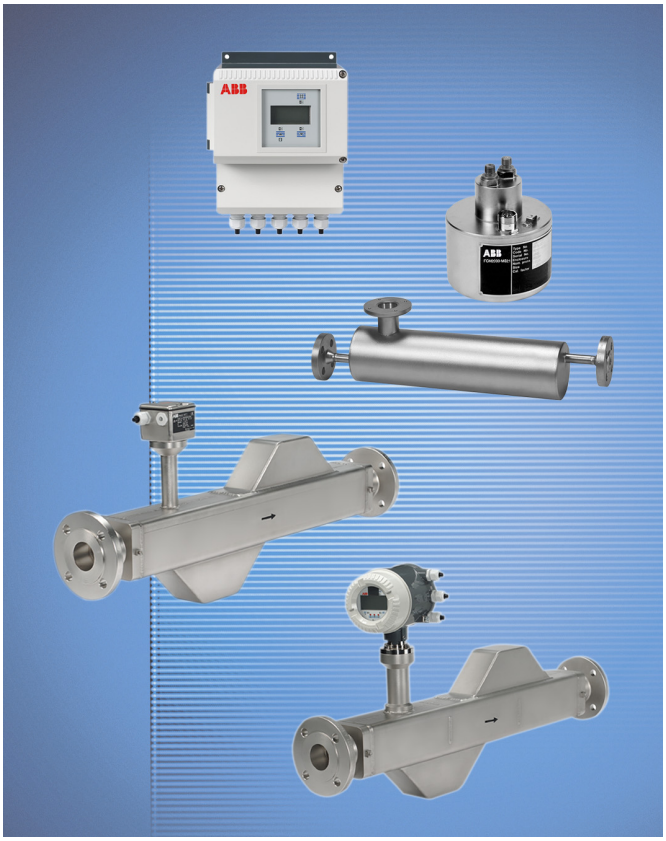
Operating Instruction
D184B111U02

Mass Flowmeter
CoriolisMaster FCM2000

Standard software
D699G001U01 C.1x
D699G001U02 C.1x
D699G001U03 C.1x



HART COMMUNICATION PROTOCOL
PROFIBUS Process field bus
Fieldbus Foundation

ABB

Mass Flowmeter
CoriolisMaster FCM2000

Operating Instruction

D184B111U02

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Translation of the original instruction

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1 Safety

1.1 General information and notes for the reader

Read these instructions carefully prior to installing and commissioning the device.

These instructions are an important part of the product and must be kept for later use.

These instructions are intended as an overview and do not contain detailed information on all designs for this product or every possible aspect of installation, operation and maintenance.

For additional information or in case specific problems occur that are not discussed in these instructions, contact the manufacturer.

The content of these instructions is neither part of any previous or existing agreement, promise or legal relationship nor is it intended to change the same.

This product is built based on state-of-the-art technology and is operationally safe. It has been tested and left the factory in a safe, maintenance-free state. The information in the manual must be observed and followed in order to maintain this state throughout the period of operation.

Modifications and repairs to the product may only be performed if expressly permitted by these instructions.

Only by observing all of the safety information and all safety/warning symbols in these instructions can optimum protection of both personnel and the environment, as well as safe and fault-free operation of the device, be ensured.

Information and symbols directly on the product must be observed. They may not be removed and must be fully legible at all times.

Important

- An additional document with Ex safety information is available for measuring systems that are used in potentially explosive areas (Applies to FM / CSA only).
- Ex safety information is an integral part of this manual. As a result, it is crucial that the installation guidelines and connection values it lists are also observed.

The icon on the name plate indicates the following:

1.2 Intended use

This device is intended for the following uses:

- To convey liquids and gases (fluids), including unstable ones
- To meter the mass flow of the fluid directly
- To meter the volumetric flow of the fluid (indirectly via mass flow and density)
- To measure fluid density
- To measure fluid temperature

The following items are included in the intended use:

- Read and follow the instructions in this manual.
- Observe the technical ratings; refer to the section 1.4 „Technical limit values“.
- Use only allowed liquids for measurement; refer to the section1.5 „Approved media“.

1.3 Improper use

The following are considered to be instances of improper use of the device:

- Operation as a flexible adapter in piping, e.g., to compensate for pipe offsets, pipe vibrations, pipe expansions, etc.
- As a climbing aid, e. g., for mounting purposes
- As a support for external loads, e. g., as a support for piping, etc.
- Adding material, e. g., by painting over the name plate or welding/soldering on parts
- Removing material, e. g., by spot drilling the housing

Repairs, alterations, and enhancements, or the installation of replacement parts, are only permissible insofar as these are described in the manual. Approval by ABB Automation Products GmbH must be sought for any activities beyond this scope. Repairs performed by ABB-authorized specialist shops are excluded from this.

1.4 Technical limit values

The meter has been designed for use exclusively within the values stated on the name plate and within the technical limit values specified on the data sheets.

The following technical limit values must be observed:

- The permissible pressure (PS) and the permissible fluid temperature (TS) must not exceed the pressure/temperature ratings (see the section titled "Specifications").
- The maximum and minimum operating temperature limits must not be exceeded or undershot.
- The permissible operating temperature must not be exceeded.
- The housing protection type must be observed during operation.
- The flowmeter sensor must not be operated in the vicinity of powerful electromagnetic fields, e.g., motors, pumps, transformers, etc. A minimum spacing of approx. 1 m (3.28 ft) must be maintained. For installation on steel parts (e.g., steel brackets), a minimum spacing of 100 mm (4") must be maintained. (These values have been calculated on the basis of IEC 801-2 and IEC TC77B.)

1.5 Approved media

When using media, please note:

- Media (fluids) may only be used if, based on the state of the art or the operating experience of the user, it can be assured that chemical and physical properties of the components coming into contact with the fluids will not be adversely affected during the operating period.
- Specifically chloride media can cause not visible corrosion damages to all media wetted components so that fluid can lead. The suitability of these materials for each application by the operator to examine.
- Media (fluids) with unknown properties or abrasive media may only be used if the operator can perform regular and suitable tests to ensure the safe condition of the meter.
- Observe the information on the name plate.

1.6 Warranty provisions

Using the device in a manner that does not fall within the scope of its intended use, disregarding this instruction, using underqualified personnel, or making unauthorized alterations releases the manufacturer from liability for any resulting damage. This renders the manufacturer's warranty null and void.

1.7 Plates and symbols

1.7.1 Safety-/ warning symbols, note symbols

DANGER – <Serious damage to health / risk to life>

This symbol in conjunction with the signal word "Danger" indicates an imminent danger. Failure to observe this safety information will result in death or severe injury.

DANGER – <Serious damage to health / risk to life>

This symbol in conjunction with the signal word "Danger" indicates an imminent electrical hazard. Failure to observe this safety information will result in death or severe injury.

WARNING – <Bodily injury>

This symbol in conjunction with the signal word “Warning“ indicates a possibly dangerous situation. Failure to observe this safety information may result in death or severe injury.

WARNING – <Bodily injury>

This symbol in conjunction with the signal word "Warning" indicates a potential electrical hazard. Failure to observe this safety information may result in death or severe injury.

CAUTION – <Minor injury>

This symbol in conjunction with the signal word “Caution“ indicates a possibly dangerous situation. Failure to observe this safety information may result in minor or moderate injury. This may also be used for property damage warnings.

NOTICE – <Property damage>!

The symbol indicates a potentially damaging situation.

Failure to observe this safety information may result in damage to or destruction of the product and/or other system components.

IMPORTANT (NOTE)

This symbol indicates operator tips, particularly useful information, or important information about the product or its further uses. It does not indicate a dangerous or damaging situation.

1.7.2 Name Plate / Factory Tag

Important

An additional document with Ex safety instructions is available for measuring systems that are used in explosion hazardous areas (Applies to FM / CSA only).
As a result, it is crucial that the specifications and data it lists are also observed.

1.7.2.1 Name plates

Standard transmitter

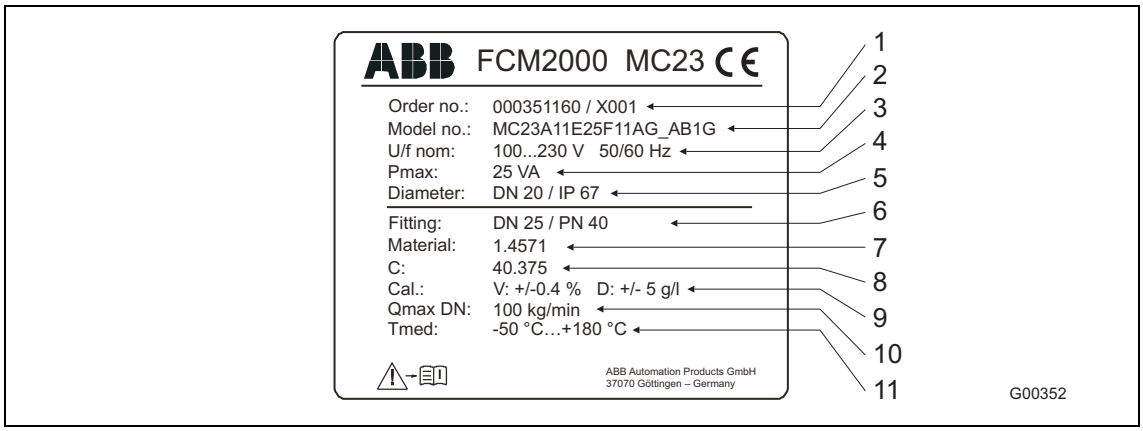


Fig. 1

1 Order no.
2 Complete model number
3 Supply voltage
4 Maximum power
5 Nominal diameter and protection class
6 Process connection and pressure rating
7 Meter tube material
8 Calibration factor
9 Calibration accuracy
10 Max. flowrate
11 Permissible fluid temperature

Transmitter with ATEX or IECEx approval

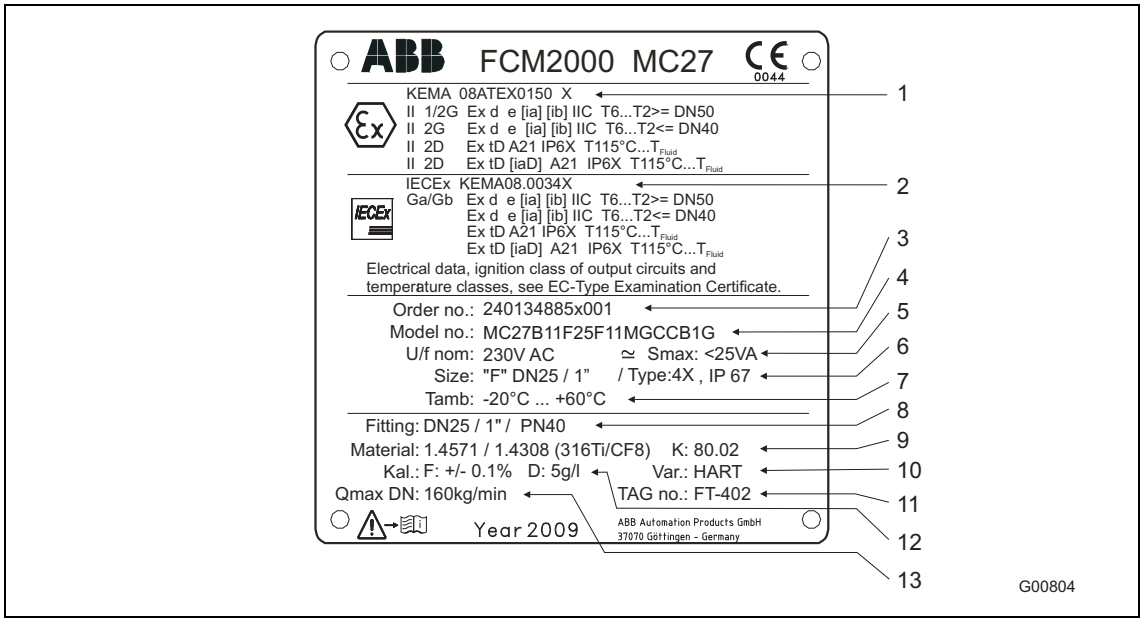


Fig. 2

1 ATEX approval
2 IECEx approval
3 Order no.
4 Complete model number
5 Supply voltage and maximum power
6 Nominal diameter and protection class
7 Ambient temperature
8 Process connection and pressure rating
9 Meter tube material and calibration factor
10 Type of communication
11 TAG no.
12 Calibration accuracy
13 Max. flowrate

1.7.2.2 Factory plates

The factory plate is located on the flowmeter primary housing. If the pressure equipment is subject to the PED (see section 3 para. 3 PED 97/23/EC), two labels are required:

Pressure equipment subject to PED

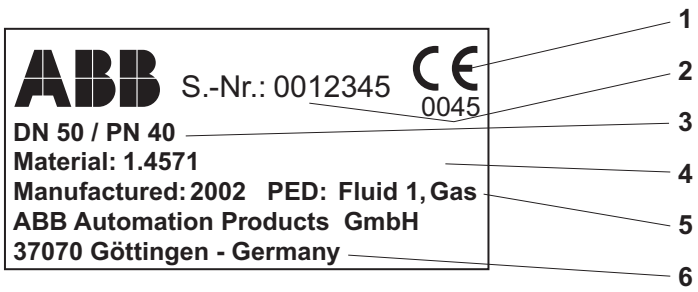


Fig. 3

The factory plate contains the following information:

1 CE mark (with number of labeled location) to confirm the device meets the requirements of pressure equipment directive 97/23/EC.

2 Serial number for identification of the pressure equipment by the manufacturer.

3 Nominal size and nominal pressure rating of pressure equipment.

4 Flange material, liner material and electrode material (parts that come into contact with fluid).

5 Year of manufacture for device and information on fluid group as per the **P**ressure**E**quipment**D**irective (PED). Fluid group 1 = hazardous fluids, liquid, gaseous.

6 Manufacturer of the pressure equipment.

Pressure equipment outside the applicable range of the PED

Fig. 4

The factory plate contains most of the specifications included on the plate described above with the following differences:

- There is no CE mark because the pressure equipment, as per section 3 para. 3 of the PED, is outside the applicable range of the pressure equipment directive 97/23/EC.
- The reason for the exception is specified in section 3 para. 3 of the PED. The pressure equipment is categorized as SEP (= sound engineering practice).

Important

If the factory plate is not present, the device is not in compliance with directive 97/23/EC. The exception applies for water, power and connected equipment accessories in accordance with guideline 1/16 of sec. 1 para. 3.2 of the pressure equipment directive.

1.8 Target groups and qualifications

Installation, commissioning, and maintenance of the product may only be performed by trained specialist personnel who have been authorized by the plant operator to do so. The specialist personnel must have read and understood the manual and comply with its instructions.

Prior to using corrosive and abrasive materials for measurement purposes, the operator must check the level of resistance of all parts coming into contact with the materials to be measured. ABB Automation Products GmbH will gladly support you in selecting the materials, but cannot accept any liability in doing so.

The operators must strictly observe the applicable national regulations with regards to installation, function tests, repairs, and maintenance of electrical products.

1.9 Returning devices

Use the original packaging or suitably secure shipping containers if you need to return the device for repair or recalibration purposes. Fill out the return form (see the Appendix) and include this with the device.

According to EC guidelines for hazardous materials, the owner of hazardous waste is responsible for its disposal or must observe the following regulations for shipping purposes:

All devices delivered to ABB Automation Products GmbH must be free from any hazardous materials (acids, alkalis, solvents, etc.).

Any hazardous material in the cavities, e.g. between the meter pipe and the housing, is to be flushed and neutralized. For flowmeter sensor MC2, the service screw (for draining condensate fluid) at the lower point of the housing (see Fig. 5) must be opened to dispose of hazardous substances and to neutralize the coil chamber. These activities must be confirmed in writing using the return form.

1.10 Disposal

ABB Automation Products GmbH actively promotes environmental awareness and has an operational management system that meets the requirements of DIN EN ISO 9001:2000, EN ISO 14001:2004, and OHSAS 18001. Our products and solutions are intended to have minimum impact on the environment and persons during manufacturing, storage, transport, use, and disposal.

This includes the environmentally friendly use of natural resources. ABB conducts an open dialog with the public through its publications.

This product/solution is manufactured from materials that can be reused by specialist recycling companies.

1.10.1 Information on WEEE Directive 2002/96/EC (Waste Electrical and Electronic Equipment)

This product/solution is not subject to the WEEE directive 2002/96/EC and relevant national laws (e. g., ElektroG in Germany).

The product/solution must be disposed of at a specialized recycling facility. Do not use municipal garbage collection points. According to the WEEE Directive 2002/96/EC, only products used in private applications may be disposed of at municipal garbage facilities. Proper disposal prevents negative effects on people and the environment, and supports the reuse of valuable raw materials.

If it is not possible to dispose of old equipment properly, ABB Service can accept and dispose of returns for a fee.

1.10.2 RoHS directive 2002/95/EC

With the Electrical and Electronic Equipment Act (ElektroG) in Germany, the European directives 2002/96/EC (WEEE) and 2002/95/EC (RoHs) are translated to national law. ElektroG defines the products that are subject to regulated collection and disposal or reuse in the event of disposal or at the end of their service life. ElektroG also prohibits the marketing of electrical and electronic equipment that contains a specific amount of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) (also known as hazardous substances with restricted uses).

The products provided to you by ABB Automation Products GmbH do not fall within the current scope of the directive on waste from electrical and electronic equipment according to ElektroG. If the necessary components are available on the market, these substances will no longer be used in new product development.

1.11 Safety instructions for transport

Observe the following instructions:

- The center of gravity is off center.
- The flow direction must correspond to the direction indicated on the device, if labeled.
- Comply with the maximum torque for all flange connections.
- Install the devices without mechanical tension (torsion, bending).
- Install flange devices with coplanar counter flanges.
- Only install devices for the intended operating conditions and with suitable seals.
- Secure the flange bolts and nuts against pipeline vibrations.

1.12 Safety instructions for electrical installation

The electrical connection may only be made by authorized specialist personnel according to the electrical plans.

The electrical connection information in the manual must be observed; otherwise, the electrical protection type may be adversely affected.

Ground the measurement system according to requirements.

1.13 Safety instructions for operation

During operation with hot fluids, contact with the surface may result in burns.

Aggressive fluids may result in corrosion or abrasion of the parts that come into contact with the medium. As a result, pressurized fluids may escape prematurely.

Wear to the flange gasket or process connection gaskets (e.g., aseptic threaded pipe connections, Tri-Clamp, etc.) may enable a pressurized medium to escape.

When using internal flat gaskets, these can become embrittled by CIP/SIP processes.

Warning – Risk to persons!

Bacteria and chemical substances can contaminate or pollute pipeline systems and the materials they are made of.
The appropriate installation conditions must be observed in order to achieve an installation that complies with EHEDG requirements.
For an installation to comply with EHEDG requirements, the process connection/gasket combinations created by the operator must always be made of parts that conform to EHEDG stipulations (EHEDG Position Paper: "Hygienic Process connections to use with hygienic components and equipment").

1.14 Maintenance and inspection safety information

Warning – Risk to persons!

When the housing cover is open, EMC and protection against contact are suspended. There are electric circuits within the housing which pose a contact risk.
The auxiliary power must be switched off before opening the housing cover.

Warning – Risk to persons!

The mounting or inspection screws (see Fig. 5) for devices ≥ DN 15 (1/2“) can be under pressure. The medium which spurts out can cause severe injuries.
Depressurize pipes before opening the inspection screws.

Warning - General hazards!

For inspection and maintenance in potentially explosive areas, observe the relevant information in this manual.

Warning - Potential damage to parts!

The inside of the housing of the flowmeter primary is filled with a shielding gas to prevent corrosion. If the inspection screws (see Fig. 5) are opened, this gas escapes and the interior of the flowmeter primary is no longer corrosion resistant. To avoid damaging the device, these screws should not be opened. The purpose of these screws is to allow for proper disposal of any contaminated fluids (in the event of pipe leakage). Inspections screws may not be used under any circumstances to connect trace heating.

Corrective maintenance work may only be performed by trained personnel.

- Depressurize the device and adjoining lines or containers before removing the device.
- Check whether hazardous materials are used as materials to be measured before opening the device. Residual amounts of hazardous material may still be present in the device and could escape when the device is opened.
- As far as provided in the scope of the operational responsibility, check the following items through a regular inspection:
  - the pressure-carrying walls / lining of the pressure device
  - the measurement-related function
  - the leak tightness
  - the wear (corrosion)

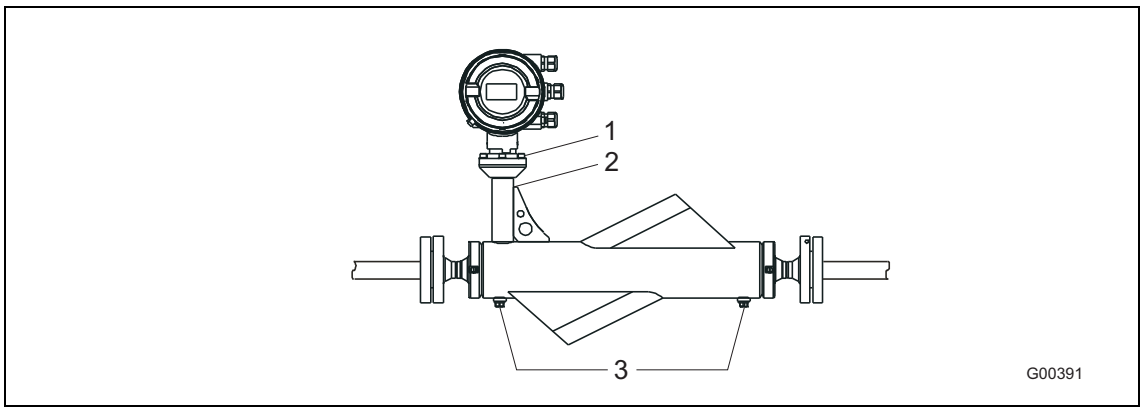


Fig. 5

1 Mounting screws
2 Tower
3 Inspection screws

2 Design and function

2.1 Design

The ABB Automation Products Mass Flowmeter operation is based on the Coriolis principle. The MC2 construction uses the classical parallel meter pipes and is characterized, in particular, by a space saving and rugged design, a wide flowmeter size spectrum at an advantageous price to the customer.

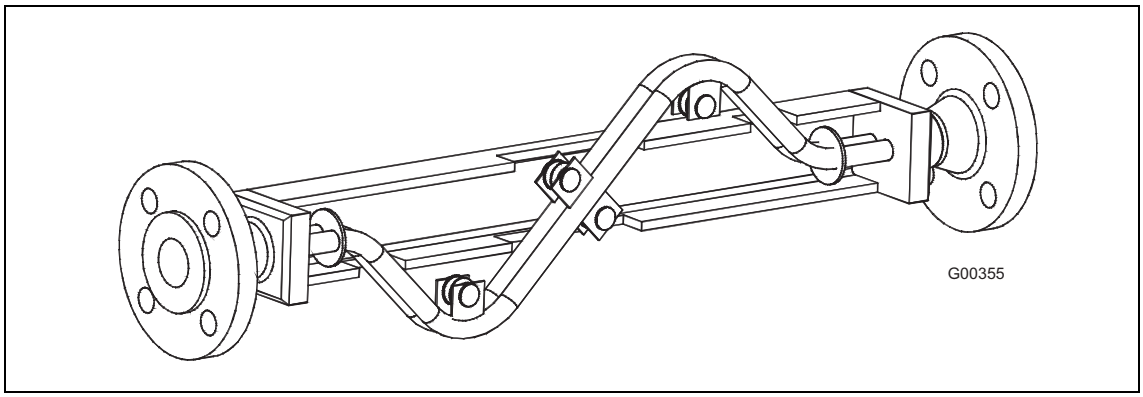


Fig. 6 MC2 Parallel Pipe Construction

2.2 Measuring principle

When a mass flows through a vibrating pipe, Coriolis forces are generated which bend and twist the pipe. These very small pipe deformations are measured by optimally mounted sensors and electronically evaluated. Because the measured phase shift of the sensor signals is proportional to the mass flowrate, the Coriolis Mass Flowmeter measures the mass flowrate in the flowmeter directly. The metering principle is independent of the density, temperature, viscosity, pressure and conductivity of the fluid.

The meter tubes always vibrate at resonance. This resonant frequency, at the operating conditions, is a function of the meter tube geometry, the characteristics of the flowmeter materials and the mass of the fluid in the meter tube, which is also vibrating. It provides an accurate measure of the density of the fluid being metered.

An integrated temperature sensor measures the fluid temperature and is utilized for corrections to temperature dependent instrument parameters. Summarizing, it is possible to simultaneously measure the mass flowrate, fluid density and temperature with the Coriolis Mass Flowmeter. Other measurement values can be derived from these values, e.g. volume flowrate or concentration.

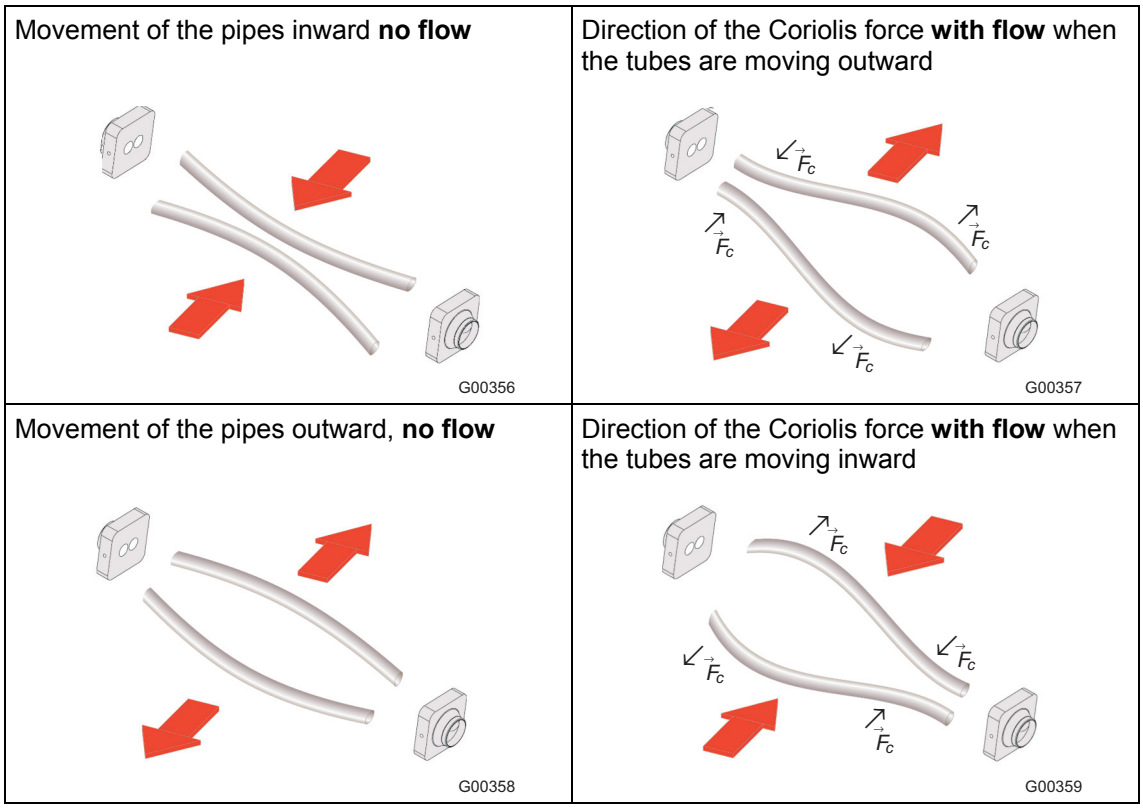


Fig. 7: Simplified Representation of the Coriolis Forces

$\vec{F}c$ = -2 m ($\vec{\omega} \times \vec{v}$)

$\vec{F}c$ = Coriolis force
$\vec{\omega}$ = Angular velocity
$\vec{v}$ = Velocity of the mass
m = Mass

2.3 Device designs

Important

An additional document with Ex safety instructions is available for measuring systems that are used in explosion hazardous areas (Applies to FM / CSA only).
As a result, it is crucial that the specifications and data it lists are also observed.

	MC2		MS2
	 G00316	 G00414	 G00315
	Standard	Hygienic (EHEDG)	Standard
Flowmeter sensor			
Model number	MC2	MC2_ _ _ 3	MS2
	DN PN	DN PN	DN PN
Flange DIN 2501/EN 1092-1	15 ... 150 40 ... 100	– –	10/15 40/100
Flange ASME B16.5	1/2 ... 6" CL 150 ... CL 600	– –	1/2" CL 150 ... CL 600
Threaded pipe connection conforming to DIN 11851	DN 15 ... DN 100 (1/2 ... 4")	DN 20 ... DN 80 (3/4 ... 3")	DN 10 (3/8")
Tri-Clamp	DIN 32676 (ISO 2852) DN 15 ... DN 100 (1/2 ... 4")	DIN 32676 (ISO 2852) DN 20 ... DN 80 (3/4 ... 3")	DIN 32676 (ISO 2852) DN 10 (3/8")
Aseptic flange DIN 11864-2	DN 15 ... DN 100 (1/2 ... 4")	DN 20 ... DN 80 (3/4 ... 3")	
"G" threaded pipe connection	–	–	1/4"
NPT threaded pipe connection	–	–	1/4"
Accuracy of mass flowrate	0.1 %/0.15 %/0.25 %/0.4"	0.1 %/0.15 %/0.25 %/0.4"	0.15 %/0.25 %/0.4"
Accuracy of density	0.005 kg/l, 0.001 kg/l	0.005 kg/l, 0.001 kg/l	0.01 kg/l
Accuracy of temperature	1 K	1 K	1 K
Materials in contact with fluid	Stainless steel Hastelloy C-4	Stainless steel 1.4435 (316L)	Stainless steel 1.4435 (316L), Hastelloy C-22
Protection class acc. to EN 60529	IP 67	IP 67	IP 67
Fluid temperature (see Section 3 / 4 of the data sheet, Section 10 of the operating instructions)	-50 ... 200 °C (-55 ... 392 °F)	-50 ... 200 °C (-55 ... 392 °F)	-50 ... 180 °C (-55 ... 356 °F)
Approvals			
Explosion protection conforming to ATEX, IEC (KEM 08 ATEX 0150X/0151X), (IECEx KEM08 00.0034X)	Zone 0/1/2 Dust-ignition-proof	Zone 0/1/2 Dust-ignition-proof	Zone 1 (ATEX only)
Other approvals for potentially explosive areas	Please contact our sales organization	Please contact our sales organization	Please contact our sales organization
Hygienic and sterile requirements	FDA	FDA, EHEDG	FDA
Transmitter			
Model number	ME2_/MC23, MC27		ME2_
Housing	Separate, field-mount housing/compact housing		Separate, field-mount housing
Cable length	Up to 50 m (164 ft.); 300 m (984 ft.) on request		5, 10, 20, or 50 m (16, 32, 65, or 164 ft.)
Supply power	100 ... 230 V AC, 24 V AC/DC		
Current output 1	Active: 0/4 ... 20 mA or passive: 4 ... 20 mA		
Current output 2	Passive: 4 ... 20 mA		
Pulse output	Active (non-ignition-proof) or passive		
Ext. output switch-off	Yes		
Ext. totalizer reset	Yes		
Forward/reverse flow metering	Yes		
Communication	HART protocol, PROFIBUS PA, FOUNDATION Fieldbus		
Pipe empty detection	Yes, based on preconfigured density alarm < 0.5 kg/l		
Self-monitoring, diagnostics	Yes		
On-site display/totalization	Yes		
Field optimized flow/density	Yes		
Protection class acc. to EN 60529	ME2: IP 65/67, NEMA 4X MC _ _: IP 67, NEMA 4X		

2.4 ATEX and IECEx device overview

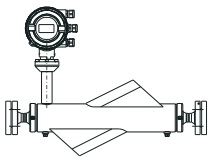
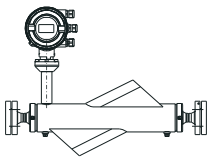
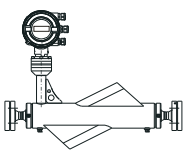
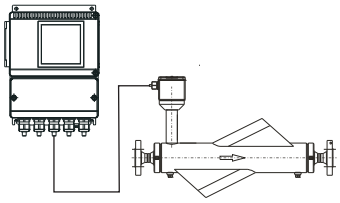
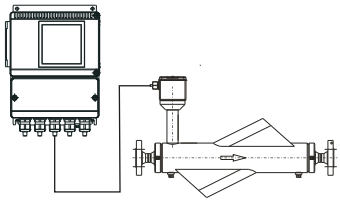
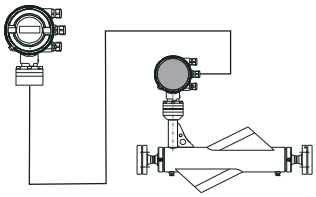
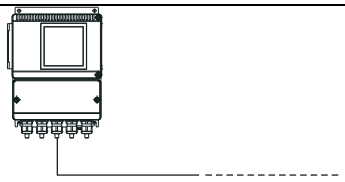
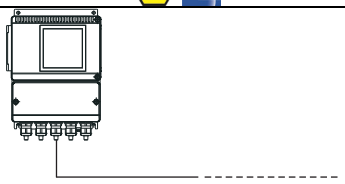
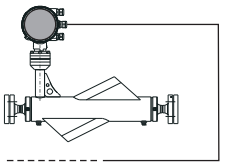
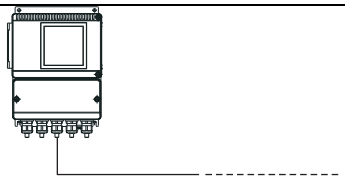
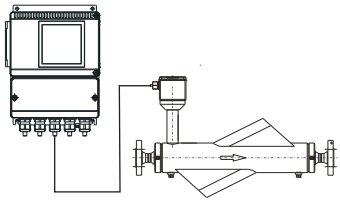
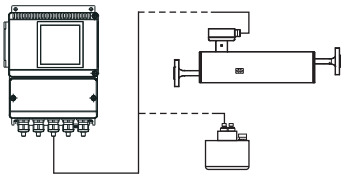
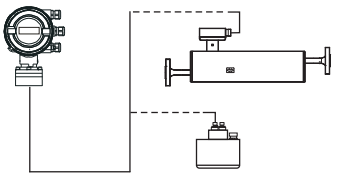
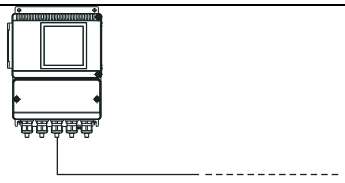
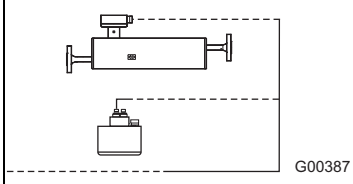
	Standard/non-Ex		Zone 2/21, 22		Zone 1/21	
Type	**MC23 A, U**		**MC23 M, N**		**MC27 B, E**	
			Ex IECEx		Ex IECEx	
1. Integral mount design − Standard/non-Ex − Ex Zone 2/21, 22 − Ex Zone 1/21						
Type	**ME21 A, U**	**MC21 A, U**	**ME21 M, N**	**MC21 M, N**	**ME26 B, E**	**MC26 B, E**
			Ex IECEx		Ex IECEx	
2. Remote mount design Transmitter and flowmeter sensor − Standard/non-Ex − Ex Zone 1/21						
Type	**ME21 A, U**		**ME21 M, N**		**MC26 B, E**	
			Ex IECEx		Ex IECEx	
3. Remote mount design Transmitter − Standard/non-Ex − Ex Zone 2/21, 22 Flowmeter sensor − Ex Zone 1/21						
Type	**ME21 A, U**		**ME21 M, N**	**MC21 M, N**		
			Ex IECEx			
4. Remote mount design (small nominal diameters) Transmitter − Standard/non-Ex − Ex Zone 2/21, 22 Flowmeter sensor − Ex Zone 2/21, 22						
Type	**ME22 A, U ...**	**MS21 A, U**			**ME27/28 B, E**	**MS26 B, E**
					Ex	
5. Remote mount design (small nominal diameters) Transmitter and flowmeter sensor − Standard/non-Ex − Ex Zone 2/21, 22 − Ex Zone 1/21						
Type	**ME24/25 A, U ...**				**MS26 B, E**	
					Ex	
6. Remote mount design (small nominal diameters) Transmitter − Standard/non-Ex − Ex Zone 2/21, 22 Flowmeter sensor − Ex Zone 1/21						

Fig. 8: FCM2000 overview

3 Transport

3.1 Inspection

Check the devices for possible damage that may have occurred during transport. Damages in transit must be recorded on the transport documents. All claims for damages must be claimed without delay against the shipper and before the installation.

3.2 General information on transport

Observe the following when transporting the device to the measurement site:

- The center of gravity is off center.
- Flanged units may not be lifted by the converter housing or terminal box.

4 Installation

Important

An additional document with Ex safety instructions is available for measuring systems that are used in explosion hazardous areas (Applies to FM / CSA only).
As a result, it is crucial that the specifications and data it lists are also observed.

4.1 Installation Requirements

4.1.1 General information

Inspection

Before installing the flowmeter sensor, check for physical damage due to possible improper handling during shipment. All claims for damage are to be made promptly to the shipper.

Installation Requirements / System Sizing Information

The FCM2000 is suitable for both indoor and outdoor installations. The standard instrument meets the requirements of Protection Class IP 67. The primary is bidirectional and can be installed in any orientation. It is important to ensure that the meter pipes are always completely filled with fluid.
The corrosion resistance of the fluid wetted materials must be evaluated.

The following points are to be considered during installation:
The preferred flow direction is indicated by the arrow on the flowmeter sensor. Flow in this direction will be indicated as positive (a forward/reverse flow calibration is available as on option).

Installation position

The FCM2000 operates in any orientation. The optimal installation orientation is vertical with the flow upwards.

Supports

In order to support the weight of the flowmeter sensor and to ensure reliable measurements when adverse external effects exist (e. g., vibrations), the primary should be installed in rigid pipelines. Two supports or hangers should be installed symmetrically and stress free in close proximity to the in- and outlet process connections.

Shut Off Devices

To conduct a system zero adjustment, shut off devices are required in the pipeline:
- in horizontal installation at the outlet,
- in vertical installation at the inlet.

When possible, shut off devices should be installed both up- and downstream from the flowmeter sensor.

Inlet Straight Sections

The mass meter does not require any flow conditioning inlet straight sections. Care should be exercised to ensure that any valves, gates, sight glasses, etc., do not cavitate and are not set into vibration by the flowmeter sensor.

System Design Information

- The presence of gas bubbles in the fluid can result in erroneous measurements, particularly in the density measurement. Therefore the flowmeter sensor should not be installed at the highest point in the system. Advantageous are installations in low pipeline sections, e. g., at the bottom of a U-section in the pipeline (invert).
- Long drop lines downstream from the flowmeter sensor should be avoided to prevent the meter tube from draining.
- Installation should be performed as stress free as possible.
- The flowmeter sensor should not come in contact with any other objects. Attachments to the housing are not permissible.
- When the cross-section of the connecting pipeline is larger than the flowmeter sensor size, suitable standard reducers should be installed.
- If strong vibrations exist in the pipeline, they should be damped using elastic pipeline elements. The damping devices must be installed beyond the supported flowmeter section and outside of the section between the shut off devices. The direct connection of flexible elements to the flowmeter sensor should be avoided.

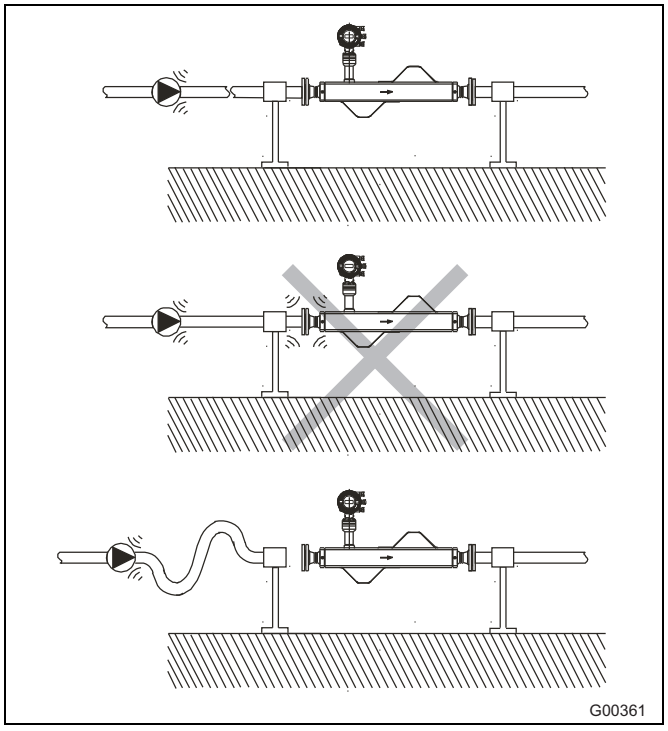


Fig. 9: Vibrations

- Care should be exercised to ensure that any dissolved gases, which may be present in many liquids, do not outgas. The back pressure at the outlet should be at least 0.2 bar (2.9 psi).
- Ensure that operation below the vapor pressure cannot occur when a vacuum exists in the meter tube.
- The flowmeter sensor should not be installed in the vicinity of strong electromagnetic fields, e. g., near motors, pumps, transformers etc.
- When operating more than one meter in one or multiple interconnected pipelines, the flowmeter primaries should be spaced distant from each other or the pipelines should be decoupled to prevent cross talk.
- Request information about special installation conditions for meter size "L".

Zero balance

In order to adjust the zero under operating conditions, it must be possible to reduce the flowrate "ZERO" while the meter tube remains completely filled. A bypass line is optimal when the process cannot be shut down. It is important for accurate measurements that during the zero adjustment there are no gas bubbles in the flowmeter sensor. It is also important that the pressure and temperature in the meter tube be the same as those which exists during operation.

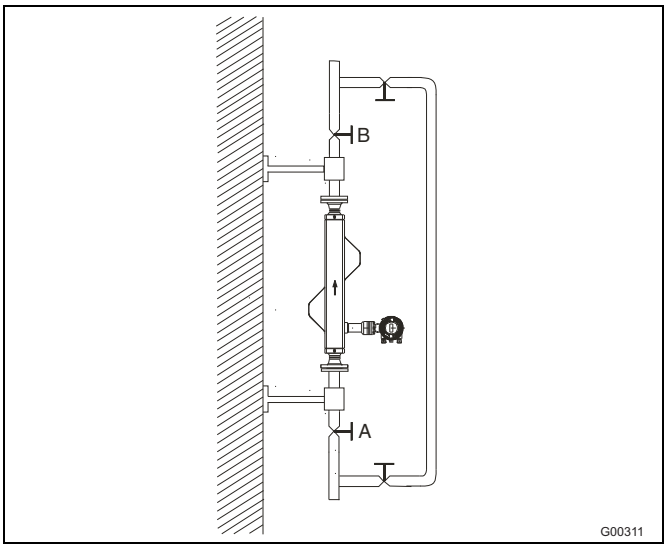


Fig. 10: Zero point adjustment with bypass line

4.1.2 Installation notes for FCM2000-MC2

Vertical installation position

The optimal installation orientation is a vertical installation with an upward flow as shown in Fig. 5. This has the advantage that any solids contained in the fluid will settle downward and any gas bubbles will move upward out of the meter tube when the flowrate is zero. Additionally, it is easy to drain the meter tube. Deposits can thereby be avoided.

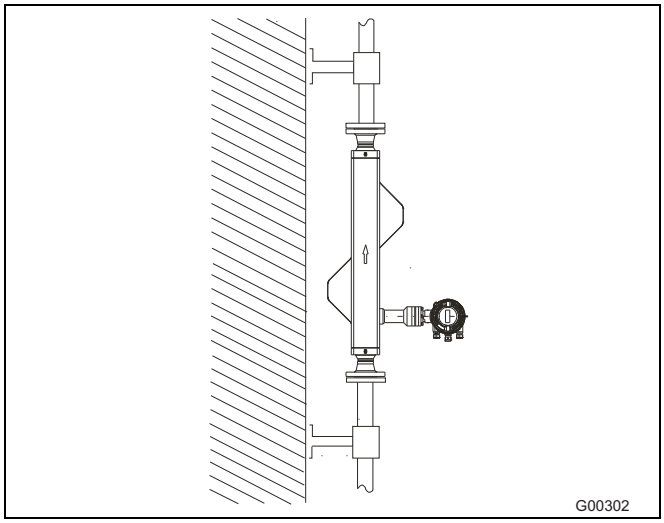


Fig. 11: Vertical installation position, self-draining (flow upwards)

Horizontal Installation Orientations

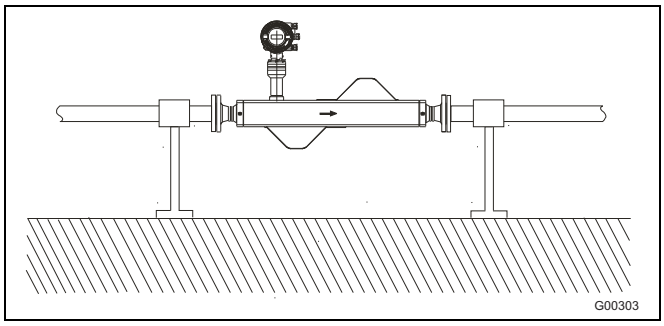


Fig. 12: Horizontal Installation Orientations

Horizontal Installations, Self Draining

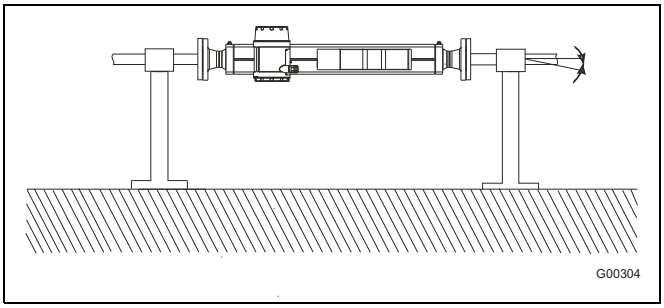


Fig. 13: Horizontal Installations, Self Draining, α 2 - 4°

Installation in a Drop Line

The installation recommendation shown in Fig. 14 is only permissible if a pipeline reduction or orifice with a smaller cross-section can be installed to prevent the flowmeter sensor from partially draining during the measurements.

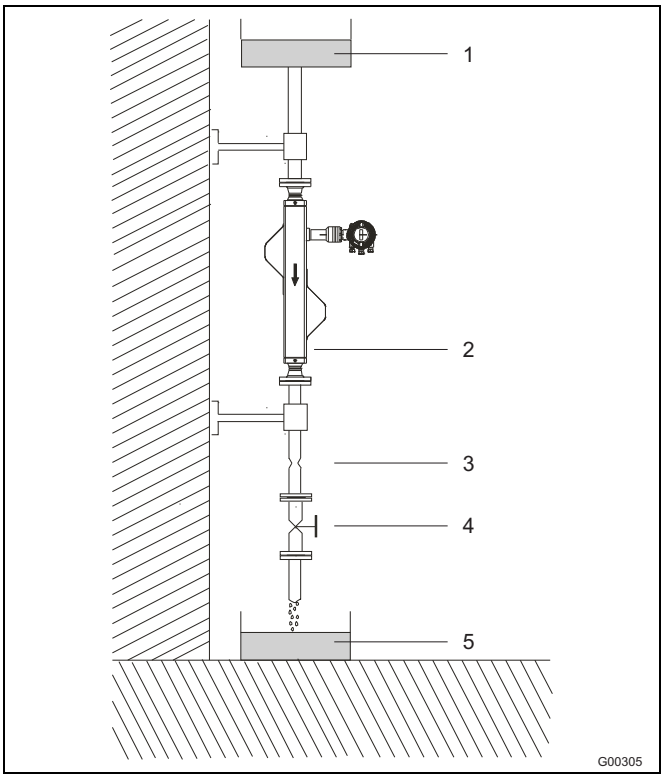


Fig. 14: Installation in a Drop Line

1 Supply reservoir
2 Flowmeter sensor
3 Orifice/pipe constriction
4 Valve
5 Product reservoir

Difficult Installation Conditions

The accumulation of air or gas bubbles in the meter pipe can lead to increased inaccuracies. Fig. Fig. 15 shows critical installation conditions.

Installations at the highest point in the pipeline (Figure A) can result in the formation of air pockets which can lead to appreciable inaccuracies.

Another difficult installation condition is immediately upstream of a free discharge (Figure B) in a drop line.

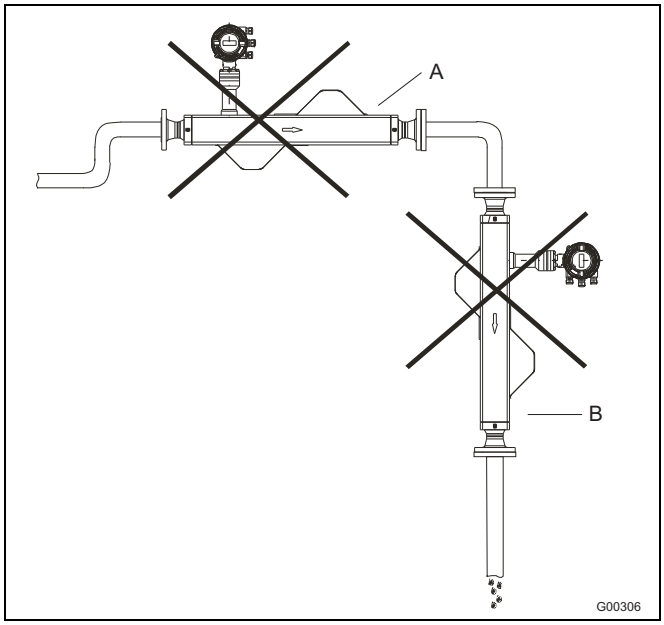


Fig. 15: Difficult Installation Conditions

Important:

Check whether the coordination flowmeter sensor and transmitter is correct. Compatible devices have the same end numbers, e. g., X001 and Y001 or X002 and Y002, on the type plate.

Pressure losses

The pressure losses, at the operating conditions, depends on the fluid and the actual flow. To calculate the pressure loss, the design program CD-CALC is provided.

4.1.3 Installation notes FCM2000-MS2

Installing the flowmeter sensor DN 1.5 (1/16")

Horizontal installation is recommended. If vertical installation is required, a flow direction from below to above is recommended for better elimination of air bubbles. In order for air to be removed from the flowmeter sensor, the flow speed in the flowmeter sensor must be at least 1 m/s. If the fluid contains solid particles, especially in conjunction with too little flow, a level installation location of the flowmeter sensor and positioning of the input flange completely on top is recommended so that the particles can be more easily flushed out. In order to avoid a partial emptying of the flowmeter sensor, a sufficient back pressure must be present at the unit (min. 0.1 … 0.2 bar/(1.45...2.9 psi)).

- Install the flowmeter sensor in a vibration-free manner to a wall or a steel frame.
- Position the flowmeter sensor at a low location in the system in order to avoid a negative pressure in the flowmeter sensor, that could lead to air or gas separation in the fluid.
- Ensure that the flowmeter sensor is not run empty (in the normal operation) as this can lead to inaccurate measurements.

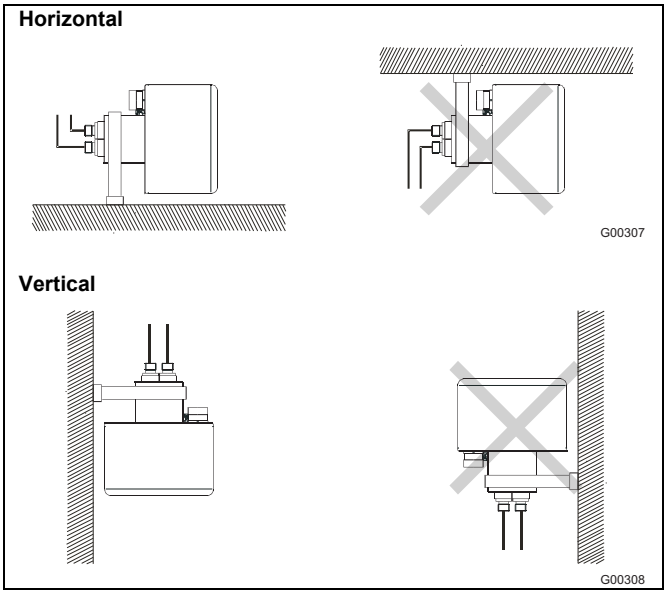


Fig. 16

High temperature version

In the high temperature design the multi-connection plug is separated from the sensor housing by a pipe. Thereby the plug can still be accessed even when the sensor is insulated.

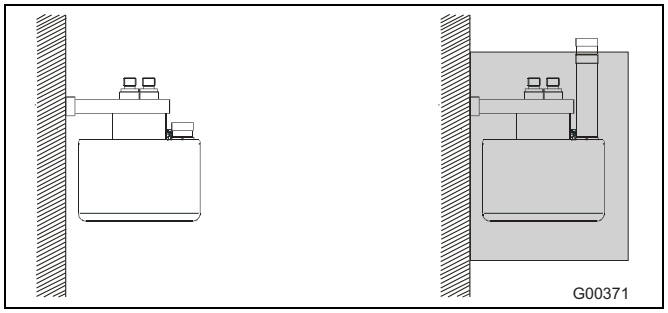


Fig. 17: Installation DN 1.5 (1/16") – vertical

Important
If there are large differences between the fluid and ambient temperature the sensor must be insulated, to prevent two phase flow and accuracy effects. This is especially important for low flowrates.
The sensor must **always** be completely filled with homogeneous liquid or a single phase gas, otherwise the accuracy could be adversely affected.
For air/gas in volatile fluids horizontal installations are recommended.

The mounting bracket included with the shipment should always be used. The bracket should be secured to a wall or a steel framework (vibration free and mechanically stable).

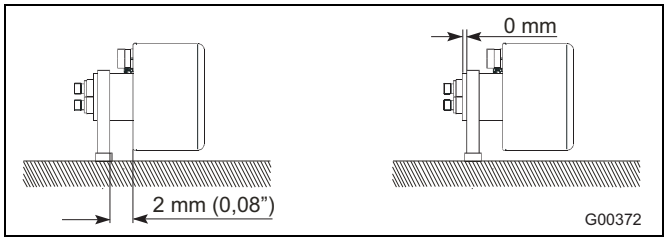


Fig. 18: Installation DN 1.5 (1/16") – horizontal

Angle multi-connection plug, horizontal

To achieve optimum performance, the multi-connection plug is to be installed as shown in the figure. The multi-connection plug can be rotated within the angle noted.

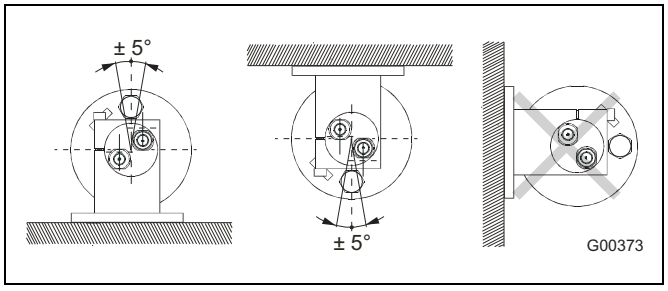


Fig. 19: Angle multi-connection plug – horizontal

Angle multi-connection plug, vertical

A specific orientation of the connection box is not prescribed for vertical installations, although the rotation of the sensor may not exceed the value shown.

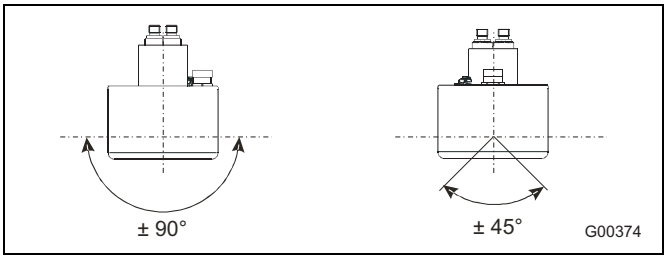


Fig. 20: Angle multi-connection plug – vertical

Installing flowmeter sensor DN3/DN6 (1/10 / 1/4")

A horizontal installation position is recommended for light flow, since air bubbles are easier to remove in this position. If the liquid is volatile or contains solid particles, vertical installation is not recommended.

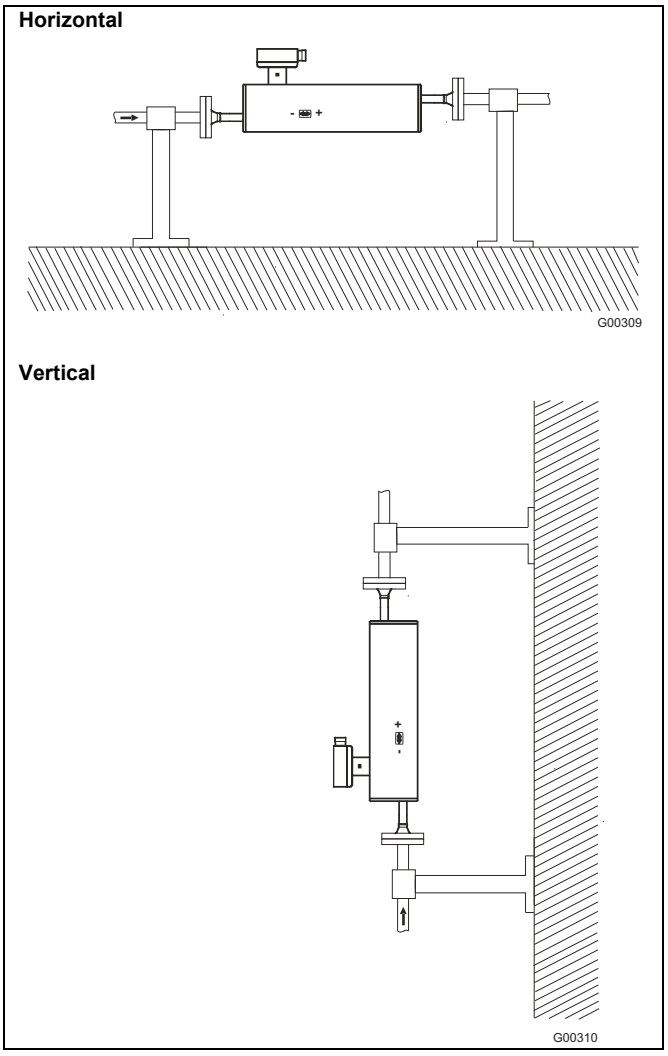


Fig. 21

4.2 Installation

Important

An additional document with Ex safety instructions is available for measuring systems that are used in explosion hazardous areas (Applies to FM / CSA only).
As a result, it is crucial that the specifications and data it lists are also observed.

4.2.1 General information on installation

The following points must be observed for the installation:

- The flow direction must correspond to the identification if present.
- The devices must be installed without mechanical tension (torsion, bending).
- Install flange units with coplanar counter flanges and use only appropriate gaskets.
- Use only gaskets made from a compatible material for the fluid and fluid temperature or use only gasket material compatible with hygienic designs
- Gaskets must not extend into the flow area since possible turbulence could influence the device accuracy.
- The pipeline may not exert any unallowable forces or torques on the device.
- Do not remove the plugs in the cable connectors until you are ready to install the electrical cable.
- Make sure the gaskets for the housing cover are seated properly. Carefully seal the cover. Tighten the cover fittings.
- Install the separate transmitter at a largely vibration-free location.
- Do not expose the transmitter to direct sunlight. Provide appropriate sun protection as necessary.

4.2.2 Pressure relief valve

Pressure Reduction Valve. The pressure values are approximations. An exact specification of the absolute value at which a rupture or leak occurs is not possible. For operating pressures/fluids, which could possibly cause a meter pipe rupture with resultant personnel injury, property damage, etc. special protective measures for the sensor installation are recommended (special arrangements, protection covers, pressure relief valves etc.).

The sensor housing incorporates a 1/8“-nipple. When the nipple is removed, a pressure relief valve can be installed to automatically block the flow to the sensor in the event of a leak.

Important

Before removing the nipple from the sensor housing the following must be considered:

Under no circumstances may humidity, liquids or foreign objects enter the flowmeter primary housing because the measurement accuracy could be adversely affected.

This type of problem can be avoided by observing the following instruction:

1. To acclimate the sensor it should be placed in a dry, clean area until it has reached an ambient temperature of approx. 20 °C (68 °F).
2. Care should be exercised when removing the nipple and installing the pressure relief valve.
3. Ensure that the pressure relief valve is correctly installed and properly tightened, so the gasket is seated correctly. Whenever it is removed the gaskets should be replaced.

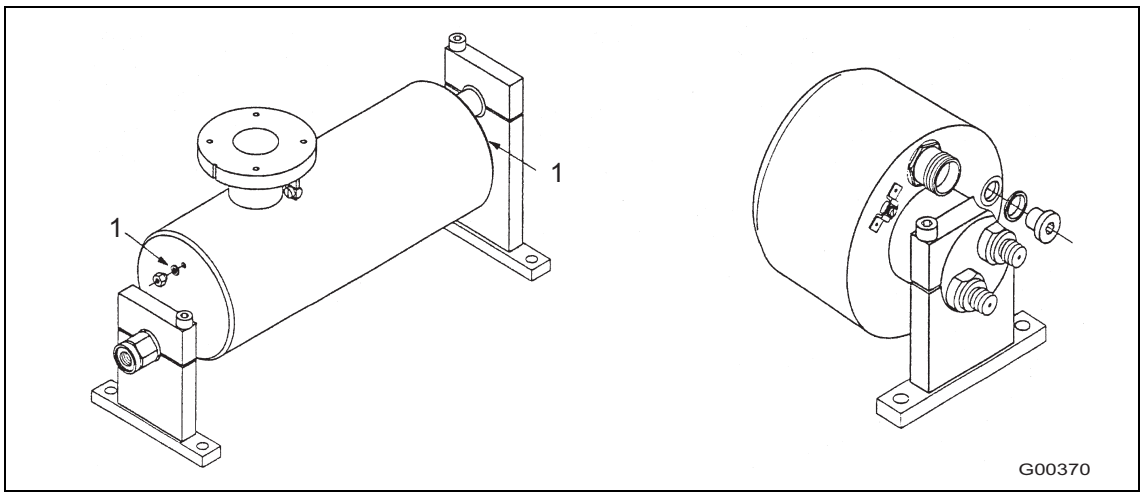


Fig. 22 Connecting nipple

1 Connecting nipple

4.3 Display / housing rotation

4.3.1 Housing rotation

Depending on the installation position, the housing or display can be rotated to enable horizontal readings. A stop in the housing will prevent a rotation of more than 330°.

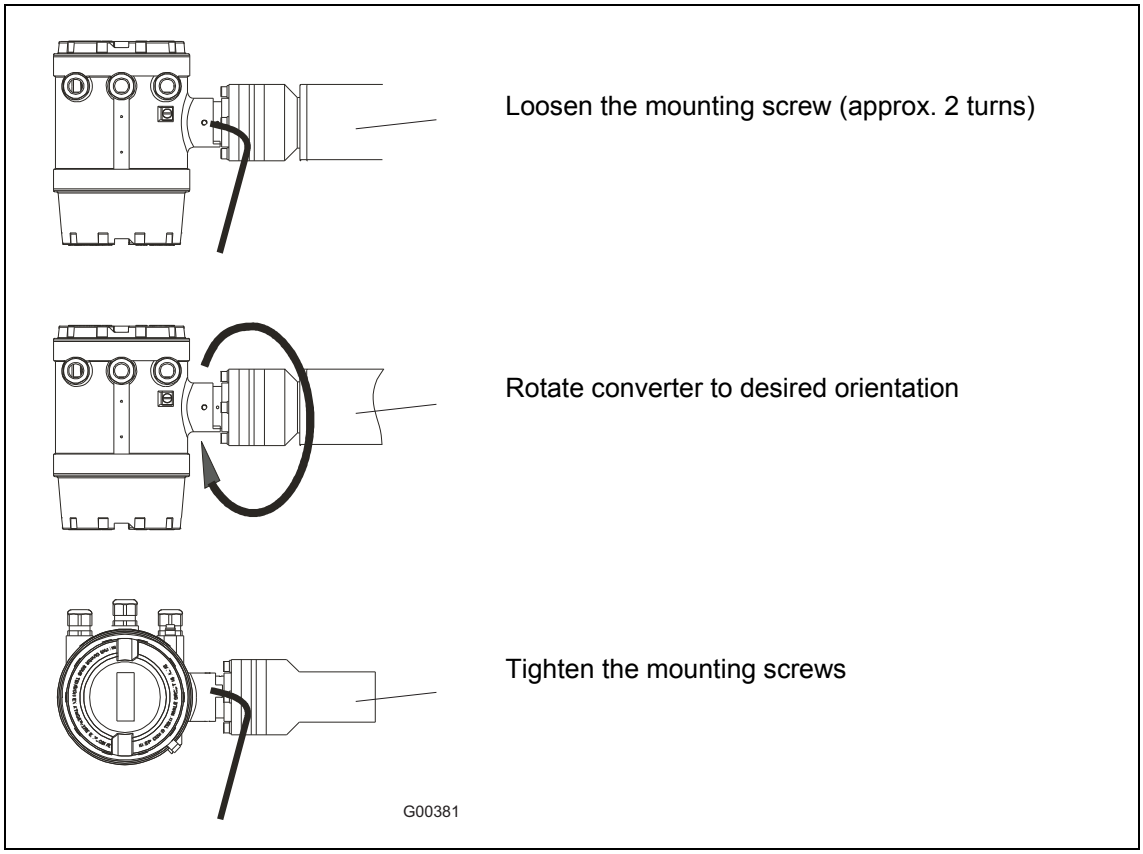


Fig. 23: Rotating the Converter Housing

Important

After positioning the converter it is essential that a head set screws are tightened.

4.3.2 Display rotation

Warning - General hazards!
When the housing is open, EMC protection is impaired and protection against contact is suspended. Before opening the housing, switch off power to all connecting cables.

Fig. 24: Converter Keypad and Display

1 External memory module (FRAM)
2 Magnet Stick

1. Screw off housing cover (the display board is secured by 4 Phillips head screws).
2. After loosening the screws the display hangs on its cable harness that connects it to the electronic plug-in unit.
3. Secure the rotated display in its new position by tightening the 4 screws.
4. Check that the gasket is seated properly.
5. Carefully reinstall the housing cover in the new position. Only then will Protection Class IP 67 (NEMA 4X) be maintained.

4.4 Installation of the field-mount housing / compact unit

4.4.1 Inspection

Before installing the flowmeter primary check for possible damage due to improper handling during shipment. All claims for damage are to be made promptly to the shipper.

4.4.2 Installing the Converter

The installation site for the transmitter must be essentially vibration free, see "Specifications". The specified temperature limits and the maximum signal cable length between the transmitter and the flowmeter sensor must not be exceeded.

Important

When selecting the installation site for a transmitter, ensure that the device will not be exposed to direct sunlight. The ambient temperature limits are to be observed. If exposure to direct sunlight cannot be avoided, a sun shade should be installed.

Field-mount housing

The housing is designed for protection class IP 67 (EN 60529) and must be mounted using 4 screws. For dimensions, see Fig. 25.

Exchanging a transmitter

The transmitter modules are identical in terms of function for all nominal diameters and can be readily exchanged. Make sure that the replacement transmitter has the same supply power specifications and input and output options. After the exchange has taken place, the measuring-point parameters are automatically uploaded into the new transmitter.

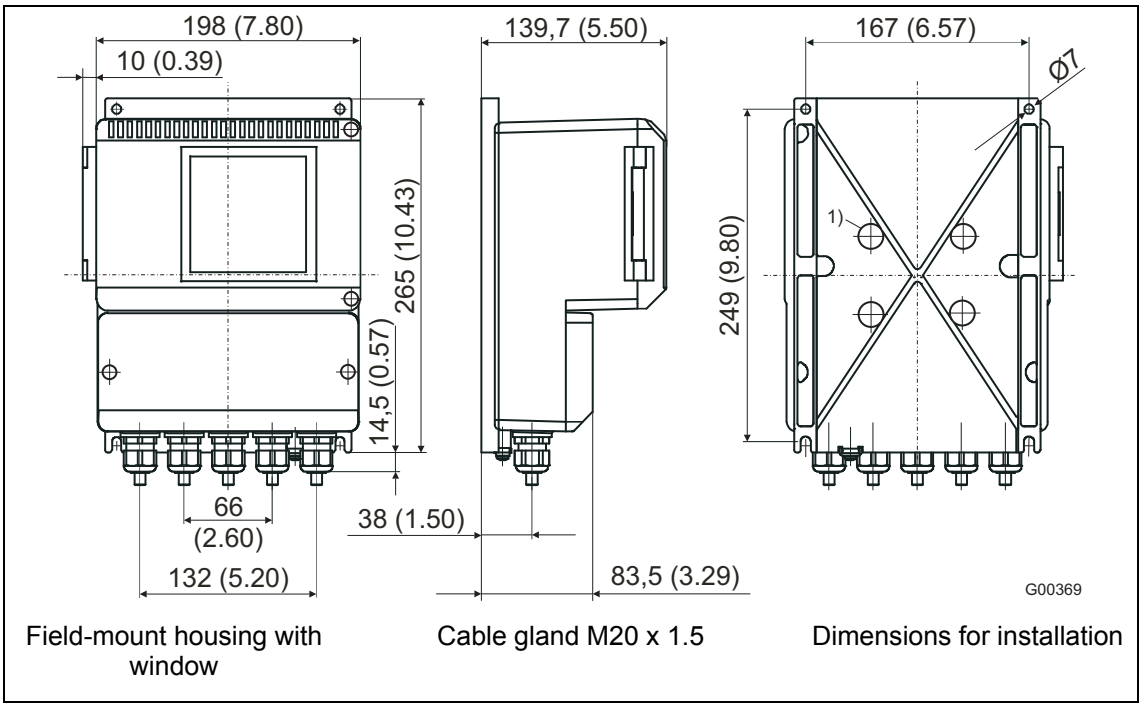


Fig. 25: Dimensions of ME21/22/23/24/25 transmitter housing

1) Installation holes for pipe mounting set for a 2" pipe installation. Mounting set available on request.

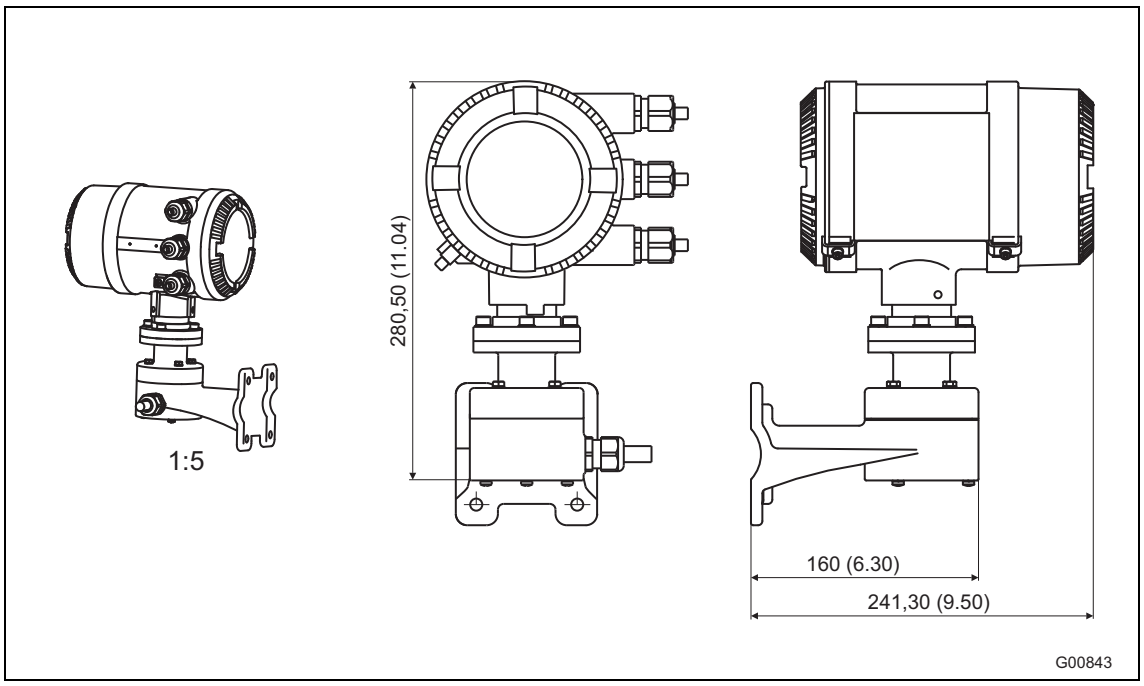


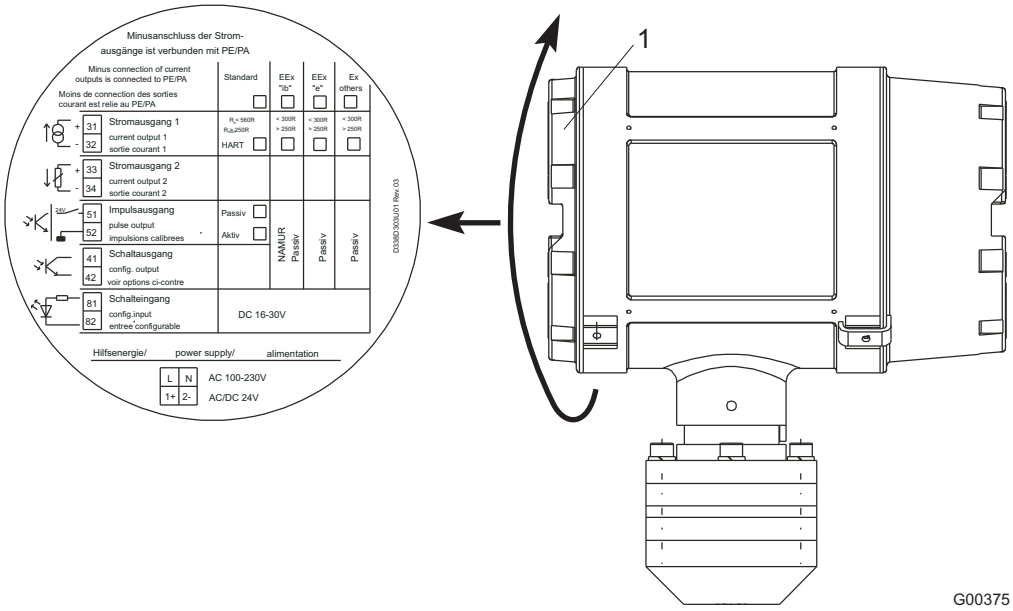
Fig. 26: Dimensions of ME26/27/28 transmitter housing

4.4.3 Connection area for compact device

Internal view of the cover

A schematic electrical connection diagram can be found on the inside of the cover. The configuration of the device is marked here.

The housing cover [1] can be easily removed by unscrewing it counterclockwise.



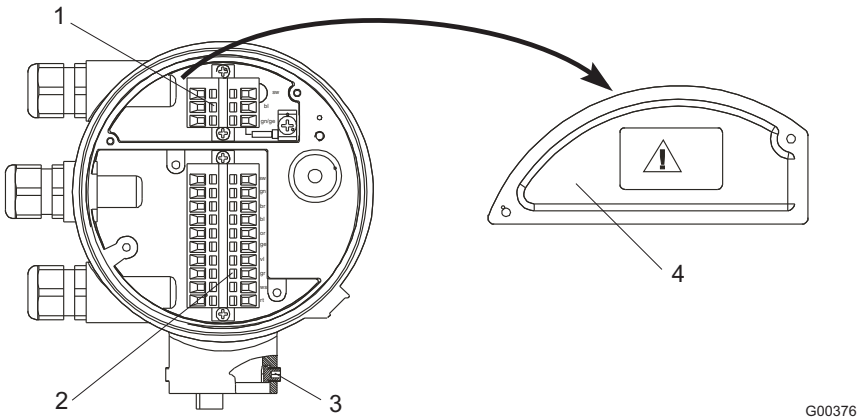


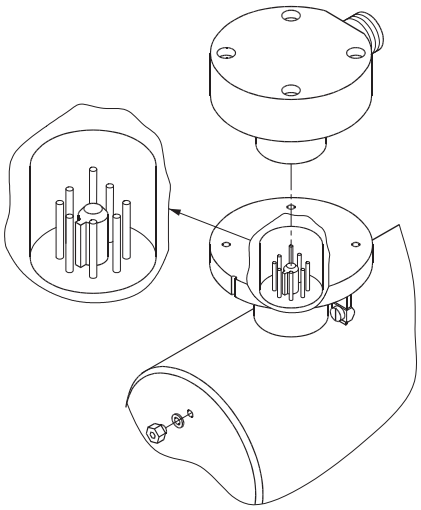
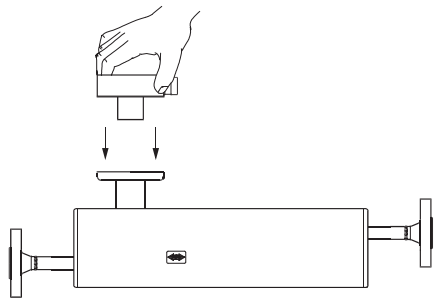
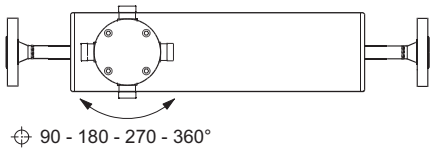
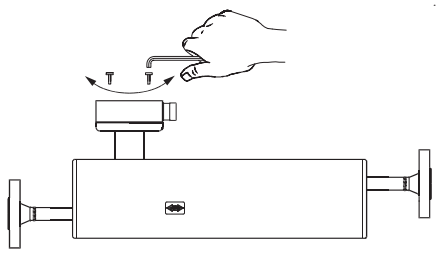
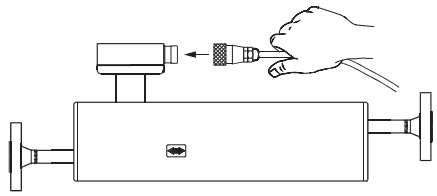
Fig. 27: Unscrewing the cover

1 **Terminal strip for supply power**
2 10-pin terminal strip for signal inputs and signal outputs
3 **Allen head screw SW3** for locking the rotatable transmitter head
4 Cover for the power supply. For supply power connections, see Fig. 41.

Important

If applicable, please place the cable shield of the peripheral signal cable for current, pulse, or digital inputs or outputs underneath the mounting bracket provided in the connection area for this purpose.

4.4.4 Connection head MS2

	For remote installation attach the adapter (if not yet installed) to the top of the flowmeter primary interface. When attaching the multi plug connector make sure that it is aligned properly (check the small locking pin). Once attached, it can be rotated 0 ... 360°.
	
 90 - 180 - 270 - 360°	The adapter can be positioned in four directions.
	Tighten the four screws with a 4 mm hexagon socket wrench to secure the adapter.
 G00412	Install the multi-plug connector and tighten the screws on the plug to ensure proper seal.

4.5 Electrical connection

Important

An additional document with Ex safety instructions is available for measuring systems that are used in explosion hazardous areas (Applies to FM / CSA only).
As a result, it is crucial that the specifications and data it lists are also observed.

4.5.1 Cutting the signal cable to length and terminating it

Cable specifications for the MC21 signal cable

The signal cable between the flowmeter sensor and the transmitter has the following specifications:

- Name: LI2YCY (TP)
- 6 x 2 x 0.22 mm^2
- 2 outer shields
- Temperature range: -30 ... 70 °C (-22 ... 158 °F)
- Loop resistance: max. 186 Ω/km
- Inductance: 0.65 mH/km approx.
- Max. cable length: 50 m (164 ft.)

Cable specifications for the MC26 signal cable

- Name: LI2YCY PiMF
- 5 x 2 x 0.5 mm^2
- Pair shielding and copper braided screen
- Temperature range: -30 ... -70 °C (-22 ... 158 °F)
- Loop resistance: max. 78.4 Ω/km
- Inductance: 0.4 mH/km approx.
- Max. cable length: 50 m (164 ft.)

Cable specifications for the MS2 signal cable

- 5 x 2 x 0.35 mm^2
- 1 outer shield
- Temperature range: -20 ... 105 °C (-4 ... 221 °F)
- Loop resistance: max. 50 Ω/km
- Inductance: 1 mH/km approx.
- Max. cable length: 50 m (164 ft.)

Cut the cable to length and terminate it as shown. (See Fig. 28 and 29.)

Important

Use wire end sleeves.

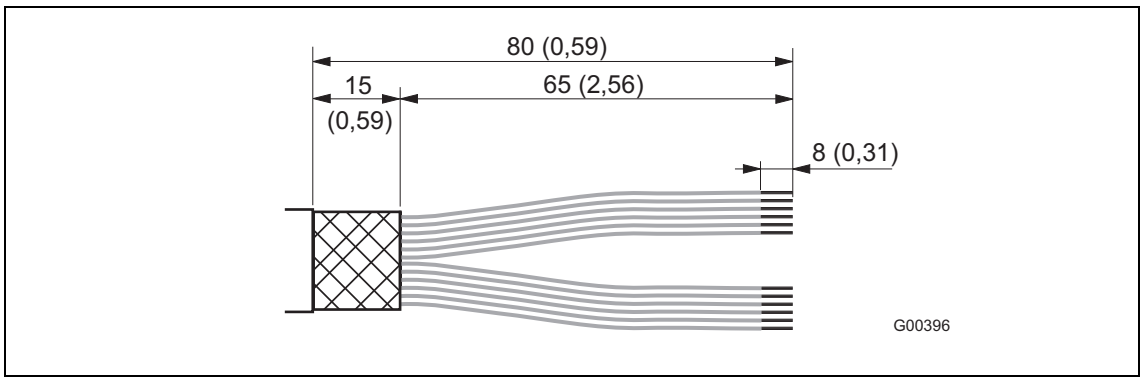


Fig. 28

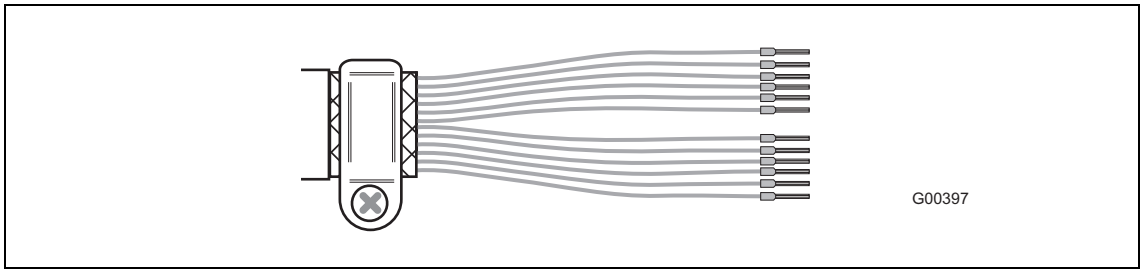


Fig. 29

4.5.2 Positioning the shield core and foil shield

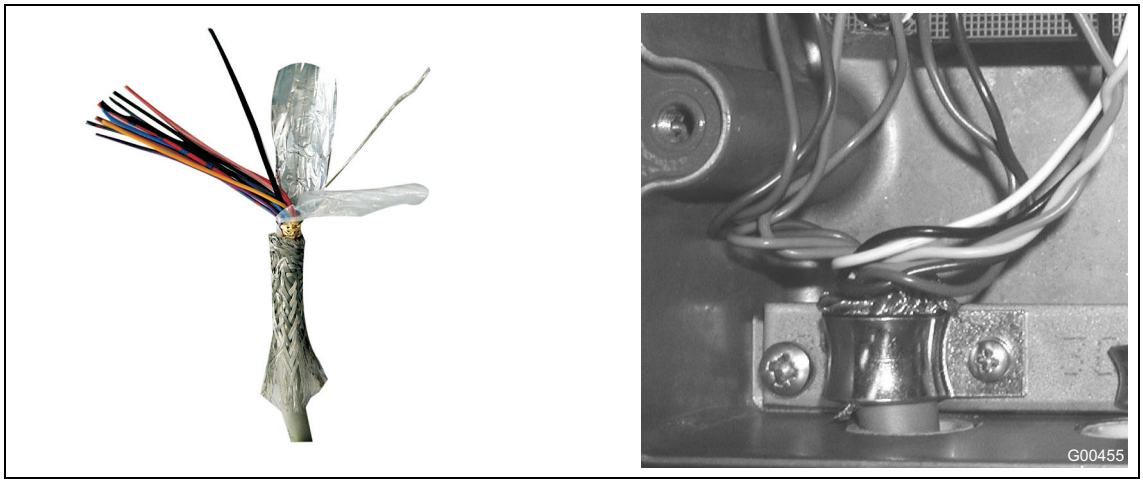


Fig. 30: Insulating the signal cable and positioning the shield core

1. Remove signal cable insulation as shown in Fig. 28.
2. Cut the braided shield to a length of approx. 15 mm (0.59").
3. Separate the cable core from the foil shield.
4. Remove cable insulation and attach the wire end sleeves.
5. Wind the shield core around the braided shield.

Observe the following points when routing cables:

- The signal cable carries a voltage signal of only a few millivolts and must, therefore, be routed over the shortest possible distance. The maximum permissible signal cable length is 50 m (164 ft.).
- Avoid routing the cable in the vicinity of electrical equipment or switching elements that can create stray fields, switching pulses, and induction. If this is not possible, run the signal cable through a metal pipe and connect this to the station ground.
- All leads must be shielded and connected to the station ground potential.
- Do not run the signal cable over junction boxes or terminal strips.
- To shield against magnetic interspersion, the cable contains outer shielding that is attached to the SE clamp.

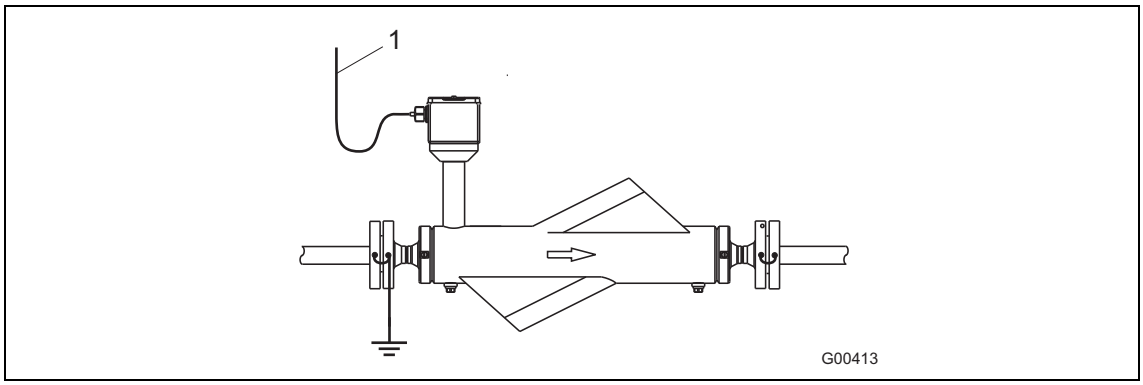


Fig. 31

1 Make sure during installation that the cable is provided with a water trap (1). For vertical installation, align the cable glands pointing downward.

4.5.3 Connecting the supply power

Attention – <Property damage>!

- The line voltage and power consumption are indicated on the name plate for the transmitter. The wire cross-section for the supply power must meet the requirements of the line protection used (VDE 0100).
- The supply power is connected to terminal L (phase), N (neutral), or 1+, 2-, and PE, as stated on the name plate. The supply power feed must be rated for the current consumption of the flowmeter system. The leads must comply with IEC 227 and/or IEC 245. Install a switch or a circuit-breaker in the supply power feed to the transmitter. This switch/circuit-breaker should be located near the transmitter and marked as belonging to the device. Connect the transmitter and flowmeter sensor with a functional ground.

4.5.4 Interconnection Examples for Peripherals

DC outputs (incl. HART)

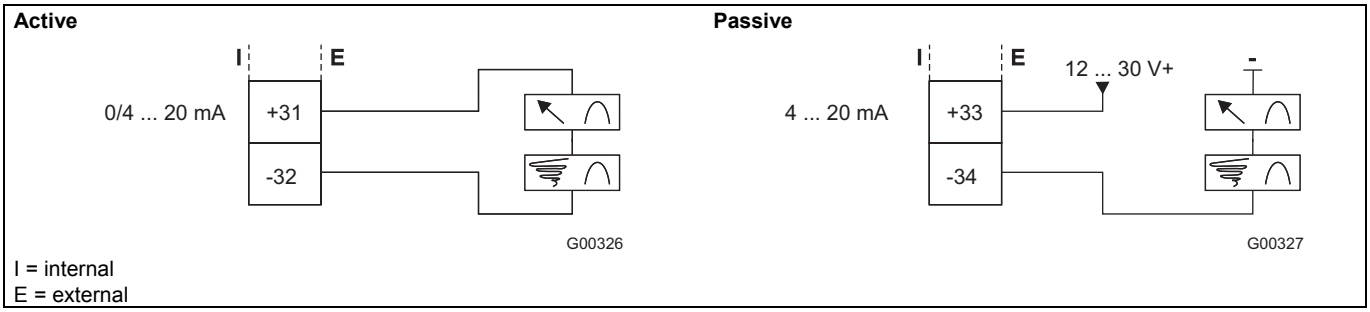


Fig. 32: Current output 1 active/passive

Switch output

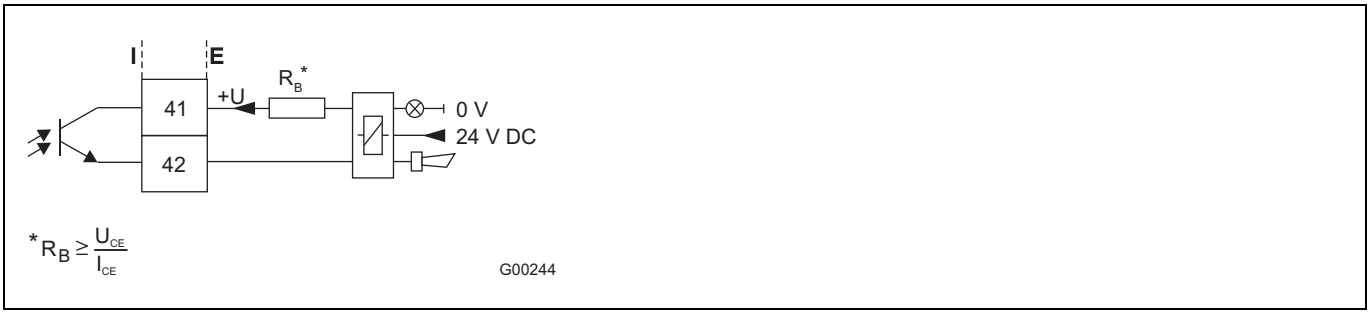


Fig. 33: Switch output for system monitoring, Max.-Min. alarm for empty tube or forward/reverse signal

Switch input

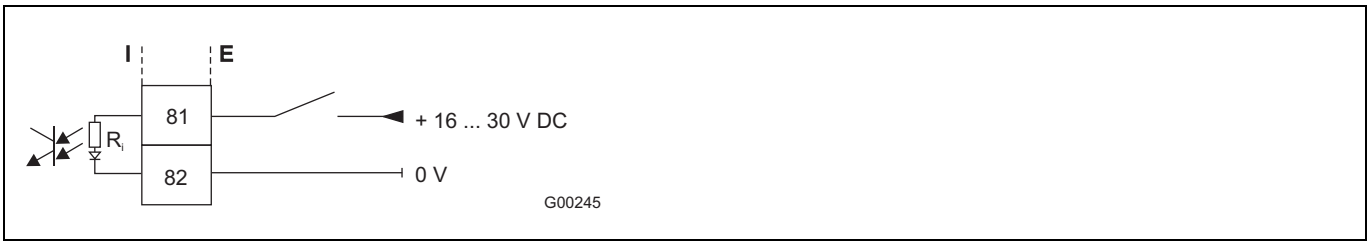


Fig. 34: Contact input for external totalizer reset and external zero return

Pulse Output

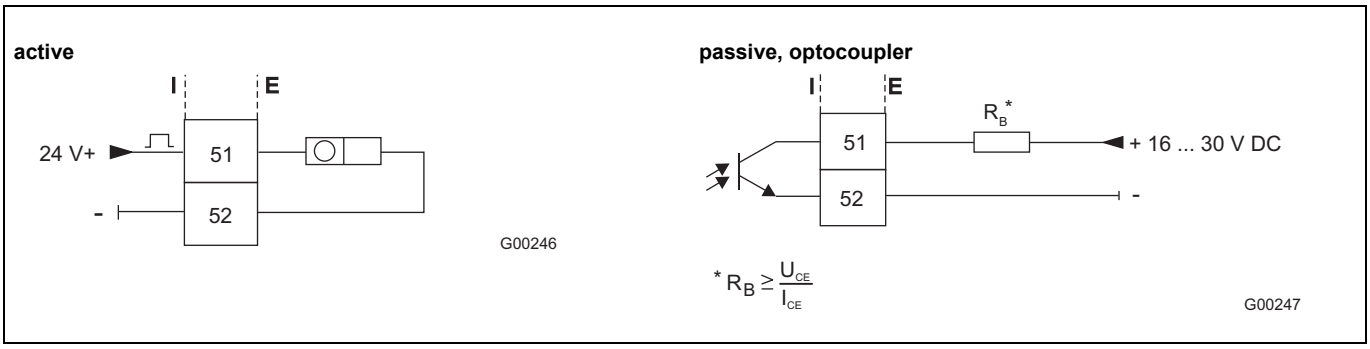
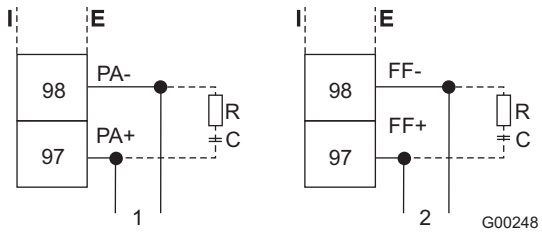


Fig. 35: Pulse output active and pulse output passive, optocoupler

PROFIBUS PA / FOUNDATION Fieldbus

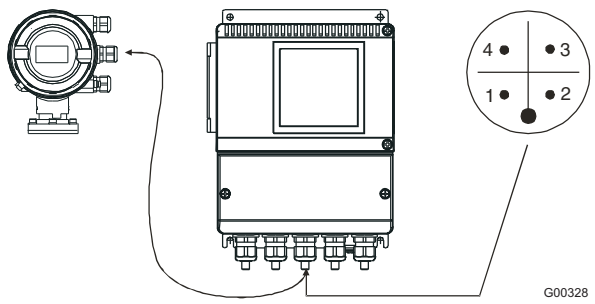


The resistance R and condenser C form the bus termination. They must be installed when the device is connected to the end of the entire bus cable.
R = 100 Ω; C = 1 µF
1 PROFIBUS PA
2 FOUNDATION Fieldbus
I = Internal
E = external

Fig. 36: Connection examples for peripherals with PROFIBUS PA or FOUNDATION Fieldbus

Connection via M12 plug (for PROFIBUS PA only)

As an option, the bus can also be connected via an M12 plug instead of the cable gland (see order information for device). The device can be shipped completely prewired. For information about suitable connectors (type EPG300) and other accessories, refer to the data sheet 10/63.6.44.



Pin assignment
(Front view showing pin insert and pins)
PIN 1 = PA+
PIN 2 = nc
PIN 3 = PA-
PIN 4 = shield

Fig. 37: Connection example via M12 plug

4.5.5 Electrical connections between the transmitter and the flowmeter sensor

Connecting transmitter ME21 to flowmeter sensor MC21

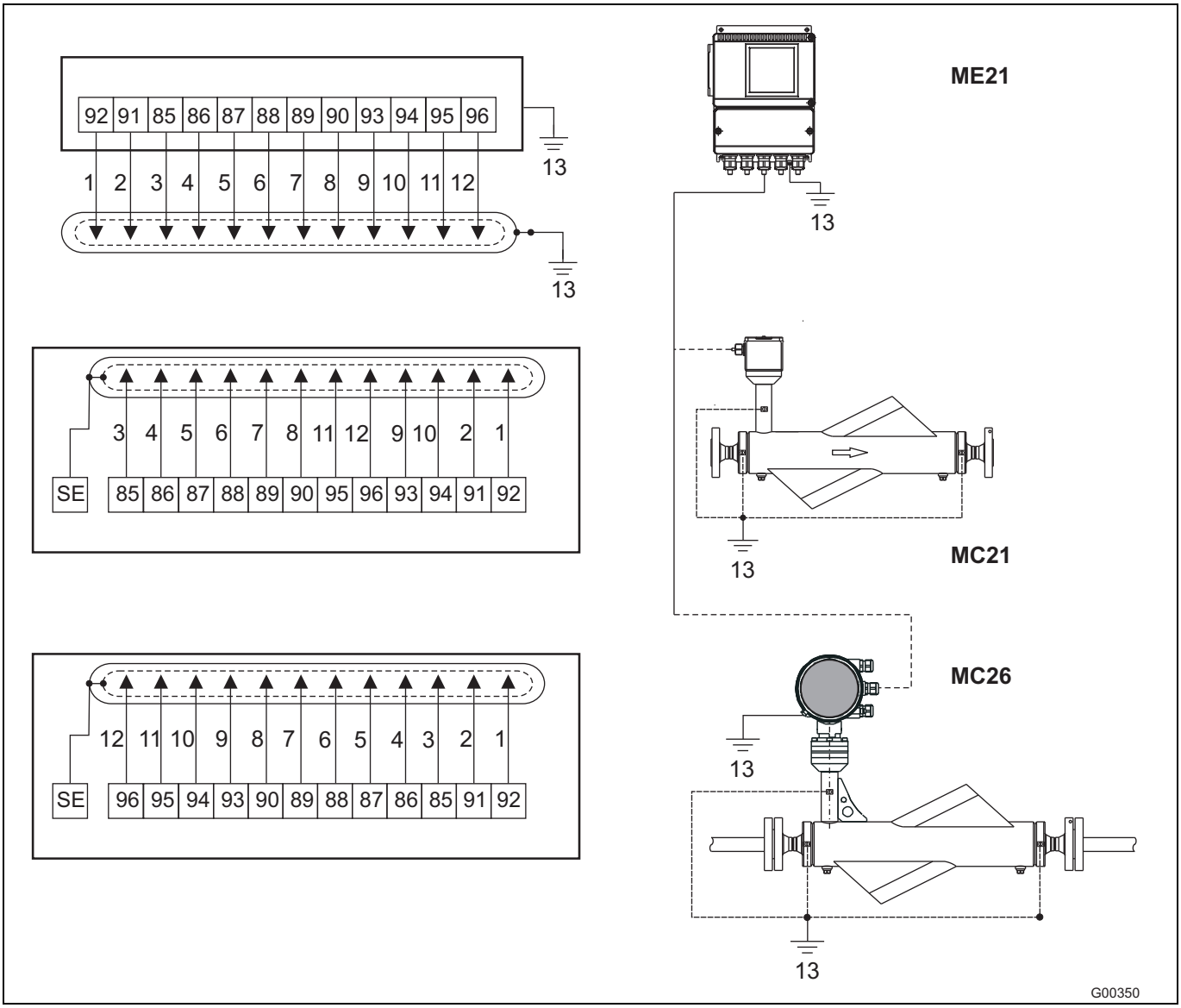


Fig. 38

91 / 92	Driver
93 / 94 / 95 / 96	Temperature
85 / 86	Sensor 1
87 / 88	Sensor 2

1 Red/blue
2 Gray/pink
3 White
4 Brown
5 Green
6 Yellow
7 Gray
8 Pink
9 Black
10 Violet
11 Blue
12 Red
13 "PA" equipotential bonding. The precise position of the ground terminals may vary according to the device type. However, the position is appropriately labeled in each case. When connecting transmitter ME21 to flowmeter sensor MC26, transmitter ME21 also has to be connected to "PA".

Connecting transmitter ME26 to flowmeter sensor MC26

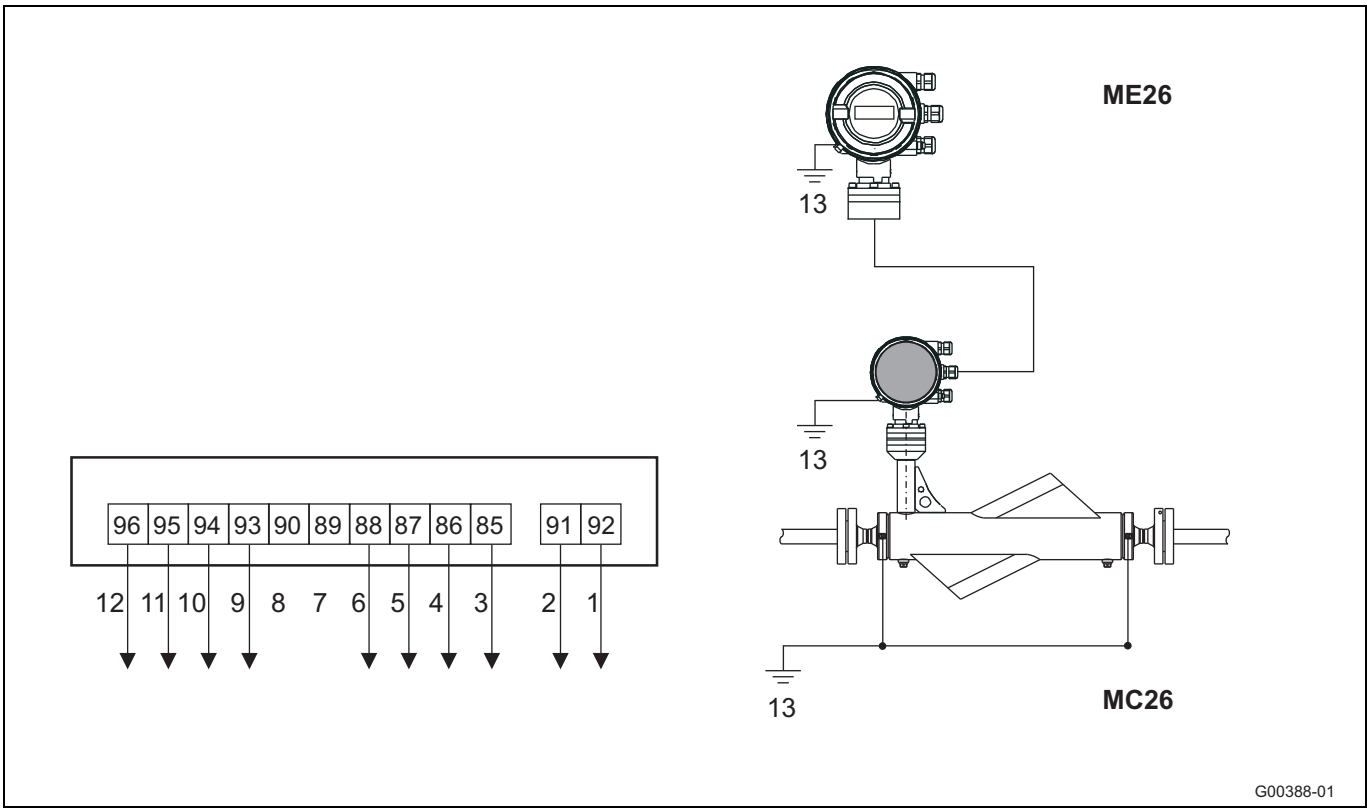


Fig. 39

91 / 92	Driver
93 / 94 / 95 / 96	Temperature
85 / 86	Sensor 1
87 / 88	Sensor 2

1	Pink
2	Gray
3	White
4	Brown
5	Green
6	Yellow
7	
8	
9	Black
10	Violet
11	Blue
12	Red
13	"PA" equipotential bonding

Important
For reasons of EMC, the wires must be routed in pairs.

Connecting transmitter ME2 to flowmeter sensor MS2

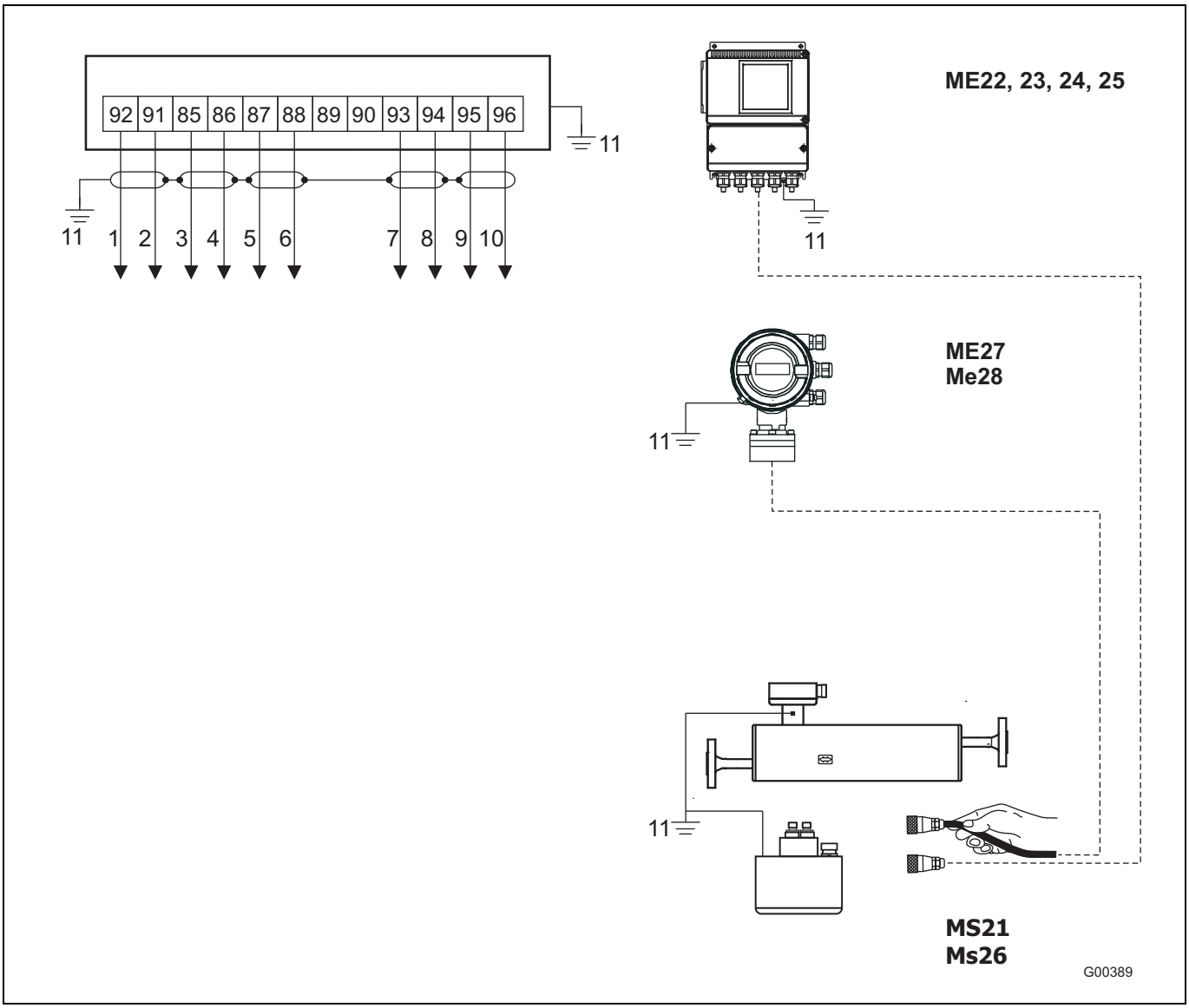


Fig. 40

91 / 92	Driver
93 / 94 / 95 / 96	Temperature
85 / 86	Sensor 1
87 / 88	Sensor 2

1	Red
2	Brown
3	Green
4	Blue
5	Gray
6	Violet
7	White
8	Black
9	Orange
10	Yellow
11	"PA" equipotential bonding. When connecting transmitter to flowmeter sensor MS26, transmitter also has to be connected to "PA".

4.5.6 Electrical connections between the transmitter and the peripherals

Input and output signals, supply power ME2/MC2

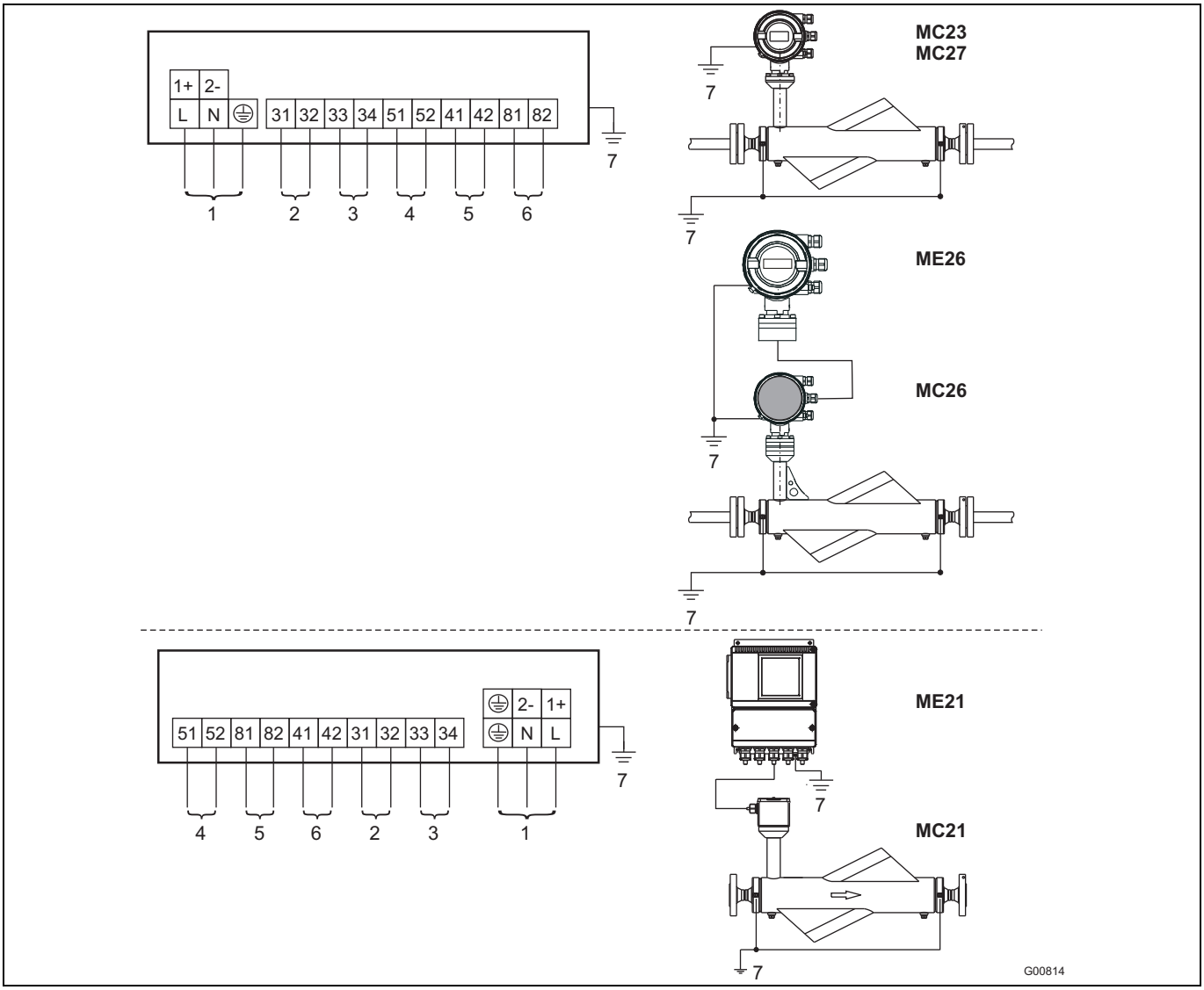


Fig. 41

1 Supply power
Line voltage: U_{AC} 100 ... 230 V AC, frequency 50/60 Hz, terminals L, N, ⏚
Low voltage: U_{AC} 24 V, frequency 50/60 Hz, terminals 1+, 2-
U_{DC} 24 V

2 Current output 1: can be selected via software
2a: function: active
Terminals: 31, 32; 0/4 … 20 mA (0 Ω ≤ R_B ≤ 560 Ω, MC27/ME26: 0 Ω <= RB <= 300 Ω)
2b: alternate function: passive (option D)
Terminals: 31, 32; 4 ... 20 mA (0 Ω ≤ R_B ≤ 600 Ω)
Source voltage 12 ≤ U_q ≤ 30 V

3 Current output 2: can be selected via software
Function: passive
Terminals: 33, 34; 4 … 20 mA (0 Ω ≤ R_B ≤ 600 Ω)
Source voltage 12 ≤ U_q ≤ 30 V

4a Passive pulse output, terminals: 51, 52
f_{max} = 5 kHz, pulse width 0.1 … 2,000 ms
Setting range: 0.001 … 1,000 pulses/unit
"Closed": 0 V ≤ U_{CEL} ≤ 2 V, 2 mA ≤ I_{CEL} ≤ 65 mA
"Open": 16 V ≤ U_{CEH} ≤ 30 V, 0 mA ≤ I_{CEH} ≤ 0.2 mA

4b Active pulse output
U = 16 ... 30 V, load ≥ 150 Ω, f_{max} = 5 kHz,

5 Contact output, passive
Terminals: 41, 42
"Closed": 0 V ≤ U_{CEL} ≤ 2 V, 2 mA ≤ I_{CEL} ≤ 65 mA
"Open": 16 V ≤ U_{CEH} ≤ 30 V, 0 mA ≤ I_{CEH} ≤ 0.2 mA

6 Contact input, passive
Terminals: 81, 82
"On": 16 V ≤ U_{KL} ≤ 30 V
"Off": 0 V ≤ U_{KL} ≤ 2 V

7 Equipotential bonding "PA" (when connecting transmitter ME2 to flowmeter sensor MC26, transmitter ME2 also has to be connected to "PA").

Important
You can find the applicable Ex-relevant connection data in the section titled "Ex relevant specifications".

Input and output signals, supply power ME2/MS2

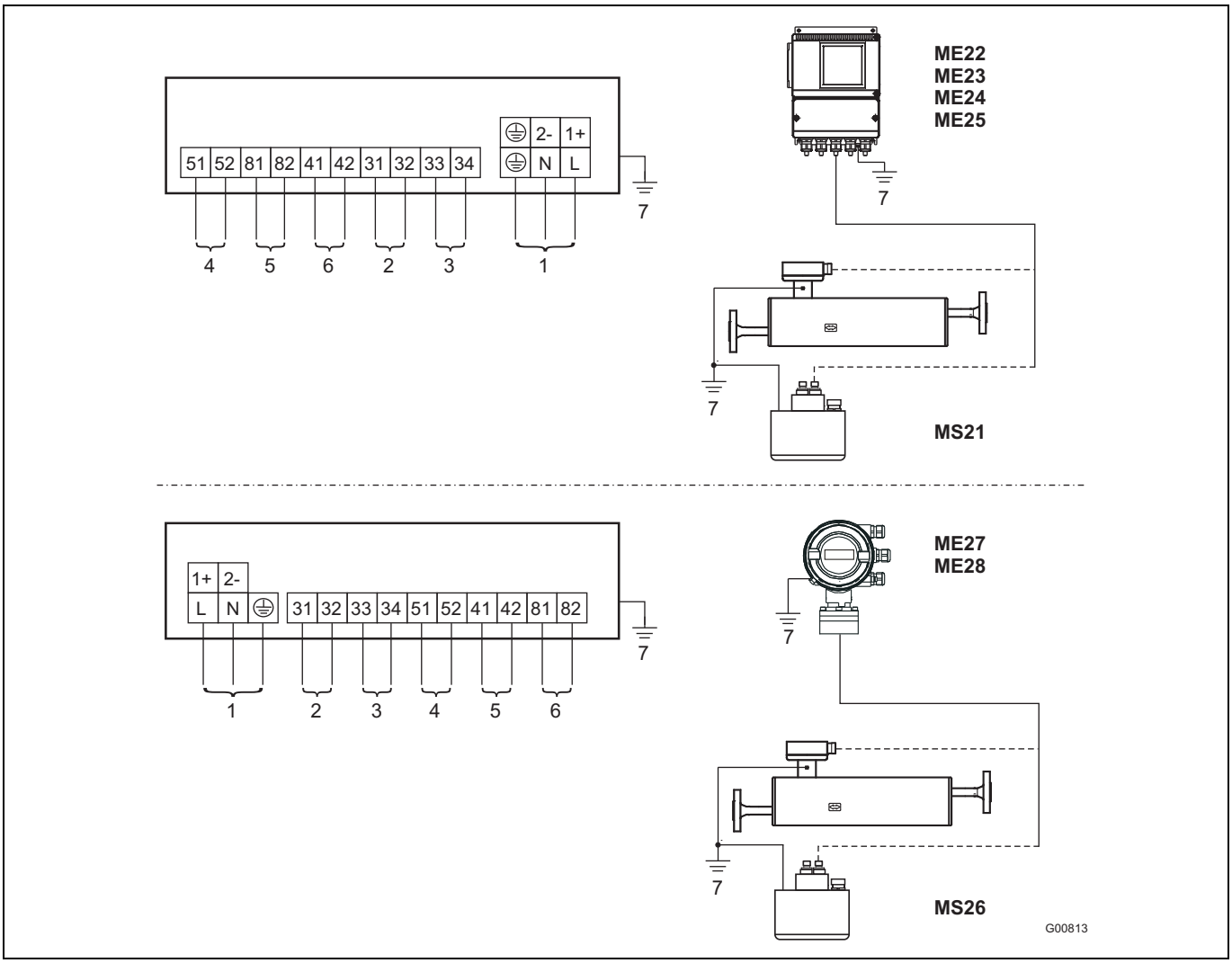


Fig. 42

1 Supply power
Line voltage: U_{AC} 100 ... 230 V AC, frequency 50/60 Hz, terminals L, N, ⏚
Low voltage: U_{AC} 24 V, frequency 50/60 Hz, terminals 1+, 2-
U_{DC} 24 V

2 Current output 1: can be selected via software
2a: function: active
Terminals: 31, 32; 0/4 … 20 mA (0 Ω ≤ R_B ≤ 560 Ω, ME27/28: 0 Ω <= RB <= 300 Ω)
2b: alternate function: passive (option D)
Terminals: 31, 32; 4 ... 20 mA (0 Ω ≤ R_B ≤ 600 Ω)
Source voltage 12 ≤ U_q ≤ 30 V

3 Current output 2: can be selected via software
Function: passive
Terminals: 33, 34; 4 … 20 mA (0 Ω ≤ R_B ≤ 600 Ω)
Source voltage 12 ≤ U_q ≤ 30 V

4a Passive pulse output, terminals: 51, 52
f_{max} = 5 kHz, pulse width 0.1 … 2,000 ms
Setting range: 0.001 … 1,000 pulses/unit
"Closed": 0 V ≤ U_{CEL} ≤ 2 V, 2 mA ≤ I_{CEL} ≤ 65 mA
"Open": 16 V ≤ U_{CEH} ≤ 30 V, 0 mA ≤ I_{CEH} ≤ 0.2 mA

4b Active pulse output
U = 16 ... 30 V, load ≥ 150 Ω, f_{max} = 5 kHz,

5 Contact output, passive
Terminals: 41, 42
"Closed": 0 V ≤ U_{CEL} ≤ 2 V, 2 mA ≤ I_{CEL} ≤ 65 mA
"Open": 16 V ≤ U_{CEH} ≤ 30 V, 0 mA ≤ I_{CEH} ≤ 0.2 mA

6 Contact input, passive
Terminals: 81, 82
"On": 16 V ≤ U_{KL} ≤ 30 V
"Off": 0 V ≤ U_{KL} ≤ 2 V

7 "PA" equipotential bonding. When transmitter ME2 is connected to flowmeter sensor MS26, transmitter ME2 also has to be connected to "PA".

PROFIBUS PA/FOUNDATION Fieldbus, supply power for ME2/MC2

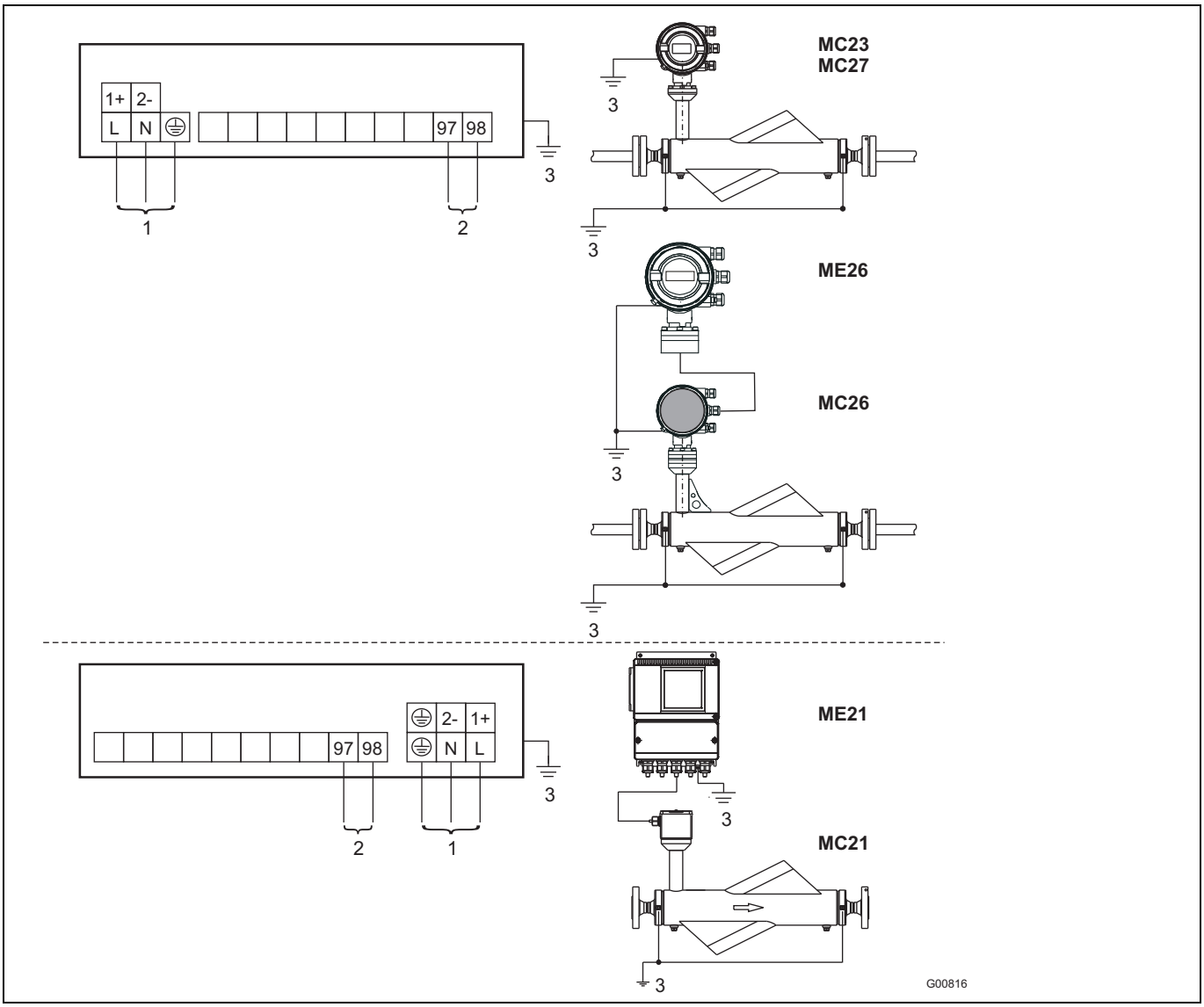


Fig. 43

1 Supply power
Line voltage: U_{AC} 100 ... 230 V AC, frequency 50/60 Hz, terminals L, N, ⏚
Low voltage: U_{AC} 24, frequency 50/60 Hz, terminals 1+, 2-
U_{DC} 24 V

2a PROFIBUS PA design conforming to IEC 61158-2 (Profile 3.0)
U = 9 … 32 V
I = 14 mA (normal operation)
I = 26 mA (in the event of an error / FDE)
Terminals: 97 / 98
Connection example via M12 plug, see Fig. 37

2b FOUNDATION Fieldbus design conforming to IEC 61158-2
U = 9 … 32 V
I = 14 mA (normal operation)
I = 26 mA (in the event of an error / FDE)
Terminals: 97/98
Connection example via M12 plug, see Fig. 37

3 The precise position of the ground terminals may vary according to the device type. However, the position is appropriately labeled in each case. When transmitter ME2 is connected to flowmeter sensor MS26, transmitter ME2 also has to be connected to equipotential bonding "PA".

PROFIBUS PA/FOUNDATION Fieldbus, supply power for ME2/MS2

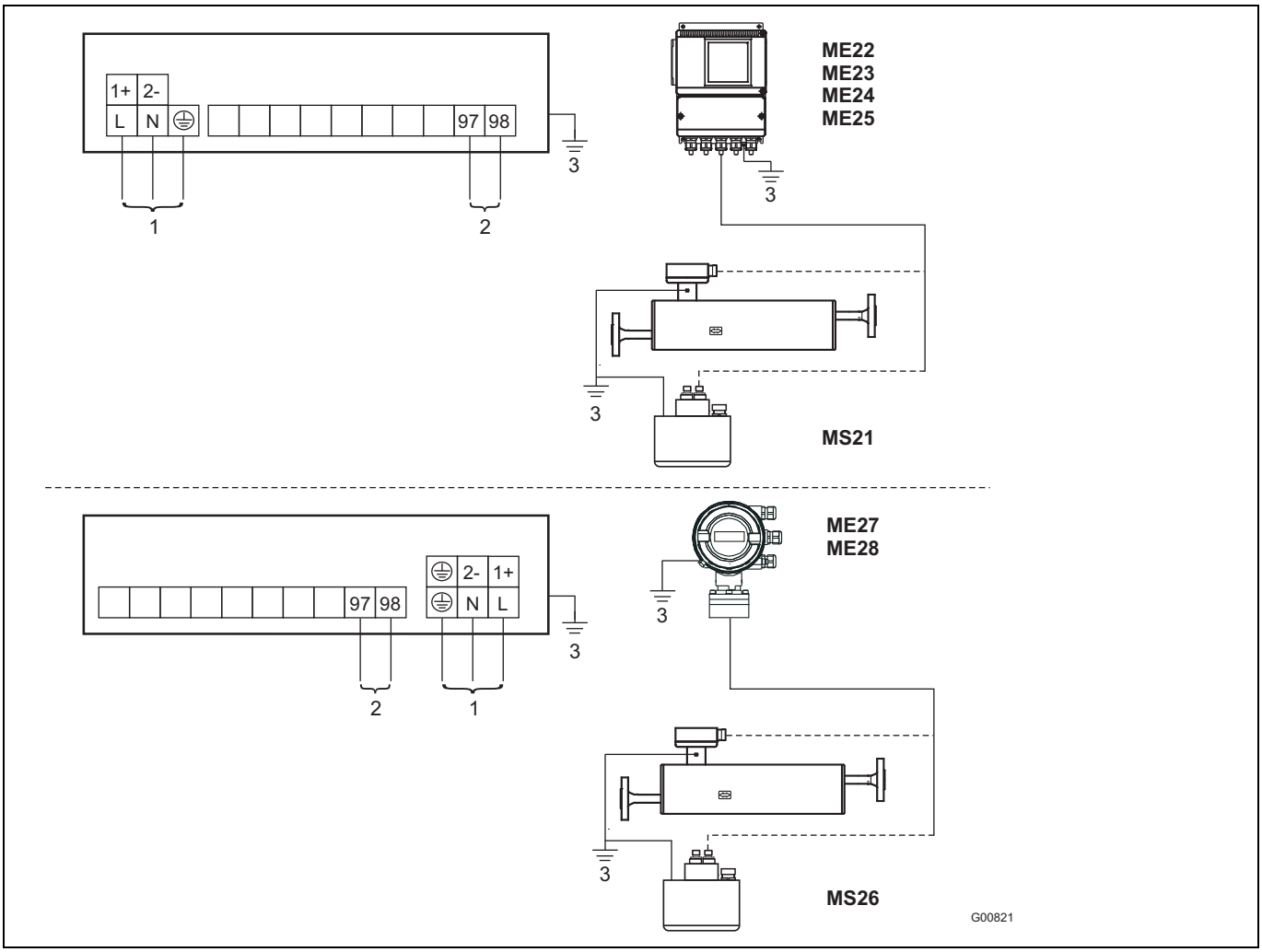


Fig. 44:

1 Supply power
Line voltage: U_{AC} 100 ... 230 V AC, frequency 50/60 Hz, terminals L, N, ⏚
Low voltage: U_{AC} 24, frequency 50/60 Hz, terminals 1+, 2-
U_{DC} 24 V

2a PROFIBUS PA design conforming to IEC 61158-2 (Profile 3.0)
U = 9 … 32 V
I = 14 mA (normal operation)
I = 26 mA (in the event of an error / FDE)
Terminals: 97 / 98
Connection example via M12 plug, see Fig. 37

2b FOUNDATION Fieldbus design conforming to IEC 61158-2
U = 9 … 32 V
I = 14 mA (normal operation)
I = 26 mA (in the event of an error / FDE)
Terminals: 97/98
Connection example via M12 plug, see Fig. 37

3 The precise position of the ground terminals may vary according to the device type. However, the position is appropriately labeled in each case. When transmitter ME2 is connected to flowmeter sensor MS26, transmitter ME2 also has to be connected to equipotential bonding "PA".

4.6 Ex relevant specifications

Important

An additional document with Ex safety instructions is available for measuring systems that are used in explosion hazardous areas (Applies to FM / CSA only).
As a result, it is crucial that the specifications and data it lists are also observed.

Overview of the different output options

	ATEX/IECEx Zone 2	ATEX/IECEx Zone 1
I Output option A/B in the order number	- Current output 1: active - Current output 2: passive - Pulse output: active/passive, switchable - Contact input and output: passive	- Current output 1: active - Current output 2: passive - Pulse output: active/passive, switchable - Contact input and output: passive
II Output option D in the order number		- Current output 1: passive - Current output 2: passive - Pulse output: active/passive, switchable - Contact input and output: passive
III Output option X and communication option 3, 5, or 7 in the order number	- Fieldbus communication (PROFIBUS PA/FOUNDATION Fieldbus)	- Fieldbus communication (PROFIBUS PA/FOUNDATION Fieldbus)

Version I: Active/Passive current outputs

Types: ME21/ME22/ME23/ME24/ME25 and MC23				
	Protection type "nA" (Zone 2)		General operating values	
	U (V)	I (mA)	U_b (V)	I_b (mA)
Current output 1 Active Terminals 31/32	30	30	30	30
Current output 2 Passive Terminals 33/34	30	30	30	30
Pulse output Active or passive Terminals 51/52	30	65	30	65
Contact output Passive Terminals 41/42	30	65	30	65
Contact input Passive Terminals 81/82	30	10	30	10

All inputs and outputs are electrically isolated from each other and from the supply power.

Types: ME26/ME27/ME28 and MC27												
	Protection type "nA" (Zone 2)		General operating values		Protection type "e" (Zone 1)		Protection type "ib" (Zone 1)					
	U_i (V)	I_i (mA)	U_b (V)	I_b (mA)	U (V)	I (A)	U_o (V)	I_o (mA)	P_o (mW)	C_o (nF)	C_o pa (nF)	L_o (mH)
Current output 1 Active Terminals 31/32 Terminal 32 is connected to "PA"	30	30	30	30	60	35	20	100	500	217	0	3.8
							U_i (V)	I_i (mA)	P_i (mW)	C_i (nF)	C_i pa (nF)	L_i (mH)
							60	100	500	2.4	2.4	0.17
Current output 2 Passive Terminals 33/34 Terminal 34 is connected to "PA"	30	30	30	30	60	35	30	100	760	2.4	2.4	0.17
Pulse output Passive Terminals 51/52	30	65	30	65	60	35	15	30	115	2.4	2.4	0.17
Contact output Passive Terminals 41/42	30	65	30	65	60	35	15	30	115	2.4	2.4	0.17
Contact input Passive Terminals 81/82	30	10	30	10	60	35	30	60	500	2.4	2.4	0.17

All inputs and outputs are electrically isolated from each other and from the supply power. Only current outputs 1 and 2 are not electrically isolated from one another.

Version II: Passive/Passive current outputs

Types: ME26/ME27/ME28 and MC27												
	Protection type "nA" (Zone 2)		General operating values		Protection type "e" (Zone 1)		Protection type "ia" (Zone 1)					
	U_i (V)	I_i (mA)	U_b (V)	I_b (mA)	U (V)	I (A)	U_i (V)	I_i (mA)	P_i (mW)	C_i (nF)	C_i pa (nF)	L_i (mH)
Current output 1 Passive Terminals 31/32	30	30	30	30	60	35	60	300	2000	0,47	0,47	0,17
Current output 2 Passive Terminals 33/34	30	30	30	30	60	35	60	300	2000	0,47	0,47	0,17
Pulse output Passive Terminals 51/52	30	65	30	65	60	35	60	300	2000	0,47	0,47	0,17
Contact output Passive Terminals 41/42	30	65	30	65	60	35	60	300	2000	0,47	0,47	0,17
Contact input Passive Terminals 81/82	30	10	30	10	60	35	60	300	2000	0,47	0,47	0,17

All inputs and outputs are electrically isolated from each other and from the supply power.

Version III: Fieldbus communication

Types ME21/ME22/ME23/ME24/ME25/ME26/ME27/ME28 and MC23/MC27										
	Protection type "nL" (Zone 2)		General operating values		Protection type "n" FNICO (Zone 2)					
	U (V)	I (mA)	U_b (V)	I_b (mA)	U_i (V)	I_i (mA)	P_i (mW)	C_i (nF)	C_i pa (nF)	L_i (mH)
Fieldbus Passive Terminals 97/98	60	500	32	10	60	500	7,000	0	0	0.17

The output and supply power are electrically isolated.

Types ME26/ME27/ME28 and MC27																
	Type of protection "e" (Zone 1)		General operating values		Protection type "ia" FISCO (Zone 1)						Protection type "ia" (Zone 1)					
	U (V)	I (A)	U_b (V)	I_b (mA)	U_i (V)	I_i (mA)	P_i (mW)	C_i (nF)	C_i pa (nF)	L_i (mH)	U_i (V)	I_i (mA)	P_i (mW)	C_i (nF)	C_i pa (nF)	L_i (mH)
Fieldbus Passive Terminals 97/98	60	35	32	10	60	380	5320	0	0	0.17	60	380	5320	0	0	0.17

The output and supply power are electrically isolated.

Special conditions

The output circuits are designed in such a way that they can be connected to both intrinsically-safe and non-intrinsically-safe circuits. It is not permitted to combine intrinsically safe and non-intrinsically safe circuits. On intrinsically safe circuits, equipotential bonding must be in place along the entire length of the cable used for the current outputs. The rated voltage of the non-intrinsically safe circuits is U_M = 60 V.

The contact output and the pulse output (terminals 41 / 42 and 51 / 52) can be wired internally as a NAMUR contact for the purpose of connecting a NAMUR amplifier.
The cable glands are supplied in black by default. If the signal outputs are wired to intrinsically safe circuits, we recommend that you use the light blue caps supplied for the appropriate cable entries.

Important
If the protective conductor (PE) is connected in the flowmeter's terminal box, you must ensure that no dangerous potential difference can arise between the protective conductor (PE) and the equipotential bonding (PA) in the potentially explosive area.

4.6.1 ATEX/IECEx Ex approval

EC type-examination certificate in accordance with ATEX and IECEx
KEMA ATEX 08ATEX0150 X, KEMA 08 ATEX 0151X, or IECEx KEM 08.0034X

4.6.1.1 Flowmeter sensor MC2 in accordance with ATEX and IECEx

Model	**MC26 and MC27 Zone 1**		
Ambient temperature	<=40 °C (104 °F)	<=50 °C (122 °F)	<=60 °C (140 °F)
Temperature class			
T1	200 °C (392 °F)	200 °C (392 °F)	200 °C (392 °F)
T2	200 °C (392 °F)	200 °C (392 °F)	200 °C (392 °F)
T3	185 °C (365 °F)	180 °C (356 °F)	180 °C (356 °F)
T4	125 °C (257 °F)	120 °C (248 °F)	120 °C (248 °F)
T5	85 °C (185 °F)	85 °C (185 °F)	75 °C (167 °F)
T6	65 °C (149 °F)	65 °C (149 °F)	60 °C (140 °F)

Model	**MC21 and MC23 Zone 2**		
Ambient temperature	<=40 °C (104 °F)	<=50 °C (122 °F)	<=60 °C (140 °F)
Temperature class			
T1	200 °C (392 °F)	200 °C (392 °F)	180 °C (356 °F)
T2	200 °C (392 °F)	200 °C (392 °F)	180 °C (356 °F)
T3	180 °C (356 °F)	180 °C (356 °F)	180 °C (356 °F)
T4	115 °C (239 °F)	115 °C (239 °F)	115 °C (239 °F)
T5	80 °C(176 °F)	80 °C(176 °F)	75 °C (167 °F)
T6	60 °C (140 °F)	60 °C (140 °F)	60 °C (140 °F)

Ambient and process conditions:
T_{amb} -20 ... 60 °C (-4 ... 140 °F)
$T_{amb,\ optional}$ -40 ... 60 °C (-40 ... 104 °F) (only for devices with a compact design)
T_{medium} -50 ... 200 °C (-58 ... 392 °F)
Protection class IP 65, IP 67, and NEMA 4X/type 4X

Specific coding in accordance with ATEX and IECEx applies depending on the design of the flowmeter sensor (compact or separate); see the overview on page 22).

Design MC21

Zone 2	**Designation**	
ATEX	II 3 G Ex nA II T6 ... T2 II 2 D Ex tD A21 IP6X T115 °C ... T_{medium}	
IECEx	Ex nA II T6 ... T2 Ex tD A21 IP6X T115 °C ... T_{medium}	

Design MC23

Zone 2	**Designation**	
ATEX	II 3 G Ex nA nR II T6 ... T2 II 3 G Ex nA nR [nL] IIC T6 ... T2 II 2 D Ex tD A21 IP6X T115°C ... T_{medium} FNICO field device	No fieldbus, no M12 plug FNICO fieldbus, no M12 plug FNICO fieldbus, no M12 plug
IECEx	Ex nA nR II T6 ... T2 Ex nA nR [nL] IIC T6 ... T2 Ex tD A21 IP6X T115 °C ... T_{medium} FNICO field device	No fieldbus, no M12 plug FNICO fieldbus, no M12 plug No M12 plug FNICO fieldbus

Design MC26

Zone 1	Designation	
ATEX	II 2 G Ex e mb [ia] IIC T6 ... T2 II 1/2 G Ex e mb [ia] IIC T6 ... T2 II 2 D Ex tD A21 IP6X T115 °C ... T_{medium}	≤ DN 40 (1 1/2") ≥ DN 50 (2")
IECEx	Ex e mb [ia] IIC T6 ... T2 Ex tD A21 IP6X T115 °C ... T_{medium}	

Design MC27

Zone 1	Designation	
ATEX		
Version II/III	II 2 G Ex d e [ia] [ib] IIC T6 ... T2	≤ DN 40 (1 1/2") 2 passive analog outputs, outputs "ia"/"e", depending on user wiring, or FISCO fieldbus
Version I	II 2 G Ex d e [ib] IIC T6 ... T2	≤ DN 40 (1 1/2") Active/passive analog outputs, outputs "ib"/"e", depending on user wiring
Version II/III	II 1/2 G Ex d e [ia] [ib] IIC T6 ... T2	≥ DN 50 (2") 2 passive analog outputs, outputs "ia"/"e", depending on user wiring, or FISCO fieldbus
Version I	II 1/2 G Ex d e [ib] IIC T6 ... T2	≥ DN 50 (2") Active/passive analog outputs, outputs "ib"/"e", depending on user wiring
Version I/II/III	II 2 D Ex tD A21 IP6X T115 °C ... T_{medium}	Outputs "e"
Version II/III	II 2 D Ex tD [iaD] A21 IP6X T115 °C ... T_{medium}	2 passive analog outputs, outputs "ia"/"e", depending on user wiring, or FISCO fieldbus
Version I	II 2 D Ex tD [ibD] A21 IP6X T115 °C ... T_{medium}	Active/passive analog outputs, outputs "ib"/"e", depending on user wiring
Version III	FISCO field device	FISCO fieldbus
IECEx		
Version II/III	Ex d e [ia] [ib] IIC T6 ... T2	2 passive analog outputs, outputs "ia"/"e", depending on user wiring, or FISCO fieldbus
Version I	Ex d e [ib] IIC T6 ... T2	Active/passive analog outputs, outputs "ib"/"e", depending on user wiring
Version I/II/III	Ex tD A21 IP6X T115 °C ... T_{medium}	Outputs "e"
Version II/III	Ex tD [iaD] A21 IP6X T115 °C ... T_{medium}	2 passive analog outputs, outputs "ia"/"e", depending on user wiring, or FISCO fieldbus
Version I	Ex tD [ibD] A21 IP6X T115 °C ... T_{medium}	Active/passive analog outputs, outputs "ib"/"e", depending on user wiring
Version III	FISCO field device	FISCO fieldbus

4.6.1.2 Flowmeter sensor MS2 in accordance with ATEX

Model	MS2 Zone 1
Ambient temperature	-20 ... 50 °C (-4 ... 122 °F)
Temperature class	
T1	180 °C (356 °F)
T2	180 °C (356 °F)
T3	180 °C (356 °F)
T4	125 °C (257 °F)
T5	80 °C (176 °F)
T6	–

Ambient and process conditions:
T_{amb} -20 ... 50 °C (-4 ... 122 °F)
T_{medium} -50 ... 180 °C (-58 ... 356 °F)
Protection class IP 65, IP 67, and NEMA 4X/type 4X

Specific coding applies for ATEX and IECEx, depending on the design of the flowmeter sensor (compact or separate); see the overview on page 22).

Design MS26

Zone 1	Designation
ATEX	II 2 G Ex ib IIC T5 ... T3

4.6.1.3 Transmitter ME2, separate design, in accordance with ATEX and IECEx

Ambient and process conditions:
T_{amb} -20 ... 60 °C (-4 ... 140 °F)
Protection class IP 65, IP 67, and NEMA 4X/type 4X

Specific coding applies for ATEX and IECEx, depending on the design of the flowmeter sensor (compact or separate); see the overview on page 22).

Design ME21 / ME24 / ME25 M, N

	Designation	
ATEX	II 3 G Ex nR II T6	No fieldbus, no M12 plug
	II 3 G Ex nR [nL] IIC T6	FNICO fieldbus, no M12 plug
	II 2 D Ex tD A21 IP6X T115 °C	No M12 plug
	FNICO field device	FNICO fieldbus
IECEx	Ex nR II T6	No fieldbus, no M12 plug
	Ex nR [nL] IIC T6	FNICO fieldbus, no M12 plug
	Ex tD A21 IP6X T115 °C	No M12 plug
	FNICO field device	FNICO fieldbus

Design ME26 for flowmeter sensor MC2

Zone 1	Designation	
ATEX		
Version II/III	II 2 G Ex d e [ia] [ib] IIC T6	2 passive analog outputs, outputs "ia"/"e", depending on user wiring, or FISCO fieldbus
Version I	II 2 G Ex d e [ib] IIC T6	Active/passive analog outputs, outputs "ib"/"e", depending on user wiring
Version I/II/III	II 2 D Ex tD A21 IP6X T115 °C	Outputs "e"
Version II/III	II 2 D Ex tD [iaD] A21 IP6X T115 °C	2 passive analog outputs, outputs "ia"/"e", depending on user wiring, or FISCO fieldbus
Version I	II 2 D Ex tD [ibD] A21 IP6X T115 °C	Active/passive analog outputs, outputs "ib"/"e", depending on user wiring
Version III	FISCO field device	FISCO fieldbus
IECEx		
Version II/III	Ex d e [ia] [ib] IIC T6	2 passive analog outputs, outputs "ia"/"e", depending on user wiring, or FISCO fieldbus
Version I	Ex d e [ib] IIC T6	Active/passive analog outputs, outputs "ib"/"e", depending on user wiring
Version I/II/III	Ex tD A21 IP6X T115 °C	Outputs "e"
Version II/III	Ex tD [iaD] A21 IP6X T115 °C	2 passive analog outputs, outputs "ia"/"e", depending on user wiring, or FISCO fieldbus
Version I	Ex tD [ibD] A21 IP6X T115 °C	Active/passive analog outputs, outputs "ib"/"e", depending on user wiring
Version III	FISCO field device	FISCO fieldbus

Design ME27/ME28 for flowmeter sensor MS2

Zone 1	Designation	
ATEX		
Version II/III	II 2 G Ex d e [ia] [ib] IIC T6	2 passive analog outputs, outputs "ia"/"e", depending on user wiring, or FISCO fieldbus
Version I	II 2 G Ex d e [ib] IIC T6	Active/passive analog outputs, outputs "ib"/"e", depending on user wiring
Version II/III	II 2 D Ex tD [iaD] A21 IP6X T115 °C	2 passive analog outputs, outputs "ia"/"e", depending on user wiring, or FISCO fieldbus
Version I	II 2 D Ex tD [ibD] A21 IP6X T115 °C	Active/passive analog outputs, outputs "ib"/"e", depending on user wiring
	FISCO field device	FISCO fieldbus

Important

When using the device in explosion hazardous areas, the additional temperature specifications in the section titled "Ex relevant specifications" on the data sheet or in the the separate Ex safety instructions (SM/FCM2000/FM/CSA) must be observed.

4.7 Digital Communication

The transmitter offers the following options for digital communication:

4.7.1 HART protocol

The unit is registered with the HART Communication Foundation.

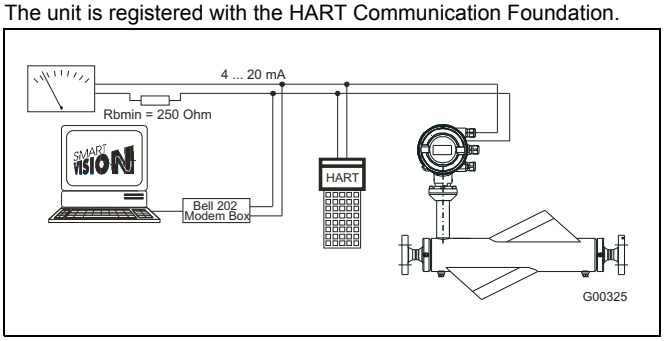


Fig. 45: Communication via HART protocol

HART protocol	
Configuration	Directly on the unit Software DSV401 (+ HART-DTM)
Transmission	FSK modulation on current output 4 ... 20 mA acc. to Bell 202 standard
Max. signal amplitude	1.2 mA_{ss}
Load of current output	Min. 250 Ω, max. = 560 Ω (ignition-proof: max. 300 Ω)
Cable	
Cable	AWG 24 twisted
Max. cable length	1,500 m (4,921 ft.)
Baud rate	1,200 baud
Display	Log. 1: 1,200 Hz Log. 0: 2,200 Hz

For additional information, see the separate interface description.

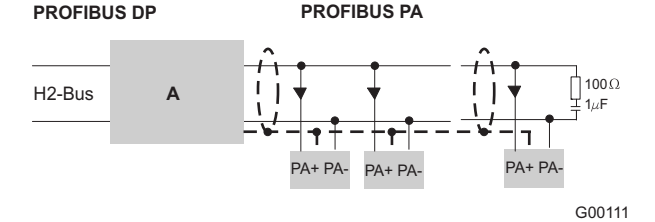
System integration

Communication (configuration, parameterization) can be performed with the DTM (Device Type Manager) available for the unit (software version B.10 and higher) and the corresponding framework applications as per FDT 0.98 or 1.2 (DSV401 R2). If you require integration into different tools/systems (e.g., AMS or Siemens S7), this is available upon request. DSV401 communication tool for HART, free 90-day test version also available upon request. DTMs are included in DSV401.

4.7.2 PROFIBUS PA protocol

The interface conforms to Profile 3.0 (PROFIBUS standard, EN 50170, DIN 19245 [PRO91]).

PROFIBUS PA ID no.:	0849 hex.
Alternative standard ID no.:	9700 or 9742 hex.
Configuration	Directly on the unit Software DSV401 (+ PROFIBUS PA DTM)
Transmission signal	Acc. to IEC 61158-2
Cable	Shielded, twisted cable (acc. to IEC 61158-2, types A or B are preferred)



A = Segment coupler (incl. bus supply and termination)

Fig. 46: Example for PROFIBUS PA interface connection

Bus topology

- Tree and/or line structure
- Bus termination: passive at both ends of the main bus line (RC element R = 100 Ω, C = 1 µF)

Voltage/Current consumption

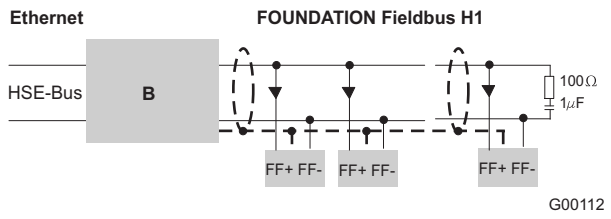
- Average current consumption: 14 mA.
- In the event of an error, the FDE (= Fault Disconnection Electronic) function integrated in the unit ensures that the current consumption can rise to a maximum of 26 mA.
- The upper current limit is restricted electronically.
- The voltage on the bus line must lie in the range of 9 ... 32 V DC.

For additional information, see the separate interface description.

Important
For PROFIBUS PA / FOUNDATION Fieldbus, FISCO/FNICO, the maximum number of units which can be connected must be restricted.

4.7.3 FOUNDATION Fieldbus (FF)

FF interface	Compliant with FF standard 890/891 and FF-902
Interoperability test campaign no.	IT 027200
Manufacturer ID	0x000320
Device ID	0x0018
Configuration	• Directly on the unit • Via services integrated in the system • National configurator
Transmission signal	Acc. to IEC 61158-2



B = Linking device (incl. bus supply and termination)

Fig. 47: Example for FOUNDATION Fieldbus interface connection

Bus topology

- Tree and/or line structure
- Bus termination: passive at both ends of the main bus line (RC element R = 100 Ω, C = 1 µF)

Voltage/Current consumption

- Average current consumption: 14 mA.
- In the event of an error, the FDE (= Fault Disconnection Electronic) function integrated in the unit ensures that the current consumption can rise to a maximum of 26 mA.
- Upper current limit: electronically restricted.
- The voltage on the bus line must lie in the range of 9 ... 32 V DC.

Bus address

The bus address is automatically assigned or can be set in the system manually.
Addresses are detected using a unique combination of manufacturer ID, device ID, and device serial number.

System integration

The following are required:

- DD (Device Description) file, which includes the device description.
- The CFF (Common File Format) file is required for engineering the segment. Engineering can be performed online or offline.

You can find both files, as well as the interface description, on the supplied CD (part no.: D184B093U35). This can be re-ordered, if necessary, from ABB at no cost.

The files needed for operation can also be downloaded from www.abb.com/flow --> Coriolis Mass --> fieldbus.org.

Important
For PROFIBUS PA / FOUNDATION Fieldbus, FISCO/FNICO, the maximum number of units which can be connected must be restricted.

5 Commissioning

Important

An additional document with Ex safety instructions is available for measuring systems that are used in explosion hazardous areas (Applies to FM / CSA only).
As a result, it is crucial that the specifications and data it lists are also observed.

5.1 General information

Inspection prior to switching on supply power

The following points must be checked before commissioning the device:

- The assignment of the flowmeter sensor to the transmitter must be correct.
- The wiring must be correct according to the electrical connection.
- The flowmeter sensor must be correctly grounded.
- The external data memory module (FRAM) must have the same serial number as the flowmeter sensor.
- The external data memory module (FRAM) must be inserted in the correct position (see Exchanging the transmitter, page 109).
- The ambient conditions must meet the specifications.
- The supply power must match the information on the name plate.

Inspection after switching on supply power

The following points must be checked after commissioning the device:

- The parameter configuration must correspond to the operating conditions.
- The system zero adjustment must have been made.

General information

- If the flow direction indicated on the display is incorrect, it could mean that the signal lead connections have been accidentally reversed.
- The locations and the sizes of the fuses may be found in the "Replaceable parts list" (page 110).

5.1.1 Switching on auxiliary power

After switching on the auxiliary power, the flowmeter sensor data in the external FRAM is compared with the data saved internally. If the data is not identical, the transmitter data is replaced automatically. Once completed, the message "Ext.Dat.loaded" is displayed. The measuring equipment is now ready for operation.

The display shows the current flowrate.

5.1.2 Device configuration

The device can be factory calibrated to customer specifications upon request. If no customer information is available, the device is delivered with factory settings.

On-site configuration requires only a few parameter settings. For information on settings, refer to the section titled "Entering data in short form". A short overview of the menu structure can be found in the section titled "Parameter overview".

The following parameters should be checked or set for commissioning:

1. **Flow range end value** (menu items "Q_{mMax}" and "Unit")

   The device is factory calibrated to the largest flow range end value, unless customer information to the contrary is available.

2. **Current outputs** (menu items "Current output 1" and "Current output 2")

   Select the desired current range (0 … 20 mA or 4 … 20 mA).

3. For devices with a fieldbus, the bus address must be set (menu item "Interface").

4. **Pulse output** (menu items "Pulse" and "Unit")

   To set the number of pulses per volume flow unit, a unit for the totalizer (e.g., kg or t) must first be selected under menu item "Unit". After that, the number of pulses has to be entered in the menu item "Pulse".

5. **Pulse width** (menu item "Pulse width")

   For external processing of the present counting pulses, the pulse width can be set to between 0.1 ms and 2,000 ms.

6. **System zero point** (menu item "System zero point")

   The fluid in the flowmeter sensor must be brought to a complete standstill. The flowmeter sensor must be full. Select the menu "System zero point". Next press ENTER. Use the STEP key to call up "automatic" and select ENTER to start the adjustment. You can choose between slow or fast adjustment. Slow adjustment generally provides a more accurate zero point.

Important

All parameters are stored automatically in the FRAM.

5.2 Preliminary checks prior to start-up

5.2.1 Hardware switch for PROFIBUS PA address setting

There is a 10-position DIP switch in the converter. It is not visible from the outside. The switch can be operated when the housing cover is open. The switch position is displayed on the device in the data link submenu. It can also be read via the PA bus in the transducer block.

Warning – Risk to persons!

When the housing cover is open, EMC and protection against contact are suspended. There are electric circuits within the housing which pose a contact risk.
The auxiliary power must be switched off before opening the housing cover.

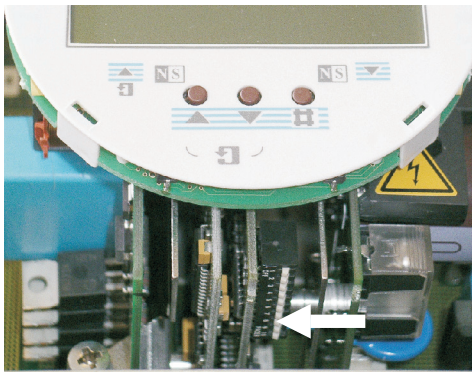


Fig. 48

Switch 8 determines whether the address is set by switch:

On: The address is set using the switches 1-7. It cannot be changed via the bus.

Off: The address is set via the bus or the menu. Switches 1-7 have no significance.

Switches 1-7: Hardware address setting, binary coded. Valid addresses 0-125.

Switch 9 and A have no significance for the address setting.

Example:

Address 50 set by switch: 50 dec = 32 hex = 110010 binary → Switch 2, 5, 6 and 8

Fig. 49

The address switch setting is only adopted when the device is restarted, not during running operation! A restart can be triggered by switching on the power supply or by software reset (Factory_Reset in Physical Block).

The factory setting of the switch is: 0000000000

If the switch addressing is switched off (last new start was with switch 8 to “On”, after new start with switch 8 to “Off”), then according to the PA specifications, the address is reset to the default value 126 and NO_ ADDRESS_CHANGE to FALSE.

5.2.2 Pulse output, change active/passive

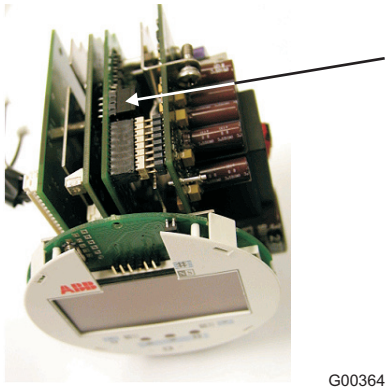
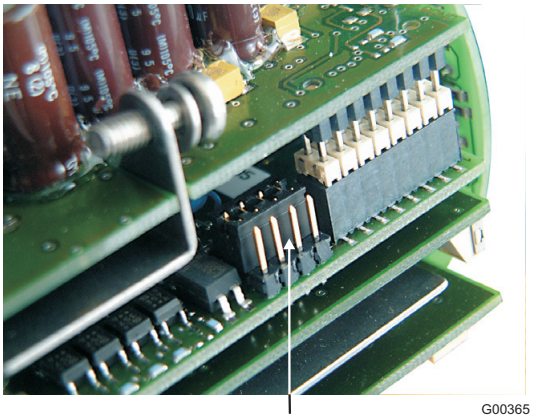
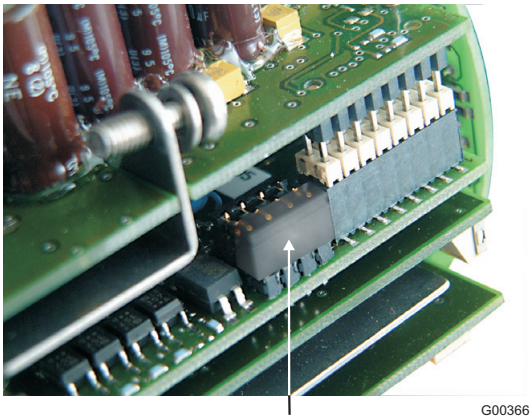


Fig. 50: Converter module



Plug-in jumper position for passive pulse output

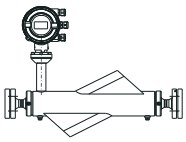


Plug-in jumper position for active pulse output

Fig. 51: Plug-in jumper position

5.2.3 Operating protection switch

In order to prevent third parties from manipulating important parameters of the converter, any changes made can be blocked by a hardware switch (see fig. 52).



Position of the operating protection switch

Fig. 52: Converter module

Turning the switch clockwise activates the programming protection while turning the switch anti-clockwise deactivates it. If you attempt to change parameters while the protection is active, the following warning will be displayed: “Error – operating protection” and the input will be rejected.

It is also possible to use a cover locking screw with a hole to seal the compact unit so that parameter changes cannot remain undetected.

5.3 Information for safe operation – ATEX, IECEx

5.3.1 Inspection

Before installing the flowmeter sensor, check whether it has been damaged due to improper transport. All claims for damages must be submitted to the shipper without delay and before installation. You must comply with the installation conditions. Flowmeter sensors must be commissioned and operated according to ElexV (German ordinance on electrical installations in potentially explosive atmospheres), EN 60079-14 (setting up electrical installations in potentially explosive atmospheres), and relevant national standards. In potentially explosive atmospheres, installation, commissioning, maintenance, and servicing must only be performed by properly trained personnel. The commissioning activities described here are performed after the flowmeter has been installed and the electrical connection has been made. The supply power is switched off. When operating the flowmeter in areas containing combustible dusts, comply with EN 61241-0:2006.

Warning - General risks!

Comply with the following instructions when opening the housing:

- Make sure there is no explosion hazard.
- A fire permit is required.
- Power to all connecting cables must be switched off.
- When the housing is open, EMC protection is suspended.
- The surface temperature of the flowmeter sensor may exceed 70 °C (158 °F), depending on the fluid temperature.

5.3.2 Output Circuits

Installation of Intrinsically Safe ”i” or Increased Safety ”e”

The output circuits are designed to be connected to either intrinsically safe or non-intrinsically safe circuits. A combination of intrinsically safe and non-intrinsically circuits is not permissible. For intrinsically safe output current circuits Potential Equalization must be maintained along the entire circuit. The test voltage for the non-intrinsically safe circuits is Um = 60 V. When shipped the black cable connectors are installed. If the signal outputs are to be connected to intrinsically safe circuits, it is recommended that the included light blue caps be used for the corresponding cable connectors.

5.3.3 NAMUR Contact

The switching output and the pulse output (terminals 41, 42 / 51, 52) can be wired internally as a NAMUR contact for the purpose of connecting to a NAMUR amplifier; this is achieved by setting the jumpers accordingly. The standard wiring shown below is the factory default. The switchover is performed via jumpers (Fig. 53). See also the section titled "Electrical connections".

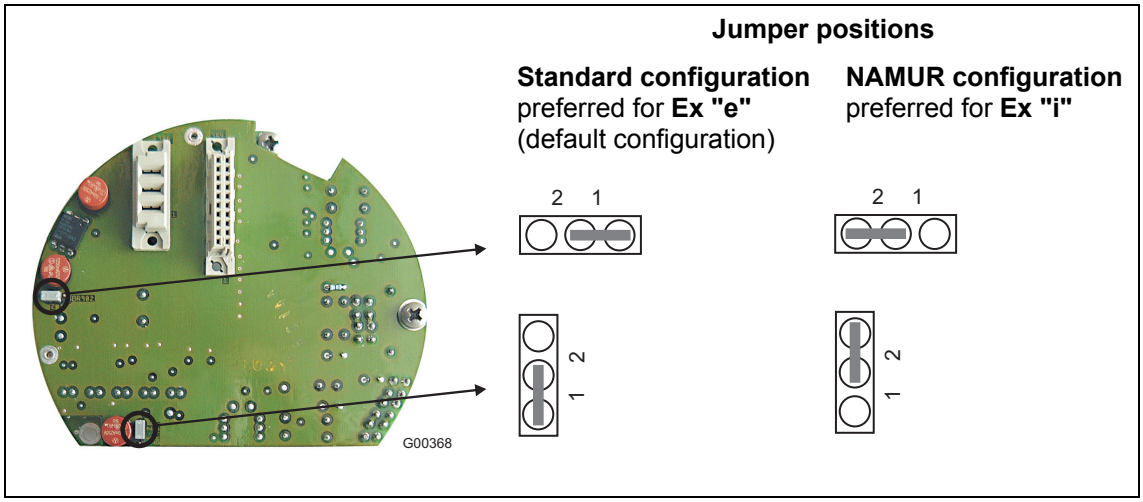


Fig. 53: Positions of jumpers

The safety specifications for intrinsically safe circuits can be found on the EC type-examination certificate.

- Make sure that the cover over the voltage supply connection is tightly closed. With intrinsically safe output circuits, the terminal box can be opened.
- It is recommended that you use the cable glands supplied (not for the -40 °C [-40 °F] version) for the output circuits as appropriate for the relevant type of protection:
  - Intrinsically safe: Blue
  - Non-intrinsically safe: Black
- The sensor and the transmitter housing must be connected via the equipotential bonding. For intrinsically safe current outputs, equipotential bonding needs to be in place all the way along the circuits.
- If the sensor is insulated, the maximum insulation thickness is 100 mm (4"). The transmitter housing must not be insulated.
- After switching off the flowmeter, wait t > 2 minutes before opening the transmitter housing.
- When commissioning the flowmeter, refer to EN 61241-1:2004 regarding use in areas containing combustible dust.
- The operator must ensure that, when connecting the protective conductor (PE), no potential differences exist between the protective conductor and the equipotential bonding (PA), even in the event of a fault.

Special information for use in Category 1:

- The inside of the meter tube or nominal sizes ≥ DN 50 (2") may correspond to Category 1 (Zone 0). The corrosion resistance of the materials must be taken into account.

5.3.4 Isolation: MC26.., MC27..

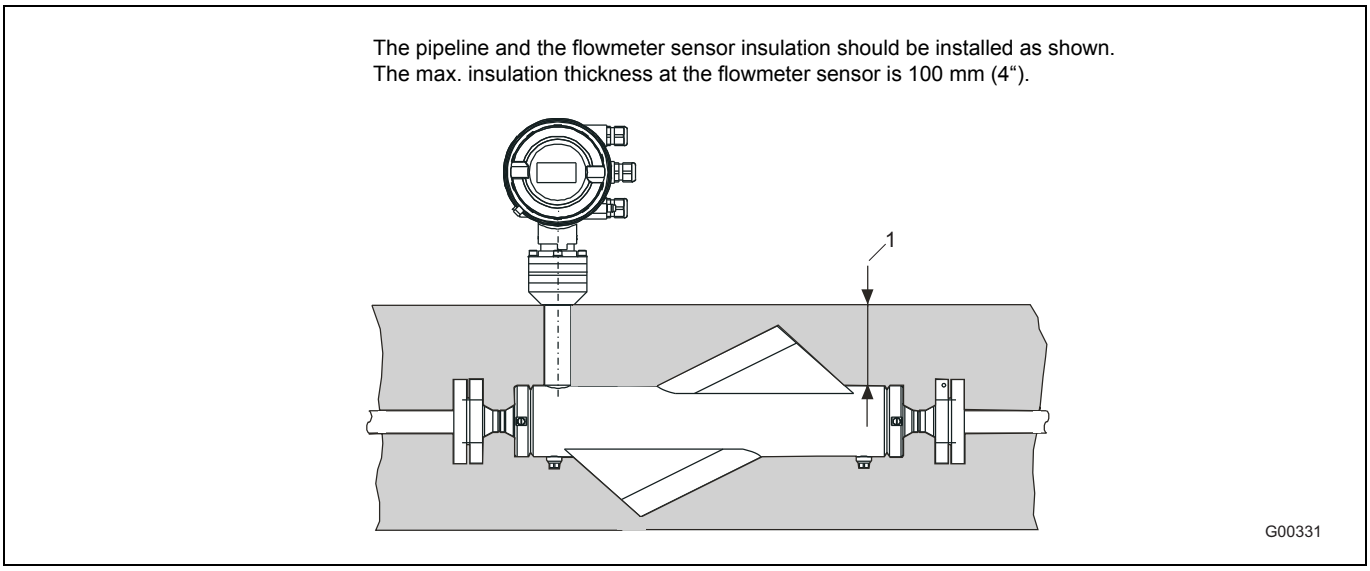


Fig. 54

1 max. 100 mm (4“)

5.3.5 Information on changing the installation

Models MC27, ME26, ME27, and ME28 can be operated in various applications:

- When connected to an intrinsically safe circuit in Zone 1, as an intrinsically safe device (Ex ia)
- When connected to a non-intrinsically safe circuit in Zone 1, as an explosion-proof device (Ex d)
- When connected to a non-intrinsically safe circuit in Zone 2, as a "non-sparking" device (Ex nA)

If a device which is already installed is to be used in a different application, i.e., its use is to be changed, the following measures must be taken/checks must be made in accordance with the applicable standards.

Models ME26/ME27/ME28 and MC27

1st application	2nd application	Measures
Zone 1: Ex d, non-intrinsically safe circuits	Zone 1: Intrinsically safe circuits	• 500 $V_{AC/1\ min}$ or 500 x 1.414 = 710 $V_{DC/1\ min}$ test between terminals 31 / 32, 33 / 34, 41 / 42, 51 / 52, 81 / 82, and / or 97 / 98 and terminals 31, 32, 33, 34, 41, 42, 51, 52, 81, 82, 97, 98, and the housing • Visual inspection, particularly of the electronic circuit boards • Visual inspection: no damage or explosion can be detected
	Zone 2: Non-sparking (nA)	• 500 $V_{AC/1min}$ or 500 x 1.414 = 710 $V_{DC/1min}$ test between terminals 31/32, 33/34, 41 / 42, 51 / 52, 81 / 82, and/or 97 / 98 and terminals 31, 32, 33, 34, 41, 42, 51, 52, 81, 82, 97, 98, and the housing • Visual inspection, particularly of the electronic circuit boards • Visual inspection: no damage or explosion can be detected
Zone 1: Intrinsically safe circuits	Zone 1: Ex d, non-intrinsically safe circuits	• Visual inspection: no damage to the threads (cover, 1/2" NPT cable glands)
	Zone 2: Non-sparking (nA)	• No special measures
Zone 2: Non-sparking (nA)	Zone 1: Intrinsically safe circuits	• 500 $V_{AC/1\ min}$ or 500 x 1.414 = 710 $V_{DC/1\ min}$ test between terminals 31 / 32, 33 / 34, 41 / 42, 51 / 52, 81 / 82, and / or 97 / 98 and terminals 31, 32, 33, 34, 41, 42, 51, 52, 81, 82, 97, 98, and the housing • Visual inspection, particularly of the electronic circuit boards • Visual inspection: no damage or explosion can be detected
	Zone 1: Ex d, non-intrinsically safe circuits	• Visual inspection: no damage to the threads (cover, 1/2" NPT cable glands)

Cables and cable entries

The devices are supplied either with cable glands or with 1/2" NPT threads; you specify which you require in the order number. The cable glands supplied are ATEX-/IECEx-certified. In order to achieve the required tightness, the outer cable diameter must be between 5 mm (0.2") and 9 mm (0.35").

Warning – Risk to persons!

Devices certified in accordance with CSA are only ever supplied with 1/2" NPT threads without glands.

However, it is also possible to supply devices certified in accordance with ATEX or IECEx with 1/2" NPT threads without glands. In such cases, the user is responsible for ensuring that the cable piping/glands are installed in accordance with the relevant national standards (e.g., NEC, CEC, ATEX 137, IEC 60079-14, etc.).

M12 PROFIBUS cable plug

Warning – Risk to persons!

The M12 plug is not approved for use with combustible dusts. In Zone 2, the plug may only be operated with energy-limited circuits (nL) such as FNICO.

Special requirements of models ME2 / MC2 M, N (Zone 2 devices)

The transmitter housing (rectangular or round, compact or separate) can be operated in Zone 2 with protection class "restricted breathing" (nR). In such cases, please take note of the following:

Warning – Risk to persons!

The user must check the device in accordance with IEC 60079-15 each time installation or maintenance has been performed, or each time the housing has been opened.

Switch off the voltage supply and wait for at least two minutes before opening the housing. Then remove a cable gland which is not being used. Cable glands certified to ATEX or IECEx are usually used, e.g., M20 x 1.5 or 1/2" NPT thread. The device being used to test the pressure is then attached to this gland. The user is responsible for ensuring that the device is sealed and installed correctly.

Re-insert the gland following the pressure test.

Before the supply power is switched on again, the housing, seals, thread, and cable entries must be subjected to a visual inspection. There must be no signs of any damage.

Notice - Potential damage to parts!

When selecting the installation site, ensure that the housing will not be exposed to direct sunlight. The ambient temperature limits must be observed. If direct sunlight cannot be avoided, appropriate sun protection equipment must be installed.
For FNICO or FISCO installations, the number of devices must be limited as per the applicable standard.

6 Parameterization

After the power to the device is switched on, a number of self-check routines are executed automatically. Subsequently, the standard display (process information) appears. The configuration of the display can be defined by the user.

6.1 Data entry

Data can be entered in various languages using three keys on the transmitter.

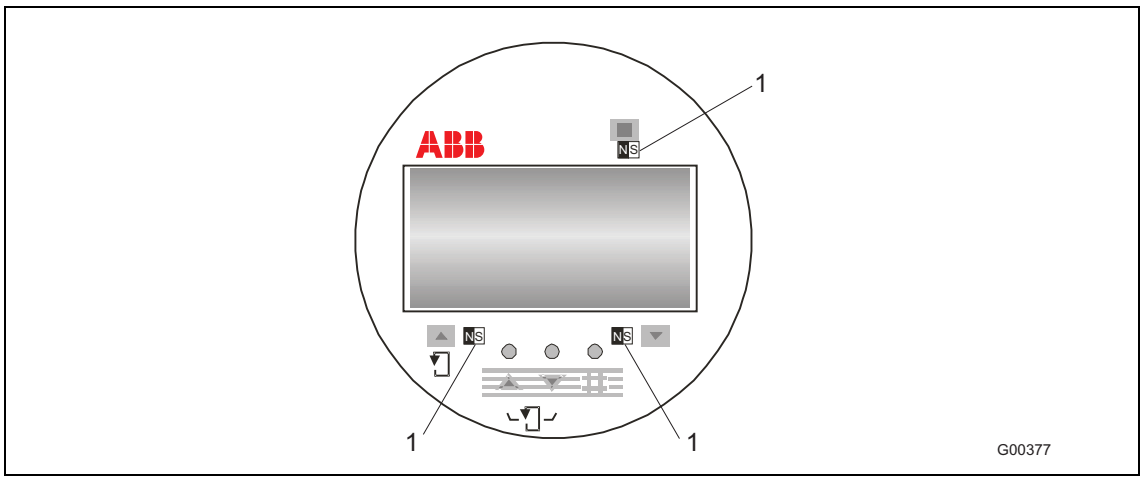


Fig. 55: Transmitter keypad and display

1 Points for inserting the magnet stick

The magnet stick can be used to configure the device even when the housing cover is closed.

Warning – General risks!
When the transmitter housing is open, EMC protection and protection against accidental contact are suspended.

When entering data, the transmitter remains online, i.e., current and pulse outputs still show the current operating mode. The functions of the individual keys are explained below:

C/CE Toggle between operating mode and menu.

STEP↓ The STEP key is one of two arrow keys. Use STEP to scroll forward through the menu. All the required parameters can be called up.

DATA↑ The DATA key is one of two arrow keys. Use DATA to scroll backward through the menu. All the required parameters can be called up.

ENTER The ENTER function requires that both arrow keys, STEP and DATA, be pressed simultaneously. ENTER has the following functions:

- Access the parameter to be changed and set the new, selected, or default parameter.

The ENTER function is effective for approx. 10 s only. If a new value is not entered within 10 s, the transmitter display reverts to the old value.

Initiating the ENTER function when using the magnet stick for operation

The ENTER function is initiated when the DATA/ENTER sensor is activated for longer than 3 seconds. The display flashes to indicate that the function is active.

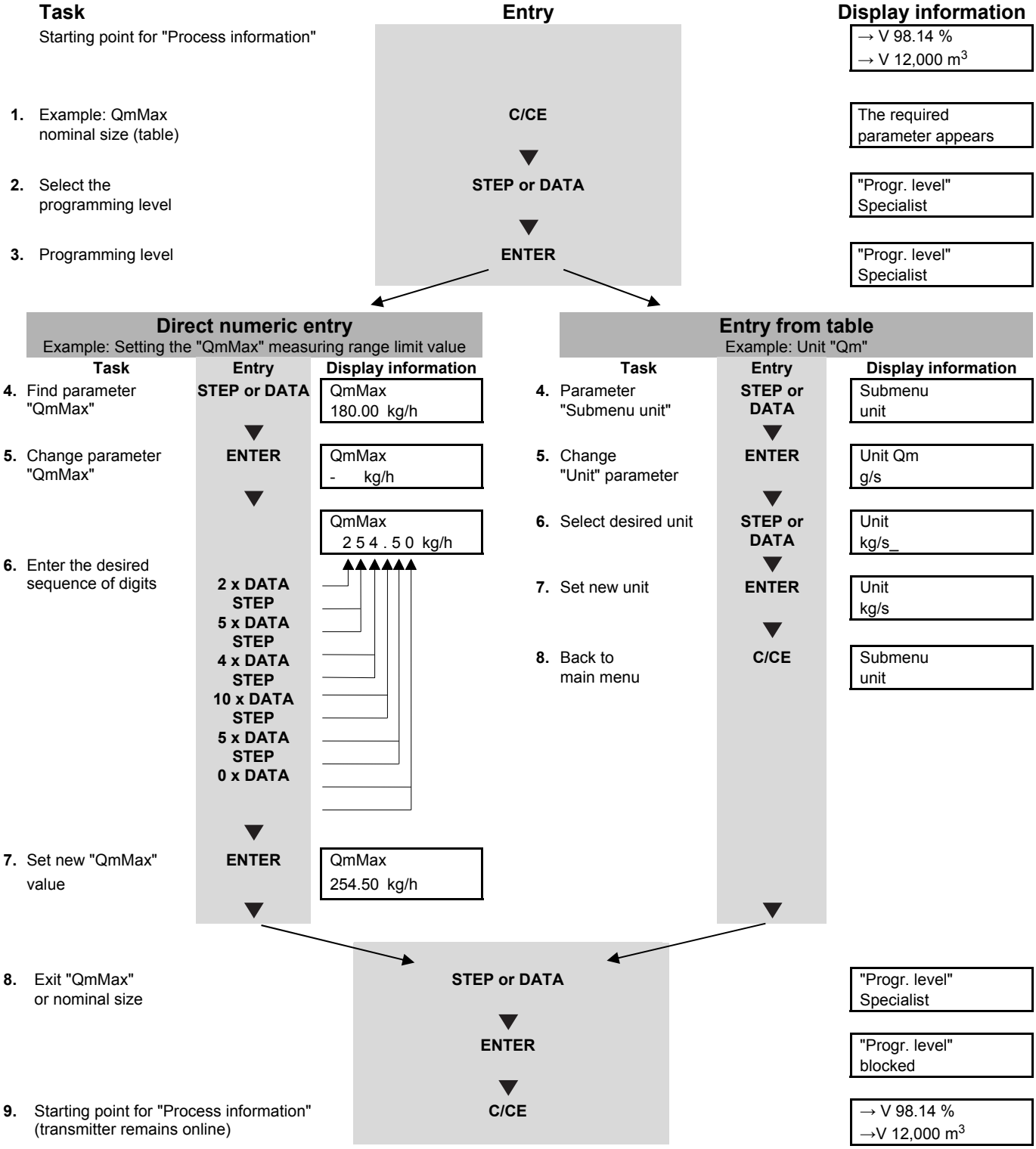
There are two different methods of entering data:

- Numeric entry
- Entry from predefined table

Important

When entering data, the values are checked for plausibility and, if necessary, rejected with an appropriate message.

6.2 Entering data in short form



6.3 Parameter overview

Parameter	Value range/Input type		Comment
*Prog. level Technician	Blocked		After pressing ENTER in the *Prog. Ebene* menu, the following programming levels can be selected: **"**Blocked**"**. Locks the device, preventing further entry of parameters. **"Standard":** The Standard menu includes all the userspecific menu settings required to operate the device. **"Technician":** Expanded Standard menu with the complete set of userspecific menu settings. **"Service":** Additional Service menu pages only required by ABB Automation Products Service personnel. If the prog. prot. code is set to 0 (default setting), the programming levels "Standard" or "Spezialist" can be selected without having to enter the "Progr. Schutz-Kodes". If any other "Progr. Schutz-Kode" has been entered (1 ... 999), the user is asked to enter the prog. prot. code (PP code) once the programming level has been selected:
Prog. Prot. Code ****	Technician*		After the correct code has been entered, the corresponding programming level is opened. If the "Service" programming level was selected, then the service code number must be entered.
Old Prog. Prot. (PS) code? ****	Technician* 0 ... 9999		
New Prog. Prot. (PS) code? ****	Technician* 0 ... 9999		
Language English	German English	Selection	The available languages are displayed in the 2nd line in the relevant language: Language — Shown as German — Deutsch English — English
Submenu Mode of operation	Technician*		The basic settings are made in this submenu.
Flow direction Supply/Return	Supply/Return	Table	As standard, the transmitter can measure flow in both directions. However, it is possible to block reverse flow measurements with this function:
	Forward		If this selection is made and the actual flow is in the reverse direction, the flow direction arrow ← R flashes on the process display (instantaneous flowrate) blinks and the flowrate value is shown as 0 %. In addition, warning 10 "Rücklauf Q" is displayed.
	Technician*		**Important!** In Forward/Reverse operating mode, the pulse output is active for both flow directions.
Directional display normal	Normal Inverse	Selection	The flow direction display can be inverted here. It must be taken into consideration that the accuracy of the flow measurement is dependent upon whether calibration was done in the forward direction only or in the forward and reverse directions.

Parameter	Value range/Input type	Comment

Parameter	Value range/Input type	Comment
DensiMass Code 4289794		When ordering software with the DensiMass option, the relevant device-specific code appears here. If this option is to be obtained subsequently, contact the ABB service team or sales organization.
DensiMass On	On Off Code invalid	
Submenu Concentration		
Medium Sugar in H2O	Variable Matrix Sodium hydro Alcohol in water Wheat starch Corn starch Sugar in H2O (BRIX)	In order to calculate the concentration of 2-phase mixtures, a temperature-density concentration matrix is needed for each mixture. ABB has already stored matrices for some common mixtures (see section 6.4.3).
Submenu Variable Matrix		
Submenu Configuration		
Number matrices 2	1 2	Selection of whether 1 matrix or 2 matrices can be entered
Number temp. 2	2 ... 20	Definition of the number of temperature values (see section 6.4.3).
Number conc. 2	2 ... 20	Definition of the number of temperature values (see section 6.4.3).
Enter conc. in % yes	Yes No	If the concentration unit is something other than %, % can be selected in addition here. This is essential when calculating net mass flows.
Reset matrix		Resets the matrix to the factory setting.

Parameter	Value range/Input type	Comment
Unit name Baume	Enter	Entry of any unit name
Min. concentr. 0.00 Baume	Enter	Entry of the minimum permissible concentration value
Max. concentr. 100.00 Baume	Enter	Entry of the maximum permissible concentration value
Submenu Matrix 1	Matrix 1 Matrix 2	
Temperature		Entry of all temperature values for the selected matrix. Rules on entry (see section 6.4.3).
Concentration in unit		Entry of all concentration values in the unit entered for the selected matrix. Rules on entry (see section 6.4.3).
Concentration in percent		Entry of all concentration values as a percentage for the selected matrix. Rules on entry (see section 6.4.3).
Density		Entry of all density values for the selected matrix. Entered values are identified by "E"; values calculated by means of interpolation or extrapolation by "B". Rules on entry (see section 6.4.3).
Matrix calculation		Calculation of the matrix based on previous entries. Missing values are interpolated or extrapolated. Rules on entry (see section 6.4.3).
Enter matrix finish		Save or reject previous entry. This excludes the possibility of changes being made inadvertently.

Parameter	Value range/Input type		Comment
Submenu Unit			In this submenu the units can be defined for the variables measured by the transmitter (mass flowrate, density, and temperature) and for the variables calculated from them (volume flowrate and mass or volume flow totals). All other flow-related entries (e.g., alarm limits or current output ranges) are then made in the units selected for those parameters.
Unit Qm kg/min	g/s, g/min, g/h, kg/s, kg/min, kg/h, kg/d, t/min, t/h, t/d, lb/s, lb/min, lb/h, lb/d, abc/s, abc/min, abc/h, abc/d		This selection defines the unit for the mass flowrate to be used for the display of both parameters QmMax and QmMax Meter Tube, plus the instantaneous mass flowrate.
Unit Qv l/s	l/s, l/min, l/h, m^3/s, m^3/min, m^3/h, m^3/d, ft^3/s, ft^3/min, ft^3/h, ft^3/d, ugl/s, ugl/min, ugl/h, mgl/d, igps, igpm, igph, igpd, bbl/s, bbl/min, bbl/h, bbl/d, abc/s, abc/min, abc/h, abc/d	Table	This selection defines the unit for the volume flowrate to be used for the display of the volume flowrate or for the entries of the min. and max. limits for the current output, for example, when the volume flowrate is to be indicated by the current output.
Density unit kg/l	g/ml, g/l, g/cm^3, kg/l, kg/m^3, lb/ft^3, lb/ugl	Table	The following units can be selected:
Unit totalizer kg	g, kg, t, lb, abc	Table	In this menu the unit for the mass totalizer can be changed. The fact that this is the mass totalizer menu is only indicated by the units that are available for selection.
Unit totalizer l	l, m^3, ft^3, ugl, igl, bbl, abc		In this menu the unit for the volume totalizer can be changed. The fact that this is the volume totalizer menu is only indicated by the units that are available for selection.
Submenu Prog. Unit Qm			Any mass flow unit preferred by the user can be defined in the menus of this submenu. The defined programmable mass flow unit can be utilized in the corresponding selection menus, just the same as all other mass flow units (e.g., as totalizer units). Not contained in the fieldbus software versions.
Unit name abc	3 ASCII Technician*	ASCII	In this menu the name or abbreviation of the programmable mass flow unit can be changed. The name can have a maximum of 3 characters. Not contained in the fieldbus software versions.

Parameter	Value range/Input type		Comment
Units factor 50.0000 kg	Technician*	float	In this menu the number of kilograms equivalent to one programmable mass flow unit must be entered. Minimum value: 0.00001 kg Maximum value: 5,000,000 kg
Submenu Prog. Unit Qv	Technician*		Any volume flow unit preferred by the user can be defined in the menus of this submenu. The defined programmable volume flow unit can be utilized in the corresponding selection menus, just the same as all other volume flow units (e.g., as totalizer units). Not contained in the fieldbus software versions.
Unit name abc	3 ASCII Technician*	ASCII	In this menu the name or abbreviation of the programmable volume flow unit can be changed. The name can have a maximum of 3 characters.
Units factor 100.0000 l	Technician*	Table	In this menu the number of liters equivalent to one programmable volume flow unit must be entered. Minimum value: 0.00001 l Maximum value: 5,000,000 l
Temp. unit °C	°C, K, °F	Table	Temperature unit
Unit concentration Sodium hydro. %	% BRIX Baume ...		The concentration unit can be selected here, in accordance with the settings made in the "Konzentration" submenu.
Submenu Flowmeter primary			The sensor-specific parameters are grouped together here.
Meter pipe TRIO 20E		Display	The configured nominal device diameter is displayed.
QmMax meter pipe 100.00 kg/min		Display	This menu displays the maximum mass flowrate for the selected nominal device diameter.
Order no. 240012345X004	16 ASCII characters	Display	Display of the order number. It is also shown on the name plate and on the label of the external memory module.

Parameter	Value range/Input type		Comment
QmMax 100.00 kg/min	QmMaxDN	float	The flow range can be set between the limits 0.01 ... 1.0 QmMax Meter Tube and applies to both flow directions. QmMax is the value used as the basis for the Qm current value, the low flow cutoff value, and the Qm alarm limits. (QmMax = 20 mA for Qm current output) **Important!** If a new nominal diameter is entered, the value of QmMax is set to QmMax Meter Tube.
Damping 5.0 s	1 ... 100 s Technician*	float	Damping can be set within the range from 1 s to a maximum of 100 s. It represents the time required for the transmitter to reach 99 % of the end value in one unit step.
Low cutoff setting 2.1 %	0 ... 10 % Technician*	float	The value set is the low flow cutoff limit as a percentage of the QmMax setting. The maximum low flow cutoff setting is 10 %. The switching hysteresis is 0.1 %. If a value of 0 % is entered for the low flow cutoff, then the switching hysteresis is also deactivated.
Submenu Field optimization	Technician*	float	
D correction 0.0000 kg/l	-50 ... 50 g/l Technician*	float	In order to attain an accuracy in the density measurement which comes close to a reproducibility of 0.0001 g/ml, this factor can be used to perform an optimization in the field. The limits of this entry are ± 0.05 g/ml.
Qm correction 0.000 %	-5 ... 5 % Technician*	float	In order to attain an accuracy in the flow measurement which comes close to or even exceeds a reproducibility of at least 0.1 % of the measured value, this factor can be used to undertake an optimization in the field. This value acts as a correction value for the current mass flowrate. It is given as a percentage of the current measured value. The limits of this entry are ± 5 % of the measured value.
C correction tab. 1 0,00 %	-1000 ... 1000 % Technician		In order to attain an accuracy in the concentration measurement which comes close to or even exceeds reproducibility, this factor can be used to undertake an optimization in the field. This value acts as a correction value for the current measured concentration value. It is given in the unit that is currently set for concentration. The correction value is based on the concentration matrix currently selected. In the case of one fixed matrix, only one correction value is available. If variable matrices are used, 2 values are available.
C correction tab. 2 0,00 %			

Parameter	Value range/Input type		Comment
System Zero adj. -0.0111 %			After pressing "ENTER", you can select whether a manual or automatic system zero adjustment is to be conducted by pressing "DATA" or "STEP".
System Zero adj. automatic?		Function	The automatic system zero adjustment can be performed quickly or slowly.
System Zero adj. Slow?			Slow
System-Nullpunkt Fast?			Fast
System Zero adj. manual?		float	"System Nullpunkt manuell" allows a numerical value to be entered directly for the system zero point. This could be used in order to change the system zero point determined by the automatic adjustment, for example. Before selecting the automatic system zero adjustment function, ensure that the following operating conditions are met: • No flowrate • No vibration • No pressure shocks • No gas bubbles in fluid • Other operating conditions (e.g., operating temperature and operating pressure)
System Zero adj. 0.011 %			
Submenu Alarm			In the following Alarm menus the minimum and maximum limits for the variables mass flowrate, density, and temperature can be set. When the value is outside of the maximum or minimum setting, the contact output can be actuated (additional settings required in the Contact Output menu). The max. alarm value must be larger than the associated min. alarm value.
Min Alarm Qm 0.00 %	0 ... 105 % Technician*	float	Set the lower mass flowrate limit. It must be lower than the upper mass flowrate limit. Minimum: 0 % Maximum: 105 %

Parameter	Value range/Input type		Comment
Max Alarm Qm 100.00 %	0 ... 105 % Technician*	float	Set the upper mass flowrate limit. It must be greater than the lower mass flowrate limit. Minimum: 0 % Maximum: 105 %
Min Alarm 0.5 kg/l	0.5 ... 3.5 kg/l Technician*		Set the lower density limit. It must be lower than the upper density limit. Minimum: 0.5 g/cm^3 Maximum: 3.5 g/cm^3
Max Alarm Dichte 3.5 kg/l	0.5 ... 3.5 kg/l Technician*		Set the upper density limit. It must be greater than the lower density limit. Minimum: 0.5 g/cm^3 Maximum: 3.5 g/cm^3
Min Alarm Temp. -50.0 °C	-50 ... 180 °C Technician*		Set the lower temperature limit. It must be lower than the upper temperature limit. Minimum: -50 °C Maximum: 180 °C
Max Alarm Temp. 100.00 °C	-50 ... 180 °C Technician*		Set the upper temperature limit. It must be greater than the lower temperature limit. Minimum: -50 °C Maximum: 180 °C
Min Alarm Concentr. 0,00 %	-5 ... 105,0 % Technician*		The lower concentration limit must be below the upper limit.
Max Alarm Concentr. 0,00 %	-5 ... 105,0 % Technician*		The upper concentration limit must be above the lower limit.

Parameter	Value range/Input type		Comment
Submenu Display			The process display can be formatted by the user for numerous display combinations.
1. Zeile Qm	Q [Bargraph] Qm Qv Q [%] Temperature Density Concentr. Unit Concentr. Percent Qm Concentration TAG Nummer Totalizer Mass Totalizer Mass>F Totalizer Mass<R Totalizer Volumes Totalizer Vol.>V Totalizer Vol.<R Totalizer Net Mass Total. Net Mass > F Total. Net Mass < R Pipe frequency Blank	Table	Selection of line 1 (See Additional parameter descriptions, page 96)
2nd Line Density	Q [Bargraph] Qm Qv Q [%] Temperature Density Concentr. Unit Concentr. Percent Qm Concentration TAG Nummer Totalizer Mass Totalizer Mass > F Totalizer Mass < R Totalizer Volumes Totalizer Vol. > F Totalizer Vol. < R Totalizer Net Mass Total. Net Mass > F Total. Net Mass < R Pipe frequency Blank	Table	Selection of line 2 (See table Additional parameter descriptions, page 96)

Parameter	Value range/Input type		Comment
1st Line Multiplex Qv	Q [Bargraph] Qm Qv Q [%] Temperature Density Concentr. Unit Concentr. Percent Qm Concentration TAG Nummer Totalizer Mass Totalizer Mass > F Totalizer Mass < R Totalizer Volumes Totalizer Vol. > F Totalizer Vol. < R Totalizer Net Mass Total. Net Mass > F Total. Net Mass < R Pipe frequency Blank	Table	In addition to the values selected for display in the 1st and 2nd lines, other values can also be displayed in multiplex operation. In a 3 second cycle the values are automatically switched back and forth. The same functions are available for programming the multiplex display as for the standard display. They can also be deactivated. (See table Additional parameter descriptions, page 96)
2nd Line Multiplex Temperature	Q [Bargraph] Qm Qv Q [%] Temperature Density Concentr. Unit Concentr. Percent Qm Concentration TAG Nummer Totalizer Mass Totalizer Mass > F Totalizer Mass < R Totalizer Volumes Totalizer Vol. > F Totalizer Vol. < R Totalizer Net Mass Total. Net Mass > F Total. Net Mass < R Pipe frequency Blank	Table	(See table Additional parameter descriptions, page 96)

Parameter	Value range/Input type		Comment
Submenu Totalizer			This submenu contains additional submenus for the totalizers for the mass and volume flow integration and one menu item to simultaneously reset all the totalizers. All four totalizers (forward, reverse, mass, and volume totalizers) count to 10 million (in the selected totalizer units). After a value of 10 million is reached, the corresponding overflow counter is incremented by one and the totalizer value reset to zero to continue counting the flow. In order to indicate in the process display that an overflow has occurred, a warning is displayed. Up to 65,535 overflows can be registered per totalizer. A value for each totalizer can be individually set or reset (by entering a zero value) in the appropriate menu. When a totalizer is set (or reset), the relevant overflow counter automatically resets to zero. If (only) "Vorlauf" was selected in the Flow Direction menu, Operating Mode submenu, then only forward menus are available in the following totalizer menus.
Submenu Totalizer Masse			
Counter → F 12345,56 kg		Display Input	Display of totalizer status; for the forward direction
Overflow → F 0		Display	Display of totalizer overflows; max. 65,535 overflows; 1 overflow = 10,000,000 forward reset
Totalizer ← R 1234,00 kg		Display Input	Display of totalizer status for reverse direction; displayed in the Forward/Reverse operating mode only
Overflow ← R 0		Display	Display of totalizer overflows Max. 65,535 overflows; 1 overflow = 10,000,000; displayed in the Forward/Reverse operating mode only
Submenu Totalizer Volume			Volume totalizer
Totalizer → F 123456,78 l		Display Input	Display of totalizer status for forward direction
Overflow → F 0		Display	Display of totalizer overflows; 1 overflow = 10,000,000
Totalizer ← R 123456,78 l		Display Input	Display of totalizer status for reverse direction; displayed in the Forward/Reverse operating mode only
Overflow ← R 0		Display	Display of totalizer overflows Max. 65,535 overflows; 1 overflow = 10,000,000; displayed in the Forward/Reverse operating mode only

Parameter	Value range/Input type		Comment
Submenu Totalizer Mass	-5 ... 105,0 % Technician		The upper concentration limit must be above the lower limit.
Counter → F 12345,56 kg		Display Input	Display of totalizer status; for the forward direction
Overflow → F 0		Display	Display of totalizer overflows; Max. 65,535 overflows; 1 overflow = 10,000,000 forward reset
Totalizer ← R 1234,00 kg		Display Input	Display of totalizer status for reverse direction; displayed in the Forward/Reverse operating mode only
Overflow ← R 0		Display	Display of totalizer overflows Max. 65,535 overflows; 1 overflow = 10,000,000; displayed in the Forward/Reverse operating mode only
Totalizer Reset		Function	After the safety message, which is used to prevent inadvertent clearing of all the totalizer values, has been acknowledged, all flow totalizers are simultaneously reset to zero. The sequential display of each totalizer is simply intended to certify that all totalizers have been reset. Example for an external totalizer: 1 kg = 1 pulse
Reset ? Yes → ENTER			

Parameter	Value range/Input type		Comment
Submenu Pulse Output			
Output of Mass	Mass / Volume 0.0001 ... 1000 Pulse/unit	float	In this menu you can select whether the pulse output should be based on mass or volume flowrate.
Qmax pulse 100.00 l			Displayed with volume output only
Qm% pulse 100,00 kg			Displayed with net mass flow output only
Pulse 631 /kg			In this menu you can specify how many pulses are to be output for each selected totalizer unit. In the above example, the output is to based on "Masse-Impulse". The pulse factor will be calculated using a unit of 1 pulse per kilogram, because for this example the selected mass totalizer unit is kilograms. For the pulse factor, values from 0.001 ... 1,000 can be entered for the pulses per totalizer unit. The entered value is checked by the transmitter and corrected, if necessary, to ensure that the output pulse frequency does not exceed 5,000 pulses/second. **Notice!** An increase in the pulses per totalizer unit can result in a reduction of the pulse width!
Pulse width 30.00 ms	0.1 ... 2000 ms	float	The pulse width can be entered as a value from 0.1 ... 2,000 ms. The transmitter checks the entry and reduces it, if necessary, to ensure that the pulse width does not exceed one half of the period at the maximum output frequency, which is calculated from the pulse factor and QmMax. (See examples Submenu Pulse Output, page 98)
Submenu Current output 1			Not contained in the fieldbus software versions.
Output Qm	Qm Qv Density Temperature Concentration Qm Concentration	float	The selections in this menu are used to define which of the measured variables listed are to be output at current output 1.

Parameter	Value range/Input type		Comment
Qv → I = 100 % 120.00 l/min	0.1 ... 10000000	float	In this menu the volume flowrate value for which the current output is to indicate its 100 % value (20 mA) is entered. The menu is only displayed when the volume flowrate is output at the current output. Maximum value: QmMax/minimum density (0.5 g/cm^3)
Density → I = 0 % 500.00 g/l	0.5 ... 3.5 g/cm^3	float	In this menu the density value for which the current output is to indicate its 0 % value (0 mA or 4 mA) is entered. The menu is only displayed when the density is output at the current output. Minimum: 0.5 g/cm^3 Maximum: 3.5 g/cm^3 The density value for a current output value of 100 % must be at least 0.01 g/cm^3 larger than the density value for a current output value of 0 %.
Density → I = 100 % 1000.00 g/l	0.5 ... 3.5 g/cm^3	float	In this menu the density value for which the current output is to indicate its 100 % value (20 mA) is entered. The menu is only displayed when the density is output at the current output. Minimum: 0.5 g/cm^3 Maximum: 3.5 g/cm^3 The density value for a current output value of 100 % must be at least 0.01 g/cm^3 larger than the density value for a current output value of 0 %.
Temp → I = 0 % -10.0 °C	-50 ... 180 °C	float	In this menu the temperature value for which the current output is to indicate its 0 % value (0 mA or 4 mA) is entered. The menu is only displayed when the temperature is output at the current output. Minimum: -50 °C Maximum: 180 °C The temperature value for a current output value of 100 % must be at least 10 °C larger than the temperature value for a current output value of 0 %.
Temp → I = 100 % 180 °C	-50 ... 180 °C	float	In this menu the temperature value for which the current output is to indicate its 100 % value (20 mA) is entered. The menu is only displayed when the temperature is output at the current output. Minimum: -50 °C Maximum: 180 °C The temperature value for a current output value of 100 % must be at least 10 °C larger than the temperature value for a current output value of 0 %.
Qm% → I = 100 % 120 kg/min			Only displayed when Qm concentration is output. Net mass flow at a current output value of 100 %.

Parameter	Value range/Input type		Comment
Current output 4 ... 20 mA	0 ... 20 mA 4 ... 20 mA Technician*	Table	Used to define the current output range. The current output can be switched between 0 ... 20 mA and 4 ... 20 mA. HART communication utilizes current output 1. This requires that a current output range of 4 ... 20 mA be selected. If a current output range of 0 ... 20 mA is selected and an attempt is made to use HART communication, a message that the current output range is not set to 4 ... 20 mA is displayed. The communication mode is not changed. If, however, the communication mode is set to HART protocol and the current output range is changed from 4 ... 20 mA to 0 ... 20 mA, a message that HART communication will be turned off is displayed and the current output range is set to 0 ... 20 mA.
Iout for Alarm Low	Low High Technician*	Table	In this menu you can select whether the high alarm current or the low alarm current is to be output at the current output when an alarm occurs. For some error states the high alarm current or low alarm current is always output, irrespective of the alarm current set here (see "Alarm overview").
Low Alarm 3.2 mA	2 ... 3.6 mA Technician*	float	In this menu the value of the low alarm current can be changed. The setting for the alarm current is a function of the current output range selected. For the current output range 0 ... 20 mA, the alarm current is 0 mA. For the current output range 4 ... 20 mA, the low alarm current can be set between the limits of 2 ... 3.6 mA. When the current output range is changed, the transmitter automatically adjusts the low alarm current to the new current output range (current output range 0 ... 20 mA to 0 mA and 4 ... 20 mA to 2 mA).
High Alarm 21 mA	21 ... 26 mA Technician*	float	In this menu the value of the high alarm current can be changed. The setting for the alarm current is independent of the current output range selected, since all range end values are 20 mA. The high alarm current can be set between the limits of 21 mA and 26 mA.

Parameter	Value range/Input type		Comment
Submenu Current output 2			In contrast to current output 1, current output 2 is not HART-enabled and has a fixed current output range (4 ... 20 mA). In the submenu for current output 2, dependent on the measured variable to be output, only those menus are displayed which are required for configuring the output. Current output 2 is always passive. Not contained in the fieldbus software versions.
Output of Qm	Qm Qv Density Concentration Qm Concentration	Table	The selections in this menu are used to define which of the measured variables listed are to be output at current output 2.
Qv → I = 100 % 120.00 l/min	0.1 ... 10000000	float	In this menu the volume flowrate value for which the current output is to indicate its 100 % value (20 mA) is entered. The menu is only displayed when the volume flowrate is output at the current output. Maximum value: QmMax/minimum density (0.5 g/cm^3)
Density → I = 0 % 0.8 kg/l	0.5 ... 3.5 g/cm^3	float	In this menu the density value for which the current output is to indicate its 0 % value (4 mA) is entered. The menu is only displayed when the density is output at the current output. Minimum: 0.5 g/cm^3 Maximum: 3.5 g/cm^3 The density value for a current output value of 100 % must be at least 0.01 g/cm^3 larger than the density value for a current output value of 0 %.
Density → I = 100 % 1.3 kg/l	0.5 ... 3.5 g/cm^3	float	In this menu the density value for which the current output is to indicate its 100 % value (20 mA) is entered. The menu is only displayed when the density is output at the current output. Minimum: 0.5 g/cm^3 Maximum: 3.5 g/cm^3 The density value for a current output value of 100 % must be at least 0.01 g/cm^3 larger than the density value for a current output value of 0 %.
Temp → I = 0 % -50.00 °C	-50 ... 180	float	In this menu the temperature value for which the current output is to indicate its 0 % value (4 mA) is entered. The menu is only displayed when the temperature is output at the current output. Minimum: -50 °C Maximum: 180 °C The temperature value for a current output value of 100 % must be at least 10 °C larger than the temperature value for a current output value of 0 %.

Parameter	Value range/Input type		Comment
Temp → I = 100 % 180.0 °C	-50 ... 180	float	In this menu the temperature value for which the current output is to indicate its 100 % value (20 mA) is entered. The menu is only displayed when the temperature is output at the current output. Minimum: -50 °C Maximum: 180 °C The temperature value for a current output value of 100 % must be at least 10 °C larger than the temperature value for a current output value of 0 %.
Qm% → I = 100 % 120 kg/min			Only displayed when Qm concentration is output. Net mass flow at a current output value of 100 %.
Iout Alarm Low	Low High Technician*	Table	In this menu you can select whether the high alarm current or the low alarm current is to be output at the current output when an alarm occurs. For some error states the high alarm current or low alarm current is always output, irrespective of the alarm current set here (see "Alarm overview").
Low Alarm 3.2 mA	3.5 ... 3.6 mA Technician*	float	In this menu the value of the low alarm current can be changed. The low alarm current can be set between the limits of 3.5 ... 3.6 mA.
High Alarm 21.0 mA	21 ... 26 mA Technician*	float	In this menu the value of the high alarm current can be changed. The high alarm current can be set between the limits of 21 mA and 26 mA.
Submenu Switch contacts			In this submenu the function assigned to the contact input and the contact output can be defined.
Contact input Totalizer reset.	No function Concentr. Table Ext. output Shut-off Totalizer reset.		Can be used to define the function of the contact input. The following functions are available: • No function • Conc. table (Can be toggled between variable matrix 1 and matrix 2 for each contact input.) • Ext. cut-off (Current and pulse outputs are set to 0 % flowrate. Internal totalizers are held.) • Totalizer reset (Resets all mass and volume totalizers.) Not contained in the fieldbus software versions.

Parameter	Value range/Input type		Comment
Contact output No function Contact output Max Alarm_ _	No function F/R-Signal _ F/R-Signal / General alarm _ General alarm / MAX/MIN Alarm _ MAX/MIN Alarm / MIN Alarm _ MIN Alarm / MAX Alarm _ MAX Alarm /		Can be used to define the function of the contact output. The following functions are available: No function (contact opened) F/R signal _ _ (if no forward flow → contact closed) F/R signal /_ (if no forward flow → contact opened) General alarm _ _ (if no general alarm → contact closed) General alarm / _ (if no general alarm → contact opened) MAX/MIN alarm _ _ (if no MAX/MIN alarm → contact closed) MAX/MIN alarm _ / (if no MAX/MIN alarm → contact opened) MIN alarm _ _ (if no MIN alarm → contact closed) MIN alarm / _ (if no MAX/MIN alarm → contact opened) MAX alarm _ _ (if no MAX alarm → contact closed) MAX alarm / _ (if no MAX alarm → contact opened) The symbols "/ _ " and "_ _" indicate normally closed and normally open contacts. A normally open contact closes when actuated (in this case when the appropriate conditions are satisfied). A normally closed contact operates in the reverse manner.
Submenu Label	8 ASCII	ASCII	Not contained in the fieldbus software versions.
TAG number 123ABCDE			The TAG number can be used to identify the measuring point (HART protocol). The length is limited, as per the HART specification, to 8 numbers and/or capital letters (packed ASCII).
Descriptor 123456789ABCDE	16 ASCII		HART descriptor The length is limited to 16 numbers and/or capital letters (packed ASCII).
Date 07.07.2001	1.1.1900 ... 31.12.2155		HART file
Unit number 1234567	0 ... 999999	Display	

Parameter	Value range/Input type		Comment
Submenu Interface			Included only with HART software.
Communication HART	HART Off Technician*		The communication mode can be selected. Available selections are: • HART • Off
Unit address 0	0 ... 15 Technician*	Integer	The device address is entered here. For HART communication, addresses 0 ... 15 are possible. **Important!** If HART is selected as the communication mode and the device address is not 0, the transmitter is in what is known as multidrop mode. In this mode, a constant 4 mA is output at current output 1 (HART current output).
PA Adresse 20	0 ... 126 Technician*		There are three ways to set the PA address: 1. Hardware switch 2. Bus 3. "PA Adresse" menu (in "Schnittstelle" submenu) on the transmitter. The hardware switch has highest priority. An address specified by a switch is fixed and cannot be changed. If the switch address setting is not active (switch 8 off), the address can be changed via the bus or via the menu. Changing the address via the bus is only possible if no cyclic communication is running. Included only in the PROFIBUS PA software.
IdentNo Selector Profile 9742			The table can be used to select one of the following settings, which determine the number of the AI and totalizer blocks: FCM2000 0849 – Device-specific profile of the FCM2000. 6 AI and 2 TOT are specified. Profile 9700 – Selection of 1 AI Profile 9742 – Selection of 3 AI and 1 TOT
AI1 Channel	TB Mass Flow TB Density TB Temperature TB TotMass > V TB TotMass < R TB TotVol > V TB TotVol < R TB Volume Flow		Every channel (AI 1 .. 6) can selectively be populated with the following values: • Mass flowrate • Volume flowrate • Density • Temperature • Internal mass totalizer (in contrast to the PA totalizer) • Internal volume totalizer (in contrast to the PA totalizer) Included only in the PROFIBUS PA software.

Parameter	Value range/Input type	Comment
AI2 Channel	TB Mass Flow TB Density TB Temperature TB TotMass > V TB TotMass < R TB TotVol > V TB TotVol < R TB Volume Flow	Included only in the PROFIBUS PA software.
AI3 Channel	TB Mass Flow TB Density TB Temperature TB TotMass > V TB TotMass < R TB TotVol > V TB TotVol < R TB Volume Flow	Included only in the PROFIBUS PA software.
AI4 Channel	TB Mass Flow TB Density TB Temperature TB TotMass > V TB TotMass < R TB TotVol > V TB TotVol < R TB Volume Flow	Included only in the PROFIBUS PA software.
AI5 Channel	TB Mass Flow TB Density TB Temperature TB TotMass > V TB TotMass < R TB TotVol > V TB TotVol < R TB Volume Flow	Included only in the PROFIBUS PA software.
AI6 Channel	TB Mass Flow TB Density TB Temperature TB TotMass > V TB TotMass < R TB TotVol > V TB TotVol < R TB Volume Flow	Included only in the PROFIBUS PA software.
TOT1 Channel	TB Mass Flow TB Volume Flow	TB Mass Flow can be assigned to the TOT 1 channel, and TB Volume Flow to the TOT 2 channel. These PROFIBUS PA totalizers can deviate from the FCM2000 internal totalizers. Included only in the PROFIBUS PA software.

Parameter	Value range/Input type		Comment
TOT2 Channel	TB Mass Flow TB Volume Flow		Included only in the PROFIBUS PA software.
TB DiagExtMask 0x080001FE0FFF	Bit-wise selection of alarms		This can be used to select the bits of the error register to be transmitted. For details, please see our FCM2000 data link documentation PROFIBUS PA. Included only in the PROFIBUS PA software.
CommSoftwareRev 2.11.0.12			Indicates the communication software version. Included only in the PROFIBUS PA software.
Dip Switch	0 ... 126 Technician*		Displays the switch position of the hardware address switch for PROFIBUS PA after Enter is pressed.
123456789A Adr. - -x - x- -x x x 20			
Submenu Function test			In this menu you can test inputs and outputs as well as the individual components of the transmitter. Also included is a Simulation menu, which provides the ability to set all measured variables in the transmitter to programmable values.
Function test Pulse Output	0.001 ... 5000 Hz Technician*	float	During normal operation the output of the pulses is dependent on the flowrate selection (mass or volume), the selected QmMax, and the pulse factor. In order to test the pulse output independently of these variables, the pulse output self-check function permits the number of pulses output per second to be entered directly. The value entered must be between 0.001 ... 5,000 pulses/s. Pressing any key terminates the self-check process and the pulse output again depends on the variables named above. Not contained in the fieldbus software.
Pulse Output 1 Hz			
Function test Iout 1	0 ... 26 mA Technician*	float	This function can be used to set a value for the current output independent of the variable assigned to the current output, for test purposes. A current between 0 ... 26 mA can be simulated. (In version A.00 the entry is made as a percentage.) Not contained in the fieldbus software.
Iout 1 10 mA			

Parameter	Value range/Input type		Comment
Function test Iout 2	on off Technician*	float	This function can be used to set a value for the current output independent of the variable assigned to the current output, for test purposes. A current between 3.5 ... 26 mA can be simulated Not contained in the fieldbus software.
Iout 2 10 mA			
Function test Contact input	on off Technician*	Table	This function can be used to determine whether the contact input is opened or closed. Not contained in the fieldbus software.
Contact input on			
Function test Contact output	on off Technician*	Table	Can be used to manually toggle the contact output. Not contained in the fieldbus software.
Contact output on			
Function test Memory	Technician*		
Submenu Simulation	Technician*		The submenu Simulation contains a number of menu items with which it is possible to set individual or even all measured variables of the transmitter to programmable values.
Simulation on	on off Technician*	Table	When simulation is turned on, additional menu items become available in the submenu Simulation. They enable you to determine for every variable whether it should be measured or simulated and what value should be assigned to it. Therefore a selection can be made from the following: Measure → The variable is measured. Enter → The variable is simulated and can be set to a fixed value using the appropriate menu. Step → The simulated variable entered can be increased or decreased in steps using the STEP and DATA keys if the process display is shown. Simulated values for the measured variables can be entered which fall outside the permissible limits, in order to test the operation of the alarms. The settings in the simulation menu are not stored. After a power outage, all simulation menus are deactivated.

Parameter	Value range/Input type		Comment
Qm Enter	Measure Enter Enter	Table	This menu can be used to select how the mass flowrate is determined while in simulation mode.
Qm 15.00 %	-115 ... +115 % Technician*	float	The mass flowrate value to be simulated can be entered as a percentage. This menu is only displayed when mass flowrate has been selected. The permissible value range is -115 % ... +115 %.
Density Enter	Measure Enter Enter Technician*	Tabelle	This menu can be used to select how the density is determined while in simulation mode.
Density 1.00 g/ml	0.3 ... 3.7 g/ml Technician*	float	The density value to be simulated can be entered. This menu is only displayed when density has been selected. The permissible value range is 0.3 ... 3.7 g/cm^3.
Temperature Enter	Measure Eingeben Enter Technician*	Table	This menu can be used to select how the temperature is determined while in simulation mode.
Temp. housing Enter	Measure Enter Enter Technician*	Tabelle	This menu can be used to select how the temperature is determined while in simulation mode.
Temperature 30 °C	-60 ... 190 °C Technician*	float	The temperature value to be simulated can be entered. This menu is only displayed when temperature has been selected. The permissible value range is -60 ... 190 °C.
Temp. housing 20 °C	Measure Enter Enter Technician*	float	
Function test HART Transmitter	Technician*		The two HART frequencies (1,200 Hz and 2,200 Hz) can be selected and output.
Function test HART Command	Technician*		The received HART commands are displayed.

Parameter	Value range/Input type		Comment
Submenu Status			The following queries can be performed: • Error log • Warning register • Power outage
Error log Number: 3			Displays the sum of all detected and active errors. Use "ENTER" to display the first error with its error number, error status (active or set), and name.
7 (Set) Temp.Messung	Example	Display	If additional errors have been registered they can be viewed by scrolling with the "STEP" and "DATA" keys. **Important!** The sequence in which the errors are displayed does not correspond to their priority.
9a (current) Density measurement			
9b (current) Density < 0.5 kg/l			
Warning Register Number: 1			Displays the sum of all detected and active warnings. Use "ENTER" to display the first warning with its warning number, warning status (active or set), and name. **Important!** The sequence in which the errors are displayed does not correspond to their priority.
4 (Set) Ext. Cut-off	Example	Display	
Power outage 5			Displays the number of power outages since the last time the power outage totalizer was reset.
Status Reset			The error log and warning register, as well as the power outage totalizer, can be reset.
Reset Yes → ENTER			

Parameter	Value range/Input type	Comment
FCM2000 10.2008 D699G001U01 B.30		In the first line, the device designation (FCM2000) and the revision date of the software (e.g., 10/2008) are displayed. In the second line, the software designation (D699G001U01) and the software revision level (B.30) are displayed. In addition to the software identification in the operator menu, the identification can also be found on the information tag on the transmitter module.

6.4 Additional parameter descriptions

6.4.1 Submenu Display

The first and second display lines can be configured to display any of the following values:

Display	Remark
Q [Bar graph]	Display of the flow as bars
Qm	Display the mass flowrate in engineering units
Qv	Display the volume flowrate in engineering units
Q [%]	Display the mass flowrate in percent
Temperature	Display the temperature in engineering units
Density	Display the density in engineering units
Conc. Unit	Display of concentration in chosen unit
Conc. Percent	Display of concentration in percent
Qm Concentration	Display of net-massflow according to present concentration
TAG number	
Totalizer mass	Display the mass forward or reverse flow totalizer dependent on the present flow direction
Totalizer mass → F	Display the mass forward flow totalizer
Totalizer mass ← R	Display the mass reverse flow totalizer
Totalizer volumes	Display the volume forward or reverse flow totalizer dependent on the present flow direction
Totalizer Vol. → F	Display the volume forward flow totalizer
Totalizer Vol. ← R	Display the volume reverse flow totalizer
Totalizer Net.Mass.	Display of Totalizer Net Massflow according to net-massflow
Totalizer Net Mass → F	Display of Totalizer Net Massflow - Forward
Totalizer Net Mass ← R	Display of Totalizer Net Massflow - Reverse
Pipe frequency[1)]	Display the frequency of the meter pipe
Blank line	

Only contained within PROFIBUS PA software	
PA Addr+State	Display of PA address and state
TB MassFlow Val	Display of the respective value of the Transducer Block
TB MassFlow Stat	Display of the respective state of the Transducer Block
TB VolFlow Value	Display of the respective value of the Transducer Block
TB VolFlow Stat	Display of the respective state of the Transducer Block
TB Density Value	Display of the respective value of the Transducer Block
TB Density Stat	Display of the respective state of the Transducer Block
TB Temper. Value	Display of the respective value of the Transducer Block
TB Temper. Stat	Display of the respective state of the Transducer Block
TB TotMass>V Val	Display of the respective value of the Transducer Block
TB TotMass>V Sta	Display of the respective state of the Transducer Block
TB TotMass<R Val	Display of the respective value of the Transducer Block
TB TotMass<R Sta	Display of the respective state of the Transducer Block
TB TotVol>V Val	Display of the respective value of the Transducer Block
TB TotVol>V Stat	Display of the respective state of the Transducer Block
TB TotVol<R Val	Display of the respective value of the Transducer Block
TB TotVol<R Stat	Display of the respective state of the Transducer Block
FB AI1 Out	Display of the respective value of the Transducer Block
FB AI1 Status	Display of the respective state of the Transducer Block
FB AI2 Out	Display of the respective value of the Transducer Block
FB AI2 Status	Display of the respective state of the Transducer Block
FB AI3 Out	Display of the respective value of the Transducer Block
FB AI3 Status	Display of the respective state of the Transducer Block
FB AI4 Out	Display of the respective value of the Transducer Block
FB AI4 Status	Display of the respective state of the Transducer Block
FB TOT1 Out	Display of the respective PA totalizer value within Function Block
FB TOT1 Status	Display of the respective state of the Transducer Block
FB TOT2 Out	Display of the respective PA totalizer value within Function Block
FB TOT2 Status	Display of the respective state of the Transducer Block

1) only in Technician menu

6.4.2 Submenu Pulse Output

Example 1	**A new pulse width is entered**
Settings	QmMax = 24 kg/min = 0.4 kg/s totalizer unit kg pulse factor = 100 pulses /kg
Input	pulse width 10 ms → 0.4 kg/s · 100 pulse/kg = 40 pulse/s → Frequency = 40 Hz → Period = 25 ms → maximum pulse width = Period /2 = 12.5 ms → Result: entered pulse width of 10 ms is acceptable
Example 2	**A new pulse factor is entered**
Settings	QmMax = 6 kg/min = 0.1 kg/s = 100 g/s totalizer unit g pulse width 10 ms
Input	pulse factor 60 pulses /g → 100 g/s · 60 pulse/g = 6000 pulse/s → Frequency = 6000 Hz The converter automatically reduces the pulse factor to 50 pulses/g which corresponds to a period of 0.2 ms (5 kHz) → maximum pulse width = Period /2 = 0.1 ms → Result: The entered pulse factor and pulse width were both automatically decreased

6.4.3 Concentration Measurement DensiMass

This software calculates on the basis of density-temperature-concentration matrices the present concentration of a 2 phase liquid. In this software the following matrices are predefined:

- Concentration of sodium hydroxyde in water
- Concentration of alcohol in water
- Concentration of sugar in water (BRIX)
- Concentration of Corn Starch
- Concentration of Wheat starch

Up to 2 variable matrics for concentration computing.

With the sofware two different concentration values are possible:

1. Concentration in respective unit (e.g.: % or °Bé),
   values are not restricted,
   value can be selected for the outputs,
   value can be selected in submenu units.
2. Concentration in percent (%),
   value range is limited to 0 ... 103,125 %. This value is mainly used for internal net massflow calculation.
   The net massflow can be selected with the pulse and current output.

Concentration MIN / MAX limit: -5.0 ... 105.0.

Entering a variable concentration matrix

The variable matrix for concentration measurement is as follows:

		Temp. 1	...	Temp. N
Concentr. Percent 1	Concentr. Unit 1	Density 1.1	...	Density N,1
...	...	...	...	...
Concentr. Percent M	Concentr. Unit M	Density 1.M	...	Density N.M

When entering a matrix the following rules have to be obeyed:

$2 \le N \le 20$; $2 \le M \le 20$; $N * M \le 100$ in case of 1 variable Matrix,
$2 \le N \le 20$; $2 \le M \le 20$; $N * M \le 50$ in case of 2 variable Matrices.

Density values of one column shall be increasing, due to the implemented algorithm.:

Density x,1 < … < Density x,2 <…< Density x,M for $1 \le x \le M$

Temperature values shall be incrasing from left to right:

Temperature 1 <…< Temperature x <…< Temperature N for $1 \le x \le N$

concentration values have to be monotone increasing or decreasing, due to the implemented algorithm.:

Concentr. 1 <…< Concentr. x < … < Concentr. N for $1 \le x \le N$
or
Concentr. 1 >…> Concentr. x > … > Concentr. N for $1 \le x \le N$

Calculation of accuracy

The accuracy of the concentration computation depends foremost on the quality of the matrix data. As density and temperature measurement is the input for the calculation both accuracies define the accuracy of the concentration measurement.

Example:

Density 0 % alcohol in water (20 °C [68 °F]) 998.23 g/l

Density 100 % alcohol in water (20 °C [68 °F]) 789.30 g/l

100 % = 208.93 g/l

0.48 % = 1 g/l

2.40 % = 5 g/l

The chosen accuracy class of the density measurement effects the accuracy of the concentration measurement directly.

Example: Input Matrix

		10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)
0 %	0 °BRIX	0.999 kg / l	0.982 kg / l	0.979 kg / l
10 %	10 °BRIX	1.010 kg / l	0.999 kg / l	0.991 kg / l
40 %	30 °BRIX	1.016 kg / l	1.009 kg / l	0.999 kg / l
80 %	60 °BRIX	1.101 kg / l	1.018 kg / l	1.011 kg / l

The unit of density and temperature corresponds to the chosen units in submenu units.

6.5 Software history

In accordance with NAMUR recommendation NE53, ABB offers a transparent and traceable software history.

6.5.1 Standard and HART version

Software D699G001U01			
Software version	**Revision date**	**Type of changes**	**Documentation**
A.1x	01/10/2000	New release	
A.2x	07/10/2003	Function enhancement	Introduction of improved, high-accuracy density correction
A.3x	11/07/2003	Function enhancement	- Implementation of new MS2 nominal diameters, DN 1.5/3/6 - Activation of the operating protection switch
A.4x	05/01/2006	Function enhancement	- Introduction of a new external FRAM storage medium with 8 kB - Introduction of "field optimization" as a submenu for field adjustment
B.1x	01/01/2007	Hardware modification	- Introduction of new hardware and corresponding software modifications
B.2x	07/01/2007	Function enhancement	- Enhancement of HART commands - NE43 conformity of current outputs
B.3x	11/01/2008	Function enhancement	- Introduction of DensiMass concentration measurement
C1.x	04/30/2009	Function enhancement	- Introduction of a new hazardous area concept - New max. fluid temperature of 200 °C

6.5.2 Fieldbus version

PROFIBUS PA software D699G001U02			
Software version	**Revision date**	**Type of changes**	**Documentation**
A.1x	05/01/2006	New release	
C1.x	04/30/2009	Function enhancement	- Introduction of a new hazardous area concept - New max. fluid temperature of 200 °C

FOUNDATION fieldbus software D699G001U03			
Software version	**Revision date**	**Type of changes**	**Documentation**
A.1x	05/01/2006	New release	
C1.x	04/30/2009	Function enhancement	- Introduction of a new hazardous area concept - New max. fluid temperature of 200 °C

Hardware			
Hardware level	**Revision date**	**Type of changes**	**Documentation**
A	01/19/2000	New release	
B	05/01/2006	Function enhancement	- Introduction of a new external FRAM storage medium with 8 kB - Introduction of improved temperature measurement
C1.x	04/30/2009	Function enhancement	- Introduction of a new hazardous area concept - New max. fluid temperature of 200 °C

PROFIBUS PA and FOUNDATION fieldbus hardware			
Hardware level	**Revision date**	**Type of changes**	**Documentation**
A	05/01/2006	New release	
C1.x	04/30/2009	Function enhancement	- Introduction of a new hazardous area concept - New max. fluid temperature of 200 °C

Important

The new 8 kB FRAM external storage medium can only be read as of software version A40 (or A10 of the fieldbus software)!

7 Error messages

7.1 Alarm Overview

The tables on the following pages are an overview of the alarm program and describe the response of the converter when errors are detected. Listed are all the possible errors together with a description of their effects on the measurements as well as the status of the current and alarm outputs. If the entry in the column is blank there is no effect on the measurement variable or no alarm signal for the particular output. If in the current output column only Alarm is listed, then an alarm output is transmitted based on the High- or Low-Alarm selections made in the current output menus.

The sequence of the errors in the tables corresponds to the error priorities. The first entry has the highest priority and the last the lowest. If multiple errors are detected simultaneously, the error with the highest priority determines the alarm status of the measurement variable and the current output. If an error with a higher priority does not affect the measurement variable or the output status, then the error with the next highest priority determines the status of the measurement variable and the outputs.

Example:

If the error 7a “T pipe measurement“ is active, the table indicates that this affects the value of the temperature measurement variable (constant 20 °C [68 °F]). Since the temperature measurement is absolutely necessary in order to calculate the density and thus also to calculate the Qv value, the current outputs that are assigned to these parameters will enter the programmed alarm state (high or low alarm). If in addition the error "Density 0.5 g/cm3" is active, then the volume flowrate is set to 0% and the current output, which signals the density, would be set to Low-Alarm regardless of the settings in the current output menu.

Priority	Error No.	Error Description	Measurement Variable						Totalizer			Current Output						Alarm Contact
			Qm [%]	Qv [%]	Density [g/cm³]	Temperature [°C]	Cconcentration	Net Massflow	Mass	Volume	Net Mass	Qm	Qv	Density	Temperature	Concentration	Net Massflow	
1	5a	Internal FRAM	0	0	1	20	0	0	–	–	–	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm
2	5b	External FRAM	0	0	1	20	0	0	–	–	–	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm
3	10	DSP communication	0	0	1	20	0	0	–	–	–	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm
4	1	AD Transmitter	0	0	1	20	0	0	–	–	–	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm
5	11d	Sensor	0	0	1	–	0	0	–	–	–	Alarm	Alarm	Alarm	–	Alarm	Alarm	Alarm
6	0	Sensor amplitude	0	0	1	–	0	0	–	–	–	Alarm	Alarm	Alarm	–	Alarm	Alarm	Alarm
7	2a	Driver	0	0	1	–	0	0	–	–	–	Alarm	Alarm	Alarm	–	Alarm	Alarm	Alarm
8	2b	Driver current	0	0	1	–	0	0	–	–	–	Alarm	Alarm	Alarm	–	Alarm	Alarm	Alarm
9	9a	Density measurement	–	0	1	–	0	0	–	–	–	–	Alarm	Alarm	–	Alarm	Alarm	Alarm
10	9b	Density < 0.5 kg/l	–	0	–	–	–	–	–	–	–	–	Alarm	Low Alarm	–	–	–	Alarm
11	7a	T Pipe measurement	–	–	–	20	0	0	–	–	–	–	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm
12	7b	T Housing measurement	–	–	–	20	–	–	–	–	–	–	–	–	Alarm	–	–	Alarm
13	3	Flowrate >105 %	105	105	–	–	–	–	–	–	–	High Alarm	High Alarm	–	–	–	High Alarm	Alarm
14	12	Concentration (Percent)	–	–	–	–	–	0	–	–	–	–	–	–	–	–	Alarm	Alarm
15	4	Ext. zero return	–	–	–	–	–	–	stop	stop	stop	Alarm	Alarm	–	–	–	Alarm	Alarm
16	8a	Iout 1 to large	–	–	–	–	–	–	–	–	–	High Alarm	High Alarm	High Alarm	High Alarm	High Alarm	High Alarm	Alarm
17	8b	Iout 1 to small	–	–	–	–	–	–	–	–	–	Low Alarm	Low Alarm	Low Alarm	Low Alarm	Low Alarm	Low Alarm	Alarm
18	8c	Iout 2 to large	–	–	–	–	–	–	–	–	–	High Alarm	High Alarm	High Alarm	High Alarm	High Alarm	High Alarm	Alarm
19	8d	Iout 2 to small	–	–	–	–	–	–	–	–	–	Low Alarm	Low Alarm	Low Alarm	Low Alarm	Low Alarm	Low Alarm	Alarm
20	6a	Totalizer Mass → V	–	–	–	–	–	–	1)	–	–	–	–	–	–	–	–	Alarm
21	6b	Totalizer Mass ← R	–	–	–	–	–	–	1)	–	–	–	–	–	–	–	–	Alarm
22	6c	Totalizer Vol. → V	–	–	–	–	–	–	–	1)	–	–	–	–	–	–	–	Alarm
23	6d	Totalizer Vol. ← R	–	–	–	–	–	–	–	1)	–	–	–	–	–	–	–	Alarm
24	6e	Totalizer Net Mass → V	–	–	–	–	–	–	–	–	1)	–	–	–	–	–	–	Alarm
25	6f	Totalizer Net Mass ← R	–	–	–	–	–	–	–	–	1)	–	–	–	–	–	–	Alarm
26	11a	Sensor A	0	0 %	1	–	0	0	–	–	–	Alarm	Alarm	Alarm	–	Alarm	Alarm	Alarm
27	11b	Sensor B	0	0 %	1	–	0	0	–	–	–	Alarm	Alarm	Alarm	–	Alarm	Alarm	Alarm
28	11c	Sensor C	0	0 %	1	–	0	0	–	–	–	Alarm	Alarm	Alarm	–	Alarm	Alarm	Alarm

7.2 Description of the warnings

Warning code and clear text	Priority	Description	Possible Causes	Corrective Measures
Warning: 1 **Simulation**	16	The Simulation is turned on	The Simulation is turned on in the submenu Self Check	Turn off Simulation
Warning: 2 totalizer reset. Not contained in the fieldbus software.	1	A totalizer was reset		
Warning: 5a Min Alarm Qm	3	The value is below the MIN Alarm setting for Qm	The value is below the MIN Alarm setting for Qm	Reduce the MIN Alarm
Warning: 5b Min Alarm	5	The value is below the MIN Alarm setting for the density	The value is below the MIN Alarm setting for the density	Reduce the MIN Alarm
Warning: 5c Min Alarm Temp.	7	The value is below the MIN Alarm setting for the temperature	The value is below the MIN Alarm setting for the temperature	Reduce the MIN Alarm
Warning: 5d Min Alarm Conc.		The value is below the MIN Alarm setting for the concentration. Hystereses: ± 0.1 of selected unit.	The value is below the MIN Alarm setting for the concentration	Reduce the MIN Alarm
Warning: 6a Max Alarm Qm	2	The value is above the MAX Alarm setting for Qm	The value is above the MAX Alarm setting for Qm	Increase the MAX Alarm
Warning: 6b Max Alarm	4	The value is above the MAX Alarm setting for the density	The value is above the MAX Alarm setting for the density	Increase the MAX Alarm
Warning: 6c Max Alarm Temp.	6	The value is above the MAX Alarm setting for the temperature	The value is above the MAX Alarm setting for the temperature	Increase the MAX Alarm
Warning: 6d Max Alarm Conc.		The value is above the MAX Alarm setting for the concentration. Hystereses: ± 0.1 of selected unit.	The value is above the MAX Alarm setting for the concentration	Increase the MAX Alarm
Warning: 7 Ext. Data loaded	9	Is displayed for 1 minute after the supply power is turned on	Ext. data memory (FRAM) was replaced	
Warning: 8a Update int. data	10	Is displayed for 1 minute after the supply power is turned on	The software was updated Ext. data memory (FRAM) was replaced	
Warning: 8b Update ext. data	11	Is displayed for 1 minute after the supply power is turned on	The software was updated Ext. data memory (FRAM) was replaced	
Warning: 9a Overflow → F Mass	12	Totalizer overflow for the forward flow mass totalizer	Totalizer overflow for the forward flow mass totalizer	Reset totalizer Comment: Increasing the totalizer unit increases the time between overflows
Warning: 9b Overflow ← R Mass	13	Totalizer overflow of the mass reverse totalizer	Totalizer overflow of the mass reverse totalizer	Reset totalizer Comment: Increasing the totalizer unit increases the time between overflows
Warning: 9c Overflow → F Volume	14	Totalizer overflow for the forward flow mass totalizer	Totalizer overflow for the forward flow mass totalizer	Reset totalizer Comment: Increasing the totalizer unit increases the time between overflows
Warning: 9d Overflow ← R Volume	14	Totalizer overflow for the reverse flow volume totalizer	Totalizer overflow for the reverse flow volume totalizer	Reset totalizer Comment: Increasing the totalizer unit increases the time between overflows
Warning: 9e Overflow → F %M		Totalizer overflow for the forward flow net mass totalizer	Totalizer overflow of the forward (oder reverse) net mass.	Reset totalizer Comment: Increasing the totalizer unit increases the time between overflows
Warning: 9f Overflow ← R %M		Totalizer overflow for the reverse net-mass totalizer	Totalizer overflow of the forward (oder reverse) net mass.	Reset totalizer Comment: Increasing the totalizer unit increases the time between overflows
Warning: 10 Reverse Q	17	Flowrate is in the reverse direction	Operating mode set to forward, actual flowrate is in reverse	In Submenu „Operating mode” change flow direction to Forward/Reverse

7.3 Description of error messages

Error code and clear text	Priority	Description	Possible Causes	Corrective Measures
Error: 0 Sensor amplitude	6	The meter size specific sensor amplitude is either 15% above or below the specified value	Does the error only occur when the flowmeter primary is full? "Energy absorbent" fluid in meter (e.g., high gas content, highly viscous liquids), so that the driver current is insufficient	Reduce gas content, change fluid
			Very strong mechanical or hydraulic disturbances in the pipeline	Decouple flowmeter primary from disturbances
			For EEx and remote design: electrical resistance for driver cable is too high	Shorten cable, reduce resistance by installing a parallel or lower resistance cable
Error: 1 AD converter	4	The AD converter is saturated or is not responding	Sensor voltage is too large	Check sensor amplitudes, check if the setting for the sensor amplitude is correct
			The AD converter is defective	Exchange DSP board
Error: 2a Driver	7	Flowmeter primary does not vibrate	Control circuit is interrupted, primary flowmeter is incompatible with converter	For remote design: Check wiring between flowmeter primary and converter
Error: 2b Driver current	8	The current limiter in the driver has responded because the driver current is insufficient	see error 0	see error 0
Error: 3 Flowrate > 103 %	13	The value set in QmMax was exceeded by more that 5%	Flow range setting too small	Increase flow range (QmMax)
			Flowrate too large	Reduce flowrate
Error: 4 Ext. Cut-off	14	The flowrate is set to zero; the totalizers are halted	The external contact input is set to „High“	Set external contact input to „Low“
Error: 5b Ext. Database	2	Loss of the external database	Database is corrupted	Turn unit off and on again, call up functional test for converter
			Ext. memory module missing	Ext. memory module must be installed
			Ext. memory module is empty	Ext. memory module must be loaded
			An external 8 kB data memory is connected to a device with a software version < A.40	Software update to >A.40 or resending of a external memory module
Error: 6a Totalizer mass → F	19	The forward mass totalizer is corrupted		Reprogram the totalizer
Error: 6b Totalizer Vol. ← R	20	The reverse mass totalizer is corrupted		Reprogram the totalizer
Error: 6c Totalizer Vol. → F	21	The forward volume totalizer is corrupted		Reprogram the totalizer
Error: 6d Totalizer Vol. ← R	22	The reverse volume totalizer is corrupted		Reprogram the totalizer
Error: 6e Total.Net mass. → F		The forward Net mass. totalizer is corrupted		Reprogram the totalizer
Error: 6f Total.Net mass. ← R		The reverse Net mass. totalizer is corrupted		Reprogram the totalizer
Error: 7a T pipe measurement	11	Erroneous temperature - measurement For the temperature compensation of the measurement variable Qm a density of 20°C is used, i.e. for a fluid temperature near 20 °C the measurements will be correct	Incorrect wiring (only for remote design)	Check wiring between flowmeter primary and converter
			Pt 100 is defective	Check the resistance of PT100 on the primary flowmeter

Error code and clear text	Priority	Description	Possible Causes	Corrective Measures
Error: 7b T instrument housing measurement	12	Erroneous temperature - measurement For the temperature compensation of the measurement variable Qm a density of 20°C is used, i.e. for a fluid temperature near 20 °C the measurements will be correct	Incorrect wiring (only for remote design)	Check wiring between flowmeter primary and converter
			Pt 100 is defective	Check the resistance of PT100 on the primary flowmeter
Error: 8a Iout 1 too large	15	The current value is above the programmed range for current output 1.	Range setting is too small	Increase range setting
Error: 8b Iout 1 too small	16	The current value is below the programmed range for current output 1	Range setting is too small	Increase range setting
Error: 8c Iout2 too large	17	The current value is above the programmed range for current output 2.	Range setting is too small	Increase range setting
Error: 8d Iout 2 too small	18	The current value is below the programmed range for current output 2	Range setting is too small	Increase range setting
Error: 9a Density measurement	9	The measured density of the fluid in the flowmeter primary is outside of the specifications	This error usually occurs together with errors 1 and 9. See errors 1 and 9	See errors 1 and 9
Error: 9b Density <0.5 kg/l	10	The density of the medium in the flowmeter primary is < 0.5 kg/l, the volume totalizers are stopped	The flowmeter primary is not completely filled with fluid.	Completely fill the flowmeter primary
Error: 11a Sensor A	23	The signal from Sensor A is missing	Sensor A is defective, or the amplitude control circuit is open	Measure resistance of Sensor A For remote design: Check wiring between flowmeter primary and converter
Error: 11b Sensor B	24	The signal from Sensor B is missing	Sensor B is defective, or the amplitude control circuit is open	Measure resistance of Sensor B. For remote design: Check wiring between flowmeter primary and converter
Error: 11d Sensor	5	The signal from at least two sensors is missing	At least two sensors are defective, or the amplitude control circuit is open	Measure resistance of the sensors. For remote design: Check wiring between flowmeter primary and converter
Error: 12 Concentration		Concentration below 0 % or above 103,125 %.	The measured density or temperature does not fit in the given and chosen matrix	Correct the chosen matrix
Error prot. user trans		Parameters cannot be changed	The operating protection switch is active	Deactivate the hardware protection switch.

8 Maintenance / Repair

Repair and maintenance activities may only be performed by authorized customer service personnel.

When replacing or repairing individual components, original spare parts must be used.

Notice - Potential damage to parts!

The electronic components of the printed circuit board can be damaged by static electricity (observe ESD guidelines). Make sure that the static electricity in your body is discharged when touching electronic components.

Warning – Electrical voltage risk!

When the housing is open, EMC protection is impaired and protection against contact is suspended.
Before opening the housing, switch off power to all connecting cables.

8.1 Flowmeter sensor

Essentially maintenance is not required for the flowmeter sensor. The following items should be checked annually:

- Ambient conditions (air circulation, humidity)
- Seal integrity of the process connections
- Cable entry points and cover screws,
- Operational reliability of the auxiliary power feed, the lightning protection and the grounds

The flowmeter sensor electrodes must be cleaned when the flowrate information on the transmitter changes when recording the identical flowrate volume. If the display shows a higher flowrate, the contamination is insulating. If the flowrate displayed is lower, the contamination results in a short-circuit.

For repairs to the lining, electrodes or magnet coil, the flowmeter must be returned to the local office of ABB.

Important

When sending the flowmeter sensor to the local office of ABB, complete the return form in the appendix and include with device.

8.2 Cleaning

When cleaning the exterior of meters, make sure that the cleaning agent used does not corrode the housing surface and the gaskets.

8.3 Exchanging the transmitter

All parameter settings are stored in an external memory module. If the electronic system is replaced, the external data memory is changed in order to keep all the parameter settings. Data specific for the flowmeter sensor and customer setting parameters are kept automatically.

When replacing the transmitter, make sure that the serial number on the external data memory matches the serial number on the flowmeter sensor. If you replace the transmitter, please do not hesitate to contact our service team if you have any queries.

When changing a transmitter to a transmitter with a lower software level, please contact our service team in any case.

8.4 Socket for the external memory module

The socket for the external memory module is located on the display board in compact design instruments (see Fig. 24) and on the connection board in the field-mount housing for remote design instruments (see Fig. 56).

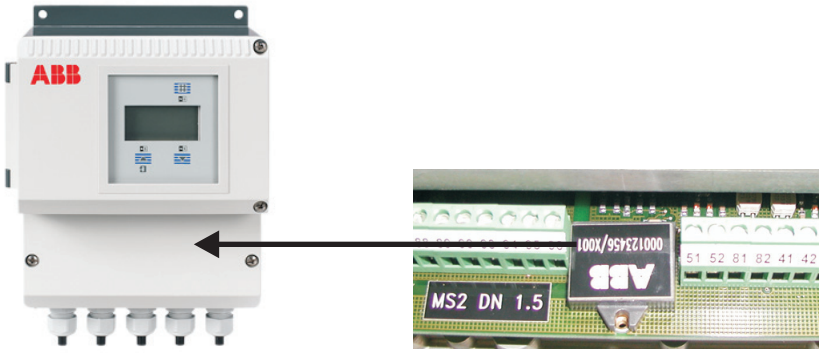


Fig. 56: Position of external memory module in the field-mount housing

Warning – Electrical voltage risk!

When the housing is open, EMC protection is impaired and protection against contact is suspended.

- Power to all connecting cables must be switched off.

9 Spare parts list

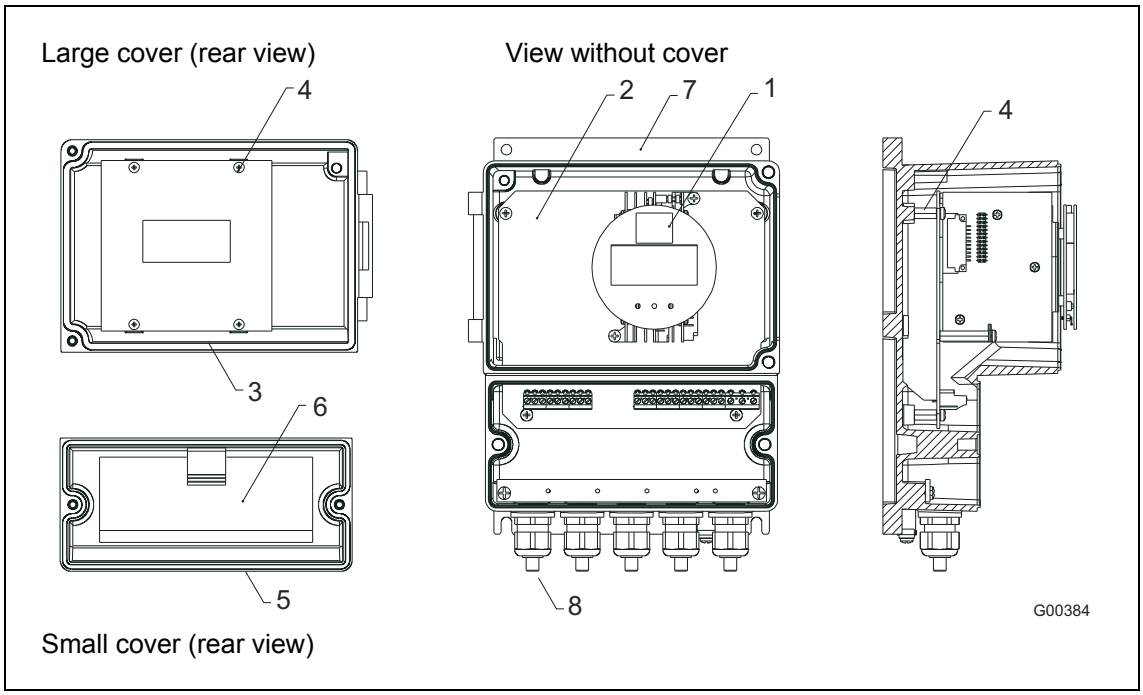


Fig. 57: Transmitter field-mount housing replaceable parts

No.	Name of part	Order number
1	Transmitter module Please contact your ABB service team.	
2	Connection board, standard	D685A1020U10
3	Large cover, complete	D641A030U01
4	Pan head Phillips screw M3 x 5 DIN 7985 SST	D085D020AU20
5	Small cover	D641A029U01
6	Electrical connection	D338D314U01
7	Field-mount housing lower section	D641A031U01
8	Cable gland M20 x 1.5	D150A008U15
	Magnet stick package	D614L537U01
	Field-mount housing fuse 4 A	D151B002U07
	24 V module fuse 2 A	D151B002U08
	100 V ... 230 V module fuse 1 A	D151B002U06

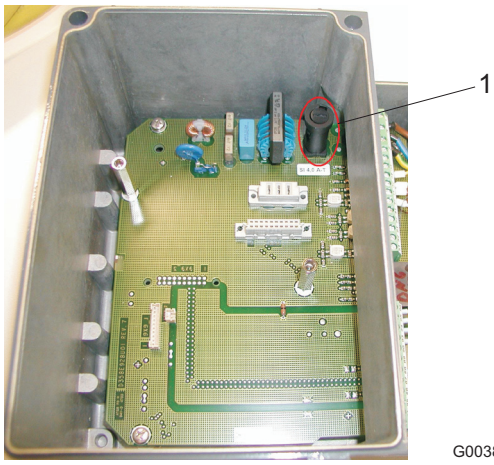


Fig. 58: Fuse in field-mount housing

1 Field-mount housing fuse

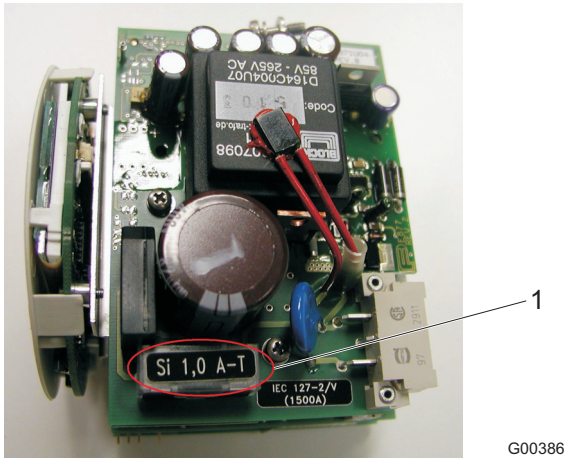


Fig. 59: Fuse in transmitter module

1 Module fuse

10 Specifications

10.1 Model FCM2000-MC2

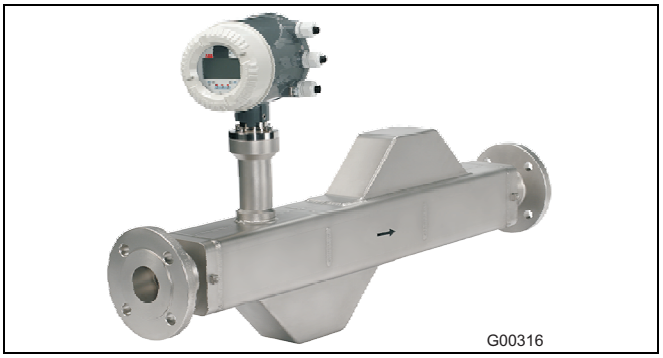


Fig. 60: FCM2000-MC2 flowmeter sensor

Nominal sizes
"E" (DN 20); "F" (DN 25); "G" (DN 40); "H" (DN 50);
"I" (DN 65); "J" (DN 80); "K" (DN 100); "L" (DN 150)

Measuring ranges for flowrate

Nominal size		Max. measuring range [Q_{max}] in [kg/min]
"E"	**DN 20 (3/4")**	0 ... 100
"F"	**DN 25 (1")**	0 ... 160
"G"	**DN 40 (1 1/2")**	0 ... 475
"H"	**DN 50 (2")**	0 ... 920
"I"	**DN 65 (2 1/2")**	0 ... 1,890
"J"	**DN 80 (3")**	0 ... 2,460
"K"	**DN 100 (4")**	0 ... 4,160
"L"	**DN 150 (6")**	0 ... 11,000

Protection class: IP 65/IP 67, NEMA 4X

Measured value deviation for flowrate DN 20 (3/4") to DN 65 (1.5") (sizes "E", "F", "G", "H", "I")
± 0.4 % of flow rate + 0.02 % of Q_{max}
± 0.25 % of flow rate + 0.02 % of Q_{max}
± 0.15 % of flow rate + 0.01 % of Q_{max}
± 0.1 % of flow rate + 0.01 % of Q_{max} (not for size "E")
(deviation from rate + zero error)

Measured value deviation for flowrate DN 80 (3") and DN 100 (4") (sizes "J", "K")
± 0.4 % of flow rate + 0.02 % of Q_{max}
± 0.25 % of flow rate + 0.02 % of Q_{max}
± 0.1 % of flow rate + 0.02 % of Q_{max}
± 0.15 % v. M. + 0.02 % v. Q_{max}
(deviation from rate + zero error)

Measured value deviation for flowrate DN 150 (6") (size "L")
± 0.4 % of flow rate ± 0.05 % of Q_{max}
± 0.25 % of flow rate ± 0.05 % of Q_{max}
± 0.15 % of flow rate ± 0.05 % of Q_{max}
± 0.1 % of flow rate ± 0.05 % of Q_{max}

Operating temperature effect
Less than ± 0.006 % of Q_{max}/1 K

Reproducibility of flowrate at rates > 5 % of Q_{max}
0.10 % of flow rate for nom. deviation ± 0.1 %
0.15 % of flow rate for nom. deviation ± 0.25 % and 0.4 %

Measuring range for density
0.5 ... 3.5 kg/dm^3

Measured value deviation for density
Standard calibration ± 5 g/l
Expanded density calibration ± 1 g/l
For separate designs, the signal cable is already calibrated and may not be either shortened or lengthened subsequently. The transmitter is calibrated accordingly and may not be changed.

Reproducibility of density
± 0.1 g/l

Measured value deviation for temperature
-50 ... 200 °C (-58 ... 392 °F) < 1 °K (1.8 °F)
For the precise temperatures for units with Ex approval, refer to the "Ex relevant specifications" section.

If the ambient temperature is below -20 °C (-4 °F), additional flowrate, density, and temperature deviations are to be expected.

10.1.1 Reference conditions

Calibration fluid
Water 25 °C (77 °F) (+ 5 K/- 5 K)
Pressure 0.5 ... 6 bar (7.3 ... 87.0 psi)

Ambient temperature
25 °C (77 °F) (+ 10 K/- 5 K)

Supply power
Line voltage as per name plate U_N ± 1 %

Warm-up phase
30 minutes

Installation according to this specification
No visible gas phase,
no external mechanical or hydraulic disturbances,
particularly cavitation

Output calibration
Pulse output

Effect of the analog output on the measurement accuracy
Similar to pulse output ± 0.1 % of measured value

10.1.2 Materials and additional specifications

Flowmeter sensor materials
Parts in contact with fluid
- Stainless steel 1.4571/1.4308 (316Ti/CF8)
- Stainless steel 1.4435/316L
- Hastelloy C-4/2.4610
- With flowmeter sensor material 1.4435 cert. acc. to EHEDG
- Option: Manufactured acc. to NACE MR0175 (ISO 15156)

Housing
- Stainless steel 1.4301/1.4308 (304/CF8)

Transmitter materials
Housing
- Alloy casting, varnished
- Mid-section: RAL 7012
- Cover: RAL 9002
- Paint coat: 80 ... 120 µm thickness

Fluid temperature
Standard: -50 ... 200 °C (-58 ... 392 °F)
The relevant ambient temperatures for use in a potentially explosive area can be found in the corresponding chapter.

Ambient temperature
-20 ... 60 °C (-4 ... 140 °F); opt. -40 ... 60 °C (-40 ... 140 °F)
The relevant ambient temperatures for use in a potentially explosive area can be found in the corresponding chapter.

Process connections
Flange DIN/ASME
Tri-clamp DIN 32676 (ISO 2852)
- DN 15 ... DN 50 (1/2 ... 2"): series 3
- DN 65 ... DN 100 (2 1/2 ... 4"): series 1

Threaded pipe connection conforming to DIN 11851
The max. permissible operating pressure is determined by the respective process connection, the fluid temperature, the screws, and the gasket material.

Pressure rating
PN 16, PN 40, PN 100 (up to DN 80 [3"])
Cl 150, Cl 300, Cl 600 (up to DN 80 [3"])

Housing as protective device (optional)
Max. 40 bar (580 psi)

Pressure Equipment Directive 97/23/EC
Conformity assessment in accordance with Category III, fluid group 1, gas

Take into consideration the corrosion resistance of the meter tube materials as regards the measuring fluid.

EHEDG-approved unit versions
The appropriate installation conditions must be observed in order to achieve an installation that complies with hygiene requirements. The process connection/gasket combination created by the operator is particularly important too. Therefore, to ensure that the installation complies with hygiene requirements, only parts that conform to EHEDG stipulations (EHEDG Position Paper "Hygienic Process connections to use with hygienic components and equipment") may be used.

Material load for process connections

Process connection	Nominal size DN	PS_{max} [bar]	TS_{max} [°C]	TS_{min} [°C]
Threaded pipe connection conforming to DIN 11851	15 ... 40 (1/2 ... 1 1/2")	40	140	-40
	50 ... 100 (2 ... 4")	25	140	-40
Tri-Clamp conforming to DIN 32676	15 ... 50 (1/2 ... 2")	16	120	-40
	65 ... 100 (2 1/2 ... 4")	10	120	-40

10.1.3 Material load curves for flanged units

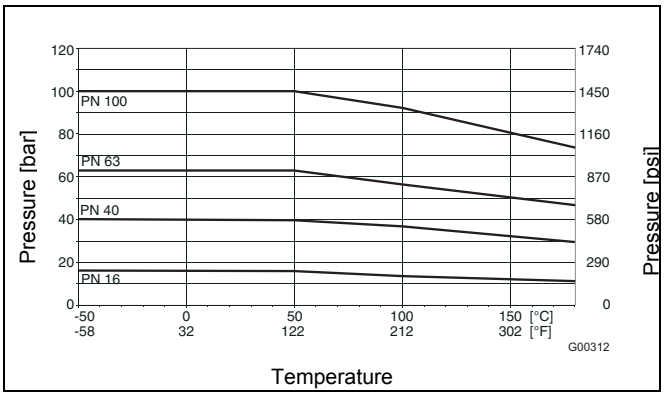


Fig. 61: DIN flange SS 1.4571 to DN 150 (6")

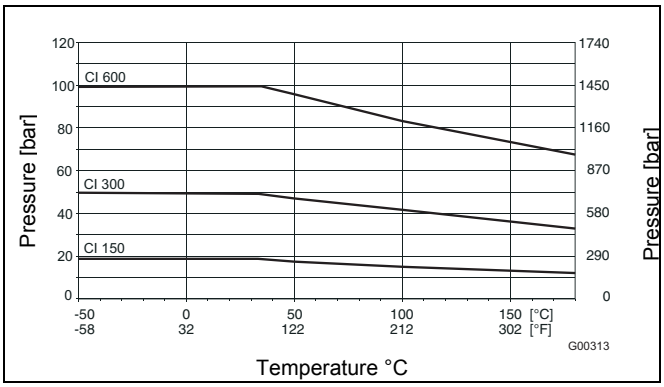


Fig. 62: ASME flange SS 1.4571 to DN 150 (6")

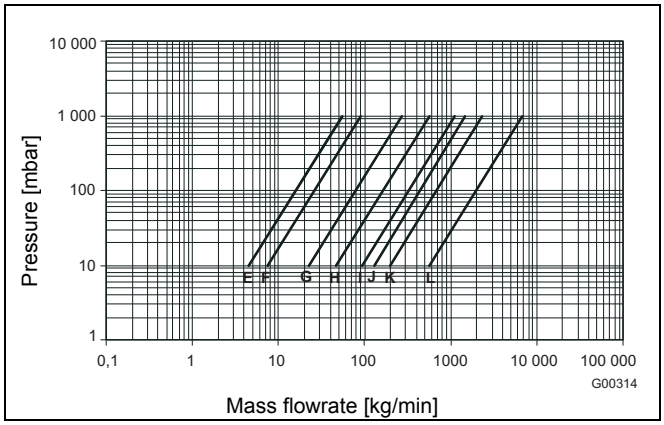


Fig. 63: Pressure loss curve FCM2000-MC2; measured with water, viscosity 1 mPa s

Viscosity range

Max. dyn. viscosity: ≤ 1 Pas (= 1,000 mPas = 1,000 cP)
At higher viscosities, please contact our ABB representatives.

10.2 Model FCM2000-MS2

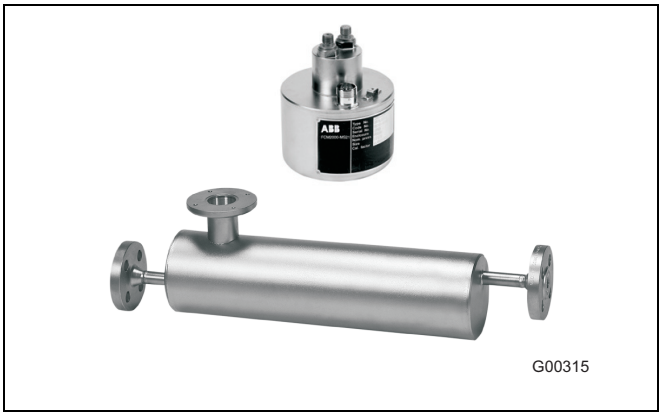


Fig. 64: FCM2000-MS2 flowmeter sensor

Nominal sizes
"S" (DN 1.5); "T" (DN 3); "U" (DN 6)

Measuring ranges for flowrate

Nominal size		Max. measuring range [Q_{max}] in [kg/h]
"S"	**DN 1.5 (1/16")**	0 ... 65
"T"	**DN 3 (1/10")**	0 ... 250
"U"	**DN 6 (1/4")**	0 ... 1000

Protection class: IP 65

Measured value deviation for flowrate
± 0.4 % of flow rate ± 0.02 % of Q_{max}
± 0.25 % of flow rate ± 0.02 % of Q_{max}
± 0.15 % of flow rate ± 0.01 % of Q_{max}
(deviation from rate + zero error)

Reproducibility of flowrate
0.1 % of flow rate for nom. deviation ± 0.15 %
0.15 % of flow rate for nom. deviation ± 0.25 % and 0.4 %

Measuring range for density
0.5 ... 3.5 kg/dm^3

Measured value deviation for density
Standard calibration ± 10 g/l
Temperature range 0 ... 100 °C (32 ... 212 °F)
Expanded density calibration available upon request

Measured value deviation for temperature
-50 ... 180 °C (-58 ... 356 °F) < 1 °K (1.8 °F)

Reference conditions

Calibration fluid
Water 25 °C (77 °F) (+ 5 K/- 5 K)
Pressure 0.5 ... 6 bar (7.3 ... 87.0 psi)

Ambient temperature
25 °C (77 °F) (+ 10 K/- 5 K)

Supply power
Line voltage as per name plate U_N ± 1 %

Warm-up phase
30 minutes

Installation according to this specification
No visible gas phase
No external mechanical or hydraulic disturbances, particularly cavitation

Output calibration
Pulse output

Effect of the analog output on the measurement accuracy
Similar to pulse output ± 0.1 % of measured value

Materials and additional specifications

Sensor materials
Parts in contact with fluid
1.4435/316L
Housing 1.4404

Fluid temperature
Standard:
-50 ... 180 °C (-58 ... 356 °F): DN 3 (1/10"), DN 6 (1/4")
-50 ... 125 °C (-58 ... 257 °F): DN 1.5 (1/16")
-50 ... 180 °C (-58 ... 356 °F): DN 1.5 (1/16") (optional)
For information about the design for operation in potentially explosive areas, refer to the corresponding chapter.

Ambient temperature
-20 ... 50 °C (-4 ... 122 °F)
For information about the design for operation in potentially explosive areas, refer to the corresponding chapter.

Process connections
G1/4" ISO 228-1
1/4" NPT ASME B1.201
Flange DIN/ASME for DN 6 (1/4")
Threaded pipe connection conforming to DIN 11851 for DN 6 (1/4")
Tri-Clamp conforming to DIN 32676 (ISO 2852) for DN 6 (1/4")
The max. permissible operating pressure is determined by the respective process connection, the fluid temperature, the screws, and the gasket material.

Pressure rating
Flange PN 40, PN 100, Cl 150, Cl 600
Thread G 1/4", 1/4" NPT, PN 100 ... PN 410 (for each option)

Installation
For more detailed instructions regarding installation, refer to the operating instructions.

Pressure loss curves

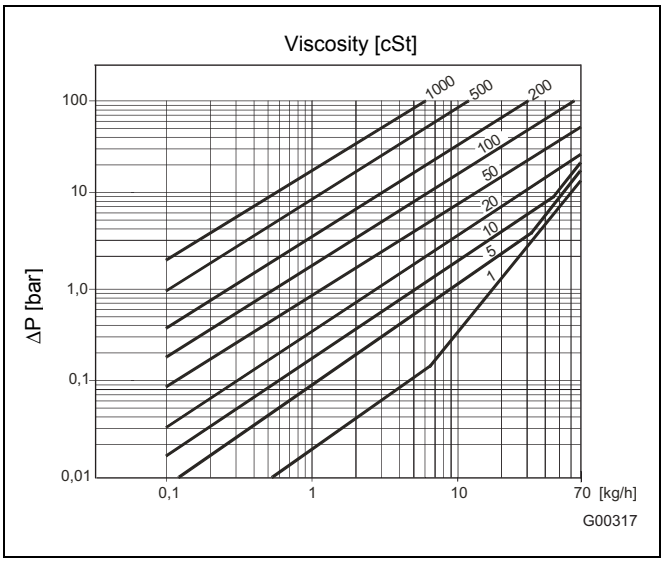


Fig. 65: Pressure losses MS21, DN 1.5 (1/16")

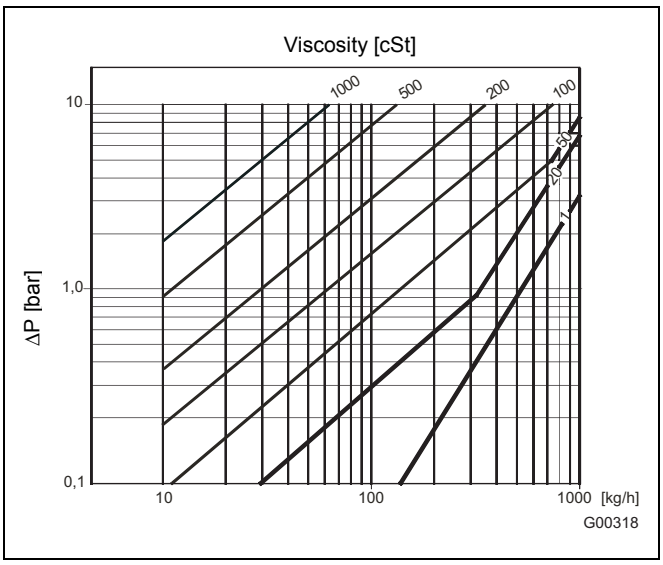


Fig. 67: Pressure losses MS21, DN 6 (1/4")

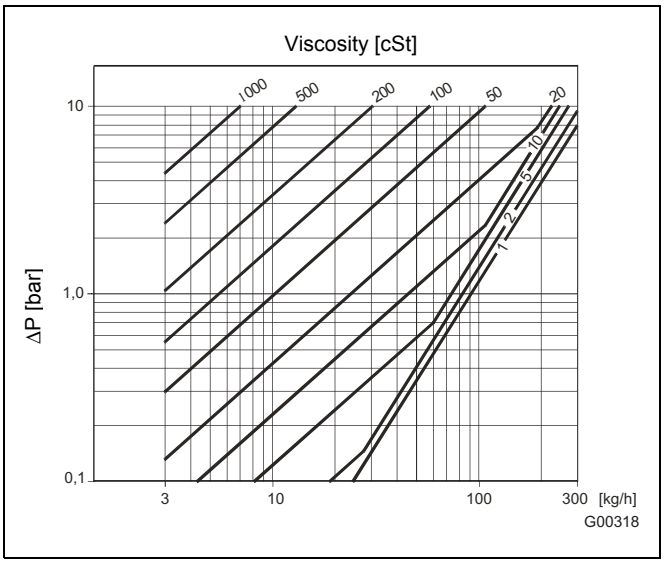


Fig. 66: Pressure losses MS21, DN 3 (1/10")

10.3 Transmitter

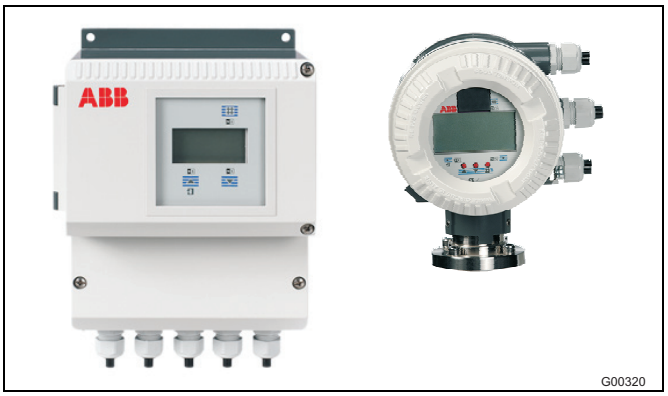


Fig. 68: FCM2000-ME2 transmitter, field-mount housing

Measuring range
Freely configurable between 0.01 Q_{max} and 1 Q_{max}

Protection class
IP 65/IP 67, NEMA 4X

Electrical connections
Cable gland M20 x 1.5 or 1/2" NPT
Max. signal cable length for separate design 50 m (longer lengths available upon request)

Supply power
Supply voltage
100 ... 230 V AC (tolerance -15 % and +10 %), 47 ... 63 Hz
20.4 ... 26.4 V AC, 47 ... 63 Hz
20.4 ... 31.2 V DC
Ripple: ≤ 5 %

Power consumption
S ≤ 25 VA

Response time
As jump function 0 ... 99 % (corr. to 5 τ) ≥ 1 s

Ambient temperature
-20 ... 60 °C (-4 ... 140 °F), optional -40 ... 60 °C (-40 ... 140 °F)
At operation below -20 °C (-4 °F), the display can no longer be read and the electronic unit should be operated with as few vibrations as possible. Complete operational reliability is achieved at temperatures above -20 °C (-4 °F).

Design
Field-mount housing and compact transmitter unit as alloy casting, varnished
Mid-section: RAL 7012, dark gray
Cover: RAL 9002, light gray
Paint coat: 80 ... 120 µm thickness

Forward/reverse flow metering
Signals are shown on the display by direction arrows and by the optocoupler for ext. signaling.

Display
The graphic display has 2 lines and features an LED backlight. Both lines are freely configurable to display the mass flowrate, volume flowrate, density, or temperature. Flow count, 7-digit with overflow counter and physical unit for mass or volume.

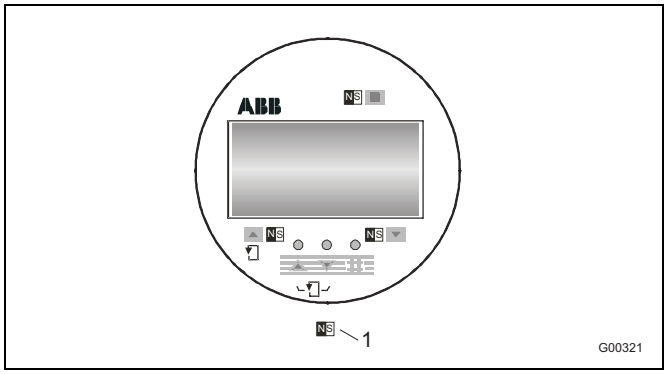


Fig. 69

1 Points for inserting the magnet stick

When the four mounting screws are loosened, the display can be installed in 4 positions. This ensures optimal readability.

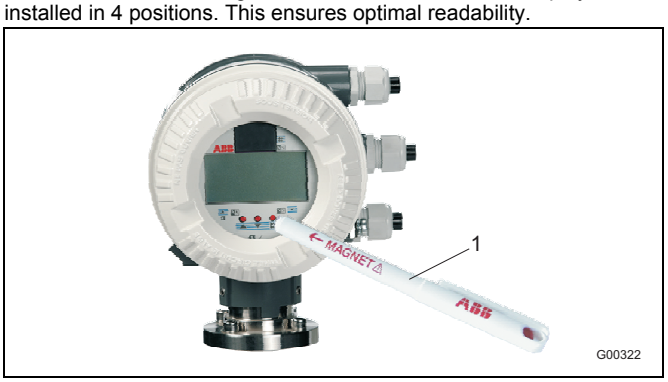


Fig. 70: Magnet stick operation

1 Magnet stick
The magnet stick can be used to parameterize the unit with a closed housing cover in the compact unit or in the field-mount housing.

Parameter adjustment

Data can also be entered in various languages using the three control buttons on the transmitter.

The transmitter housing can be rotated 180° in each direction. The display can be installed in 4 positions to ensure optimal readability. In multiplex mode, the flow indicators are displayed in %, physical unit, or bar graph, totalizer status, forward or reverse flow, TAG no., in addition to the selection of 1st and 2nd display lines.

Data backup

Via FRAM, all data over 10 years old is stored without supply power at shut-off or failure of the line voltage. Additional security is provided by another FRAM in the transmitter, through data exchange or data storage for process information.

Hardware and software identification acc. to NAMUR recommendation NE53.

Important

The unit complies with NAMUR recommendations NE21 and NE43, "Electromagnetic compatibility of equipment for process and lab control technology", as well as EMC Directive 2014/30/EU (EN 61326) and Low-Voltage Directive 2014/35/EU (EN 61010-1).

11 Appendix

11.1 Other applicable documents

- Data sheet (D184S068Uxx)
- Commissioning Instruction (CI/FCM2000-EN)
- Ex safety instructions (SM/FCM2000/FM/CSA)
- Interface description for devices with HART communication (D184B108U07 / 08)
- Interface description for devices with PROFIBUS PA communication (D184B093U33 / 34)
- Interface description for devices with FOUNDATION Fieldbus communication (D184B093U35 / 36)

11.2 Approvals and certifications

CE mark	CE	The version of the device in your possession meets the requirements of the following European directives: - EMC Directive 2014/30/EU - Low Voltage Directive 2014/35/EU - Pressure Equipment Directive (PED) 97/23/EC Pressure equipment does not feature a CE mark indicating PED compliance on the factory tag if the following conditions prevail: - The maximum permissible pressure (PS) is less than 0.5 bar. - Due to insignificant pressure risks (nominal size ≤ DN 25/1"), no approval procedures are required.
Explosion protection	Ex IECEx FM C US APPROVED	Designation relating to intended use in potentially explosive atmospheres in compliance with: - ATEX Directive (marking in addition to CE marking) - IEC standards - $_{c}FM_{us}$ Approvals for Canada and United States

Important (Notice)
All documentation, declarations of conformity, and certificates are available in ABB's download area.
www.abb.com/flow

11.3 Overview of setting parameters and technical design

Measuring point:	TAG no.:
Flowmeter model:	Converter Type:
Order no.:	Order no.:
Measured medium temp.:	Power supply:
HART Descriptor:	System zero point:
Instrument No.	

Parameter		Setting range
Prog. Protection code:	.....	0 ... 250 (0 = factory specification)
Language:	.....	German, English
Flow direction:	.....	Supply/Return, forward
Unit Q_m:	.....	g/s, g/min, g/h, kg/s, kg/min, kg/h, kg/d, t/min, t/h, t/d, lb/s, lb/min, lb/h, lb/d, abcd/s, abcd/min, abc/h, abc/d
Unit Q_v:	.....	l/s, l/min, l/h, m^3/s, m^3/min, m^3/h, m^3/d, ft^3/s, ft^3/min, ft^3/h, ft^3/d, ugl/s, ugl/min, ugl/h, mgl/d, igl/s, igl/min, igl/h, igl/d, bbl/s, bbl/min, bbl/h, bbl/d, abc/s, abc/min, abc/h, abc/d
Unit Density:	.....	g/ml, g/l, g/cm^3, kg/l, kg/m^3, lb/ft^3, lb/ugl
Unit Mass Totalizer:	.....	g, kg, t, lb, abc
Unit Volume Totalizer:	.....	l, m^3, ft^3, ugl, igl, bbl, abc
Unit name prog. mass unit:	.....	3 ASCII
Unit factor prog. mass unit:	.....	
Unit name prog. volume unit:	.....	3 ASCII
Unit factor prog. volume unit:	.....	
Unit Temperature:	.....	°C, K, °F
$Q_{m,\ max}$:	.....	0.01 ... 1.0 $Q_{m,max,DN}$
Damping:	.....	1 ... 100 s
Low cut-off setting:	.....	0 ... 10 %
Min-Alarm Mass:	.....	0 ... 105 %
Max-Alarm Mass:	.....	0 ... 105 %
Min-Alarm Density:	.....	0.5 ... 3.5 kg/l
Max-Alarm Density:	.....	0.5 ... 3.5 kg/l
Min-Alarm Temp.:	.....	-50°... 180°C
Max-Alarm Temp.:	.....	-50°... 180°C
Peak detector:	.....	ON/OFF
Max. hold time:	.....	0 ... 300 s
Density limit:	.....	0.5 ... 3.5 kg/l

Parameter		Setting range
Display line 1:	.....	Q_m, Q_v, Q [%], Q [bar graph], temperature, density, totalizer mass → F totalizer mass ← R, totalizer mass, totalizer vol. → F, totalizer vol. ← R, totalizer volume, pipe frequency, driver current, blank line, sensor ampl. A, B, TAG Number
Display line 2:	.....	see 1st display line
Multiplex line 1:	.....	see 1st display line
Multiplex line 2:	.....	see 1st display line
Output Q_{max} pulse:	.....	Mass / Volume
Pulse factor:	.....	0.0001 ... 1000 pulse/unit
Output for current output 1:	.....	Q_m, Q_v, density, temperature
Volume flow at 100%:	.....	0,1 ... 1000000
Density at 0 %:	.....	0,1 ... 1000000
Density at 100 %:	.....	0,1 ... 1000000
Temp. at 0 %:	.....	-50 ... 190 °C
Temp. at 100 %:	.....	-50 ... 190 °C
Type of current output:	.....	0 ... 20 mA or 4 ... 20 mA
I_{out} with alarm:	.....	Low/High
Low Alarm I1:	.....	2 ... 3.6 mA
High Alarm I1:	.....	21 ... 26 mA
Output for current output 2:	.....	Q_m, Q_v, density, temperature
Volume flow at 100%:	.....	0,1 ... 1000000
Density at 0 %:	.....	0,1 ... 1000000
Density at 100 %:	.....	0,1 ... 1000000
Temp. at 0 %:	.....	-50 ... 190 °C
Temp. at 100 %:	.....	-50 ... 190 °C
Type of current output:	.....	0 ... 20 mA or 4 ... 20 mA
I_{out} with alarm:	.....	Low/High
Low Alarm I2:	.....	2 ... 3,6 mA
High Alarm I2:	.....	21 ... 26 mA
Contact input:	.....	no function, ext. output switch off, totalizer reset
Contact output:	.....	Max-Min alarm, general alarm, F/R-Signal
Communication HART:	.....	HART, off
HART Instrument Address:	.....	0 ... 15

Contact input/output:	☐ Yes	☐ No
Communication:	☐ HART protocol	☐ No
Pulse output:	☐ Active	☐ Passive
Limit alarm	☐ Yes	☐ No

Statement on the contamination of devices and components

Repair and / or maintenance work will only be performed on devices and components if a statement form has been completed and submitted.

Otherwise, the device / component returned may be rejected. This statement form may only be completed and signed by authorized specialist personnel employed by the operator.

Customer details:

Company:	
Address:	
Contact person:	Telephone:
Fax:	E-mail:

Device details:

Type:	Serial no.:
Reason for the return/description of the defect:	

Was this device used in conjunction with substances which pose a threat or risk to health?

☐ Yes ☐ No

If yes, which type of contamination (please place an X next to the applicable items)?

Biological	☐	Corrosive / irritating	☐	Combustible (highly / extremely combustible)	☐
Toxic	☐	Explosive	☐	Other toxic substances	☐
Radioactive	☐				

Which substances have come into contact with the device?

1.

2.

3.

We hereby state that the devices / components shipped have been cleaned and are free from any dangerous or poisonous substances.

Town/city, date	Signature and company stamp

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The Company's policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice.

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