



Vortex Flowmeter / Swirl Flowmeter FV4000 / FS4000

Operating Instruction

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1 Safety

1.1 General information and notes for the reader

You must 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 future reference.

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 if 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 perfect working order from a safety perspective. 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 instructions 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.

1.2 Intended use

This device is intended for the following uses:

- To convey fluids, gases (including unstable gases), and steams
- To measure the flow of the operating volume in mass flow or standard units under constant operating conditions (pressure, temperature)
- To measure the flow of saturated steam in mass flow units at varying temperatures/pressures, if the flowmeter sensor is fitted with a temperature sensor (option)

Using these products as intended involves observing the following points:

- Read and follow the instructions in this manual.
- Observe the technical limit values (refer to the section "Specifications").
- Use only approved liquids for measurement (refer to the section "Permissible measuring agents").

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

1.4 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.

1.5 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.

1.6 Plates and symbols

1.6.1 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.

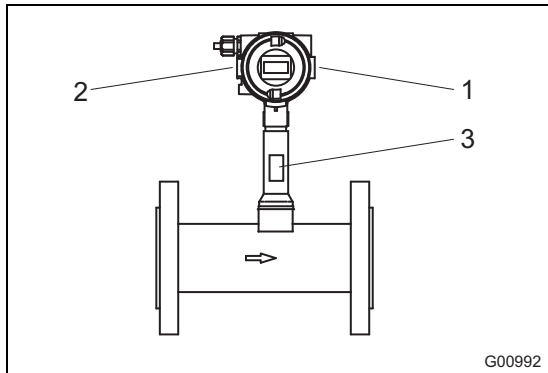
Failure to observe this safety information may result in damage to or destruction of the product and/or other system components.



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.

1.6.2 Name Plate / Factory Tag



- 1 Name plate
- 2 Name plate, hazardous area
- 3 Factory tag

Fig. 1

1.6.2.1 Identifying the meter design

1. Identifying the model:

The model number of the meter (see no. 1 in the description of the name plates) can be found on the name plate. The connection diagram appears in the section titled "Electrical connection". Technical data, material load curves, etc., appear sorted by model in the section titled "Technical data".

2. Identifying the transmitter design:

The transmitter design can be identified from the name plate.

3. Identifying the software version:

The software version can be displayed when the transmitter is switched on.

1.6.2.2 Name plates

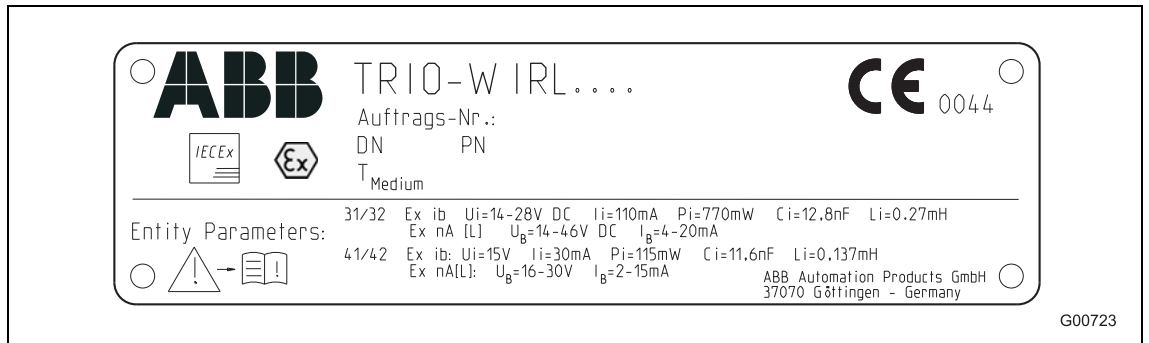


Fig. 2: Name plate

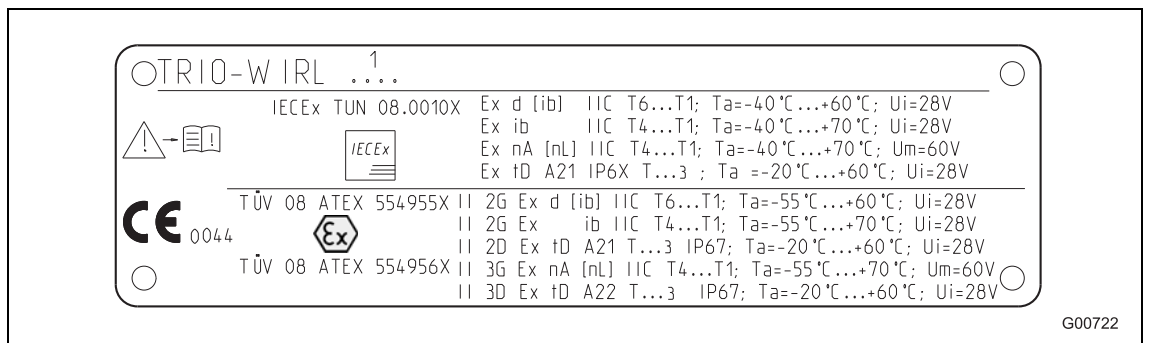


Fig. 3: Name plate, hazardous area

1.6.2.3 Factory Tag

The factory tag is located on the flowmeter sensor 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

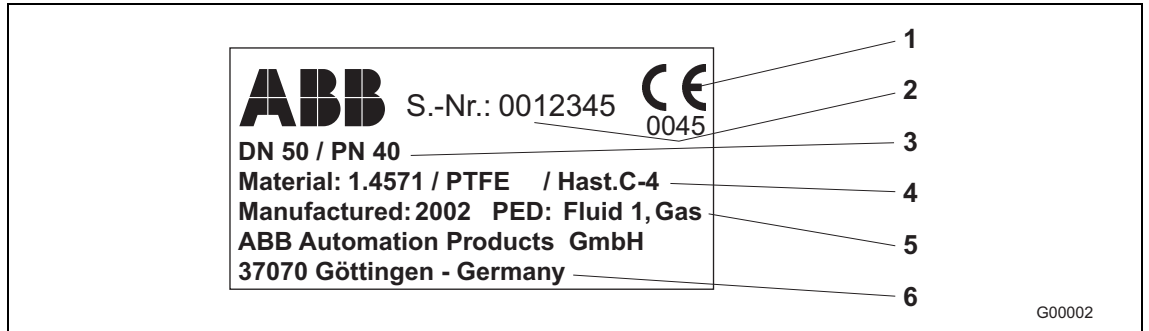


Fig. 4

- | | |
|--|--|
| <ul style="list-style-type: none"> 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. | <ul style="list-style-type: none"> 4 Flange material, liner material and electrode material (wetted parts). 5 Year of manufacture and specification of fluid group as per the pressure equipment directive (PED). Fluid group 1 = hazardous liquids, gaseous. 6 Manufacturer of the pressure equipment. |
|--|--|

Pressure equipment outside the applicable range of the PED



Fig. 5

The factory tag 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).

i

Important

If the factory tag 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.

1.7 Transport safety information

Please consider the following when transporting the device (in particular if your device weighs more than 50 kg (110,23 lb)):

- The fact that the center of gravity might not be in the center of the unit
- Any available attachment points
- Transportation safety equipment (e. g. gaskets for openings)

1.8 Installation safety information

Observe the following instructions:

- The flow direction must correspond to the direction indicated on the meter, if labeled.
- The maximum torque must not be exceeded for all flange connections.
- The meters must be installed without mechanical tension (torsion, bending).
- Wafer units must be installed with coplanar counter flanges.
- Equipment must only be installed for the intended operating conditions and with suitable gaskets.
- Flange bolts and nuts must be secured to provide protection against pipeline vibrations.
- The required length of straight pipeline must be provided upstream and downstream of the meter.
- The pipeline must be supported upstream and downstream of the meter.

1.9 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.

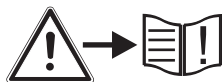
i

Important

The transmitter meets the EMC requirements set out in EN 61326 / NAMUR NE21. There is no EMC protection or protection against accidental contact when the housing cover is open.

Please observe the specific information about meters for hazardous areas in the section titled "Ex relevant specifications".

Follow the operating instructions to ensure proper installation. The relevant operating instructions for the meter contain all installation and safety instructions. The icon on the name plate indicates the following:



To ensure proper operation, comply with the supplementary safety information in the operating instructions and certificates.

Depending on the application, operators must comply with relevant national installation specifications (e.g., NEC, CEC, ATEX137, IEC60079-14, etc.).

1.10 Safety information for operation

Operation with abrasive fluids and/or cavitation can damage pressurized components.

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

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

Due to wear on the flange gasket, a pressurized medium may escape



Important

- As a general rule, when operating the meter, the detailed information in these operating instructions on the subjects of "electrical safety" and "electromagnetic compatibility" must be observed.
- For operation in potentially explosive areas, observe the relevant information in these operating instructions.

1.11 Safety instructions for operation in hazardous areas

Specific requirements affecting the connection for the supply power and the switching output apply for operation in hazardous areas. Please follow the instructions in the section titled **11 „Ex relevant specifications“**.

1.12 Safety information for maintenance and inspection



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 before touching electronic components.

When the housing is open, EMC protection is limited.

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)

1.13 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 operating pressure (PS) and the permissible temperature of the medium (TS) must not exceed the pressure/temperature values (p/T ratings).
- The maximum operating temperature must not be exceeded.
- The permitted operating temperature must not be exceeded.
- The housing protection type must be observed.

1.14 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.

The meter tube, solid bodies (FV4000-VR4, FV4000-VT4 Vortex flowmeters only), inlet and outlet pipes (FS4000-SR4, FS4000-ST4 Swirl flowmeters only), sensor and gasket come into contact with the measured medium.

1.15 Returning devices

Use the original packaging or a suitably secure packaging for returning the device for repair or for recalibration. Include the properly filled out return form (see attachment) 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 its shipping:

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

Rinse out and neutralize hazardous materials from all hollow spaces such as between meter tube and housing. These activities must be confirmed in writing using the return form.

Please contact Customer Center Service acc. to page 2 for nearest service location.

1.16 Integrated management system

ABB Automation Products GmbH operates an integrated management system, consisting of:

- Quality management system to ISO 9001:2008
- Environmental management system to ISO 14001:2004
- Occupational health and safety management system to BS OHSAS 18001:2007 and
- Data and information protection management system

Environmental awareness is an important part of our company policy.

Our products and solutions are intended to have a minimal impact on the environment and on people during manufacturing, storage, transport, use, and disposal.

This includes the environmentally-friendly use of natural resources. We conduct an open dialog with the public through our publications.

1.17 Disposal

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

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

This product is not subject to WEEE Directive 2002/96/EC or relevant national laws (e.g., ElektroG in Germany).

The product must be disposed of at a specialist 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.

1.17.2 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 into 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 certain amounts 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 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 at the right time, in the future these substances will no longer be used in new product development.

2 Design and function

2.1 Principles of measurement

2.1.1 Vortex flowmeter

The operating principle of the Vortex flowmeter is based on the Karman street. As the fluid flows over and under the solid body, vortices are shed alternately above and below. The shedding of these vortices due to the flow forms a vortex trail (Karman street).

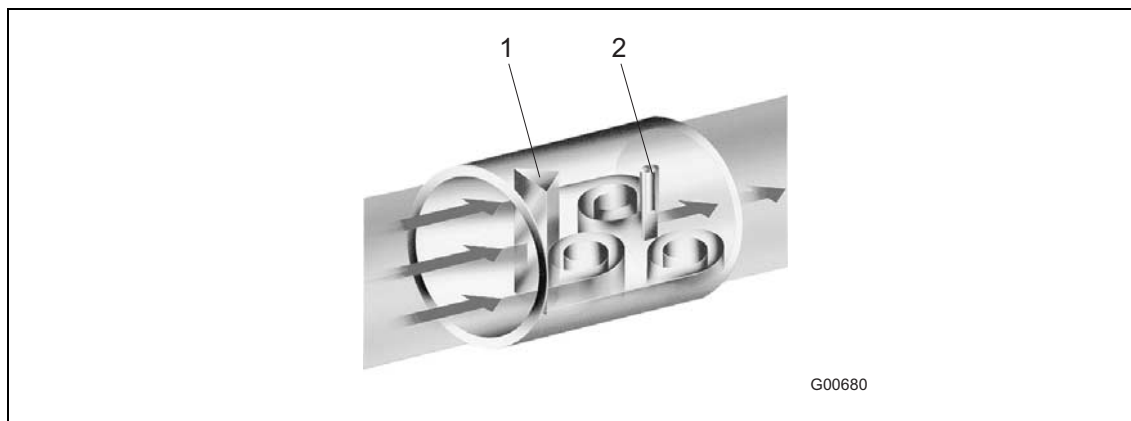


Fig. 6: Principle of measurement, FV4000

1 Solid body

2 Piezo sensor

The frequency f of vortex shedding is proportional to the flow velocity v and inversely proportional to the width of the solid body d :

$$f = St \times \frac{v}{d}$$

St , known as the Strouhal number, is a dimensionless number which has a decisive impact on the quality of vortex flow measurement.

If the solid body is dimensioned appropriately, the Strouhal number St will be constant across a very wide range of the Reynolds number Re (Fig. 7).

$$Re = \frac{v \times D}{\vartheta}$$

ϑ = Kinematic viscosity

D = Nominal size of meter tube

Consequently, the vortex shedding frequency to be evaluated is dependent solely upon the flow velocity and not at all upon media density and viscosity.

The local changes in pressure induced by vortex shedding are detected by a piezo sensor and converted into electrical pulses corresponding to the vortex frequency.

The frequency signal from the flowmeter sensor, which is proportional to the flow, undergoes downstream processing in the transmitter.

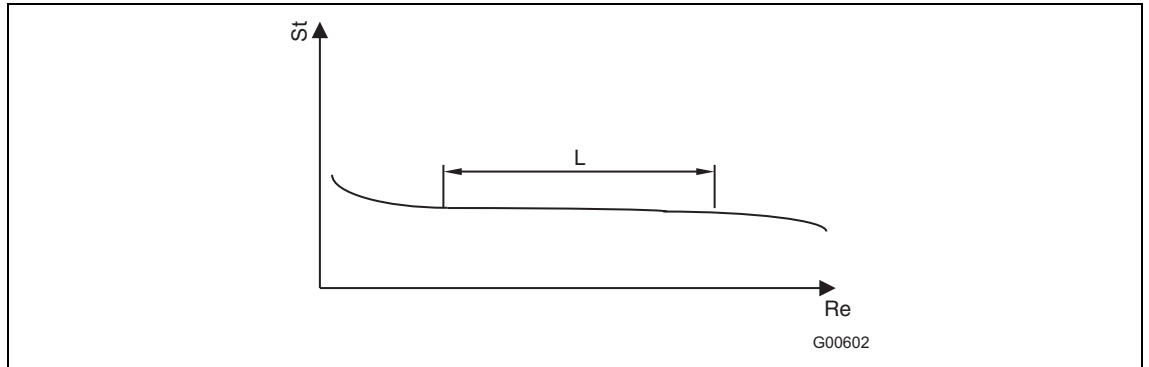


Fig. 7: How the Strouhal number is dependent upon the Reynolds number

St = Strouhal number

Re = Reynolds number

L = Linear flow area

Design and function

2.1.2 Swirl flowmeter

The inlet pipe converts the axial flow of the incoming media into rotational movement. In the center of this rotation a vortex core is formed which is forced into a secondary spiral-shaped rotation by the backflow.

The frequency of this secondary rotation is proportional to the flow and, if the internal geometry of the meter exhibits an optimum design, will be linear over a wide flow range. This frequency is measured by a piezo sensor. The frequency signal from the flowmeter sensor, which is proportional to the flow, undergoes downstream processing in the transmitter.

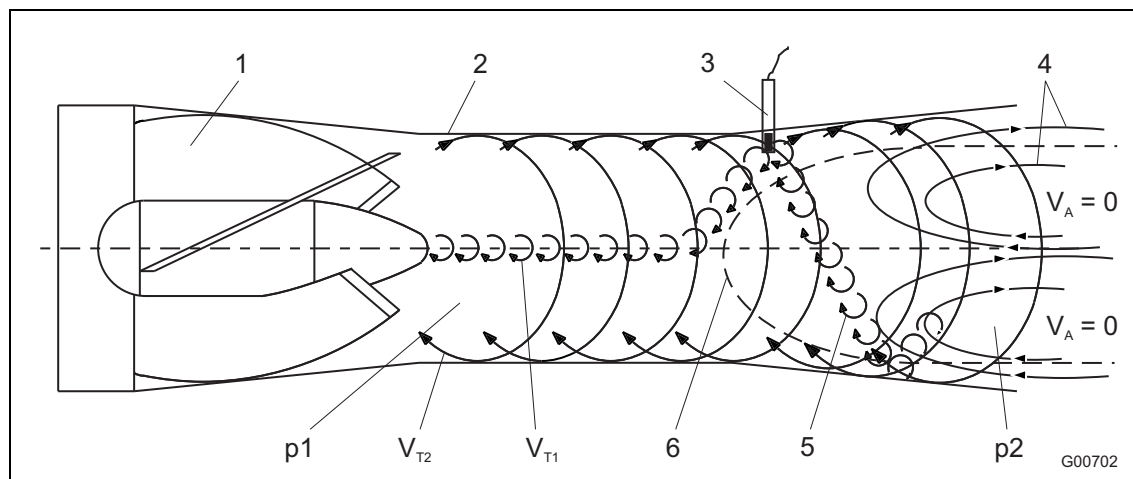


Fig. 8: Principle of measurement of the Swirl flowmeter

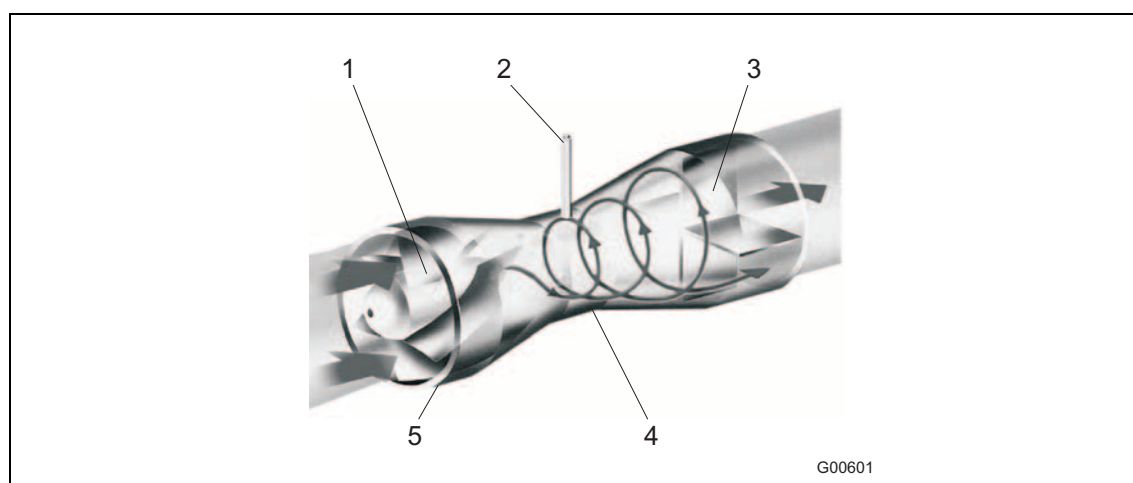


Fig. 9: Principle of measurement of FS4000-ST4/SR4 Swirl flowmeters

- | | |
|----------------|--------------------|
| 1 Inlet pipe | 4 Stagnation point |
| 2 Piezo sensor | 5 Housing |
| 3 Outlet pipe | |

2.2 Design

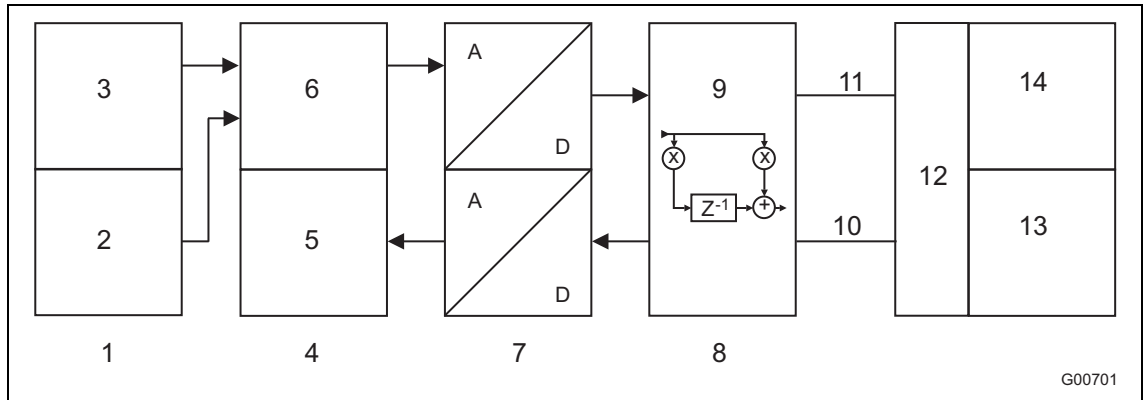


Fig. 10

- | | |
|---|---|
| 1 Sensor | 8 DSP |
| 2 Vibration sensor | 9 FIR ¹⁾ filter algorithm and gain control |
| 3 Flow sensor | 10 Serial interface |
| 4 Amplifier with automatic gain control | 11 Frequency |
| 5 Gain control | 12 CPU |
| 6 Amplifier | 13 Current output |
| 7 A/D-D/A converter | 14 Switching output |

1) FIR = Finite Impulse Response

The flow and vibration piezo elements from the sensor deliver signals which are forwarded to the analog-to-digital converter via an amplifier. A gain control mechanism in the DSP controls gain via the D/A converter. Gain control is used to adapt the necessary signal gain dynamically. The filter algorithm in the DSP evaluates the signals, picks up the flow signal and sends this frequency to the CPU for conversion into flow units. This data is then shown on the display and transmitted on the current and switching outputs or via fieldbus communication.

Design and function

2.3 Device designs

A general distinction is made between two designs.

2.3.1 Integral mount design

The transmitter is installed directly on the flowmeter sensor.

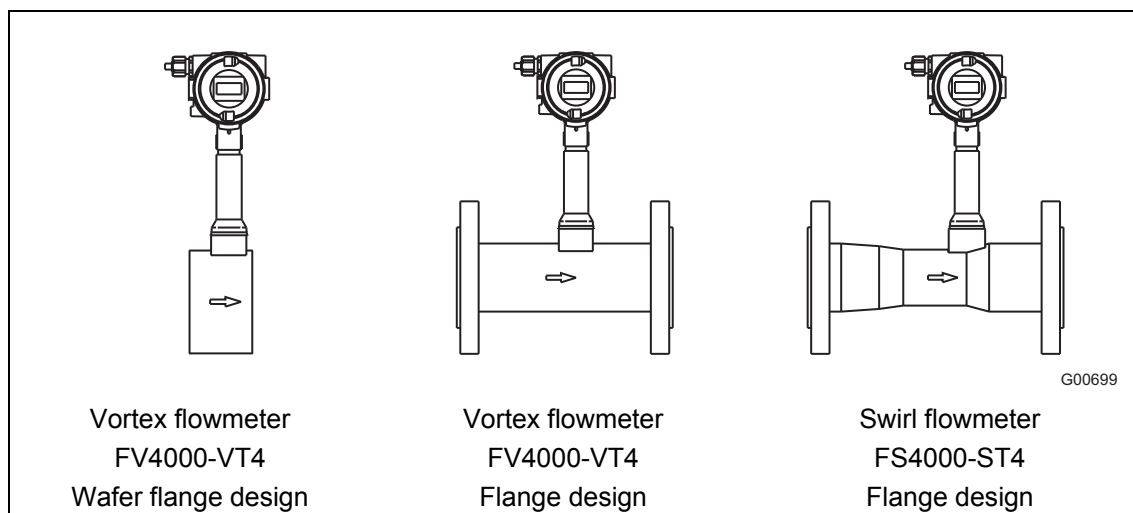


Fig. 11

2.3.2 Remote mount design

The transmitter can be installed up to 10 m (33 ft) away from the flowmeter sensor. The cable is permanently connected to the transmitter. It can be made shorter if required.

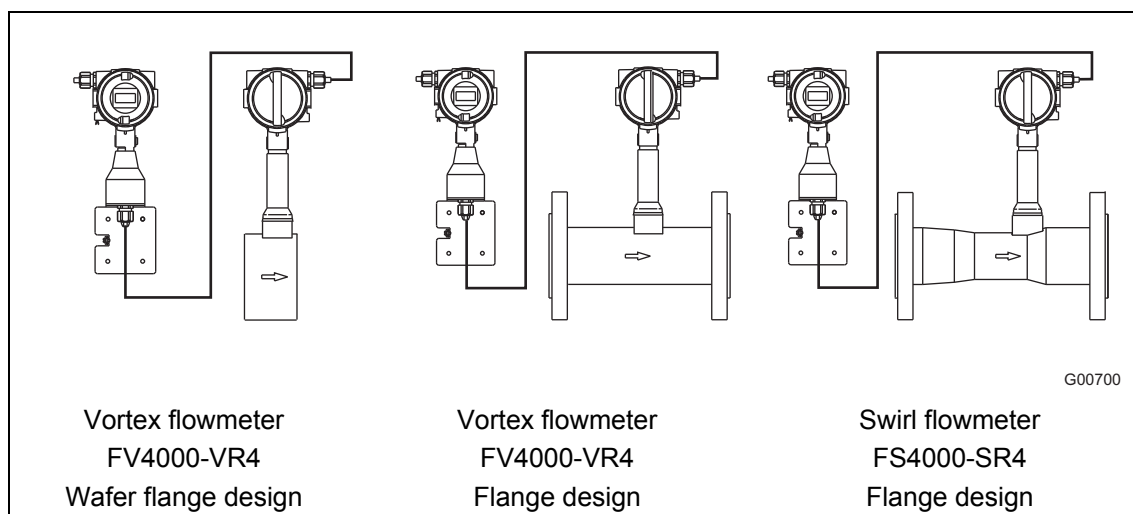


Fig. 12

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 Transport of flanged units smaller than DN 350

**Warning – Risk of injury due to meter slipping!**

The center of gravity of the complete meter may be higher than the lifting straps. Make sure that the meter cannot rotate or slip unintentionally during transport. Support the meter laterally.

**Notice - Potential damage to parts**

A lifting strap must be used to transport flanged units smaller than DN 350. Wrap the straps around both process connections when lifting the meter. Chains should not be used, since these may damage the housing.

3.3 Transport of flanged units larger than DN 300

**Notice - Potential damage to parts**

Using a forklift to transport the meter can dent the housing. Flanged units must not be lifted by the center of the housing when using a forklift for transport. Flanged units must not be lifted by the terminal box or by the center of the housing. Only the eyebolts fitted to the meter must be used to lift the meter and set it down in the pipeline.

4 Mounting

4.1 Installation Requirements

A Vortex or Swirl flowmeter can be installed at any point in the pipeline system. However, the following installation conditions must be considered:

- Compliance with the ambient conditions
- Compliance with the recommended inflow/outflow sections
- The flow direction must correspond to that indicated by the arrow on the flowmeter sensor.
- Compliance with the required minimum interval for removing the transmitter and replacing the sensor
- Avoidance of mechanical vibrations of the pipeline (by fitting supports if necessary)
- The internal diameter of the flowmeter sensor and the pipe must be identical.
- Avoidance of pressure vibrations at zero flow by fitting gates at intervals in long pipeline systems
- Attenuation of alternating (pulsating) flow during piston pump or compressor conveying by using appropriate damping devices. The residual pulse must not exceed 10 %. The frequency of the conveying equipment must not be within the range of the measuring frequency of the flowmeter.
- Valves / gates should normally be arranged in the flow direction downstream of the flowmeter (typically: 3 x DN). If the medium is conveyed through piston/plunger pumps or compressors (pressures for fluids > 10 bar (145 psi)), it may be subject to hydraulic vibration in the pipeline when the valve is closed. If this does occur, the valve absolutely has to be installed in the flow direction upstream of the flowmeter. Suitable damping devices (e.g. air vessels) might need to be fitted.
- When fluids are measured, the sensor must always be filled with media and must not run dry.
- When fluids are measured and during damping there must be no evidence of cavitation.
- The relationship between the temperature of the media and the ambient temperature has to be taken into account (see "Ambient conditions" in the section titled "Technical data").
- At high media temperatures > 150 °C (302 °F), the flowmeter sensor must be installed so that the electronics are pointing to the side or downward.

4.2 Recommended inflow and outflow sections

4.2.1 Vortex flowmeter

In order to maximize operational reliability, the flow profile at the inflow end must not be distorted if at all possible. Provision should be made for an inflow section measuring approx. 15 times the nominal diameter. At elbows, the inflow section should measure at least 25 times the nominal diameter, at round elbows 40 times the nominal diameter and where shutoff valves appear in the inflow section, 50 times the nominal diameter. A value 5 times the size of the nominal diameter is required at the outflow end.

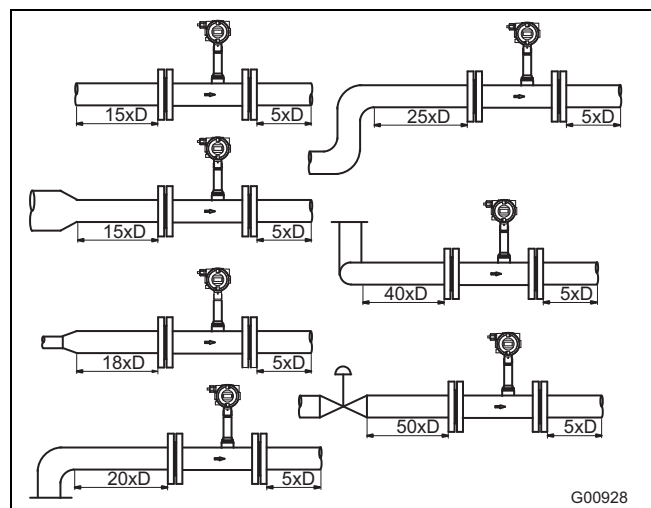


Fig. 13: Recommended inflow and outflow sections

4.2.2 Swirl flowmeter

On account of its operating principle, the Swirl flowmeter functions virtually without inflow and outflow sections. The figure below shows the recommended inflow and outflow sections for various installations. Inflow and outflow sections are not required if the elbow radius of single or double pipe elbows upstream and downstream of the meter is greater than 1.8 x D. Similarly, additional inflow and outflow sections are not required downstream of reductions with flange transition pieces conforming to DIN 28545 (a/2 = 8).

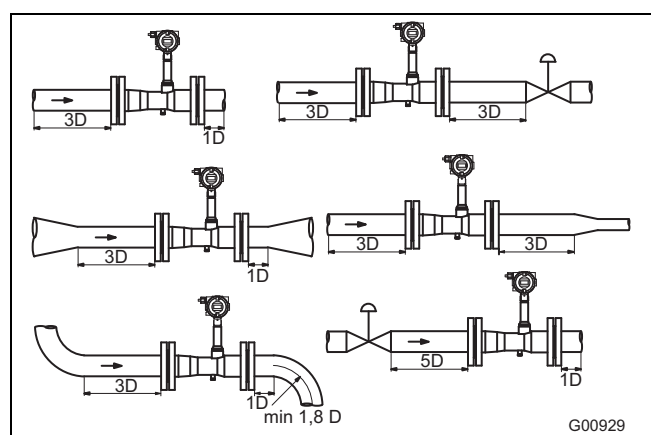


Fig. 14: Recommended inflow and outflow sections

4.3 Installation at high media temperatures > 150°C (302°F)

At high media temperatures > 150°C (302 F) the flowmeter sensor must be installed so that the transmitter is pointing to the side or downward (see the figure below).

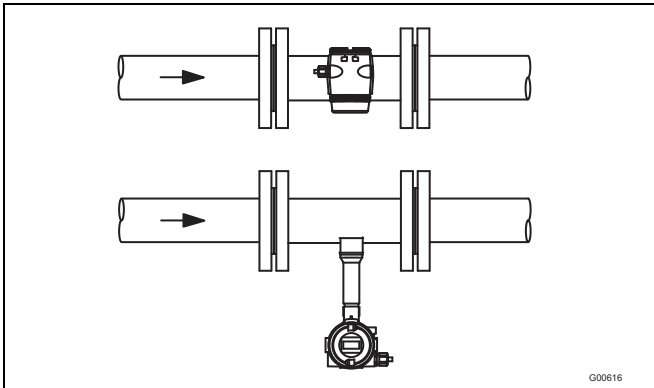


Fig. 15

4.4 Installation for pressure and temperature measurement

As an option, the flowmeter can be fitted with a Pt100 for direct temperature measurement. This temperature measurement supports, for example, the monitoring of the media temperature or the direct measurement of saturated steam in mass flow units.

If pressure and temperature are to be compensated externally (e.g. with the "Sensycal"), the measuring points must be installed as illustrated in the figure below.

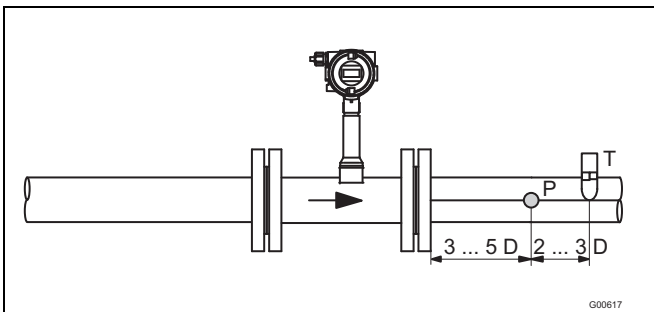


Fig. 16: Arrangement of temperature and pressure measuring points

4.5 Installation of final controlling equipment

Final controlling equipment must be arranged at the outflow end spaced at a minimum 5 x DN.

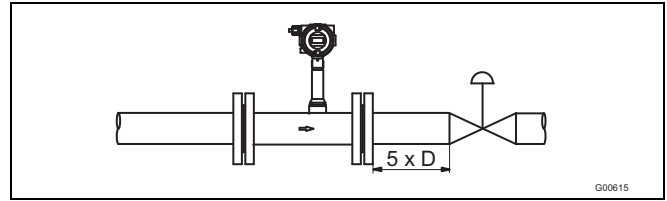


Fig. 17: Installation of final controlling equipment

If the medium is conveyed through piston / plunger pumps or compressors (pressures for fluids > 10 bar (145 psi)), it may be subject to hydraulic vibration in the pipeline when the valve is closed. If this does occur, the valve absolutely has to be installed in the flow direction upstream of the flowmeter. The FS4000 Swirl flowmeter is particularly suited to such scenarios. Suitable dampers (e.g. air vessels in the case of pumping using a compressor) might need to be used.

4.6 General information on installation

The following points must be observed during installation:

- The meter tube must always be completely full.
- The flow direction must correspond to the marking, if there is one.
- The maximum torque for all flange connections must be complied with.
- The meters must be installed without mechanical tension (torsion, bending).
- Wafer design flowmeters with coplanar counter flanges may only be installed with suitable gaskets.
- Only gaskets made from a material which is compatible with the media and its temperature may be used.
- Gaskets must not extend into the flow area since possible turbulence could affect the accuracy of the meters.
- The pipelines must not exert any impermissible forces or torques on the meter.
- Do not remove the plugs in the connectors until you are ready to install the electrical cable.
- Make sure the gaskets for the housing cover are seated properly. Carefully gasket the cover. Tighten the cover fittings.
- Do not expose the transmitter to direct sunlight and provide for appropriate sun protection where necessary.
- When selecting the installation site, make sure that moisture cannot penetrate the terminal housing or transmitter compartment.
- Make sure the signal cable connectors are plugged in and tightened properly to ensure IP 67 protection.

4.7 Mounting the meter tube

The flowmeter sensor can be installed at any location in a pipeline subject to compliance with the installation conditions.

1. Position the flowmeter sensor coplanar and centered between the pipes.
2. Install gaskets between the surfaces of the flowmeter sensor and the counter flange.



Important

The flowmeter sensor gaskets and the flowmeter sensor must be centered. This will ensure accurate measurement results. Do not allow the gaskets to extend into the pipeline. Otherwise the flow profile will be distorted.

3. Use the appropriate screws for the holes.
4. Slightly grease the threaded nuts.
5. Tighten the nuts in a crosswise manner as shown in the figure. Observe the selected tightening torque!



Important

Torques for screws depend on temperature, pressure, screw and gasket materials. The relevant applicable regulations must be taken into consideration.

First tighten the nuts to approx. 50 % of the maximum torque, then to 80 %, and finally a third time to the maximum torque. Do not exceed the maximum selected torque.

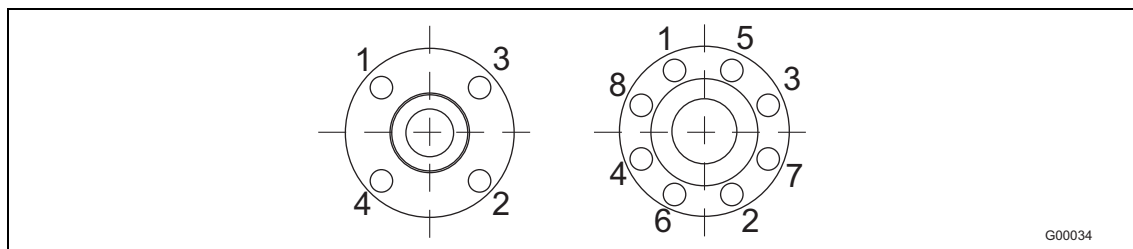


Fig. 18



Important

Tighten flange screws and nuts to prevent them coming loose. This is recommended in the case of pipeline vibration. Supports/damping devices should always be installed to prevent pipeline vibration.

4.8 Centering the wafer design

Wafer type devices (FV4000-VT4/VR4 only) are centered via the outer diameter of the sensor body with the corresponding bolts. Depending on the nominal pressure rating, sleeves for the bolts, a centering ring (up to DN 80) or segments can be ordered as additional accessories.

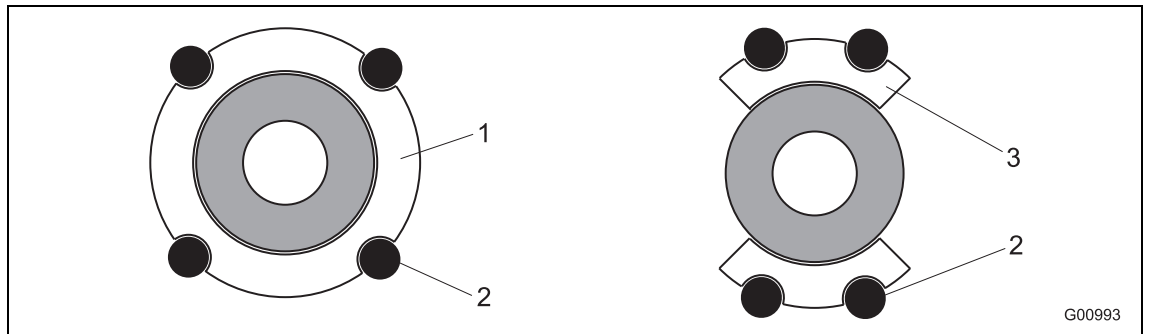


Fig. 19: Centering the wafer type design with ring or segment

- 1 Centering
- 2 Bolt

- 3 Centering segment

G00993

4.9 Flowmeter insulation

The pipeline may be insulated up to a maximum of 100 mm (4 inch) upper edge.

Use of trace heating

Trace heating may be used under the following conditions:

- If it is fixed directly on or around the pipeline
- If, in the case of existing pipeline insulation, it is installed inside the insulation (the maximum height of 100 mm (4 inch) must not be exceeded)
- If the maximum temperature the trace heating is able to produce is less than or equal to the maximum temperature of the fluid.

The requirements to be met by integrators set out in EN 60079-14 must be complied with!

Please note that the use of trace heaters will not impair EMC protection or generate additional vibrations.

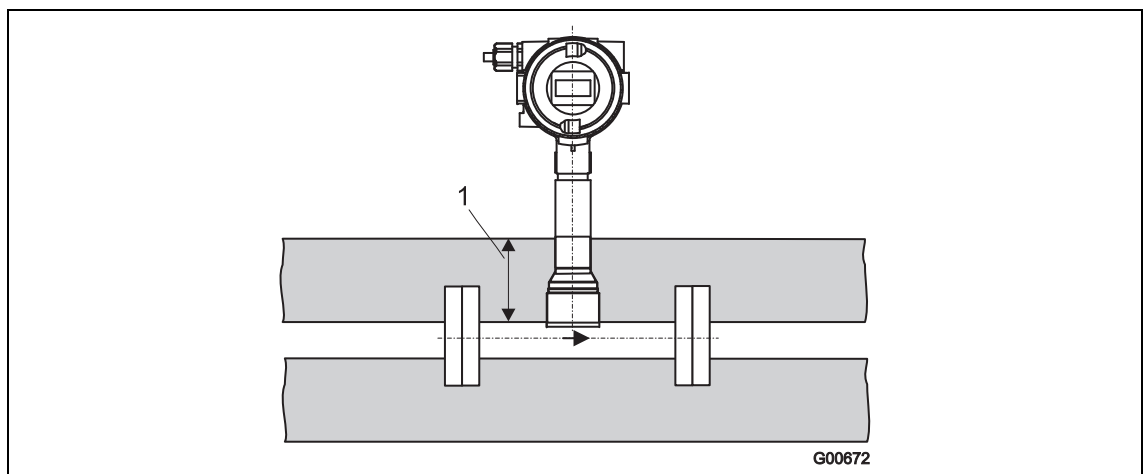


Fig. 20: Flowmeter insulation

1 Maximum 100 mm (4 inch)

4.10 Transmitter orientation

During installation, the transmitter housing can be turned to a position appropriate for reading requirements. A simple mechanical stop in the transmitter housing prevents rotation in excess of 330°. This stop protects the cable running from the flowmeter sensor.

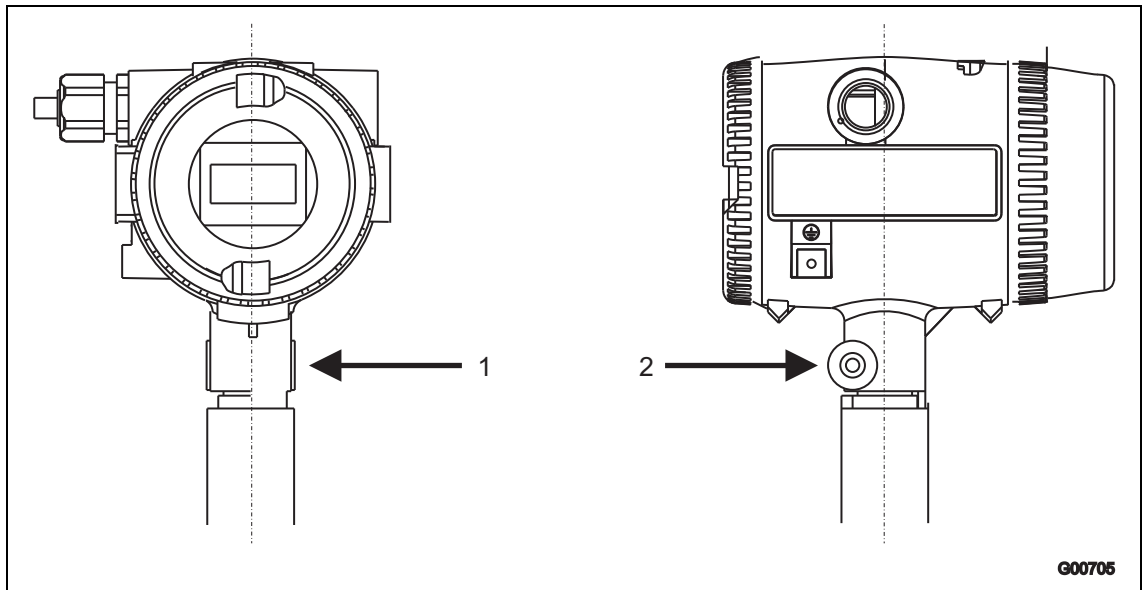


Fig. 21: Rotating the transmitter housing

1 Bolt

2 Stop screw

1. Unscrew the stop screw on the transmitter housing with a 4 mm Allen key.
2. Push the bolts out.
3. Turn the transmitter housing in the required direction.



Notice - Potential damage to parts

The transmitter housing must not be lifted up, since this could tear away the cable coming out of the housing.

4. Put the bolts back in.
5. Fasten the stop screw.

4.11 Rotating the display

The display can be rotated in 90° increments to make its content more legible.



Notice - Potential damage to parts!

Disconnect the flowmeter from the power supply. Ensure compliance with the waiting times before opening the flowmeter as specified on the flowmeter plate (see chapter 11 "Ex relevant specifications"). Installation engineers must have statically discharged themselves before touching electronic components.

EMC protection is no longer assured when the flowmeter cover is open.

When the cover is open, the inside of the meter must be protected against the ingress of dust and moisture.

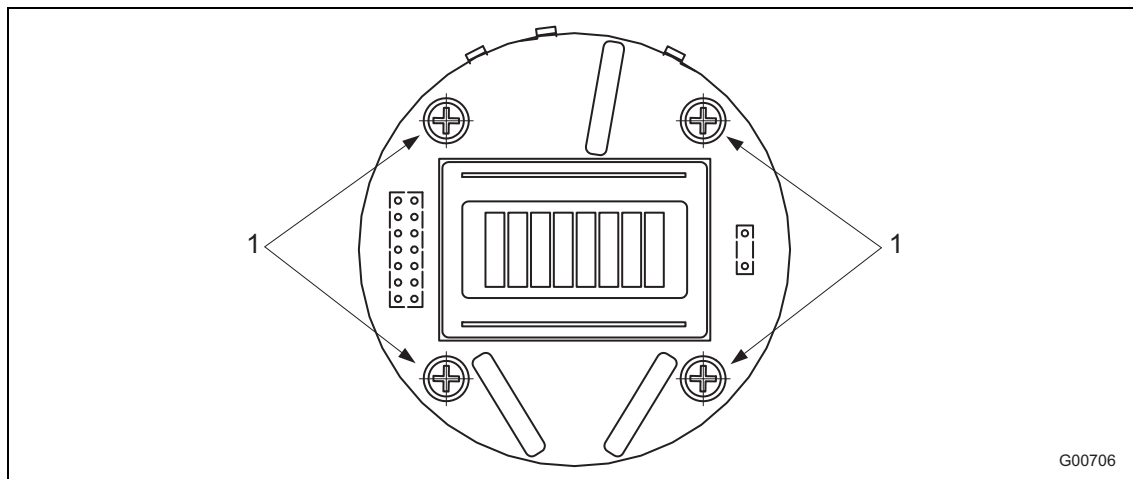


Fig. 22: Rotating the display

1 Phillips head screws

1. Unscrew the front housing cover. The lock on the cover needs to be undone first on meters for hazardous areas.



Important

After switching off the supply power, wait $t > 2$ minutes before opening the flameproof housing.

2. Remove the white clip-on cover.
3. Unscrew the 4 Phillips head screws (1) from the corners of the display.
4. Turn the display to the required position. Take care not to over-rotate the connecting cable!
5. Then screw the display panel back in place.
6. Fasten the white cover.
7. Finally, tighten the housing cover hand-tight. The lock on the cover needs to be re-attached on meters for hazardous areas.

5 Electrical connections



WARNING - General risks

Observe the applicable regulations governing electrical installation. Connections must only be established in a dead-voltage state. Since the transmitter has no switch-off elements, overvoltage protection devices, lightning protection, and voltage separation capacity must be provided at the plant (overvoltage / lightning protection is optional).

Check that the existing operating voltage corresponds to the voltage indicated on the name plate.

The same lines are used for both the supply power and output signal.



Important

Please ensure compliance with applicable requirements when making electrical connections for meters approved for use in the USA and Canada!

USA:

Meters approved for use in the USA must be connected in compliance with the National Electrical Code (NEC).

Canada:

Meters approved for use in Canada must be connected in compliance with the Canadian Electrical Code (CEC).

5.1 Cable connection area

5.1.1 HART design

The transformer has a two-wire design. This means that the supply voltage and the measuring signal (4 ... 20 mA) are routed on the same wire. An additional switching output is also available.

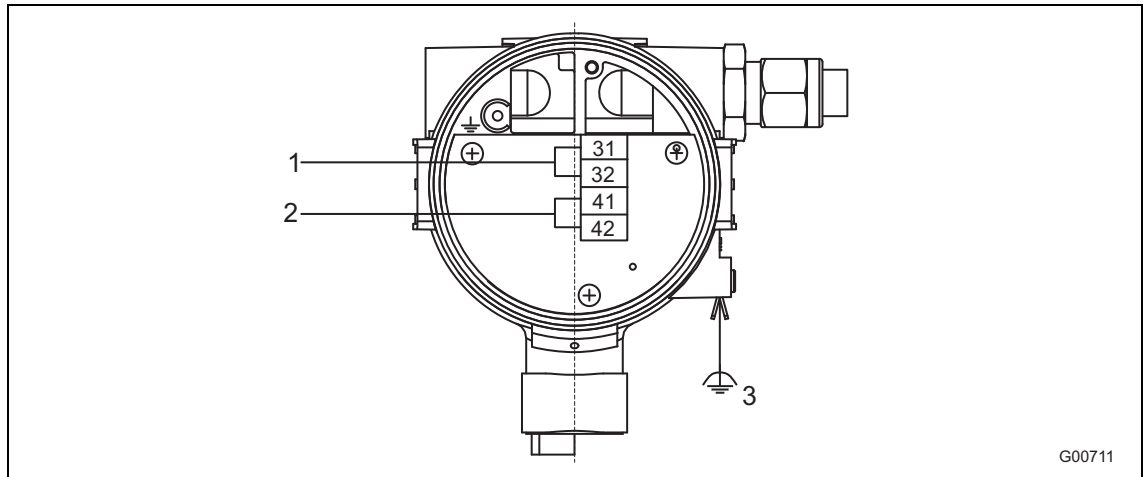


Fig. 23: Cable connection area

- 1 Current output terminals
- 2 Switching output terminals
- 3 Functional ground

Pin configuration

| Connection | Description |
|------------|--------------------|
| 31 | Supply power |
| 32 | Supply power |
| 41 | Switching output + |
| 42 | Switching output - |
| | Functional ground |

Supply power (terminals 31 / 32)

| | |
|-----------------------|--|
| Standard | 14 ... 46 V DC |
| Hazardous area design | See chapter 11 "Ex relevant specifications". |
| Residual ripple | Maximum 5 % or. ± 1.5 Vpp |
| Power consumption | < 1 W |

Connection examples

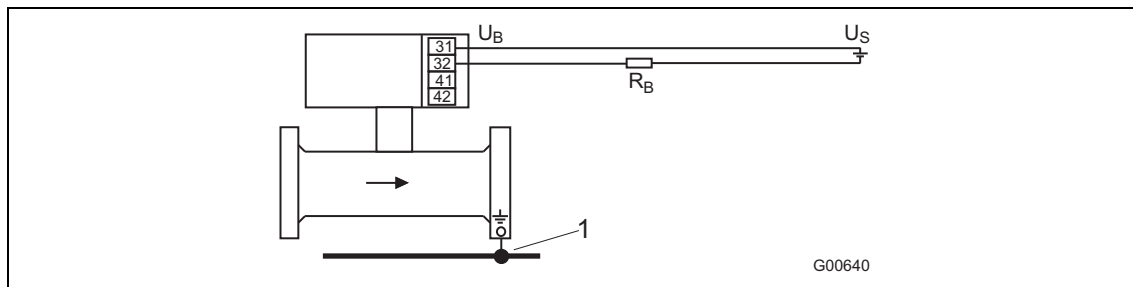


Fig. 24: Supply power from central voltage supply

1 Functional ground

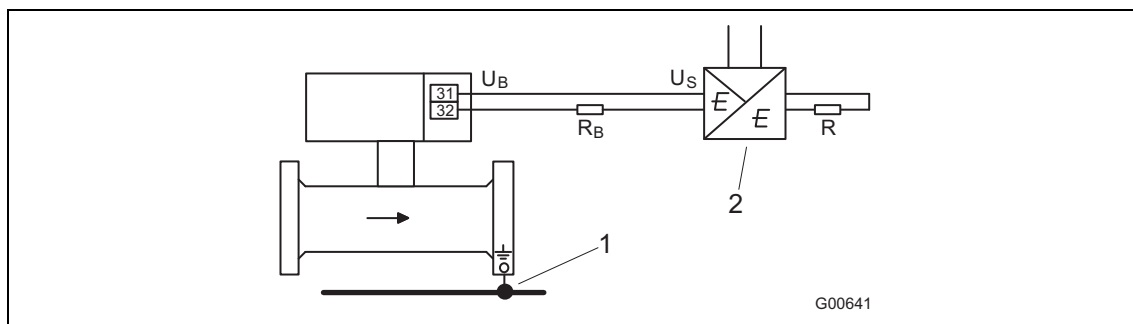


Fig. 25: Supply power (DC or AC) from power supply unit

1 Functional ground

2 Power supply unit

5.1.2 Fieldbus design

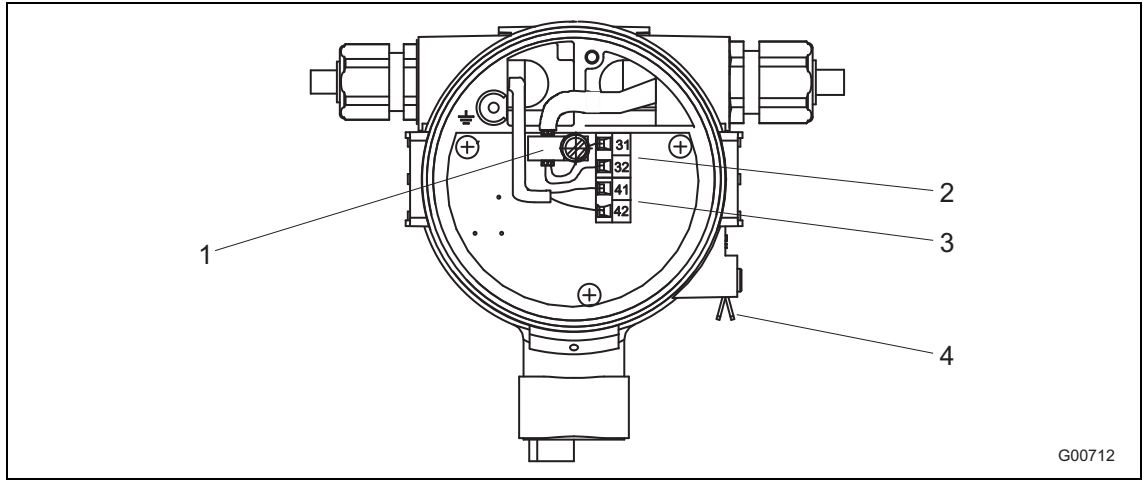


Fig. 26: Cable connection area

- 1 Terminal for bus cable shield
- 2 "Bus" terminals
- 3 "Switching output" terminals
- 4 Functional ground

Pin configuration

| Connection | Description | |
|------------|--|---------------------|
| | PROFIBUS PA | FOUNDATION fieldbus |
| 31 | PA+ 1) | FF+ 2) |
| 32 | PA- 1) | FF- 2) |
| 41 (C9) | Switching output + | |
| 42 (E9) | Switching output - | |
| ⏏ | Terminal for cable shield, functional ground | |

1) Connection for PROFIBUS PA to IEC 1158-2
 2) Connection for FOUNDATION fieldbus (H1)

5.2 Cable connection

5.2.1 Standard design, HART

1. A suitable voltage supply cable must be used for the electrical connection of the transmitter.
2. Unscrew the cover from the cable connection area at the rear of the transmitter.



Important

After switching off the supply power, wait $t > 2$ minutes before opening the flameproof housing. (Hazardous area protection only!)

3. Insert the supply voltage cable into the cable connection area through the cable gland and fasten to the cable grip to prevent accidental disconnection.
4. Tighten the cable gland.



Notice - Potential damage to parts!

If the supply voltage cable is not fastened with the cable grip, there is a risk of it being pulled completely out of the transmitter housing should the strain fall below the required level, thereby interrupting the electrical connection.

The sheathing of the supply voltage cable must not be damaged. Otherwise, protection class IP 67 for the flowmeter cannot be ensured.

5. Remove the insulation from the cable sheath and the wires and connect these to the corresponding terminals (see the section titled "Cable connection area").
6. Screw on the cover for the cable connection area fully and fasten hand-tight. Make sure the gaskets for the cover are seated properly.

5.2.2 Connection via flameproof cable gland ("Ex d design")

The electrical connection for the flowmeter is made via the cable gland on the unit. Alternatively, the flowmeter can be connected using an approved flame-resistant conduit gland located directly on the unit. If this option is selected, the cable gland has to be removed first.



Important

The requirements set out in EN 500181 Section 13.1 and 13.2 must be complied with.

The requirements to be met by integrators set out in EN 60079-14 must be complied with when selecting conduit glands.

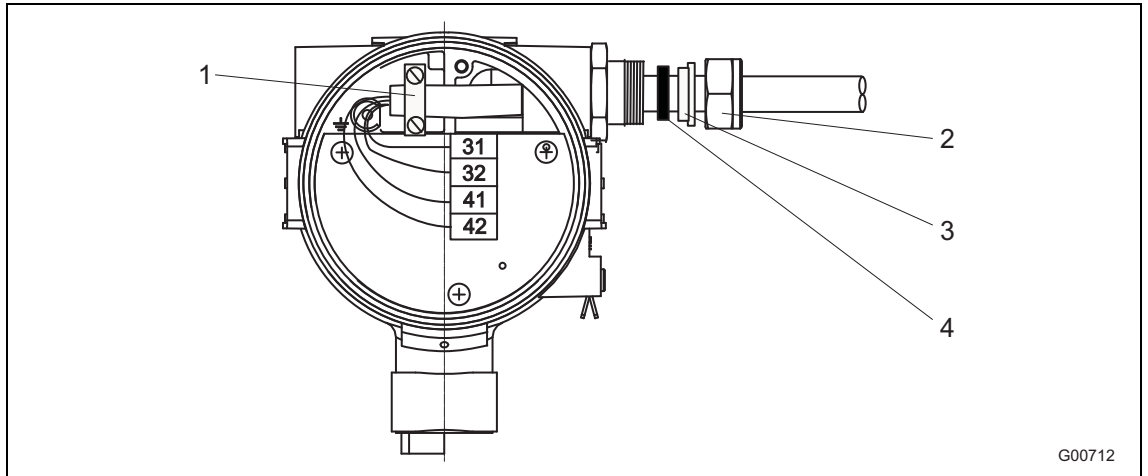


Fig. 27: Electrical connection of the flameproof design with open cable gland

- | | |
|--------------|-----------|
| 1 Cable grip | 3 Sleeve |
| 2 Lock nut | 4 Gaskets |

i

Important

After switching off the supply power, wait $t > 2$ minutes before opening the flameproof housing.

1. Unscrew the cover from the cable connection area at the rear of the transmitter.
2. Remove the cable gland.
3. Install the conduit gland.
4. Route the connecting cable through.

i

Important

The outer diameter of the unshielded connecting cable must be between 8.0 mm (0.31 inch) and 11.7 mm (0.46 inch)

5. Tighten the lock nut on the gland to a torque of 32.5 Nm (23.97 lbf-ft).
6. Fasten the connecting cable inside the housing with the additional cable grip.
7. Connect the bare wires to the corresponding terminals (see the section titled "Cable connection area").
8. Screw on the cover for the cable connection area fully and fasten hand-tight. Make sure the gaskets for the cover are seated properly.

5.2.2.1 Voltage supply, 4 ... 20 mA / HART

| Electrical variable | Value |
|---|----------------------------------|
| Supply voltage | $U_B \geq 14 \text{ V DC}$ |
| Supply voltage | $U_S = 14 \dots 46 \text{ V DC}$ |
| Maximum permissible load for the power supply unit (e. g. display, load) | R_B |
| Maximum permissible load for the output circuit (determined by the power supply unit) | R |

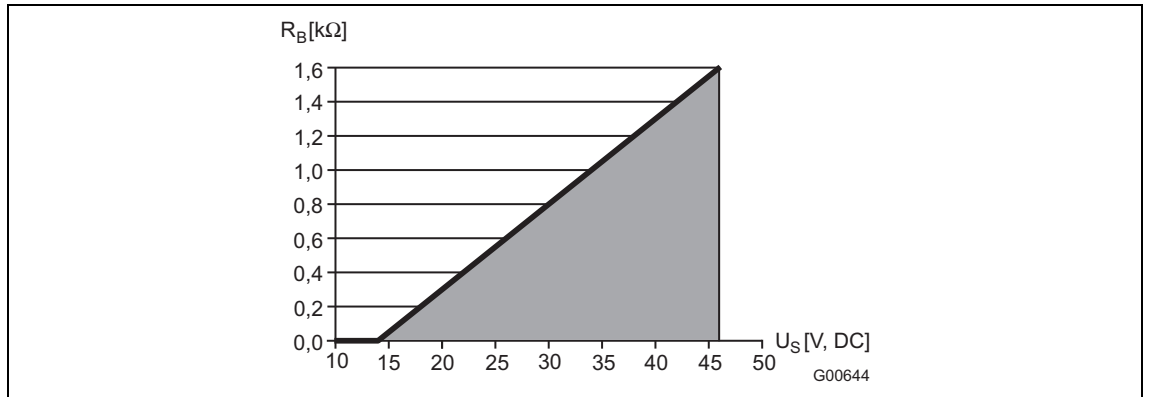


Fig. 28: Load diagram for current output, load via supply power

In HART communication, the smallest load is 250 Ω. The load R_E is calculated on the basis of the available supply voltage U_S and the selected signal current as follows:

$$R_E = \frac{U_S}{I_B}$$

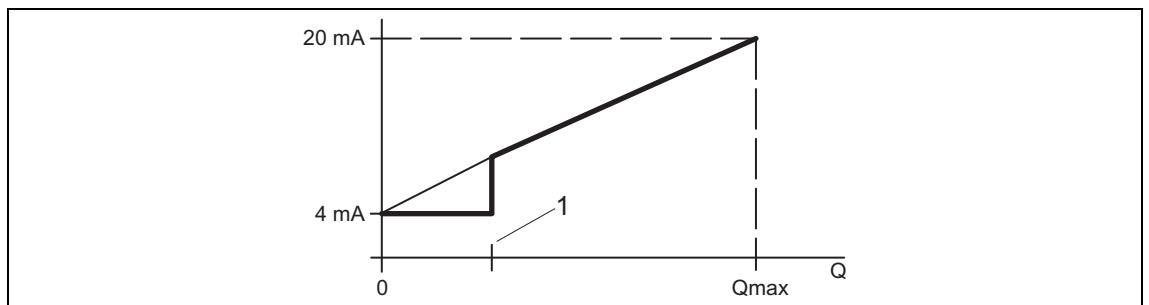


Fig. 29: Current output
1 Low flow

The measurement value output at the current output is as shown in the figure: Above the low flow, the current is a straight line that would have 4 mA in $Q = 0$ and 20 mA in $Q = Q_{max}$ operating mode. Due to low flow cutoff, the flow is set to 0 below x % Q_{max} or the low flow (in other words, the current is 4 mA).

5.2.3 Standard design, PROFIBUS PA / FOUNDATION fieldbus

1. A suitable bus cable must be used for the electrical connection of the transmitter.
A shielded, twisted cable is recommended (in accordance to IEC 61158-2, types A or B are preferred).



Important

The permissible cable length in the segment, including all spur lines, is restricted to a maximum of 1,900 m (6,324 ft). It is determined by the cable type and the type of explosion protection (hazardous area protection). For hazardous protection, no special measures need to be taken up to 1,000 m (3,281 ft) in accordance with the FISCO model. However, special measures are required with regard to explosion protection for longer cable lengths.

2. Unscrew the cover from the cable connection area at the rear of the transmitter.



Important

After switching off the supply power, wait $t > 2$ minutes before opening the flameproof housing.

3. Remove the insulation from the cable sheath, the shield and the wires as specified (see the section titled "Cable connection area").
4. Insert the bus cable into the cable connection area through the cable gland and fasten to the cable grip on level with the shield to prevent accidental disconnection.
5. Tighten the cable gland.



Notice - Potential damage to parts!

If the bus cable is not fastened to the cable grip, the shield will not have a functional ground. Furthermore, there is a risk of the cable being pulled completely out of the transmitter housing should the strain fall below the required level, thereby interrupting the electrical connection.

The sheath of the bus cable must not be damaged. Otherwise, protection class IP 67 for the flowmeter cannot be ensured.

6. Connect the bare wires to the corresponding terminals (see the section titled "Cable connection area").
7. Screw on the cover for the cable connection area fully and fasten hand-tight. Make sure the gaskets for the cover are seated properly.

Electrical connections

5.2.3.1 Bus Connection

The fieldbus transmitter is suitable for connection to the ABB multibarrier, the segment coupler (PROFIBUS PA design only) and special power supply units or a linking device (FOUNDATION fieldbus design only). As well as the bus connection (terminals 31 / 32) there is also a freely configurable switching output (terminals 41 / 42) available.

| Electrical variable | Value |
|--|-------------------------------|
| Supply voltage | $U = 9 \dots 32 \text{ V DC}$ |
| Current (normal operation) | $I = 10 \text{ mA}$ |
| Current (in the event of an error / FDE) | $I = 13 \text{ mA}$ |

VT4A / ST4A models

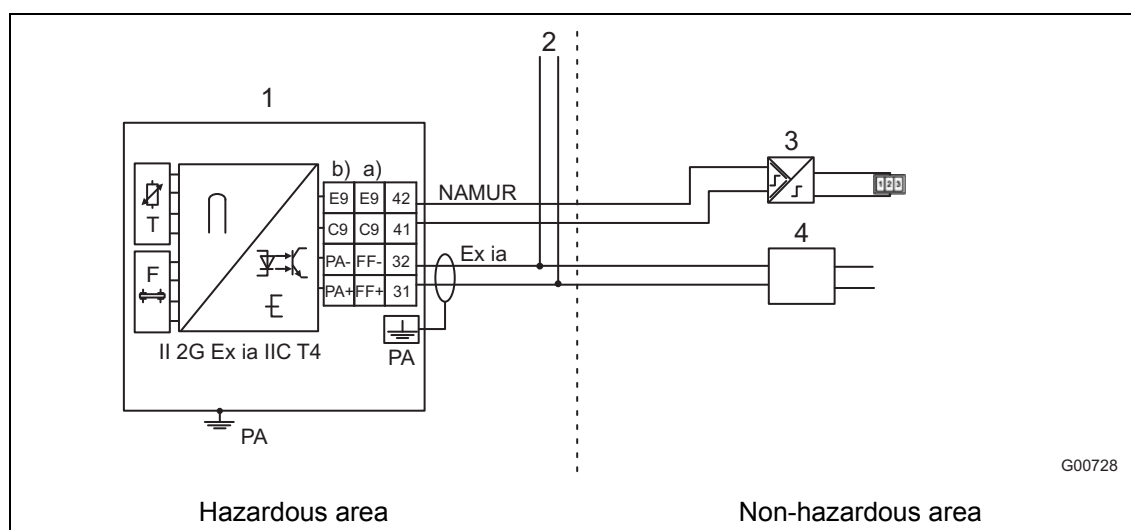


Fig. 30: Electrical connection, FV4000-VT4A / FS4000-ST4A

- | | | | |
|---|---------------------------------------|---|--|
| 1 | Flowmeter sensor and transmitter | 4 | PROFIBUS PA: Intrinsically safe segment coupler FOUNDATION fieldbus: Intrinsically safe supply isolator, zener barrier/power supply unit |
| 2 | Other bus nodes | | |
| 3 | Switching amplifier (NAMUR DIN 19234) | | |

5.2.4 Remote mount design

1. Use the cable connected to the flowmeter sensor to make the electrical connection between the flowmeter sensor and the transmitter.
2. Unscrew the cover from the cable connection area at the rear of the transmitter.



Important

After switching off the supply power, wait $t > 2$ minutes before opening the flameproof housing.

3. Remove the insulation from the cable sheath, the shield and the wires as specified (see the section titled "Cable connection area").
4. Insert the bus cable into the cable connection area through the cable gland and fasten to the cable grip on level with the shield to prevent accidental disconnection.
5. Tighten the cable gland.



Notice - Potential damage to parts!

If the bus cable is not fastened to the cable grip, the shield will not have a functional ground. Furthermore, there is a risk of the cable being pulled completely out of the transmitter housing should the strain fall below the required level, thereby interrupting the electrical connection.

The sheath of the bus cable must not be damaged. Otherwise, protection class IP 67 for the flowmeter cannot be ensured.

6. Connect the bare wires to the corresponding terminals (see the section titled "Cable connection area").
7. Screw on the cover for the cable connection area fully and fasten hand-tight. Make sure the gaskets for the cover are seated properly.

5.2.4.1 Laying the signal cable (remote design only)

Remote design FV4000-VR4 Vortex and FS4000-SR4 Swirl flowmeters are based on the FV4000-VT4 / FS4000-ST4 compact meters with all options. The transmitter is installed separately from the flowmeter sensor, if this is positioned in a location which is difficult to access. This design can also be advantageous if the measuring point is located in extreme ambient conditions. The distance between the flowmeter sensor and the transmitter must not exceed 10 m (33 ft). A special cable connects the flowmeter sensor to the transmitter. The cable is permanently connected to the transmitter.

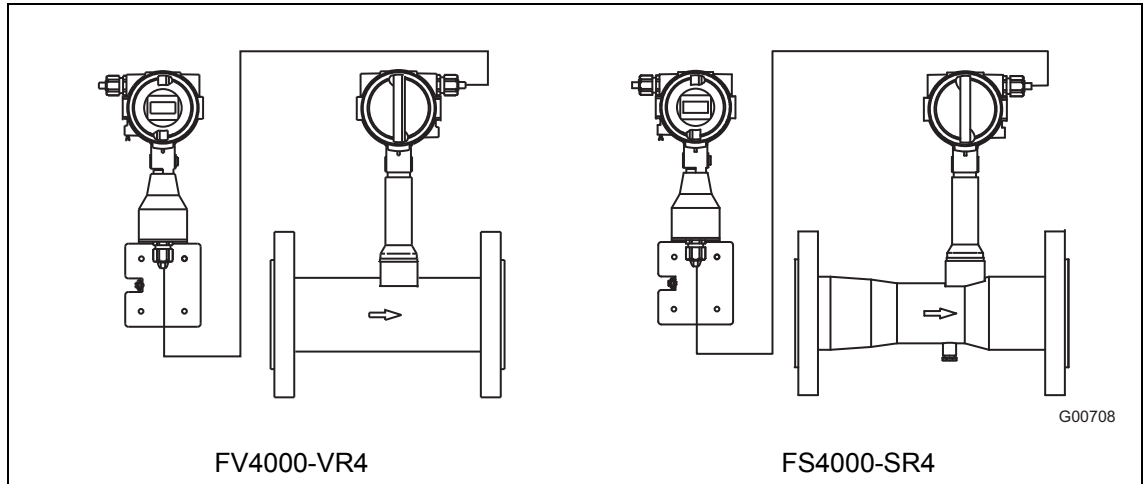


Fig. 31: Vortex / Swirl flowmeters

i**Important**

Please observe the following when laying the signal cable:

- The signal cable carries a voltage signal of only a few millivolts and must, therefore, be routed along the shortest distance possible. The maximum permissible signal cable length is 10 m (33 ft).
- All leads must be shielded and connected to the station ground potential. For this purpose, the cable shield must be connected underneath the cable clamp.
- Avoid routing the signal 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 operational ground.
- Make sure during installation that the cable is provided with a water trap. For vertical installation, align the cable glands pointing downward.

Once installation is complete, cut the connecting cable to length as far as the flowmeter sensor. The transmission signal between the sensor and the transmitter is not amplified, so the connections need to be routed carefully. Lay the wires in the terminal box so that they are not affected by vibration.

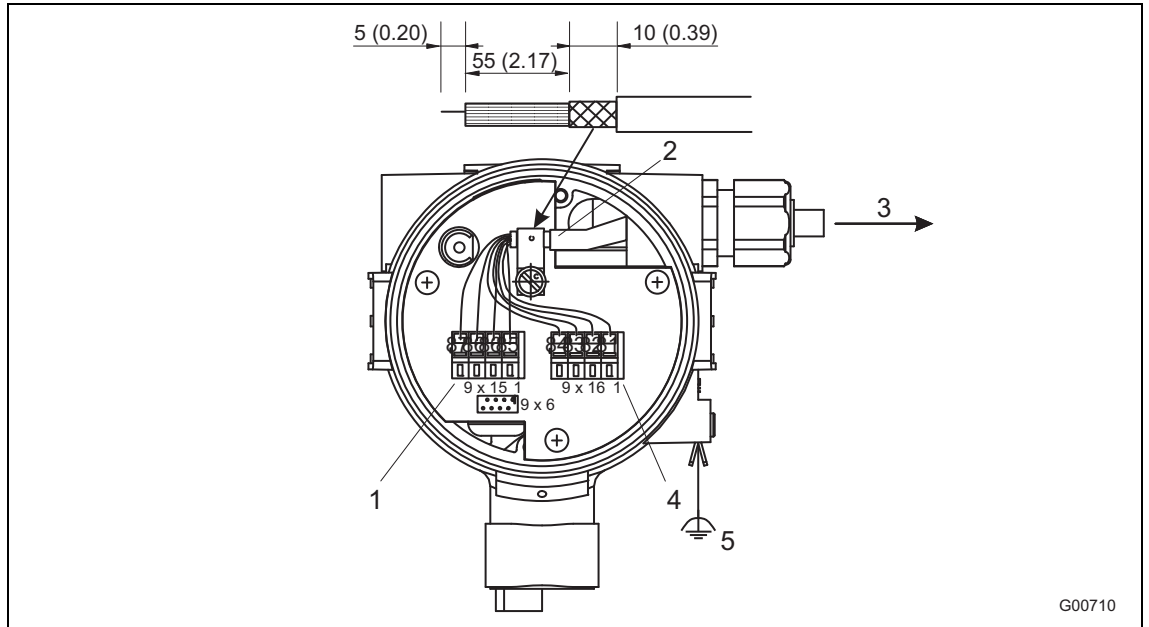


Fig. 32: Flowmeter sensor cable connection area (dimensions in mm (inch))

- 1 Flowmeter sensor cable connection area
- 2 Close-up of signal cable fastening
- 3 To transmitter
- 4 Terminals for Pt100
- 5 Functional ground

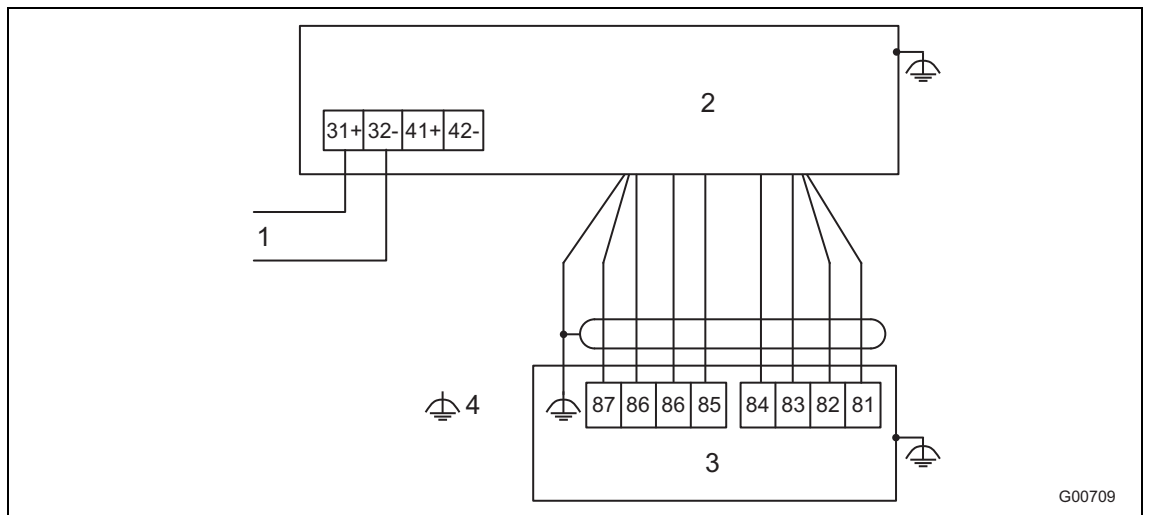


Fig. 33: Connection between transmitter and flowmeter sensor

- 1 Voltage supply connection
- 2 Converter
- 3 Flowmeter sensor
- 4 Functional ground

Wire colors, signal cable

| Wire color | White | Brown | Green | Yellow | Gray | Pink | Blue | Red |
|------------|-------|-------|-------|--------|------|------|------|-----|
| Connection | 87 | 86 | 86 | 85 | 84 | 83 | 82 | 81 |

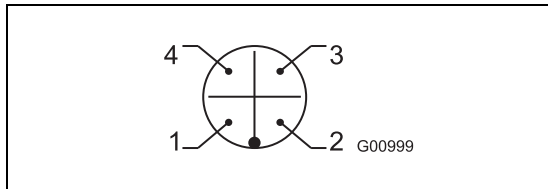
5.3 M12 plug-in connector, PROFIBUS PA

As an option, the electrical connection can also be made using an M12 plug-in connector. The device can be shipped completely prewired. The M12 plug-in connector is installed in the terminal box instead of the cable gland.



Important

Matching sockets (type EPG300) can be found in data sheet 10/63-6.44-xx, along with other accessories.



| PIN | Assignment |
|-----|------------|
| 1 | PA+ (31) |
| 2 | NC |
| 3 | PA- (32) |
| 4 | Shield |

Fig. 34

5.4 Switching output

The function of the switching output can be selected in the software. It can be assigned as a pulse output, a min./max. alarm (temperature or flow) or a system alarm. It can be configured as a NAMUR contact (to DIN 19234) or as a passive optocoupler.

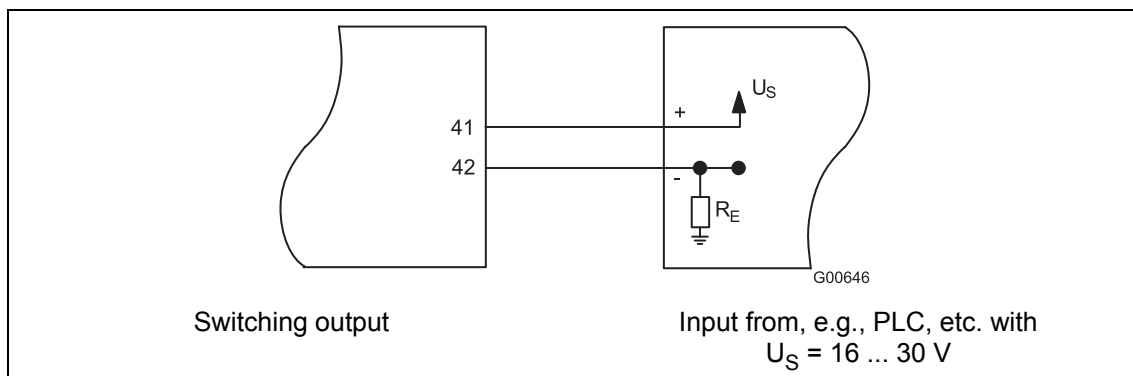


Fig. 35: Electrical connection

| Function | Technical data |
|---------------------|--|
| Pulse output | $f_{max} = 100 \text{ Hz}, 1 \dots 256 \text{ ms}$ |
| NAMUR contact | Closed: $1 \text{ K}\Omega$, open: $> 10 \text{ K}\Omega$ |
| Passive optocoupler | $0 \leq U_{CEL} \leq 2 \text{ V}, 16 \text{ V} \leq U_{CEH} \leq 30 \text{ V}$ $0 \leq I_{CEH} \leq 0.2 \text{ mA}, 2 \text{ mA} \leq I_{CEL} \leq 15 \text{ mA}$ |

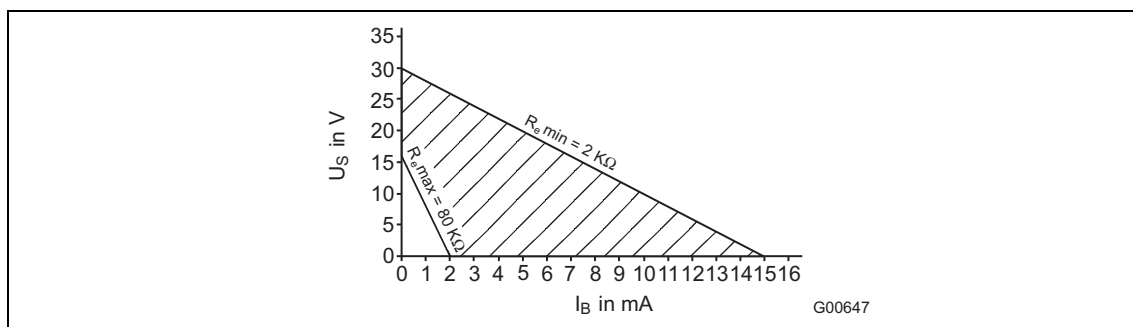


Fig. 36: Load resistance of the switching output as a function of current and voltage

5.5 Configuration of the switching output

The switching output can be configured as both a NAMUR contact and an optocoupler.

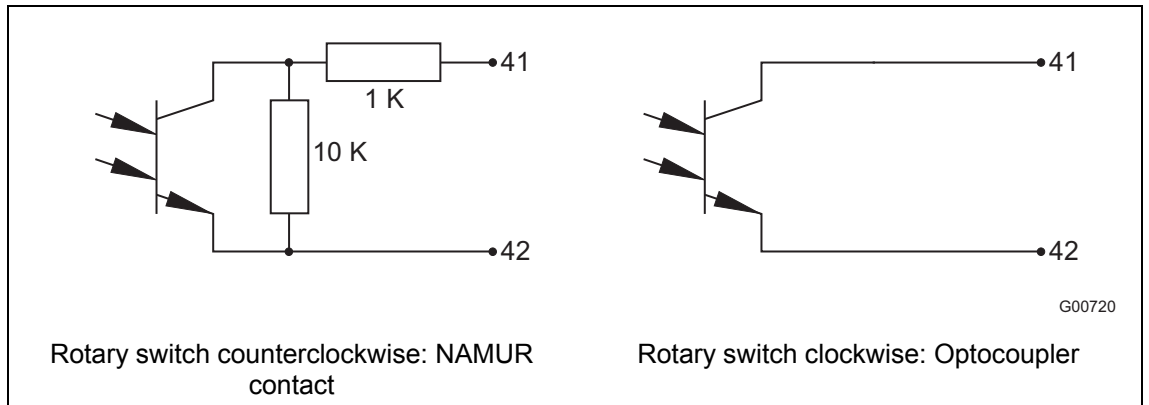


Fig. 37: Switching output circuit diagram

The switching output of the transmitter is factory-configured on the basis of the order code. The following table lists contact types and their matching order codes and Ex approval.

| Order code | Ex approval | Contact type |
|------------------------|---------------------------|---------------|
| VT40, VR40, ST40, SR40 | None | Optocoupler |
| VT41, VR41, ST41, SR41 | Ex ib / Ex nA [nL] | NAMUR contact |
| VT42, VR42, ST42, SR42 | Ex d / Ex ib / Ex nA [nL] | Optocoupler |
| VT43, VR43, ST43, SR43 | cFM _{US} | Optocoupler |
| VT4A, VR4A, ST4A, VR4A | II 2G Ex ia IIC T4 | NAMUR contact |

If necessary, the switching output can be modified subsequently should prevailing site conditions change.

1. Disconnect the flowmeter from the line supply.
2. Unscrew the front housing cover. The lock on the cover needs to be undone first on meters for hazardous areas.



Important

Observe the waiting times for hazardous area designs, see chapter 11 "Ex relevant specifications".

3. Remove the transmitter from the housing. To do this, unscrew the three Phillips head screws and carefully take the transmitter out of the housing.

- Set the configuration switch as illustrated below.

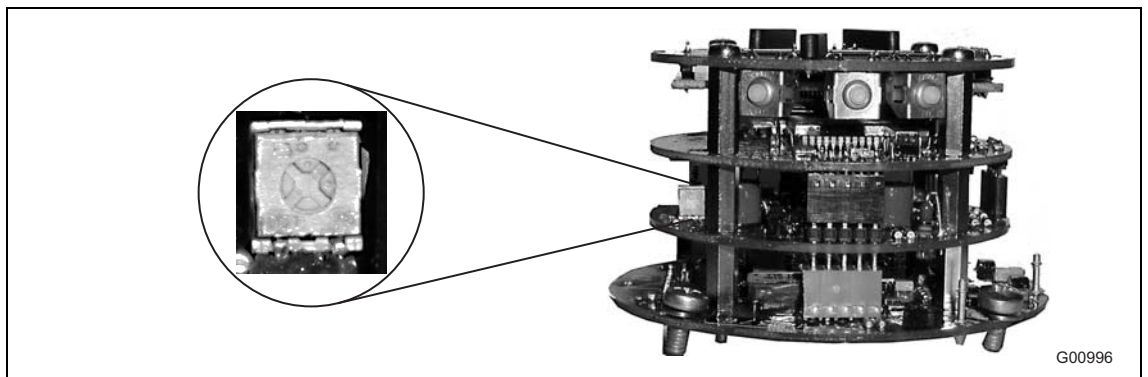


Fig. 38: Position of the configuration switch

- Carefully put the transmitter back into the housing. Make sure it is centered correctly.



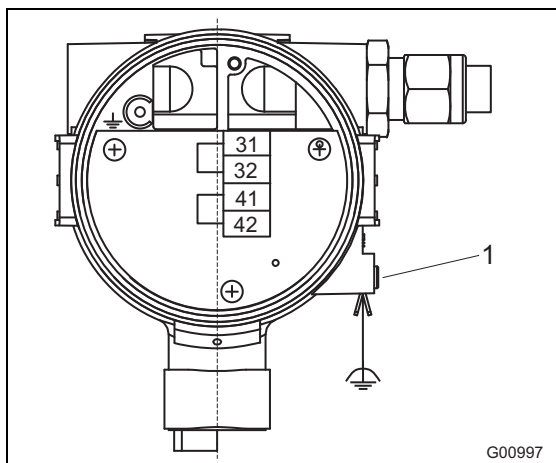
Notice - Potential damage to parts!

If the transmitter is not placed into the housing correctly, the electrical plug-in connectors at the rear can twist or break off.

Position the transmitter so that the three screw holes on the base plate are located exactly in front of the threaded bolts.

- Tighten the three screws again.
- Tighten the housing cover screws until they are hand-tight. The lock on the cover needs to be re-attached on meters for hazardous areas.

5.6 Functional ground/Equipotential bonding



- Functional ground/equipotential bonding screw terminals

Fig. 39

Functional ground connection

- Unscrew the screw terminal on the transmitter housing.
- Insert the fork-type cable lug for functional ground into the terminal between the two metal tabs.
- Tighten the screw terminal.

6 Commissioning

6.1 Preliminary checks prior to start-up

The following points must be checked before commissioning:

- The supply power must be switched off.
- The supply power must match information on the name plate.
- The pin assignment must correspond to the connection diagram.
- The unit must be grounded.
- The temperature limits must be observed.

6.2 Commissioning the unit



Important

Please ensure compliance with the specific instructions for installing explosion-proof equipment. These can be found in section 11 "Ex relevant specifications".

6.2.1 Switching on the supply power

After switching on the supply power, the display (if in use) shows the current flow after a few seconds.

6.2.2 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 (see Standard display format on page 61).

6.3 Information on voltage/current consumption

The switch-on response meets the requirements set out in draft DIN IEC 65C/155/CDV, June 1996. The mean current consumption of the device is 10 mA. In the event of an error, the FDE (fault disconnection electronic) function integrated into the device ensures that the current consumption can rise to a maximum of 13 mA. The upper limit of the voltage is electronically limited. The supply voltage for the standard design (model V_40 / S_40)) is 9 ... 32 V DC. The intrinsically safe design (model V_4A / S_4A) has a supply voltage range of 9 ... 24 V DC.

6.4 Setting the bus address (PROFIBUS PA)

If no bus address information is supplied by the customer, the unit will be shipped with an address setting of "126" (addressing via the bus). The address has to be set to within the valid range (0, 2 ... 125) during installation and start-up.



Important

The set address may only appear once in the segment.

The address can be set either locally on the unit (via the miniature switch 8 on the digital board), using system tools, or via a PROFIBUS DP master class 2 such as SMART VISION.

Switch 8 is factory-set to "Off"; in other words, addressing is via the fieldbus.

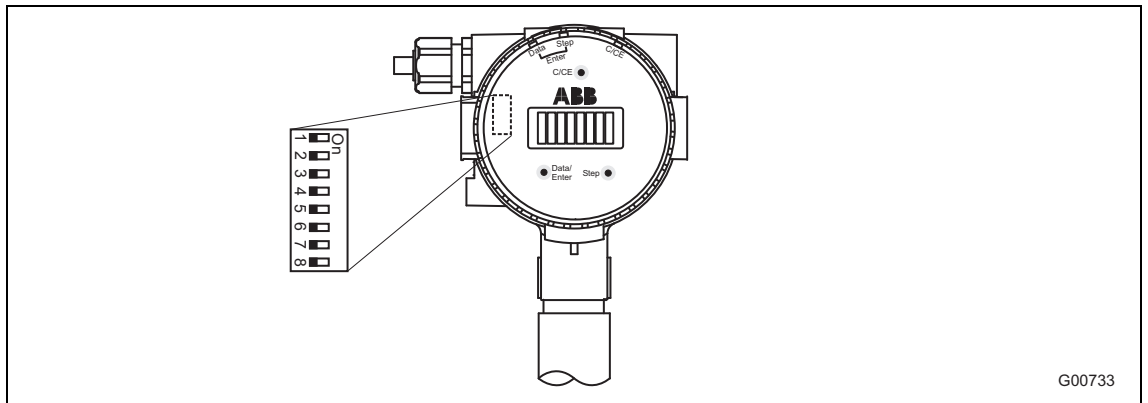


Fig. 40: Position of the miniature switch

Setting the bus address

- 1 Unscrew the front cover from the transmitter housing.
- 2 Set the bus address using the following table.

| Switch | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|----------------|-----------------------|---|---|---|----|----|----|---------------------|
| Setting | Device address | | | | | | | Address mode |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Bus |
| On | 1 | 2 | 4 | 8 | 16 | 32 | 64 | Local |

3. Screw the cover back into place.

Definition of the address mode

| Setting of switch 8 | Address mode |
|---------------------|--|
| Off (bus) | Addressing is via the bus. |
| On (local) | Addressing is via miniature switches 1 to 7. |



Important

In the case of local addressing, address settings are not applied until the device is switched on.

Example

Setting of bus address 81:

| Switch | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---------|----|-----|-----|-----|----|-----|----|----|
| Setting | On | Off | Off | Off | On | Off | On | On |

The bus address is set by adding together the corresponding address values of switches 1 to 7. To set bus address 81, switches 1, 5, and 7 have to be set to "On", since the corresponding address values 1, 16, and 64 add together to make 81.

Switch 8 must be set to "On" in order that the bus address can be set with the miniature switch.

6.5 Setting the bus address (FOUNDATION fieldbus)

On the FOUNDATION fieldbus, the bus address is set automatically via the LAS (LinkActiveScheduler). Addresses are detected via a unique number (DEVICE_ID) made up of the manufacturer ID, the device ID and the device serial number.

6.6 Checking the parameters

ABB Automation Products sets the parameters of the measuring system and assigns all necessary values on the basis of the ordering information. Since the devices are suitable for universal use (i.e., for fluids and gases), we recommend checking and if necessary modifying the following parameters in the transmitter during installation and start-up.

| Parameter | Check |
|-------------------------|---|
| Nominal diameter | <ul style="list-style-type: none"> • Check value on name plate. |
| k factor | <ul style="list-style-type: none"> • The value displayed must match the value on the flowmeter sensor. |
| Operating mode | <ul style="list-style-type: none"> • Select the required operating mode. • Which flow unit is the meter to display the flow in/is the flowmeter to add values? • Selection between units of volume and units of mass flow (depending upon the selected operating mode). • Enter the required measuring range in the unit selected above with the "Qmax operating mode" parameter. • Range 0.15 ... 1.15 x "QmaxDN operation" |
| Qmin operation | <ul style="list-style-type: none"> • Check the low flow value. • Range 0.02 ... 0.25 x QmaxDN |
| Unit totalizer | <ul style="list-style-type: none"> • Select the unit of flow for internal flow totalizing with the parameter. This unit is also valid for the pulse output (switching output via terminals 41/42). |
| Damping | <ul style="list-style-type: none"> • The response time of the electronics affects the local display, the pulse output and the transducer block. |
| Display submenu | <ul style="list-style-type: none"> • Configuration of the local display • Configuration of the switching output, if applicable |

7 Communication

7.1 HART protocol communication

The HART protocol is used for digital communication between a process control system or PC, a handheld terminal, and the Vortex / Swirl flowmeter. It can be used to send all parameters (e.g., measuring point parameters) from the transmitter to the process control system or PC. Conversely, it also provides a means of reconfiguring the transmitter. Digital communication utilizes an alternating current superimposed on the analog output (4 ... 20 mA) that does not affect any meters connected to the output.

Transmission method

FSK modulation of the current output (4 ... 20 mA) is implemented in accordance with the Bell 202 standard. The maximum signal amplitude is 1.2 mA SS.

Logic 1 representation: 1200 Hz

Logic 0 representation: 2200 Hz

The SMART VISION® WINDOWS software is used for HART communication. Detailed documentation is available on request.

Current output load

Minimum > 250 Ω, maximum 750 Ω

The maximum cable length (shielded and twisted) is 1500 m (4921 ft) with a cross-section of 0.25 mm² (AWG 24).

Baud rate

1200 baud

Current output for alarm

The "High" state (= 21 ... 23 mA) is programmable and corresponds to NAMUR NE43. Operation using the HART protocol is described in operating instructions D184B108Uxx.

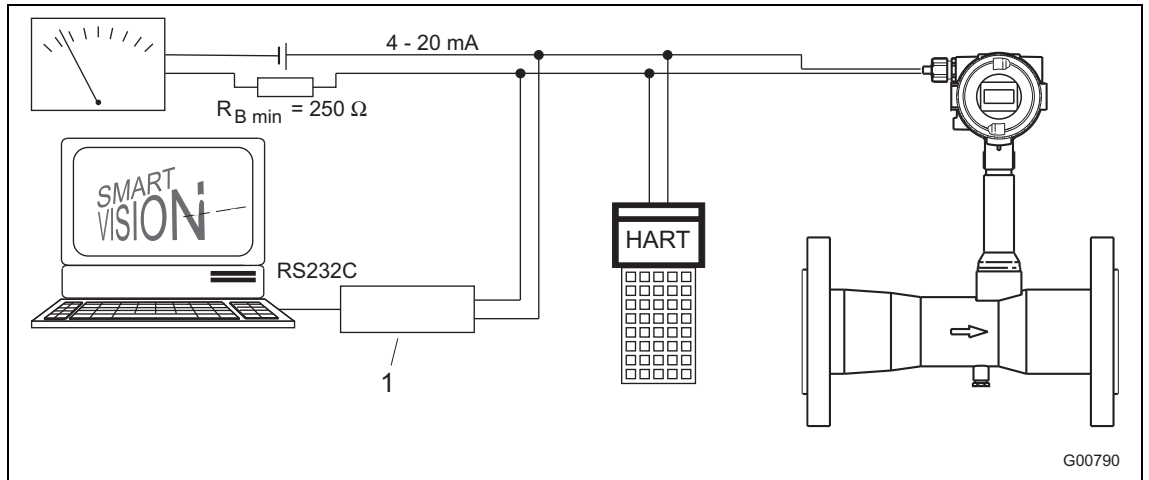


Fig. 41: HART communication

1 FSK modem



Important

Up-to-date DD/EDD data can also be downloaded from the ABB homepage at <http://www.abb.com/flow>.

7.2 PROFIBUS PA communication



Important

This section contains basic information about flowmeter designs supporting PROFIBUS PA and FOUNDATION fieldbus communication. You will find more detailed information in the supplementary interface descriptions for the meter "PROFIBUS PA interface description" (part no. D184B093Uxx). These appear on the CD supplied with the meters (part no. D699D002Uxx), which, if necessary, can be ordered separately from ABB at any time free of charge.

The fieldbus transmitters are suitable for connection to DP / PA segment couplers and the ABB MB204 multibarrier. The meter's PROFIBUS PA interface conforms with Profile B V.3.0 (fieldbus standard PROFIBUS, EN 50170, DIN 19245 [PRO91]). The transmitter transmission signal is designed according to IEC 61158-2. Certification has been obtained to verify conformity with the standard. The meter's PROFIBUS PA ID no. is 05DC hex. The meter can also be operated using standard ID numbers 9700 hex and 9740 hex. The meter's intrinsically safe design conforms to the FISCO model.

Configuration instructions

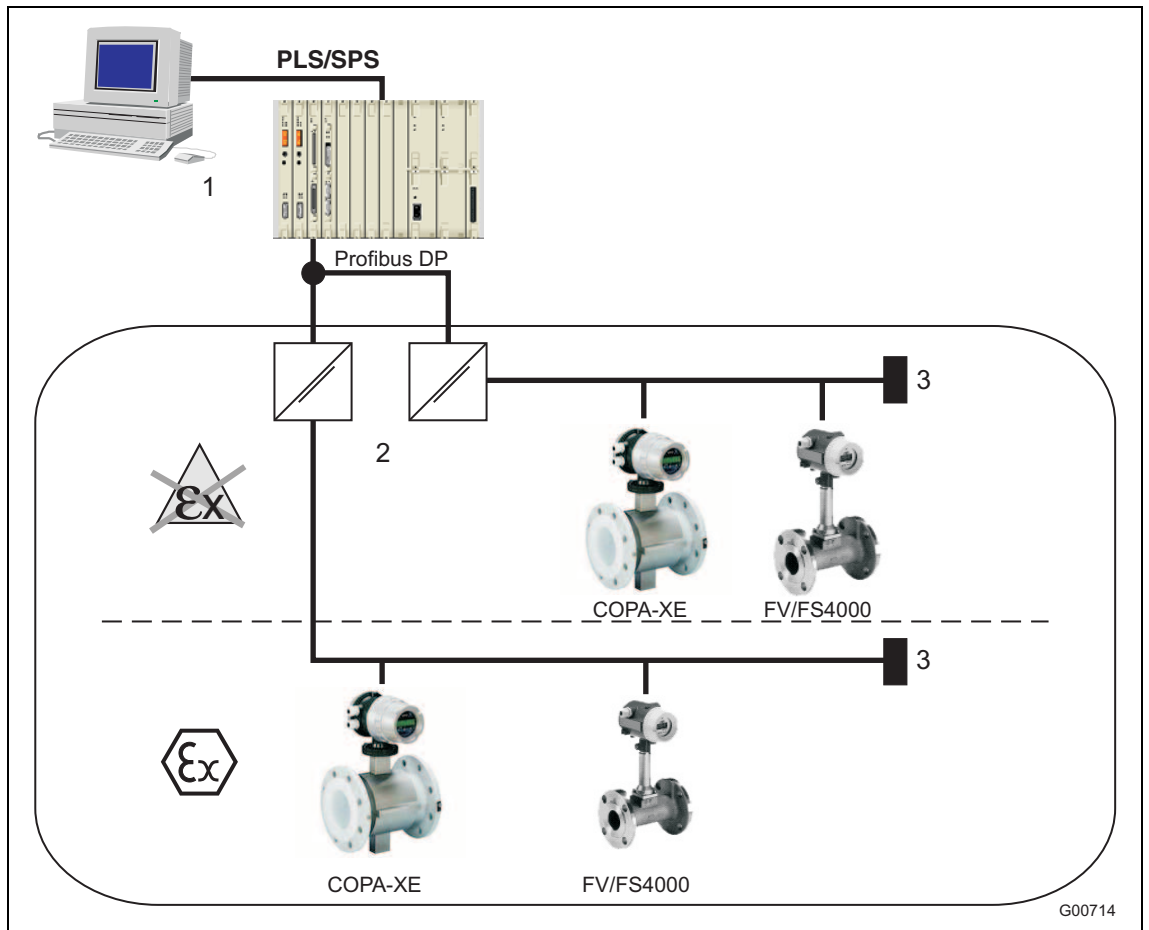


Fig. 42: Typical PROFIBUS PA network

- 1 I/O level
- 2 DP / PA bus coupler (with bus termination)
- 3 Bus termination

The maximum number of bus nodes in a segment is listed in the following table.

| DP / PA segment coupler | Type I | Type II | Type III | Type IV |
|---|--------------|-----------|-----------|---------------|
| Area of application | Ex ia/ib IIC | Ex ib IIC | Ex ib IIC | Non-hazardous |
| Supply voltage | 13.5 V | 13.5 V | 13.5 V | 24 V |
| Supply current I _s | ≤ 110 mA | ≤ 110 mA | ≤ 250 mA | ≤ 500 mA |
| Loop resistance R _s | ≤ 40 Ω | ≤ 40 Ω | ≤ 18 Ω | ≤ 130 Ω |
| Cable length, type B AWG 20 (0.5 mm ²) | ≤ 500 m | ≤ 500 m | ≤ 250 m | ≤ 1700 m |
| Cable length, type A AWG 18 (0.8 mm ²) | ≤ 900 m | ≤ 900 m | ≤ 400 m | ≤ 1900 m |
| No. of nodes at 10 mA | 8 | 8 | 19 | 32 |

Brochure "PROFIBUS - Solutions from ABB" (no. 30/FB-10) contains more detailed information about configuration. Accessories such as terminal blocks, connectors, and cables are listed in data sheet 10/63-6.44. Supplementary information also appears both on the ABB homepage at <http://www.abb.com> and on the homepage of the PROFIBUS User Organization at <http://www.profibus.com>.

System integration

The use of the PROFIBUS PA Profile B, V3.0, means that the meters are not only interoperable (in other words, devices from different manufacturers can be physically connected to one and the same bus and communicate on it), they are also interchangeable (in other words, devices from different manufacturers can be interchanged without having to modify the configuration in the process control system).

To support interchangeability, ABB provides three different GSD (generic station description) files for system integration. During system integration, users decide whether to install the full range of functions or only part. Devices are interchanged using the ID number selector parameter, which can only be modified on an acyclic basis. The following table describes the available GSD files:

| Number and type of function blocks | ID number | GSD file name | Bitmaps |
|---|-----------|---------------|--|
| 1 x AI | 0 x 9700 | PA 139700.gsd | ABB05DCb.bmp ABB05DCn.bmp ABB05DCs.bmp |
| 1 x AI; 1 x TOT | 0 x 9740 | PA 139740.gsd | |
| 2 x AI; 1 x TOT and all manufacturer-specific parameters | 0 x 05DC | ABB_05DC.gsd | |

The GSD files appear on the CD included in the scope of supply. The standard GSD files "PA1397xx.gsd" are available for download from the PNO homepage at <http://www.profibus.com>.

The GSD files, along with the "PROFIBUS PA interface description" for the device (part no. D184B093Uxx) appear on the CD included in the scope of supply (part no. D699D002Uxx). The CD can be ordered separately from ABB at any time free of charge if required.

Block diagram

The diagram illustrates the function of the blocks available in the device. A communication tool or a PLC with "master class 2" functionality can access all blocks for parameterization acyclically.

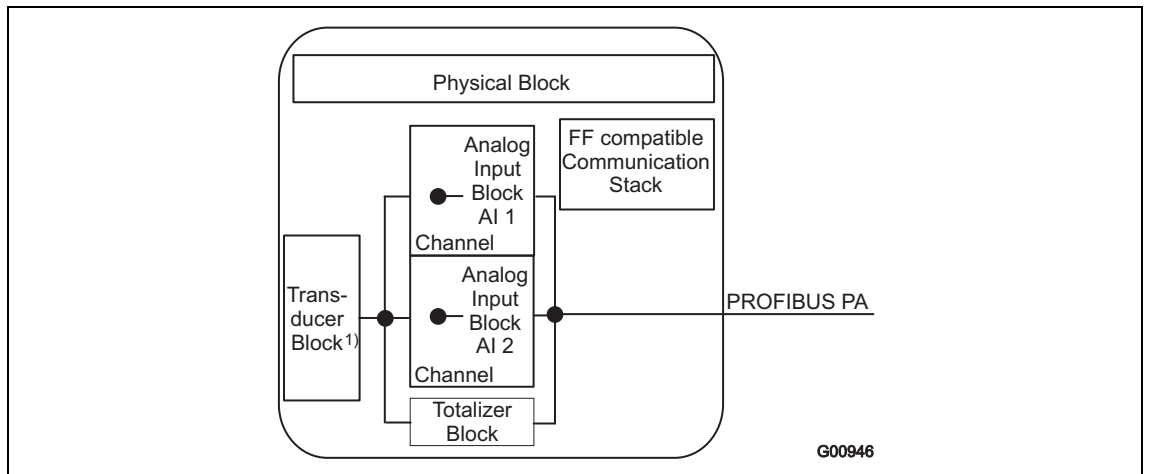


Fig. 43: Block diagram

1) Flow rate, temperature (option)

| Block | Description |
|--|--|
| Physical block (meter properties and current status) | Contains device-specific properties such as software version, TAG no., etc. |
| Transducer block (measuring parameters) | Contains flowmeter data such as nominal size, k factor measuring ranges, etc., along with all manufacturer-specific parameters not contained in the function blocks. |
| Analog input block (output of measured value and status) | Users can select the measured values which are relevant for their applications (Qv (volume flow, Qn (volume flow under standard conditions), Qm (mass flow) or temperature (option)) via the channel selector. |
| Totalizer block | The totalizer reading can be checked or modified via the PROFIBUS PA-DTM in SMART VISION here acyclically, for example. The totalizer can be reset cyclically. |



Important

Detailed descriptions of the blocks / parameters appear in the separate "PROFIBUS PA interface description" for the device (part no. D184B093Uxx). This appears on the CD included in the scope of supply.

Parameter settings are made acyclically via the device's PROFIBUS PA-DTM.

7.3 FOUNDATION fieldbus communication

The fieldbus transmitters have been designed for connection to special bus power supply units and the ABB MB204 multibarrier. On the standard design (model ...40), the permissible output voltage range is 9 ... 32 V DC. On the intrinsically safe design (model ...4A), the voltage is limited to 9 ... 24 V DC. The device's FOUNDATION fieldbus interface conforms to standards FF-890/891 and FF902/90. The transmission signal of the transmitter is designed in accordance with IEC 61158-2.

The device has been registered by the Fieldbus Foundation and meets all current requirements (successful completion of the FF Conformance Test, compliance with FF spec. 1.4 and successful completion of the test with the ITK 4.5.1.). The reg. no. is IT013600. The device is registered with the Fieldbus Foundation under manufacturer ID 0x000320 and device ID 0x0015. The device supports LAS functionality. The device's intrinsically safe design conforms to the FISCO model.

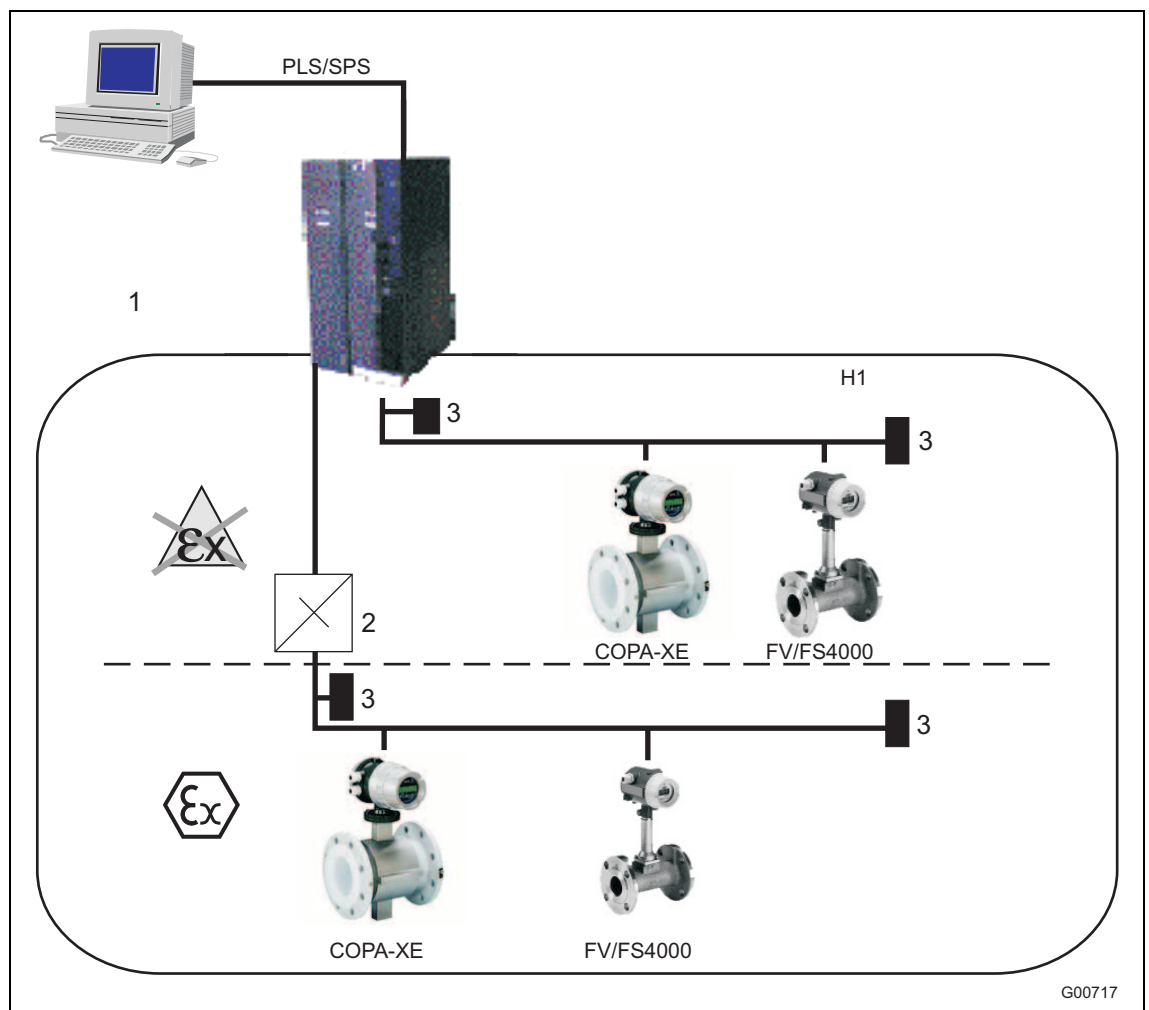


Fig. 44: Typical FOUNDATION fieldbus network

- 1 I/O level / Linking device
- 2 Zener barrier
- 3 Bus termination



Important

In this level, the I/O level also provides the voltage supply for the FOUNDATION fieldbus (H1). Bus termination can also be implemented in the linking device.

The maximum number of bus nodes in a segment is listed in the following table:

| 2- or 4-wire technology | No explosion protection | Ex ia (intrinsic safety) |
|---------------------------------|-------------------------|--------------------------|
| 2-wire technology (bus-powered) | 2 ... 12 | 2 ... 6 |
| 4-wire technology | 2 ... 32 | 2 ... 6 |

For more detailed configuration instructions, please see brochure "FOUNDATION fieldbus solutions from ABB" (brochure no. 7592 FF). Further information is also available on the ABB homepage at <http://www.abb.com> as well as on the homepage of the Fieldbus Foundation at <http://www.fieldbus.org>.

System integration

For integration into a process control system, a DD (device description) file, which contains the device description, as well as a CFF (common file format) file are required. The CFF file is required for segment engineering. Engineering can be performed online or offline.

The function blocks are described in the separate "FOUNDATIONS Fieldbus interface description for the meter" (part no. D184B093U23).

You can find both files, as well as the interface description, on the CD included in the scope of supply (part no. D699D002U01). The CD can be ordered separately from ABB at any time free of charge if required. The files can also be downloaded from <http://www.fieldbus.org>.

Block diagram

The diagram illustrates the function of the blocks available in the device. Communication tools such as the NI Configurator, system tools or even a PLC supporting the appropriate function can be used to access all blocks for parameterization acyclically.

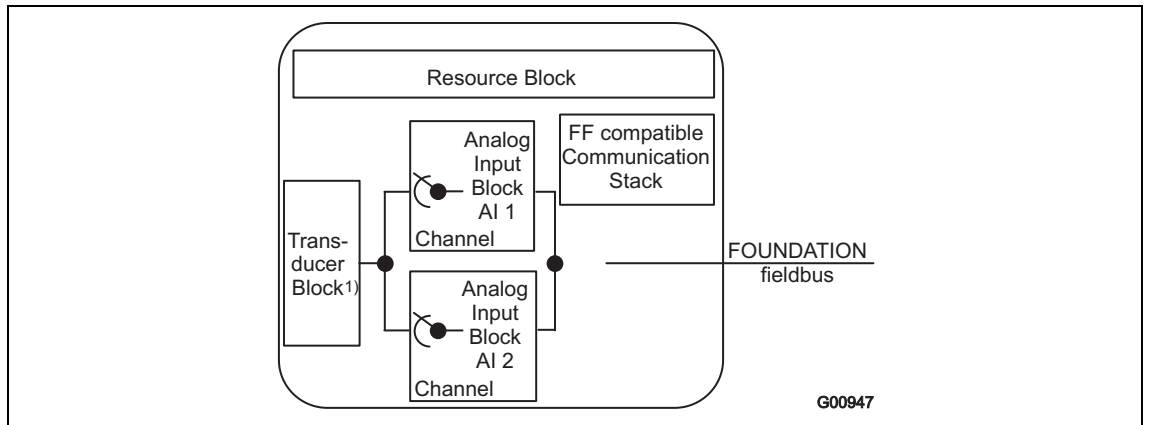


Fig. 45: Block diagram

1) Flow (instantaneous value, total) and temperature (option)

| Block | Description |
|--------------------|--|
| Resource block | Contains device-specific properties such as software version, TAG no., etc. |
| Transducer block | Contains flowmeter data such as nominal size, k factor, etc., along with all manufacturer-specific parameters not contained in the AI block. These include the volume flow totalizer parameters. The transducer block also contains a totalizer. |
| Analog input block | Users can select the measured values which are relevant for their applications (Qv (volume flow, Qn (volume flow under standard conditions), Qm (mass flow), totalizer or temperature (option)) via the channel selector. |



Important

Detailed descriptions of the blocks / parameters appear in the separate "PROFIBUS PA interface description" for the device (part no. D184B093Uxx). This appears on the CD included in the scope of supply.

Parameter settings are made acyclically.

7.4 Software history

7.4.1 TRIO-WIRL FV4000 HART version

| Software D699F004U01 | | | |
|----------------------|---------------|----------------------|--|
| Software version | Revision date | Type of changes | Documentation / Supplements |
| A.1X | 12/1999 | Market entry | |
| A.2X | Not released | Function enhancement | |
| A.3X | 07/2006 | Function enhancement | Change to current output response to NAMUR NE43 |
| A.4X | 11/2008 | Function enhancement | Masking of the current output in the event of error 3 / error 9 |
| B.1X | 11/2008 | Market entry | Software for transmitter D674A659U10 and U12, launch 12/2008 onwards, same functionality at A.42 |

7.4.2 TRIO-WIRL FV4000 PROFIBUS PA

| Software D200SF003U01 | | | |
|-----------------------|---------------|----------------------|--|
| Software version | Revision date | Type of changes | Documentation / Supplements |
| A.1X | 12/1999 | Market entry | |
| A.2X | 09/2006 | Function enhancement | Totalizer arithmetic modified, higher internal readings possible |

7.4.3 TRIO-WIRL FV4000 FOUNDATION fieldbus

| Software D200F002U01 | | | |
|----------------------|---------------|----------------------|------------------------------------|
| Software version | Revision date | Type of changes | Documentation / Supplements |
| A.1X | 04/2002 | Market entry | |
| A.2X | 07/2007 | Function enhancement | Reregistration due to new CFF file |

8 Parameterization

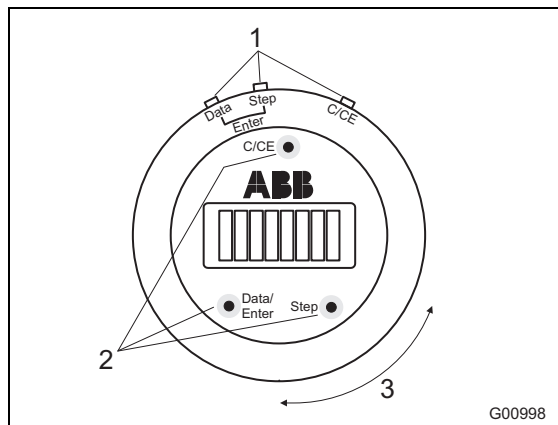
8.1 Standard display format

When the device is switched on, the flowmeter runs various self-tests automatically.

The standard display then appears (process information). The configuration of the display can be defined by the user. The following display formats can be selected:

| Display format | Operating flow with physical display | Totalized operating flow | Fluid temperature |
|----------------|--|--|--|
| Display | <div style="border: 1px solid black; padding: 5px; display: inline-block;"> Qv m³/h 13.56 </div> | <div style="border: 1px solid black; padding: 5px; display: inline-block;"> Qv m³ 409.8 </div> | <div style="border: 1px solid black; padding: 5px; display: inline-block;"> T °C 185.6 </div> |

8.2 Operation using the control buttons on the transmitter



- 1 Control buttons
- 2 Magnet sensors
- 3 Rotating display panel

Fig. 46: Position of control buttons and magnet sensors

Control buttons

To enter data with the housing cover removed, use the three control buttons "Data", "Step", and "C/CE" at the top of the display panel.

| Control button | Function |
|----------------|---|
| C/CE | Press the "C/CE" control button to change from the operating mode to the menu and vice versa. |
| Step | The "Step" control button is one of two arrow buttons. Press "Step" to move forward through the menu. All required parameters can be called up. |
| Data | The "Data" control button is one of two arrow buttons. Press "Data" to move backward through the menu. All required parameters can be called up. |
| Enter | <p>The "Enter" function requires that both arrow buttons, "Step" and "Data", be pressed simultaneously. The "Enter" function activates and deactivates programming protection. It can also be used to call up further parameters for modification and apply new, selected or set parameters.</p> <p>The "Enter" function can also be activated by pressing and holding down just the "Data" control button for more than 3 s. The display flashes to indicate that this function is active. As soon as the control button is released, the "Enter" function is executed.</p> <p>If, following execution of the "Enter" function, no more entries are made for approx. 10 s, the display will revert to the previous value. After another 10 s without any entries, the process information will reappear.</p> |

Magnet sensors

When the housing cover is closed, data is entered with the "Data / ENTER", "Step", and "C/CE" magnet sensors and the magnet stick.

| Control button | Function |
|----------------|--|
| C/CE | These magnet sensors function in the same way as the control buttons of the same name. |
| Step | |
| Data | |
| Enter | The "Enter" function is activated by pressing and holding down the "Data / Enter" magnet sensor for more than 3 s. The display flashes to indicate that this function is active. As soon as the magnet stick is taken away from the magnet sensor, the "Enter" function is executed. |



Important

The flow continues to be measured during data entry.

8.3 Navigation and data entry

8.3.1 Selecting parameters in a submenu

1. Deactivate programming protection (see page 65).



Important

If an attempt is made to modify a parameter when programming protection is active, "* Prog. protect." will appear on the display.

2. Press the "C/CE" button once.
The display changes to menu mode.
3. Press the "Data" and "Step" buttons to select the required menu.
4. Then execute the "Enter" function (by pressing "Data" and "Step" at the same time).
The current parameter settings appear on the display.
5. Run the "Enter" function again.
6. Repeat steps 1 to 4.
An underscore appears after the current parameter settings.
7. Now press "Data" or "Step" to select the new parameter and apply your selection with the "Enter" function.
8. Reactivate programming protection (see page 66).

8.3.2 Changing a parameter value

Where there are multiple parameters, a numerical value has to be entered. The "Data" and "Step" buttons are also used to enter numbers.

If a parameter requiring a numerical entry is selected, a "0" will appear in the top left-hand line and the corresponding unit will be shown in the line below.

1. Press "Data" to enter the numerical value.
Pressing this button repeatedly will show the numbers 1 to 0 consecutively, along with special characters if these are required.
2. Once the correct numerical value has been set, press the "Step" button.
Another "0" appears in the next numerical location.
3. Repeat step 1 to set the correct numerical value here.
4. Keep repeating steps 2 and 3 until the entire numerical value has been entered.
5. Finally, run the "Enter" function again.
The numerical value of the parameter is applied.

8.3.3 Saving parameters



Important

Should the supply power fail, all device parameters and the meter reading will be backed up safely in an FRAM. This means that the transmitter will be ready to resume operation immediately when the power is restored.

Parameterization

8.4 Parameter overview

8.4.1 Menu levels

The menu system has three levels.

| Menu level | Function |
|----------------------|---|
| Standard (level 1) | The "Standard" menu is used for quick parameterization of the meter. All customer-specific menu entries required for the operation of the meter can be made here. |
| Specialist (level 2) | Unlike the "Standard" menu, the "Specialist" menu shows all customer-relevant menu parameters. |
| Service (level 3) | The "Service" menu is accessed exclusively for after-sales service of ABB Automation Products. |

8.4.2 Menu level parameters

| Standard | Specialist | Service |
|--|--|---------|
| Progr. level P.protect. code Language QmaxDN operation Qmax Totalizer Damping Hardware config. Display Error register | Progr. level P.protect. code Language Flowmeter sensor Nominal size Mean k factor Operating mode Unit Qvol QmaxDN operation Qmax Qmin operation Totalizer Damping Hardware config. Iout for alarm Error 3/9 Pulse factor Display Error register Function test Device address Order number 50VT4 02/10/07 | - |

8.5 Programming protection

8.5.1 Deactivating programming protection



Important

Programming protection has to be deactivated prior to parameterization.

| Step | Button / Magnet sensor | Display format | Comments |
|--|--------------------------|---|----------------------|
| | | <div style="border: 1px solid black; padding: 2px; display: inline-block;">Qv % 10.5</div> | Standard display |
| 1. Activate parameterization mode. | "C/CE", "Step" or "Data" | <div style="border: 1px solid black; padding: 2px; display: inline-block;">Language</div> | A parameter appears. |
| 2. Find the "Progr. level" menu item. | "Step" or "Data" | <div style="border: 1px solid black; padding: 2px; display: inline-block;">Progr. Level</div> | |
| 3. Show the current programming level. | „Enter“ | <div style="border: 1px solid black; padding: 2px; display: inline-block;">Blocked</div> | |
| | „Enter“ | <div style="border: 1px solid black; padding: 2px; display: inline-block;">Blocked</div> | |
| 4. Select the required programming level. | "Step" or "Data" | <div style="border: 1px solid black; padding: 2px; display: inline-block;">Standard_</div> | or |
| | "Step" or "Data" | <div style="border: 1px solid black; padding: 2px; display: inline-block;">Specialist_</div> | or |
| | "Step" or "Data" | <div style="border: 1px solid black; padding: 2px; display: inline-block;">Service_</div> | |
| 5. Return to the parameterization mode menu level. | „Enter“ | <div style="border: 1px solid black; padding: 2px; display: inline-block;">Progr. Level</div> | |

8.5.2 Activating programming protection



Important

Programming protection has to be reactivated following parameterization.

| Step | Button / Magnet sensor | Display format | Comments |
|--|------------------------|-------------------------|------------------|
| 1. Find the "Progr. level" menu item. | "Step" or "Data" | Progr. Level | |
| 2. Show the current programming level. | „Enter“ | Specialist | |
| | „Enter“ | Specialist_ | |
| 3. Select the "Blocked" parameter. | "Step" or "Data" | Service_ | or |
| | "Step" or "Data" | Standard_ | or |
| | "Step" or "Data" | Blocked | |
| 4. Reactivate programming protection. | „Enter“ | Progr. Level | |
| 5. Go back to standard display. | „C/CE“ | Qv % 10.5 | Standard display |

8.6 Menu structure



Important

All parameters with a dark-gray background are part of the "Standard" menu level.

| Buttons | Menu item | Buttons | Set parameter | Buttons | Configurable parameters | Comments |
|------------------|--------------------------|----------------------|-------------------------|------------------|-------------------------|---|
| „C/CE“ | Progr. Level | „Enter“ + „Enter“ | Blocked | „Step“ | Standard_ | "Standard" menu: Standard menu with all customer-specific menu entries needed to operate the meter. |
| | | | | „Step“ | Specialist_ | "Specialist" menu: Special menu with all customer-specific menu entries. |
| | | | | „Step“ | Service_ | "Service" menu: Additional display of the service menu following entry of the correct service code number "SRV code" (this menu is only available to ABB Service). Entry type: from table |
| „Data“ „Step“ | ProgProt Code | „Enter“ + „Enter“ | Change Code | „Enter“ | 0 | If a number other than "0" (factory setting) has been selected for the "P.protect. code", it will only be possible to deactivate programming protection by entering a number from 1 to 9999 as the "P.protect. code". |
| | | „Enter“ | New Code | „Enter“ | 9999 | |
| „Data“ „Step“ | Language | „Enter“ + „Enter“ | English_ | „Data“ „Step“ | German_ | Languages: German, English |
| „Data“ „Step“ | Flowmeter primary | „Enter“ + „Enter“ | VORTEX VT / VR_ | „Data“ „Step“ | DDM ST / SR_ | To select the flowmeter sensor: VORTEX: FV4000-VT4/VR4 DDM: FS4000-ST4/SR4 |
| „Data“ „Step“ | Meter size | „Enter“ | D 15mm 0.5in | | | To display the nominal size of the flowmeter sensor: A: ANSI D: DIN |
| „Data“ „Step“ | Avg. k-Factor | „Enter“ | 52000.0 1/m3 | | | To display the mean calibration: k factor |
| „Data“ „Step“ | Diam. Correct. | „Enter“ | Sched.40 | | | Selection: Sched.40, Sched.80 This parameter only appears on flowmeter sensors with ANSI process connection. Correction of the inner diameter offset for connecting cables Sched. 40 or Sched.80. |

| Buttons | Menu item | Buttons | Set parameter | Buttons | Configurable parameters | Comments |
|------------------|------------------|----------------------|------------------|---------|-------------------------|---|
| „Data“ „Step“ | Flow mode | „Enter“ + „Enter“ | Liquid Qv | | Liquid Qv | Medium: Fluid Operating mode: Operating volume Selection: Volume flow i Important The selection of the possible operating modes depends upon the medium and the sensor design. |
| | | | | „Step“ | Liquid Qm (D) | Medium: Fluid Operating mode: Mass Selection: Mass flow |
| | | | | „Step“ | Liquid Qm (D,T) | Medium: Fluid Operating mode: Mass with correction (Pt100 required) Selection: Mass flow |
| | | | | „Step“ | Liquid Qm (V,T) | Medium: Fluid Operating mode: Mass with correction (Pt100 required) Selection: Mass flow |
| | | | | „Step“ | Gas Qv | Medium: Gas / Steam Operating mode: Operating volume Selection: Operating flow |
| | | | | „Step“ | Gas Norm Qn(pT) | Medium: Gas Operating mode: Standard volume with correction (Pt100 required) Selection: Standard flow |
| | | | | „Step“ | Gas std Qs (Cmp) | Medium: Gas Operating mode: Standard volume Selection: Standard flow |
| | | | | „Step“ | Gas Mass Qm (pT) | Medium: Gas Operating mode: Mass with correction (Pt100 required) Selection: Mass flow |
| | | | | „Step“ | Gas Mass Qm (D) | Medium: Gas / Steam Operating mode: Mass Selection: Mass flow |

| Buttons | Menu item | Buttons | Set parameter | Buttons | Configurable parameters | Comments |
|------------------|----------------------------|----------------------|-------------------------|---------|--------------------------|---|
| | | | | „Step“ | S-Steam Qm | Medium: Saturated steam Operating mode: Mass with correction (Pt100 required) Selection: Saturated steam mass flow |
| | | | | „Step“ | S-Steam Qv | Medium: Saturated steam Operating mode: Operating volume Selection: Saturated steam volume flow |
| „Data“ „Step“ | Unit Density | „Enter“ + „Enter“ | g/ml_ | „Step“ | g/cm3_ | Selection: g/ml, g/cm3, g/l, kg/l, kg/m3, lb/ft3, lb/ugl The menu appears when the following operating modes are selected: Fluid Qm (D,T), fluid Qm (V,T), gas mass Qm (pT), gas mass Qm (D) |
| „Data“ „Step“ | Ref. density | „Enter“ + „Enter“ | 1.000 kg/l | „Enter“ | 0 kg/l | Selection: 0.001 ... 1000000 The menu appears when the following operating modes are selected: Fluid Qm (D,T), fluid Qm (V,T), gas mass Qm (D) |
| „Data“ „Step“ | Normal dens. | „Enter“ + „Enter“ | 0.001 kg/l kg/l | „Enter“ | 0 kg/l | Selection: 0.000 ... 0.100 The menu appears when the following operating mode is selected: Gas mass Qm (pT) |
| „Data“ „Step“ | Compressibility | „Enter“ + „Enter“ | 1.000 | „Enter“ | 0 | Selection: 0.001 ... 1000000 The menu appears when the following operating mode is selected: Gas standard Qs (Cmp) Standard factor = ρ_b / ρ_0 |
| „Data“ „Step“ | Standard Conditions | „Enter“ + „Enter“ | 1.0133 bara 0 °C | „Enter“ | 1.0133 bara 20 °C | Selection: 0.001 ... 1000000 The menu appears when the following operating modes are selected: Gas mass Qm (pT), gas standard Qn (pT) |

Parameterization

| Buttons | Menu item | Buttons | Set parameter | Buttons | Configurable parameters | Comments |
|------------------|-------------------------------|----------------------|---------------|---------|-------------------------|---|
| „Data“ „Step“ | Units Temp | „Enter“ + „Enter“ | °C _ | „Enter“ | F _ | Selection: °C, F, K |
| „Data“ „Step“ | Reference Temp | „Enter“ | 20.0 °C | | | Selection: -200.0 ... 500 The menu appears when the following operating modes are selected: Fluid Qm (D), fluid Qm (D,T), gas standard Qs (Cmp) |
| „Data“ „Step“ | Pressure Poper abs | „Enter“ + „Enter“ | 1.0 bar | | | The menu appears when the following operating mode is selected: Gas mass Qm (pT) |
| „Data“ „Step“ | Vol.Exp- ansion | „Enter“ + „Enter“ | 1.00 %/K | | | The menu appears when the following operating mode is selected: Fluid Qm (V,T) |
| „Data“ „Step“ | Density extens. | „Enter“ + „Enter“ | 1.00 %/K | | | The menu appears when the following operating mode is selected: Fluid Qm (D,T) |
| „Data“ „Step“ | Units Qvol | „Enter“ + „Enter“ | l/s _ | „Step“ | l/m _ | Selection: l/s, l/m, l/h, m3/s, m3/m, m3/h, m3/d, ft3/s, ft3/m, ft3/h, ft3/d, usgps, usgpm, usgph, usmgd, igps, igpm, igph, igpd, bbl/s, bbl/m, bbl/h, bbl/d The menu appears when the following operating modes are selected: Fluid Qm (D,T), fluid Qm (V,T), gas mass Qm (pT), gas mass Qm (D) |
| „Data“ „Step“ | Units Qm | „Enter“ + „Enter“ | g/s _ | „Step“ | g/m _ | Selection: g/s, g/m, g/h, kg/s, kg/m, kg/h, kg/d, t/m, t/h, t/d, lb/s, lb/m, lb/h, lb/d The menu appears when the following operating modes are selected: Fluid Qm (D), fluid Qm (D,T), gas standard Qs (Cmp), gas mass Qm (pT), gas mass Qm (D) |



Important

The "Qvol" and "Qm" parameters are dependent upon the selection made under "Operating mode".

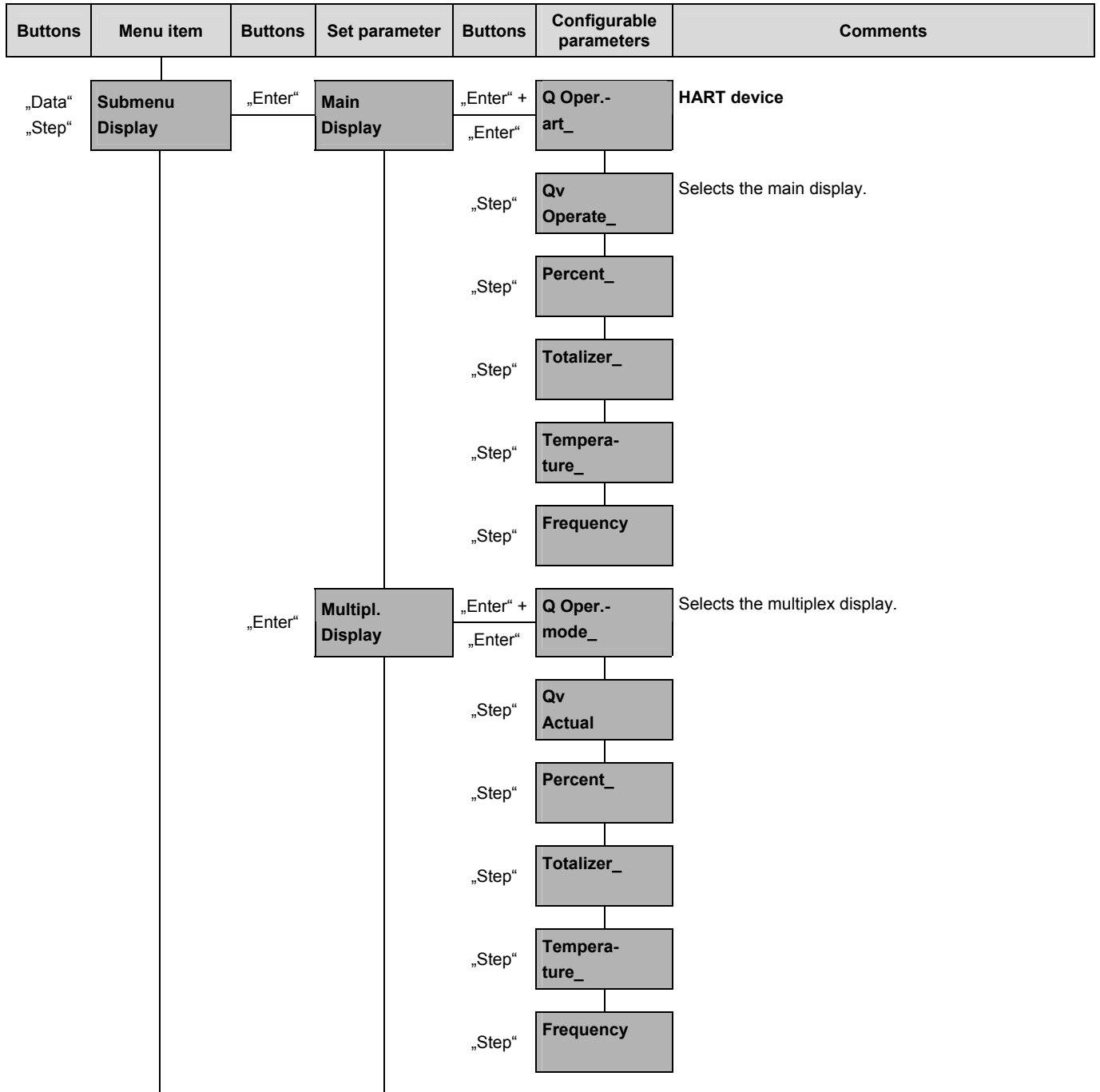
| Buttons | Menu item | Buttons | Set parameter | Buttons | Configurable parameters | Comments |
|------------------|--------------------------|----------------------|----------------------------|---------|-------------------------------|---|
| „Data“ „Step“ | QmaxDN Actual | „Enter“ + „Enter“ | 84.000 m3/h | | | Displays the maximum flowrate for the selected nominal size. |
| „Data“ „Step“ | Qmax | „Enter“ + „Enter“ | 84.000 m3/h | „Enter“ | 0 m3/h | Selection: 0.15 ... 1.15 x QmaxDN QmaxDN = Upper range value for the selected flow mode (= 20 mA) |
| „Data“ „Step“ | Qmin Actual | „Enter“ | 1.000 m3/h | „Enter“ | 0 m3/h | 2 ... 25 % of the QmaxDN volume |
| „Data“ „Step“ | Totalizer | „Enter“ | Totalizer value | „Enter“ | 0.0000 m3 | Sets the totalizer to a defined starting value. |
| | | | Over- flow | „Enter“ | 10 | Displays the totalizer overflow: max. 65,535 1 overflow = 10,000,000 |
| | | | Units Totalizer | „Enter“ | m3 ft3 | Selection: m3, ft3, usgal, igal, igl, bbl, l, g, kg, t, lb Selects the totalizer unit as a function of the selected operating mode (volume or mass flow). |
| | | | Totalizer reset | „Enter“ | Reset -> Enter_ | Press "Enter" to clear the totalizer and the overflow. |
| „Data“ „Step“ | Damping | „Enter“ | 50.0 s | „Enter“ | 0 s | Selection: 0.2 ... 100 s Attenuates the current output. Response time: 1 τ (= 63 %) for sudden changes in flow. |

| Buttons | Menu item | Buttons | Set parameter | Buttons | Configurable parameters | Comments |
|------------------|-------------------------|----------------------|----------------------|---------|-------------------------|--|
| „Data“ „Step“ | Hardware Config. | „Enter“ | I/HART s | „Enter“ | I/HART s | Configuration of the switching output: Current, HART protocol |
| | | | | „Step“ | I/HART/Puls_Bin_ | Current, HART protocol Switching output: Pulse |
| | | | | „Step“ | I/HART/Q_Alarm_ | Current, HART protocol Switching output: "Flow" max./min. alarm with alarm closed. |
| | | | | „Step“ | I/HART/T_Alarm_ | Current, HART protocol Switching output: "Temperature" max./min. alarm with alarm closed. |
| | | | | „Step“ | I/HART/S_Alarm_ | Current, HART protocol Switching output: System alarm with alarm closed. |
| „Data“ „Step“ | Min. Q_Alarm | „Enter“ + „Enter“ | 10.000 %_ | „Enter“ | 0 %_ | Selection: 0 ... 100 % of Qmax (0 % = off) Min. "flow" alarm |
| „Data“ „Step“ | Max. Q_Alarm | „Enter“ + „Enter“ | 80.000 %_ | „Enter“ | 0 %_ | Selection: 0 ... 100 % of Qmax (100 % = off) Max. "flow" alarm |
| | | | | | | i Important The "Min. Q_Alarm" and "Max. Q_Alarm" menu items are only displayed if the "I/HART/Q_Alarm" parameter is selected. |
| „Data“ „Step“ | Min. T_Alarm | „Enter“ + „Enter“ | 50 C_ | „Enter“ | 0 C_ | Selection: -60 ... 410 C (-60 C = off) Min. "temperature" alarm |
| „Data“ „Step“ | Max. T_Alarm | „Enter“ + „Enter“ | 180.000 C_ | „Enter“ | 0 C_ | Selection: -60 ... 410 C (410 C = off) Max. "temperature" alarm |
| | | | | | | i Important The "Min. Q_Alarm" and "Max. Q_Alarm" menu items are only displayed if the "I/HART/T_Alarm" parameter is selected. |

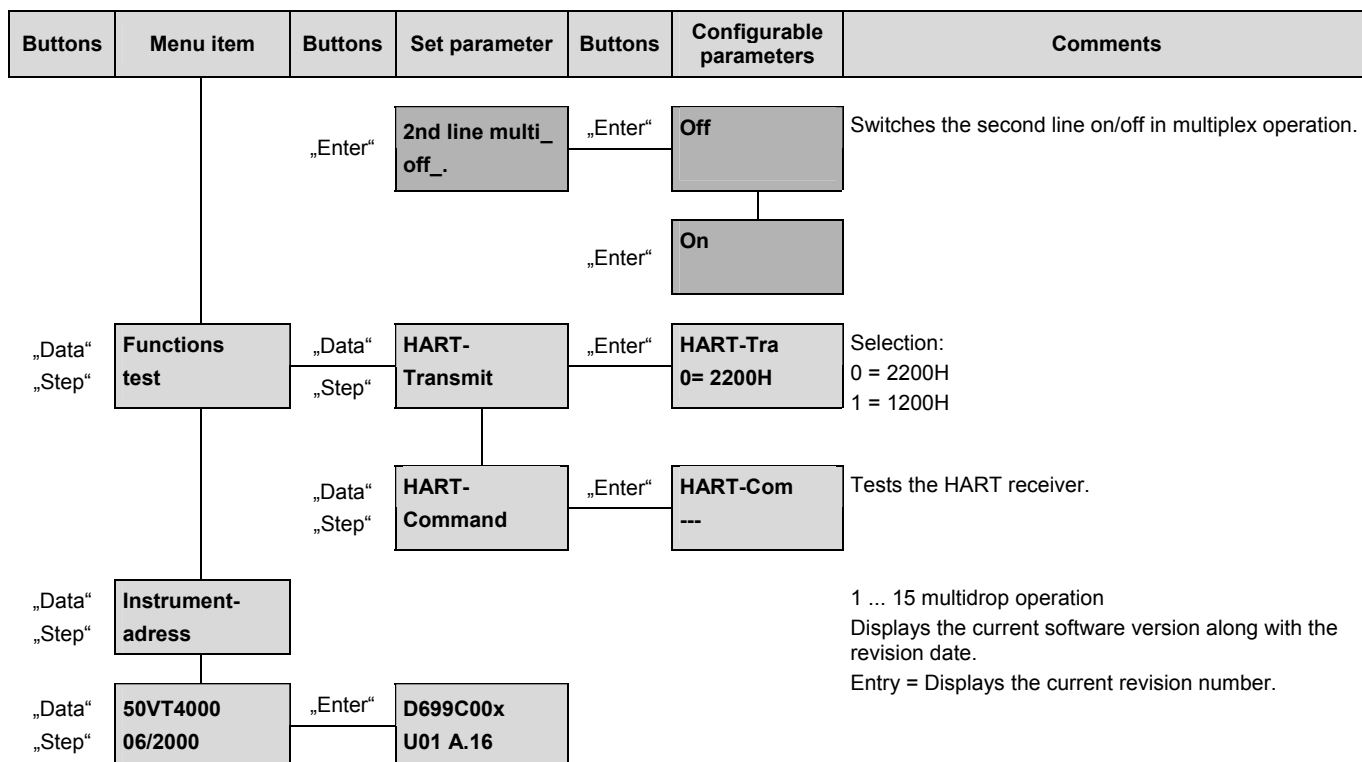
| Buttons | Menu item | Buttons | Set parameter | Buttons | Configurable parameters | Comments |
|------------------|----------------------------|----------------------|----------------------------|---------|-------------------------|---|
| „Data“ „Step“ | Error 3 / 9 | „Enter“ + „Enter“ | Error 3+9 aus_ | „Enter“ | Both on | Selection: on / off Activates / deactivates errors 3 + 9 (overshooting of measuring range by more than 3.125 %). |
| | | | | | Error 3 off | |
| „Data“ „Step“ | Iout at Alarm | „Enter“ | 22.4 mA_ | „Enter“ | 0 mA_ | Selection: 21 ... 23 mA Current output value for alarm programmable. |
| „Data“ „Step“ | Pulse Factor | „Enter“ | 100.000 1/m3 | „Enter“ | 5 1/m3 | Selection: 0.001 ... 1000 pulses / unit Selected unit for the output for the internal and external flow totalizer. |
| | | | | | | i Important The "Pulse width" menu is only displayed if the "I/HART/Pulse_Bin" parameter is selected. |
| „Data“ „Step“ | Pulse- width | „Enter“ | 10 ms | „Enter“ | 0 ms | Selection: 1 ... 256 ms Maximum 50 % on / off. If this value is overshoot, a warning will appear on the display. |
| „Data“ „Step“ | Error- Register | „Enter“ | Mains interrupt | „Enter“ | 14 | Totalizer for the number of power failures since first use. |
| | | „Data“ „Step“ | | | | Displays any errors that have occurred. Press the "Enter" button to reset. |

| Buttons | Menu item | Buttons | Set parameter | Buttons | Configurable parameters | Comments |
|------------------|----------------------|------------------|-----------------------|---------|-------------------------|---|
| „Data“ „Step“ | Function test | „Enter“ | Iout | „Enter“ | 0 % | Manually controlled test of current output. (100 % = 20 mA) |
| | | „Data“ „Step“ | Q Simulation | „Enter“ | 0.0 Hz | Selection: 0 ... 2500 Hz sensor frequency Simulation (current and pulse output). Switch on by entering the starting value in "Hz". Switch off by entering "0" Hz. On changing to the process display, the frequency can be modified with the "Data" and "Step" buttons (± 5 Hz). |
| | | „Data“ „Step“ | Main FRAM | | | |
| | | „Data“ „Step“ | Backup FRAM | | | |
| | | „Data“ „Step“ | Contact output | „Enter“ | Contact off | The contact is switched on or off as required with the "Data" and "Step" buttons. |
| | | „Data“ „Step“ | Pulse output | „Enter“ | 4Hz Rate on | Selection: 0 = pulses 1 = no pulse |

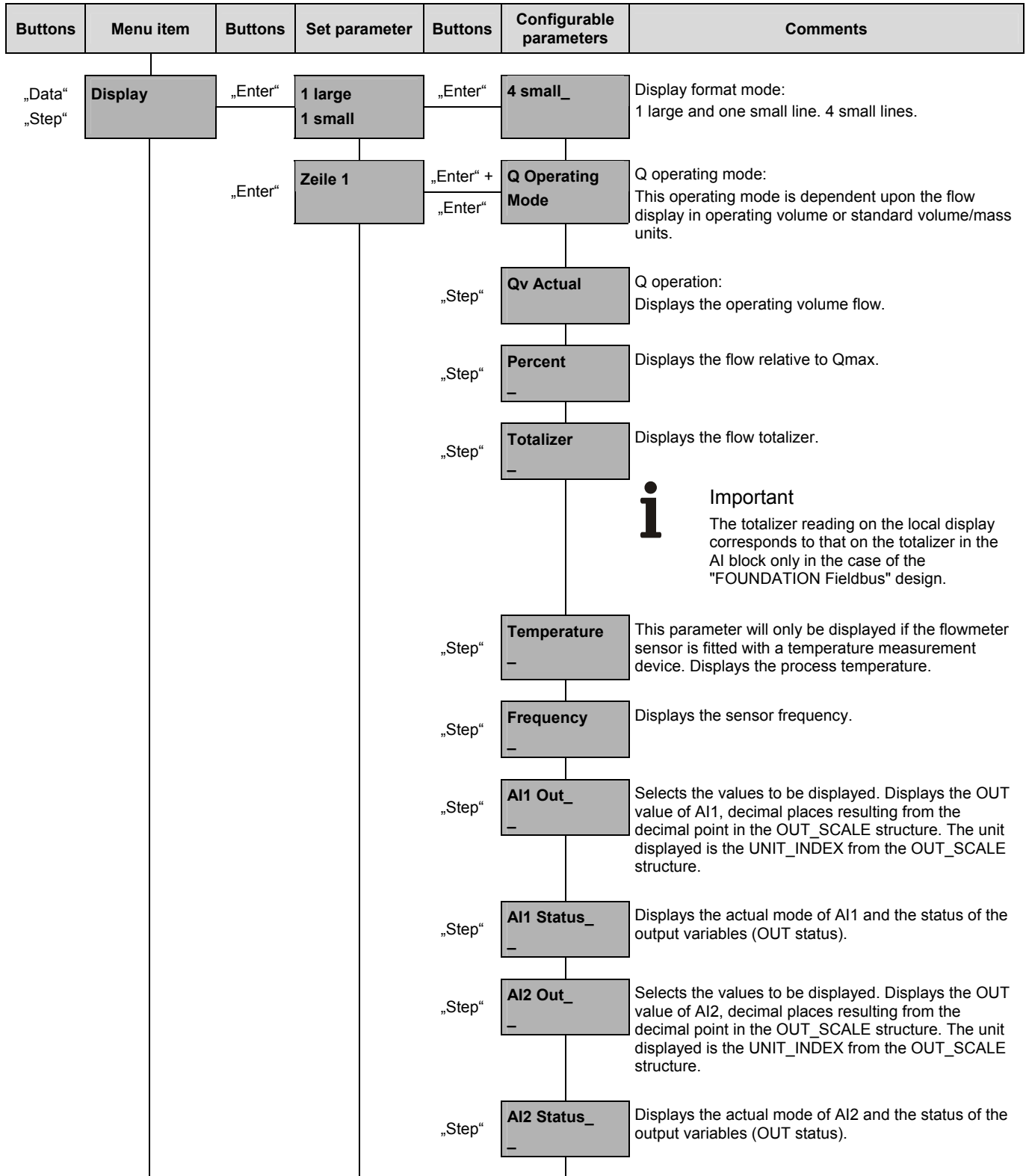
8.6.1 Menu structure – Enhancement for HART



Parameterization



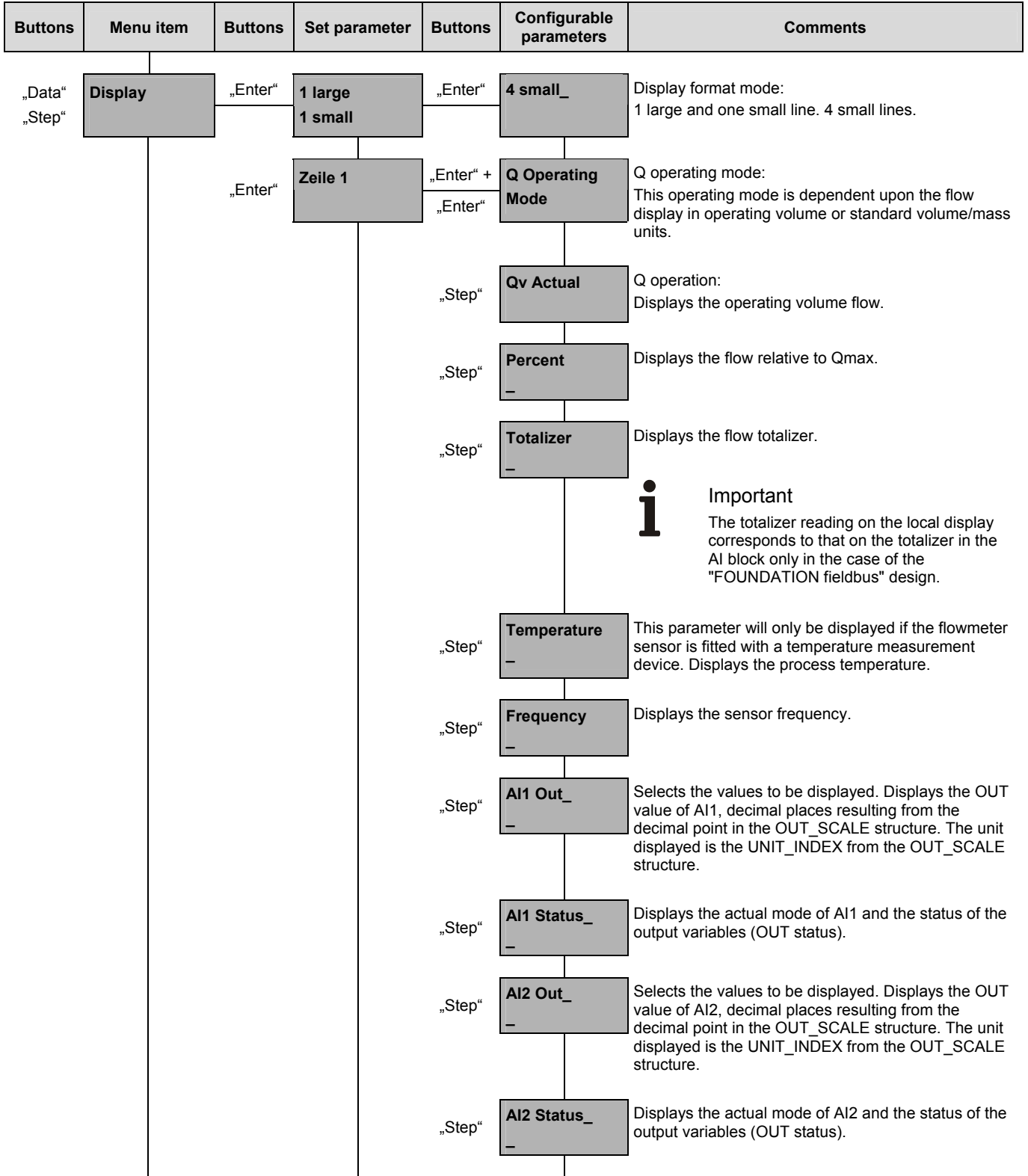
8.6.2 Menu structure – Enhancement for PROFIBUS PA



| Buttons | Menu item | Buttons | Set parameter | Buttons | Configurable parameters | Comments | |
|------------------|---------------------------|------------------|--------------------------------|--------------------------|-------------------------------------|---|--|
| „Data“ „Step“ | Display | „Enter“ | 1 large 1 small | „Enter“ | Totalizer Total_ | Displays the total value of the totalizer block. The displayed unit is UNIT_TOTAL. | |
| | | | | „Step“ | Totalizer Status_ | Displays the actual mode of the totalizer and the status of the output variables (total status). | |
| | | | | „Step“ | Adr + State_ | Displays the PA address and the status of cyclic communication (Stop, Clear, Operate). | |
| | | | „Enter“ | Display 2.row | „Enter“ | Totalizer | Displays the flow totalizer. |
| | | | „Enter“ | Display 4.row | „Enter“ | Q Operating Mode | Q operating mode: This operating mode is dependent upon the flow display in operating volume or standard volume/mass units. |
| | | | „Enter“ | Contrast ■■■■■ | | | The "Data" and "Step" buttons are used to set the display contrast. |
| | | | | | | | |
| „Data“ „Step“ | Error Register | „Enter“ | Mains interrupt | „Enter“ | 14 | Totalizer for the number of power failures since first use. | |
| | | „Data“ „Step“ | | | | | Displays any errors that have occurred. Press the "Enter" button to reset. |
| „Data“ „Step“ | Function test | „Data“ | Function DIP-Switch | „Enter“ | PA-Adr.:50 set by switch | Displays the current setting of the DIP switches on the digital panel. Switches 1-7: PROFIBUS address | |
| | | „Step“ | | „Enter“ | 1-7: Bus-Adr. Protect | Switch 8: Defines the addressing mode: Off = Addressing via bus On = Addressing via miniature switches 1-7 | |
| | | | | „Enter“ | 8: on = Adr by swit | Note: A change to the local bus address will only be applied when the device is switched on. | |
| | | | | „Enter“ | 8: off = Adr by bus | | |
| | | | | „Enter“ | x = on - = off xx----- | | |
| | | | | | | | |

| Buttons | Menu item | Buttons | Set parameter | Buttons | Configurable parameters | Comments |
|------------------|--|---------|---|---------|--|---|
| „Data“ „Step“ | PROFIBUS PA | „Enter“ | Software Rev Communication: 0 | | | Displays the communication software version. Sets the ID no. for the selector. Note: Modes can only be changed when in STOP and not during cyclic communication. |
| „Data“ „Step“ | | „Enter“ | IdentNr Selector Triowirl 05DC 2*AI+TOT | „Enter“ | IdentNr Selector Profile 9740 AI+TOT | Channel setting of the first AI block. When setting the channel, the unit for the channel is also copied to the AI block (to OUT_SCALE.UNIT_INDEX). |
| | | | | „Enter“ | IdentNr Selector Profile 9700 AI | |
| „Data“ „Step“ | | „Enter“ | AI1 Channel Qv | „Enter“ | AI1 Channel Qoper. mode | Channel setting of the first AI block. Selection and description as first AI block. Channel setting for totalizer block. |
| | | | | „Enter“ | AI1 Channel Temperature | |
| | | | | „Enter“ | AI1 Channel Frequency | |
| | | | | „Enter“ | AI1 Channel int. Total. | |
| „Data“ „Step“ | | „Enter“ | AI2 Channel Qv | „Enter“ | AI2 Channel Qoper. mode | Channel setting of the second AI block. Selection and description as first AI block. |
| „Data“ „Step“ | | „Enter“ | TOT Channel Qv | „Enter“ | TOT Channel Qoper. mode | Channel setting for totalizer block. |
| „Data“ „Step“ | TRIO-WIRL PA 50VT4 PA 11/2001 D200F003U01 A.1_ | | | | | Displays the current software version along with the revision date. |

8.6.3 Menu structure – Enhancement for FOUNDATION fieldbus



| Buttons | Menu item | Buttons | Set parameter | Buttons | Configurable parameters | Comments |
|------------------|---|------------------|--|---------|-----------------------------------|--|
| „Data“ „Step“ | Functions test | „Data“ „Step“ | Function DIP-Switch | „Enter“ | 1: Simulate Enable | Displays the current setting of the DIP switches on the digital panel. Switch 1: Releases the simulation of the AI function blocks. Switch 2: Hardware write protection for write access via bus (locks all blocks). Switch 3: Write protection for local operation of device (button and magnet stick). |
| | | | | „Enter“ | 2: Write Protect | |
| | | | | „Enter“ | 3: Simulate Enable | |
| | | | | „Enter“ | x = on - = off xx----- | |
| „Data“ „Step“ | FF | „Enter“ | Software Rev Communication: 0 | | | Displays the communication software version for the FOUNDATION fieldbus. Displays the current software version along with the revision date. |
| „Data“ „Step“ | TRIO-WIRL FF 50VT4 FF 11/2001 D200F002U01 A.1_ | | | | | |

Parameterization

8.7 Description of parameters

8.7.1 Nominal size

This parameter is used to adapt the electronics, which are the same for all nominal sizes, to the corresponding flowmeter sensor. The nominal size is factory-set as appropriate for the corresponding flowmeter sensor (see name plate).

8.7.2 Mean k factor

The mean k factor shown on the display has to match the value on the flowmeter sensor. Every meter is calibrated with five measuring points on the test bench. The calibration factors (k factors) are entered in the flowmeter sensor and recorded on the test log. A mean calibration factor is calculated and engraved on the flowmeter sensor. The following tables show the typical k factors for corresponding nominal sizes, along with the frequencies generated in the flowmeter when measuring fluids and gases.



Important

The values indicated are typical k factors and frequencies for the associated device models. Precise data can be found in the test logs included in the respective scopes of supply.

FV4000-VT4/VR4 Vortex flowmeter

| Nominal size | | Typical k factor | Fluid f_{\max} at $Q_{v\max}$ (Hz) | | Gas f_{\max} at $Q_{v\max}$ (Hz) | |
|--------------|-------|------------------|--------------------------------------|-----|------------------------------------|------|
| DN | Inch | | Max. ($1/m^3$) | DIN | ANSI | DIN |
| 15 | 1/2 | 225000 | 370 | 450 | 1520 | 1980 |
| 25 | 1 | 48000 | 240 | 400 | 2040 | 1850 |
| 40 | 1 1/2 | 14500 | 270 | 270 | 2120 | 1370 |
| 50 | 2 | 7500 | 180 | 176 | 1200 | 1180 |
| 80 | 3 | 2100 | 140 | 128 | 1000 | 780 |
| 100 | 4 | 960 | 100 | 75 | 700 | 635 |
| 150 | 6 | 290 | 50 | 50 | 480 | 405 |
| 200 | 8 | 132 | 45 | 40 | 285 | 240 |
| 250 | 10 | 66 | 29 | 36 | 260 | 225 |
| 300 | 12 | 39 | 26 | 23 | 217 | 195 |

FS4000-ST4/SR4 Swirl flowmeter

| Nominal size | | Typical k factor Max. (1/m ³) | Fluid f _{max} at Qvmax (Hz) | Gas f _{max} at Qvmax (Hz) |
|--------------|-------|--|---|---------------------------------------|
| DN | Inch | | | |
| 15 | 1/2 | 440000 | 185 | 1900 |
| 20 | 3/4 | 165000 | 100 | 1200 |
| 25 | 1 | 86000 | 135 | 1200 |
| 32 | 1 1/4 | 33000 | 107 | 1200 |
| 40 | 1 1/2 | 24000 | 110 | 1330 |
| 50 | 2 | 11100 | 90 | 1100 |
| 80 | 3 | 2900 | 78 | 690 |
| 100 | 4 | 1620 | 77 | 700 |
| 150 | 6 | 460 | 40 | 470 |
| 200 | 8 | 194 | 23 | 270 |
| 300 | 12 | 54 | 16 | 92 |
| 400 | 16 | 27 | 13 | 80 |

The transmitter calculates the operating flow using the following formula:

$$Q = \frac{f}{k}$$

Q Operating flow [m³/s]

F Frequency [1/s]

k Calibration k factor [1/m³]

8.7.3 Hardware config.

This submenu allows users to specify the response of the switching output (terminals 41, 42). Depending upon the selection ("Pulse", "Flow alarm", "Temperature alarm", "System alarm"), the "Pulse width", "Min Q_Alarm", "Max Q_Alarm", "Min T_Alarm" or "Max T_Alarm" menus will appear respectively.

8.7.4 Error 3/9

Error detection for errors "3" and "9" can be activated/deactivated in the "Error 3/9" menu. The following settings are possible:

| Configuration | Function |
|------------------------------------|---|
| "Errors 3+9 off" (factory setting) | If the set measuring range is overshoot by more than 3.125 %, the current output will maintain the 20.5 mA it will have reached by this point until the flow returns to a level below the upper range value set for the measuring range. |
| "Both on" | If the set measuring range is overshoot by more than 3.125 %, the current output will switch to the set fault current (factory setting 22.4 mA). If QmaxDN is overshoot by more than 20 %, error "9" will also be output as a warning before the device is overloaded. |
| "Error 3 off" | If the set measuring range is overshoot by more than 3.125 %, the current output will maintain the 20.5 mA it will have reached by this point. If QmaxDN is overshoot by more than 20 %, error "9" will also be output and the current output will switch to the set fault current. |

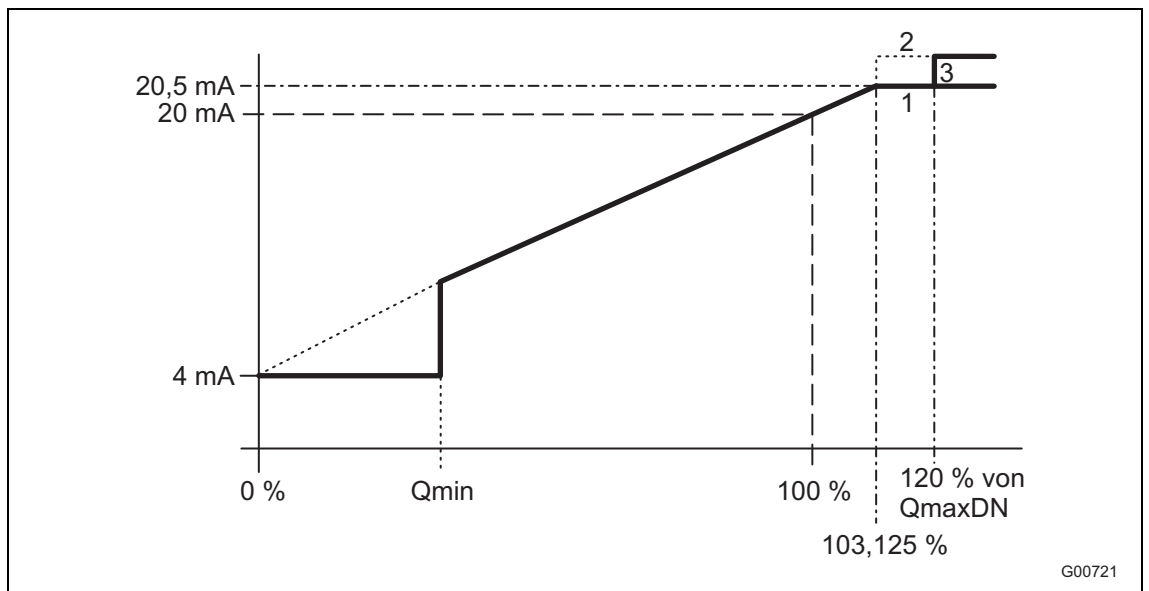


Fig. 47: Current output in the event of an alarm

- 1 Current output without errors "3" and "9", output: 20.5 mA (NAMUR NE43)
- 2 Current output with errors "3" and "9", the output switches to alarm status (21 ... 23 mA, configurable)
- 3 Current output with error "9", the output switches to alarm status at 120 % of QmaxDN (21 ... 23 mA, configurable)

8.7.5 Standard factor

Under constant operating conditions (constant pressure and temperature), the standard factor can be entered here.

The standard factor is defined as the ratio between standard flow and operating flow:

$$\text{Standard factor} = \frac{Q_n}{Q_v} = \frac{(1,013 \text{ bar} + p)}{1,013 \text{ bar}} \times \frac{273}{(273 + T)}$$

Since the mass flow is constant, the following formula applies:

$$\frac{Q_n}{Q_v} = \frac{\rho_v}{\rho_n}$$

- Qn Standard flow
- Qv Operating flow
- P Operating pressure [bar ü]
- T Temperature [°C]
- ρv Operating density
- ρn Standard density

8.7.6 Operating density

Please refer to the "AP-Calc" product selection and dimensioning program, which ABB provides free of charge.

8.8 Parameterization of gases, steams, and liquids

The selection of possible operating modes, the required parameters associated with them and the additional menu items that become visible are summarized in the following tables.



Important

The selection of possible operating modes is dependent upon how the flowmeter is calibrated.

| Operating mode | Medium | Flow type | Calculation | Correction parameter | Additional menus that become visible |
|-------------------------------|--------|-------------|--|---|--|
| Fluid Qv | Fluid | Volume flow | - | - | - |
| Fluid Qm(D) | | Mass flow | $Q_m = Q_v \times \rho_b$ | Reference density constant | Unit of density Reference density Unit Qm |
| Fluid ¹⁾ Qm (D, T) | | | $Q_m = Q_v \times \rho(T_b)$ $\rho(T) = \rho_b \times (1 + (T_b - T_0) \times \beta_2)$ | Reference density ρ_b Reference temperature T_0 Temperature measured T_b Density compensating coefficient β_2 | Unit of density Reference density Reference temperature Unit Qm D. comp. coeffi. |
| Fluid ¹⁾ Qm (V, T) | | | $Q_m = Q_n \times \rho_b$ $Q_n = \frac{Q_v}{(1 + (T_b - T_0) \times \beta_1)}$ | Volume expansion coefficient [%/K] β_1 Reference temperature T_0 Temperature measured T_b Reference density ρ_b | Unit of density Reference density Reference temperature Vol._expansion Unit Qm |

- Qm Mass flow
- Qv Operating flow
- Qn Standard flow
- Pbtr Reference pressure

- β_1 Volume expansion coefficient
- β_2 Density compensating coefficient
- ρ_0 Standard density
- ρ_b Reference density

1) These operating modes can only be selected if the flowmeter is fitted with a temperature measurement device.

| Operating mode | Medium | Flow type | Calculation | Correction parameter | Additional menus that become visible |
|------------------------------------|-----------------|---|---|--|--|
| Gas standard ¹⁾ Qn (pT) | Gas | Standard flow 1.013 bar / 0 °C 0 ... 1.013 bar / 20 °C | $Q_n = Q_v \times \frac{P_{btr}}{1,013 \text{ bar}} \times \frac{273 \text{ K}}{273 \text{ K} + T_b}$ | Reference pressure Pbtr abs Temperature measured T _b | Reference pressure Unit of pressure Standard condition |
| Gas stnd ¹⁾ Qs (pT) | | Standard flow 14.7 psia / 60 °F | $Q_s = Q_v \times \frac{P_{btr}}{14,7 \text{ psia}} \times \frac{60 \text{ °F}}{60 \text{ °F} + T_b}$ | Reference pressure Pbtr abs Temperature measured T _b | Reference pressure Unit of pressure Standard condition |
| Gas standard Qn (KmpF) | | Standard flow 1.013 bar / 0 °C | Qn = Qv × Normfaktor Normfaktor = $\frac{\rho_b}{\rho_0}$ | Standard factor as constant (compression factor) | Standard factor |
| Gas mass ¹⁾ Qm (pT) | | Mass flow standard condition at 1.013 bar / 0 °C or 1.013 bar / 20 °C | Qm = ρ ₀ × Qn $Q_n = Q_v \times \frac{P_{btr}}{1,013 \text{ bar}} \times \frac{273 \text{ K}}{273 \text{ K} + T_b}$ | Reference pressure Pbtr abs Standard density ρ ₀ Temperature measured T _b | Unit of density Standard density Standard condition Reference temperature Pressure_Pbtr_abs Unit Qm |
| Gas Qv | Gas / Steam | Operating flow | - | - | - |
| Gas mass Qm (D) | | Mass flow | Qm = Qv × ρ _b | Reference density constant ρ _b | Unit of density Reference density Unit Qm |
| S steam ¹⁾ Qm | Saturated steam | Mass flow | Qm = Qv × ρ _b (T _b) Correction using saturated steam table | Temperature measured T _b | Unit Qm |
| S steam Qv | | Operating flow | - | - | - |

| | | | |
|------|--------------------|----------------|----------------------------------|
| Qm | Mass flow | β1 | Volume expansion coefficient |
| Qv | Operating flow | β2 | Density compensating coefficient |
| Qn | Standard flow | ρ ₀ | Standard density |
| Pbtr | Reference pressure | ρ _b | Reference density |

1) These operating modes can only be selected if the flowmeter is fitted with a temperature measurement device.

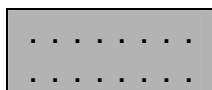
9 Error messages

9.1 Error register

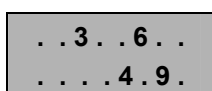
This menu contains the error register and the power failure totalizer.

All errors are saved permanently in the error register, regardless of whether they prevail for a short or a prolonged period. Every digit or letter on the error register LCD display represents an error.

9.1.1 Error register LCD display when no errors are pending



9.1.2 Error register LCD display when errors are pending



9.1.3 Power failure totalizer

The transmitter counts the number of power failures. This information can be read from the error register.



Important

Only ABB Service personnel are able to clear the power failure totalizer.

9.1.4 Clearing the error register

The error register is cleared using the "ENTER" function.

9.2 Error description

| Error no. | Plain text message | Priority | Description | Possible cause | Troubleshooting |
|-----------|-----------------------------|----------|---|---|--|
| 0 | Steam calculation | 7 | Mass flow for saturated steam calculated incorrectly | Steam temperature < 55 °C (131 °F) | Increase steam temperature |
| | | | | Steam temperature > 370 °C (698 °F) | Reduce steam temperature |
| 1 | Front End | 1 | Problem affecting preamplifier board | - | Replace transmitter plug-in module / Contact ABB Service |
| 2 | Not assigned | - | - | - | - |
| 3 | Flow > 3 % | 2 | The value set in Qmax is being exceeded by more than 3 % | Measuring range too small | Increase "Qmax!" measuring range |
| | | | | Flow too large | Reduce flow |
| 4 | Not assigned | - | - | - | - |
| 5 | M database | 0 | Main database damaged beyond repair, loss of transmitter's internal database | Reduce flow | Replace meter and switch back on, replace transmitter plug-in module if necessary, contact ABB Service |
| 6 | Meter damaged beyond repair | 1 | Flowmeter damaged beyond repair, values displayed are invalid | - | Reprogram the meter |
| 7 | Temperature | 7 | Problem affecting temperature measurement | Pt100 faulty | Replace sensor |
| | | | | Wiring errors between sensor and transmitter affecting VR / SR models | Check wiring |
| 8 | Not assigned | - | - | - | - |
| 9 | Qv > 120 % of QmaxDN | 2 | Maximum possible measuring range (QmaxDN) overshoot | Flow too large (software only) level < A30 | Reduce flow |
| B | B base | 0 | Backup database damaged beyond repair, loss of external database (sensor board) | External database faulty | Switch the meter off and back on again, sensor board might be faulty, contact ABB Service |

10 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 before touching electronic components.

When the housing is open, EMC protection is limited.

The flowmeters do not require any maintenance if they are used as intended under normal operating conditions. It is sufficient to check them following the instructions in this section.



Warning - General risks!

Explosion-proof flowmeters must either be repaired by the manufacturer or approved by a certified expert following repair work. The relevant safety precautions must be taken before, during, and after repair work.

Only disassemble the flowmeter to the extent necessary for cleaning, inspection, repairs, and replacement of damaged components.

10.1 Maintaining the flowmeter sensor

Essentially no maintenance is 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 supply power feed, the lightning protection and the grounds

10.2 Cleaning

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

10.3 Replacing the transmitter



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 before touching electronic components.

When the housing is open, EMC protection is limited.

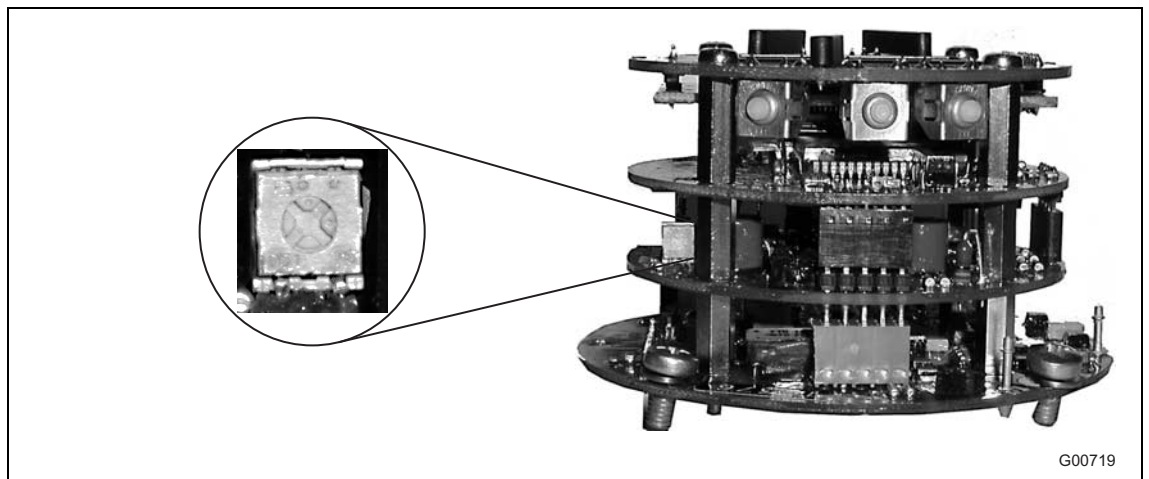
1. Disconnect the flowmeter from the line supply.
2. Unscrew the front housing cover. The lock on the cover needs to be undone first on meters for hazardous areas.



Important

Observe the waiting times for hazardous area designs, see chapter 11 "Ex relevant specifications".

3. Remove the transmitter from the housing. To do this, unscrew the three Phillips head screws and carefully take the transmitter out of the housing.
4. Set the configuration switch as illustrated below.



G00719

Fig. 48: Position of the configuration switch

5. Carefully put the transmitter back into the housing. Make sure it is centered correctly.



Notice - Potential damage to parts!

If the transmitter is not placed into the housing correctly, the electrical plug-in connectors at the rear can twist or break off.

Position the transmitter so that the three screw holes on the base plate are located exactly in front of the threaded bolts.

6. Then tighten the three screws again.

7. Finally, tighten the housing cover hand-tight. The lock on the cover needs to be re-attached on meters for hazardous areas.

10.4 Disassembling the flowmeter

1. Before starting work on the flowmeter, make sure that it and any adjacent lines or vessels have been depressurized.



Warning - General risks

Prior to disassembly, check whether hazardous materials have been used as flow media. Residual amounts of hazardous material may still be present in the device and could escape when it is opened.

The pipeline must be depressurized prior to opening the device.



Notice - Potential damage to parts

Never unscrew the fixing screws from the base or the transmitter from the base. Doing so can damage the meter beyond repair.

In the event of problems, please contact ABB Service.

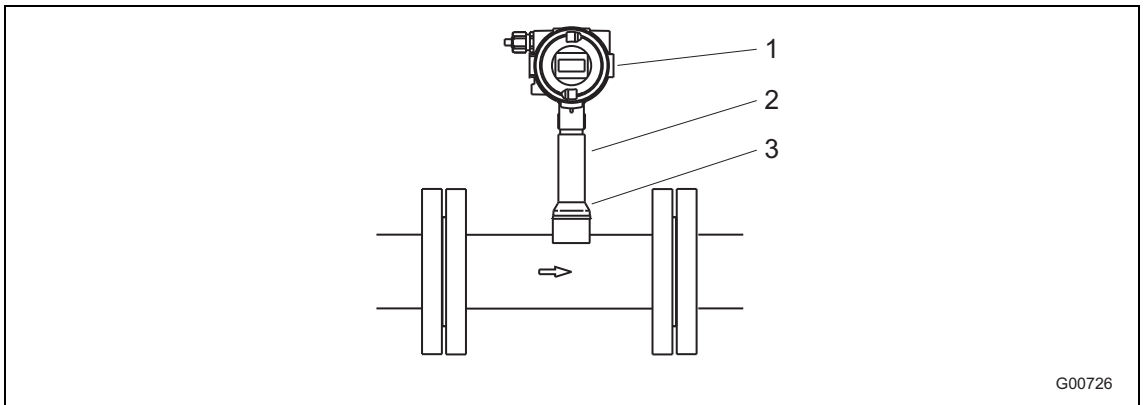


Fig. 49: Parts attached to the Swirl and Vortex meters

- 1 Transmitter
- 2 Base
- 3 Fixing screws

11 Ex relevant specifications

11.1 General ex relevant specifications

11.1.1 HART devices

Models designed for hazardous areas with ATEX / IECEx approval

| Models | Approvals |
|---------------------------|--|
| VT41 / ST41 / VR41 / SR41 | <ul style="list-style-type: none"> • Operation in Zone 1: Ex ib IIC (intrinsically safe supply) • Operation in Zone 2: Ex nA [nL] IIC (non-intrinsically safe supply) • Operation in Zone 21 / 22: Ex tD A21 / Ex tD A22 (non-intrinsically safe supply or intrinsically safe supply) |



Important

All types of protection are noted on the name plate.
 Flowmeters operating in Category 3 (Zone 2 / 22) may subsequently be operated in Category 2 (Zone 1 / 21) without modification.
 The respective applicable maximum values must be complied with.

| Models | Approvals |
|---------------------------|--|
| VT42 / ST42 / VR42 / SR42 | <ul style="list-style-type: none"> • Operation in Zone 1: Ex d [ib] IIC (non-intrinsically safe supply) • Operation in Zone 1: Ex ib IIC (intrinsically safe supply) • Operation in Zone 2: Ex nA [nL] IIC (non-intrinsically safe supply) • Operation in Zone 21 / 22: Ex tD A21 / Ex tD A22 (non-intrinsically safe supply or intrinsically safe supply) |



Important

All types of protection are noted on the name plate. In the case of operation in Zone 1, the user specifies the type of protection by means of the type of supply.
 Flowmeters operated in Category 3 (Zone 2) may subsequently be operated in Category 2 (Zone 1) without modification. Within Category 2, the Ex d [ib] design may subsequently be operated as Ex ib without modification.
 The respective applicable maximum values must be complied with. The significant differences between models are listed in the table titled "Differences between explosion-proof designs with regard to safety engineering". Detailed descriptions appear later in this section.

Models designed for hazardous areas with American approval

| Models | Approvals |
|---------------------------|--|
| VT43 / ST43 / VR43 / SR43 | <ul style="list-style-type: none"> • Explosion-proof XP/Class I/Div 1/BCD/T4 Ta = 70 °C Type 4X • Dust-ignition-proof DIP/Class II,III/Div 1/EFG/T4 Ta = 70 °C Type 4X DIP/Class II,III /Div 2 /EFG /T4 Ta=70°C Type 4X • Intrinsic safety IS/Class I, II,III/Div 1 ABCDEFG/T4 Ta = 70 °C Entity Type 4X • Non-incendive NI/Class I/Div 2/ABCD/T4 Ta = 70 °C Type 4X |

11.1.2 Fieldbus devices

Models: VT4A, VR4A, ST4A, SR4A

The hazardous area design of the device is based on the PTB's FISCO model (FISCO = fieldbus intrinsically safe concept).

Proof of intrinsic safety for interconnection with other intrinsically safe equipment is not required under the boundary conditions specified.

- All nodes must have FISCO approval, e.g., from the PTB, TÜV, BVS, KEMA.
- The maximum cable length in a segment is restricted to 1,000 m for Ex ia and 1,900 m for Ex ib.
- The bus cable (type A) has to exhibit the following values: $R' = 15 \Omega/\text{km}$, $L' = 0.4 \dots 1 \text{ mH}/\text{km}$, $C' = 80 \dots 200 \text{ nF}/\text{km}$
- The following applies for every field device (U_i, I_i, P_i): $U_0 \leq U_i, I_0 \leq I_i, P_0 \leq P_i$
- All nodes act as passive current sinks.
- No power is fed in when a bus node is sending.

There is only one active device per segment (supply unit / segment coupler).

Designation: II 2G Ex ia IIC T4

11.1.3 Differences between explosion-proof designs with regard to safety engineering

| Difference | Model | | | | | |
|--|--------------------------------------|--|--|--|---|-----------------------------------|
| | VT42/ST42 VR42/SR42 | VT42/ST42 VR42/SR42 VT41/ST42 VR41/SR41 | VT42/ST42 VR42/SR42 VT41/ST42 VR41/SR41 | VT42/ST42 VR42/SR42 VT41/ST42 VR41/SR41 | VT43/ST43 VR43/SR43 | VT43/ST43 VR43 |
| Type of protection | Ex d [ib] | Ex ib | Ex nA [nL] | Dust / housing | XP | IS |
| Zone (category) | 1 (2G) | 1 (2G) | 2 (3G) | 21 (2D) | Class I DIV 1 | Class I, II, III DIV 1 |
| Housing components in addition to the housing with particular relevance for explosion protection | Flameproof cable gland, safety catch | None | None | Safety catch | NPT thread prepared for conduit fitting, safety catch | |
| Waiting time on opening the transmitter | 2 min | 2 min | 2 min | 2 min | 2 min | No |
| Temperature class | T6 (sensor T4) | T4 | T4 | T85 °C ... T _{med} | T4 | T4 |
| Permissible ambient temperature | ...41 | - | (-40) -20 ... 70 °C ((-40) -4 ... 158 °F) | -20 ... 60 °C (-4 ... 140 °F) | - | - |
| | ...42 | (-40) -20 ... 60 °C ((-40) -4 ... 140 °F) | | -20 ... 60 °C (-4 ... 140 °F) | - | - |
| | ...43 | - | - | - | (-45) -20 ... 70 °C ((-49) -4 ... 158 °F) | |
| Supply voltage | Um = 60 V UB = 14 ... 46 V | ib: Ui = 28 V | Um = 60 V UB = 14 ... 46 V | Um = 60 V UB = 14 ... 46 V Ui = 28 V | UB = 14 ... 46 V | V _{max} = 14 ... 28 V |



Notice - Damage to the electrical system

Under certain circumstances, the process medium can enter the electrical system via the conduit system and cause damage to it.

To prevent the measuring agent from penetrating the electrical system in this way, the devices are equipped with gaskets conforming to the requirements of ANSI / ISA 12.27.01.

The following requirements apply to process gaskets between electrical systems and flammable or combustible process media for installations in North America:

- When used in Canada, the surface temperature of all parts must be limited to a maximum of 165 °C (329 °F) in Class II, Group E, F or G.
- All conduits must be sealed off at a length of 46 cm (18 inches).

ABB flowmeters are designed and developed for industrial use all over the world. The substances that flow through the pipe systems in which these devices are used include combustible and flammable measuring agents. The devices are normally connected to the electrical system via conduits.

The FV4000-VT43/VR43 and FS4000-ST43/SR43 flowmeters are designed to be dual seal devices.

To comply with the requirements of ANSI / ISA 12.27.01, the operating conditions must be limited to the following values, depending on the materials used:

| Material | | Design | Operating temperature | Nominal sizes | Pressure rating |
|---------------------------|------------------|---------------|--|----------------------------------|----------------------|
| Flange / Pipe | Sensor gasket | Sensor gasket | | | |
| Material as per model key | Graphite | Flush | -55 °C ... 280 °C (-67 °F ... 536 °F) | FS4000 (Drall) DN15 to DN400 | PN63 / Class 300 |
| | Graphite special | | -55 °C ... 400 °C (-67 °F ... 752 °F) | | PN63 / Class 300 |
| | Kalrez 3018 | O-ring | 0 °C ... 280 °C (-55 °F ... 536 °F) | FV4000 (Vortex) DN15 to DN300 | PN100 / Class 600 |
| | Viton | | -55 °C ... 230 °C (-67 °F ... 446 °F) | | PN100 / Class 600 |
| | PTFE | | -55 °C ... 200 °C (-67 °F ... 392 °F) | | PN100 / Class 600 |

11.2 Ex "ib" / Ex "n" design for VT41/ST41 and VR41/SR41 (4 ... 20 mA / HART)

i Important
The devices may only be operated in explosive areas if the housing covers have been fully closed.

EC type-examination certificate TÜV 08 ATEX 554808 X / TÜV 10 ATEX 387786 X ¹⁾

Designation:

- II 2G Ex ib IIC T4
- II 2D Ex tD A21 T85°C...T_{medium} IP 67

Declaration of conformity TÜV 08 ATEX 554833 X / TÜV 10 ATEX 556214 X ¹⁾

Designation:

- II 3G Ex nA [nL] IIC T4
- II 3D Ex tD A22 T85°C...T_{medium} IP 67

Certificate of conformity IECEx TUN 07.0014 X / TUN 10.0024 X

Designation:

- Ex ib IIC T4...T1
- Ex nA [nL] IIC T4...T1
- Ex tD A21 IP6X TX°C

1) Not for Shanghai production site

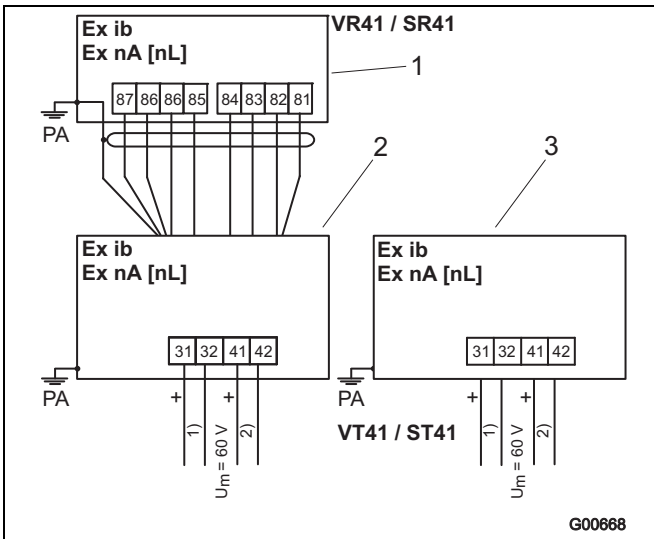


Fig. 50: Electrical connection for VT41 / ST41 and VR41 / SR41

- 1 Flowmeter sensor
- 2 Transmitter
- 3 Flowmeter

Flowmeter sensor wire colors

| Terminal | Wire color |
|----------|------------|
| 81 | Red |
| 82 | Blue |
| 83 | Pink |
| 84 | Gray |
| 85 | Yellow |
| 86 | Green |
| 86 | Brown |
| 87 | White |

- 1) Supply power terminals 31 / 32
 - a) Ex ib: $U_i = 28 \text{ V DC}$
 - b) Ex nA [nL] $U_B = 14 \dots 46 \text{ V DC}$
- 2) Switching output, terminals 41/ 42
The switching output (passive) optocoupler is designed as a NAMUR contact (to DIN 19234).
When the contact is closed, the internal resistance is approx. 1,000 Ω. When the contact is open, it is > 10 KΩ. The switching output can be changed over to "optocoupler" if required.
 - a) NAMUR with switching amplifier
 - b) Switching output (optocoupler)
 - Ex ib: $U_i = 15 \text{ V}$
 - Ex nA [nL]: $U_B = 16 \dots 30 \text{ V}$
 $I_B = 2 \dots 15 \text{ mA}$

i Important
The installation instructions in accordance with EN 60079-14 must be complied with.
When commissioning the flowmeter, refer to IEC 61241-1-2 regarding use in areas with combustible dust. The transmitter housing cover must be secured by means of the safety locking device. After switching off the supply power, wait t > 2 minutes before opening the transmitter housing.

11.2.1 Supply power or supply current

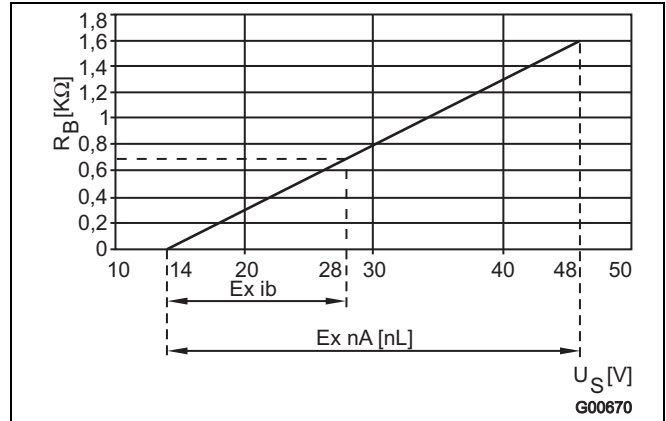


Fig. 51

The minimum voltage U_S of 14 V is based on a load of 0 Ω.

U_S = supply voltage

R_B = Maximum permissible load in power supply circuit, e.g., indicator, recorder or power resistor

Ex relevant specifications

11.2.2 Approval data for hazardous areas

| Power supply circuit | Terminals 31, 32 |
|---|--|
| Type of protection $U_m = 60\text{ V}$ | Zone 1: Ex ib IIC $T_{amb} = (-40\text{ °C}) -20 \dots 70\text{ °C}$ $U_i = 28\text{ V}$ $I_i = 110\text{ mA}$ $P_i = 770\text{ mW}$ Effective internal capacitance: 14.6 nF Effective internal capacitance to ground: 24.4 nF Effective internal inductance: 0.27 mH |
| | Zone 2: Ex nA [nL] IIC $T_{amb} = (-40\text{ °C}) -20 \dots 70\text{ °C}$ $U_B = 14 \dots 46\text{ V}$ |
| | Zone 21 / 22: Ex tD A21 / Ex tD A22 $T_{amb} = -20\text{ °C} \dots 60\text{ °C}$ |

| Power supply circuit | Terminals 41, 42 |
|---|---|
| Type of protection $U_m = 60\text{ V}$ | Zone 1: Ex ib IIC $U_i = 15\text{ V}$ $I_i = 30\text{ mA}$ $P_i = 115\text{ mW}$ Effective internal capacitance: 11.6 nF Effective internal capacitance to ground: 19.6 nF Effective internal inductance: 0.14 mH |
| | Zone 2: Ex nA [nL] IIC $U_B = 16 \dots 30\text{ V}$ $I_B = 2 \dots 15\text{ mA}$ |
| | Zone 21 / 22: Ex tD A21 / Ex tD A22 $T_{amb} = -20\text{ °C} \dots 60\text{ °C}$ |

The devices must be installed in a protected environment in accordance with the specific conditions on the test certificate. Pollution degree 3 (see IEC 60664-1) must not be exceeded for the macro environment of the device. The devices conform to degree of protection IP 65 / IP 67. If the device is installed as intended, this requirement is met by the housing as standard.

When connected to the line supply / not connected to the line supply, the electrical circuits must not exceed overvoltage category III / II.

11.2.3 Medium temperatures / Temperature classes

For the supply circuit "Terminals 31, 32" and the switching outputs "Terminals 41, 42", cables suitable for temperatures up to $T = 110\text{ °C}$ ($T = 230\text{ °F}$) can be used without restriction.

Category 2/3G

For cables suitable only for temperatures up to $T = 80\text{ °C}$ ($T = 176\text{ °F}$), the interconnection of both circuits needs to be taken into account in the event of a fault. Otherwise, the restricted temperature ranges listed in the following table shall apply.

Category 2D

For cables suitable only for temperatures up to $T = 80\text{ °C}$ ($T = 176\text{ °F}$), the restricted temperature ranges listed in the following table shall apply.

| Ambient temperature ²⁾ | Max. temperature at used connecting cable, "Terminals 31, 32", "Terminals 41, 42" | Max. permissible medium temperature |
|--|---|--|
| $(-40) -20 \dots 70\text{ °C}$ ³⁾ $((-40) -4 \dots 158\text{ °F})$ ³⁾ | 110 °C (230 °F) | 280 °C / 400 °C ¹⁾ (536 °F / 752 °F) ¹⁾ |
| $(-40) -20 \dots 70\text{ °C}$ ³⁾ $((-40) -4 \dots 158\text{ °F})$ ³⁾ | 80 °C (176 °F) | 160 °C (320 °F) |
| $(-40) -20 \dots 60\text{ °C}$ $((-40) -4 \dots 140\text{ °F})$ | | 240 °C (464 °F) |
| $(-40) -20 \dots 55\text{ °C}$ $((-40) -4 \dots 131\text{ °F})$ | | 280 °C (536 °F) |
| $(-40) -20 \dots 50\text{ °C}$ $((-40) -4 \dots 122\text{ °F})$ | | 320 °C (608 °F) ¹⁾ |
| $(-40) -20 \dots 40\text{ °C}$ $((-40) -4 \dots 104\text{ °F})$ | | 400 °C (752 °F) ¹⁾ |

1) Medium temperatures > 280 °C (> 536 °F) with FV4000 Vortex flowmeter only

2) The permissible limits for the ambient temperature are approval- and order-specific (standard: -20 °C (-4 °F)).

3) Category 2D (dust-ignition proof) maximum 60 °C (140 °F)

| Maximum medium temperature | Temperature class |
|----------------------------|-------------------|
| 130 °C (266 °F) | T4 |
| 195 °C (383 °F) | T3 |
| 290 °C (554 °F) | T2 |
| 400 °C (752 °F) | T1 |

11.3 Ex "d" / Ex "ib" / Ex "n" design for VT42/ST42 and VR42/SR42 (4 ... 20 mA / HART)



Important

The devices may only be operated in explosive areas if the housing covers have been fully closed.

EC type-examination certificate TÜV 08 ATEX 554955 X / TÜV 10 ATEX 387788 X ¹⁾

Designation

- Transmitter / flowmeter
 II 2G Ex d [ib] IIC T6
 II 2G Ex ib IIC T4
 II 2D Ex tD A21 T 85 °C ... T_{medium} IP 67

- Flowmeter sensor
 II 2G Ex ib IIC T4
 II 2D Ex tD A21 T 85 °C ... T_{medium} IP 67

Declaration of conformity TÜV 08 ATEX 554956 X / TÜV 10 ATEX 556215 X ¹⁾

Designation on sensor / transmitter / flowmeter:
 II 3G Ex nA [nL] IIC T4
 II 3D Ex tD A22 T85°C...T_{medium} IP 67

Certificate of conformity IECEx TUN 08.0010 X / TUN 10.0025 X

Designation:
 Ex d [ib] IIC T6 to T1
 Ex ib IIC T4 to T1
 Ex tD A21 IP6X T85°C...T_{medium}
 Ex nA [nL] IIC T4 to T1

1) Not for Shanghai production site

Flowmeter sensor wire colors

| Terminal | Wire color |
|----------|------------|
| 81 | Red |
| 82 | Blue |
| 83 | Pink |
| 84 | Gray |
| 85 | Yellow |
| 86 | Green |
| 86 | Brown |
| 87 | White |

- 1) Supply power terminals 31 / 32
 a) Ex ib: $U_i = 28 \text{ V DC}$
 b) Ex d [ib] / Ex nA [nL] $U_B = 14 \dots 46 \text{ V DC}$
- 2) Switching output, terminals 41/ 42
 The switching output (passive) is designed as an optocoupler. If required, the switching output (passive) can be designed as a NAMUR contact (to DIN 19234).
 a) NAMUR with switching amplifier
 b) Switching output (optocoupler)
 - Ex ib: $U_i = 15 \text{ V}$
 - Ex d [ib] / Ex nA [nL]: $U_B = 16 \dots 30 \text{ V}$
 $I_B = 2 \dots 15 \text{ mA}$



Important

Supply current (supply power) and switching output must be either only intrinsically safe or only non-intrinsically safe. A combination of the two is not permitted. On intrinsically safe circuits, equipotential bonding must be in place along the entire length of the cable used.

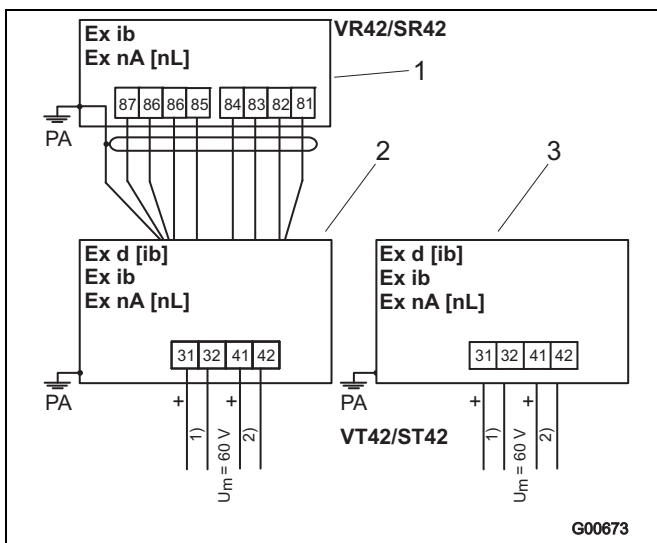


Fig. 52: Electrical connection for VT42 / ST42 and VR42 / SR42

- 1 Flowmeter sensor
- 2 Transmitter
- 3 Flowmeter

Ex relevant specifications

11.3.1 Supply power or supply current

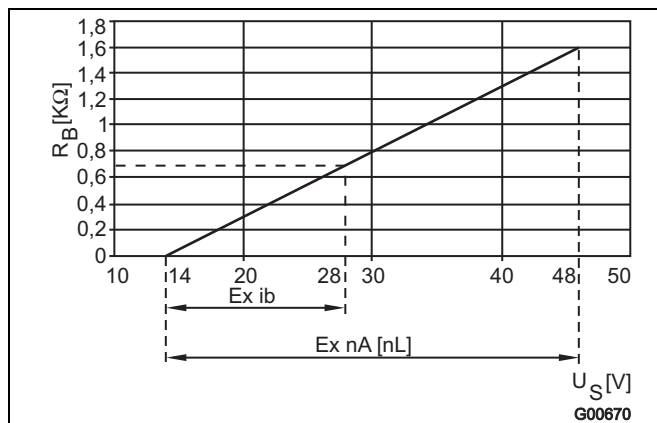


Fig. 53

The minimum voltage U_S of 14 V is based on a load of 0Ω .

U_S = supply voltage

R_B = Maximum permissible load in power supply circuit, e.g., indicator, recorder or power resistor



Important

The installation instructions in accordance with EN 60079-14 must be complied with.

When commissioning the flowmeter, refer to IEC 61241-1-2 regarding use in areas with combustible dust. The transmitter housing cover must be secured by means of the safety locking device. After switching off the supply power, wait $t > 2$ minutes before opening the transmitter housing.

11.3.2 Approval data for hazardous areas

| Power supply circuit | Terminals 31, 32 |
|--|---|
| Type of protection $U_m = 60 \text{ V}$ | Zone 1: Ex d [ib] IIC $T_{amb} = (-40 \text{ °C}) -20 \dots 60 \text{ °C}$ Zone 2: Ex nA [nL] IIC $T_{amb} = (-40 \text{ °C}) -20 \dots 70 \text{ °C}$ $U_B = 14 \dots 46 \text{ V}$ |
| | Zone 1: Ex ib IIC $T_{amb} = (-40 \text{ °C}) -20 \dots 70 \text{ °C}$ $U_i = 28 \text{ V}$ $I_i = 110 \text{ mA}$ $P_i = 770 \text{ mW}$ Effective internal capacitance: 14.6 nF Effective internal capacitance to ground: 24.4 nF Effective internal inductance: 0.27 mH |
| | Zone 21 / 22; Ex td A21 / Ex tD A22 $T_{amb} = -20 \dots 60 \text{ °C}$ |

| Power supply circuit | Terminals 41, 42 |
|--|--|
| Type of protection $U_m = 60 \text{ V}$ | Zone 1: Ex d [ib] IIC Zone 2: Ex nA [nL] IIC $U_B = 16 \dots 30 \text{ V}$ $I_B = 2 \dots 15 \text{ mA}$ |
| | Zone 1: Ex ib IIC $U_i = 15 \text{ V}$ $I_i = 30 \text{ mA}$ $P_i = 115 \text{ mW}$ Effective internal capacitance: 11.6 nF Effective internal capacitance to ground: 19.6 nF Effective internal inductance: 0.14 mH |
| | Zone 21 / 22; Ex td A21 / Ex td A22 $T_{amb} = -20 \dots 60 \text{ °C}$ |

When connected to the line supply / not connected to the line supply, the electrical circuits must not exceed overvoltage category III / II.

11.3.3 Medium temperatures / Temperature classes

For the supply circuit "Terminals 31, 32" and the switching outputs "Terminals 41, 42", cables suitable for temperatures up to T = 110 °C (T = 230 °F) can be used without restriction.

Category 2/3G (Ex ib IIC)

For cables suitable only for temperatures up to T= 80 °C (T = 176 °F), the interconnection of both circuits needs to be taken into account in the event of a fault. Otherwise, the restricted temperature ranges listed in the following table shall apply.

Category 2D

For cables suitable only for temperatures up to T= 80 °C (T = 176 °F), the restricted temperature ranges listed in the following table shall apply.

| Ambient temperature ²⁾ | Max. temperature at used connecting cable, "Terminals 31, 32", "Terminals 41, 42" | Max. permissible medium temperature |
|---|---|--|
| (-40) -20 ... 60 °C (-40) -4 ... 140 °F) | 110 °C (230 °F) | 280 °C / 400 °C ¹⁾ (536 °F / 752 °F) ¹⁾ |
| (-40) -20 ... 60 °C (-40) -4 ... 140 °F) | 80 °C (176 °F) | 240 °C (464 °F) |
| (-40) -20 ... 55 °C (-40) -4 ... 131 °F) | | 280 °C (536 °F) |
| (-40) -20 ... 50 °C (-40) -4 ... 122 °F) | | 320 °C (608 °F) ¹⁾ |
| (-40) -20 ... 40 °C (-40) -4 ... 104 °F) | | 400 °C (752 °F) ¹⁾ |

- 1) Medium temperatures > 280 °C (> 536 °F) with FV4000 Vortex flowmeter only
- 2) The permissible lower limits for the ambient temperature are approval- and order-specific (standard: -20 °C (-4 °F)).

| Hazardous area design | Maximum medium temperature | Temperature class |
|---------------------------------|----------------------------|-------------------|
| Ex d [ib] IIC | 80 °C (176 °F) | T6 ³⁾ |
| | 95 °C (203 °F) | T5 ³⁾ |
| Ex ib IIC bzw. Ex nA [nL] | 130 °C (266 °F) | T4 |
| | 195 °C (383 °F) | T3 |
| | 290 °C (554 °F) | T2 |
| | 400 °C (752 °F) | T1 |

3) Not possible for flowmeter sensor version VR42 / SR42

11.4 FM approval design for the USA and Canada for VT43/ST43 and VR43/SR43 (4 ... 20 mA / HART)



Important

The devices may only be operated in explosive areas if the housing covers have been fully closed.

Designation

| | |
|---------------------|---|
| Explosion-proof | XP/Class I/Div 1/BCD/T4 Ta = 70 °C Type 4X |
| Dust-ignition-proof | DIP/Class II,III/Div 1/EFG/T4 Ta = 70 °C Type 4X |
| Intrinsic safety | IS/Class I, II,III/Div 1/ABCDEFG/T4 Ta = 70 °C Entity Type 4X |
| Non-incendive | NI/Class I/Div 2/ABCD/T4 Ta = 70 °C Type 4X |
| Suitable | S/Class II,III/Div 2/FG/T4 Ta = 70 °C Type 4X |

The devices must be installed in a protected environment in accordance with the specific conditions on the test certificate. Pollution degree 3 (see IEC 60664-1) must not be exceeded for the macro environment of the device. The devices conform to degree of protection IP65 / IP67. If the device is installed as intended, this requirement is met by the housing as standard.

When connected to the line supply / not connected to the line supply, the electrical circuits must not exceed overvoltage category III / II.

IS Entity see: SD-50-2681 (Fig. 35)

Parameters: Vmax, Imax, Pi, Li, Ci

Enclosure: Type 4X

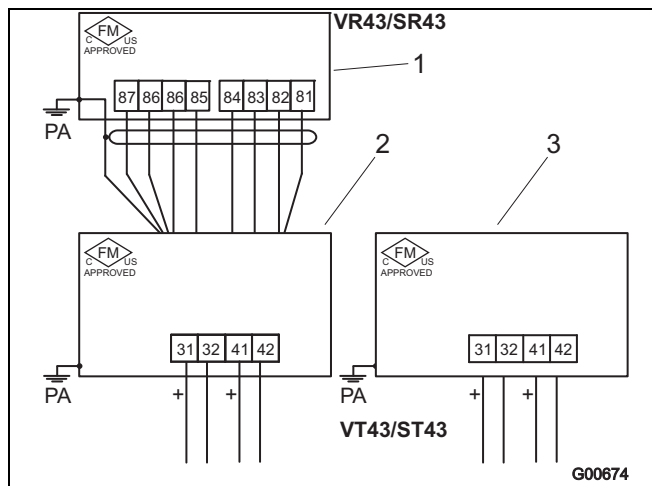


Fig. 54: Electrical connection for VT43 / ST43 and VR43 / SR43

- 1 Flowmeter sensor
- 2 Transmitter
- 3 Flowmeter

Flowmeter sensor wire colors

| Terminal | Wire color |
|----------|------------|
| 81 | Red |
| 82 | Blue |
| 83 | Pink |
| 84 | Gray |
| 85 | Yellow |
| 86 | Green |
| 86 | Brown |
| 87 | White |

Ex relevant specifications

11.4.1 Supply power or supply current

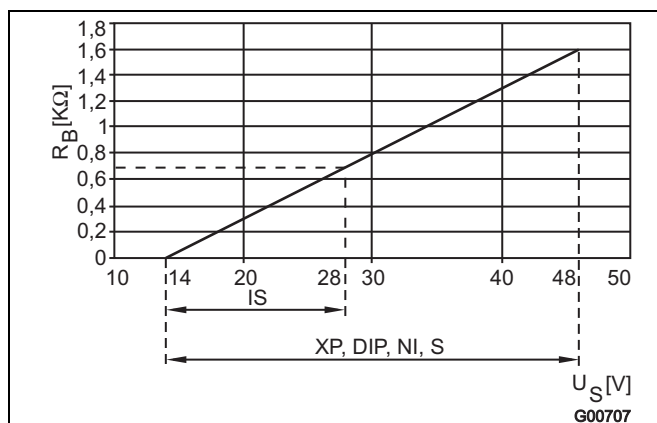


Fig. 55

The minimum voltage U_S of 14 V is based on a load of 0 Ω .

U_S = supply voltage

R_B = Maximum permissible load in power supply circuit, e.g., indicator, recorder or power resistor

11.4.2 Medium temperatures / Temperature classes

For the supply circuit "Terminals 31, 32" and the switching outputs "Terminals 41, 42", cables suitable for temperatures up to $T = 110^\circ\text{C}$ ($T = 230^\circ\text{F}$) can be used without restriction.

For cables suitable only for temperatures up to $T = 80^\circ\text{C}$ ($T = 176^\circ\text{F}$), the restricted temperature ranges listed in the following table shall apply.

| Ambient temperature | Max. temperature at used connecting cable, "Terminals 31, 32", "Terminals 41, 42" | Max. permissible medium temperature |
|---|---|--|
| (-45) -20 ... 70 °C (-49) -4 ... 158 °F) | 110 °C (230 °F) | 280 °C / 400 °C ¹⁾ (536 °C / 752 °F) ¹⁾ |
| (-45) -20 ... 60 °C (-49) -4 ... 140 °F) | 80 °C (176 °F) | 240 °C (464 °F) |
| (-45) -20 ... 55 °C (-49) -4 ... 131 °F) | | 280 °C (536 °F) |
| (-45) -20 ... 50 °C (-49) -4 ... 122 °F) | | 320 °C (608 °F) ¹⁾ |
| (-45) -20 ... 40 °C (-49) -4 ... 104 °F) | | 400 °C (752 °F) ¹⁾ |

1) Medium temperatures > 280 °C (> 536 °F) with VT43 / VR43 Vortex flowmeter only

11.4.3 Approval data for hazardous areas

Supply circuit terminals 31, 32

| Explosion-proof | XP/Class I/Div 1/BCD/T4 Ta = 70 °C Type 4X | $U_B = 14 \dots 46 \text{ V}$ |
|---------------------|--|---|
| Dust-ignition-proof | DIP/Class II,III/Div 1/EFG/T4 Ta = 70 °C Type 4X DIP/Class II,III /Div 2 /EFG /T4 Ta=70°C Type 4X | |
| Intrinsic safety | IS/Class I, II,III/Div 1 ABCDEFG/T4 Ta = 70 °C Entity Type 4X | $V_{\max} = 28 \text{ V}$ $I_{\max} = 110 \text{ mA}$ $P_i = 770 \text{ mW}$ Effective internal capacitance: 14.6 nF Effective internal inductance: 0.27 mH |
| Non-incendive | NI/Class I/Div 2/ABCD/T4 Ta = 70 °C Type 4X | $U_B = 14 \dots 46 \text{ V}$ |

Supply circuit terminals 41, 42

| Explosion-proof | XP/Class I/Div 1/BCD/T4 Ta = 70 °C Type 4X | $U_B = 16 \dots 30 \text{ V}$ $I_B = 2 \dots 15 \text{ mA}$ |
|---------------------|--|--|
| Dust-ignition-proof | DIP/Class II,III/Div 1/EFG/T4 Ta = 70 °C Type 4X DIP/Class II,III /Div 2 /EFG /T4 Ta=70°C Type 4X | |
| Intrinsic safety | IS/Class I, II,III/Div 1 ABCDEFG/T4 Ta = 70 °C Entity Type 4X | $V_{\max} = 15 \text{ V}$ $I_{\max} = 30 \text{ mA}$ $P_i = 115 \text{ mW}$ Effective internal capacitance: 11 nF Effective internal inductance: 0.14 mH |
| Non-incendive | NI/Class I/Div 2/ABCD/T4 Ta = 70 °C Type 4X | $U_B = 16 \dots 30 \text{ V}$ $I_B = 2 \dots 15 \text{ mA}$ |

11.4.4 Trio-Wirl control drawing

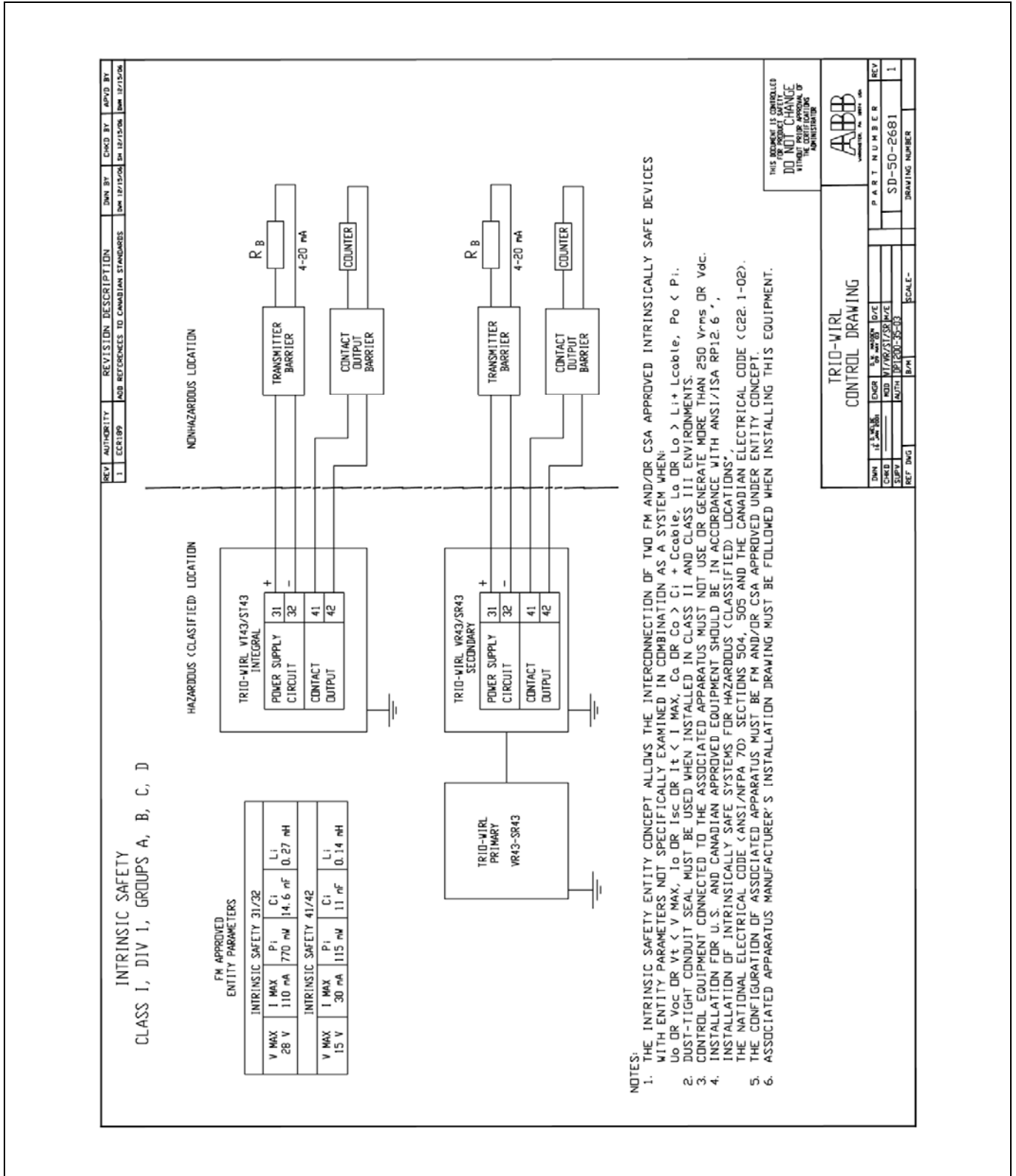


Fig. 56: Electrical connection and connection data, VT43 / VR43 and ST43 / SR43

Ex relevant specifications

11.5 Ex "ia" design for VT4A/ST4A and VR4A/SR4A (fieldbus)

i Important
The devices may only be operated in explosive areas if the housing covers have been fully closed.

EC type-examination test certificate TÜV 10 ATEX 556309 X / TÜV 10 ATEX 387782 X ¹⁾

Designation

II 2G Ex ia IIC T4 Gb
II 2 D Ex ta IIIC T85°C ... T_{medium} Db IP67 (type VT4A. / ST4A.)
II 2 D Ex ta IIIC T85°C Db IP67 (type VR4A. / SR4A.)

Certificate of conformity IECEx CoC TUN 10.0028 X / CoC TUN 10.0029 X

Designation

Ex ia IIC T4 Gb
Ex ia IIIC T85°C ... T_{medium} Db IP67 (type VT4A. / ST4A. / VR4A. / SR4A.)
Ex ia IIIC T85°C Db IP67 (type VR4A. / SR4A.)

The hazardous area design is based on the PTB's FISCO model (FISCO = fieldbus intrinsically safe concept).

1) Not for Shanghai production site

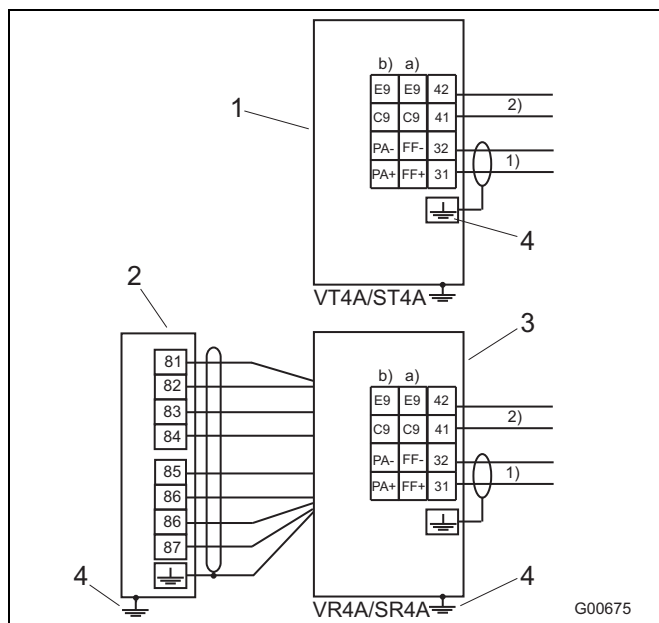


Fig. 57: Electrical connection for PROFIBUS PA interface connection

- | | |
|--------------------|---------------------|
| 1 Flowmeter | 3 Transmitter |
| 2 Flowmeter sensor | 4 Functional ground |

Flowmeter sensor wire colors

| Terminal | Wire color |
|----------|------------|
| 81 | Red |
| 82 | Blue |
| 83 | Pink |
| 84 | Gray |
| 85 | Yellow |
| 86 | Green |
| 86 | Brown |
| 87 | White |

11.5.1 PROFIBUS PA electrical connection

1) Terminals 31, 32

Function PA+, PA-
Connection for PROFIBUS PA to IEC 1158-2
U = 9 ... 24 V, I = 10 mA (normal operation)
13 mA (in the event of an error / FDE)

2) Terminals 41, 42

Function C9, E9
Switching output: Function can be selected via software as a pulse output (fmax: 100 Hz, 1 ... 256 ms), min. / max. alarm or system alarm.
Configured as NAMUR contact to DIN 19234.
Closed: 1 KΩ
Open: > 10 KΩ

M12 plug-in connector

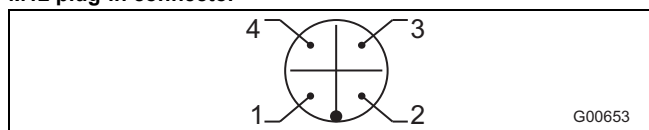


Fig. 58: Assignment for connection using optional M12 plug-in connector

| Pin | Assignment |
|-----|------------|
| 1 | PA+ (31) |
| 2 | NC |
| 3 | PA- (32) |
| 4 | Shield |

11.5.2 FOUNDATION fieldbus electrical connection

1) Terminals 31, 32

Function FF+, FF-
Connection for FOUNDATION fieldbus (H1) to IEC 1158-2
U = 9 ... 24 V, I = 10 mA (normal operation)
13 mA (in the event of an error / FDE)

2) Terminals 41, 42

Function C9, E9
Switching output: Function can be selected via software as a pulse output (fmax: 100 Hz, 1 ... 256 ms), min. / max. alarm or system alarm.
Configured as NAMUR contact to DIN 19234.
Closed: 1 KΩ
Open: > 10 KΩ

i Important

The installation instructions in accordance with EN 60079-14 must be complied with.
When commissioning the flowmeter, refer to IEC 61241-1-2 regarding use in areas with combustible dust. The transmitter housing cover must be secured by means of the safety locking device. After switching off the supply power, wait t > 2 minutes before opening the transmitter housing.

11.5.3 Approval data for hazardous areas

II 2D T 85 °C ... T_{medium} IP 67 /
T_{amb} = -20 °C ... 60 °C

| Power supply circuit | Terminals 31/32 |
|----------------------|---|
| Type of protection | II 2G Ex ia IIC T4 / T _{amb} = (-40 °C) -20 ... 70 °C U _i = 24 V I _i = 380 mA P _i = 9.12 W The effective internal capacitance and inductance are negligibly low. |

| Power supply circuit | Terminals 41/42 |
|----------------------|--|
| Type of protection | II 2G Ex ia IIC T4 U _i = 15 V I _i = 30 mA P _i = 115 mW Effective internal capacitance: 3.6 nF Effective internal capacitance to ground: 3.6 nF Effective internal inductance: 0.14 mH |

VR4A / SR4A only

| Type of protection | II 2G Ex ia IIC T4 |
|---|---------------------------|
| Piezo sensor | U ₀ = 8.5 V |
| Terminals 85, 86, 86, 87 | I ₀ = 1,073 mA |
| Pt100 circuit, terminals 81, 82, 83, 84 | P ₀ = 2,280 mW |

i Important (Note)

The devices must be installed in a protected environment in accordance with the specific conditions on the test certificate. Pollution degree 3 (see IEC 60664-1) must not be exceeded for the macro environment of the device. The devices conform to protection type IP 65 / IP 67. If the device is installed as intended, this requirement is met by the housing as standard. When connected to the line supply / not connected to the line supply, the electrical circuits must not exceed overvoltage category III / II.

11.5.4 Medium temperatures / Temperature classes

For the supply circuit "Terminals 31, 32" and the switching outputs "Terminals 41, 42", cables suitable for temperatures up to T = 110 °C (T = 230 °F) can be used without restriction.

Category 2/3G

For cables suitable only for temperatures up to T= 80 °C (T = 176 °F), the interconnection of both circuits needs to be taken into account in the event of a fault. Otherwise, the restricted temperature ranges listed in the following table shall apply.

Category 2D

For cables suitable only for temperatures up to T= 80 °C (T = 176 °F), the restricted temperature ranges listed in the following table shall apply.

| Ambient temperature 2) | Max. temperature at used connecting cable, "Terminals 31, 32", "Terminals 41, 42" | Max. permissible medium temperature |
|--|---|--|
| (-30) -20 ... 70 °C ((-22) -4 ... 158 °F) | 110 °C (230 °F) | 280 °C / 400 °C 1) (536 °C / 752 °F) 1) |
| (-30) -20 ... 70 °C ((-22) -4 ... 158 °F) | 80 °C (176 °F) | 160 °C (320 °F) |
| (-30) -20 ... 60 °C ((-22) -4 ... 140 °F) | | 240 °C (464 °F) |
| (-30) -20 ... 55 °C ((-22) -4 ... 131 °F) | | 280 °C (536 °F) |
| (-30) -20 ... 50 °C ((-22) -4 ... 122 °F) | | 320 °C (608 °F) 1) |
| (-30) -20 ... 40 °C ((-22) -4 ... 104 °F) | | 400 °C (752 °F) 1) |

1) Medium temperatures > 280 °C (> 536 °F) with FV4000 Vortex flowmeter only
2) The permissible limits for the ambient temperature are approval- and order-specific (standard: -20 °C (-4 °F)).

| Maximum medium temperature | Temperature class |
|----------------------------|-------------------|
| 130 °C (266 °F) | T4 |
| 195 °C (383 °F) | T3 |
| 290 °C (554 °F) | T2 |
| 400 °C (752 °F) | T1 |

12 Specifications

12.1 Nominal diameter selection

The nominal diameter is selected on the basis of the maximum operating flow Q_v max. If maximum spans are to be achieved, this should not be less than half the maximum flowrate for each nominal diameter (Q_v max DN), although reduction to approx. 0.15 Q_v max DN is possible. The linear lower range limit value is dependent upon the Reynolds number (see accuracy information).

If the flow to be measured is the standard flow (standard condition: 0 °C (32 °F), 1,013 mbar) or mass flowrate, this must be converted to the operating flow and the most appropriate nominal device diameter must be selected from the flow range tables (Tables 1, 2, 3).

- ρ = Operating density (kg/m³)
- ρ_N = Standard density (kg/m³)
- P = Operating pressure (bar)
- T = Operating temperature (°C)
- Q_v = Operating flow (m³/h)
- Q_n = Standard flow (m³/h)
- Q_m = Mass flowrate (kg/h)
- η = Dynamic viscosity (Pas)
- ν = Kinematic viscosity (m²/s)

1. Conversion of standard density (ρ_n) --> operating density (ρ)

$$\rho = \rho_n \times \frac{1,013 + \rho}{1,013} \times \frac{273}{273 + T}$$

2. Conversion to operating flow (Q_v)

a) From standard flow (Q_n) -->

$$Q_v = Q_n \frac{\rho_n}{\rho} = Q_n \frac{1,013}{1,013 + \rho} \times \frac{273 + T}{273}$$

b) From mass flowrate (Q_m) -->

$$Q_v = \frac{Q_m}{\rho}$$

3. Dynamic viscosity (η) --> kinematic viscosity (ν)

$$\nu = \frac{\eta}{\rho}$$

Calculating the Reynolds number:

$$Re = \frac{Q}{(2827 \cdot \nu \cdot d)}$$

Q = Flow in m³/h

d = Pipe diameter in m

ν = Kinematic viscosity m²/s (1 cst = 10⁻⁶ m²/s)

The current Reynolds number can also be calculated using our AP-Calc calculation program.

12.2 Measured value deviation for flow measurement

Deviation in percentage terms from the measured value under reference conditions (including the transmitter) in the linear measuring range between Re_{min} and Q_{max} (see "Measuring ranges" table).

| | FV4000-VT4/VR4 | FS4000-ST4/SR4 |
|------------------------------------|--------------------|----------------|
| Fluids | $\leq \pm 0,75 \%$ | $\pm 0,5 \%$ |
| Gases / Steam | $\leq \pm 1 \%$ | |
| Current output | | |
| Additional measurement uncertainty | $< 0,1 \%$ | |
| Temperature effect | $< 0,05 \%$ / 10 K | |

Misalignment associated with installation or deinstallation may affect the measuring error.

Additional measuring errors may occur if there are deviations from the reference conditions.

12.2.1 Reproducibility as a percentage of the measured value

| DN | Inch | FV4000-VT4/VR4 | FS4000-ST4/SR4 |
|-------------|------------|----------------|----------------|
| 15 | 1/2" | 0,3 % | |
| 25 ... 250 | 1" ... 6" | 0,2 % | |
| 200 ... 300 | 8" ... 12" | 0,25 % | 0,2 % |

12.3 Measured value deviation for temperature

Measured value deviation (including transmitter)

$\pm 2 \text{ }^\circ\text{C}$

Reproducibility

$\leq 0.2 \%$ of measured value

Product selection and dimensioning program



Important

The ABB "AP-Calc" program can be used free of charge when selecting an appropriate flowmeter for a given application. The program runs in a Microsoft WINDOWS[®] environment.

12.4 Permissible pipeline vibrations

Guide values: The values specified for acceleration g are intended as guide values. The actual limits will depend on the nominal diameter, the measuring range within the entire measuring span, and the frequency of the vibrations. Therefore, the acceleration value g has only limited meaning.

FV4000:

Fluid: max. 1.0 g, 0 ... 130 Hz

Gas / steam: max. 0.3 g, 0 ... 130 Hz

FS4000:

Fluid: max. 0.3 g, 0 ... 130 Hz

Gas / steam: max. 0.3 g, 0 ... 130 Hz

12.5 Reference conditions for flow measurement

| | FV4000-VT4/VR4 | FS4000-ST4/SR4 |
|--|--|----------------|
| Set flow range | 0.5 ... 1 x Q _{vmaxDN} | |
| Ambient temperature | 20 °C (68 °F) ± 2K | |
| Humidity | 65 % rel. humidity ± 5 % | |
| Air pressure | 86 ... 106 kPa | |
| Supply power | 24 V DC | |
| Signal cable length | 10 m (32.8 ft) (FV4000-VR or FS4000-SR only) | |
| Current output load | 250 Ω (4 ... 20 mA only) | |
| Fluid for calibration | Water: approx. 20 °C (68 °F), 2 bar (29 psi) | |
| Calibration loop internal diameter | = internal diameter of meter | |
| Unobstructed straight upstream section | 15 x DN | 3 x DN |
| Downstream section | 5 x DN | 1 x DN |
| Pressure measurement | 3 ... 5 x DN downstream of meter | |
| Temperature measurement | 2 ... 3 x DN downstream after pressure measurement | |

12.6 FV4000-VT4 / VR4 flowrates
12.6.1 Fluid flowrates

| DN | | DIN pipe | | | ANSI pipe | | | |
|-----|--------|----------|---|--|-----------|---|--------------------------------------|--|
| | | Re min | Q _{v,maxDN} (m ³ /h) | Frequency (Hz) at Q _{v,max} | Re min | Q _{v,maxDN} (m ³ /h) | Q _{v,maxDN} (US gal/min) | Frequency (Hz) at Q _{v,max} |
| 15 | 1/2" | 10000 | 6 | 370 | 11000 | 5,5 | 24 | 450 |
| 25 | 1" | 20000 | 18 | 240 | 23000 | 18 | 79 | 400 |
| 40 | 1 1/2" | 20000 | 48 | 270 | 23000 | 48 | 211 | 270 |
| 50 | 2" | 20000 | 70 | 180 | 22000 | 66 | 291 | 176 |
| 80 | 3" | 43000 | 170 | 140 | 48000 | 160 | 704 | 128 |
| 100 | 4" | 33000 | 270 | 100 | 44000 | 216 | 951 | 75 |
| 150 | 6" | 67000 | 630 | 50 | 80000 | 530 | 2334 | 50 |
| 200 | 8" | 120000 | 1100 | 45 | 128000 | 935 | 4117 | 40 |
| 250 | 10" | 96000 | 1700 | 29 | 115000 | 1445 | 6362 | 36 |
| 300 | 12" | 155000 | 2400 | 26 | 157000 | 2040 | 8982 | 23 |

The flowrates apply for fluids at 20 °C (68 °F), 1,013 mbar (14.69 psi), ρ = 998 kg/m³ (62.30 lb/ft³).

12.6.2 Gas / Steam flowrates

| DN | | DIN pipe | | | ANSI pipe | | | |
|-----|--------|----------|---|--|-----------|---|--|--|
| | | Re min | Q _{v,maxDN} (m ³ /h) | Frequency (Hz) at Q _{v,max} | Re min | Q _{v,maxDN} (m ³ /h) | Q _{v,maxDN} (ft ³ /min) | Frequency (Hz) at Q _{v,max} |
| 15 | 1/2" | 10000 | 24 | 1520 | 11000 | 22 | 13 | 1980 |
| 25 | 1" | 20000 | 150 | 2040 | 23000 | 82 | 48 | 1850 |
| 40 | 1 1/2" | 20000 | 390 | 2120 | 23000 | 340 | 200 | 1370 |
| 50 | 2" | 20000 | 500 | 1200 | 22000 | 450 | 265 | 1180 |
| 80 | 3" | 43000 | 1200 | 1000 | 48000 | 950 | 559 | 780 |
| 100 | 4" | 33000 | 1900 | 700 | 44000 | 1800 | 1059 | 635 |
| 150 | 6" | 67000 | 4500 | 480 | 80000 | 4050 | 2384 | 405 |
| 200 | 8" | 120000 | 8000 | 285 | 128000 | 6800 | 4002 | 240 |
| 250 | 10" | 96000 | 14000 | 260 | 115000 | 12000 | 7063 | 225 |
| 300 | 12" | 155000 | 20000 | 217 | 157000 | 17000 | 10006 | 195 |

The flowrates apply for gas at ρ = 1.2 kg/m³ (0.075 lb/ft³).

12.7 FS4000-ST4 / SR4 flowrates

12.7.1 Fluid flowrates

| DN | | Re min | Q _{v,max} DN (m ³ /h) | Q _{v,max} DN (US gal/min) | Frequency (Hz) at Q _{v,max} DN |
|-----|--------|--------|---|------------------------------------|---|
| 15 | 1/2" | 2100 | 1,6 | 7,0 | 185 |
| 20 | 3/4" | 3500 | 2 | 8,8 | 100 |
| 25 | 1" | 5200 | 6 | 26 | 135 |
| 32 | 1 1/4" | 7600 | 10 | 44 | 107 |
| 40 | 1 1/2" | 13500 | 16 | 70 | 110 |
| 50 | 2" | 17300 | 25 | 110 | 90 |
| 80 | 3" | 15000 | 100 | 440 | 78 |
| 100 | 4" | 17500 | 150 | 660 | 77 |
| 150 | 6" | 43000 | 370 | 1620 | 50 |
| 200 | 8" | 44000 | 500 | 2200 | 30 |
| 300 | 12" | 115000 | 1000 | 4400 | 16 |
| 400 | 16" | 160000 | 1800 | 7920 | 13 |

The flowrates apply for fluids at 20 °C (68 °F), 1,013 mbar (14.69 psi), $\nu = 1 \text{ cSt}$, $\rho = 998 \text{ kg/m}^3$ (62.30 lb/ft³).

12.7.2 Gas / Steam flowrates

| DN | | Q _{v,min} (m ³ /h) | Q _{v,max} DN (m ³ /h) | Q _{v,min} (ft ³ /min) | Q _{v,max} DN (ft ³ /min) | Frequency (Hz) at Q _{v,max} DN |
|-----|--------|--|---|---|--|---|
| 15 | 1/2" | 2.5 | 16 | 1.4 | 9.4 | 1900 |
| 20 | 3/4" | 5 | 25 | 2.9 | 14 | 1200 |
| 25 | 1" | 5 | 50 | 2.9 | 29 | 1200 |
| 32 | 1 1/4" | 8 | 130 | 4.7 | 76 | 1300 |
| 40 | 1 1/2" | 12 | 200 | 7.0 | 117 | 1400 |
| 50 | 2" | 18 | 350 | 10 | 206 | 1200 |
| 80 | 3" | 60 | 850 | 35 | 500 | 690 |
| 100 | 4" | 65 | 1500 | 38 | 882 | 700 |
| 150 | 6" | 150 | 3600 | 88 | 2110 | 470 |
| 200 | 8" | 200 | 4900 | 117 | 2880 | 320 |
| 300 | 12" | 530 | 10000 | 311 | 5880 | 160 |
| 400 | 16" | 1050 | 20000 | 618 | 11770 | 150 |

The flowrates apply for gas / steam at $\rho = 1.2 \text{ kg/m}^3$ (0.075 lb/ft³).

The frequency information is for orientation purposes only. For individual nominal diameters and designs, ranges are supplied in which typical frequencies lie.

12.8 Static overpressure in the case of fluids

To avoid cavitation, a static overpressure is required downstream of the flowmeter (downstream pressure). This can be estimated using the following formula:

$$p_2 \geq 1,3 \times p_{Dampf} + 2,6 \times \Delta p'$$

p_2 = Static overpressure downstream of the flowmeter (mbar)

p_{Dampf} = Steam pressure of fluid at operating temperature (mbar)

$\Delta p'$ = Pressure drop, medium (mbar)

12.9 Overload capability

Gases

15 % above maximum flow

Fluids

15 % above maximum flow (no cavitation permitted!)

12.10 Temperature of medium



Important

Please note the information in the section titled "Explosion protection".
Compliance with the permissible temperature range for the gaskets is mandatory.

| | FV4000-VT4/VR4 | FS4000-ST4/SR4 |
|-----------|---------------------------------|-----------------------|
| Standard | -55 ... 280 °C (-67 ... 536 °F) | |
| HT design | -55 ... 400 °C (-67 ... 752 °F) | - |

12.11 Flowmeter insulation

The pipeline may be insulated up to a maximum of 100 mm (4 inch) upper edge.

Use of trace heating

Trace heating may be used under the following conditions:

- If it is fixed directly on or around the pipeline
- If, in the case of existing pipeline insulation, it is installed inside the insulation (the maximum height of 100 mm (4 inch) must not be exceeded)
- If the maximum temperature the trace heating is able to produce ≤ the maximum temperature of the medium

The requirements to be met by integrators set out in EN 60079-14 must be complied with!

Please note that the use of trace heaters will not impair EMC protection or generate additional vibrations.

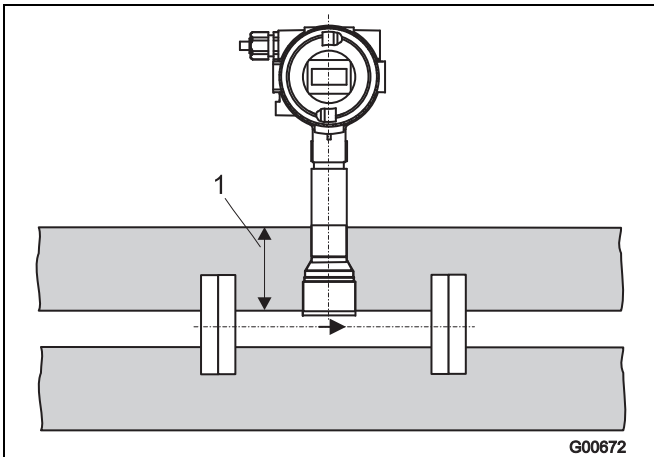


Fig. 59: Flowmeter insulation
1 Maximum 100 mm (4 inch)

12.12 Ambient conditions

Resistance to climate to DIN 40040

Permissible ambient temperature range

| Explosion protection / Model | Temperature range |
|---|--|
| None / VT40 and VR40 / ST40 and SR40 | -20 ... 70 °C (-4 ... 158 °F) |
| | -55 ... 70 °C (-67 ... 158 °F) |
| Ex ib / VT41 and VR41 / ST41 and SR41 | -20 ... 70 °C (-4 ... 158 °F) ¹⁾ |
| | -40 ... 70 °C (-67 ... 158 °F) ¹⁾ |
| Ex ia / VT4A and VR4A / ST4A and SR4A | -20 ... 60 °C (-4 ... 140 °F) |
| | -30 ... 60 °C (-40 ... 140 °F) |
| Ex d / VT42 and VR42 / ST42 and SR42 | -20 ... 60 °C (-4 ... 140 °F) |
| | -40 ... 60 °C (-40 ... 140 °F) |
| cFM _{US} / VT43 and VR43 / ST43 and SR43 | -20 ... 70 °C (-4 ... 158 °F) |
| | -45 ... 70 °C (-49 ... 158 °F) |

¹⁾ Category 2D (dust-ignition proof) maximum 60° C (140° F)

Permissible air humidity

| Design | Humidity |
|---------------|---|
| Standard | Relative humidity max. 85 %, annual mean ≤ 65 % |
| Climate-proof | Relative humidity ≤ 100 % permanent |

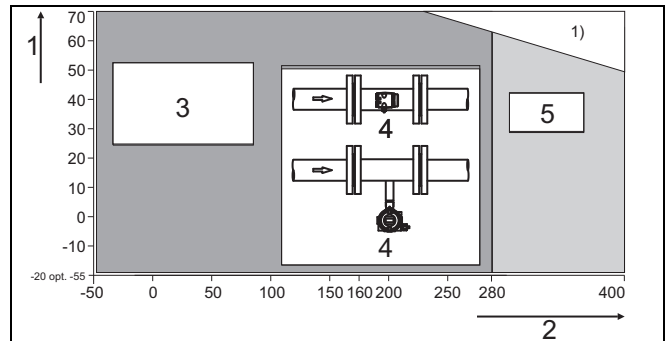


Fig. 60: Relationship between the temperature of the fluid and the ambient temperature

- | | |
|---|---|
| 1 Ambient temperature | 4 Installation for medium temperature > 150 °C (302 °F) |
| 2 Media temperature | |
| 3 Permissible temperature range for standard design (≤ 280 °C (≤ 536 °F)) | 5 HT design (≤ 400 °C (≤ 752 °F)), FV4000-VT4 only |

¹⁾ For the supply circuit (terminals 31 / 32) and the switching outputs 41 and 42, cables suitable for temperatures up to T = 110 °C (230 °F) may be used without restriction. Cables which are only suitable for temperatures up to T = 80 °C (176 °F) restrict the temperature ranges. These restrictions also apply to the VR version (remote design) and the PROFIBUS PA design with plug connector.



Important

The legibility of the display can be impaired at temperatures < 0 °C (< 32 °F) and > 55 °C (> 131 °F). The functionality of the meter and the outputs remains unaffected by this. Please refer to the order information for ambient temperatures < -20 °C (< -4 °F).

Please note the information in the section titled 13 „Transmitter specifications”.

12.13 Process connections

| | Flange design | | Wafer flange design | |
|-----------------------|---------------------------------|--|---------------------|--|
| | Process connection | Operating pressure | Process connection | Operating pressure |
| FV4000-VT4/VR4 | DN15 ... DN300 | O-ring gasket: DIN PN 10 ... PN 40, option up to PN 160 ASME Class 150 / 300, option up to 900 lb Flat gasket (graphite): Maximum PN 64 / ASME Class 300 lb | DN25 ... DN150 | O-ring gasket: DIN PN 64, option up to PN 100 ASME Class 150 / 300, option up to 600 lb Flat gasket (graphite): Maximum PN 64 / ASME Class 300 lb |
| FS4000-ST4/SR4 | DN 15 ... DN 200 ¹⁾ | DIN PN 10 ... PN 40 ASME Class 150/300 | - | - |
| | DN 300 ... DN 400 ¹⁾ | DIN PN 10 ... PN 16 ASME Class 150 | | |

1) Other designs on request.

12.14 Materials

| Component | Material | Temperature range | |
|---------------------------------|--|---|------------------------------------|
| | | FV4000-VT4/VR4 | FS4000-ST4/SR4 |
| Meter housing | Stainless steel 1.4571 (316Ti) / 316L / CF8 / CF8C, Option: Hastelloy C | -55 ... 400 °C (-67 ... 752 °F) | -55 ... 280 °C (-67 ... 536 °F) |
| Swirl body / Inlet/outlet pipes | Stainless steel 1.4571 (316Ti) / 316L / CF8 / CF8C, Option: Hastelloy C | (CF8: -55 ... 300 °C (-67 ... 572 °F)) | |
| Sensor | Stainless steel 1.4571, Option: Hastelloy C | | |
| Sensor gasket ¹⁾ | Kalrez (3018) o-ring | 0 ... 280 °C (32 ... 536 °F) | 0 ... 280 °C (32 ... 536 °F) |
| | Kalrez (6375) o-ring | -20 ... 275 °C (-4 ... 527 °F) | 20 ... 275 °C (68 ... 527 °F) |
| | Viton o-ring | -55 ... 230 °C (-67 ... 446 °F) | -55 ... 230 °C (-67 ... 446 °F) |
| | PTFE o-ring | -55 ... 200 °C (-67 ... 392 °F) | -55 ... 200 °C (-67 ... 392 °F) |
| | Graphite | -55 ... 280 °C (-67 ... 536 °F) | -55 ... 280 °C (-67 ... 536 °F) |
| | Graphite special | -55 ... 400 °C (-67 ... 752 °F) (High temperature) | - |
| Housing, electronics | Cast aluminum, varnished | | |

1) Other designs on request.

12.15 Weights

The dimension tables contain weight details.

12.15.1 Permissible operating pressures FV4000

Process connection DIN flange

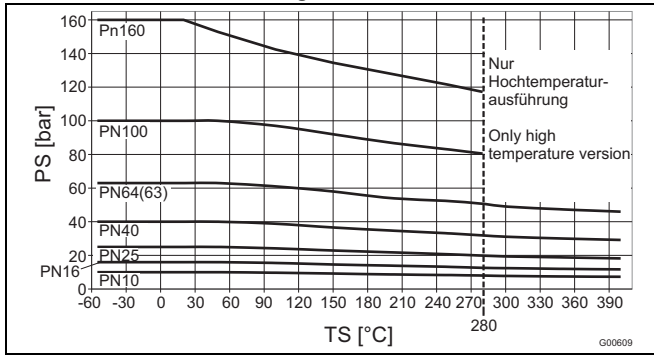


Fig. 61: High temperature design only, version FV4000 (TRIO-WIRL VT / VR)

PS Pressure (bar) TS Temperature (°C)

Process connection ASME flange

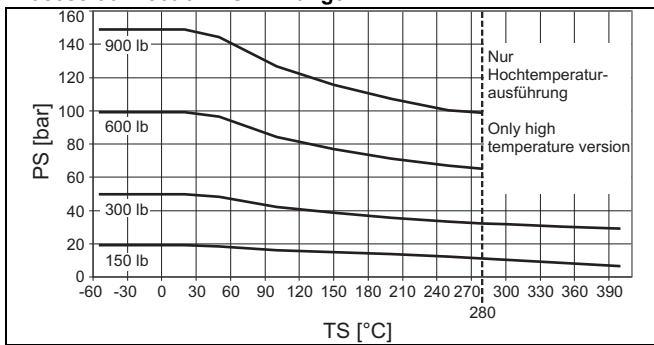


Fig. 62: High temperature design only, version FV4000 (TRIO-WIRL VT / VR)

PS Pressure (bar) TS Temperature (°C)

Aseptic flange to DIN 11864-2

- DN 25 to DN 40:
PS = 25 bar to TS = 140 °C if suitable gasket materials are selected
- DN 50 and DN 80:
PS = 16 bar to TS = 140 °C if suitable gasket materials are selected

Process connection DIN wafer

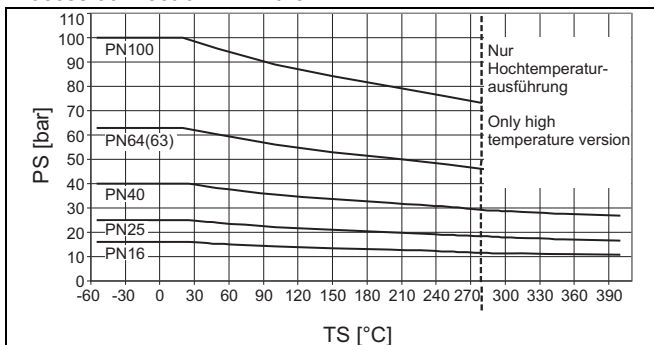


Fig. 63: High temperature design only

PS Pressure (bar) TS Temperature (°C)

Process connection ASME wafer

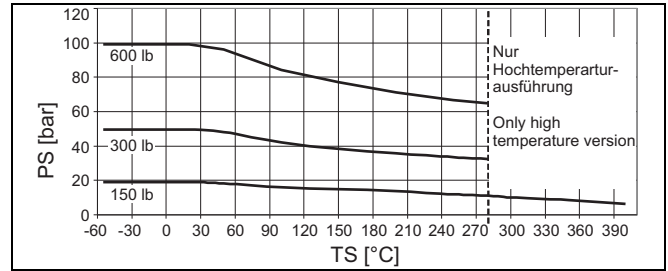


Fig. 64: High temperature design only

PS Pressure (bar) TS Temperature (°C)

12.15.2 Permissible operating pressures FS4000

Process connection DIN flange

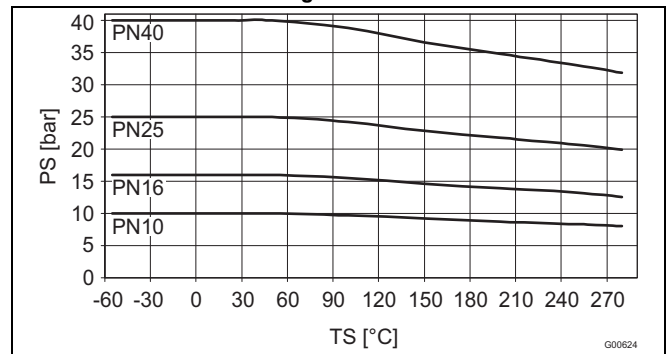


Fig. 65

PS Pressure (bar) TS Temperature (°C)

Process connection ASME flange

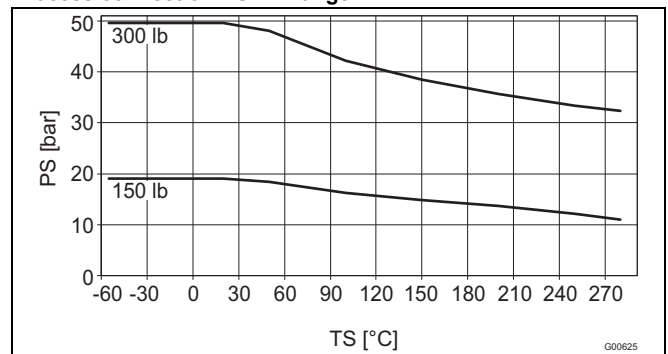


Fig. 66

PS Pressure (bar) TS Temperature (°C)

13 Transmitter specifications

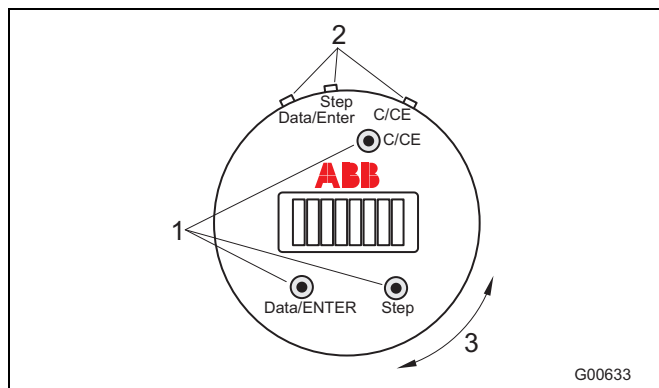


Fig. 67: Transmitter keypad and LCD display

- 1 Magnet sensors
- 2 Control buttons for direct entry
- 3 Can be rotated +/- 90 °

Measuring ranges

The full-scale value can be set at any point between the maximum possible upper range value $1.15 \times Q_{\max DN}$ and $0.15 \times Q_{\max DN}$.

Parameter setting

Data can be entered using 3 control buttons (not with the Ex "d" hazardous area design) or, if the housing is sealed, directly from an external location using a magnetic pen.

Data is entered in plain text with the display or using digital communication via the HART protocol or PROFIBUS PA/FOUNDATION fieldbus.

Flow operating modes

The following operating modes can be selected dependent upon the design purchased (with or without Pt100):

Fluid medium:

- Operating flow
- Mass flow with constant or temperature-dependent density

Gas/steam medium:

- Operating flow
- Mass flow with constant or temperature-dependent density (at constant pressure)
- Standard flow with constant or temperature-dependent standard factor (at constant pressure)
- Mass flow with saturated steam and temperature-driven density

Data backup

Counter readings and parameters for specific measuring points backed up in FRAM (more than 10 years without supply power) in the case of shutdown or should the supply voltage fail.

Damping

Configurable from 1 ... 100 s, corresponds to 5 τ.

$Q_{v \min}$ (low flow)

Configurable between 2 ... 25 % of $Q_{\max DN}$ (max. operating flow per nominal size). The actual low flow is determined by application and installation.

Function tests

Software-internal function tests can be used to test individual internal modules. For the purpose of commissioning and testing, the current output (4 ... 20 mA design) or the digital output signal (fieldbus designs) can be simulated in line with flowrates selected by the user (manual process control). The switching output can also be controlled directly for the purpose of function testing.

Electrical connection

Screw-type terminals, plug-in connection on PROFIBUS PA (option) cable gland: -standard., Ex "ib" / Ex "ia": M20 x 1.5; NPT 1/2 " -Ex d": NPT 1/2"

Ingress protection

IP 67 to EN 60529

Display

High-contrast LCD display, 2 x 8-digit (4 ... 20 mA design) or 4 x 16-digit (PROFIBUS PA / FOUNDATION fieldbus design). Shows the instantaneous flowrate along with the totalized flow or temperature of the medium (option).

On the 4 ... 20 mA design, the multiplex function enables 2 values (e.g., flowrate and totalized flow) to be displayed virtually in parallel. Up to 4 values can be displayed on the fieldbus design.

Switching output terminals 41 / 42 (standard on all designs)

The function can be selected via the software:

- Max./min. alarm for flow or temperature
- System alarm
- Pulse output: f_{\max} : 100 Hz; t_{on} : 1 ... 256 ms

Contact type:

- Standard and Ex "d": Optocoupler $U_H = 16 \dots 30 \text{ V}$
 $I_L = 2 \dots 15 \text{ mA}$
- Ex "ib" / Ex "ia": Configured as NAMUR contact

EMC protection





The flowmeter corresponds to NAMUR recommendations NE21. Electromagnetic compatibility of equipment for process and lab control technology 5/93 and EMC Directive 2004/108/EC (EN 61326-1). Note: EMC protection and protection against accidental contact are limited when the housing cover is open.

14 Appendix

14.1 Additional documents

- Data sheet (D184S035Uxx)
- Commissioning instructions (CI/FV4000/FS4000)
- Interface description for devices with HART communication (D184B108U03/04)
- Interface description for devices with PROFIBUS PA communication (D184B093U21/22)
- Interface description for devices with FOUNDATION fieldbus communication (D184B093U23/24)

14.2 Approvals and certifications

| | | |
|-----------------------------|---|---|
| <p>CE mark</p> |  | <p>The version of the meter in your possession meets the requirements of the following European directives:</p> <ul style="list-style-type: none"> - ATEX directive 94/9/EC - EMC directive 2004/108/EC - Pressure equipment directive (PED) 97/23/EC <p>Pressure equipment does <u>not</u> receive a CE mark indicating PED compliance on the factory tag in the event of the following conditions prevailing:</p> <ul style="list-style-type: none"> - The maximum permissible pressure (PS) is less than 0.5 bar - Due to low pressure risks (meter size ≤ DN 25 / 1") no approval procedures are required. |
| <p>Explosion Protection</p> |    | <p>Identification for intended use in potentially explosive atmospheres according to:</p> <ul style="list-style-type: none"> - ATEX directive (marking in addition to CE marking) - IEC standards - _cFM_{US} Approvals for Canada and United States |



IMPORTANT (NOTE)

All documentation, declarations of conformity and certificates are available in ABB's download area.

www.abb.com/flow



EG-Konformitätserklärung EC-Certificate of Compliance

Hiermit bestätigen wir die Übereinstimmung der
Herewith we confirm that our



TRIO-WIRL Durchflußmesser TRIO-WIRL Flowmeter

Modell VT41.; VT42.; ST41.; ST42.; VR41.; VR42.; SR41.; SR42.
Model VT41.; VT42.; ST41.; ST42.; VR41.; VR42.; SR41.; SR42.

mit den grundlegenden Sicherheits- und Gesundheitsanforderungen gem. der Richtlinie 94/9/EG des Rates der Europäischen Gemeinschaft. Die Sicherheits- und Installationshinweise der Produktdokumentation sind zu beachten.

are in compliance with the Essential Health and Safety Requirements with refer to the council directives 94/9/EC of the European Community. The safety and installation requirements of the product documentation must be observed.

Die TRIO-WIRL Durchflußmesser dienen zur Messung des Durchflusses von Gasen, Dämpfen und Flüssigkeiten.

The TRIO-WIRL Flowmeters are utilized to meter the flowrate of gases, steam or liquids.

EG-Baumusterprüfbescheinigung: TÜV 08 ATEX 554808 X; TÜV 08 ATEX 554955 X
EC-Type Examination Certificate:

Konformitätsaussage: TÜV 08 ATEX 554833 X; TÜV 08 ATEX 554956 X
Conformity Declaration

Benannte Stelle: TÜV Hannover/Sachsen-Anhalt e.V., Kennnummer 0044
Notified Body:

Geräte-Kennzeichnung: II 2G Ex d [ib] IIC T6 bzw. II 2G Ex ib IIC T4 bzw.
II 3G Ex nA[nL] IIC T4 bzw. II 3D Ex tD A22 T85°C ... T_{Medium}
Apparatus code: II 2G Ex d [ib] IIC T6 or II 2G Ex ib IIC T4 or
II 3G Ex nA[nL] IIC T4 or II 3D Ex tD A22 T85°C ... T_{Medium}

Sicherheitstechnische Daten: siehe EG-Baumusterprüfbescheinigung
Safety values: refer to EC-Type Examination Certificate
Angewandte Normen: und siehe Konformitätsaussage.
Standards: and refer to Conformity Declaration.

Göttingen, 20. November 2008

BZ-13-8019, Rev01, 12165

Unterschrift / Signature
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Innovation Manager DEAPR Instrumentation

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USt-IdNr.: DE 115 300 097

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Geschäftsführung:
Christian Wendler

Bankverbindung:
Commerzbank AG Frankfurt
Konto: 569 635 200
BLZ: 500 400 00



EG-Konformitätserklärung
EC-Certificate of Compliance



Hiermit bestätigen wir die Übereinstimmung der
Herewith we confirm that our

TRIO-WIRL Durchflußmesser
TRIO-WIRL Flowmeter

Modell V_4A.; S_4A. "Feldbus"
Model V_4A.; S_4A. "Fieldbus"

mit den grundlegenden Sicherheits- und Gesundheitsanforderungen gem. der Richtlinie 94/9/EG des Rates der Europäischen Gemeinschaft. Die Sicherheits- und Installationshinweise der Produktdokumentation sind zu beachten.
are in compliance with the Essential Health and Safety Requirements with refer to the council directives 94/9/EC of the European Community. The safety and installation requirements of the product documentation must be observed.

Die TRIO-WIRL Durchflussmesser dienen zur Messung des Durchflusses von Gasen, Dämpfen und Flüssigkeiten.
The TRIO-WIRL Flowmeters are utilized to meter the flowrate of gases, steam or liquids.

EG-Baumusterprüfbescheinigung: TÜV 10 ATEX 556309 X
EC-Type Examination Certificate:

| | |
|---|--|
| Benannte Stelle: <i>Notified Body:</i> | TÜV NORD CERT GmbH |
| Geräte-Kennzeichnung: | II2G Ex ia IIC T4 Gb FISCO II2D Ex ta IIIC T85°C... TMedium Db IP67 oder II2D Ex ta IIIC T85°C Db IP67 |
| Apparatus code: | II2G Ex ia IIC T4 Gb FISCO II2D Ex ta IIIC T85°C... TMedium Db IP67 or II2D Ex ta IIIC T85°C Db IP67 |
| Sicherheitstechnische Daten: <i>Safety values:</i> | siehe EG-Baumusterprüfbescheinigung <i>refer to EC-Type Examination Certificate</i> |
| Angewandte Normen: <i>Standards:</i> | EN 60 079-0: 2009 EN 60 079-11: 2007 EN 60 079-27:2008 EN 60 079-31:2009 |

Göttingen, 08. August 2011

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i.V. Dr. Günter Kuhlmann
(R&D Manager)

ÜZ-13-8014, Rev.3, 19215

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EG-Konformitätserklärung EC Declaration of Conformity

Hiermit bestätigen wir die Übereinstimmung der aufgeführten Geräte mit den Richtlinien des Rates der Europäischen Gemeinschaft, welche mit dem CE-Zeichen gekennzeichnet sind. Die Sicherheits- und Installationshinweise der Produktdokumentation sind zu beachten.

We herewith confirm that the listed devices are in compliance with the council directives of the European Community and are marked with the CE marking. The safety and installation requirements of the product documentation must be observed.

| | |
|--|--|
| Hersteller: <i>Manufacturer:</i> | ABB Automation Products GmbH, Dransfelder Straße 2, 37079 Göttingen - Germany |
| Gerät: <i>Device:</i> | Wirbel-Durchflussmesser / Drall-Durchflussmesser <i>Vortex Flowmeter / Swirl Flowmeter</i> |
| Modelle: <i>Models:</i> | FV4000-VT4 / -VR4 ; FS4000-ST4 / -SR4 <i>FV4000-VT4 / -VR4 ; FS4000-ST4 / -SR4</i> |
| EG-Richtlinie: <i>EC directive:</i> | 2004/108/EG * (EMV) 2004/108/EC * (EMC) |
| Europäische Norm: <i>European Standard:</i> | EN 61326-1, 10/2006 * EN 61326-2-3, 05/2007 * EN 61326-1, 10/2006 * EN 61326-2-3, 05/2007 * |

* einschließlich Nachträge / *including alterations*

Göttingen, 03. Juli 2009

i.V. Dr. Günter Kuhlmann
(R&D Manager)

i.A. Dirk Steckel
(R&D Electrical Safety)

ABB Automation Products GmbH

BZ-13-5029, Rev.02, 12942

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USt-IdNr.: DE 115 300 097

Vorsitz des Aufsichtsrates:
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Geschäftsführung:
Christian Wendler

Bankverbindung:
Commerzbank AG Frankfurt
Konto: 569 635 200
BLZ: 500 400 00



**EG-Konformitätserklärung
EC-Declaration of Conformity**

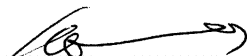


Hiermit bestätigen wir die Übereinstimmung des aufgeführten Gerätes mit den Richtlinien des Rates der Europäischen Gemeinschaft, welche mit dem CE-Zeichen gekennzeichnet sind. Die Sicherheits- und Installationshinweise der Produktdokumentation sind zu beachten.

Herewith we confirm that the listed instrument is in compliance with the council directives of the European Community and are marked with the CE marking. The safety and installation requirements of the product documentation must be observed.

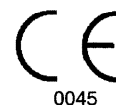
| | |
|---|---|
| Hersteller: <i>manufacturer:</i> | ABB Automation Products GmbH, 37070 Göttingen - Germany |
| Modell: <i>model:</i> | V_4.. V_4.. |
| Richtlinie: <i>directive:</i> | Druckgeräterichtlinie 97/23/EG <i>pressure equipment directive 97/23/EC</i> |
| Einstufung: <i>classification:</i> | Ausrüstungsteile von Rohrleitungen <i>pipng accessories</i> |
| Normengrundlage: <i>technical standard:</i> | AD 2000 Merkblätter |
| Konformitätsbewertungsverfahren: <i>conformity assessment procedure:</i> | B1 (EG-Entwurfsprüfung) + D (Qualitätssicherung Produktion) <i>B1 (EC design-examination) + D (production quality assurance)</i> |
| EG-Entwurfsprüfbescheinigungen: <i>EC design-examination certificates:</i> | Nr. 07 202 0124 Z 0052/2/0003 Nr. 07 202 0124 Z 0413/2/0001 |
| benannte Stelle: <i>notified body:</i> | TÜV Nord e.V. Rudolf-Diesel-Str. 5 37075 Göttingen - Germany |
| Kennnummer: <i>identification no.</i> | 0045 |

Göttingen, den 21.10.2002

ppa 
(B.Kammann, Standortleiter APR Göttingen)



EG-Konformitätserklärung EC-Declaration of Conformity



Hiermit bestätigen wir die Übereinstimmung des aufgeführten Gerätes mit den Richtlinien des Rates der Europäischen Gemeinschaft, welche mit dem CE-Zeichen gekennzeichnet sind. Die Sicherheits- und Installationshinweise der Produktdokumentation sind zu beachten.
Herewith we confirm that the listed instrument is in compliance with the council directives of the European Community and are marked with the CE marking. The safety and installation requirements of the product documentation must be observed.

| | |
|---|---|
| Hersteller: <i>manufacturer:</i> | ABB Automation Products GmbH, 37070 Göttingen - Germany |
| Modell: <i>model:</i> | S_4.. S_4.. |
| Richtlinie: <i>directive:</i> | Druckgeräterichtlinie 97/23/EG <i>pressure equipment directive 97/23/EC</i> |
| Einstufung: <i>classification:</i> | Ausrüstungsteile von Rohrleitungen <i>pipng accessories</i> |
| Normengrundlage: <i>technical standard:</i> | AD 2000 Merkblätter |
| Konformitätsbewertungsverfahren: <i>conformity assessment procedure:</i> | B1 (EG-Entwurfsprüfung) + D (Qualitätssicherung Produktion) <i>B1 (EC design-examination) + D (production quality assurance)</i> |
| EG-Entwurfsprüfbescheinigung: <i>EC design-examination certificate:</i> | Nr. 07 202 0124 Z 052/2/0004 |
| benannte Stelle: <i>notified body:</i> | TÜV Nord e.V. Rudolf-Diesel-Str. 5 37075 Göttingen - Germany |
| Kennnummer: <i>identification no.</i> | 0045 |

Göttingen, den 21.05.2002

ppa
(K.Wiskow, Personalleiter APR Göttingen)

14.3 Overview of technical design and setting parameters

| Measuring point: | TAG no.: |
|-------------------------------|---|
| Sensor model: | |
| Order no. | Device no.: |
| Medium: | Voltage supply: |
| | |
| Parameter | Setting range |
| Prog. protection code: | 0-9999 (0=factory setting) |
| Language: | |
| Nominal size: | DN 15 - 400 |
| Operating mode: | |
| Q _{max} | 0.15 Q _{max} DN to 1.15 Q _{max} DN |
| Standard factor: | 0.001 - 1,000 (operating density / standard density) |
| Reference density: | |
| Density unit: | g/ml, g/cm ³ , g/l, kg/l, kg/m ³ , lb/ft ³ , lb/ugl |
| Unit Q _{vol} | l/s, l/min, l/h, l/d, m ³ /s, m ³ /min, m ³ /h, m ³ /d, ft ³ /s, ft ³ /m, ft ³ /h, ft ³ /d, bbl/s, bbl/min, bbl/h, bls/d, USgpps, USgpm, USgph, Usmgd, igps, igpm, igph, igpd |
| Unit Q _m | kg/s, kg/min, kg/h, kg/d, t/min, t/h, t/d, g/s, g/min, g/h, lb/s, lb/min, lb/h, lb/d |
| Unit totalizer: | l, m ³ , igal, USgal, ft ³ , bbl, kg, t, g, lb |
| Max. alarm: | % |
| Min. alarm: | % |
| Pulse factor: | 0.001 to 1,000 pulse/phys. unit |
| Pulse width: | 0.100 - 2,000 ms |
| Low flow (Q _{min}): | 2 - 25 % of flow range upper range value |
| Damping: | 0.5 - 99.99 seconds |
| 1st display line: | Q (%), Q (unit), totalizer, temperature |
| 2nd display line: | Q (%), Q (unit), totalizer, temperature |
| 2nd multiplex line: | ON / OFF |
| Communication: | <input type="checkbox"/> HART protocol <input type="checkbox"/> PROFIBUS PA <input type="checkbox"/> FOUNDATION fieldbus FF |

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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