the sensor

NOTICE!

Correct sensor operation

Damage to the product or its surroundings

- Correct measuring and dosing is only possible if the sensor is working perfectly
- Check and calibrate the sensor regularly

NOTICE!

Compensation of control deviations

Damage to the product or its surroundings

- This controller cannot be used in control circuits which require rapid compensation (< 30 s)

3.2 Correct and proper use

NOTICE!

Compensation for control deviations

Damage to the product or its surroundings

- The controller can be used in processes, which require compensation of > 30 seconds

NOTICE!

Correct and proper use

The unit is intended to measure and regulate liquid media. The marking of the measured variables is located on the controller and is absolutely binding.

The unit may only be used in accordance with the technical details and specifications provided in this operating manual and in the operating manuals for the individual components (such as, for example, sensors, fittings, calibration devices, metering pumps etc.).

Any other uses or modifications are prohibited.

4 Functional description

Brief functional description

The DULCOMETER® Compact Controller for pH and redox measured variables provides basic functions for water treatment applications. It has a fixed configuration with the following features:

- Measured variables pH and redox (can be switched over on the DULCOMETER® Compact Controller)
- Language independent operation (use of abbreviations, such as *[INPUT]*, *[OUTPUT]*, *[CONTROL]*, *[ERROR]*)
- Illuminated display
- 3 LEDs indicate the operating states (*[f-REL]* active, *[P-REL]* active, error)
- Sensor monitoring of pH
- P or PID control characteristics
- Selectable control direction (raise or lower measured value)
- Impulse frequency relay *[f-REL]* for metering pump control
- Power relay *[P-REL]*, configurable as alarm, limit value or pulse width modulated (PWM) control output for metering pumps
- Analogue output 0/4…20 mA, can be configured as a measured value or correction variable
- Suction function for all actuators
- Digital input to switch off the DULCOMETER® Compact Controller or to process a sample water limit contact by remote control
- Temperature sensor input (Pt 1000) for temperature compensation of the pH value
- Protection class IP67 (wall/pipe mounting), protection class IP54 (control panel mounting)

Applications:

- Waste water treatment
- Treatment of drinking water
- Swimming pool water treatment

4.1 Flow diagram

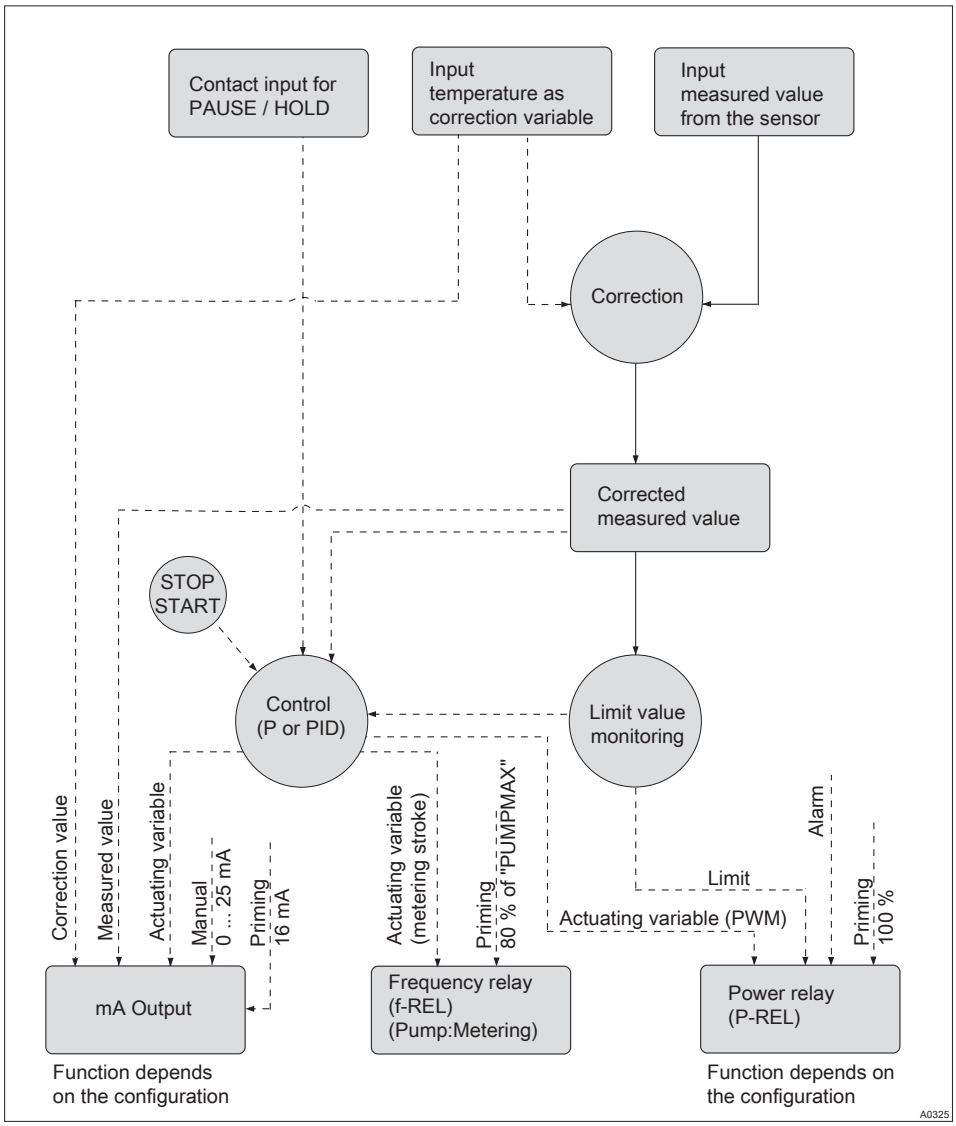


Fig. 1: Flow diagram

4.2 Overview of the first level menu

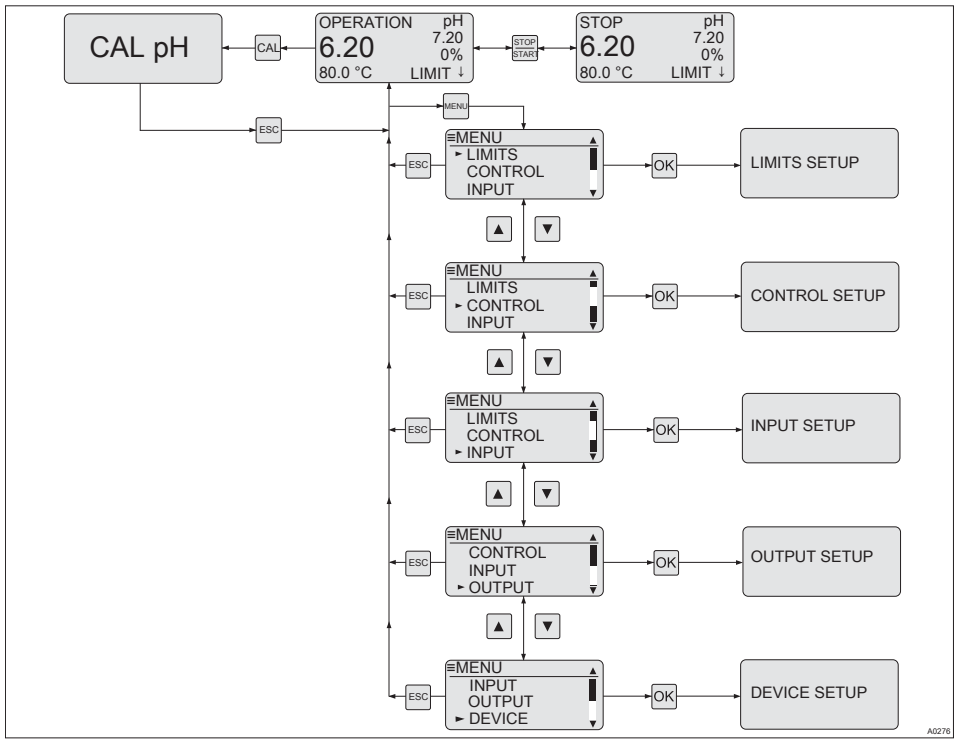
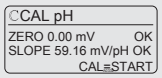
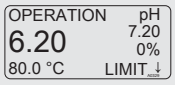
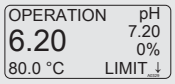
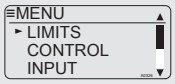
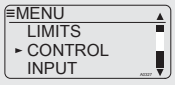
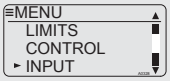
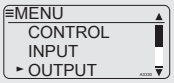
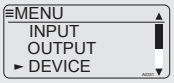


Fig. 2: Overview of the first level menu; shown for pH

Display view	Selection with:	Reference	Function
OPERATION pH 6.20 7.20 0% 80.0 °C LIMIT ↓		*Chapter 7 'Operating diagram' on page 43*	
CAL			Changes to the calibration menu.

Display view	Selection with:	Reference	Function
	CAL	*Chapter 8.1 'pH sensor calibration (CAL)' on page 48*	The calibration menu enables calibration of controller and sensor.
			
STOP START			Stop/Start the control and metering function.
	STOP START	*Chapter 9.2 'STOP/START key' on page 73*	By pressing the STOP key, the control is stopped. The STOP key can be pressed independently of the currently displayed menu. However the STOP state is only shown in the continuous display.
	MENU	*Chapter 7.3 'Continuous display' on page 45*	Changes from the continuous display to the setting menu.
	OK	*Chapter 8.3 'Setting limit values [LIMITS]' on page 58*	Enables the setting of the limit value for limit value monitoring.
▲ ▼			
	OK	*Chapter 8.4 'Setting the control [CONTROL]' on page 60*	Enables parameter setting for the control.
▲ ▼			

Display view	Selection with:	Reference	Function
	OK	*Chapter 8.5 'Input setting (INPUT)' on page 63*	Enables setting of the measured value input parameter.
	OK	*Chapter 8.6 ' Output setting (OUTPUT)' on page 66*	Enables setting of the mA output parameter.
	OK	*Chapter 8.7 'DEVICE setting' on page 70*	Enables adjustment of the password and the controller *[RESTART]* function.

5 Assembly and installation

- **User qualification, mechanical installation:** trained qualified personnel, see ↳ *Chapter 2.2 'Users' qualifications' on page 10*
- **User qualification, electrical installation:** Electrical technician, see ↳ *Chapter 2.2 'Users' qualifications' on page 10*

⚠ CAUTION!

Possible consequence: Material damage.

The hinge between the front and rear part of the housing cannot absorb high levels of mechanical loading. When working on the DULCOMETER® Compact Controller, firmly hold the top section of the controller housing.

⚠ CAUTION!

Check band for strain relief

Possible consequence: Material damage.

The ribbon cable and its socket cannot be mechanically loaded. Hence it is essential that when mounting the controller in the control panel mounting, the check strap (part number 1035918) is fitted for strain relief and mechanical securing. Without the check strap, the ribbon cable or its socket could be damaged if they were to fall out of the controller upper housing.

! NOTICE!

Mounting position and conditions

- The controller conforms to IP 67 degree of protection (wall/pipe mounting) or IP 54 (control panel mounting) requirements. This degree of protection is only achieved if all seals and cable glands are correctly fitted.
- The (electrical) installation should only take place after (mechanical) installation
- Ensure that there is unimpeded access for operation
- Ensure safe and low-vibration fastening
- Avoid direct sunlight
- Permissible ambient temperature of the controller at the installation location: -10 ... +60 °C at max. 95% relative air humidity (non-condensing)
- Take into consideration the permissible ambient temperature of the sensors and other components connected
- The controller is only suitable for operation in closed rooms. If operated outside, the controller must be protected against the environment by a suitable protective enclosure

Read-off and operating position

- *Install the device in a favourable position for reading and operating (preferably at eye level)*

Mounting position

– *Leave sufficient free space for the cables*

Packaging material

Dispose of packaging material in an environmentally responsible way. All packaging components carry the corresponding recycling code.

5.1 Scope of delivery

The following parts belong to the standard scope of delivery of a DULCOMETER® Compact Controller.

Description	Quantity
Assembled device	1
Cable connection set DMTa/DXMa (metr.)	1
Operating instructions	1

5.2 Mounting (mechanical)

The DULCOMETER® Compact Controller is suitable for mounting on a wall, pipe or control panel.

Mounting materials (contained in the scope of supply):

Description	Quantity
Wall/tube retaining bracket	1
Round head screws 5x45 mm	2
Washer 5.3	2
Rawlplug Ø 8 mm, plastic	2

5.2.1 Wall mounting

Mounting (mechanical)

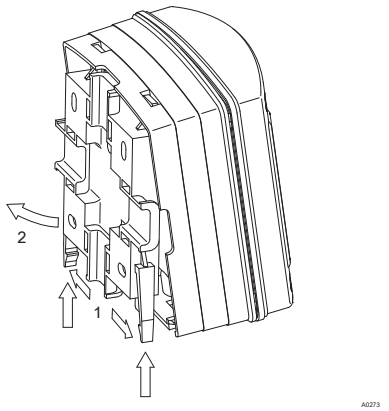


Fig. 3: Removing the wall/pipe bracket

1. Remove the wall/pipe bracket. Pull the two snap-hooks (1) outwards and push upwards
2. Fold out the wall/pipe bracket (2) and pull out in a downwards direction
3. Mark two drill holes diagonal to each other by using the wall/pipe bracket as a drilling template
4. Drill holes: Ø 8 mm, d = 50 mm

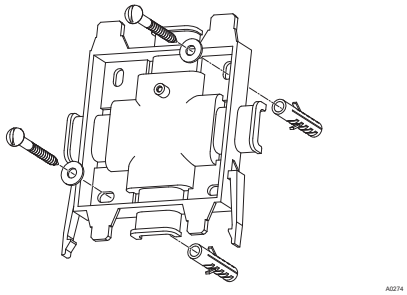


Fig. 4: Screwing on the wall/pipe bracket using washers

5. Screw on the wall/pipe bracket using the washers
6. Suspend the DULCOMETER® Compact Controller at the top in the wall/pipe bracket and push using light pressure at the bottom against the wall/pipe bracket. Then press upwards until the DULCOMETER® Compact Controller audibly snaps into position.

5.2.2 Pipe mounting

Mounting (mechanical)

Pipe diameter

Pipe diameter: 25 mm to 60 mm.

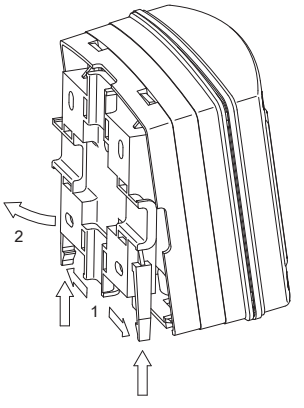


Fig. 5: Removing the wall/pipe bracket

1. Remove the wall/pipe bracket. Pull the two snap-hooks (1) outwards and push upwards
2. Fold out the wall/pipe bracket (2) and pull out in a downwards direction
3. Secure the wall/pipe bracket using cable ties (or pipe clips) to the pipe

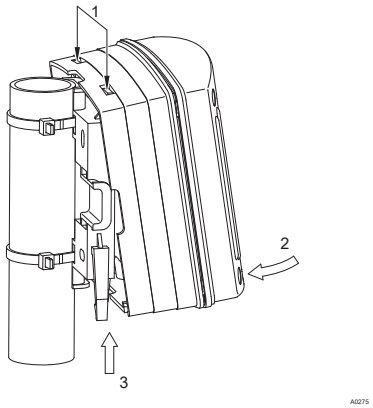


Fig. 6: Suspend and secure the DULCOMETER® Compact Controller

4. Suspend the DULCOMETER® Compact Controller at the top (1) in the wall/pipe bracket and push using light pressure at the bottom (2) against the wall/pipe bracket. Then press upwards (3) until the DULCOMETER® Compact Controller audibly snaps into position

5.2.3 Control panel mounting

Mounting kit for control panel installation of the DULCOMETER® Compact Controller: Order number 1037273

Description	Quantity
Drilling template sheet 3872-4	1
PT screw (3.5 x 22)	3
Profile seals	2
Strain relief strip DF3/DF4	1
PT screw (3.5 x 10)	2
Individual parts packed in transparent cover / Mounting kit is not contained in the standard scope of supply	

CAUTION!

Material thickness of control panel

Possible consequence: material damage

– The thickness of the material of the control panel should be at least 2 mm to ensure secure fixing

In the mounted state, the DULCOMETER® Compact Controller extends approx. 30 mm from the control panel.

Preparing the control panel

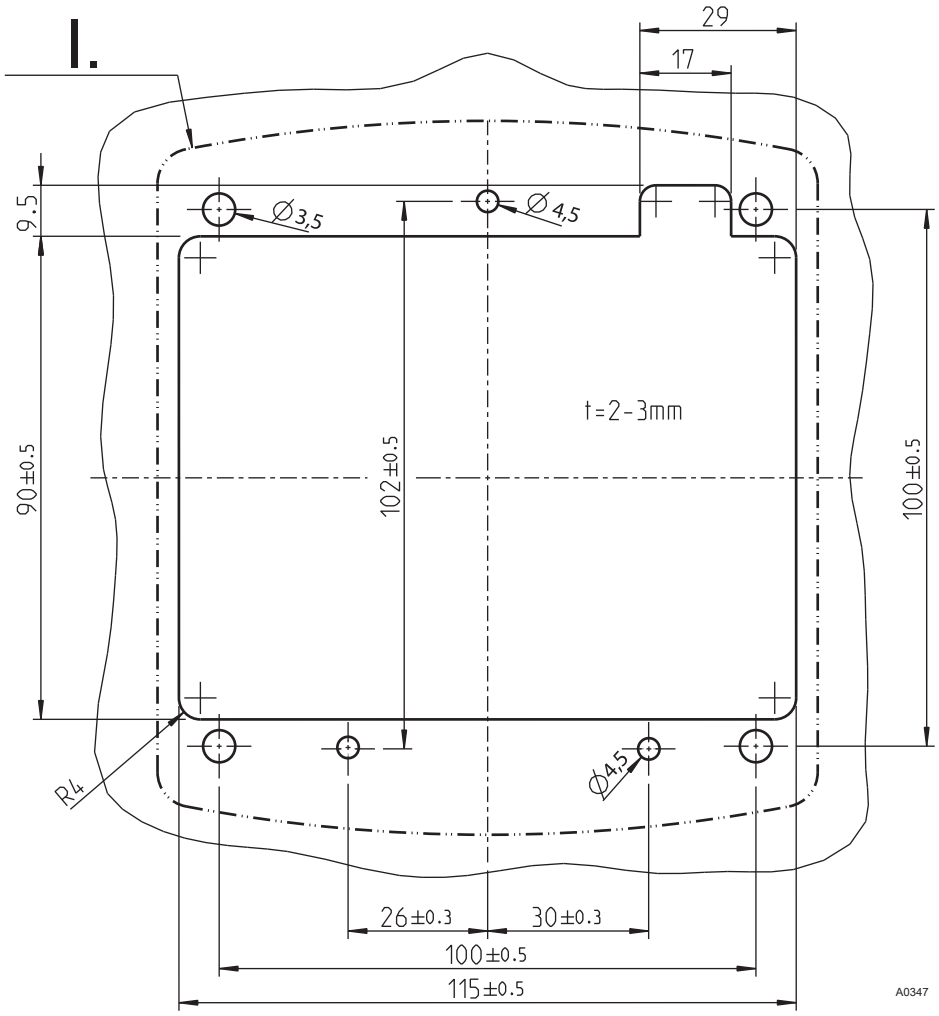


Fig. 7: The drawing is not to scale and is intended for information purposes only.

I. Outline contour of the DULCOMETER® Compact Controller housing

1. Mark the exact position of the DULCOMETER® Compact Controller on the control panel using the drilling template

2.

Core hole

Adhere to the 3.5 mm Ø as the core hole diameter for screwing in the fixing bolts.

Drill four holes for the bolts for the top section of the controller housing using a 3.5 mm Ø drill bit

3. Drill three holes for the bolts for the bottom section of the controller housing using a 4.5 mm Ø drill bit

4. Drill four holes using an 8 mm Ø drill bit and use a jigsaw to cut the cut-out

⇨ Deburr all the edges.

Fitting the DULCOMETER® Compact Controller into the cut-out in the control panel

NOTICE!

Ribbon cable base

The base for the ribbon cable is firmly soldered onto the PCB. The base cannot be removed. Open the base lock (3) to loosen the ribbon cable, see Fig. 8

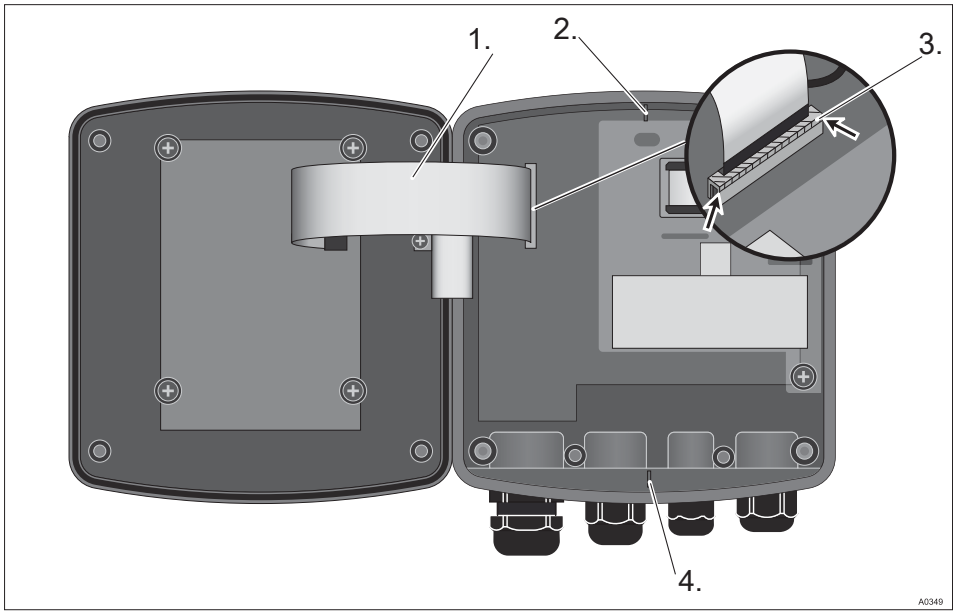


Fig. 8: Loosening the ribbon cable

1. Undo four screws and open the DULCOMETER® Compact Controller
2. Open the right and left lock (3) (arrows) on the base and pull the ribbon cable (1) out of the socket
3. Use pliers to break off the catches (2 and 4). These are not needed for control panel installation

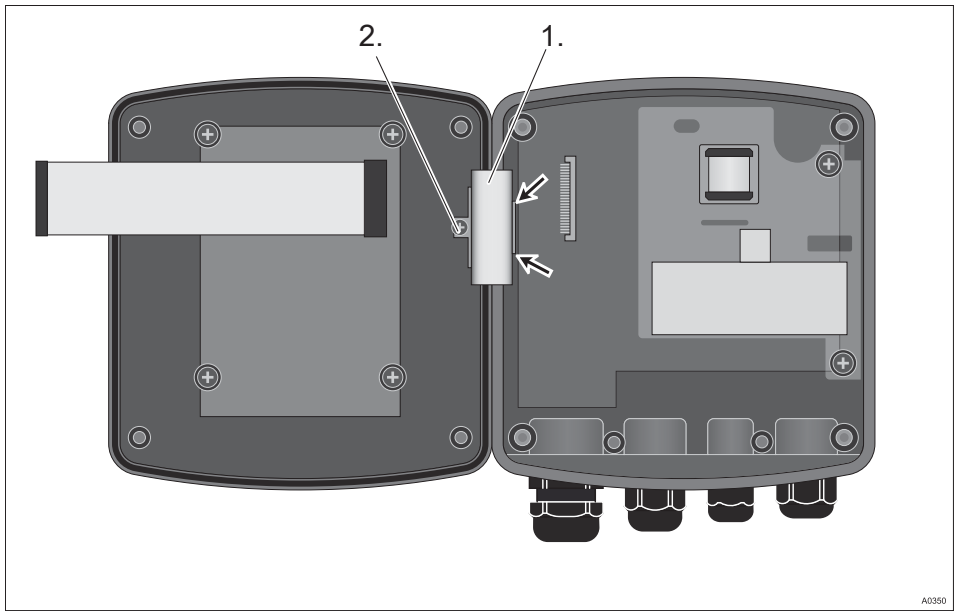


Fig. 9: Dismantle the hinge

4. Remove the screw (2), unclip the hinge (1) on the bottom section of the controller housing (arrows) and remove the hinge

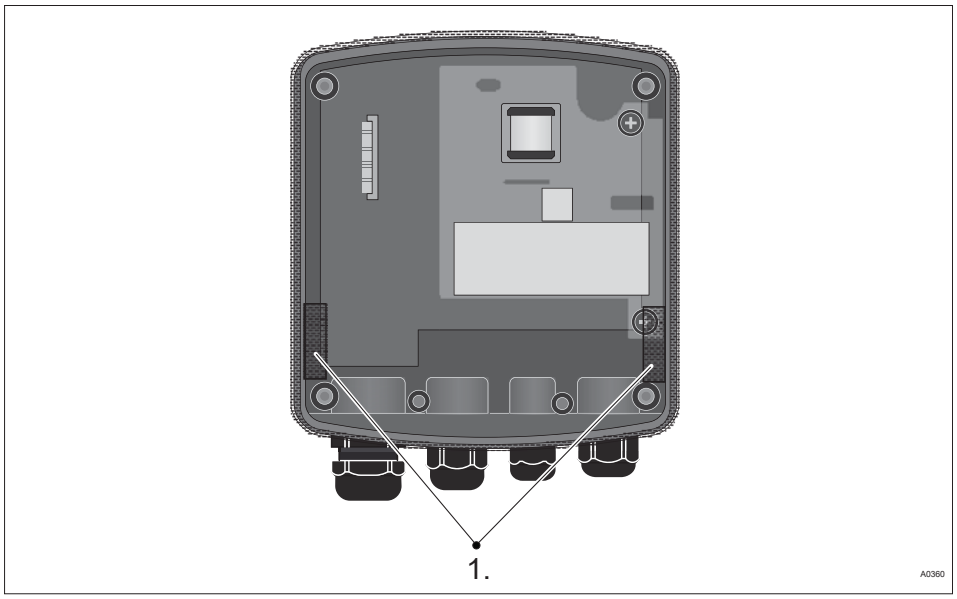


Fig. 10: Fitting the profile seal on the bottom section of the controller housing

5. Position the profile seal evenly around the upper edge of bottom section of the DULCOMETER® Compact Controller housing. Arrange the clips (1) as shown in the figure

   ⇨ Ensure that the profile seal evenly surrounds the upper edge of the housing.

6. Insert the bottom section of the DULCOMETER® Compact Controller housing with the profile seal from behind into the cut-out and use three screws to secure it in place

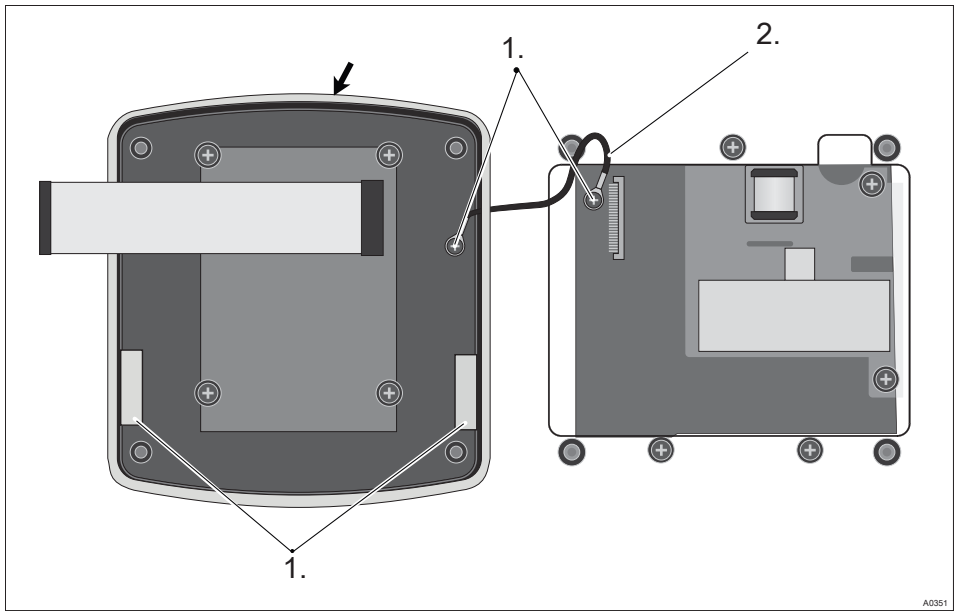


Fig. 11: Fitting the profile seal onto the top section of the controller housing

7. Position the profile seal (arrow) evenly into the groove in the top section of the DULCOMETER® Compact Controller housing. Arrange the clips (3) as shown in the figure

8. Secure the strain relief (2) using two screws (1)

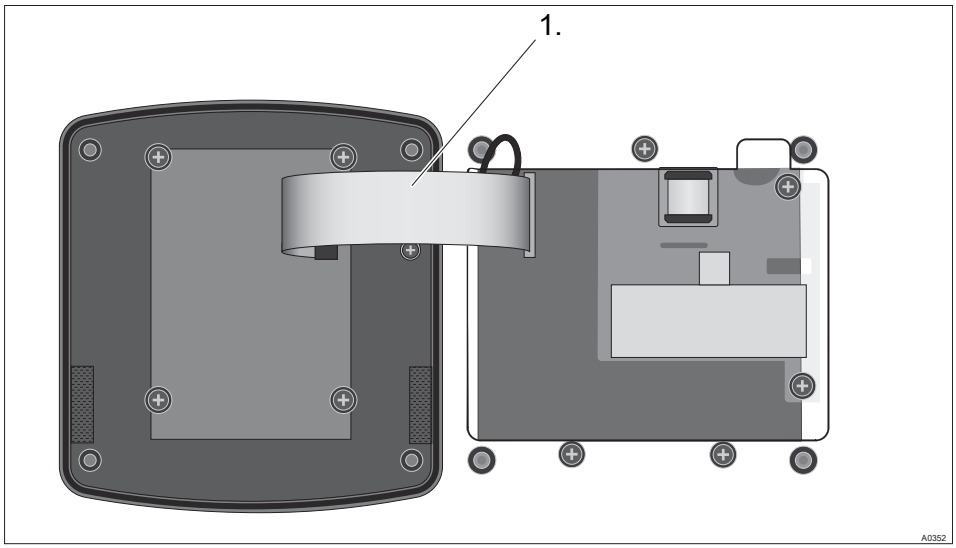


Fig. 12: Push and lock the ribbon cable in its base

9. Push and lock the ribbon cable (1) in its base
10. Screw the top section of the controller housing onto the bottom section of the DULCOMETER® Compact Controller housing
11. Once again check that the profile seals are fitted properly
    ⇨ IP 54 degree of protection can only be provided if the control panel is mounted correctly

5.3 Installation (electrical)

WARNING!

Live parts!

Possible consequence: Fatal or very serious injuries

- Measure: Disconnect the electrical power supply to the device before opening the housing and secure to prevent unintentional reconnection
- Disconnect damaged or defective devices or devices that have been tampered with and prevent unintended reconnection
- The provision of a suitable isolating device (emergency-off switch, etc.) is the responsibility of the plant operator

The signal leads of the DULCOMETER® Compact Controller must not be routed alongside interference-prone cabling. Faults could lead to malfunctions of the DULCOMETER® Compact Controller.

5.3.1 Cable Cross-Sections and Cable End Sleeves

	Minimum cross-section	Maximum cross-section	Stripped insulation length
Without cable end sleeve	0.25 mm^2	1.5 mm^2	
Cable end sleeve without insulation	0.20 mm^2	1.0 mm^2	8 - 9 mm
Cable end sleeve with insulation	0.20 mm^2	1.0 mm^2	10 - 11 mm

5.3.2 Installation of coaxial cable to guard terminal XE1

CAUTION!

Maximum length of the coaxial cable 10 m

Incorrect measured value due to too long a coaxial cable

Possible consequence: Slight or minor injuries, material damage.

The maximum length of the coaxial cable may not exceed 10 m when using redox or pH sensors. The measurement signal can otherwise be falsified by the effects of interference.

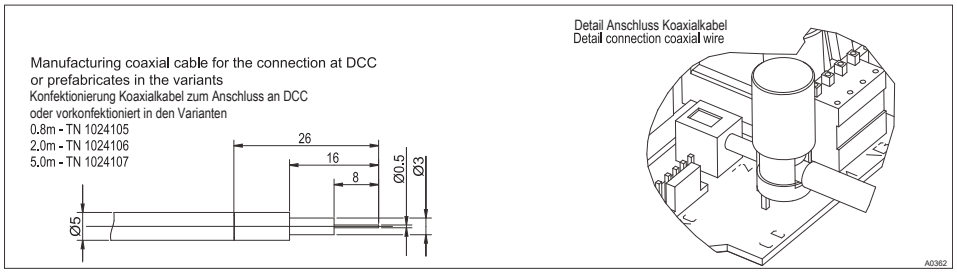


Fig. 13: Installation of Coaxial Cable to Guard Terminal XE1

When installing the coaxial cable for the guard terminal XE 1, the lengths of insulation to be removed from the coaxial cable must be adhered to. The guard terminal *'is tightened'* by hand.

5.3.2.1 Terminal diagram / wiring

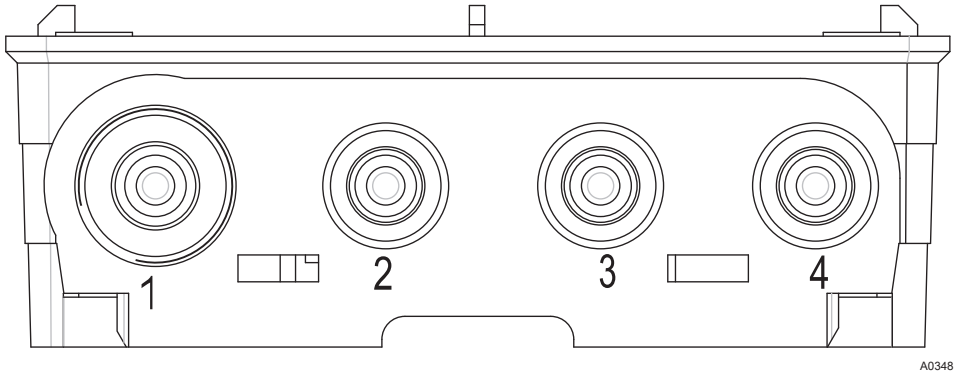


Fig. 14: Threaded connector number

Wiring

Threaded connector no. Size	Description	Terminal Description	Terminal number	Pol	Function	Recommended cable ⌀	Remarks
1 / M20	ph/redox Input 1		XE 1	Ref. El.	pH/ redox sensor	⌀ 5	Guide cable through multiple M20 / 2x**5** mm seal inserts
			XE 2	meas. sig			
	Temp. input Pt 1000	XE 4	1	+	Temp. sensor	⌀ 5	
			2	-			
2 / M16	Wire jumper **or** potential equaliser	XE 3			] Short circuit	⌀ 4,5 *	Guide 4-core cable through multiple M 16 / 2x**4,5** mm seal inserts
		XE 3	1	free	Potential equaliser***		

Threaded connector no. Size	Description	Terminal Description	Terminal number	Pol	Function	Recommended cable ⌀	Remarks
			2	Ref. volt.			
	Standard signal output	XA 1	1	+ 15 V	e.g. recorder / actuator		
			2	-			
	Contact input	XK 1	1	+	Pause	⌀ 4,5 *	Guide 4-core cable through multiple M 16 / 2x**4,5** mm seal inserts
			2	-			
	Relay output (f-relay)	XR 2	1		Frequency controlled metering pump		
			2				
*** To achieve protection class IP 67 please use original Prominent cable, part number 1036759**							
***** When using as a potential equaliser, the short circuit bridge ⌋ must be removed!**							
3 / M16	Relay output **or** Relay output **or** Relay output (P-relay)	XR1	1	COM	Solenoid valve / metering pump ** raise / lower	⌀ 5	Guide cable through single M16 seal insert
			2	NO			
		XR1	1	COM	Limit relay		
			2	NO			
		XR1	1	COM	Alarm relay		
			3	NC			

Threaded connector no. Size	Description	Terminal Description	Terminal number	Pol	Function	Recommended cable ⌀	Remarks
** An RC suppressor must be connected (not part of the scope of delivery)							
4 M16	Mains connection	XP 1	1	N	85 ... 253 V eff.	⌀ 6,5	Guide cable through single M16 seal insert
			2	L			

Legend to the "Wiring" table

Abbreviation	Meaning
Pol.	Polarity
Ref. El.	Reference electrode
meas sig.	Measurement signal (glass electrode)
Ref. pot.	Internal reference potential
f-relay	Pump frequency relay
P-relay	Power relay
COM	Common relay contact (root)
NO	Contact *'normally opened'*
NC	Contact *'normally closed'*

Terminal diagram

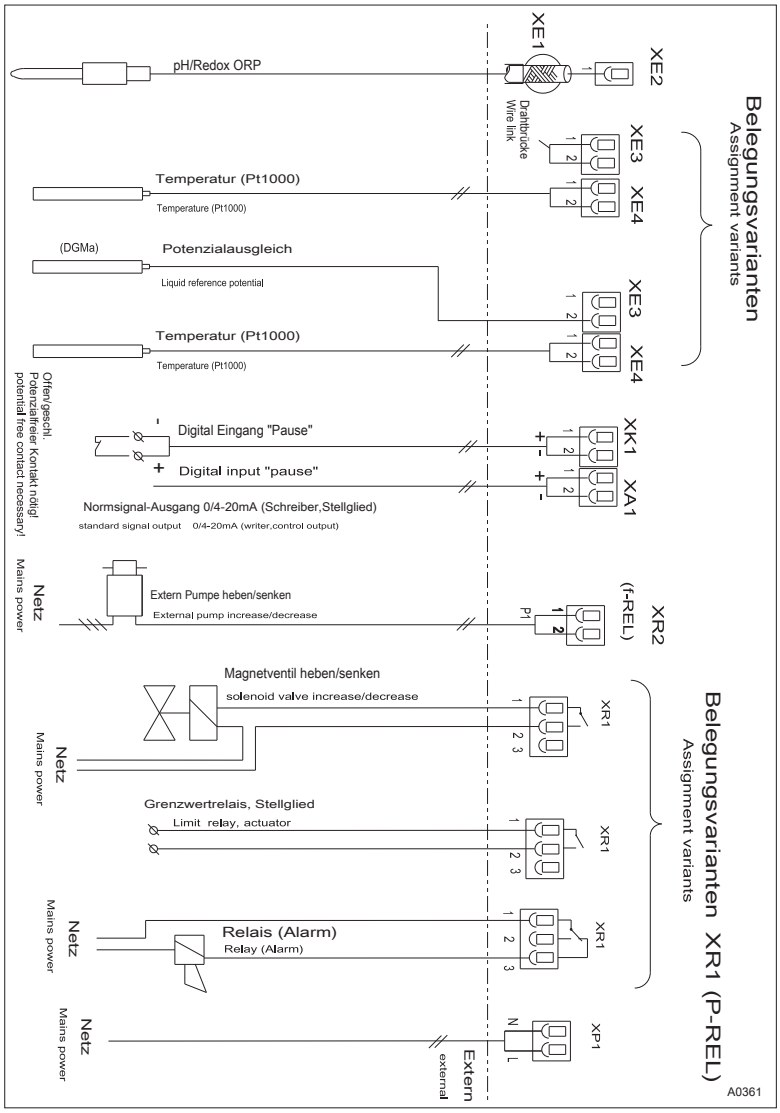


Fig. 15: Terminal diagram

5.3.3 Installation (electrical)

The cable must be routed in a site-provided cable duct to ensure strain relief

1. Undo the four housing screws
2. Slightly lift the controller housing top section forwards and fold it to the left

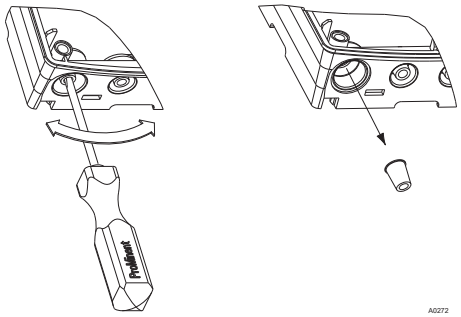


Fig. 16: Punch out threaded holes

3. *Large threaded connection (M 20 x 1.5)*

   Small threaded connection (M 16 x 1.5)

   Punch out as many threaded connections on the bottom side of the controller housing bottom section as required
4. Guide the cable into the respective reducing inserts.
5. Insert the reducing inserts into the threaded connectors
6. Guide the cable into the controller.
7. Connect the cable as indicated in the terminal diagram
8. Screw the required threaded connections in and tighten
9. Tighten the clamping nuts of the threaded connections so that they are properly sealed
10. Click the controller housing top section on to the controller housing bottom section
11. Manually tighten the housing screws
12. Once again check the seating of the seal. Only if the mounting is correct, is protection class IP 67 (wall/pipe mounting) or IP 54 (control panel mounting) achieved

5.4 Switching of inductive loads

If you connect an inductive load, i.e. a consumer which uses a coil (e.g. an alpha motorised pump), then you must protect your controller with a protective circuit. If in doubt, consult an electrical technician for advice.

The RC member protective circuit is a simple, but nevertheless very effective, circuit. This circuit is also referred to as a snubber or Boucherot member. It is primarily used to protect switching contacts.

When switching off, the connection in series of a resistor and capacitor means that the current can be dissipated in a damped oscillation.

Also when switching on, the resistor acts as a current limiter for the capacitor charging process. The RC member protective circuit is highly suitable for AC voltage supplies.

The magnitude of the resistance R of the RC member is determined according to the following equation:

$R=U/I_L$

(Where U= Voltage across the load and I_L = current through the load)

The magnitude of the capacitor is determined using the following equation:

$C=k * I_L$

k=0,1...2 (dependent on the application).

Only use capacitors of class X2.

Units: R = Ohm; U = Volt; I_L = Ampere; C = µF

If consumers are connected which have a high starting current (e.g. plug-in, switched mains power supplies), then a means of limiting the starting current must be provided.

The switching-off process can be investigated and documented using an oscilloscope. The voltage peak at the switch contact depends on the selected RC combination.

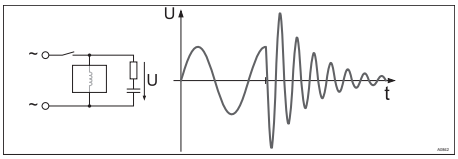


Fig. 17: Switching-off process shown on the oscillogram.

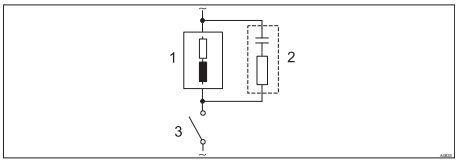


Fig. 18: RC protective circuit for the relay contacts

Typical AC current application with an inductive load:

- 1) Load (e.g. alpha motor-driven pump)
- 2) RC-protective circuit
  - Typical RC protective circuit at 230 V AC:
  - Capacitor *[0.22µF/X2]*
  - Resistance *[100 Ohm / 1 W]* (metal oxide (pulse resistant))
- 3) Relay contact (XR1, XR2, XR3)

6 Commissioning

- **Users' qualification:** trained user, see *Chapter 2.2 'Users' qualifications' on page 10*

WARNING!

Sensor run-in periods

This can result in hazardous incorrect metering

– Correct measuring and metering is only possible if the sensor is working perfectly
– Please read the operating manual for the sensor
– The sensor must be calibrated after commissioning

Following completion of mechanical and electrical assembly, the DULCOMETER® Compact Controller should be integrated into the measuring point.

6.1 Initial commissioning

When first switching on the DULCOMETER® Compact Controller the DULCOMETER® Compact Controller is in a STOP state.

Selection of the measurement variable, controller setting and setting of the various, process-dependent, parameters takes place next. *Chapter 8 'Operating menus for the measured variables pH and ORP' on page 48*.

6.2 Selection of the measured variable

The pH and redox measurement variables are set in the *'INPUT'* menu.

NOTICE!

Reset to factory settings

If you set or switch the measurement variable, all parameters in the controller are reset to the factory settings for the selected measurement variable.

You must then reset all the controller functions.

6.3 Setting the controller during commissioning

NOTICE!

Reset to factory settings

When switching over the metering direction, all actuators in the DULCOMETER® Compact Controller are reset to the factory settings for the selected metering direction.

For safety reasons, all actuators are deactivated. The base load is reset to 0 %. All parameters relating to the actuator, are reset to the factory setting.

Consequently all parameters relating to the actuator, must be reset.

The DULCOMETER® Compact Controller only controls *'one-way'*. Only one position or one negative control variable can be calculated. The direction of the control variable is set in the *'PUMP'* menu. There is no dead zone. In this sense, control cannot be *'switched off'* (except with *'STOP'* or *'PAUSE'*).

The value of the P-proportion of the control (Xp) is specified with the DULCOMETER® Compact Controller in the units of the corresponding measurement variable (e.g. 1.5 pH).

For pure P-control and a separation between the set and actual values, which corresponds to the Xp value, the calculated control variable is +100 % (with the setting *'raise'*) or -100 % (with the setting *'lower'*).

7 Operating diagram

7.1 Overview of equipment/Control elements

- **User qualification:** instructed user, see *Chapter 2.2 'Users' qualifications' on page 10*

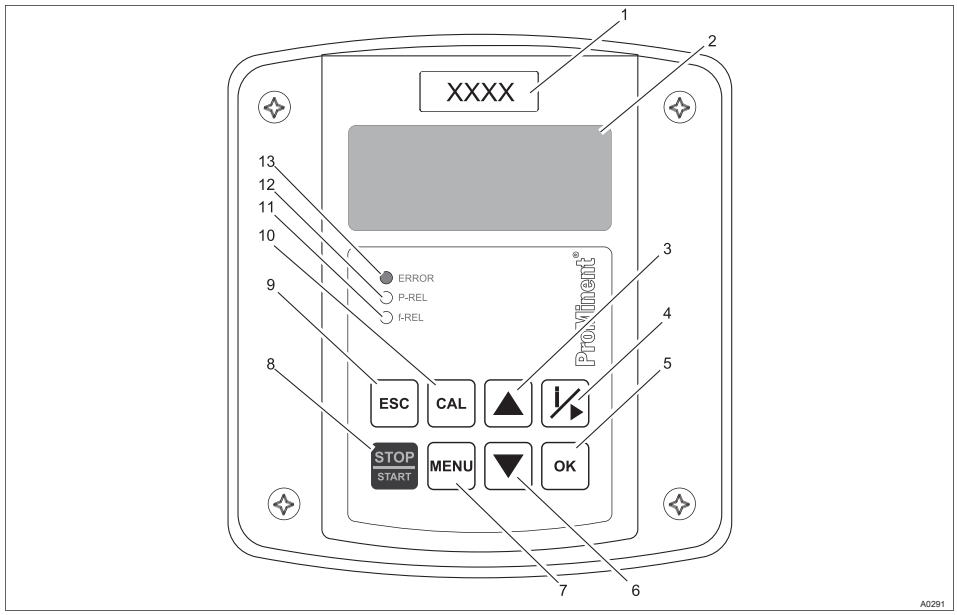


Fig. 19: Overview of equipment/Control elements

Function	Description
1st respective measured variable	Affix the measured variable label here
2. LCD display	
3. UP key	Too increase a displayed number value and to jump upwards in the operating menu
4. INFO/RIGHT key	Opens the info menu or moves the cursor one place to the right

Function	Description
5. OK key	To apply, confirm or save a displayed value or status or to acknowledge an alarm
6. DOWN key	Too decrease a displayed number value and to jump down in the operating menu
7. MENU key	Accesses the controller operating menu
8. STOP/START key	Starts and stops control and metering function
9. ESC key	Jumps a level back in the operating menu, without storage or changing entries or values
10. CAL key	For accessing the calibration menu and navigating within the calibration menu.
11. f-REL LED	Shows the activated state of the f-relay
12. P-REL LED	Shows the activated state of the P-relay
13. ERROR LED	Indicates a controller error state. A text message is displayed simultaneously in the LCD continuous display

7.2 Adjusting display contrast

If the DULCOMETER® Compact Controller is set to *'continuous display'* , you can set the contrast of the LCD-display. By pressing the ▲ key you can adjust the LCD display contrast so it is darker. By pressing the ▼ key you can adjust the LCD display contrast so it is lighter. Here each key press represents a contrast level. I.e. the key must be pressed once for each contrast level.

7.3 Continuous display

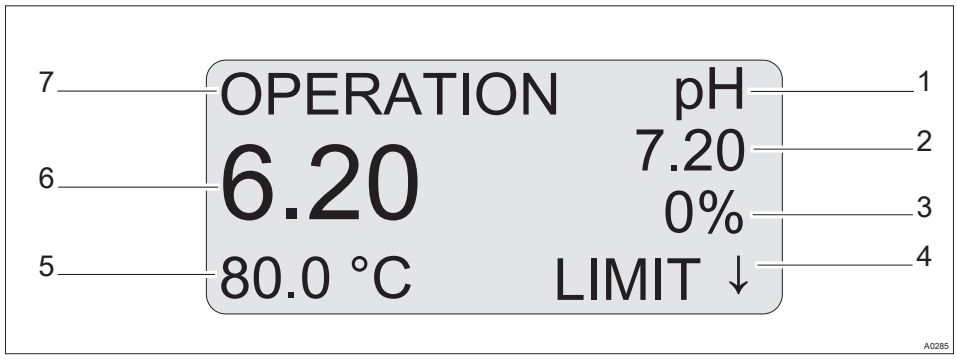


Fig. 20: Continuous display

1 Measured variable
2 Setpoint
3 Control variable
4 Possible error text: e.g. "Limit↓" (Direction of the limit value transgression, e.g. here lower limit value transgression)
5 Temperature (Correction variable)
6 Measured value (actual value)
7 Mode

7.4 Info display

In the info display, the most important parameters for each menu item of the first menu level are displayed.

Access to the info display from the continuous display is by pressing the key. Pressing the key again calls the next info display. Pressing the ESC key recalls the continuous display again.

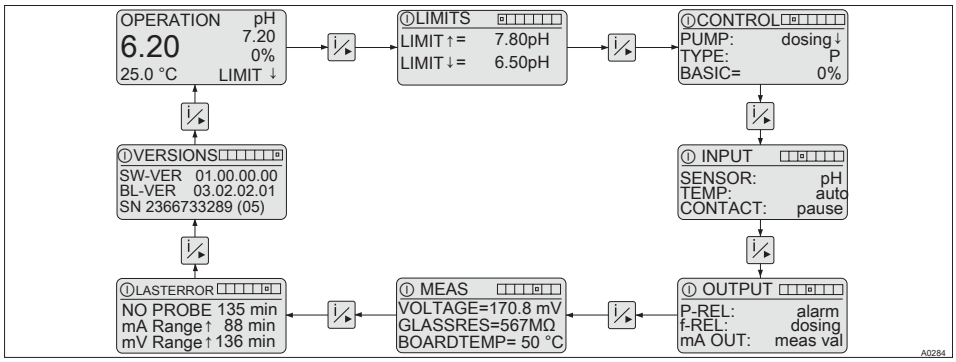


Fig. 21: Info display

Using the OK key you can jump from the currently displayed info display directly to the selection menu of this info display.

Using the ESC key you can jump back to the info display.

Info display "MEAS"

The "MEAS" info display shows the following measured values:

- *[VOLTAGE]: currently measured sensor mV value*
- *[GLASSRES]: measured glass resistance of connected pH sensors for media temperatures of 15 °C to 80 °C. The displayed value is only valid when used with ProMinent pH sensors*
- *[BOARDTEMP]: Current housing interior temperature*

7.5 Password

Access to the setting menu can be limited using a password. The DULCOMETER® Compact Controller is supplied with the password *'5000'*. Using the preset password *'5000'* the DULCOMETER® Compact Controller is setup so that all menus can be accessed without any limitations.

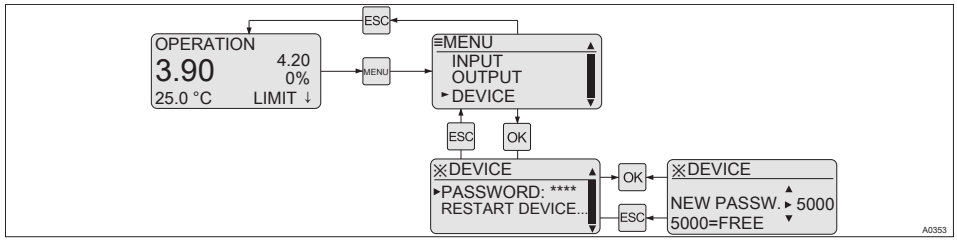


Fig. 22: Password setting

Password	Possible values			
Factory setting	Increment	Lower value	Upper value	Remarks
5000	1	0000	9999	5000 = *[FREE]*

8 Operating menus for the measured variables pH and ORP

- **User qualification:** instructed user, see *Chapter 2.2 'Users' qualifications' on page 10*

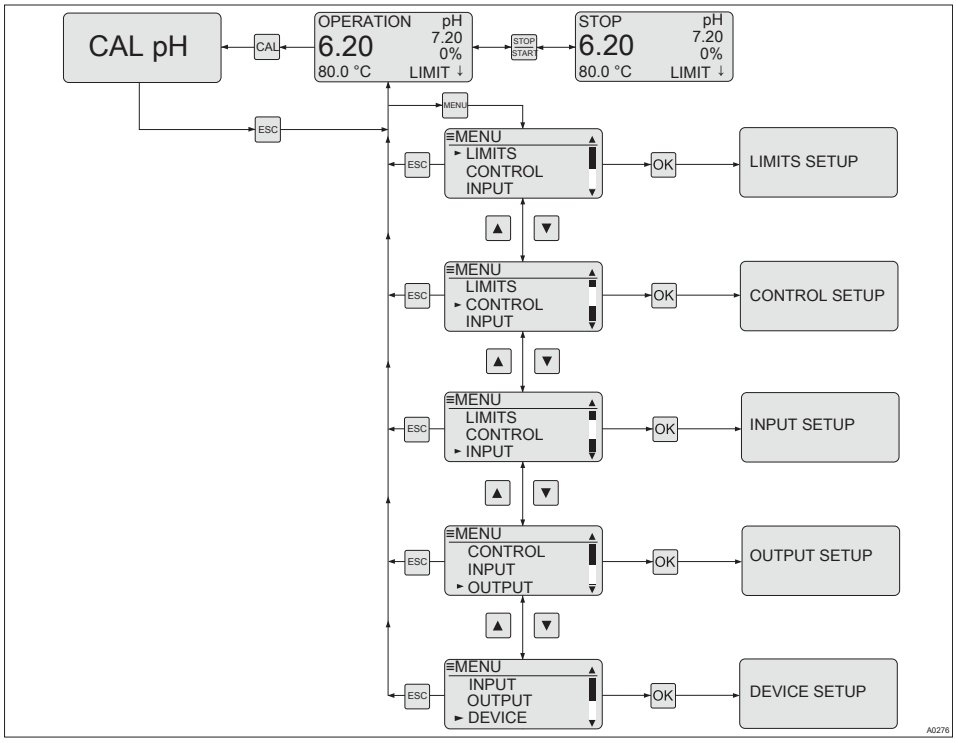


Fig. 23: Operating menu overview

8.1 pH sensor calibration (CAL)

Correct sensor operation

- *Correct measuring and metering is only possible if the sensor is working perfectly*
- *Observe the sensor operating instructions*
- *The carrying out of a 2-point calibration is strongly recommended and is to be preferred to a single point calibration*

During calibration, the DULCOMETER® Compact Controller sets the control outputs to *'0'*. Exception to this: a basic load or a manual control variable has been set. This remains active. The mA standard signal output is frozen.

When calibration/testing has been completed successfully, all of the error checks relating to the reading are restarted. The DULCOMETER® Compact Controller saves all the determined data for zero point and slope when the calibration is successful.

Used buffer

Dispose of the used buffer solution. Related info: see buffer solution safety data sheet.

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remarks
Buffer temperature	Measured value	0.1 °C	0 °C	120 °C	The temperature can only be adjusted under *'TEMP'* *'auto'* or *'manual'*
Buffer values	Start value = 7.00 pH (ZERO) 4.00 pH (SLOPE)	0.01 pH	0.00 pH	14.00 pH	Limit value ZERO = 6..8 pH Limit value SLOPE = < 6 pH; > 8 pH

2-Point Calibration

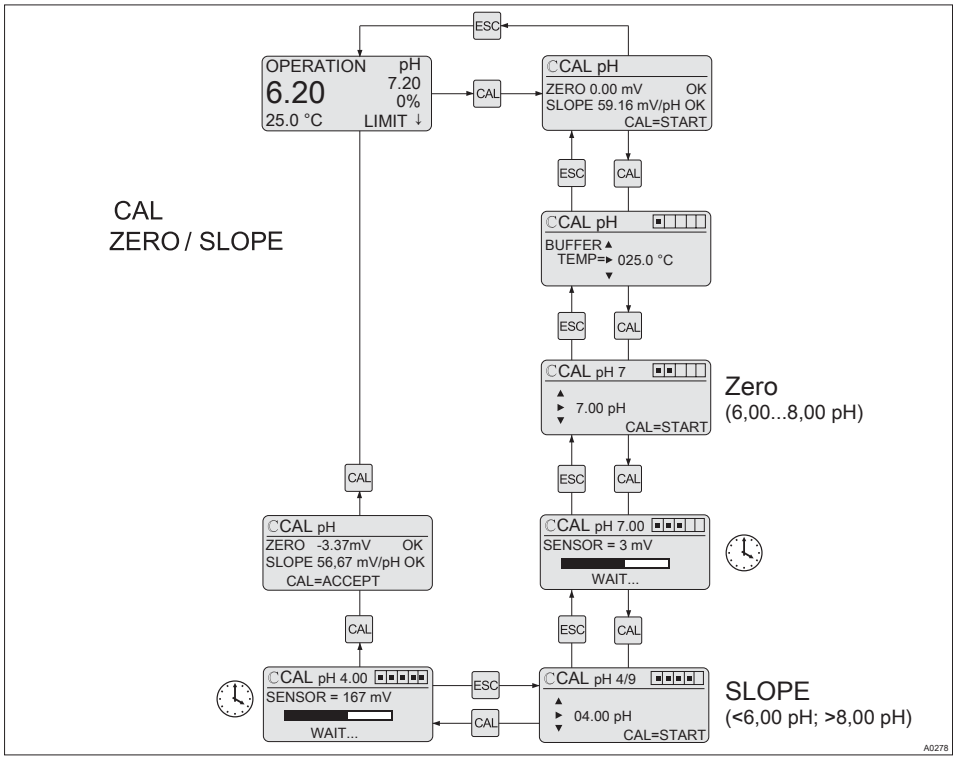


Fig. 24: 2-Point calibration pH sensor

Valid calibration values

Valid calibration:

- *Zero point -60 mV…+60 mV*
- *Slope 40 mV/pH…65 mV/pH*

Two test containers with a buffer solution are required for calibration. The pH value of the buffer solutions should be at least 1.5 pH units apart. Thoroughly rinse the sensor with water when changing the buffer solution.

1. Select the calibration menu CAL
2. Start the calibration CAL
3. If temperature has been selected (only if *'TEMP'* is set to *'auto'* or *'manual'*), then set the buffer temperature with the keys ▲, ▼ and 1/x
4. Confirm the entry by pressing the OK key
5. Set the pH-value of the buffer *'ZERO'* using the keys ▲, ▼ and 1/x
6. Immerse sensor in the buffer solution containing test container 1 (e.g. pH 7). In so doing, slightly move the sensor
7. Then press CAL
   ⇨ Calibration is running 🕘.
8. Then press CAL to accept the value
   ⇨ if CAL=ACCEPT is shown in the display and the displayed mV value is stable.
9. Remove the sensor from the buffer solution, rinse thoroughly in water and then dry with a cloth (pad dry, don't rub!)
10. Set the pH-value of the buffer *'SLOPE'* using the keys ▲, ▼ and 1/x
11. Immerse sensor in the buffer solution containing test container 2 (e.g. pH 4). In so doing, slightly move the sensor
12. Then press CAL
    ⇨ Calibration is running 🕘.
13. Then press CAL to accept the value
    ⇨ if CAL=ACCEPT is shown in the display and the displayed mV value is stable.
14. The determined values for the zero point and slope are displayed

⇨ The calibration is now saved as successful if the values for *'ZERO'* and *'SLOPE'* are both *'OK'*.

Incorrect calibration

Should the result of the calibration lie outside the specified tolerance limits, an error message appears 'ERR'. In this case the current calibration will not be applied.

Check the prerequisites for the calibration and clear the error. Then repeat the calibration

15. Then press CAL to confirm the result or to terminate the calibration (if necessary, as unsuccessful)

1-Point slope calibration

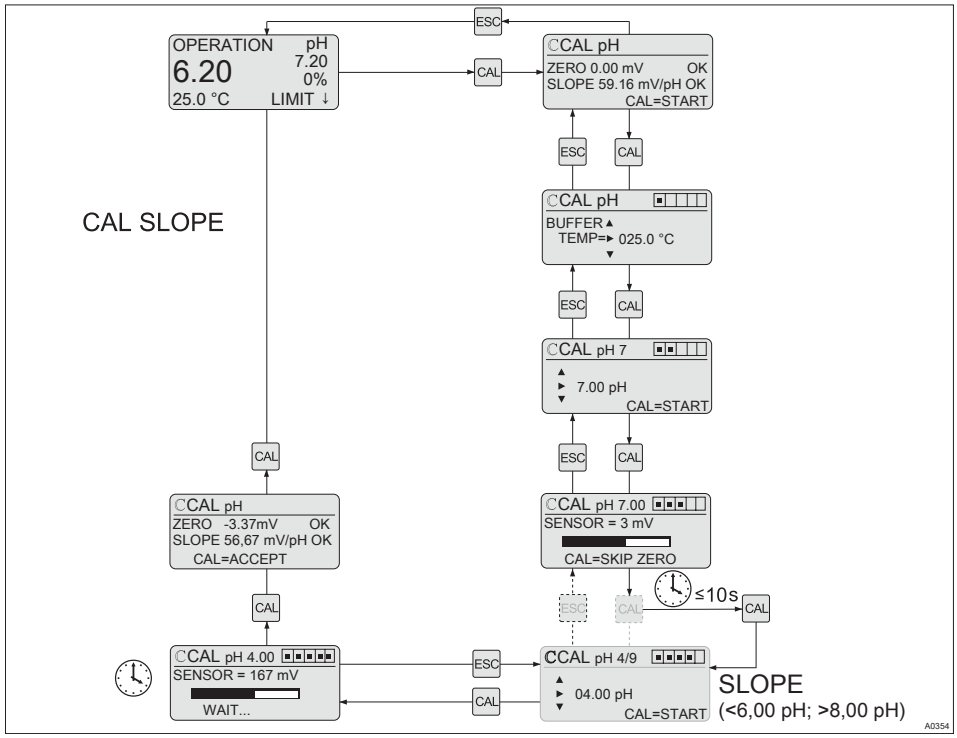


Fig. 25: Single point slope calibration

Valid calibration values

Valid calibration:

– *Slope 40 mV/pH…65 mV/pH*

One test container with a buffer solution is required for calibration. Again with the single point calibration the buffer values for *'ZERO'* and *'SLOPE'* must be at least 1.5 pH units apart. If these buffer values are not recognised, then you must carry out a 2-point calibration.

1. Select the calibration menu CAL
2. Start the calibration CAL

3. If temperature has been selected (only if *'TEMP'* is set to *'auto'* or *'manual'*), then set the buffer temperature with the keys ▲, ▼ and 1/x

4. Confirm the entry by pressing the OK key or CAL key

5. Do not set the pH-value of the buffer *'ZERO'* . Press the CAL key to confirm and if *'CAL=SKIP ZERO'* appears (within no more than 10 s), press the CAL key again

   ⇨ You have skipped the zero point calibration and are now in the slope calibration screen

6. Set the pH-value of the buffer *'SLOPE'* using the keys ▲, ▼ and 1/x

7. Immerse sensor in the buffer solution containing test container (e.g. pH 4). In so doing, slightly move the sensor

8. Then press CAL

   ⇨ Calibration is running 🕘.

9. Then press CAL to accept the value

10. The determined values for the zero point and slope are displayed

    ⇨ The calibration is now saved as successful if the values for *'ZERO'* and *'SLOPE'* are both *'OK'*.

> ***Incorrect calibration***
>
> *Should the result of the calibration lie outside the specified tolerance limits, an error message appears 'ERR'. In this case the current calibration will not be applied.*
>
> *Check the prerequisites for the calibration and clear the error. Then repeat the calibration*

11. Then press CAL to confirm the result or to terminate the calibration (if necessary, as unsuccessful)

Single point zero point calibration

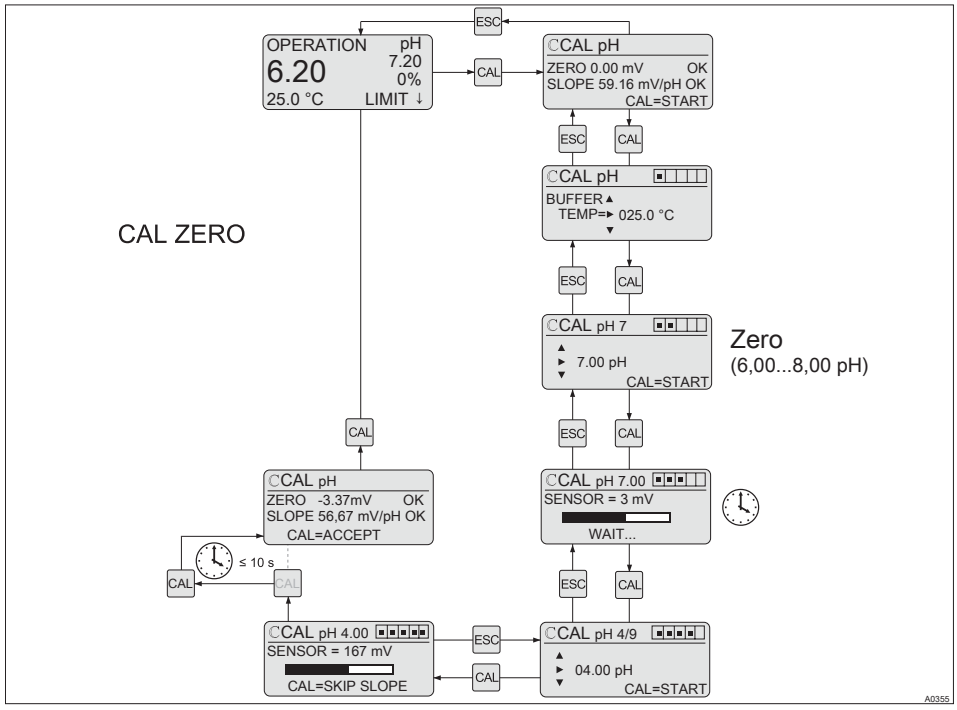


Fig. 26: Single point zero point calibration

Valid calibration values

Valid calibration:

– *Zero point -60 mV…+60 mV*

One test container with a buffer solution is required for calibration. Again with the single point calibration the buffer values for *'ZERO'* and *'SLOPE'* must be at least 1.5 pH units apart. If these buffer values are not recognised, then you must carry out a 2-point calibration.

1. Select the calibration menu CAL
2. Start the calibration CAL

3. If temperature has been selected (only if *'TEMP'* is set to *'auto'* or *'manual'*), then set the buffer temperature with the keys ▲, ▼ and 1/x
4. Confirm the entry by pressing the OK key again
5. Set the pH-value of the buffer *'ZERO'* using the keys ▲, ▼ and 1/x
6. Immerse sensor in the buffer solution containing test container (e.g. pH 7). In so doing, slightly move the sensor
7. Then press CAL
   ⇨ Calibration is running.
8. Then press CAL to accept the value
9. Do not set the pH-value of the buffer *'SLOPE'*. Press the CAL key to confirm and if *'CAL=SKIP SLOPE'* appears (within no more than 10 s), press the CAL key again
   ⇨ The calibration is now saved as successful if the values for *'ZERO'* and *'SLOPE'* are both *'OK'*.

Incorrect calibration

Should the result of the calibration lie outside the specified tolerance limits, an error message appears 'ERR'. In this case the current calibration will not be applied.

Check the prerequisites for the calibration and clear the error. Then repeat the calibration

10. Then press CAL to confirm the result or to terminate the calibration (if necessary, as unsuccessful)

8.2 Redox sensor calibration (CAL)

Redox sensor calibration

The redox sensor cannot be calibrated. It is only possible to set an 'OFFSET' of the order of ± 40 mV and then make a comparison using this value. Should the redox sensor differ by more than ± 40 mV from the reference value, then it must be checked in accordance with the requirements of the sensor operating instructions.

Correct sensor operation

– *Correct measuring and metering is only possible if the sensor is working perfectly*
– *Observe the sensor operating instructions*

During the calibration: the DULCOMETER® Compact Controller sets the control outputs to *'0'*. Exception to this: a basic load or a manual control variable has been set. This remains active. The mA standard signal output is frozen.

Used buffer

Dispose of the used buffer solution. Related info: see buffer solution safety data sheet.

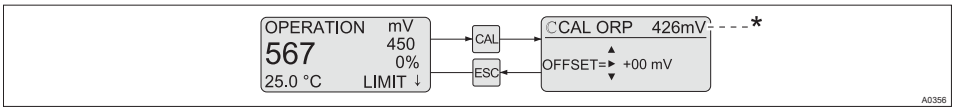


*Fig. 27: Redox sensor calibration (CAL) * corrected value*

A container with a redox buffer solution (e.g. 465 mV) is needed for testing.

1. Select the Test menu CAL
2. Immerse redox sensor in the redox buffer solution containing test container (e.g. 465 mV)
3. Wait until the mV value has stabilised
4. Adjust the displayed mV values using the keys ▲, ▼ and ↵ to the mV value of the redox buffer solution in the test container. Confirm the value by pressing CAL . The OFFSET value is transferred into the measuring parameters

   ⇨ ESC quits the test menu without transferring the OFFSET value into the measuring parameters.
5. If the redox sensor is unclean or defective, it must be cleaned as described in the redox sensor operating instructions, or alternatively replaced

8.3 Setting limit values *[LIMITS]*

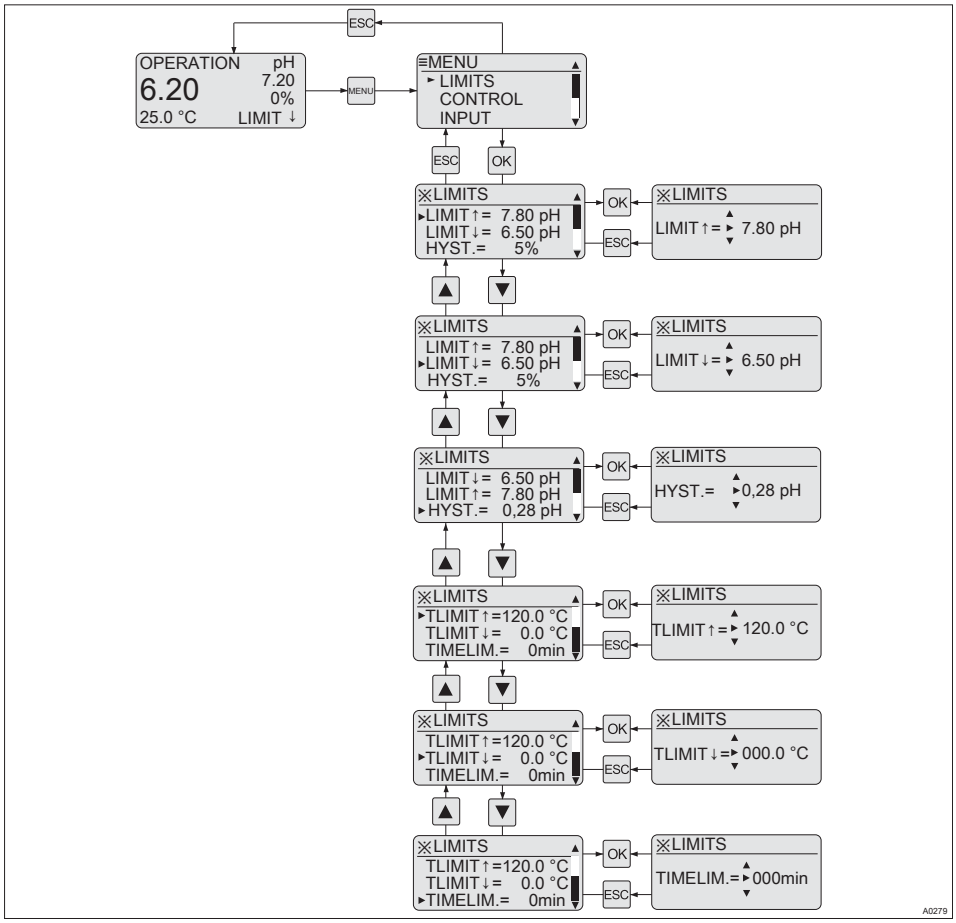


Fig. 28: Setting limit values [LIMITS]

Setting		Possible values			
Display	Starting value	Increment	Lower value	Upper value	Remark
[LIMIT ↑ pH]	8.50 pH	0.01 pH	0.00	14.00	upper pH limit value
[LIMIT ↓ pH]	6.50 pH	0.01 pH	0.00	14.00	lower pH limit value
[LIMIT ↑ ORP]	800	1 mV	-1000 mV	1000 mV	upper ORP limit value
[LIMIT ↑ ORP]	600	1 mV	-1000 mV	1000 mV	lower ORP limit value
[HYST.]	0.28 pH	0.01 pH	0.00	14.00	hysteresis for pH
	20 mV	1 mV	-1000 mV	1000 mV	hysteresis for ORP
[TLIMIT ↑ °C]	120.0 °C	0.1 °C	0.0 °C	120.0 °C	upper limit correction value °C
[TLIMIT ↓ °C]	0.0 °C	0.1 °C	0.0 °C	120.0 °C	lower limit correction value °C
[TLIMIT ↑ °F]	248.0 °F	0.1 °F	32.0 °F	248.0 °F	upper limit correction value °F
[TLIMIT ↓ °F]	32.0 °F	0.1 °F	32.0 °F	248.0 °F	lower limit correction value °F
[TIMELIM.]	0 min = OFF	1 minute	0	999	Checktime after a limit value has been exceeded or undershot pH / ORP

Hysteresis = *[HYST.]*

If the value has fallen below a limit value, then the limit value criteria are reset when the measured value has reached the value of the limit value plus hysteresis.

If the value has fallen below a limit value, then the limit value criteria are reset when the measured value has reached the value of the limit value minus hysteresis.

If the limit value criteria no longer exist on expiry of *[TIMELIM]* , then the control is automatically reactivated.

8.4 Setting the control *[CONTROL]*

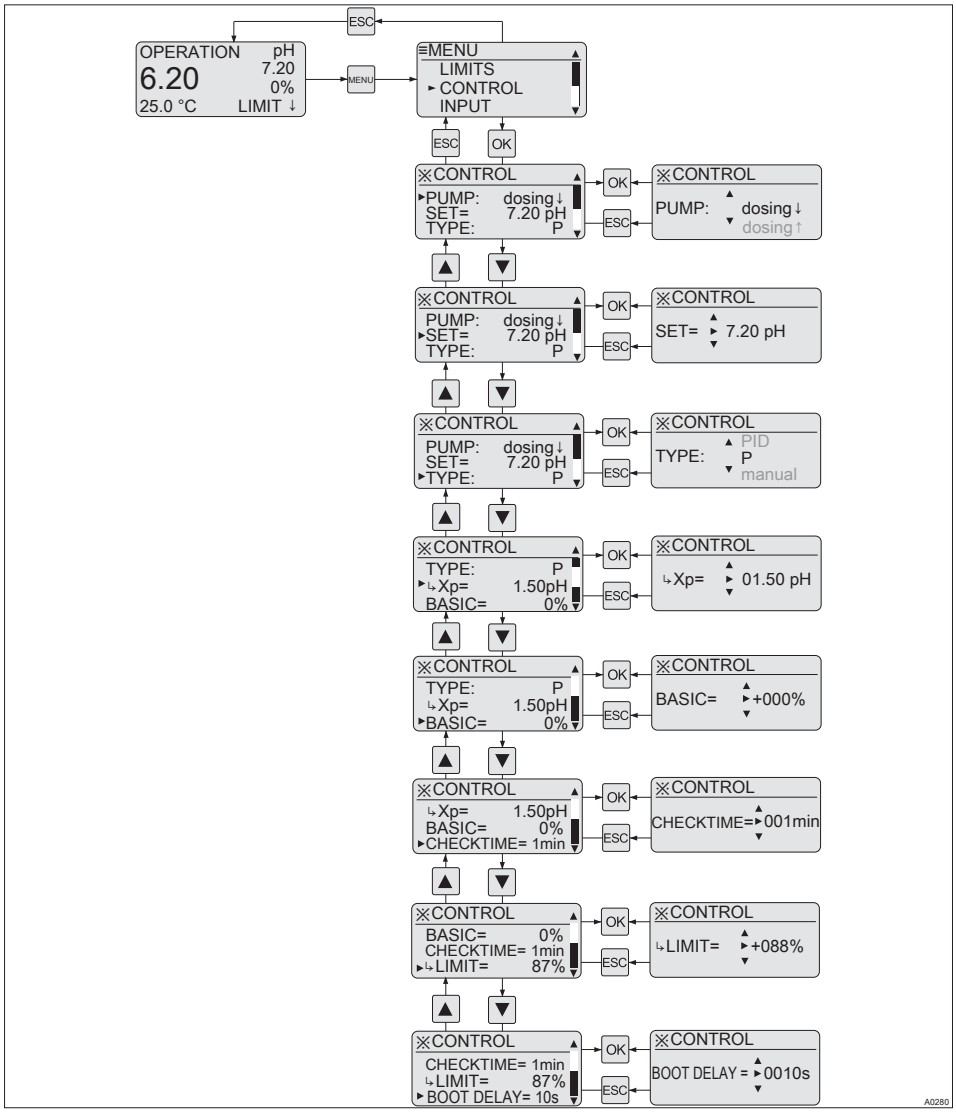


Fig. 29: Setting the control [CONTROL]

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remark
[PUMP]	dosing ↓	dosing ↓ dosing ↑			Mono-directional control direction [2]
[SET]	7.20 pH	0.01 pH	0.00 pH	14.00 pH	pH setpoint
[SET]	750 mV	1 mV	-1000 mV	1000 mV	ORP voltage set-point
[TYPE]	P	P Manual PID			Controller type
[↳Xp]	1.50 pH	0.01 pH	0.01 pH	70.00 pH	P-proportion of the pH control variable
[↳Xp]	100 mV	1 mV	1 mV	3000 mV	P-proportion of the ORP control variable
[↳Ti]	0 s	1 s	0 s	9999 s	PID control integral action time (0 seconds = no I-proportion)
[↳Td]	0 s	1 s	0 s	2500 s	PID control derivative action time (0 seconds = no D-proportion)
[BASIC] [1]	0%	1%	- 100%	100%	Basic load
[↳MANUAL] [1]	0%	1%	- 100%	100%	Manual control value
[CHECK-TIME]	0 min	1 min	0 min	999 min	Control checktime 0 minutes = off

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remark
[↳LIMIT][1]	0%	1%	- 100%	100%	Checktime limit. No basic load, only PID control value
[BOOT DELAY]	0 s	1 s	0 s	9999 s	Control delay period after the start of the meas-uring point. After it is switched on, the unit only meas-ures but does not control during this period.

1 = in an upwards direction with mono-directional control: 0 .. +100% (setting with PUMP: dosing↑), in a downwards direction: -100..0% (setting with PUMP: dosing↓).

2 = When switching over the metering direction, all actuators in the DULCOMETER® Compact Controller are reset to the factory settings for the selected metering direction.

8.5 Input setting (INPUT)

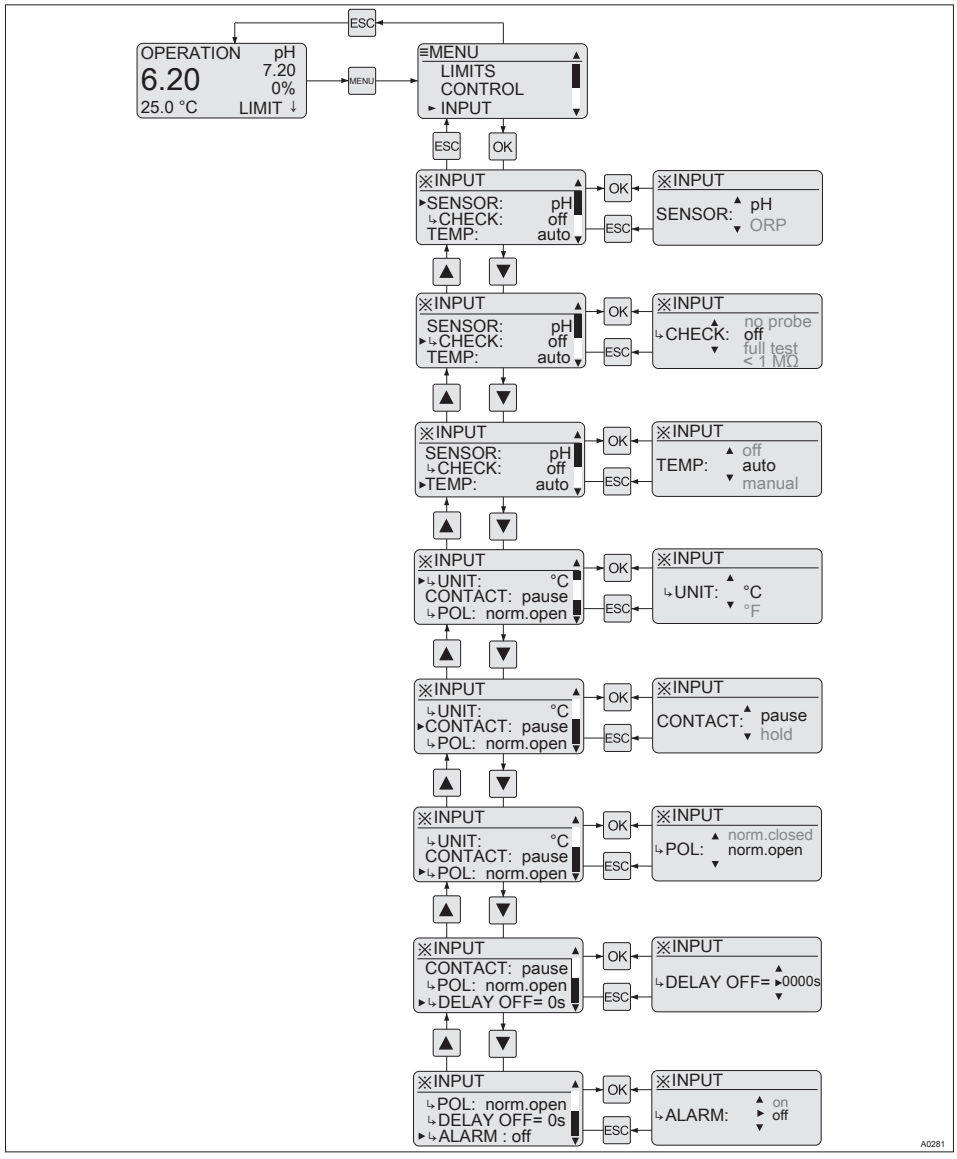


Fig. 30: Input setting (INPUT)

Setting		Possible values			
Display	Starting value	Increment	Lower value	Upper value	Remarks
Sensor	pH	pH			Process variables switchover pH <--> redox [1.]
		ORP			
↳CHECK	off	off			Sensor monitoring *'off'*
		< 1 MΩ			Sensor break check (glass break)
		no probe			Check for presence
		full test			Check for sensor break and presence
TEMP	off	auto			Pt 1000
		manual			manual
		off			Correction off
↳UNIT	°C	°C			Correction variable unit
		°F			
↳VALUE	25.0 °C	0.1 °C	0.0 °C	120.0 °C	Manual correction variable °C
↳VALUE	77.0 °F	0.1 °F	32 °F	248 °F	Manual correction variable °F
CONTACT	pause	pause			Configuration digital contact input
		hold			
↳POL	norm.open	norm.open			Polarity of the contact input
		norm.closed			

[1.] Attention: If this setting is changed, all parameters are reset to the corresponding factory settings

Setting		Possible values			
Display	Starting value	Increment	Lower value	Upper value	Remarks
↳DELAY OFF	0 s	1 s	0 s	1000 s	Contact input switch-off delay. Switching off of the contact input is delayed by this period.
↳ALARM	OFF	ON			Switch on and off use of the alarm relay *'PAUSE/ HOLD'*
		OFF			
1. Attention: If this setting is changed, all parameters are reset to the corresponding factory settings					

↳CHECK = With configured pH measured variables, it is possible to monitor a sensor connected to the potentiometric input for fault states. This check is disabled as standard.

Monitoring for sensor breakage: The sensor breakage check (glass breakage) identifies a defective sensor due to its low internal resistance. Correctly functioning pH sensors have very high resistances with internal resistances in the high MΩ range. The DULCOMETER® Compact Controller is capable of recognising broken sensors from their internal resistance. This function should be deactivated if very low resistance sensors are used.

Check for presence: The "Presence check" identifies a disconnected sensor or a broken cable. This function should be disabled if pH sensors are used which have a high internal resistance across their entire operating range.

8.6 Output setting (OUTPUT)

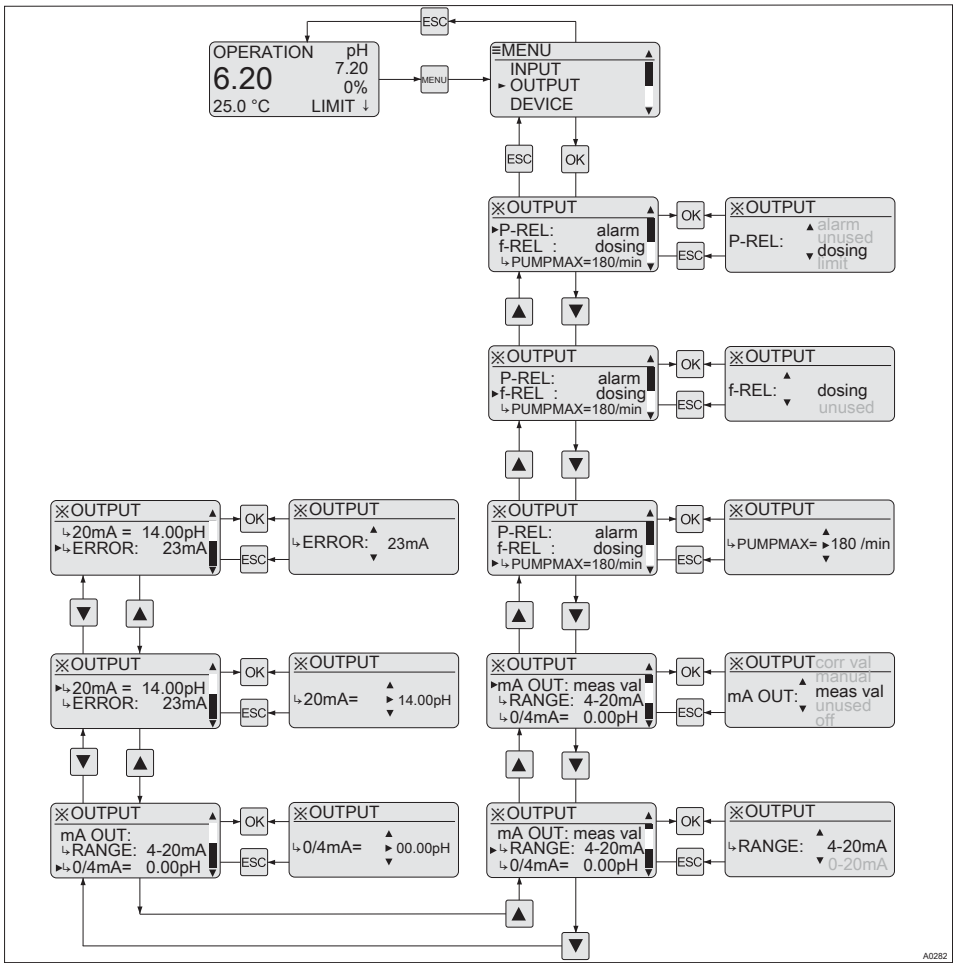


Fig. 31: Output setting (OUTPUT)

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remarks
P-REL (Power relay)	alarm	alarm			Alarm relay
		unused			off
		dosing			PWM relay
		limit			Limit relay
↳PERIOD	60 s	1 s	30 s	6000 s	Cycle time of the PWM control (P-REL = dosing)
↳MIN ON [1]	10 s	1 s	5 s	PERIOD/4 or 999	Minimum switch on period using PWM control (P-REL = dosing)
↳DELAY ON	0 s	1 s	0 s	9999 s	Switch-on delay limit value relay (P-REL = limit)
↳DELAY OFF	0 s	1 s	0 s	9999 s	Switch-off delay limit value relay (P-REL = limit)
f-REL	dosing	dosing			Activation of the low power relay (frequency relay)
		unused			

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remarks
↳PUMPMAX	1 rpm	1	1	500	Maximum stroke rate of the low power relay (frequency relay)
mA OUT (Output value of the mA standard signal output)	meas val	off			off
		meas val			meas val
		corr val			corr val
		dosing			dosing = control value
		manual			manual
↳RANGE	4 - 20 mA	0 - 20 mA			Range of the mA standard signal output
		4 - 20 mA			
↳0/4 mA	2.00 pH	0.01 pH	0.00 pH	14.00 pH	pH value assigned 0/4 mA
↳20 mA	12.00 pH	0.01 pH	0.00 pH	14.00 pH	pH value assigned 20 mA
↳0/4 mA	0 mV	1 mV	-1000 mV	1000 mV	Redox value assigned 0/4 mA
↳20 mA	1000 mV	1 mV	-1000 mV	1000 mV	Redox value assigned 20 mA
↳0/4 mA	0.0 °C	0.1 °C	0.0 °C	120.0 °C	Temp. value assigned 0/4 mA
↳20 mA	100.0 °C	0.1 °C	0.0 °C	120.0 °C	Temp value assigned 20 mA

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remarks
↳0/4 mA	32.0 °F	0.1 °F	32.0 °F	248.0 °F	Temp. value assigned 0/4 mA
↳20 mA	212.0 °F	0.1 °F	32.0 °F	248.0 °F	Temp value assigned 20 mA
↳20 mA [2]	- 100 %	1 %	10 %/ - 10 %	100 % / - 100 %	Control value assigned 20 mA (0/4 mA is fixed as 0%)
↳VALUE	4.00 mA	0.01 mA	0.00 mA	25.00 mA	Manual output current value
↳ERROR	off	23 mA			Output current value upon fault, 23 mA
		0/3.6 mA			Output current value upon fault, 0/3.6 mA
		off			off = no fault current is output

1 = The parameter maximum occurs at PERIOD/4 or 999, whichever is smaller

2 = dependent on metering direction, the limits are either -10% and -100% or +10% and +100%

8.7 DEVICE setting

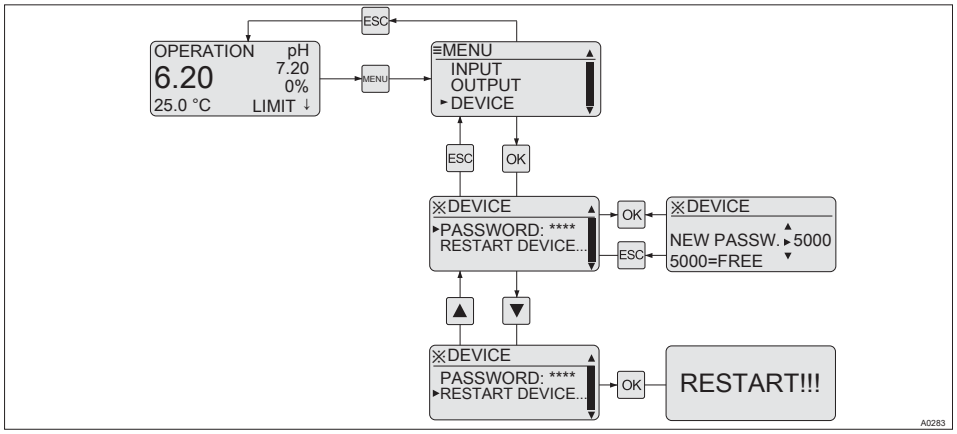


Fig. 32: Device setting

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remarks
Password	5000	1	0000	9999	5000 = no password protection
Restart device					Controller is restarted

9 Control parameters and functions

- **User qualification:** trained user, see ↳ *Chapter 2.2 'Users' qualifications' on page 10*

9.1 DULCOMETER® Compact Controller function states

DULCOMETER® Compact Controller function states have the following priority:

- 1. *'STOP'*
- 2. *'PAUSE/HOLD'*
- 3. *'CAL'* (calibration)
- 4. *'OPERATION'* (normal mode)

"CAL" (calibration) peculiarities

- Control goes to basic load, mA measurement outputs are frozen
- New faults are detected, however they have no effect on the alarm relay or the mA output
- Detection of measurement variable relevant faults during *'CAL'* (calibration process) are suppressed (e.g. LIMIT↑)

"PAUSE" peculiarities

- Control is switched to 0% control variable. The I-proportion is saved
- New faults are detected, however they have no effect on the alarm relay or the mA output
- Special case alarm relay in *'PAUSE'*: If activated the output relay switches to *'PAUSE'* (error message CONTACTIN)

"HOLD" peculiarities

- Control and all other outputs are frozen
- New faults are detected, however they have no effect on the alarm relay or the mA output. However the effect of already existing faults (e.g. fault current) remains
- Special case alarm relay: Activation of the frozen alarm relay is permitted (= no alarm), if all faults have been acknowledged or have disappeared
- Special case alarm relay in *'HOLD'*: If activated the output relay switches to *'HOLD'* (error message CONTACTIN)

"STOP" peculiarities

- Control OFF
- New faults are detected, however they have no effect on the alarm relay or the mA output
- The alarm relay is switched off in *'STOP'*

Peculiarities of the "START" event, i.e. switching from "STOP" to "OPERATION" (normal mode)

- Fault detection starts afresh, all existing faults are deleted

Generally applicable information

- If the cause of a fault disappears, then the fault message in the LCD footer disappears.
- A previously existing *'PAUSE/HOLD'* state is not influenced by starting a *'CAL'* (calibration) process. If during *'CAL'* (calibration) the functional state *'PAUSE/HOLD'* is released, then all states will remain frozen until the end of the *'CAL'* (calibration) process.

- If *'CAL'* (calibration) is started while functional state *'OPERATION'* (normal mode) is active, then the functional state *'PAUSE/HOLD'* is ignored until *'CAL'* (calibration) completes. However STOP/START is possible at any time
- An alarm can be acknowledged or removed as follows: By clearing all faults by pressing the STOP START key and the OK key while the continuous display is visible

9.2 STOP/START key

The control function is started / stopped by pressing the STOP START key. The STOP START key can be pressed independently of the currently displayed menu. However, the [STOP]state is only shown in the continuous display.

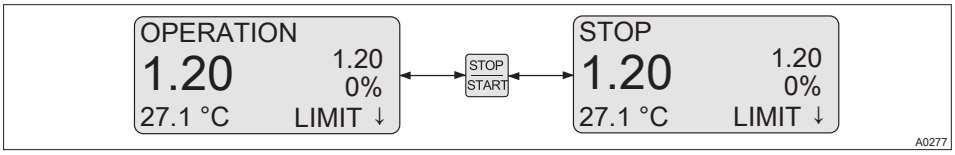


Fig. 33: STOP START-Key

When the controller is first switched on, the controller is in *[STOP]*status.

Upon certain defined fault conditions, the controller switches to the *[STOP]*status. The control is then off (= 0 % control variable).

To differentiate between the fault-related *[STOP]* and the operating status *[STOP]* by pressing the STOP START key, instead of *[STOP]*the identifier *[ERROR STOP]* is displayed.

Pressing the STOP START key causes operating status *[ERROR STOP]* to change to operating status *[STOP]* . Pressing STOP START once more causes the controller to be started again.

In *[STOP]*state, the controller must be started manually by pressing the STOP START key.

[STOP] of the controller causes the following:

- Control is stopped
- The P-relay functioning as a limit value relay and a PWM relay are switched to the de-energised state
- The P-relay acting as an alarm relay activates (no alarm)

Restarting of the controller causes the following:

- If a *[STOP]*state existed, then the controller must be manually started after being switched back on.
- Fault detection starts afresh, all existing faults are deleted

9.3 Priming (PRIME)

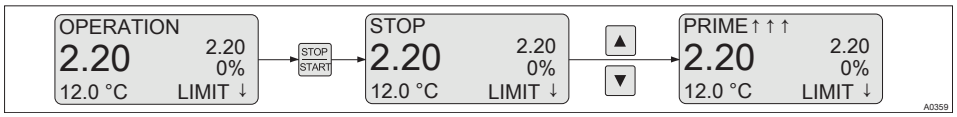


Fig. 34: Priming, e.g. to vent a pump

While the continuous display is visible and the states *'STOP'* or *'OPERATION'* are active, simultaneously pressing ▲ and ▼ causes the priming function *'PRIME'* to be started.

At the same time, dependent on the configuration of the controller, the output relay (P-REL) is actuated at 100 %, the frequency relay (f-REL) is actuated at 80 % of "PUMPMAX" and 16 mA is output at the mA output. However this is only the case if these outputs are set as actuator *'dosing'*.

The power relay (P-REL) starts after priming in an activated state.

You can use this function, for example, to transport the feed chemical up to the pump to vent the metering line.

9.4 Hysteresis limit

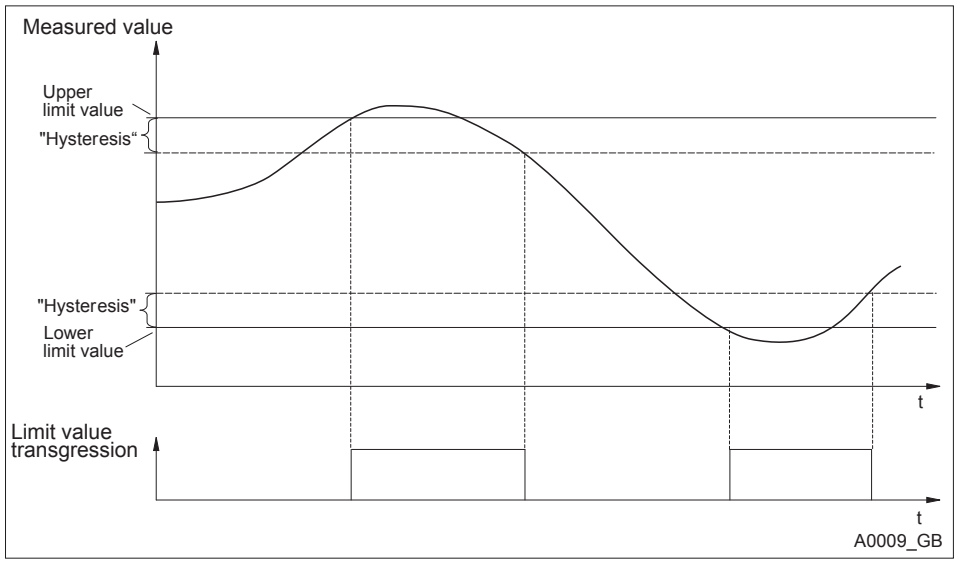


Fig. 35: Hysteresis

Upper limit value = LIMIT↑ Lower limit value = LIMIT↓

The range between LIMIT↑ and LIMIT↓ is the **valid measuring range.**

The DULCOMETER® Compact Controller has fixed *'hysteresis'*.

Measured variable	Hysteresis
pH	0.28 pH
Redox	20 mV

The *'Hysteresis'* acts to cause an increase in the limit value transgression, i.e. if the *'Limit↑'* of e.g. pH 7.5 was exceeded, then the criterion for a limit value transgression is only removed again when the value falls below pH 7.22. The hysteresis behaviour for a *'Limit↓'* functions in an analogue way (the hysteresis value is here added to the Limit↓), for example *'Limit ↓'* pH 4.00, hysteresis pH 0.28, then the limit value transgression criterion is only removed again when the pH exceeds 4.28.

9.5 Temperature correction variable for pH

The correction variable compensates for the effect of the temperature of the medium on the measured value. The correction variable is the temperature of the medium to be measured. The temperature of the medium affects the pH value to be measured.

Operating modes

- *[off]*: No temperature compensation takes place
  - For measurements which do not require temperature compensation
- *[auto]*: The DULCOMETER® Compact Controller evaluates the temperature signal of the connected temperature sensor
  - For measurements using a temperature sensor (Pt1000) (0 -120 °C)
- *[manual]*: The temperature of the medium to be measured has to be measured by the user. The measured value is then entered using the keys ▼ and ▲ in the parameter *'VALUE'* in the DULCOMETER® Compact Controller and saved using the key OK
  - For measurements where the medium to be measured has a constant temperature, which has to be taken into account in the control process

9.6 Checkout time for measured variable and correction variable

Error text	Description
LIMIT ERR	Checkout time of the measured variable
TLIMITERR	Checkout time of the correction variable

If upon the expiry of the checkout time, the valid measuring range is not reached, then the DULCOMETER® Compact Controller exhibits the following behaviour:

- **LIMIT ERR:** The control is switched off. An error current is emitted, provided the output is configured as a measured variable output
- **TLIMITERR:** The control is switched off. An error current is emitted, provided the output is configured as a correction variable output or a measured variable output

Initially the transgression of a limit is only a limit value transgression. This leads to a *'WARNING'*. Switching on the control time *'TIMELIM'* (> 0 minutes), creates an alarm from the limit value transgression. In the event of a *[TLIMITERR]* a, the control switches to *[STOP]*.

9.7 Checkout time control

Monitoring of the control path

The checkout time monitors the control path. The checkout time mechanism permits detection of possible defective sensors.

Dead time determination

Each control path has a dead time. The dead time is the time, which the control path requires to detect a change or addition of metered chemicals using its own instrumentation.

You must select the checkout time so that it is greater than the dead time. You can determine the dead time, by operating the metering pump in manual mode and, for example, dosing acid.

NOTICE!

Dead time determination

You should only determine the dead time if the current process cannot be negatively influenced by the manual metering.

You must determine the time, which the control path (i.e. the entirety of controllers, sensors, measurement water, flow gauges, etc.) requires to detect a first change in the measured value starting from the beginning of dosing. This time is the *'dead time'*. A safety margin, e.g. 25%, must be added to this dead time. You must allocate an appropriate safety margin for your own particular process.

The parameter *'LIMIT'* can be used to set a limit for the control variable. If the control variable exceeds this limit value, the CHECKTIME fault is triggered (checkout time of the control has elapsed). The control is switched to basic load and a fault current output.

9.8 Power relay "P-REL" as limit value relay

The power relay *'P-REL'* can be configured as a limit value relay. It always act only on the measurement variable, whereby the limits are set in *'LIMITS'* . The relay is activated upon infringement of either the top or lower limit values.

Constant checking is carried out to determine whether a limit has been infringed and if this is interrupted with the power relay configured *'P-REL= limit'* for at least *'DELAY ON'* seconds, then the relay is activated. If the limit value transgression disappears for at least *'DELAY OFF'* seconds, then the limit value relay is again deactivated.

The limit value relay is deactivated immediately upon: *'STOP'*, user calibration, *'PAUSE'* and *'HOLD'*.

9.9 Setting and functional description of "Relay Used as a Solenoid Valve"

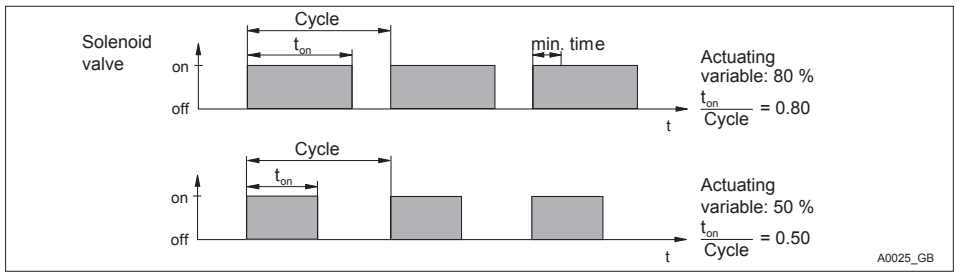


Fig. 36: Solenoid valve (= P-REL: dosing)

min. time *[MIN ON]* Cycle = *[PERIOD]* (in seconds)

Solenoid valve switching times

The switching times of the relay (solenoid valve) depend on the cycle time, the control variable and the 'min. time' (smallest permissible switch-on time for the connected device). The actuating variable determines the ratio t_{on}/cycle and thus also the switching times.

The 'min. time' affects the switching times in two situations:

1. Theoretical switching time < min. time

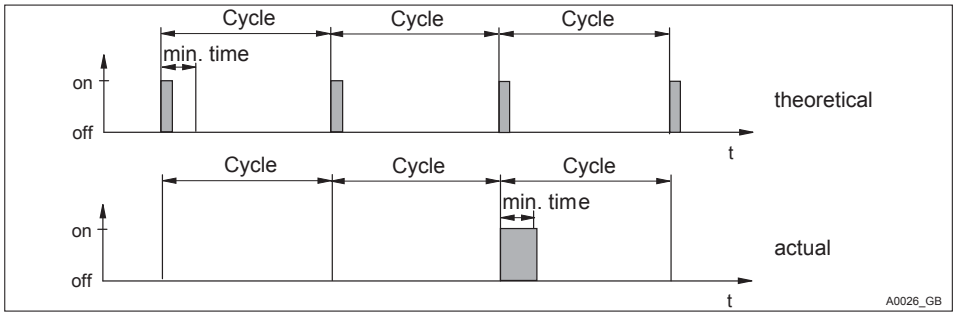


Fig. 37: Theoretical switching time < min. time

min. time *[MIN ON]*
Cycle = *[PERIOD]* (in seconds)

The DULCOMETER® Compact Controller does not switch on for a certain number of cycles until the sum of the theoretical switching times exceeds *'min. time'* . Then it switches for the duration of this total time.

2. Theoretical switching time > (cycle - min. time)

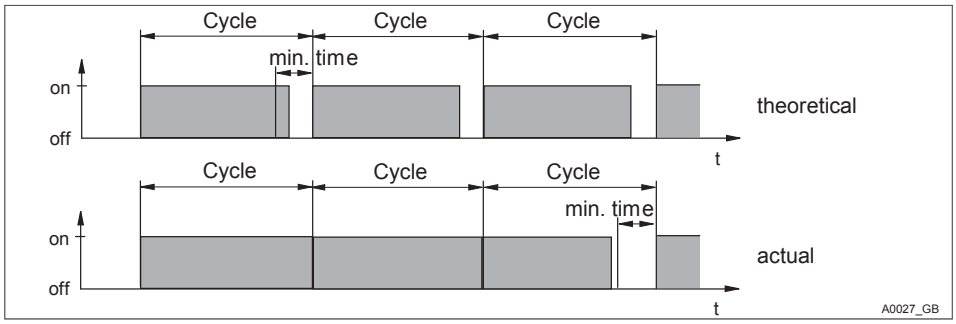


Fig. 38: Theoretical switching time > (cycle - min. time) and calculated switching time < cycle

min. time *[MIN ON]*
Cycle = *[PERIOD]* (in seconds)

The DULCOMETER® Compact Controller does not switch off for a certain number of cycles until the differences between the cycle and the theoretical switching time exceed *'min. time'* .

9.10 Alarm relay

The alarm relay triggers in *'OPERATION'* (normal mode) if an error occurs which has been defined as *'ERROR'* and not just as *'WARNING'*.

The error message *'ALARM'* in the continuous display is marked with a ✻ (star) and can be acknowledged with the OK key. The alarm and the ✻ will then disappear.

9.11 "Error logger" operating mode

The last three errors are displayed. Also displayed is how long ago (in minutes) they occurred. When a new fault occurs, the oldest fault is deleted.

Faults are only shown which occur in operating status *'OPERATION'*, i.e. not in operating status *'STOP'*, *'CAL'* (user calibration), *'HOLD'* or *'PAUSE'*.

Only *'ERRORs'* are shown, not *'WARNINGS'*, e.g. a *'LIMIT ERR'* is shown, but not *'LIMIT↑'*.

A fault, whose display has lasted for 999 minutes is automatically deleted from the *'Error Logger'*. The *'Error Logger'* is neither saved nor backed up in the event of power loss.

10 Maintenance

- **Users' qualification:** trained user, see *Chapter 2.2 'Users' qualifications' on page 10*

The DULCOMETER® Compact Controller is maintenance free.

10.1 Changing the fuse, DULCOMETER® Compact Controller

WARNING!

Danger from electrical voltage

Possible consequence: Fatal or very serious injuries.

- The DULCOMETER® Compact Controller does not have a mains switch
- When working inside the control unit, disconnect the control unit from the mains power via an external switch or by removing the external fuse

NOTICE!

Use only 5 x 20 mm micro-fuses

Possible consequence: Damage to the product or its surroundings

- 5x20 T 0.315 A
- Part number 732404

Fuse change

The mains fuse is located in a sealed fuse holder in the inside of the device.

1. Disconnect the controller from the mains power
2. Open the controller and fold the controller housing top section to the left
3. Remove the PCB cover
4. Remove the micro-fuse using a suitable tool
5. Fit the micro-fuse using a suitable tool
6. Refit the PCB cover
7. Replace controller housing top section and close the controller

10.2 Fault reporting and troubleshooting

- **Users' qualification for diagnostics:** trained user, see *Chapter 2.2 'Users' qualifications' on page 10*. Further measures depend on the type and scope of possible troubleshooting measures to be carried out.

Fault reporting and troubleshooting

Display	Description / cause	Status[1]	Mode[2]	Measured variable output[3]	Correction variable output[4]
pH/mV RANGE ↓	Input voltage too low	Error	Basic load	Fault current	-
pH/mV RANGE↑	Input voltage too high	Error	Basic load	Fault current	-
T RANGE ↓	Measured temperature beneath measuring range	Error	Basic load	Fault current	Fault current
T RANGE ↑	Measured temperature above measuring range	Error	Basic load	Fault current	Fault current
CAL ERROR	No valid user calibration exists	Error	-	-	-
NO PROBE	If activated: pH sensor monitoring outputs: no sensor	Error	Basic load	Fault current	-
PROBE ERR	If activated: pH sensor monitoring outputs: sensor break	Error	Basic load	Fault current	-
CHECK-TIME	Control checkout time elapsed	Error	Basic load	Fault current	-
mA RANGE ↑	mA output current has an upper limit	Error	-	-	-

Display	Description / cause	Status[1]	Mode[2]	Measured variable output[3]	Correction variable output[4]
mA RANGE ↓	mA output current has a lower limit	Error	-	-	-
LIMIT ↑	Measured variable exceeds upper set limit	Warning	-	-	-
LIMIT ↓	Measured variable falls below lower set limit	Warning	-	-	-
T LIMIT ↑	Correction variable exceeds upper set limit	Warning	-	-	-
T LIMIT ↓	Correction variable falls below lower set limit	Warning	-	-	-
LIMIT ERR	Set checkout time for monitoring the measurement variable limits has elapsed	Error	Stop	Fault current	-
TLIMITERR	Set checkout time for monitoring the correction variable limits has elapsed	Error	Stop	Fault current	Fault current
NO CAL	No valid user calibration exists	Warning	-	-	-
CONTACTIN	If activated: Power relay is activated in *'PAUSE/HOLD'*	Error	-	-	-

1 = *[Status]* Error status after occurrence of the fault (error means: alarm relay deactivates, *'*'* is displayed before the error message, can be acknowledged with OK)

2 = *[Mode]* Resulting controller mode (relates to control variable and thus, as necessary, mA output)

3 = *[Measured variable output]* Consequence for the current output, if this is set as *'a measured variable output'*

4 = *[Correction variable output]* Consequence for the current output, if this is set as *'a correction variable output'*

11 Technical data DULCOMETER® Compact Controller

11.1 Permissible ambient conditions

Degree of protection (IP)

The controller fulfils the IP 67 degree of protection requirements (wall/pipe mounting) or IP 54 (control panel mounting). This degree of protection is only achieved if all seals and threaded connectors are correctly fitted.

Permissible ambient operating conditions

Temperature	-10 °C ... 60 °C
Air humidity	< 95 % relative air humidity (non-condensing)

Permissible ambient storage conditions

Temperature	-20 °C ... 70 °C
Air humidity	< 95 % relative air humidity (non-condensing)

11.2 Sound Pressure Level

No noise generation measurable

11.3 Material data

Part	Material
Housing lower and upper section	PC-GF10
Bracket rear side housing bottom section	PPE-GF20
Operating film	Polyester PET membrane
Seal	Expanded PUR
Cover screws	Stainless steel A2
Profile seal (control panel mounting)	Silicone

11.4 Chemical Resistance

The device is resistant to normal atmospheres in plant rooms

11.5 Dimensions and weights

Complete device:	128 x 137 x 76 mm (W x H x D)
Packaging:	220 x 180 x 100 mm (W x H x D)
Weight of device without packaging:	approx. 0.5 kg
Gross weight of device with packaging:	approx. 0.8 kg

12 Electrical data

Mains connection	
Nominal voltage range	100 – 230 VAC ±10 %
Frequency	50 – 60 Hz
Current consumption	50 – 100 mA

The mains connection is isolated from other switching parts by reinforced insulation. The device has no mains switch; a fuse is fitted.

Power relay (P-relay)	
Loading of switching contacts	5 A; no inductive loads

Outputs galvanically isolated from other switching parts by reinforced insulation.

Digital input	
Open circuit voltage	15 V DC max.
Short circuit current	approx. 6 mA
Max.switching frequency	Static For switching processes such as *'PAUSE'*, *'HOLD'*, etc.

NOTICE!

Do not supply with voltage

For the connection of an external semi-conductor or mechanical switch.

mA Output	0 - 20 mA	4 - 20 mA	manual
Current range	0 – 20.5 mA	3.8 – 20.5 mA	0 - 25 mA
In the event of a fault	0 or 23 mA	3.6 or 23 mA	
Max. load	480 Ω at 20.5 mA		
Max. output voltage	19 V DC		
Overvoltage-resistant up to:	±30 V		
Output accuracy	0.2 mA		

Galvanically isolated from all other connections (500 V)

mV input	
Measuring range	-1 V ... + 1 V 0 pH ... 14 pH
Measurement accuracy	±0.25 % of the measuring range
Sensor monitoring of input (low resistance threshold) (can be switched off)	< 500 kΩ ... 1 MΩ (short circuit)
Sensor monitoring of input (high resistance threshold) (can be switched off)	no pH sensor connected
Display glass sensor resistance of ProMinent pH sensor	0 ... 5000 MΩ
Overvoltage-resistant up to:	±5 V

Pump control (f-relay)	
Max. switching voltage:	50 V (protective low voltage)
Max. switching current:	50 mA
Max. residual current (open):	10 µA
Max. resistance (closed):	60 Ω
Max. switching frequency (HW) at 50% filling factor	100 Hz

Digital output galvanically isolated from all other connections via OptoMos relay.

Temperature input	
Temperature measuring range:	0...120 °C
Measuring flow:	approx. 1.3 mA
Measuring accuracy:	±0.8 % of measuring range
Overvoltage-resistant up to:	±5 V
Short circuit-resistant	Yes

For connection of a Pt1000 temperature sensor using a 2-wire system. Not galvanically isolated from the mV input

13 Spare parts and accessories

Spare parts	Part number
Fine fuse 5x20 T 0.315 A	732404
Wall/tube retaining bracket	1002502
Guard terminal top part (knurled nut)	733389
Measured variable labels	1002503
DMT fixing strap	1002498
Cable connection set DMTa/DXMa (metric)	1022312
Controller housing lower part (processor/PCB), fully assembled	Identity code DCCA_E_E1 ...
Controller housing top part (display/operating part), fully assembled	Identity code DCCA_E_E2 ...

Accessories	Part number
Mounting kit for control panel installation	1037273
Check strap	1035918

14 Replacing spare part units

- **User qualification, mechanical installation:** trained qualified personnel, see ↳ *Chapter 2.2 'Users' qualifications' on page 10*
- **User qualification, electrical installation:** Electrical technician, see ↳ *Chapter 2.2 'Users' qualifications' on page 10*

⚠ CAUTION!

Check strap for strain relief

Possible consequence: Material damage.

The ribbon cable and its base cannot be mechanically stressed. Hence it is essential when mounting the controller in the control panel, that the check strap (part number 1035918) is fitted for strain relief and mechanical fixing. Without the check strap, the ribbon cable or its base could be damaged if they were to fall out of the top part of the controller housing.

14.1 Replacing the top part of the housing

! NOTICE!

Ribbon cable base

The base of the ribbon cable is firmly soldered onto the PCB. The base cannot be removed. Open the base lock (3) to loosen the ribbon cable, see Fig. 39

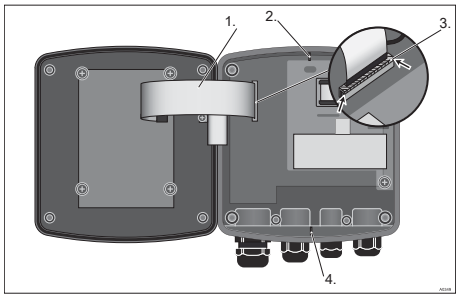


Fig. 39: Loosening the ribbon cable

1. Undo four screws and open the DULCOMETER® Compact Controller
2. Open the right and left lock (3) (arrows) on the base and pull the ribbon cable (1) out of the socket
3. The catches (2 and 4) are not needed with units for control panel installation.

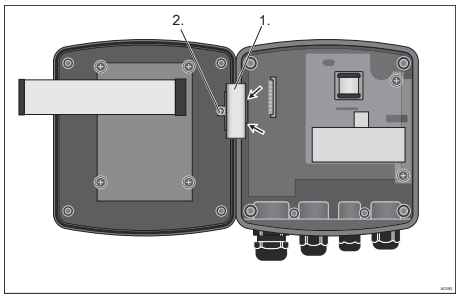


Fig. 40: Dismantling the hinge

4. Remove the screw (2), unclip the hinge (1) on the lower part of the controller housing (arrows) and remove the hinge

5. With control panel installation: Remove the two screws and remove the strain relief

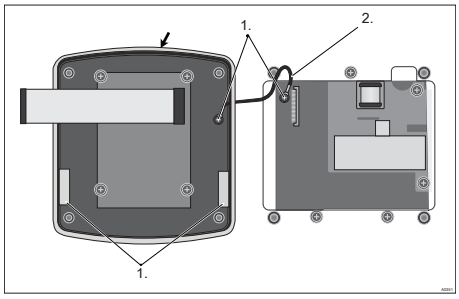


Fig. 41: With control panel installation: Fit the profile seal onto the top part of the controller housing

6. With control panel installation: Position the profile seal (arrow) evenly into the groove in the top part of the DULCOMETER® Compact Controller housing. Arrange the flaps (3) as shown in the figure

7. With control panel installation: Secure the strain relief (2) using two screws (1)

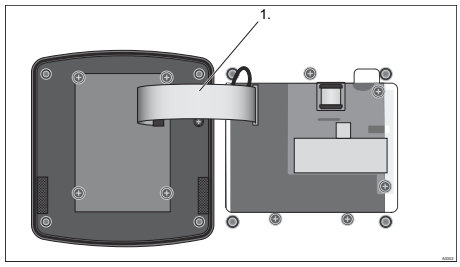


Fig. 42: Pushing and locking the ribbon cable in its base

8. Push and lock the ribbon cable (1) in its base

9. Fit the hinge

10. Screw the top part of the controller housing onto the lower part of the DULCOMETER® Compact Controller housing

11. With control panel installation: Re-check that the profile seals are fitted properly

    ⇨ Re-check that the seal is seated properly. Only if the mounting is correct, can IP 67 (wall/pipe mounting) or IP 54 (control panel mounting) degree of protection be achieved

14.2 Replacing the lower part of the housing (wall/tube retaining bracket)

Complete commissioning of the controller

Once the lower part of the housing has been replaced, it is necessary to fully commission the measuring and control point, as the new lower part of the housing does not have specific settings, only factory settings.

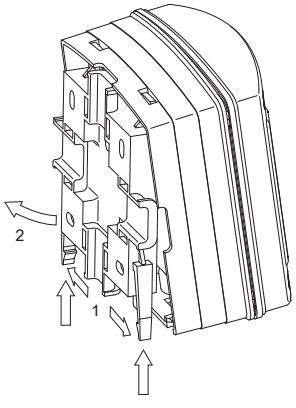


Fig. 43: Removing the wall/tube retaining bracket

1. Remove the wall/tube retaining bracket. Pull the two snap-hooks (1) outwards and push upwards

NOTICE!

Ribbon cable base

The base of the ribbon cable is firmly soldered onto the PCB. The base cannot be removed. Open the base lock (3) to loosen the ribbon cable, see Fig. 39

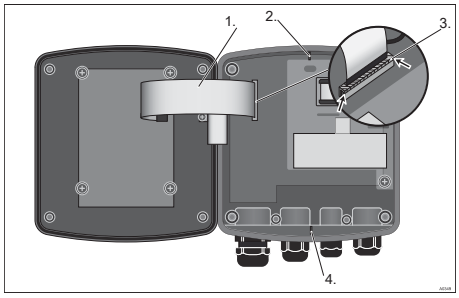


Fig. 44: Loosening the ribbon cable

2. Undo four screws and open the DULCOMETER® Compact Controller

3. Open the right and left lock (3) (arrows) on the base and pull the ribbon cable (1) out of the base. The catches (2 and 4) are used to aligned the two halves of the housing.

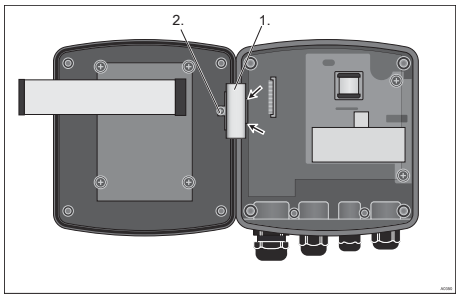


Fig. 45: Dismantling the hinge

4. Remove the screw (2), unclip the hinge (1) on the lower part of the controller housing (arrows) and remove the hinge

5. Label the cable connectors fitted to distinguish them and remove the cables from the lower part of the controller

Preparing the new lower part of the controller housing

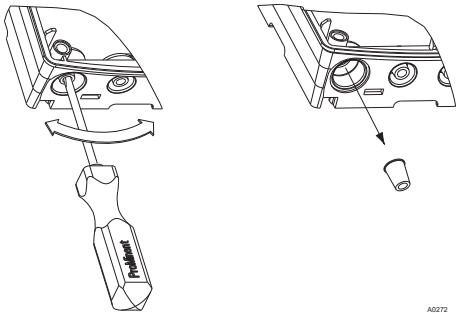


Fig. 46: Punching out the threaded holes

6.

Large threaded connection (M 20 x 1.5)

Small threaded connection (M 16 x 1.5)

Punch out as many threaded holes on the bottom of the lower part of the controller housing as required

Fit the cable and threaded connectors

7. Guide the cable into the respective reducing inserts

8. Insert the reducing inserts into the threaded connectors

9. Guide the cable into the controller

10. Connect the cable as indicated in the terminal diagram

11. Screw in the required threaded connectors and tighten

12. Tighten the threaded connector clamping nuts so that they are properly sealed

Refit the controller

13. Fit the hinge

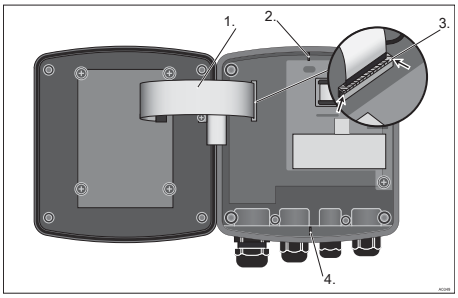


Fig. 47: Fix the ribbon cable

14. Push and lock the ribbon cable (1) in its base. The catches (2 and 4) are used to aligned the two halves of the housing.

15. Screw the top part of the controller housing onto the lower part of the DULCOMETER® Compact Controller housing

16. Re-check that the seal is seated properly. IP 67 degree of protection (wall/pipe-mounting) can only be provided if the installation is correct

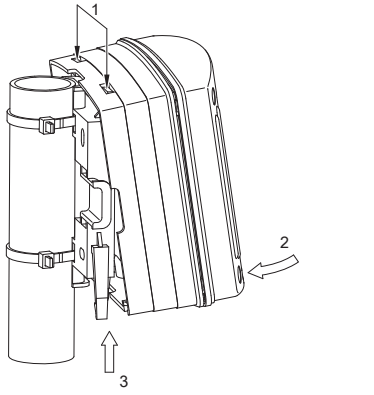


Fig. 48: Suspend and secure the DULCOMETER® Compact Controller

17. Suspend the DULCOMETER® Compact Controller at the top (1) in the wall/tube retaining bracket and push using light pressure at the bottom (2) against the wall/pipe retaining bracket. Then press upwards (3) until the DULCOMETER® Compact Controller audibly snaps into position

14.3 Replacing the lower part of the housing (control panel installation)

Complete commissioning of the controller

Once the lower part of the housing has been replaced, it is necessary to fully commission the measuring and control point, as the new lower part of the housing does not have specific settings, only factory settings.

NOTICE!

Ribbon cable base

The base of the ribbon cable is firmly soldered onto the PCB. The base cannot be removed. Open the base lock (3) to loosen the ribbon cable, see Fig. 39

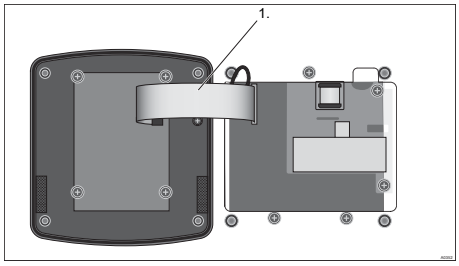


Fig. 49: Loosen the ribbon cable from the base

1. Undo four screws and open the DULCOMETER® Compact Controller

2. Open the right and left lock on the base and pull the ribbon cable (1) out of the base.

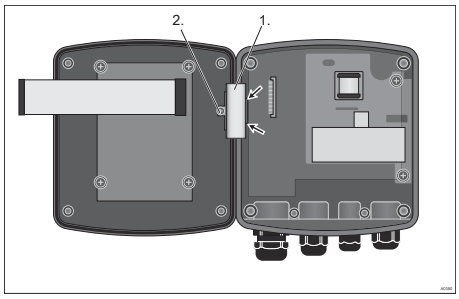


Fig. 50: Dismantling the hinge

3. Remove the screw (2), unclip the hinge (1) on the lower part of the controller housing (arrows) and remove the hinge

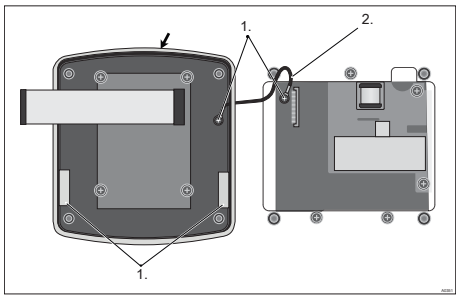


Fig. 51: Removing the strain relief

4. Remove the strain relief (2). Remove the screws (1) to do so.

5. Check the profile seal (arrow), then position the profile seal evenly into the groove in the top part of the DULCOMETER® Compact Controller housing. Arrange the flaps (3) as shown in the figure

6. Remove the top part of the controller housing (3 fixing bolts)

7. Label the cable connectors fitted to distinguish them and remove the cables from the lower part of the controller

Preparing the new lower part of the controller housing

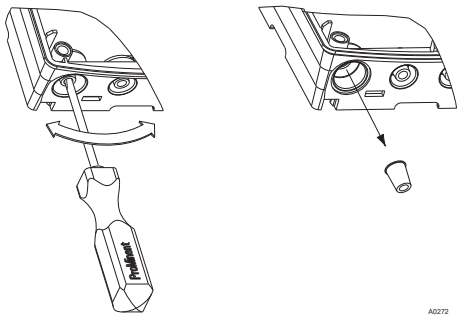


Fig. 52: Punching out the threaded holes

8.

Large threaded connection (M 20 x 1.5)

Small threaded connection (M 16 x 1.5)

Punch out as many threaded holes on the bottom of the lower part of the controller housing as required

Fit the cable and threaded connectors

9. Guide the cable into the respective reducing inserts

10. Insert the reducing inserts into the threaded connectors

11. Guide the cable into the controller

12. Connect the cable as indicated in the terminal diagram

13. Screw in the required threaded connectors and tighten

14. Tighten the threaded connector clamping nuts so that they are properly sealed

Refit the controller

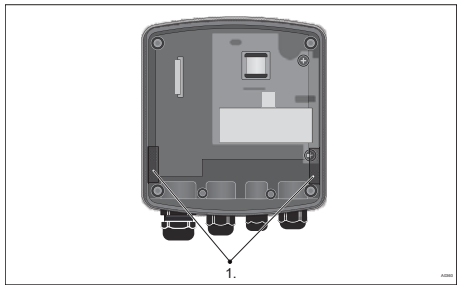


Fig. 53: Fitting the profile seal on the lower part of the controller housing

15. Use pliers to break off the catches. They are not needed for control panel installation

    Position the profile seal evenly around the top edge of the lower part of the DULCOMETER® Compact Controller housing. Arrange the flaps (1) as shown in the figure

    ⇨ Ensure that the profile seal evenly surrounds the top edge of the housing.

16. Insert the lower part of the DULCOMETER® Compact Controller housing with the profile seal from behind into the cut-out and use three screws to secure it in place

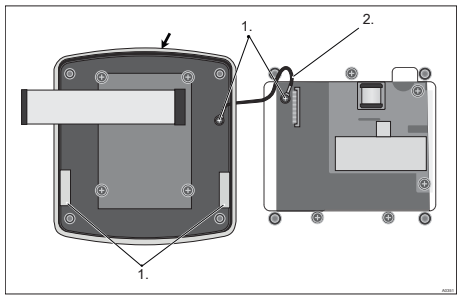


Fig. 54: Fit the profile seal onto the top part of the controller housing

17. Position the profile seal (arrow) evenly into the groove in the top part of the DULCOMETER® Compact Controller housing. Arrange the flaps (3) as shown in the figure

18. Secure the strain relief (2) using two screws (1)

19. Fit the hinge

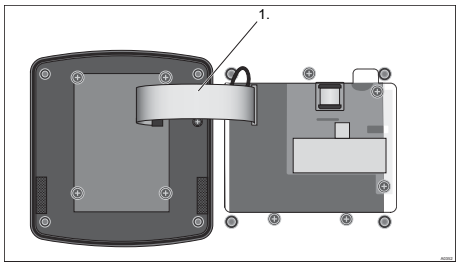


Fig. 55: Pushing and locking the ribbon cable in its base

20. Push and lock the ribbon cable (1) in its base

21. Screw the top part of the controller housing onto the lower part of the DULCOMETER® Compact Controller housing

22. Re-check that the profile seals are fitted properly

    ⇨ IP 54 degree of protection can only be provided if the control panel is mounted correctly

15 Standards complied with and Declaration of Conformity

The EC Declaration of Conformity for the controller is available to download on our homepage.

EN 60529 Specification for degrees of protection provided by housings (IP code)

EN 61000 Electromagnetic Compatibility (EMC)

EN 61010 Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements

EN 61326 Electrical equipment for measuring, control and laboratory use - EMC requirements (for class A and B devices)

16 Disposal of Used Parts

- **User qualification:** instructed user, see *Chapter 2.2 'Users' qualifications' on page 10*

NOTICE!

Regulations governing the disposal of used parts

– Note the current national regulations and legal standards which apply in your country

The manufacturer will take back decontaminated used units providing they are covered by adequate postage.

Decontaminate the unit before returning it for repair. To do so, remove all traces of hazardous substances. Refer to the Material Safety Data Sheet for your feed chemical.

A current Declaration of Decontamination is available to download on the ProMinent website.

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ProMinent GmbH
Im Schuhmachergewann 5 - 11
69123 Heidelberg, Germany
Telephone: +49 6221 842-0
Fax: +49 6221 842-419
Email: info@prominent.com
Internet: www.prominent.com

986214, 4, en_GB

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INDUMART Canada
www.indumart.com

Fillable Standard Pressure Gauges

PI-201/2 - Gauge, Pressure, 0-30psi, Indumart, P16T2-FG-30
PI-301 - Gauge, Pressure, 0-15psi, Indumart, P16T2-FG-15
PI-301/2 - Gauge, Pressure, 0-30psi, Indumart, P16T2-FG-30
PI-401/2 - Gauge, Pressure, 0-30psi, Indumart, P16T2-FG-30
PI-501/2 - Gauge, Pressure, 0-30psi, Indumart, P16T2-FG-30
PI-551/2 - Gauge, Pressure, 0-30psi, Indumart, P16T2-FG-30
PI-553/554 - Gauge, Pressure, 0-60psi, Indumart, P16T2-FG-60
PI-703/704 - Gauge, Pressure, 0-60psi, Indumart, P16T2-FG-60
PI-601/602 - Gauge, Pressure, 0-15psi, Indumart, P16K2-FG-15

SERIES: P16

Dial: 1½", 2", 2½", 4"
Accuracy: 1.6%, 2.5%

DESCRIPTION

Indumart *P16 Series* Fillable Standard Pressure Gauges are used at measuring points with high dynamic alternating loads and strong vibrations and pulses. The glycerin filling of the case provides lubrication of the moving parts which protects the measuring system against wear and at the same time ensures smooth pointer movement and thus good readability.

Indumart *P16 Series* pressure gauges have a high level of functional safety and long service lives. These gauges are suitable for applications in hydraulics, compressors and pumps.

Various types of wall or panel mounting configurations are available.

SPECIFICATIONS

Accuracy	1.6% (2½" & 4" dials); 2.5% (1½" & 2" dials)
Dial Sizes	1½" (40 mm), 2" (50 mm), 2½" (63 mm), 4" (100 mm)
Case	St. steel (standard)
Bezel	St. steel; crimped bezel
Connection	Centre back or bottom
Thread	⅛" NPT (1½" dial only), ¼" NPT (2", 2½", 4" dials) ½" NPT (option for 4" dial), BSP thread (option)
Window	Plexiglas
Bourdon Tube	Brass (std.), st. steel (option)
Max. Temperature	60°C
Range	0...10 to 0...8000 psi; 0...60 to 0...60000 kPa; 0...0.6 to 0...600 bar Vacuum and compound ranges are available; see the Range Table

ORDER CODES

Model P16 ☐ ☐ – ☐

CONNECTION
Back — K
Bottom — T

DIAL SIZE
40 mm (1½") — 0
50 mm (2") — 1
63 mm (2½") — 2
100 mm (4") — 4

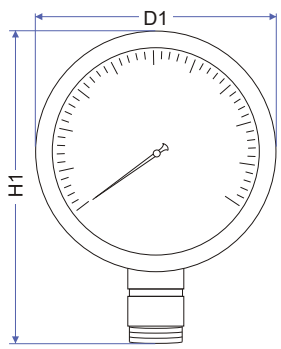
OPTIONS (more than one option may be selected)

Glycerine Filling	FG
Silicon Filling	FS
St. Steel Internal	IT
½" Process Connection (100 mm dial only)	TH
BSP Thread	TB
Back Flange for Wall Mounting (not for 40 mm dial)	MK
Front Flange for Panel Mounting (not for 40 mm dial)	MF
Clamp with 2 Screws (63 mm dial only)	MS

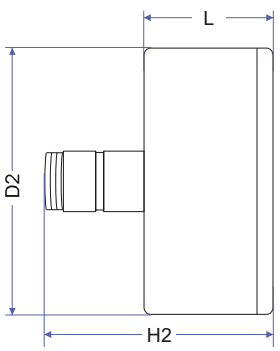
Example: P16T2-FG,IT

DIMENSIONS (mm) & WEIGHT

	Ø40 mm	Ø50 mm	Ø63 mm	Ø100 mm
D1	45	55	68	111
D2	41	51	63	100
H1	70	75	84	145
H2	47	52	57	74
L	29	30	30	35
Weight (g)	100	100	150	400



Bottom connection



Centre back connection

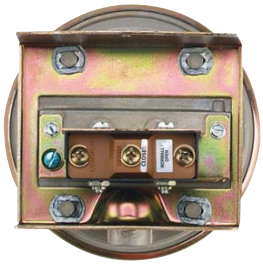
Specifications may change without prior notice.

Series 1800 Low Differential Pressure Switches for General Industrial Service

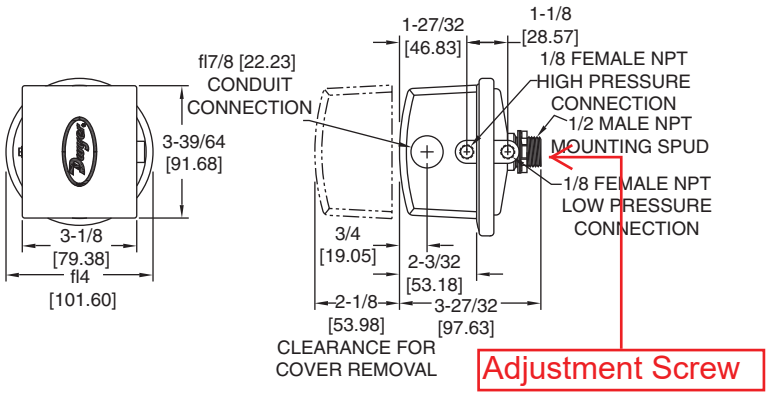
Specifications — Installation and Operating Instructions

PSL-301 - Switch, Pressure, 1823-2
PSL501 - Switch, Pressure, 1823-40
PSL-601/2 - Switch, Pressure, 1823-40
PSL-7911 - Switch, Pressure, 1823-2

Model 1823 pressure switch. UL and CSA Listed, FM and CENELEC approved.



Series 1823 pressure switch. Conduit enclosure removed to show electric switch.



Construction and dimensions. Series 1823 pressure switches.

One of our most popular pressure switches. Combines small size and low price with 2% repeatability for enough accuracy for all but the most demanding applications. Set point adjustment inside the mounting switch on one side of a wall or panel with adjustment easily accessible on the opposite side.

***Model 1823 shown; (1823 replaces 1820, 1821 and 1822 which are similar).**

Environmental (MIL) Switch

Unlisted Model 1820 can be furnished with special snap switch sealed against the environment for high humidity and/or for government applications. Similar to standard Model 1823 except dead band is slightly greater. Specify Model 1820 (Range No.) "MIL" in ordering.

SERIES 1823 SWITCHES — OPERATING RANGES & DEADBANDS

Model Number	Operating Range, Inches W.C.	Approximate Dead Band	
		At Min. Set Point	At Max. Set Point
1823-00	0.07 to 0.22	0.05	0.05
1823-0	0.15 to 0.5	0.06	0.06
1823-1	0.3 to 1.0	0.08	0.08
1823-2	0.5 to 2.0	0.10	0.12
1823-5	1.5 to 5.0	0.14	0.28
1823-10	2.0 to10	0.18	0.45
1823-20	3 to 22	0.35	0.70
1823-40	5 to 44	0.56	1.10
1823-80	9 to 85	1.30	3.0

SPECIFICATIONS

Service: Air and non-combustible, compatible gases.

Wetted Materials: Consult Factory.

Temperature Limits: -30 to 180°F (-34 to 82.2°C). 1823-00, -20 to 180°F (-28.9 to 82.2°C).

Pressure Limits: 10 psig (68.95 kPa) continuous, 25 psig (172.4 kPa) surge.

Switch Type: Single-pole double-throw (SPDT).

Repeatability: ±2%.

Electrical Rating: 15 A @ 120-480 VAC, 60 Hz. Resistive 1/8 HP @125 VAC, 1/4 HP @ 250 VAC, 60 Hz. De-rate to 10 A for operation at high cycle rates.

Electrical Connections: 3 screw type, common, normally open and normally closed.

Process Connections: 1/8″ female NPT.

Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.

Set Point Adjustment: Screw type inside mounting spud.

Weight: 1 lb, 5 oz (595 g).

Agency Approvals: CE, UL, CSA, FM.

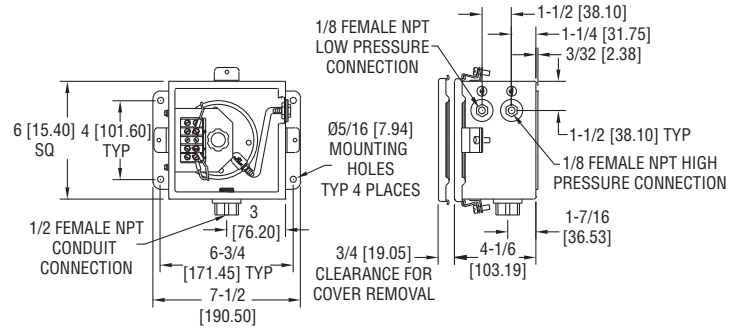
DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Phone: 219/879-8000 www.dwyer-inst.com
Fax: 219/872-9057 e-mail: info@dwyer-inst.com

INSTALLATION

1. Select a location free form excessive vibration and where oil or water will not drip upon the switch. See special housings for unusual conditions.
2. **While not required, positioning the pressure connections down is recommended.** Mount the switch with the diaphragm in a vertical plane. Switch with the diaphragm in a vertical plane. Switch must be recalibrated for each change in operating position.
3. Connect switch to source of pressure differential. Metal tubing with 1/4" O.D. is recommended but any tubing system which will not restrict the air flow is satisfactory. Note that the low pressure connection may be made to the 1/2" spud at the back of the switch if desired. If so connected, drill 1/16" diameter holes in the Spring Retainer flange and the head of Adjustment Screw to provide opening to the switch interior and plug the other low pressure connection.
4. Electrical connections to the standard single pole, double throw snap switch are provided by means of screw terminals marked "common", "norm open", and "norm closed". The normally open contacts close and the normally closed contact open when pressure increases beyond the set point.
5. Switch loads should not exceed the maximum specified current rating of 15 amps resistive. Switch capabilities decrease with high load inductance or rapid cycle rates. whenever and application involves one or more of these factors, the user may find it desirable to limit the switched current to 10 amps or less in the interest of prolonged switch life.

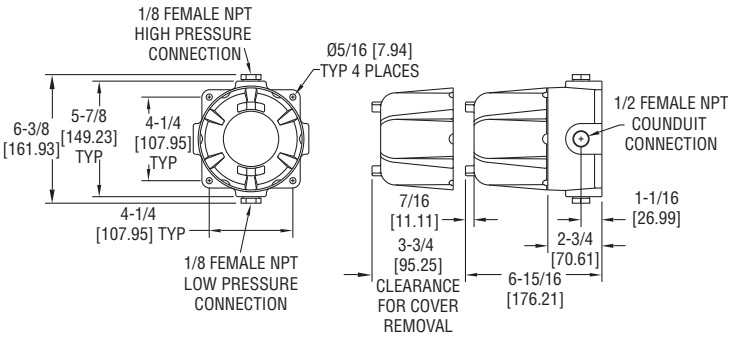
ADJUSTMENT

1. If the switch has been factory preset, check the set-point before placing in service to assure it has not shifted in transit.
2. If switching has not been preset or it is desired to change the point, observe the following procedure:
   a. To adjust the set point turn the slotted Adjustment Screw clockwise to increase the set point and counterclockwise to decrease the set point.
   b. The following is a recommended procedure for calibrating or checking calibration: Use a "T" assembly with three rubber tubing leads, all as short as possible and the entire assembly offering minimum flow restriction. Run one lead to the pressure switch, another to a manometer of known accuracy and appropriate range, and apply pressure through the third tube. Make final approach to the set point slowly. Note the manometer and pressure switch will have different response characteristics due to different internal volumes, lengths of tubing, oil drainage, etc. Be certain switch is checked in position it will assume in use, i.e. vertical, horizontal, etc.



Weatherproof Enclosure

16 ga. steel enclosure for unusually wet or oily conditions. Withstands 200 hour salt spray test. Gasketed cover. Weight 5-1/2 lb (2.5 kg). Switch must be installed at factory. Specify "WP" in addition to switch catalog number.



Explosion-Proof Housing

Cast iron base and aluminum dome cover. Approximate weight 7-1/2 lb (3.4 kg). Specify "EXPL" in addition to switch catalog number.

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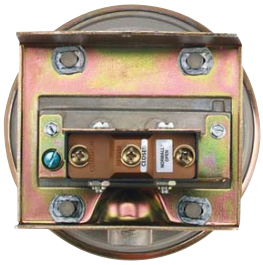
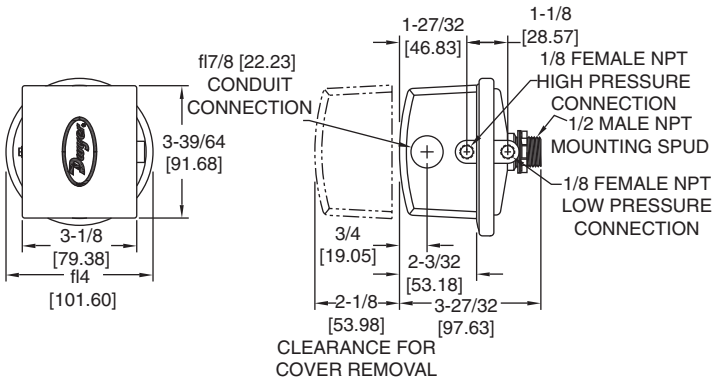
SERIE 1800 Interruptor Para Baja Presión Diferencial

Model 1823 pressure switch. UL and CSA Listed, FM approved.



Series 1823 pressure switch. Conduit enclosure removed to show electric switch.



Construction and dimensions. Series 1823 pressure switches.

Uno de nuestros mas populares interruptores de presión. Combina un pequeño tamaño y bajo precio, con una repetibilidad del 2%, exactitud suficiente para las aplicaciones con mas demanda. El ajuste del punto de operación en un extremo, permite instalar el interruptor de un lado en las pared o tablero, permitiendo acceso al tornillo de ajuste.

Interruptor para Ambiente Húmedo (MIL)

El modelo 1820 puede ser fabricado son un sello especial a prueba de intemperie, o para aplicaciones con alta humedad. Similar al modelo 1823, excepto que la banda de operación es mayor.

Especifique el modelo 1820 (Rango No.) “Mil” en su orden.

Model Number	Operating Range, Inches W.C.	Approximate Dead Band	
		At Min. Set Point	At Max. Set Point
1823-00	0.07 to 0.22	0.05	0.05
1823-0	0.15 to 0.5	0.06	0.06
1823-1	0.3 to 1.0	0.08	0.08
1823-2	0.5 to 2.0	0.10	0.12
1823-5	1.5 to 5.0	0.14	0.28
1823-10	2.0 to10	0.18	0.45
1823-20	3 to 22	0.35	0.70
1823-40	5 to 44	0.56	1.10
1823-80	9 to 85	1.30	3.0

Especificaciones:
Interruptor de presión diferencial operado por diafragma de 4”, para activar un interruptor de presión tipo simple polo doble tiro. El diafragma esta controlado por un resorte calibrado que se puede ajustar para fijar la presión diferencial exacta a la cual el interruptor actuara. El movimiento del diagragma es transmitido al botón del interruptor por un medio mecánico. Interruptor Dwyer Instruments, Inc. Catalogo No. 1823-__ __ para el rango de operación requerido.

SPECIFICATIONS

Service: Air and non-combustible, compatible gases.

Wetted Materials: Consult Factory.

Temperature Limits: -30 to 180°F (-34 to 82.2°C). 1823-00, -20 to 180°F (-28.9 to 82.2°C).

Pressure Limits: 10 psig (68.95 kPa) continuous, 25 psig (172.4 kPa) surge.

Switch Type: Single-pole double-throw (SPDT).

Repeatability: ±2%.

Electrical Rating: 15 A @ 120-480 VAC, 60 Hz. Resistive 1/8 HP @125 VAC, 1/4 HP @ 250 VAC, 60 Hz. De-rate to 10 A for operation at high cycle rates.

Electrical Connections: 3 screw type, common, normally open and normally closed.

Process Connections: 1/8″ female NPT.

Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.

Set Point Adjustment: Screw type inside mounting spud.

Weight: 1 lb, 5 oz (595 g).

Agency Approvals: CE, UL, CSA, FM.

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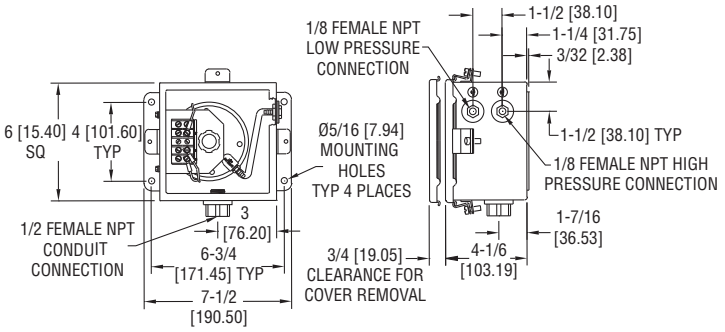
Phone: 219/879-8000 **www.dwyer-inst.com**
Fax: 219/872-9057 **e-mail: info@dwyer-inst.com**

INSTALACIÓN:

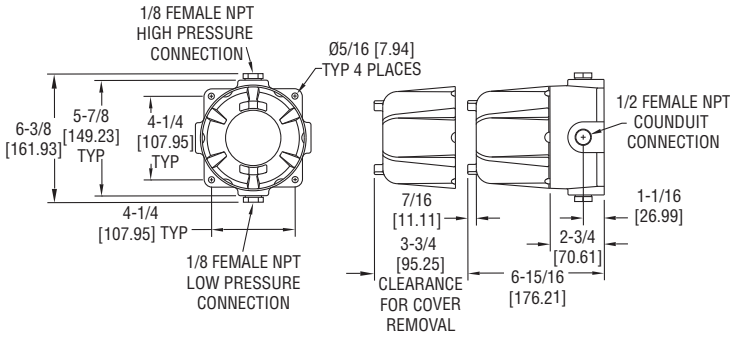
1. Seleccione una ubicación libre de vibración excesiva, en donde el agua o aceite no entre al interruptor. Revise encapsulados especiales para aplicaciones especiales.
2. Mientras no se requiera otra, las conexión de presión inferior es recomendada. Monte el interruptor con el diafragma en posición vertical, el interruptor debe recalibrarse para cada cambio de posición.
3. Conecte el interruptor a la fuente de presión diferencial. Tubo metálico con diámetro de 1/4" es recomendado, pero cualquier sistema de tubería que no restrinja el flujo de aire es bueno.
4. Conexiones eléctricas estándar de los interruptores SPDT, común, NA y NC. Los contactos cambian cuando se incrementa la presión del punto de operación.
5. La carga del interruptor no debe exceder los 15 Amp. Especificados. Las capacidades decrecen con altas cargas inductivas y ciclos rápidos de actuación, por lo que en estos casos los limites de corriente deben ser 10 Amp. 0 menores para incrementar la vida del interruptor.

AJUSTES:

1. Si el interruptor ha sido calibrado en fabrica, revise el punto de operación antes de ponerlo en servico.
2. De lo contrario, siga los siguientes pasos:
   A. Para ajustar el punto de operación, gire el tornillo de calibración en sentido de las manecillas del reloj para aumentar el valor y en contra de las manecillas del reloj para dis minuir el valor del punto de operación.
   B. Lo siguiente se recomienda para calibrar o revisar la calibración: Use una T con tres mangueras plásticas, tan pequeñas como sean posible. Conecte una manguera al interruptor de presión, otra al manómetro y por la tercera aplique la presión de esta forma podrá ajustar el interruptor a la presión requerida lo mas exacto posible.



Encapsulado a Prueba de Intemperie
Encapsulado de acero para condiciones húmedas y/o aceitosas, soporta pruebas de 200 horas de spray salino, pesa 5-1/2 libras. El interruptor debe ser instalado en la planta al momento de su fabricación. Especifique "WP" mas el modelo del interruptor en catalogo.



Encapsulado a Prueba de Explosión
Encapsulado a base de Hierro y Aluminio, pesa aproximadamente 7-1/2 libras. Especifique "EXPL" mas modelo del interruptor en catalogo.

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P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.

Phone: 219/879-8000 www.dwyer-inst.com
Fax: 219/872-9057 e-mail: info@dwyer-inst.com

PSL-7911 - Meter, Flow, Pitot Tube, 4"

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smart technology. sustainable solutions.℠

PITOT TUBE AIR FLOW METERS
PFLOW SERIES

Application:

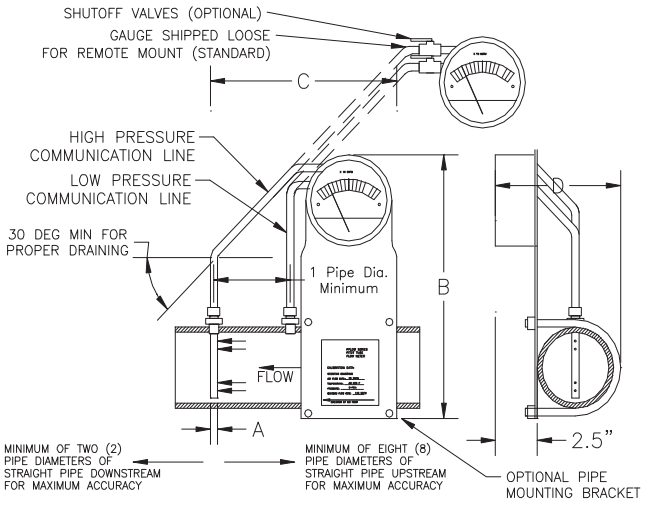
newterra Pitot Tube Air Flow Meters are designed to be a cost effective, accurate flow meters that are calibrated for your site-specific conditions. The unique self draining design allows the meter to function in process lines with high humidity and moisture content as well as dry air lines. The PFLOW meter takes two pressure readings in your process line, one at a high-pressure, zero velocity and one at a low-pressure, full velocity. The pressure differential is used to calibrate the meter for a desired flow and operating conditions. When ordering the flow meter, it is critical to supply: operating temperature, pressure or vacuum in psia, and the pipe ID. The PFLOW meter can be supplied with any scale range required in scfm (25deg C, 14.7psia) or acfm at your listed operating conditions.

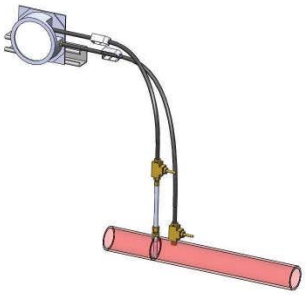
Construction:

The high, static pressure is measured using a 304 Stainless Steel probe inserted into the process line. The probe is designed with 4 measurement ports that provide an average reading for flow through your process pipe. Multiple ports on the static pressure line ensure that you can maintain an accurate reading while the tube is self-draining. The low pressure point is measured by tapping a 1/4" hole in the process line ahead of the high-pressure port. This tapping is completed on the top of the pipe to minimize moisture collection in the pressure communication lines. The differential pressure gauge is connected to the pressure ports using 3/8" Buna-N and the brass connections are capable of handling temperatures as high as 250 deg F. The Dwyer Magnehelic ® gauge provides a large, clear and accurate display of your airflow reading.

Standard Features:

- 304SS static pressure probe
- Brass compression fittings and Buna-N pressure communication tubing
- Direct read display can be calibrated for your specific operating conditions. Display can read ACFM or SCFM but SCFM is recommended as there is less error when the meter is operating above or below the calibrated pressure. Other units are available on request.
- Large 4" display for accurate reading
- Standard gauges are shipped loose for installation in an existing pipeline. The gauges can be wall mounted in site-specific locations. A pipe bracket can be purchased.





Dimensions Chart:

Part Number	A	B	C	D	Pipe
1" PFLOW	1/4"	12"	12"	4.75"	1"
1-1/2" PFLOW	3/8"	12"	12"	5.25"	1.5"
2" PFLOW	3/8"	12"	12"	5.75"	2"
3"PFLOW	1/2"	12"	12"	6.75"	3"
4"PFLOW	1/2"	14"	14"	7.75"	4"
6"PFLOW	1/2"	14"	14"	9.75"	6"
8"PFLOW	1/2"	14"	14"	12"	8"

Larger pitot tubes can be supplied as required.

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PITOT TUBE AIR FLOW METERS
PFLOW SERIES

Specifications:

Maximum Air Temperature:	250 °F (standard) 300 °F (high temp version)	Accuracy:	2.5 % of scale at calibration point
Max. Operating Pressure	15 psig (standard unit) 35 psig (medium pressure unit) 80 psig (high pressure unit)	Pressure Drop:	Less than 2" WC pressure drop in high flow applications
Repeatability:	1% of scale at calibration point		

The following table provides recommended flow rates for each meter at a given operating pressure range. These values are suitable for temperatures between 70-100 deg F. For meter applications outside this temperature range and outside of the operating pressure ranges listed below please contact our sales department for help in choosing a suitable meter.

Operating pressure	Recommended Operating Flow rates (SCFM)				
	0-5 psi	5-10 psi	0-10" Hg	10-20" Hg	20-26" Hg
PFLOW 1"	15-40	17-50	12-35	8-25	6-20
PFLOW 1-1/2"	35-90	40-115	25-75	20-60	15-50
PFLOW 2"	60-160	70-200	50-150	30-100	25-80
PFLOW 3"	135-360	150-450	100-300	75-250	50-180
PFLOW 4"	250-650	275-800	200-550	120-450	100-320
PFLOW 6"	550-1500	600-1800	450-1200	275-1000	200-750
PFLOW 8"	1000-2500	1100-3200	750-2250	500-1750	350-1250

Calibration and Correction Factors:

Each PFLOW pitot tube is calibrated for a specific operating temperature and pressure. If the pitot tube operates at a different pressure or temperature than the original design, the flow measurement can be adjusted with the following equation: (Units of $Flow_1$ and $Flow_2$ will be the same)

$Flow_1 = Flow_2 \times (P_2/P_1 \times ((T_1+460) / (T_2+460))^{1/2}$

Pressure units: psia, Temperature units: °F

Options Table:

Option	Description
Orientation:	The flow meter gauge can be oriented for flows from Left to Right, Right to Left, Up or Down as required for your specific application.
Site Specific Calibration and Gauge Range:	The following information is required to calibrate the flow meter for your specific application: Operating Pressure (psia): Operating Temperature (°F or °C): Operating Flow Rate (acfm or scfm or other scales as required): Maximum Flow rate (better accuracy is achieved when the operating flow rate is approximately ¾ of the scale range of the flow meter)
4-20ma Option	Flow meters can be ordered with 4-20ma outputs for control systems. Three versions are available: Nema 7 (Class 1 Div 1) FM or CSA approved Two Wire Connection: 24VDC+, Signal Output Power Consumption: 20mA 316SS Wetted parts Nema 4 (Weatherproof) or Nema 1 (General Purpose) Three Wire Connection: 24VDC+, 24VDC-, Signal Output Accuracy on all 4-20ma outputs: 2.5% of full scale for meter Aluminum with Silicon diaphragm
Shutoff Valves	The pressure gauges are not designed to operate with water collecting within the internal components. If you will be operating with hot wet air or condensing air streams, then it is recommended that we install shutoff valves in the pressure communication lines to isolate the gauge from the process lines when the operator is not taking a flow reading.
Pre Installed Section of Pipe	The flow meters can be preinstalled in a section of pipe with any configuration of material and fittings on the end. This will allow the PFLOW meter to be factory installed and tested in this section of pipe before leaving our facility.
Pipe Mounting Bracket	A pipe-mounting bracket can be supplied to allow the gauge to mount directly on the pipe as shown in the above picture.

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PITOT TUBE AIR FLOW METERS
PFLOW SERIES

Company Name: _____ Purchase Order Number: _____

Contact Name: _____ Contact Number (PH/FAX):_____/_____

(Note: Please include relevant credit information to set up an account if required.
Ship to Address: _____

Billing Address: _____

Credit Card Orders (Please check card type)

❑ VISA ❑ MASTERCARD

Credit Card Number: _____ Expiry Date (m/y): _____ / _____

Meter Size: (please check box)

❑ 1” ❑ 2” ❑ 4” ❑ 8”

❑ 1-1/2” ❑ 3” ❑ 6”

Process Pipe Material and Schedule: (please check box)

❑ Schedule 40 PVC ❑ Schedule 40 Steel

❑ Schedule 80 PVC ❑ Schedule 80 Steel

For other Materials and Schedule Specify Inner Diameter of Pipe: _____

Orientation: (please check box)

❑ Flow from Left to Right ❑ Flow Up

❑ Flow from Right to Left ❑ Flow Down

4-20mA Output (please check box)

❑ Nema 7, Class 1 Div 1, 316SS, with flow gauge ❑ Nema 7, Class 1 Div 1, 316SS, no direct read display

❑ Nema 4, Weatherproof, with flow gauge ❑ Nema 4, Weatherproof, no direct read display

❑ Nema 1, General Purpose, with flow gauge ❑ Nema 1, General Purpose, no direct read display

❑ None

Calibration Information (Required Information):

Operating Pressure: _____ **Operating Temperature:** _____

Elevation or Atmospheric Pressure: _____

Operating Flow Rate: _____ **Maximum Flow Rate*:** _____

Scfm units are preferred but any flow units can be provided. The operating flow rate should be approximately ¾ of full scale to allow for an accurate reading at that flow rate. Note Lowest accurate reading is at ¼ of full scale.
*Options for Maximum Flow Rates include:1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100 and any scale can be multiplied by 10, 100, 1000, 10000

Switch-Tek

Powered Level Switch

LZ12, LU10, LP15 and LO10 Series Manual

Flowline Inc.
10500 Humbolt Street
Los Alamitos, CA 90720
Tel: (562) 598-3015
Fax: (562) 431-8507
www.flowline.com

About Switch-Pak™ Powered Level Switches: This manual contains information on all four series of powered level switches; Vibration (LZ12 series), Ultrasonic (LU10 series), Optic Leak (LO10 series) and SuperGuard Capacitance (LP15 series). The switches all feature two outputs: 1) a 4 or 20 mA current switch and 2) a 60VA SPST dry contact relay. All four series are manufactured with thermoplastics, including the cable, making them submersible in design and ideal for corrosive applications. Package the switches with either Flowline controllers (LC10 or LC40 series) or interface directly to another controller or PLC.

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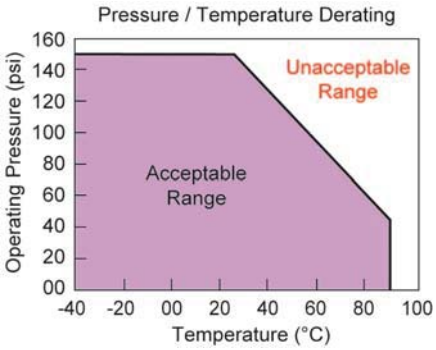
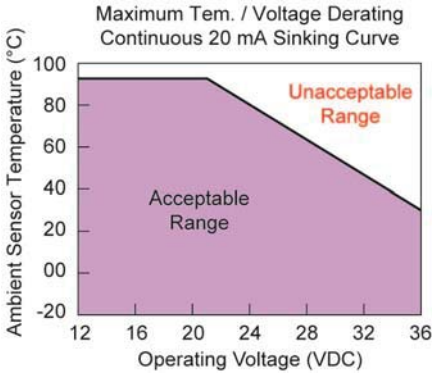
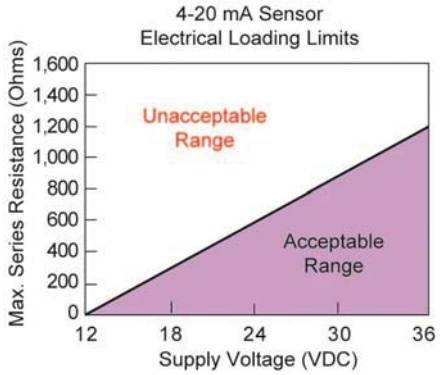
Common Specifications:

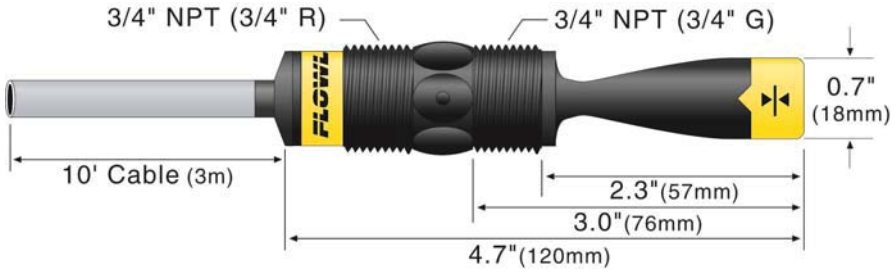
Orientation:	Universal	Pressure:	150 psi (10 bar) @ 25 °C., derated @ 1.667 psi (.113 bar) per °C. above 25° C.
Accuracy:	± 1 mm in water		
Repeatability:	± 0.5 mm in water		
Supply voltage:	12-36 VDC	Sensor rating:	NEMA 6 (IP68)
	12-30 VDC (LZ12 Only)	Cable type:	4-conductor, #22 AWG (shielded)
Consumption:	25 mA maximum	Cable length:	10' (3m) - Standard
Contact type:	(1) SPST relay		25' (7.6m) or 50' (15.2m) - Special
Contact rating:	60VA (125 VAC max / 1A max)	Process mount:	3/4" NPT (3/4" G / R)
Contact output:	Selectable NO/NC	Mount. gasket:	Viton® (G / R version only)
Process temp.:	F: -40° to 176°	Classification:	General purpose
	C: -40° to 80°	CE compliance:	EN 61326 EMC / EN 61010-1 safety







Vibration Switch (LZ12 Series): The Tuning Fork vibration switch operates at a nominal frequency of 400 Hz. As the switch becomes immersed in a liquid or slurry, a corresponding frequency shift occurs. When the measured frequency shift reaches the set point value, the switch changes state indicating the presence of a liquid or slurry medium. For optimum performance and proactive maintenance, the sensor automatically adjusts for coating, and if necessary, outputs a preventative maintenance alarm.



⚠ ***Do not squeeze the forks together. Doing so could damage or break the sensor and void the warranty.***

When powering up the LZ12, the start-up procedure requires the switch to cycle through a wet condition for 1/2 second in order to determine an initial resonance.

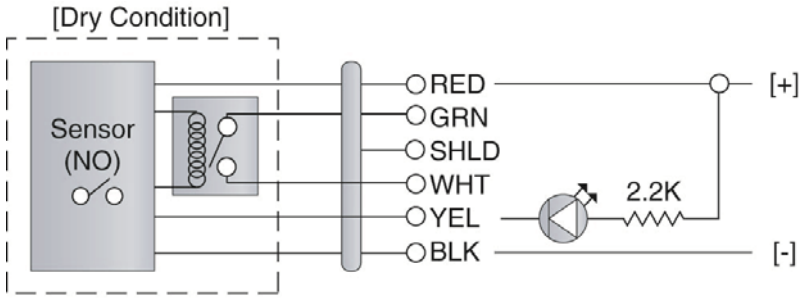
LZ12 Specifications:

Sensor material:	Ryton® (glass fill) Viton® cable grommet	Maint. alarm: Cable jacket mat'l:	NPN transistor, 10 mA max. PP
Process Temp.:	F: -40° to 176° C: -40° to 80°	Cable type:	5-conductor, #24 AWG (shielded)

Configurations:

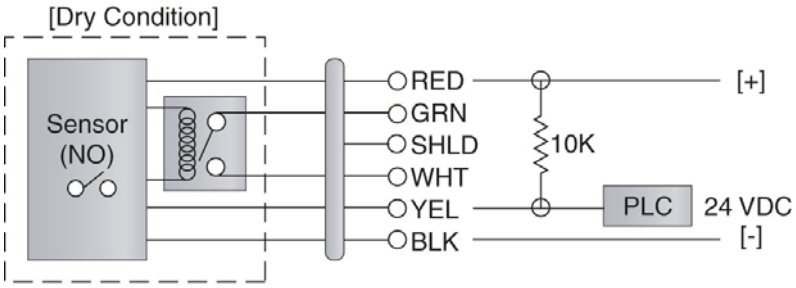
Part Number	Material (body)	Material (cable)	Thread (inside x outside)
LZ12-1405	Ryton	Polypropylene	¾" NPT x ¾" NPT
LZ12-1425	Ryton	Polypropylene	¾" R x ¾"G

Maintenance Alarm (LZ12 Vibration only): For optimum performance and proactive maintenance, the sensor automatically adjusts for coating, and if necessary, outputs a preventative maintenance alarm. The Yellow wire is a NPN transistor designed to switch when a build-up of material prevents the vibration switch from operating at its operational frequency. Use the Yellow wire to identify when the Vibration switch requires cleaning. To wire the maintenance output wire to an LED, follow the wiring diagram below. The Yellow wire is connected to the LED and a 2.2kΩ resistor in series and referenced back to the (+) of the power supply.



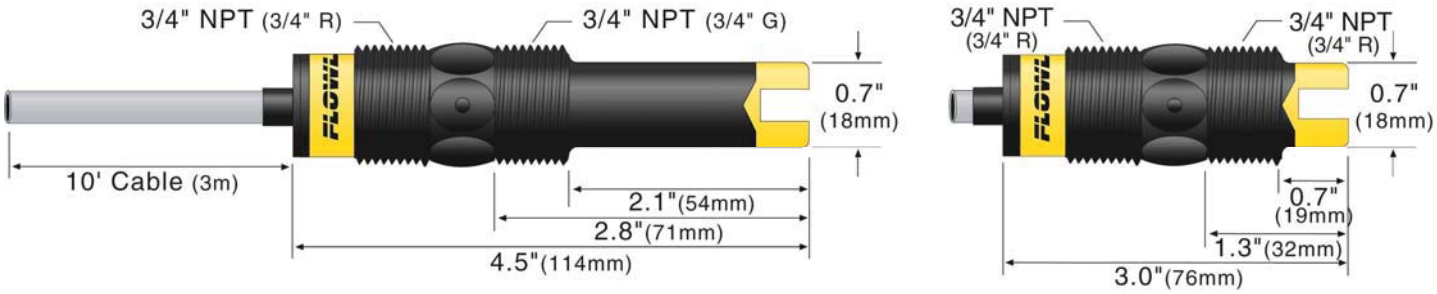
Sensor Power
[RED & BLK wires] / 36 VDC Max.
5 ±1mA Dry / 22 ±1mA Wet
Relay Rating
[GRN & WHT wires] / 60 VA
Maintenance Alarm
[YEL wire] / NPN Transistor / 10mA Max.

To wire the maintenance output wire to a PLC, follow the wiring diagram below. The Yellow wire is connected to the PLC input with a 10 kΩ resistor parallel to the PLC input and the (+) of the power supply.



Sensor Power
[RED & BLK wires] / 36 VDC Max.
5 ±1mA Dry / 22 ±1mA Wet
Relay Rating
[GRN & WHT wires] / 60 VA
Maintenance Alarm
[YEL wire] / NPN Transistor / 10mA Max.

Ultrasonic Switch (LU10 Series): The Ultrasonic level switch generates a 1.5 MHz ultrasonic wave from a miniature piezoelectric transducer located on one side of the gap within it's sensing tip. Another piezo transducer, located on the other side of the gap, acts as a microphone, picking up the sound wave. When liquid enters the gap, there is a change in the speed the wave crosses the gap. This change in the speed of sound identifies whether the sensor is in liquid or in air.



⚠ ***The sensor should be installed so that the liquid will drip out of the gap when the sensor becomes dry.***

LU10 Specifications:

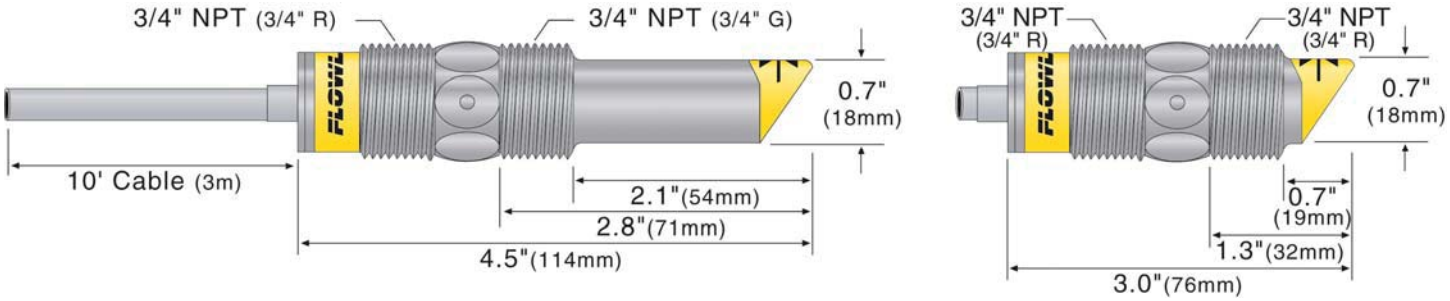
Sensor material:	1_ _5: PP 2_ _5: PFA	Cable jacket mat'l:	1_ _5: PP 2_ _5: PFA
Classification:	Intrinsically safe	Parameters:	CSA: Vmax = 32V, Imax = 300 mA, Pmax = 1.3 W; Ci = 0 µF, Li = 0 µH EEx: Ui = 32V; Ii = 300 mA; Pi = 1.3 W; Ci = 0 µF; Li = 0 µH
Approvals:	CSA: Class I, Groups A, B, C & D; Class II, Groups E, F and G; Class III EEx: Class 1, Division 1, Groups A, B, C, D; EEx ib IIC T6	Certificates:	CSA: LR 79326 EEx: LCIE 01.E6048 X

Configurations:

Part Number	Length	Material (body)	Material (cable)	Thread cable side x sensor side
LU10-1305	Short (3")	Polypropylene	Polypropylene	(¾" NPT) x (¾" NPT)
LU10-1325	Short (3")	Polypropylene	Polypropylene	(¾" R) x (¾"R)
LU10-1405	Long (4.5")	Polypropylene	Polypropylene	(¾" NPT) x (¾" NPT)
LU10-1425	Long (4.5")	Polypropylene	Polypropylene	(¾" R) x (¾"G)
LU10-2305	Short (3")	PFA	PFA	(¾" NPT) x (¾" NPT)
LU10-2325	Short (3")	PFA	PFA	(¾" R) x (¾"R)
LU10-2405	Long (4.5")	PFA	PFA	(¾" NPT) x (¾" NPT)
LU10-2425	Long (4.5")	PFA	PFA	(¾" R) x (¾"G)

Optic Leak Detection Switch (LO10 Series): The Optic Leak Detector use principles of optical refraction to detect the presence or absence of fluid. A pulsed infrared light beam is internally generated by a light emitting diode and aimed at the slanted optical tip of the sensor. If the tip is dry, the light beam bounces at a 90 degree angle to a receiving photo transistor, indicating a dry condition. If the tip is immersed in liquid, the light beam will refract out into the liquid instead of being reflected to the photo transistor, indicating a wet condition.

⚠ **The LO10 series is designed as a leak detection switch. The switch should be installed in applications where under normal conditions, it remains away from the liquid and will only come into contact during a leak.**



⚠ ***The Optic Leak Detector cannot detect the presence or absence of specular application liquids that reflect light (such as milk), or viscous liquids (such as paint) that form a coating on the sensor tip.***

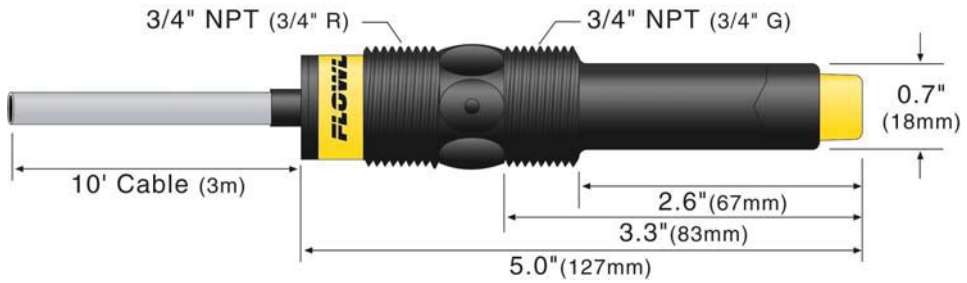
LO10 Specifications:

Sensor material: 1_ _5: PP 2_ _5: PFA	Cable jacket mat'l: 1_ _5: PP 2_ _5: PFA

Configurations:

Part Number	Length	Material (body)	Material (cable)	Thread cable side X sensor side
LO10-1305	Short (3")	Polypropylene	Polypropylene	(¾" NPT) x (¾" NPT)
LO10-1325	Short (3")	Polypropylene	Polypropylene	(¾" R) x (¾"R)
LO10-1405	Long (4.5")	Polypropylene	Polypropylene	(¾" NPT) x (¾" NPT)
LO10-1425	Long (4.5")	Polypropylene	Polypropylene	(¾" R) x (¾"G)
LO10-2305	Short (3")	PFA	PFA	(¾" NPT) x (¾" NPT)
LO10-2325	Short (3")	PFA	PFA	(¾" R) x (¾"R)
LO10-2405	Long (4.5")	PFA	PFA	(¾" NPT) x (¾" NPT)
LO10-2425	Long (4.5")	PFA	PFA	(¾" R) x (¾"G)

SuperGuard Capacitance Switch (LP15 Series): The SuperGuard level switch generates a pulse-wave radio frequency signal from the capacitance electrode located in the sensing tip of each sensor. When liquid comes into contact with the sensing tip, the capacitance as measured by the sensor changes based on the dielectric constant of the liquid. The guard circuit rejects the negative effects of coating buildup on the probe by eliminating the coating signal path between the active and reference electrodes.



⚠ ***The sensor's operation may vary based on the dielectric properties of various application liquids. The LP15 series sensor is factory-calibrated to be used with liquids with a dielectric value between 20 and 80. Liquids with a dielectric constant less than 20 will not be detected by an LP15 series sensor.***

Table of Common Dielectric Constants: NOTE: Liquids with a dielectric constant less than 20 will not be detected by an LP15 series level switch.

Acetone 21	Chlorotoluene 4.7	Ethylene chloride .. 10.5	Isobutyl methyl ketone 13	Nitrotoluene 25	Trichloroethylene 3.4
Acetoaldehyde 22.2	Chloroform ....4.5 to 5.0	Ethyl acetate 6.4	Jet fuel 1.7	Naphthalene ..2.3 to 2.5	Trichloroacetic acid 4.5
Acetyl methyl hexyl ketone 28	Chlorine, liquid 2.0	Ethyl salicylate 8.6	Lead carbonate 18	Oils, vegetable 2.5 to 3.5	Terephthalic acid ..... 1.5 to 1.7
Alcohol ..... 16 to 31	Carbon tetrachloride 2.2	Ethyl stearate 2.9	Lead nitrate 38	Oils, mineral ..2.3 to 2.4	Thinner 3.7
Ammonia ..... 15 to 25	Cyan 2.6	Ethyl silicote 4.1	Methyl salicylate 9.0	Oils, petroleum .....1.8 to 2.2	Urea 3.5
Acetic acid .... 4.1 to 6.2	Cyclohexane methanol 3.7	Formic acid 59	Methanol 33	Oleic acid 2.5	Vinyl chloride .. 2.8 to 6
Butyl chloride 9.6	D.I. Water 20	Ferric oleate 2.6	Methyl alcohol .33 to 38	Propane, liquid .....1.8 to 1.9	Vinyl alcohol 1.8 to 2.0
Barium chloride 9 to 11	Ethyl toluene 2.2	Freon 2.2	Margarine, liquid .....2.8 to 3.2	Potassium nitrate .....5.0 to 5.9	Water, 20°C 80
Benzene 2.3	Ethyl alcohol 23	Glycerine 47	Methyl acetate 7.3	Potassium chloride .. 5.0	Water, 100°C 48
Benzine 2.3	Ethylene glycol 37	Glycol 30	N-butyl formate 2.4	Stearic acid 2.3	
Barium nitrate 5.6	Ethylene oxide 14	Glycol nitrite 27	Nitrobenzene ...26 to 35	Toluene 2.4	
Bromine 3.1	Ethylene dichloride .....11 to 17	Gasoline ..... 2 to 2.2			
Chlorobenzene . 4.7 to 6		Hydrochloric acid ... 4.6			
		Isobutyric acid 2.7			

LP15 Specifications:

Dielectric range:	>20 constants	Sensor material:	PP
Conductive range:	>100 miromhos	Cable jacket mat'l:	PP

Configurations:

Part Number	Material (body)	Material (cable)	Thread cable side x sensor side
LP15-1405	Polypropylene	Polypropylene	(¾" NPT) x (¾" NPT)
LP15-1425	Polypropylene	Polypropylene	(¾" R) x (¾"G)

About Manual: PLEASE READ THE ENTIRE MANUAL PRIOR TO INSTALLING OR USING THIS PRODUCT. This manual includes information on all models of Flowline Switch-Tek™ Powered Level Switches: LZ12, LU10, LP15 and LO10 series. Please refer to the part number located on the sensor label to verify the exact model which you have purchased.

User's Responsibility for Safety: FLOWLINE manufactures a wide range of liquid level switches and technologies. While each of the these switches are designed to operate in a wide variety of applications, it is the user's responsibility to select a switch model that is appropriate for the application, install it properly, perform tests of the installed system, and maintain all components. The failure to do so could result in property damage or serious injury.

Proper Installation and Handling: Because this is an electrically operated device, only properly trained staff should install and/or repair this product. Use a proper sealant with all installations. *Note: Always install the 3/4" Viton gasket with all versions of Switch-Tek™ with metric threads. The G threaded version will not seal unless the gasket is properly installed.* Never over tighten the sensor within the fitting, beyond a maximum of 80 inch-pounds torque. Always check for leaks prior to system start-up.

Material Compatibility: The LU10 and LO10 series sensors are available in two different wetted materials. Models L_10-1__5 are made of Polypropylene (PP). Models L_10-2__5 are made of Perfluoroalkoxy (PFA). The LZ12 series is made of made of Ryton® (40% glass filled) and the LP15 series is made of PP. Make sure that the model you have selected is compatible with the application liquid. To determine the chemical compatibility between the sensor and its application liquids, refer to an industry reference such as the Compass Corrosion Guide (available from Compass Publications, phone 858-589-9636).

Wiring and Electrical: The supply voltage used to power the sensor should never exceed a maximum of 36 volts DC *(30 VDC for LZ12 series)*. Electrical wiring of the sensor should be performed in accordance with all applicable national, state, and local codes.

Flammable, Explosive and Hazardous Applications: Only the LU10-___5 series switch is rated for use in hazardous locations. Refer to the Certificate of Compliance for all applicable intrinsically safe ratings and entity parameters. Refer to the National Electric Code (NEC) for all applicable installation requirements in hazardous locations. **DO NOT USE THE LZ12, LP15 OR LO10 SERIES GENERAL PURPOSE SWITCH IN HAZARDOUS LOCATIONS.**

Warning

The rating for the relay is 60 VA (125 VAC max / 1A max).

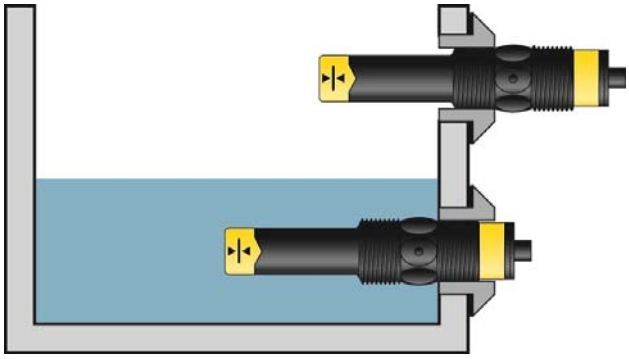
Flowline's Switch-Tek™ level switches are not recommended for use with electrically charged application liquids. For most reliable operation, the liquid being measured may need to be electrically grounded.

Always install the 3/4" Viton gasket with all versions of the powered sensors with metric threads. The G threaded version will not seal unless the gasket is installed properly.

Make a Fail-Safe System: Design a fail-safe system that accommodates the possibility of switch and/or power failure. FLOWLINE recommends the use of redundant backup systems and alarms in addition to the primary system. Adding a redundant high level float switch to the system is a cost effective means to prevent costly tank overflows.

All of the Switch-Tek™ Powered Level Sensors have a single internal relay. The normally open (NO) or normally closed (NC) operation is user selected based on the desired system control. Always design a fail-safe system that accommodates for the possibility of functional and/or power failure to the instrument. The "normal" relay state is where the relay coil is de-energized and the relay indicator is OFF. Therefore, if power is cut OFF to the switch it will de-energize the relay. Make sure that the de-energized state is the safe state in your system design. As such, if switch power is lost, a pump will turn OFF if it is connected to the normally open side of the relay.

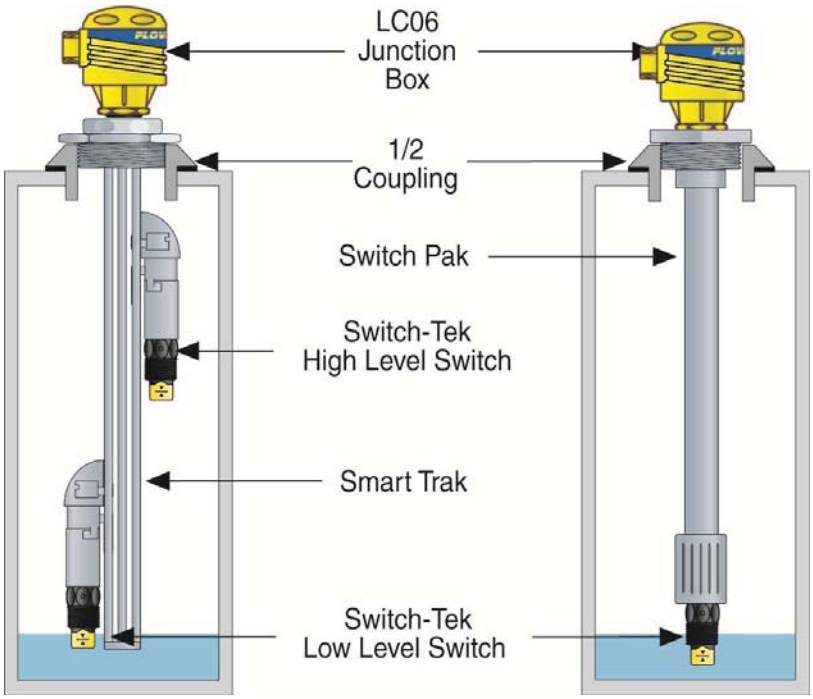
Through Wall Installation: Flowline's Switch-Tek™ level switches may be installed through the top, side or bottom of a tank wall. The sensor has male 3/4" NPT threads on either side of a 15/16" wrench flat. This enables the user to select the sensor's mounting orientation, installed outside of the tank in, or inside of the tank out.



⚠ ***Always install the 3/4" Viton gasket with the metric (long sensor length) versions of the L_ _ _-_ _2_. The G threaded version of the Switch-Tek™ will not seal unless the gasket is installed properly.***

Top Wall Installation: The powered level switches may be installed through the top wall of a tank. Flowline's Smart Trak LM10 series mounting system is an in-tank fitting which enables users to install up to four FLOWLINE sensors of any technology, to any depth, along the entire length of track. Smart Trak may be installed through the top wall of any tank using a standard 2" NPT tank adapter. If no tank top installation is available, Flowline's side mount bracket, LM50-1001, enables Smart Trak to be installed directly to the side wall of a tank. *Do not use PFA Teflon sensors with Smart-Trak.*

Flowline's Switch Pak LM45 series mounting system is an in-tank fitting which enables users to install one FLOWLINE sensor, of any technology, to a specific depth. The Flowline sensor may be installed onto the 3/4" NPT adapter at the end of the Switch Pak. Switch Pak may be installed through the top wall of any tank using a standard 2" NPT tank adapter. Flowline's side mount bracket, model LM50-1001, may also be used if top wall installation is not available.

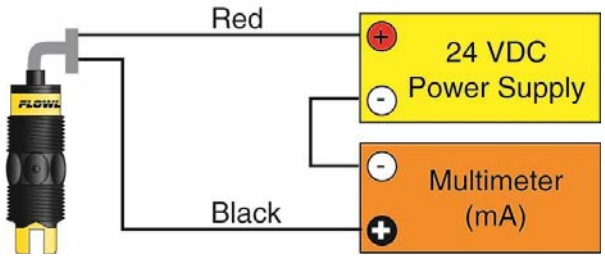


Supply Voltage: The supply voltage to the Switch-Tek™ level switch should never exceed a maximum of 36 VDC. Flowline controllers have a built-in 13.5 VDC power supply which provides power to all of Flowline's electrically powered sensors. Alternative controllers and power supplies, with a minimum output of 12 VDC up to a maximum output of 36 VDC (30 VDC with LZ12 series), may also be used with the Switch-Tek™ level switch.

Required Cable Length: Determine the length of cable required between the Switch-Tek™ level switch and its point of termination. Allow enough slack to ensure the easy installation, removal and/or maintenance of the sensor. The cable length may be extended up to a maximum of 1000 feet, using a well-insulated, 14 to 20 gauge shielded four conductor cable.

Wire Stripping: Using a 10 gauge wire stripper, carefully remove the outer layer of insulation from the last 1-1/4" of the sensor's cable. Unwrap and discard the exposed foil shield from around the signal wires, leaving the drain wire attached if desired. With a 20 gauge wire stripper, remove the last 1/4" of the colored insulation from the signal wires.

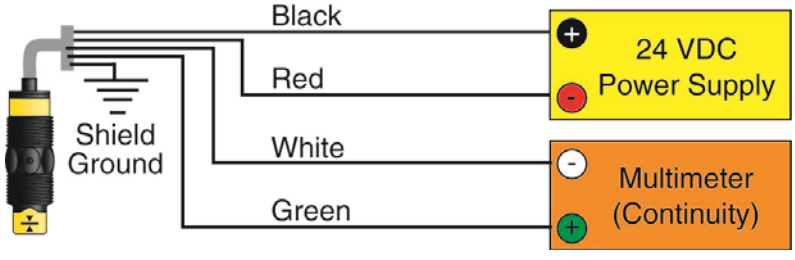
Signal Outputs (Current sensing): The standard method used by Flowline controllers; this technology uses only two wires (Red and Black). The sensor draws 5 mA when it is dry, and 22 mA when wet. NC/NO status must be set by the controller. The White and Green wires are not used.



Signal Output (Relay switching): Allows the sensor to switch a small load on or off directly, using an internal 1A relay (60 VAC/60 VDC). Only model LU10-___5 uses the relay and features 4 wires (red, black, white and green) and a shield wire. The NO/NC status is set by the polarity of the voltage feeding the red and black wires. The green wire is the common for the relay and the white wire is the NO or NC, depending on the polarity of red and black.

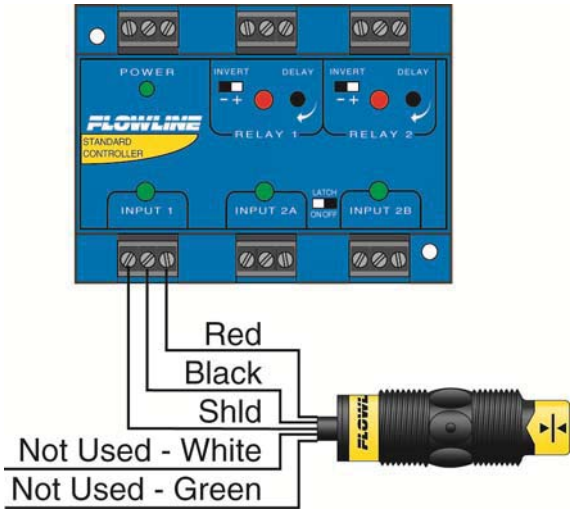
Normally Open Wiring:

Normally Closed Wiring:

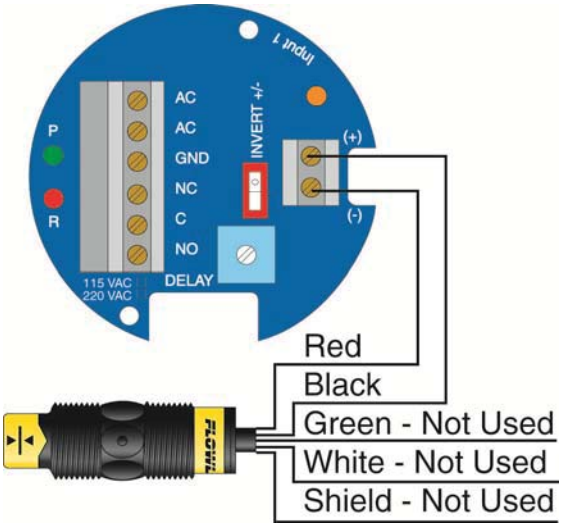


Wiring to a FLOWLINE Controller

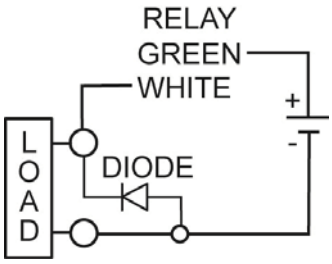
LC40 Series Controller (4 or 20 mA output)**:**
LC42-1001 Shown



LC10/LC11 Series Controller (4 or 20 mA output)**:**
LC11-1001 shown



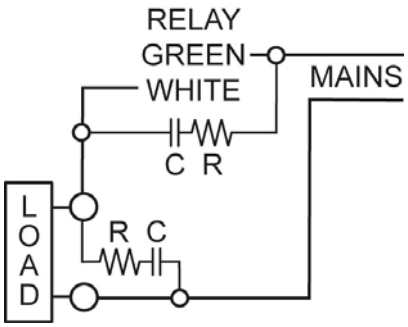
Switching Inductive Loads: The use of suppressors (snubbers) is strongly recommended when switching inductive loads to prevent disrupting the microprocessor's operation. The suppressors also prolong the life of the relay contacts. Suppression can be obtained with a catch diode for DC circuits and a resistor-capacitor (RC) for AC circuits.



Catch Diode

- Always use stepper relays between the sensor and external loads. For DC circuits use a catch diode such as 1N4148, shown on left.

Refer to the following circuits for RC network assembly and installation:



Choose R and C as follows:

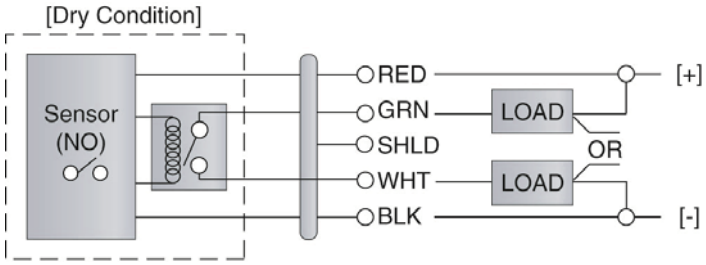
- R: 0.5 to 1 Ohms for each volt across the contacts
- C: 0.5 to 1 µF for each amp through closed contacts

Notes:

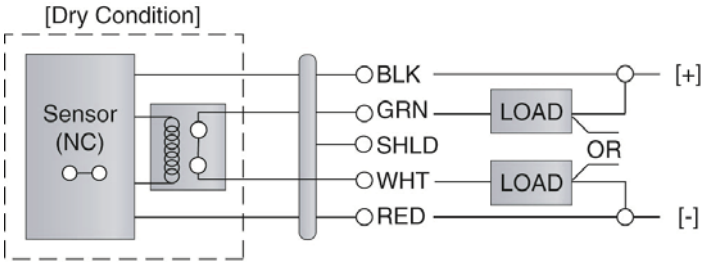
1. Use capacitors rated for 250 VAC.
2. RC networks may affect load release time of solenoid loads. Check to confirm proper operation.
3. Install the RC network at the meters relay screw terminals. An RC network may also be installed across the load. Experiment for best results.

Wiring the Relay Output: Switch-Tek™ requires 12 - 36 VDC (30 VDC max. for LZ12 series) power to operate the sensor and switch the relay. All illustrations below identify a Dry switch state as the normal position of the relay.

Switching a Normally Open DC Load:
The Red wire connects to Positive (+) of the power supply and the Black wire connects to Negative (-). The LOAD can be attached to either the Green or White wires. Complete the circuit by connecting the Green to (+) VDC power or White to (-) VDC power (see illustration below).

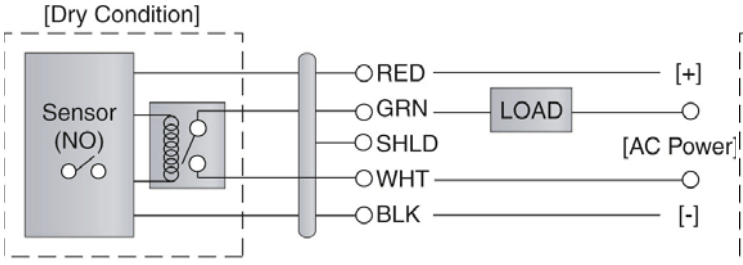


Switching a Normally Closed DC Load:
The Black wire connects to Positive (+) of the power supply and the Red wire connects to Negative (-). The LOAD can be attached to either the Green or White wires. Complete the circuit by connecting the Green to (+) VDC power or White to (-) VDC power (see illustration below).

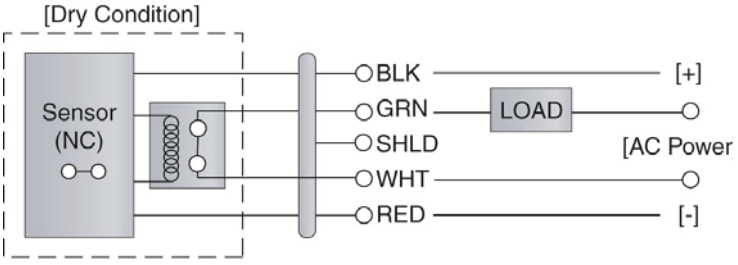


Sensor Power	*Relay Rating*
[RED & BLK wires] / 36 VDC Max. 5 ±1mA Dry / 22 ±1mA Wet	[GRN & WHT wires] / 60 VA

Switching a Normally Open AC Load:
The Red wire connects to Positive (+) of the DC power supply and the Black wire connects to Negative (-). The LOAD can be attached to the Green wire and the Hot of the VAC power. Connect the White to the Neutral of the VAC power (see illustration below).



Switching a Normally Closed AC Load:
The Black wire connects to Positive (+) of the DC power supply and the Red wire connects to Negative (-). The LOAD can be attached to the Green wire and the Hot of the VAC power. Connect the White to the Neutral of the VAC power (see illustration below).

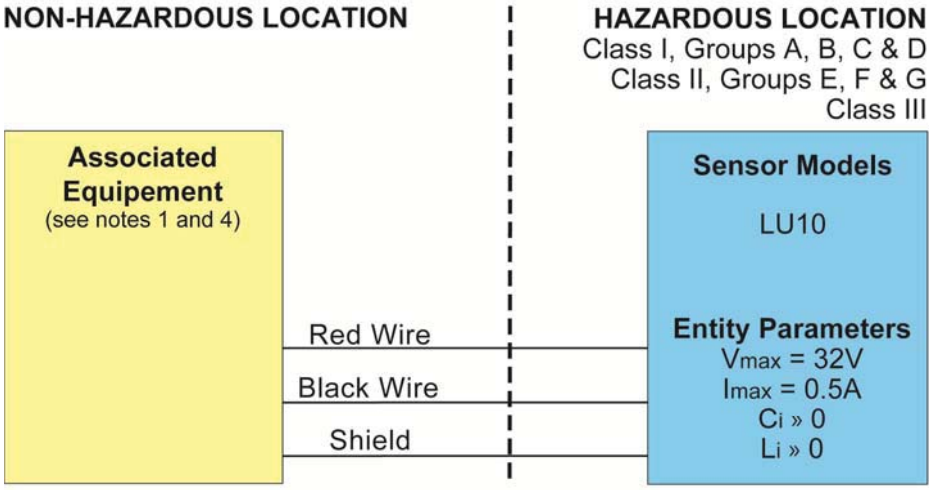


Sensor Power	*Relay Rating*
[RED & BLK wires] / 36 VDC Max. 5 ±1mA Dry / 22 ±1mA Wet	[GRN & WHT wires] / 60 VA

Models LU10-___5 Only: The LU10-___5 level switch has been approved for use in Class I, Groups A, B, C & D; UNDER CERTIFICATE NUMBER LR 79326-4. DO NOT USE THE LZ12, LP15 or LO10 SERIES IN INTRINSICALLY SAFE APPLICATIONS. The Entity parameter for the LU10-_ _ _5 are:

Vmax = 32 VDC / Imax = 0.5 A / Ci = 0 µF / Li = 0 mH

Intrinsically Safe Control Drawing:

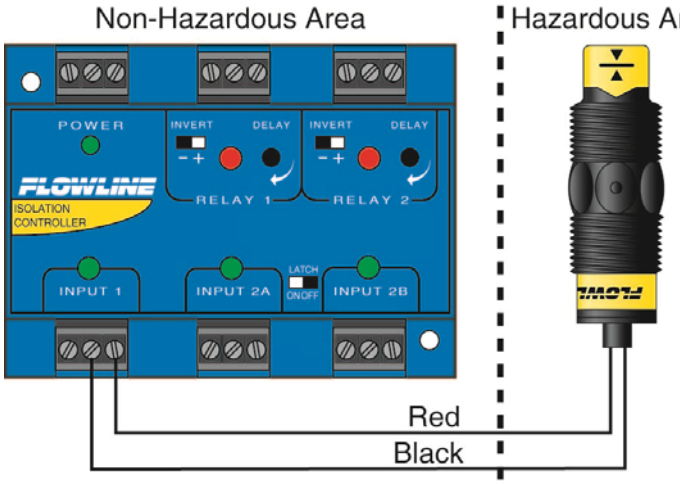


Notes:
1. CSA certified associated equipment with entity parameters.
2. $V_{max} \geq V_{oc}$, $I_{max} \geq I_{sc}$, $C_i + C_{cable} \leq C_a$., $L_i + L_{cable} \leq L_a$.
3. Installation should be in accordance with CEC Part I, or NFPA 70.
4. Associated equipment must be installed per manufacturers instructions

Sensor Drawing: LSD1
Rev. B 10-01-02

Wiring to a Flowline Controller: LC90 Series Controller (4 or 20 mA Signal Output)

LC90 Series
Entity Parameter
Voc = 17.47 VDC
Isc = 0.4597 A
Ca = 0.494 µF
La = 0.119 µH

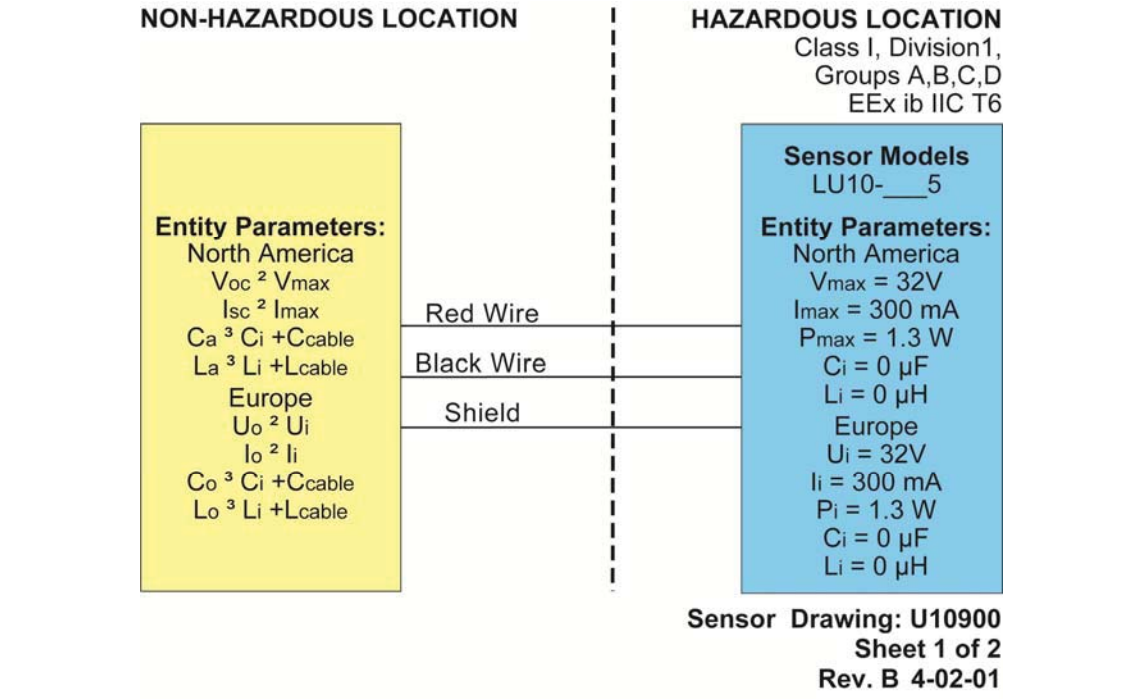


LU10 series
Entity Parameter
Vmax = 32 VDC
Imax = 0.5 A
Ci = 0 µF
Li = 0 µH

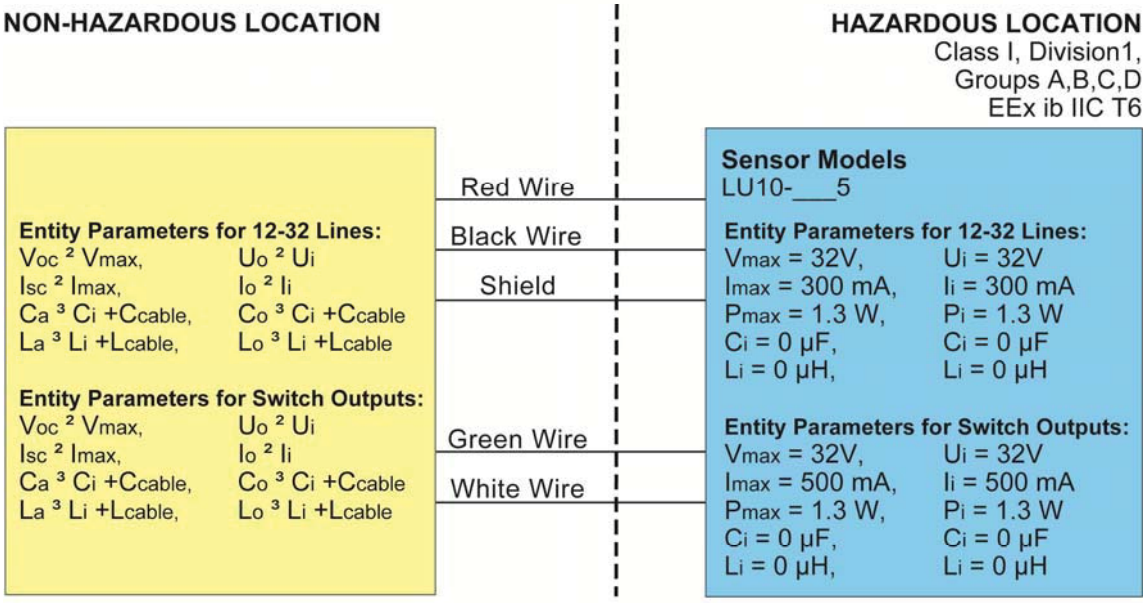
Models LU10-___5 Only: The LU10-___5 level switch has been approved for use in Class I, Division 1, Groups A, B, C & D; EEx ib IIC T6; UNDER CERTIFICATE NUMBER LCIE 01.E6048X. DO NOT USE THE LZ12, LP15 or LO10 SERIES IN INTRINSICALLY SAFE APPLICATIONS. The Entity parameter for the LU10-___5 are:

North America - Vmax = 32 VDC / Imax = 0.5 A / Pmax = 1.3 W / Ci = 0 µF / Li = 0 µH
Europe - Ui = 32 VDC / Ii = 0.5 A / Pi = 1.3 W / Ci = 0 µF / Li = 0 µH

Intrinsically Safe Control Drawing:



Sensor Drawing: U10900
Sheet 1 of 2
Rev. B 4-02-01

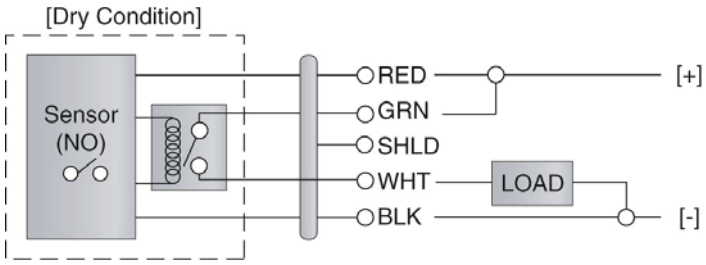


Notes: PARAMETERS DEPEND ON OUTPUT TYPE
1. Installation should be in accordance with CEC Part 1, or NFPA 70.
2. Associated Equipment shall be CSA certified with entity parameters connected in accordance with manufacturers instructions.

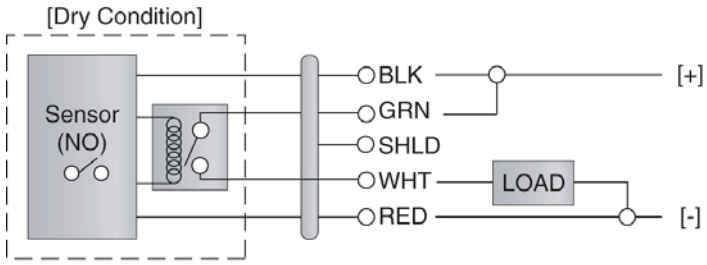
Sensor Drawing: U10900
Sheet 2 of 2
Rev. B 4-02-01

Wiring as a P-Channel or N-Channel output: The Switch-Tek™ can be substituted for either a P-Channel (PNP, sourcing) output or an N-Channel (NPN, sinking) output.

Normally Open DC Load as a P-Channel Output:
The Red wire connects to Positive (+) of the power supply and the Black wire connects to Negative (-). The Green wire is jumped to the Red wire while the White wire is connected to the LOAD. Jumper the LOAD to the Negative (-) to complete the circuit.

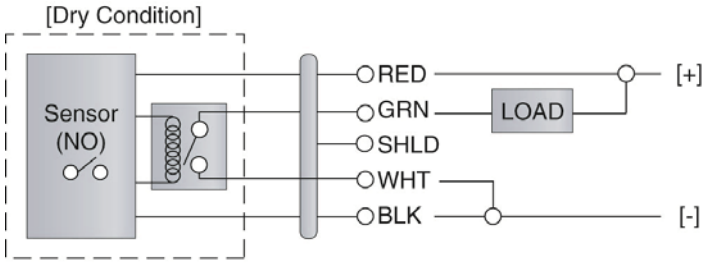


Normally Closed DC Load as a P-Channel Output:
The Black wire connects to Positive (+) of the power supply and the Red wire connects to Negative (-). The Green wire is jumped to the Black wire while the White wire is connected to the LOAD. Jumper the LOAD to the Negative (-) to complete the circuit.

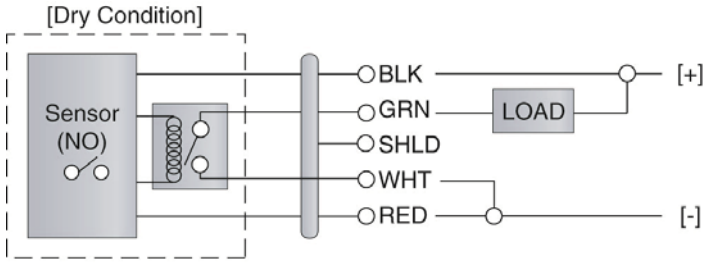


Sensor Power	*Relay Rating*
[RED & BLK wires] / 36 VDC Max. 5 ±1mA Dry / 22 ±1mA Wet	[GRN & WHT wires] / 60 VA

Normally Open DC Load as a N-Channel Output:
The Red wire connects to Positive (+) of the power supply and the Black wire connects to Negative (-). The White wire is jumped to the Black wire while the Green wire is connected to the LOAD. Jumper the LOAD to the Positive (+) to complete the circuit.



Normally Closed DC Load as a N-Channel Output:
The Black wire connects to Positive (+) of the power supply and the Red wire connects to Negative (-). The White wire is jumped to the Red wire while the White wire is connected to the LOAD. Jumper the LOAD to the Positive (+) to complete the circuit.



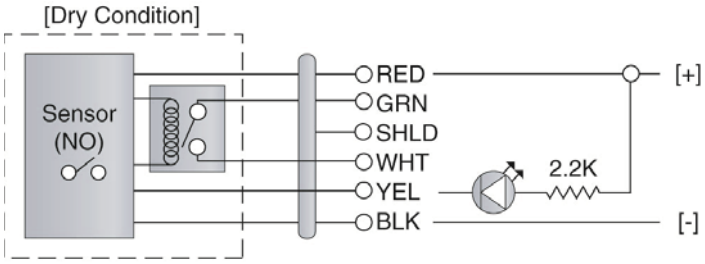
Sensor Power	*Relay Rating*
[RED & BLK wires] / 36 VDC Max. 5 ±1mA Dry / 22 ±1mA Wet	[GRN & WHT wires] / 60 VA

General: The Switch-Tek™ level switch requires no periodic maintenance except cleaning as required. It is the responsibility of the user to determine the appropriate maintenance schedule, based on the specific characteristics of the application liquids.

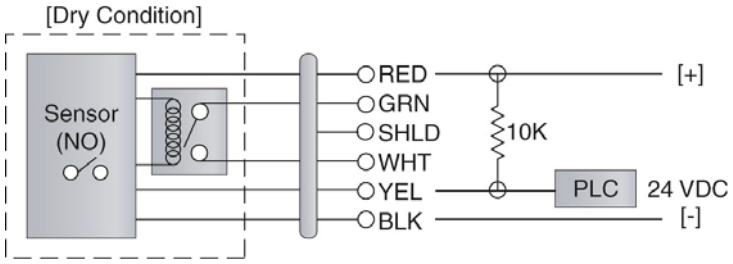
Cleaning procedure:

1. **Power:** Make sure that all power to the switch, controller and/or power supply is completely disconnected.
2. **Switch removal:** In all through-wall installations, make sure that the tank is drained well below the sensor prior to removal. Carefully, remove the sensor from the installation.
3. **Cleaning the switch:** Use a soft bristle brush and mild detergent, carefully wash the Switch-Tek™ level switch. Do not use harsh abrasives such as steel wool or sandpaper, which might damage the surface sensor. Do not use incompatible solvents which may damage the sensor's PP, PFA, PVDF or Ryton plastic body.
4. **Sensor installation:** Follow the appropriate steps of installation as outlined in the Installation section of this manual.

Maintenance Output to LED (LZ12 Only):
To wire the maintenance output wire to an LED, follow the wiring diagram below. The Yellow wire is connected to the LED and a 2.2kΩ resistor in series and referenced back to the (+) of the power supply.



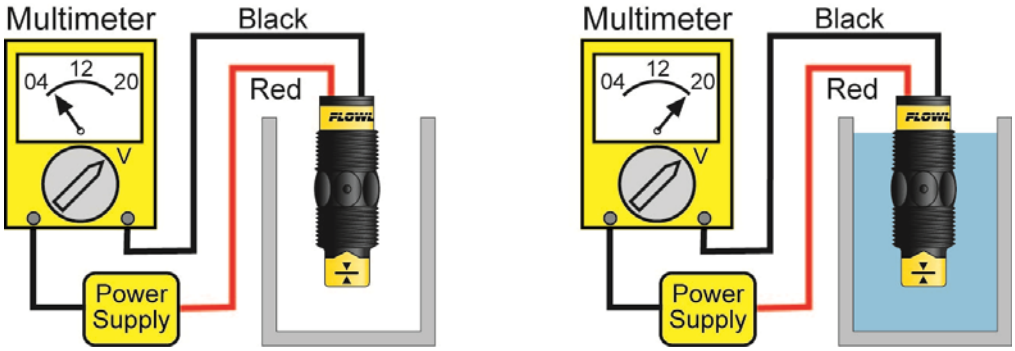
Maintenance Output to PLC (LZ12 Only):
To wire the maintenance output wire to a PLC, follow the wiring diagram below. The Yellow wire is connected to the PLC input with a 10 kΩ resistor parallel to the PLC input and the (+) of the power supply.



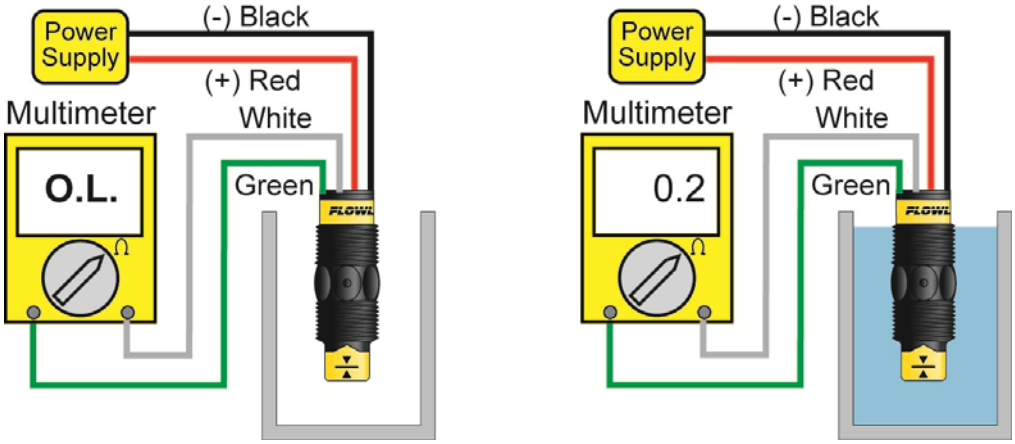
Sensor Power	*Relay Rating*	*Maintenance Alarm*
[RED & BLK wires] / 36 VDC Max. 5 ±1mA Dry / 22 ±1mA Wet	[GRN & WHT wires] / 60 VA	[YEL wire] / NPN Transistor / 10mA Max.

Testing the installation:

1. **Power:** Turn on power to the controller and/or power supply.
2. **Immersing the switch:** Immerse the sensing tip in its application liquid, by filling the tank up to the switches point of actuation. An alternate method of immersing the switch during preliminary testing is to hold a cup filled with application liquid up to the switch's tip.
3. **Test:** With the switch being fluctuated between wet and dry states, the switch indicator light in the controller should turn on and off. If the controller doesn't have an input indicator, use a voltmeter or ammeter to ensure that the switch produces the correct signal (see below).
4. **Point of actuation:** Observe the point at which the rising or falling fluid level causes the switch to change state, and adjust the installation of the switch if necessary.



Example: Testing the LU10 series with a Multimeter set to read current (mA). When wired NO [Red to (+)], the meter will read 5mA, ±1mA when dry and will read 20mA, ±1mA when wet.



Example: Testing the LU10 series with a multimeter set to read resistance (ohms). When wired NO [Red to (+)], the meter will read O.L when dry and will read some small amount of resistance (ex. 0.2 Ohms) when wet.

Warranty

Flowline warrants to the original purchaser of its products that such products will be free from defects in material and workmanship under normal use and service in accordance with instructions furnished by Flowline for a period of two years from the date of manufacture of such products. Flowline's obligation under this warranty is solely and exclusively limited to the repair or replacement, at Flowline's option, of the products or components, which Flowline's examination determines to its satisfaction to be defective in material or workmanship within the warranty period. Flowline must be notified pursuant to the instructions below of any claim under this warranty within thirty (30) days of any claimed lack of conformity of the product. Any product repaired under this warranty will be warranted only for the remainder of the original warranty period. Any product provided as a replacement under this warranty will be warranted for the full two years from the date of manufacture.

Returns

Products cannot be returned to Flowline without Flowline's prior authorization. To return a product that is thought to be defective, go to www.flowline.com, and submit a customer return (MRA) request form and follow the instructions therein. All warranty and non-warranty product returns to Flowline must be shipped prepaid and insured. Flowline will not be responsible for any products lost or damaged in shipment.

Limitations

This warranty does not apply to products which: 1) are beyond the warranty period or are products for which the original purchaser does not follow the warranty procedures outlined above; 2) have been subjected to electrical, mechanical or chemical damage due to improper, accidental or negligent use; 3) have been modified or altered; 4) anyone other than service personnel authorized by Flowline have attempted to repair; 5) have been involved in accidents or natural disasters; or 6) are damaged during return shipment to Flowline. Flowline reserves the right to unilaterally waive this warranty and dispose of any product returned to Flowline where: 1) there is evidence of a potentially hazardous material present with the product; or 2) the product has remained unclaimed at Flowline for more than 30 days after Flowline has dutifully requested disposition. This warranty contains the sole express warranty made by Flowline in connection with its products. ALL IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY DISCLAIMED. The remedies of repair or replacement as stated above are the exclusive remedies for the breach of this warranty. IN NO EVENT SHALL FLOWLINE BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND INCLUDING PERSONAL OR REAL PROPERTY OR FOR INJURY TO ANY PERSON. THIS WARRANTY CONSTITUTES THE FINAL, COMPLETE AND EXCLUSIVE STATEMENT OF WARRANTY TERMS AND NO PERSON IS AUTHORIZED TO MAKE ANY OTHER WARRANTIES OR REPRESENTATIONS ON BEHALF OF FLOWLINE. This warranty will be interpreted pursuant to the laws of the State of California. If any portion of this warranty is held to be invalid or unenforceable for any reason, such finding will not invalidate any other provision of this warranty.

For complete product documentation, video training, and technical support, go to www.flowline.com.

For phone support, call 562-598-3015 from 8am to 5pm PST, Mon - Fri.

(Please make sure you have the Part and Serial number available.)

SCR-201/2 - Filter, Rotary screen, Newterra 17" wide SCR-50

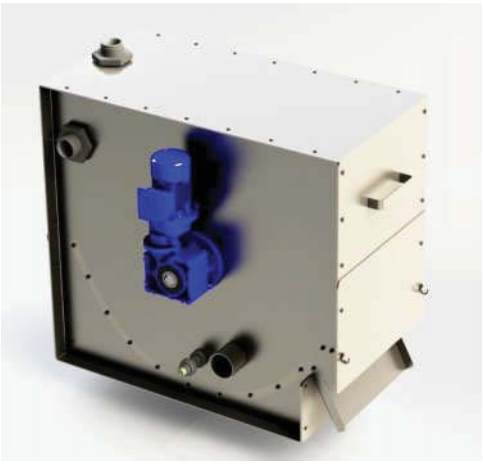
newterra
smart technology. sustainable solutions.

Waste Water Inlet Screens – SCR SERIES

newterra Inlet Screens are specifically designed to protect newterra MicroClear™ flat sheet membranes from fouling due to excessive debris from waste water plant influent. The SCR series is designed to complement the newterra small to medium size wastewater MBR plants. Typically the screens would be used at the inlet to the Equalization Basin or the Aeration Basin. The SCR units are rotating brush design with 0.5mm crossflow wedgewire screens, and are designed to minimize complexity while achieving superior performance.

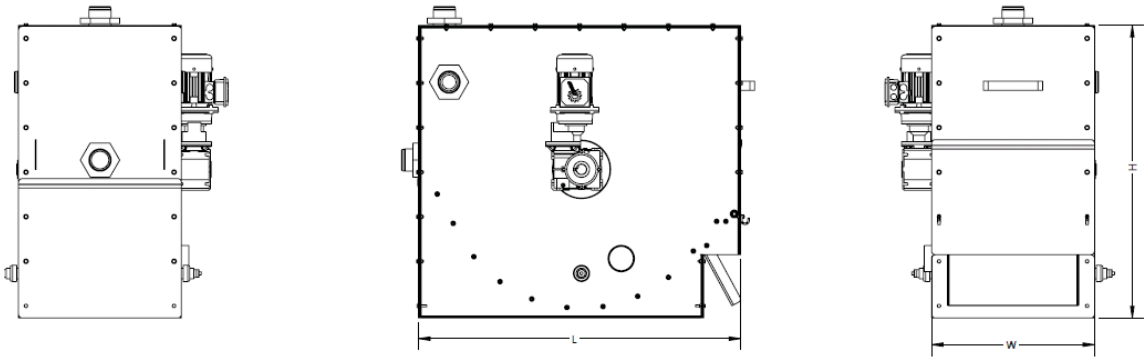
Standard Features:

- 304 SS construction
- 1/4 HP Gearbox/motor (waterproof aluminum)
- Easily replaceable heavy duty brushes
- Standard inlet on Top,Sides,Back
- Internal inlet baffling to provide full screen contact no matter which inlet is chosen
- Bag support
- High Level Switch Coupling
- Gravity Outlet
- Simple, reliable shear pin shaft/motor protection
- Can ship knocked down, easily assembled on site



Options:

- Stands
- Discharge Pump Tank
- Complete Packages c/w pumps and controls



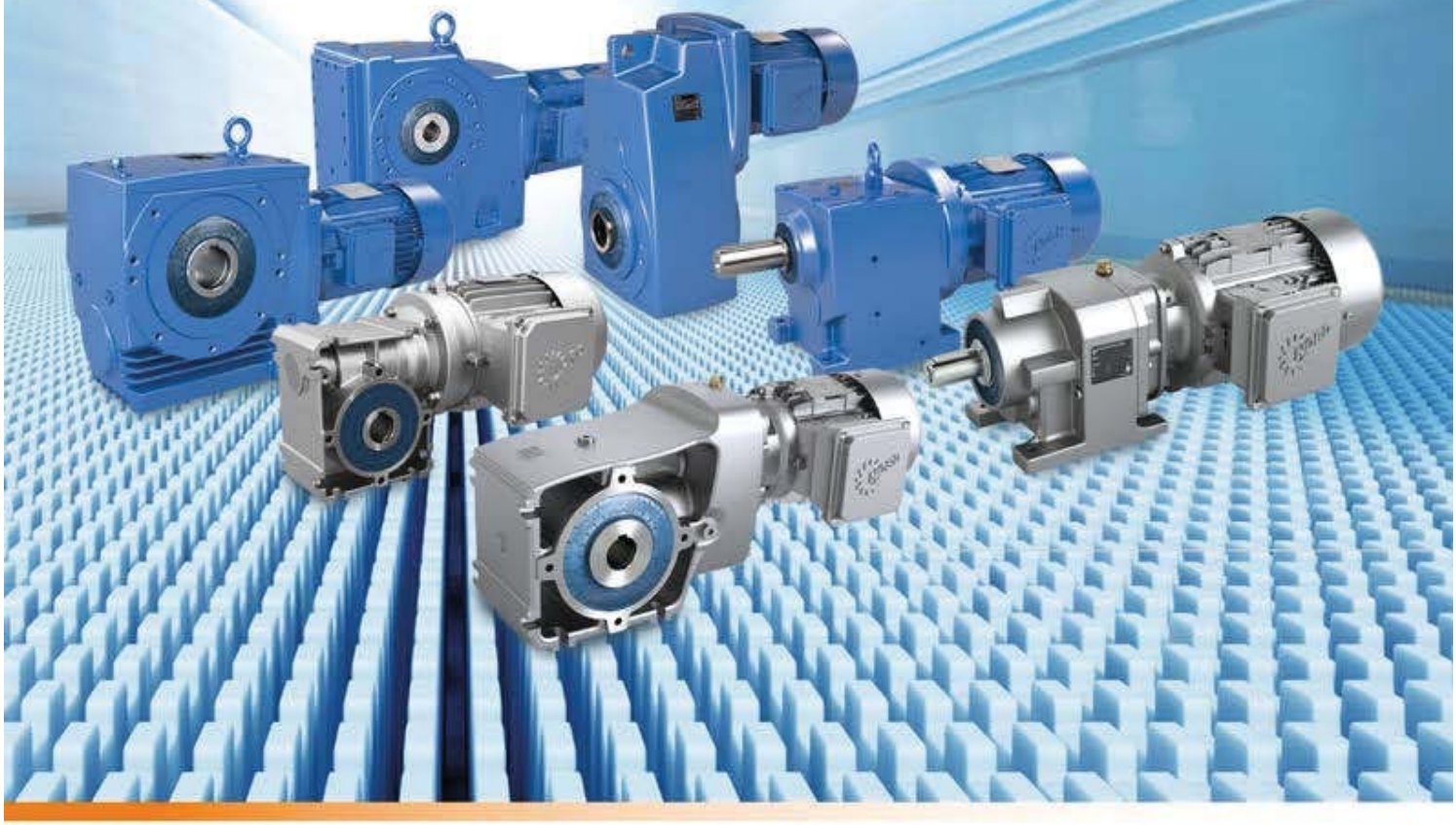
Dimension Chart:

Part Number	Width "W"	Standard Height "H"	Standard Overall Length "L"	Shipping Weight [lbs]	Inlet Size	Outlet Size	Nominal Flowrate gpm	Nominal Flowrate lps	Nominal Flowrate gpd	Nominal Flowrate m3/day
SCR-50	23"	39"	43"	150	2"	Open Bottom	50	3.2	72,000	273
SCR-100	41"	39"	43"	200	3"	Open Bottom	100	6.4	144,000	547

Nominal flowrates based on typical municipal characteristics

Intelligent Drivesystems, Worldwide Services

SCR-201/2 - Gear Motor, 230/460V 50/60 3P, 60/50hz 1/4hp
SK1SI63/H10-56C-63L/4 FRD DIV2 NSD+ 400:1
Nord Gear, 4.3 RPM, CSA CL1 DIV2"



EN

B 1000

Gear units

Operating and Assembly Instructions

NORD DRIVESYSTEMS

E-1278

General safety and operating instructions

1. General

Depending on its protection class, the device may have live, bare, moving or rotating parts or hot surfaces during operation,.

Unauthorised removal of covers, improper use, incorrect installation or operation causes a risk of serious personal injury or material damage.

All transport, installation, commissioning and maintenance work must be carried out by qualified specialist personnel (national accident prevention regulations must be observed).

Within the meaning of this basic safety information, qualified specialist personnel are persons who are familiar with the installation, assembly, commissioning and operation of the product and who have the training and experience to recognise and avoid any hazards and risks.

2. Correct use

NORD products may only be used according to the information in the catalogue and the associated technical documentation.

Compliance with the operating and installation instructions is a **prerequisite for fault-free operation** and for the fulfilment of any warranty claims. **These operating and installation instructions must be read** before working with the device!

These operating and installation instructions contain important information about **servicing**. They must therefore be kept **close to the device**.

All details regarding technical data and permissible conditions at the installation site must be complied with.

3. Transport, storage

Information regarding transport, storage and correct handling must be complied with.

4. Installation

The device must be protected against impermissible loads. In particular, during transport and handling, components must not be deformed or changed. Touching of electronic components and contacts must be avoided.

5. Electrical Connection

When working on live three-phase motors, the applicable national accident prevention regulations must be complied with (e.g. BGV A3, formerly VBG 4).

The electrical installation must be implemented according to the applicable regulations (e.g. cable cross-section, fuses, earth lead connections).

Information regarding EMC-compliant installation – such as shielding, earthing and installation of cables – can be found in the three-phase motor documentation. Compliance with the limiting values specified in the EMC regulations is the responsibility of the manufacturer of the system or machine.

6. Operation

Appropriate safety measures must be taken for applications where failure of the device may result in injury.

Where necessary, systems in which NORD devices are installed must be equipped with additional monitoring and protective equipment according to the applicable safety requirements, e.g. legislation concerning technical equipment, accident prevention regulations, etc.

All covers and guards must be kept closed during operation.

7. Maintenance and repairs

After the device has been disconnected from the power supply, live equipment components and power connections should not be touched immediately, because of possible charged capacitors.

Further information can be found in this documentation.

These safety instructions must be kept in a safe place!

Documentation

Name:	B 1000
Part No.:	6052802
Series:	Gear units and geared motors
Type series:	
Gear unit types:	**Helical gear unit** **NORDBLOC helical gear units** **Standard helical gear units** **Parallel shaft gear units** **Bevel gear units** **Helical worm gear units** **MINIBLOC worm gear units** **UNIVERSAL worm gear units**

Version list

Title, Date	Order number	Comments
B 1000, February 2013	6052802 / 0713	-
B 1000, September 2014	6052802 / 3814	General corrections
B 1000, April 2015	6052802 / 1915	New gear unit types SK 10382.1 + SK 11382.1
B 1000, March 2016	6052802 / 0916	General corrections New bevel gear units SK 920072.1 + SK 930072.1
B 1000, September 2016	6052802 / 3816	General corrections New SK 071.1 helical gear unit, SK 171.1, SK 371.1, SK 571.1, SK 771.1;

Table 1: Version list B 1000

Copyright notice

As an integral component of the device described here, this document must be provided to all users in a suitable form.
Any editing or amendment or other utilisation of the document is prohibited.

Publisher

Getriebebau NORD GmbH & Co. KG
Getriebebau-Nord-Straße 1 • 22941 Bargteheide, Germany • http://www.nord.com/
Fon +49 (0) 45 32 / 289-0 • Fax +49 (0) 45 32 / 289-2253

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1 Notes

1.1 General information

Read the Operating Manual carefully prior to performing any work on or putting the gear unit into operation. Strict compliance with the instructions in this Operating Manual is essential. This Operating Manual and all associated special documentation must be kept in the immediate vicinity of the gear unit.

Getriebebau NORD accepts no liability for damage to persons, materials or assets as a result of the non-observance of this Operating Manual, operating errors or incorrect use. General wearing parts, e.g. radial seals are excluded from the warranty.

If additional components are attached to or installed on or in the gear unit (e.g. motor, cooling system, pressure sensor etc.) or components (e.g. cooling system) are supplied with the order, the operating instructions for these components must be observed.

If geared motors are used, compliance with the Motor Operating Manual is also necessary.

If you do not understand the contents of this Operating Manual or additional operating instructions, please consult Getriebebau NORD!

1.2 Safety and information symbols

1.2.1 Explanation of labels used

DANGER	Indicates an immediate danger, which may result in death or serious injury.
WARNING	Indicates a possibly dangerous situation, which may result in death or serious injury.
CAUTION	Indicates a possibly dangerous situation, which may result in slight or minor injuries.
NOTICE	Indicates a possibly harmful situation, which may cause damage to the product or the environment.
Note	Indicates hints for use and useful information.

1.3 Correct use

These gear units generate a rotational movement and are intended for use in commercial systems. The gear unit must only be used according to the information in the technical documentation from Getriebebau NORD.

Commissioning (start of proper operation) is prohibited until it has been established that the machine complies with the local laws and directives. The EMC Directive 2004/108/EC and the Machinery Directive 2006/42/EC in their currently valid scope of application must be complied with in particular.

DANGER! — **Explosion hazard**

Serious injury and material damage due to explosion are possible.

Use in explosion hazard areas is prohibited.

WARNING — **Injury to persons**

Appropriate safety measures must be taken for applications where failure of a gear unit or geared motor may result in injury.

Safeguard a wide area around the hazard zone.

WARNING — **Material damage and personal injury**

If the gear unit is not used as designed, this may cause damage to the gear unit or the premature failure of components. Personal injury as a result of this cannot be ruled out.

Strict compliance with the technical data on the type plate is essential. The documentation must be observed.

1.4 Safety information

Observe all safety information, including that provided in the individual sections of this Operating Manual. All national and other regulations on safety and accident prevention must also be observed.

DANGER! **Severe personal injury**

Serious physical and property damage may result from inappropriate installation, non-designated use, incorrect operation, non-compliance with safety information, unauthorised removal of housing components or safety covers and structural modifications to the gear unit.

- All work, e.g. transportation, storage, installation, electrical connection, commissioning, servicing, maintenance and repair must only be performed by qualified specialist personnel.
- Observe the Operating Manual
- Observe the safety information
- Observe the safety and accident prevention regulations.
- Tighten the drive elements or secure the parallel key before switching on.
- Do not make any structural modifications.
- Do not remove any safety devices.
- If necessary, wear hearing protection when working in the immediate vicinity of the gear unit.
- All rotating components must be provided with guards. In standard cases, covers are fitted by NORD . The covers must always be used if contact protection is not provided by other methods.

DANGER! **Injury to persons**

The surfaces of gear units or geared motors may become hot during or shortly after operation. Danger of burns!

- Installation and maintenance work must only be performed when gear unit is at a standstill and has cooled down. The drive must be isolated and secured to prevent accidental start-up.
- Wear protective gloves.
- Shield hot surfaces with contact guards.
- Do not store inflammable objects or substances in the immediate vicinity of the gear unit.

WARNING **Injury to persons**

Serious injury and material damage due to improper transport are possible.

- No additional loads may be attached.
- Transportation aids and lifting gear must have an adequate load-bearing capacity.
- Pipes and hoses must be protected from damage.

⚠ CAUTION **Injury to persons**

Danger of cuts from exterior edges of attachment adapters, flanges and covers.

Contact freezing with metallic components in case of low temperatures.

In addition to personal protective equipment, wear suitable protective gloves and suitable goggles during assembly, commissioning, inspection and maintenance, in order to prevent injuries.

It is recommended that repairs to NORD Products are carried out by the NORD Service department.

1.5 Other documents

Further information may be obtained from the following documents:

- Gear unit catalogues (G1000, G1012, G1014, G1035, G1050, G2000),
- Operating and maintenance instructions for the electric motor,
- if applicable, the Operating Manuals for attached or supplied options

1.6 Disposal

Observe the current local regulations. In particular, lubricants must be collected and disposed of correctly.

Gear unit components	Material
Gear wheels, shafts, rolling bearings, parallel keys, locking rings, …	Steel
Gear unit housing, housing components, …	Grey cast iron
Light alloy gear unit housing, light alloy gear unit housing components, …	Aluminium
Worm gears, bushes, ...	Bronze
Radial seals, sealing caps, rubber components,…	Elastomers with steel
Coupling components	Plastic with steel
Flat seals	Asbestos-free sealing material
Gear oil	Additive mineral oil
Synthetic gear oil (type plate code: CLP PG)	Polyglycol-based lubricants
Cooling spiral, embedding material of the cooling spiral, screw fittings	Copper, epoxy, yellow brass

Table 2: Disposal of materials

2 Description of gear unit

2.1 Type designations and gear unit types

Gear unit types / Type designations
Helical gear units
SK 11E, SK 21E, SK 31E,SK 41E, SK 51E (1-stage)
SK 02, SK 12, SK 22, SK 32, SK 42, SK 52, SK 62N (2-stage)
SK 03, SK 13, SK 23, SK 33N, SK 43, SK 53 (3-stage)
SK 62, SK 72, SK 82, SK 92, SK 102 (2-stage)
SK 63, SK 73, SK 83, SK 93, SK 103 (3-stage)
NORDBLOC helical gear units
SK 320, SK 172, SK 272, SK 372, SK 472, SK 572, SK 672, SK 772, SK 872, SK 972 (2-stage)
SK 273, SK 373, SK 473, SK 573, SK 673, SK 773, SK 873, SK 973 (3-stage)
SK 071.1, SK 371.1, SK 571.1, SK 771.1 (1-stage)
SK 072.1, SK 172.1, SK 372.1, SK 572.1, SK 672.1, SK 772.1, SK 872.1, SK 972.1 (2-stage)
SK 373.1, SK 573.1, SK 673.1, SK 773.1, SK 873.1, SK 973.1 (3-stage)
Standard helical gear units
SK 0, SK 01, SK 20, SK 25, SK 30, SK 33 (2-stage)
SK 10, SK 200, SK 250, SK 300, SK 330 (3-stage)
Parallel shaft gear unit
SK 0182NB, SK 0282NB, SK 1282, SK 2282, SK 3282, SK 4282, SK 5282, SK 6282, SK 7282, SK 8282, SK 9282, SK 10282, SK 11282 (2-stage)
SK 1382NB, SK 2382, SK 3382, SK 4382, SK 5382, SK 6382, SK 7382, SK 8382, SK 9382, SK 10382, SK 10382.1, SK 11382, SK 11382.1, SK 12382 (3-stage)
Bevel gear units
SK 92072, SK 92172, SK 92372, SK 92672, SK 92772; SK 920072.1, SK 92072.1, SK 92172.1, SK 92372.1, SK 92672.1, SK 92772.1, SK 93072.1, SK 93172.1, SK 930072.1, SK 93372.1, SK 93672.1, SK 93772.1 (2-stage)
SK 9012.1, SK 9016.1, SK 9022.1, SK 9032.1, SK 9042.1, SK 9052.1, SK 9062.1, SK 9072.1, SK 9082.1, SK 9086.1, SK 9092.1, SK 9096.1 (3-stage)
SK 9013.1, SK 9017.1, SK 9023.1, SK 9033.1, SK 9043.1, SK 9053.1 (4-stage)
Helical worm gear units
SK 02040, SK 02050, SK 12063, SK 12080, SK 32100, SK 42125 (2-stage)
SK 13050, SK 13063, SK 13080, SK 33100, SK 43125 (3-stage)
MINIBLOC worm gear units
SK1 S32, SK1 S40, SK 1S50, SK 1S63, SK 1SU..., SK 1SM31, SK 1SM40, SK 1SM50, SK 1SM63 (1-stage)
SK 2S32NB, SK 2S40NB, SK 2S50NB, SK 2S63NB, SK 2SU…, SK 2SM40, SK 2SM50, SK 2SM63 (2-stage)

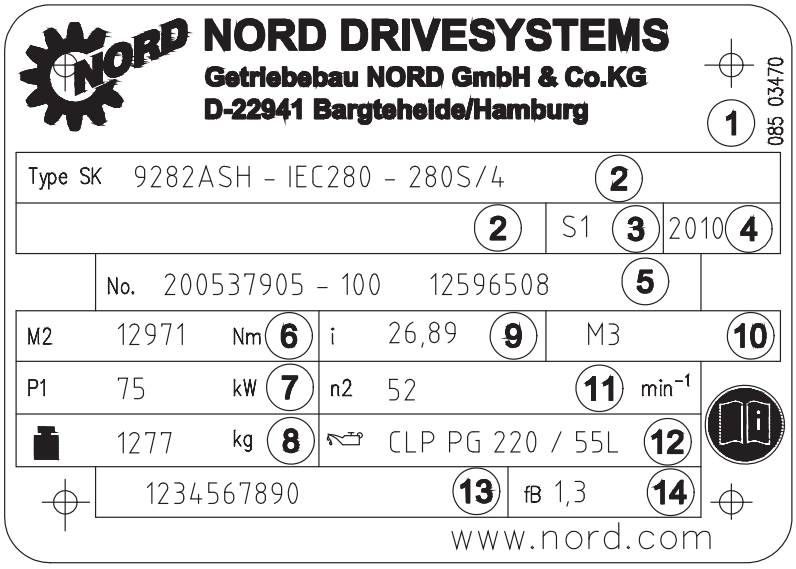
Gear unit types / Type designations					
UNIVERSAL worm gear units SK 1SI31, SK 1SI40, SK 1SI50, SK 1SI63, SK 1SI75, SK 1SIS31, …, SK 1SIS75, SK 1SID31, …, SK 1SID63, SK 1SMI31, …, SK 1SMI75, SK 1SMID31, …, SK 1SMID63, SK 1SIS-D31, …, SK 1SIS-D63 (1-stage), SK 2SMID40, SK 2SMID50, SK 2SMID63, SK 2SID40, …, SK 2SID63 (2-stage)					
Versions / Options					
-	Foot mounting with solid shaft	D	Torque support	IEC	Standard IEC motor mounting
A	Hollow shaft version	K	Torque bracket	NEMA	Standard NEMA motor attachment
V	Solid shaft version	S	Shrink disc	W	With free drive shaft
L	Solid shaft both sides	VS	Reinforced shrink disc	VI	Viton radial seals
Z	Output flange B14	EA	Hollow shaft with internal spline	OA	Oil expansion tank
F	Output flange B5	G	Rubber buffer	OT	Oil level tank
X	Foot mounting	VG	Reinforced rubber buffer	SO1	Synthetic oil ISO VG 220
XZ	Base and output flange B14	R	Back stop	CC	Casing cover with cooling spiral
XF	Base and output flange B5	B	Fastening element	DR	Pressure venting
AL	Reinforced axial output bearings	H	Covering cap as contact guard	H10	Modular contrate pre-stage
5	Reinforced output shaft (Standard helical gear units)	H66	Covering cap IP66	/31	Worm pre-stage
V	Reinforced drive shaft (Standard helical gear units)	VL	Reinforced bearings	/40	Worm pre-stage
		VL2	Agitator version		
		VL3	Drywell agitator version		

Table 3: Type designations and gear unit types

Double gear units consist of two single gear units. They are to be treated as per the instructions in this Manual, i.e. as two individual gear units.

Type designation for double gear units: e.g. SK 73 /22 (consisting of single gear units SK 73 and SK 22)

2.2 Type plate



	Explanation
1	Matrix or bar code
2	NORD gear unit type
3	Operating mode
4	Year of manufacture
5	Serial number
6	Rated torque of gear unit output shaft
7	Drive power
8	Weight according to ordered version
9	Overall gear unit ratio
10	Installation orientation
11	Rated speed of gear unit output shaft
12	Lubricant type, viscosity and quantity
13	Customer's part number
14	Operating factor

Fig. 1: Type plate (example) with explanation of the type plate fields

3 Assembly instructions, storage, preparation, installation

Please observe all general safety instructions (please see chapter 1.4 "Safety information"), the safety information in the individual sections and the proper use (please see chapter 1.3 "Correct use")bestimmungsgemäße Verwendung</dg_ref_source_inline>.

3.1 Transporting the gear unit

WARNING — **Hazard due to heavy loads**

Severe injuries and material damage due to falling or tipping heavy loads are possible.

- Standing under the gear unit during transport is **extremely dangerous**.
- To prevent injury, **the danger area must be generously cordoned off.**
- Only transport using the eyebolts attached to the gear unit.
- No additional loads may be attached.
- If geared motors have an additional eyebolt attached to the motor, this must also be used.
- The thread of the eyebolt must be fully screwed in.
- Avoid pulling the eyebolts at an angle.

NOTICE — **Gear unit damage**

Damage to the gear unit due to improper use is possible.

- Prevent damage to the gear unit. Impacts to the free ends of the shafts may cause internal damage to the gear unit.
- Use adequately dimensioned and **suitable means of transportation**. Lifting tackle must be designed for the weight of the gear unit. The weight of the gear unit can be obtained from the dispatch documents.

3.2 Storage

For short-term storage before commissioning, please observe the following:

Store in the installation position (please see chapter 6.1 "Configurations and maintenance") and secure the gear unit against falling,

- Lightly oil bare metal housing surfaces and shafts
- Store in a dry place.
- Temperature in the range from – 5 °C to + 50 °C without large fluctuations,
- Relative humidity less than 60 %,
- No direct exposure to sunlight or UV light,
- No aggressive, corrosive substances (contaminated air, ozone, gases, solvents, acids, alkalis, salts, radioactivity etc.) in the immediate vicinity,
- No vibration or oscillation

3.3 Long-term storage

CAUTION — **Injury to persons**

Incorrect, or excessively long storage may result in malfunctions of the gear unit.

Perform an inspection of the gear unit prior to commissioning if the permissible storage time has been exceeded.

Information — **Long-term storage**

For storage or standstill periods in excess of 9 months, Getriebebau NORD recommends the long-term storage option.

With the long-term storage option and the use of the measures listed below, storage for up to 2 years is possible. As the actual influences on the unit greatly depend on the local conditions, these times should only be regarded as guide values.

Conditions of the gear unit and storage area for long-term storage prior to commissioning:

- Store in the installation position (please see chapter 6.1 "Configurations and maintenance") and secure the gear unit against falling.
- Transportation damage to the external paint must be repaired. Check that a suitable rust inhibitor is applied to the flange bearing surfaces. If necessary apply a suitable rust inhibitor to the surfaces.
- Gear units with the long-term storage option are completely filled with lubricant or have VCI corrosion protection agent mixed with the gear oil (see adhesive label on the gear unit, or are not filled with oil, but rather with small quantities of VCI concentrate.
- The sealing band in the vent plug must not be removed during storage. The gear unit must remain sealed tight.
- Store in a dry place.
- In tropical regions, the gear unit must be protected against damage by insects
- Temperature in the range from – 5 °C to + 40 °C without large fluctuations,
- Relative humidity less than 60 %,
- No direct exposure to sunlight or UV light,
- No aggressive, corrosive substances (contaminated air, ozone, gases, solvents, acids, alkalis, salts, radioactivity etc.) in the immediate vicinity,
- No vibration or oscillation

Measures during storage or standstill periods

- If the relative humidity is <50 % the gear unit can be stored for up to 3 years.

Measures before commissioning

- If the storage or standstill period exceeds 2 years or the temperature during short-term storage has greatly deviated from the standard range, the lubricant in the gear unit must be replaced before commissioning.
- If the gear unit is completely filled, the oil level must be reduced before commissioning.
- For gear units without oil filling, the oil level for the version must be filled before commissioning. The VCI concentrate may remain in the gear unit. Lubricant quantities and types must be filled according to the details on the type plate.

3.4 Preparing for installation

⚠ CAUTION — **Injury to persons**

Transport damage may cause malfunctions of the gear unit, which may cause material damage or personal injury.

Please inspect the delivery for transport and packaging damage immediately on receipt. Report any damage to the carrier immediately. Gear units with transport damage must not be commissioned.

The drive unit must be inspected and may only be installed if no damage is apparent. In particular the radial seals and the sealing caps must be inspected for damage.

Pay attention to leaked lubricants, they may cause slips.

All bare metal surfaces and shafts of the gear unit are protected against corrosion with oil, grease or corrosion protection agents before shipping.

Thoroughly remove all oil, grease or corrosion protection agents and any dirt from the shafts and flange surfaces before assembly.

In applications where an incorrect rotational direction may result in damage or potential risk, the correct rotational direction of the output shaft is to be established by test running the drive when uncoupled and guaranteeing such for subsequent operation.

Gears with integrated return stops are marked with arrows on the drive/driven sides. The arrows point in the rotation direction of the gear unit. When connecting the motor and during motor control, it must be ensured that the gear unit can only operate in the direction of rotation. (For further explanations see catalogue G1000 and WN 0-000 40)

NOTICE — **Gear unit damage**

For gear units with an integrated back stop, switching the drive motor to the blocked direction of rotation, i.e. incorrect direction of rotation, may result in damage to the gear unit.

Take care that the direction of rotation is correct.

Ensure that no aggressive or corrosive substances are present in the area surrounding the installation site or are subsequently expected during operation, which attack metal, lubricants or elastomers. In case of doubt, please contact Getriebebau NORD and take the recommended action.

Oil expansion tanks (Option OA) must be fitted in accordance with works standard WN 0-530 04. For gear units with an M10x1 vent plug, works standard WN 0-52135 must be also be observed during installation.

Oil level tanks (Option OT) must be fitted in accordance with works standard WN 0-521 30.

If venting of the gear unit is provided, the vent or the pressure vent must be activated before commissioning. To activate, remove the transport securing device (sealing cord). Position of the vent plug (please see chapter 6.1 "Configurations and maintenance").

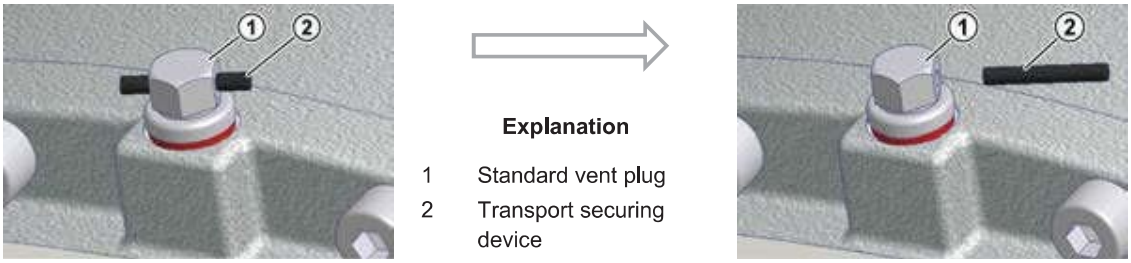


Figure 2: Activating the vent plug

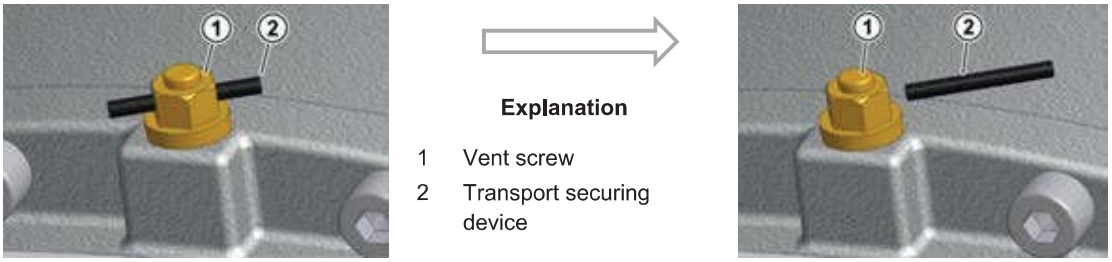


Figure 3: Activating the vent plug

Before commissioning, the vent plug must be replaced with the special pressure vent which is supplied as a loose part.

This is done by unscrewing the vent fitting and replacing it with the special pressure vent and seal (refer to Section 6.1 "Configurations and maintenance"). Double gear units consist of two single units and are equipped with 2 oil chambers and 2 pressure vents.

Figure 4: Removing the vent plug and fitting the special pressure vent

(please see chapter 6.5 "Torque values")

3.5 Installing the gear unit

⚠ WARNING — **Danger of burns**

The surfaces of gear units or geared motors may become hot during or shortly after operation.

Hot surfaces which can be touched directly must be protected with a contact guard.

⚠ WARNING — **Danger to persons**

If the foundation or the fastening of the gear unit is not adequately dimensioned, the gear unit may detach, fall down or rotate in an uncontrolled manner.

The foundation and the gear unit fastening must be appropriately designed for the weight and the torque. All bolts must be used to fasten the gear unit

NOTICE — **Damage to the gear unit due to overheating**

The gear unit may be damaged by overheating.

When installing, check that the cooling air from the motor fan can circulate around the geared motor and the gear unit without obstruction.

The eyebolts screwed into the gear units must be used during installation. No additional load may be attached to the gear unit.

If geared motors have an additional eyebolt attached to the motor, this must also be used. Avoid pulling the eyebolts at an angle. Observe the safety information (please see chapter 1.4 "Safety information").

The base and/or flange to which the gear unit is fitted should be vibration-free, torsionally strong and flat. The smoothness of the mating surface on the base or flange must be according to tolerance class K according to DIN ISO 2768-2. All contamination to the bolting surfaces of gear unit and base and/or flange must be thoroughly removed.

The gear housing must always be earthed. With geared motors, earthing via the motor connection must be ensured.

The gear unit must be precisely aligned with the drive shaft of the machine in order to prevent additional forces from being imposed on the gear unit due to distortion.

Welding of the gear unit is prohibited. The gear unit must not be used as the earth connection for welding work, as this may cause damage to the bearings and gear wheels.

The gear unit must be installed in the correct orientation(please see chapter 6.1 "Configurations and maintenance"). (UNIVERSAL SI and SM gear unit types do not depend on the configuration). Changes to the installation position after delivery require adjustment of the quantity of oil, and often other measures such as e.g. the installation of encapsulated roller bearings. **Damage may result if the stated installation position is not observed.**

All gear unit feet and/or all flange bolts on each side must be used. Bolts must have a minimum quality of 8.8. The bolts must be tightened to the correct torques (please see chapter 6.5 "Torque values"). Tension-free bolting must be ensured, particularly for gear units with a foot and flange.

The oil inspection screws, oil drain screws and the vent valves must be accessible.

3.6 Fitting hubs on the gear shafts

NOTICE — **Gear unit damage**

The gear unit may be damaged by axial forces.

Do not subject the gear unit to harmful axial forces when fitting the hubs. In particular, do not hit the hubs with a hammer.

Drive and driven elements, e.g. coupling and chain-wheel hubs must be mounted onto the drive and driven shaft of the gear unit using suitable pullers that will not apply damaging axial forces onto the gear unit.

Information — **Installation**

Use the end thread of the shafts for pulling. Fitting can be aided by coating the hub with lubricant or heating it up to approx. 100 °C beforehand.

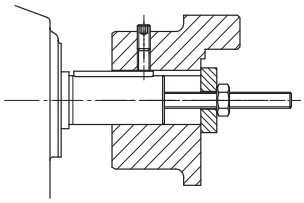


Figure 5: Example of a simple pulling device

DANGER — **Severe personal injury**

There is a danger of injury due to rapidly rotating drive and driven elements.

Drive and driven elements, such as belt drives, chain drives, shrink disks, fans and couplings must be fitted with contact protection.

Drive and driven elements may only subject the drive unit to the maximum radial forces F_R and axial forces F_A which are specified in the catalogue. Observe the correct tension, particularly on belts and chains.

Additional loads due to unbalanced hubs are not permitted.

The transverse force must be applied to the gear unit as closely as possible.

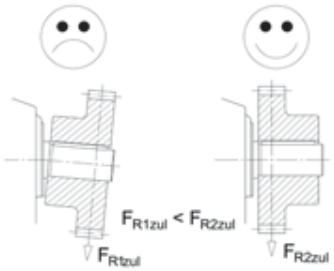


Figure 6: Correct assembly of drive elements

3.7 Fitting push-on gear units

NOTICE — **Gear unit damage**

The bearings, gear wheels, shafts and housing may be damaged by incorrect fitting.

- Observe the assembly instructions.
- The push-on gear unit must be fitted onto the shaft using a suitable puller, which will not exert damaging axial forces on the gear unit. In particular, do not hit the gear unit with a hammer.

Assembly and subsequent dismantling is aided by applying an anti-corrosive lubricant to the shaft before fitting (e.g. NORD Anti-Corrosion Part No. 089 00099). Excess grease or anti-corrosion agent may escape after assembly and may drip off. Clean these points on the output shaft after a running-in time of approx. 24 hours. This escape of grease is not due to a leak in the gear unit.

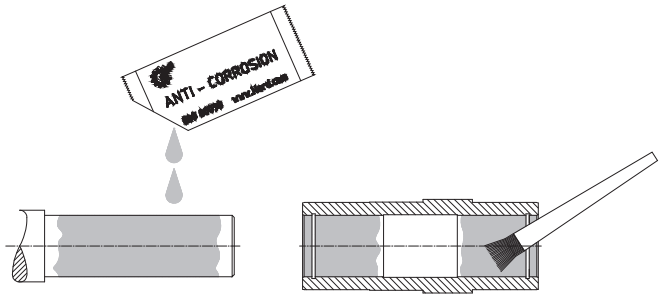


Figure 7: Applying lubricant to the shaft and the hub

Information — **Fastening element**

The gear unit can be fitted to shafts with and without a shoulder using the fastening element (Option B). Tighten the bolt of the fastening element to the correct torque (please see chapter 6.5 "Torque values"). For gear units with option H66, the factory-fitted closing cap must be removed before assembly.

For push-on gear units with option H66 and fastening element (Option B) the pressed-in closing cap must be pushed out before fitting the gear unit. The pressed-in closing cap may be destroyed during dismantling. As standard a second closing cap is supplied as a loose spare part. After fitting the gear unit, fit the new / new condition closing cap as described in Section 3.9 "Fitting the covers".

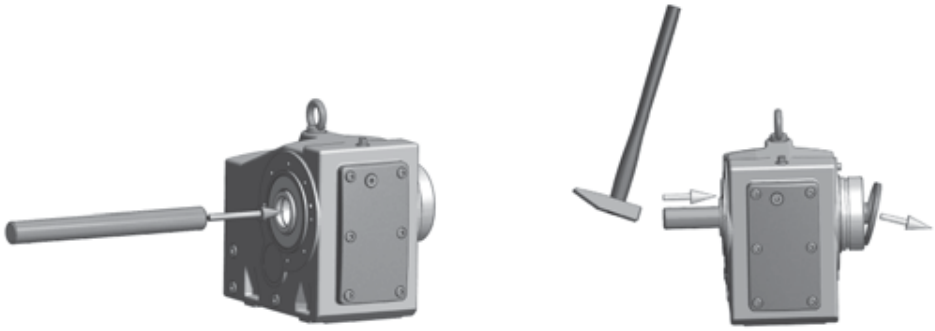


Figure 8: Removing the factory-fitted closing cap

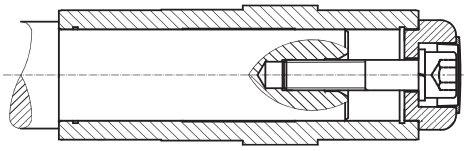


Figure 9: Gear unit mounted to shaft with a shoulder using the fastening element

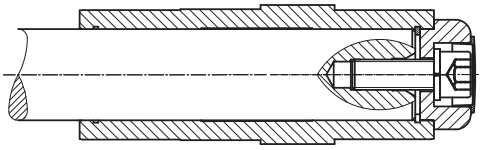


Figure 10: Gear unit mounted to shaft without a shoulder using the fastening element

A gear unit can be dismantled from a shaft with a shoulder using the following device, for example.

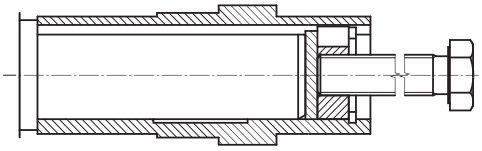


Figure 11: Dismantling using dismantling device

When assembling push-on gears with torque supports, the support must not be distorted. Tension-free mounting is aided by the rubber buffer (Option G or VG).

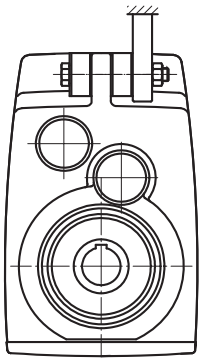


Figure 12: Mounting the rubber buffer (Option G or VG) on parallel shaft gear units

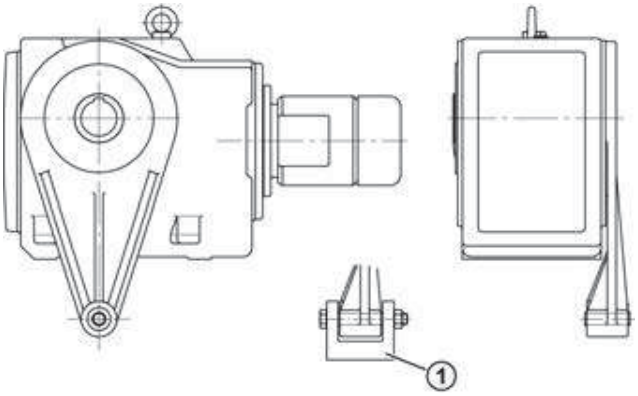
To fit the rubber buffer, tighten the screw fastening until there is no play between the contact surfaces when there is no load.

Then turn the fastening nut half a turn in order to pre-tension the rubber buffer (only applies for screw fastenings with adjusting threads). Greater pre-tension is not permissible

WARNING — **Risk of injury**

The gear unit may suddenly rotate around the shaft if the bolts are loosened.

Secure the screw fastening against loosening, e.g. with Loctite 242 or a second nut.



	Explanation
1	Always support torque support on both sides

Fig. 13: Attaching the torque support on bevel gear and worm gear units

Tighten the fastenings of the torque support with the correct tightening torques (please see chapter 6.5 "Torque values") and secure against loosening (e.g. Loctite 242, Loxeal 54-03).

3.8 Fitting shrink discs

⚠ CAUTION — **Risk of injury**

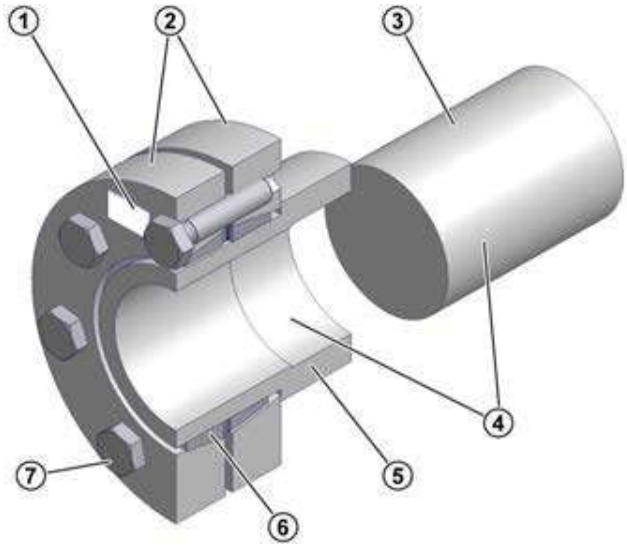
Risk of injury from incorrect mounting and dismantling of the shrink disc.

Observe the instructions.

NOTICE — **Gear unit damage**

If the tensioning bolts are tightened without the solid shaft inserted, the hollow shaft may be permanently deformed.

Do not tighten bolts if the solid shaft is not inserted!



	Explanation
1	Shrink disc, type, part no. and torque details for tensioning screws
2	Tensioning flanges
3	Solid shaft of machine
4	Shaft and hollow shaft bore **FREE OF GREASE**
5	Hollow shaft of gear unit
6	Double half-slotted inner ring
7	Tensioning screws DIN 931 (933) -10.9

Figure 14: Hollow shaft with shrink disc

The shrink discs are supplied by the manufacturer ready for fitting. They must not be dismantled prior to fitting.

The solid shaft of the machine runs **free of grease** in the hollow shaft of the gear unit.

Assembly sequence

1. Remove any transport securing devices.
2. Loosen but do not remove tightening bolt and tighten gently by hand until there is no play between the flanges and the inner ring.
3. Slide the shrink disc onto the hollow shaft until the outer clamping flange is flush with the hollow shaft. The shrink disc is easier to slide on if the bore of the inner ring is lightly greased.
4. Prior to mounting, grease the solid shaft only in the area which will later come into contact with the bronze bush in the hollow shaft of the gear unit. Do not grease the bronze bush, in order to prevent grease penetrating the area around the shrink connection.
5. The hollow shaft of the gear unit must be completely de-greased and **completely free of grease.**
6. In the area of the shrink connection the solid shaft of the machine must be degreased and **completely free** of grease.
7. Insert the solid shaft of the machine into the hollow shaft so as to completely fill the area around the shrink connection.
8. Position the clamping flange by gently tightening the bolts.
9. Tighten the tensioning bolts successively in a clockwise direction by several turns – not crosswise – with approx. ¼ rotation per turn. Tighten the bolts with a torque wrench to the torque indicated on the shrink disc.
10. When the tensioning bolts have been tightened, there must be an even gap between the clamping flanges. If this is not the case, the gear unit must be dismantled and the shrink disc connection checked for correct fit.

Dismantling sequence:

1. Loosen the tensioning bolts successively in a clockwise direction by several turns with approx. ¼ rotation per turn. Do not remove the bolts from their thread.
2. Loosen the clamping flanges from the cone of the inner ring.
3. Remove the gear unit from the solid shaft of the machine.

If a shrink disk has been in use for a long period or is dirty, it must be dismantled, cleaned and the conical surfaces coated with Molykote G Rapid Plus or a similar lubricant before it is refitted. The threads and head surfaces of the screws must be treated with grease without Molykote. Any damaged or corroded elements must be replaced.

3.9 Fitting the covers

WARNING — **Risk of injury**

There is a danger of injury due to shrink discs and freely rotating shaft journals.

- Use a cover (Option H and Option H66) as a guard.
- If this does not achieve sufficient protection against contact according to the required protection type, the machinery and plant constructor must ensure this by means of special attached components.

All fixing screws must be used and tightened to the correct torque (please see chapter 6.5 "Torque values"). For covers with Option H66, press in the new / new condition closing cap by tapping it lightly with a hammer.

Figure 15: Fitting the covers, Option SH, Option H, and Option H66

3.10 Fitting the covers

WARNING — **Risk of injury**

There is a danger of injury due to freely rotating shaft journals.

- Use a cover cap as a guard
- If this does not achieve sufficient protection against contact according to the required protection type, the machinery and plant constructor must ensure this by means of special attached components.

Many versions of the universal worm gear unit are supplied with plastic cover caps as standard. These cover caps protect the shaft sealing ring against the entry of dust and other possible contamination. The cover caps can be removed by hand without the use of tools and pushed onto the A or B side.

The cover cap must be removed before installing the universal worm gear unit. After installation is complete, the cover cap must be pushed into the threaded holes on the output flange on the corresponding side. Care must be taken that the cover cap is removed and pushed on vertically, in order not to damage the expansion elements of the cover cap.

Fig. 16: Removal and fitting of the cover cap

3.11 Fitting a standard motor

The maximum permitted motor weights indicated in the table below must not be exceeded when attaching the motor to an IEC/NEMA adapter:

Maximum permitted motor weights														
IEC motor size	63	71	80	90	100	112	132	160	180	200	225	250	280	315
NEMA motor size		56C	143T	145T	182T	184T	210T	250T	280T	324T	326T	365T		
Max. motor weight [kg]	25	30	40	50	60	80	100	200	250	350	500	700	1000	1500

WARNING **Risk of injury**

Severe injuries may be caused by rapidly rotating parts when installing and servicing couplings.

Secure the drive unit against accidental switch-on.

Assembly procedure to attach a standard motor to the IEC adapter (Option IEC/NEMA adapter)

1. Clean the motor shaft and flange surfaces of the motor and the IEC /NEMA adapter and check for damage. The mounting dimensions and tolerances of the motor must conform to DIN EN 50347/NEMA MG1 Part 4.
2. Push the coupling sleeve onto the motor shaft so that the motor parallel key engages into the groove in the sleeve on tightening.
3. Tighten the coupling sleeve on the motor shaft in accordance with the motor manufacturer's instructions until it touches the collar. With motor sizes 90, 160, 180 and 225, any spacer bushes must be positioned between the coupling sleeve and the collar. With standard helical gear units, dimension B between the coupling sleeve and the collar must be observed (see Figure 17). Certain NEMA adapters require adjustment of the coupling in accordance with the specifications indicated on the adhesive plate.
4. If the coupling half contains a threaded pin, the coupling must be secured axially on the shaft. The threaded pin must be coated prior to use with a securing lubricant e.g. Loctite 242, Loxeal 54-03 and tightened to the correct torque (please see chapter 6.5 "Torque values").

.

5. Sealing of the flange surfaces of the motor and the IEC/NEMA adapter is recommended if the motor is installed outdoors or in a humid environment. Before the motor is installed, the flange surfaces must be completely coated with surface sealant Loctite 574 or Loxeal 58-14 so that the flange seals after mounting.
6. Mount the motor on the IEC/NEMA adapter. Do not forget to fit the gear rim or the splined sleeve provided (see illustration below).
7. Tighten the bolts of the IEC/NEMA adapter with the correct torque (please see chapter 6.5 "Torque values").

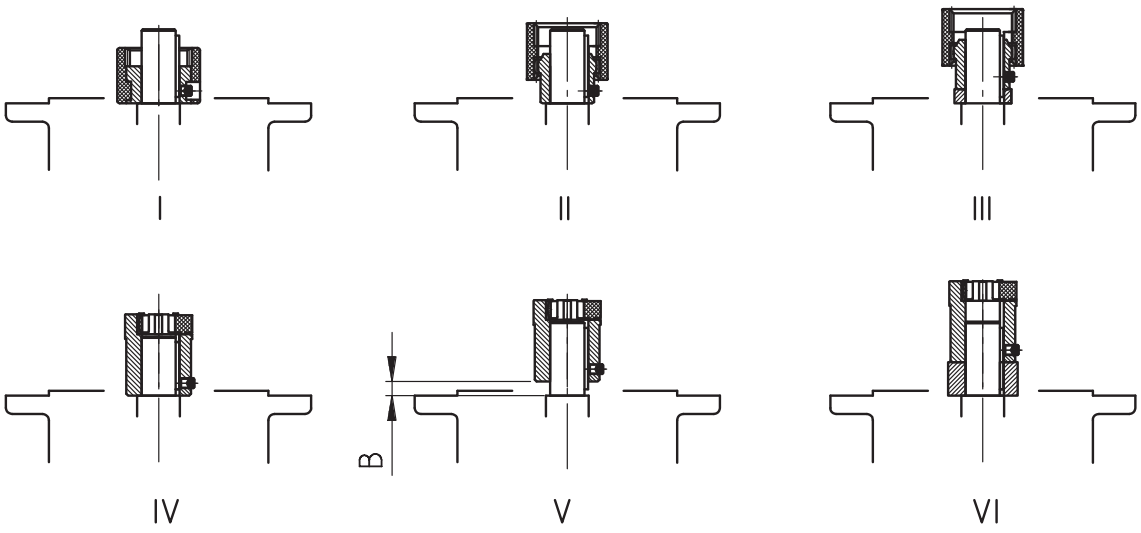


Figure 17: Fitting the coupling onto the motor shaft - various types of coupling

I Curved tooth coupling

II Curved tooth coupling, two-part

III Curved tooth coupling, two-part with spacer bush

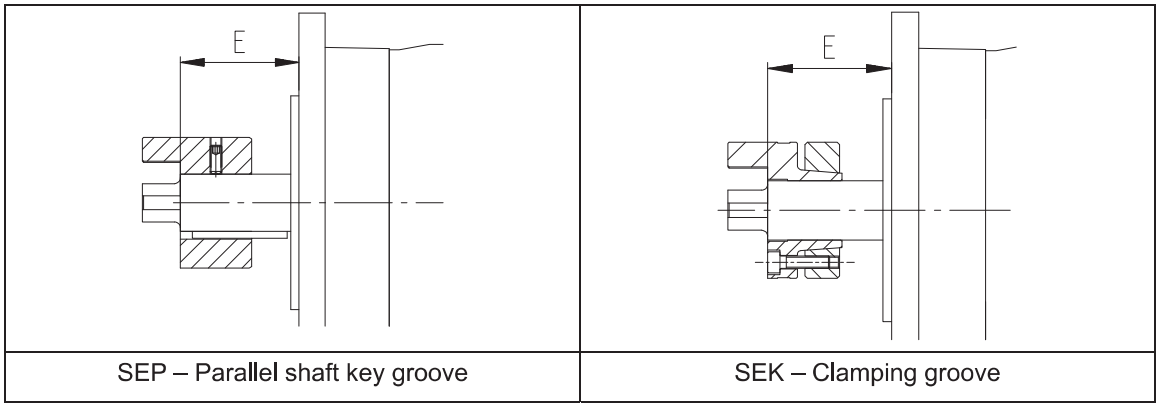
IV Claw coupling, two-part

V Claw coupling, two-part, observe dimension B:

Standard helical gear unit: SK 0, SK 01, SK 20, SK 25, SK 30, SK 33 (2-stage) SK 010, SK 200, SK 250, SK 300, SK 330 (3-stage)		
	IEC size 63	IEC size 71
Dimension B (Fig. V)	B = 4.5 mm	B = 11.5 mm

VI Claw coupling two-part with spacer bush

3.12 Installation of a servo motor (Option SEP / SEK)



SEP – Parallel shaft key groove	SEK – Clamping groove

E = Coupling installation size of flange system

Cylinder type	Coupling size*	Installation size E [mm]
SE. 100	GS 19	40
SE. 130	GS 24	50
SE. 165	GS 28	58
SE. 215	GS 28	80
	GS 48	80
SE. 300	GS 48	82
*) All coupling sizes are available as SEP or SEK versions, the ring gear has a hardness of (Shore) 98 Sh-A-GS, colour red		

Table 4: Allocation of cylinder types to coupling sizes

To prevent damage to the coupling, the dimension E which is stated in Table 12 must be complied with!

Assembly sequence for the connection of a servo motor to the servo adapter (Option SEP / SEK)

Please refer to the coupling manufacturer's operating/installation instructions for the assembly of the two halves of the coupling.

3.13 Fitting the cooling coil to the cooling system

WARNING — **Risk of injury**

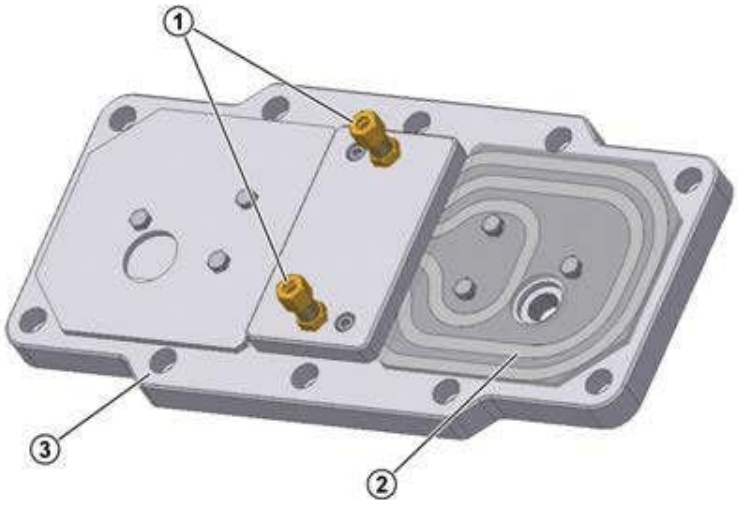
Possibility of injury due to pressure discharge.

Ensure that the pressure is released from the cooling circuit before carrying out any work on the gear unit.

The cooling coil is installed in the casing cover. Cutting ring screw threads according to DIN 2353 are located at the casing cover for the connection of a pipe with an external diameter of 10 mm.

Remove the closing cap from the screw neck prior to assembly to avoid any contamination of the cooling system. The screw necks should be connected with the coolant circuit, which must be provided by the operator. The flow direction of the coolant is irrelevant.

Make sure not to twist the screw necks during or after assembly as the cooling coil may be damaged. It must be ensured that no external forces act on the cooling coil.



	Explanation
1	Cutting ring screw threads
2	Cooling coil
3	Housing cover

Figure 18: Cooling cover