Operating Instruction OI/FCB300-EN

CoriolisMaster FCB330, FCB350
Coriolis Mass Flowmeter

Power and productivity
for a better world™

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Coriolis Mass Flowmeter

Operating Instruction
OI/FCB300-EN

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Translation of the original instruction

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Contents

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 liquids and gases (including unstable liquids and gases)
- To meter mass flow directly
- To meter volumetric flow (indirectly via mass flow and density)
- To measure the density of the liquid or gas
- To measure the temperature of the liquid or gas

Using these products as intended involves observing the following points:
- Read and follow the instructions in this manual
- Observe the technical ratings (refer to the “Technical limit values” section)
- Use only approved media for measurement (refer to the “Permissible media for measurement” section)

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.
- Use as a climbing aid, e.g., for mounting purposes
- Use as a support for external loads, e.g., as a support for piping, etc.
- Addition of material, e.g., by painting over the name plate or welding/soldering on parts
- Removal of 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.
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 manual, 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 potentially 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 injuries
This symbol in conjunction with the signal word "CAUTION" indicates a potentially dangerous situation. Failure to observe this safety information may result in minor or moderate injury. The symbol may also be used for property damage warnings.

NOTICE – Property damage
This 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. The signal word "IMPORTANT (NOTE)" does not indicate a dangerous or harmful situation.

1.6.2 Name plate

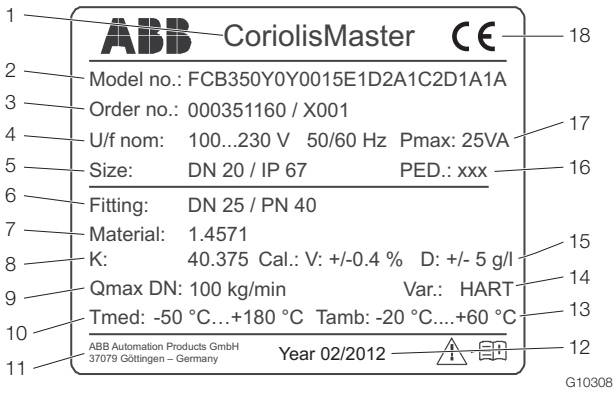


Fig. 1: Name plate for integral mount design flowmeter sensor
1 Full designation | 2 Order code | 3 Order number |
4 Power supply | 5 Nominal diameter / Degree of protection |
6 Process connection / Pressure rating | 7 Meter tube material |
8 Calibration factor | 9 Maximum flow rate |
10 Medium temperature range | 11 Manufacturer |
12 Year of construction (month / year) |
13 Ambient temperature range | 14 Communication |
15 Calibration accuracy | 16 PED mark |
17 Maximum power consumption | 18 CE mark

1.7 Transport safety instructions

Observe the following instructions:

- Do not expose the device to moisture during transport. Pack the device accordingly.
- Pack the device so that it is protected against vibrations during transport, e.g., by using air-cushioned packaging.
- Depending on the device, the center of gravity may not be in the center of the equipment.

1.8 Installation safety instructions

Prior to installation, check the devices for possible damage that may have occurred as a result of improper transport. Details of any damage that has occurred in transit must be recorded on the transport documents. All claims for damages must be submitted to the shipper without delay and before installation.

- 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).
- Install flange devices 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.

1.9 Safety instructions for electrical installation

The electrical connection may only be established by authorized specialist personnel and in accordance with the connection diagrams.
The electrical connection information in the manual must be observed; otherwise, the type of electrical protection may be adversely affected.
Ground the measurement system according to requirements.

1.10 Safety instructions for operation

Before switching on the device, make sure that your installation complies with the environmental conditions listed in the chapter “Technical Data” or on the data sheet.
If there is a chance that safe operation is no longer possible, take the device out of operation and secure it against unintended startup.
During operation with hot media, contact with the surface may result in burns.
Aggressive media may result in corrosion and abrasion of the parts that come into contact with the medium. As a result, pressurized media may escape prematurely.
Wear to the flange gasket or process connection gaskets (e.g., aseptic threaded pipe connections, Tri-Clamp, etc.) may enable a pressurized medium to escape.
When using internal flat gaskets, these can become embrittled through CIP/SIP processes.

WARNING – Risk of poisoning!
Bacteria and chemical substances can contaminate or pollute pipeline systems and the materials they are made of.
Observe the following instructions in installations conforming to EHEDG requirements.

- The appropriate installation conditions must be observed in order to achieve an installation that complies with EHEDG requirements.
- In order to achieve compliance with EHEDG requirements, the combination of process connection and gaskets selected by the operator must consist solely of EHEDG-compliant parts. Note the information in the latest version of the following document:
  EHEDG Position Paper: "Hygienic process connections to use with hygienic components and equipment".

1.11 Technical limit values

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

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

1.12 Permissible media for measurement

When using media for measurement, please note:

- Media 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 transmitter wetted parts will not be adversely affected during the operating period.
- Media containing chloride in particular can cause corrosion damage to stainless steels which, although not visible externally, can damage wetted parts beyond repair and lead to the medium for measurement escaping. It is the operator's responsibility to check the suitability of these materials for the application at hand.
- Media 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.
- Follow the instructions on the name plate.

1.13 Safety information for inspection and maintenance

WARNING – Electrical dangers!
When the housing is open, EMC protection is impaired and there is no longer any protection against accidental contact.
Switch off the power supply before opening the housing.

Corrective maintenance work may only be performed by trained personnel.

- Before removing the device, depressurize it and any adjacent lines or containers.
- Check whether hazardous materials have been 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 it is opened.

Within the scope of operator responsibility, check the following as part of a regular inspection:

- the pressure-carrying walls / lining of the pressure device
- the measurement-related function
- the leak tightness
- the wear (corrosion)

1.14 Returning devices

Use the original packaging or a secure transport container of an appropriate type if you need to return the device for repair or recalibration purposes. Fill out the return form (see the Appendix) and include this with the device.
According to the EU Directive governing hazardous materials, the owner of hazardous waste is responsible for its disposal or must observe the following regulations for shipping purposes:
All devices delivered to ABB must be free from any hazardous materials (acids, alkalis, solvents, etc.).

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

1.15 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 minimum 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.

1.16 Disposal

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

1.16.1 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 collection points. 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.

1.16.2 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 regulations on hazardous substances with restricted uses or the directive on waste 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 Function and System Design

2.1 General remarks

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

2.2 Measuring principle

When a mass flows through a vibrating pipe, Coriolis forces are generated which bend and twist the pipe. These very small pipe deformations are measured by optimally mounted sensors and electronically evaluated. Because the measured phase shift of the sensor signals is proportional to the mass flow rate, the Coriolis Mass Flowmeter measures the mass flow rate in the flowmeter directly. The metering principle is independent of the density, temperature, viscosity, pressure and conductivity of the fluid.
The meter tubes always vibrate at resonance. This resonant frequency, at the operating conditions, is a function of the meter tube geometry, the characteristics of the flowmeter materials and the mass of the fluid in the meter tube, which is also vibrating. It provides an accurate measure of the density of the fluid being metered.
An integrated temperature sensor measures the fluid temperature and is utilized for corrections to temperature-dependent instrument parameters. Summarizing, it is possible to simultaneously measure the mass flow rate, fluid density and temperature with the Coriolis Mass Flowmeter. Other measurement values can be derived from these values, e.g. volume flow rate or concentration.

Function for calculating Coriolis force

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

Element in formula	Description
$\vec{F}c$	Coriolis force
$\vec{\omega}$	Angular velocity
$\vec{v}$	Velocity of the mass
m	Mass

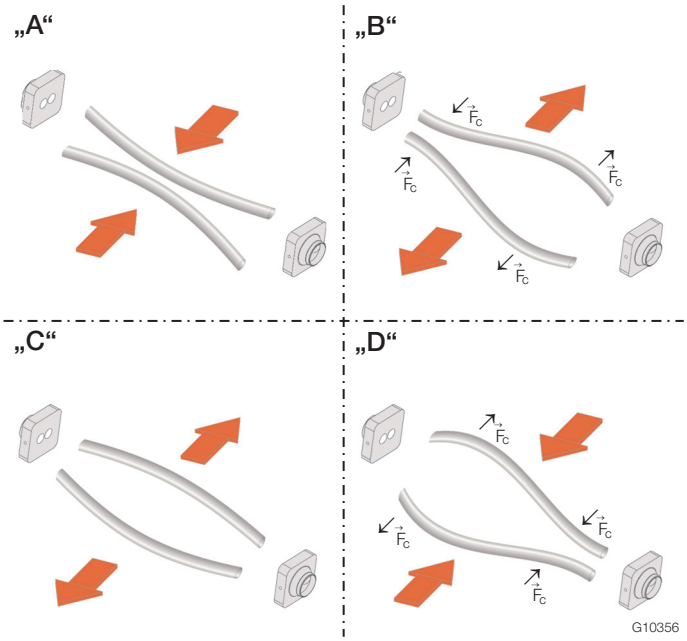
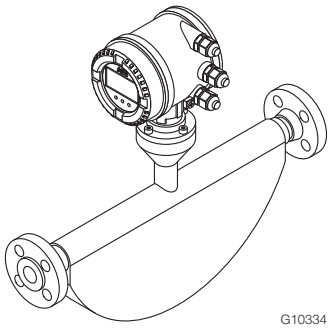


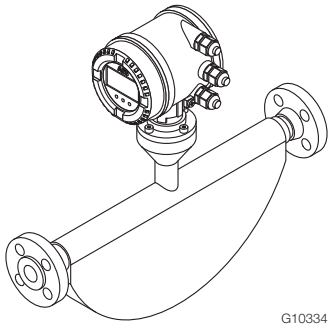
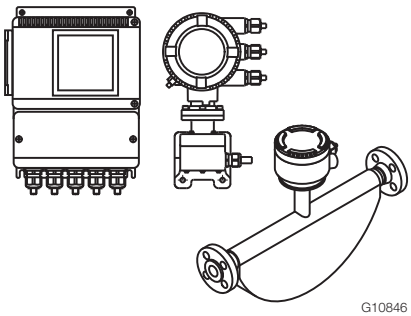
Fig. 2: Simplified representation of Coriolis forces

Fig. 2	Description
"A"	Movement of the pipes inward no flow
"B"	Direction of the Coriolis force with flow when the tubes are moving outward
"C"	Movement of the pipes outward no flow
"D"	Direction of the Coriolis force with flow when the tubes are moving inward

2.3 Device designs

	FCBXXX flowmeter sensor (integral mount design)	
	 G10334	
	Standard applications	**Highly accurate applications**
Model number	FCB330	FCB350
Process connections		
— Flange DIN 2501 / EN 1092-1	DN 10 … 65, PN 40 … 100	DN 10 … 65, PN 40 … 100
— Flange ASME B16.5	DN 1/4“ … 2 1/2“ PN CL150 … CL600	DN 1/4“ … 2 1/2“ PN CL150 … CL600
— Threaded pipe connection DIN 11851	DN 10 … 65 (1/4“ … 2 1/2“)	DN 10 … 65 (1/4“ … 2 1/2“)
— Tri-Clamp	DIN 32676 (ISO 2852) BPE Tri-Clamp DN 10 … 65 (1/4“ … 2 1/2“)	DIN 32676 (ISO 2852) BPE Tri-Clamp DN 10 … 65 (1/4“ … 2 1/2“)
Measuring accuracy for liquids		
— Mass flow	0.4 % and 0.25 % of rate (o. r.)	0.1 % and 0.15 % of rate (o. r.)
— Volume flow	0.4 % and 0.25 % of rate (o. r.)	0.15 % of rate (o. r.)
— Density	0.01 kg/l	— 0.002 kg/l — 0.001 kg/l (option) — 0.0005 kg/l (following on-site calibration under operating conditions)
— Temperature	1 K	0.5 K
Measuring accuracy for gases	1 % of rate (o. r.)	0.5 % of rate (o. r.)
Wetted materials	Stainless steel	Stainless steel
Degree of protection acc. to EN 60529	IP 67	IP 67
Permissible temperature of the medium being measured	-50 … 160 °C (-58 … 320 °F)	-50 … 200 °C (-58 … 392 °F)
Approvals and certificates [1]		
— Explosion protection ATEX / IECEx	Zone 0, 1, 2, dust ignition protection	Zone 0, 1, 2, dust ignition protection
— Explosion protection cFMus	Class I Div. 1, Class I Div. 2	Class I Div. 1, Class I Div. 2
— Explosion protection other approvals	On request	
— Hygienic and sterile requirements	FDA, 3A, EHEDG	
Enclosure	Integral mount design, remote mount design	

1 Partially under preparation

	FCTXXX transmitter	
	 G10334	 G10846
Enclosure	Integral mount design	Remote mount design
Cable length	Maximum 10 m (33 ft), remote mount design only	
Power supply	100 … 230 V AC, 24 V AC/DC	
Current output	Current output 1: 0/4 … 20 mA active or 4 … 20 mA passive Current output 2: 4 ... 20 mA passive	
Pulse output	Active (non-hazardous) or passive	
External output zero return	Yes	
External totalizer reset	Yes	
Forward / reverse flow metering	Yes	
Communication	HART protocol	
Empty pipe detection	Yes, based on preconfigured density alarm < 0.5 kg/l	
Self-monitoring and diagnostics	Yes	
Local display / totalization	Yes	
Field optimization for flow and density	Yes	
Degree of protection acc. to EN 60529	Integral mount design: IP 65/IP 67, NEMA 4X Remote mount design: IP 67, NEMA 4X	

3 Transport

3.1 Inspection

Check the devices immediately after unpacking for possible damage that may have occurred from improper transport. Details of any damage that has occurred in transit must be recorded on the transport documents.
All claims for damages must be submitted to the shipper without delay and before installation.

3.2 General remarks

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

— The center of gravity is off center.
— Flange devices may not be lifted by the transmitter housing or terminal box.

4 Mounting

4.1 General remarks

The following points must be observed during installation:

- 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).
- Install flange and wafer type devices with coplanar counter flanges and use only appropriate gaskets.
- Use only gaskets made from a compatible material for the medium and medium temperature or use only gasket material compatible with hygienic designs.
- Gaskets must not extend into the flow area since possible turbulence could influence the device accuracy.
- The pipeline may not exert any unallowable forces or torques on the device.
- Do not remove the plugs in the cable connectors until you are ready to install the electrical cable.
- Make sure the gaskets for the housing cover are seated properly. Carefully gasket the cover. Tighten the cover fittings.
- A separate transmitter must be installed at a largely vibration-free location.
- Do not expose the transmitter and sensor to direct sunlight. Provide appropriate sun protection as necessary.
- When installing the transmitter in a control cabinet, make sure adequate cooling is provided.

4.2 Flowmeter sensor

The device can be installed at any location in a pipeline under consideration of the installation conditions.

1. Remove protective plates, if present, to the right and left of the flowmeter sensor.
2. Position the flowmeter sensor coplanar and centered between the pipes.
3. Install gaskets between the sealing surfaces.

4.3 Transmitter

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

IMPORTANT (NOTE)

When selecting a location for the transmitter, make sure that it will not be exposed to direct sunlight.
If exposure to direct sunlight cannot be avoided, a sun shade should be installed.
The limit values for the ambient temperature must be observed.

Field-mount housing

The housing is designed for protection class IP 67 (EN 60529) and must be mounted using 4 screws. For dimensions, see Fig. 3 and Fig. 4.

4.3.1 Transmitter in remote mount design (option F1 or F2)

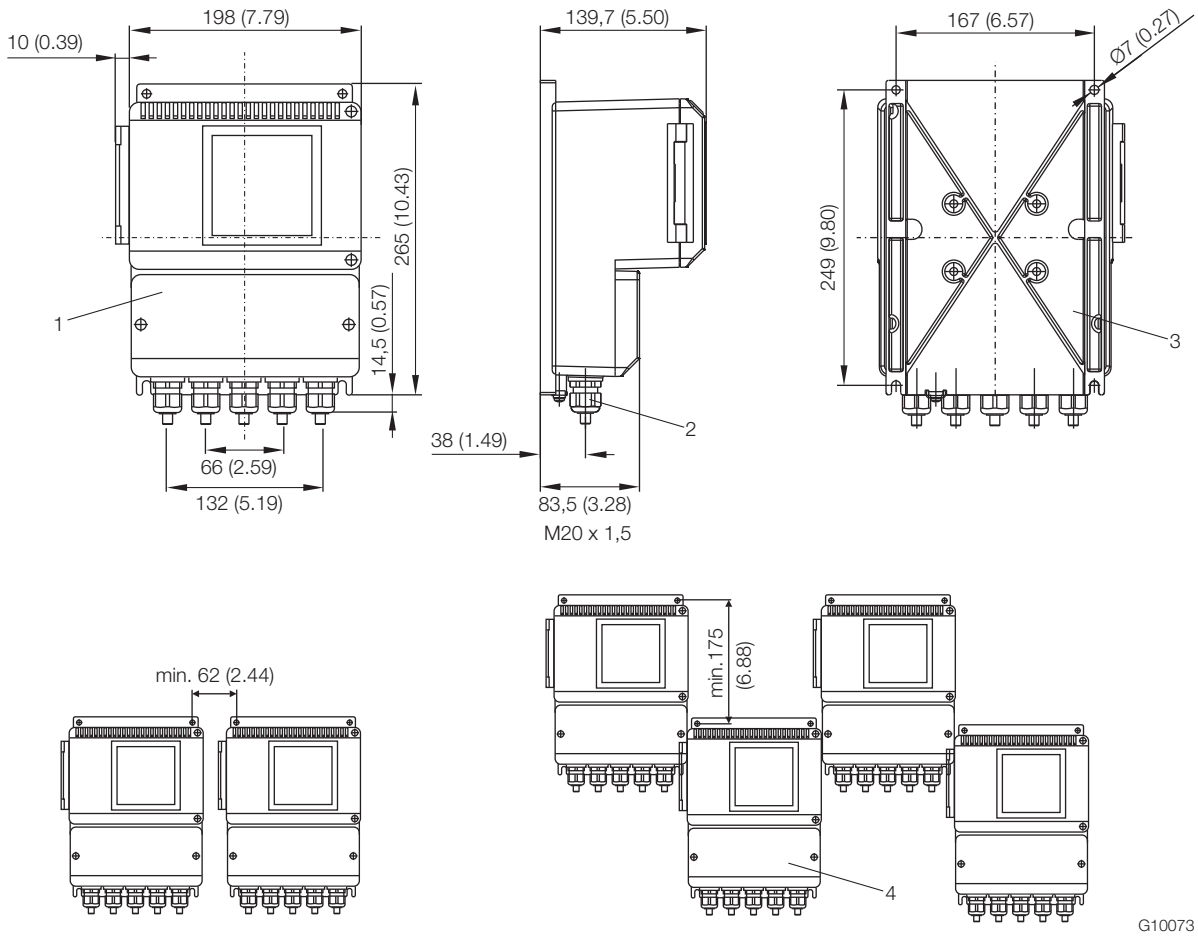


Fig. 3: Dimensions in mm (inch)
1 Field-mount enclosure with window | 2 Cable gland M20 x 1.5 |
3 Installation holes for pipe mounting set, for 2" pipe installation; mounting set available on request (order no. 612B091U07) |
4 IP 67 degree of protection

4.3.2 Transmitter in remote mount design (option R1 or R2)

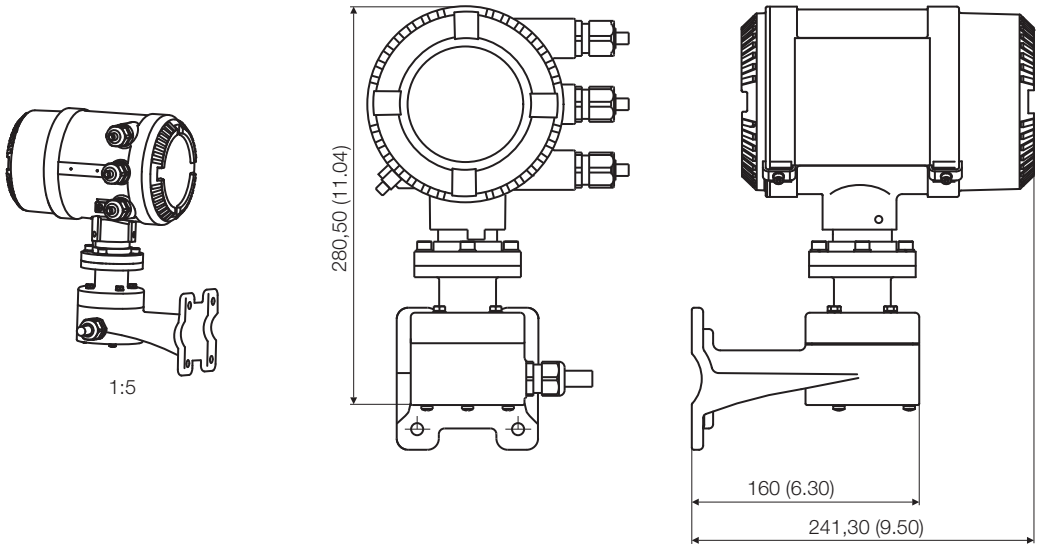


Fig. 4: Dimensions in mm (inch)

4.4 Rotating the transmitter and LCD display

Depending on the installation position, the transmitter housing or LCD display can be rotated to enable horizontal readings.

4.4.1 Transmitter enclosure

To rotate the transmitter housing, proceed as described below. A stop in the transmitter housing will prevent rotation through more than 330°.

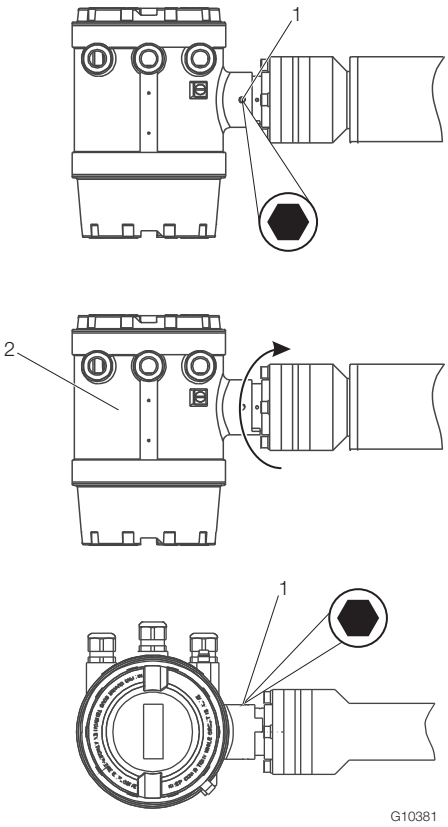


Fig. 5: Rotating the transmitter housing
1 Fixing screw | 2 Transmitter housing

1. Loosen the fixing screw approx. 2 turns.
2. Turn the transmitter housing to the required position.
3. Tighten the fixing screw.

4.4.2 LCD indicators

WARNING – Electrical dangers!
When the housing is open, EMC protection is impaired and there is no longer any protection against accidental contact.
Switch off the power supply before opening the housing.

To rotate the transmitter housing, proceed as described below.

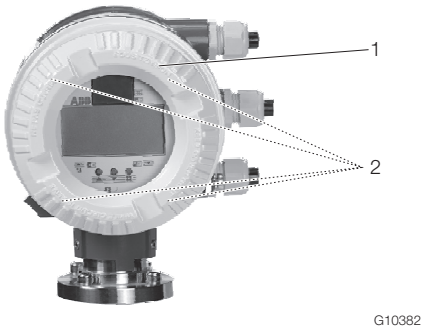


Fig. 6: Rotating the LCD display

1. Switch off the power supply.
2. Unscrew the housing cover (1).
3. Loosen the four fixing screws (2) on the LCD display. The LCD display is now hanging from the cable harness that connects it to the electronic plug-in unit.
4. Screw the LCD display into the required position. Take care not to damage the cable harness when tightening the screws.
5. Screw on housing cover (1) again.

NOTICE – Potentially adverse effect on housing ingress protection
If the gasket (o-ring) is seated incorrectly or damaged, this may have an adverse effect on the housing ingress protection.
Before closing the housing cover, check the gasket (o-ring) for any damage and replace if necessary. Check that the gasket is properly seated when closing the housing cover.

4.5 Installation instructions

4.5.1 Installation requirements/System sizing information

The CoriolisMaster FCB330, FCB350 is suitable for both indoor and outdoor installations. The standard device has an IP 67 enclosure. The flowmeter sensor is bidirectional and can be installed in any mounting position. It is important to ensure that the meter pipes are always completely filled with fluid. The material resistance of all wetted parts must be clarified.

The following points are to be considered during installation:

- The preferred flow direction is indicated by the arrow on the flowmeter sensor. Flow in this direction will be indicated as positive (a forward/reverse flow calibration is available as an option).
- The presence of gas bubbles in the meter tube increases the likelihood of erroneous measurements, particularly when measuring density. Therefore, the sensor should not be installed at the highest point in the system. Advantageous are installations in low pipeline sections, e.g., at the bottom of a U-section in the pipeline (invert).
- Long drop lines downstream of the flowmeter sensor should be avoided to prevent the meter tube from draining.
- Once the flowmeter has been installed, check that it is not subject to mechanical tension.
- Check that the flowmeter sensor does not come into contact with other objects. Do not attach the flowmeter sensor to the enclosure.
- Make sure that any gases dissolved in the medium do not outgas and that the meter tubes are always completely full. To safeguard this, a minimum back pressure of 0.2 bar (2.9 psi) is recommended.
- In case of gas measurements ensure that the gases are dry and do not contain liquids.
- Make sure that operation below the vapor pressure cannot occur when a vacuum exists in the meter tube or when liquids with a low boiling point are being processed.
- Do not install the flowmeter sensor in the vicinity of strong electromagnetic fields (e.g., pumps, motors, transformers, etc.).
- Make sure that there is no risk of cross talk between multiple flowmeter sensors. To prevent cross talk, the flowmeter sensors should be spaced distant from one other or the pipelines between them should be decoupled.
- Request information about special installation conditions for meter size "L".

4.5.2 Supports

In order to support the weight of the flowmeter sensor and to ensure reliable measurements when adverse external effects exist (gas bubbles in the medium, for example), the flowmeter sensor should be installed in a rigid pipeline.
Two supports or hangers should be installed symmetrically and with zero tension in the direct vicinity of the process connections.

4.5.3 Shut-off devices

To conduct a system zero adjustment, shut-off devices are required in the pipeline:

- In horizontal installations at the outlet side
- In vertical installations at the inlet side

If possible, shut-off devices should be installed both upstream and downstream of the sensor.

4.5.4 Inlet sections

The flowmeter sensor does not require any inlet sections. Make sure that any valves, gates, sight glasses, etc., in the vicinity of the flowmeter sensor do not cavitate and are not set in vibration by the flowmeter sensor.

4.5.5 Model in remote mount design

Make sure that the flowmeter sensor and transmitter are assigned correctly. Compatible devices have the same end numbers, e. g., X001 and Y001 or X002 and Y002, on the name plate.

4.5.6 Pressure loss

Pressure loss is determined by the properties of the medium and the flow.
Documents to help you to calculate pressure loss can be downloaded from www.abb.com/flow.

4.6 Mounting positions

The flowmeter operates in any mounting position. The ideal installation position is vertical with flow from bottom to top.

4.6.1 Vertical installation in riser

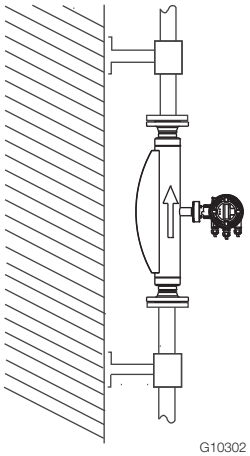


Fig. 7: Vertical installation, self-draining

4.6.2 Vertical installation in a drop line

Make sure that the flowmeter sensor is always completely full while measurements are being taken.

A pipeline reduction or an orifice must also be installed underneath the flowmeter sensor. The cross-section of the pipeline reduction or orifice must be smaller than the cross-section of the pipeline in order to prevent the flowmeter sensor from running dry while measurements are being taken.

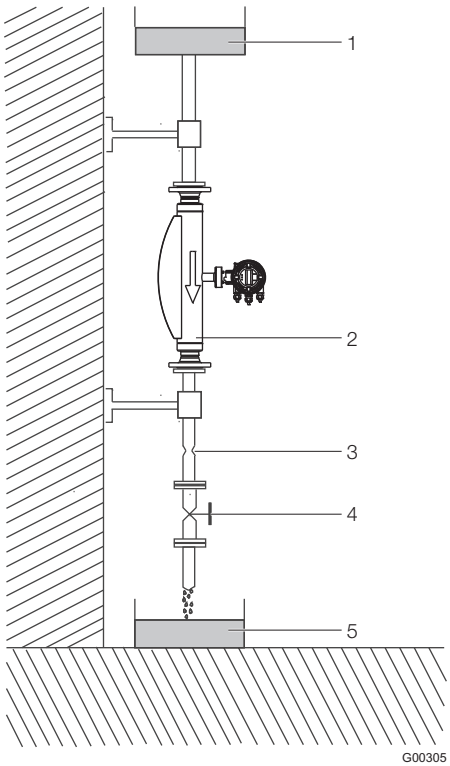


Fig. 8: Vertical installation in a drop line
1 Supply reservoir | 2 Flowmeter sensor | 3 Orifice or pipe constriction | 4 Valve | 5 Product reservoir

4.6.3 Horizontal installation in case of measurement of liquids

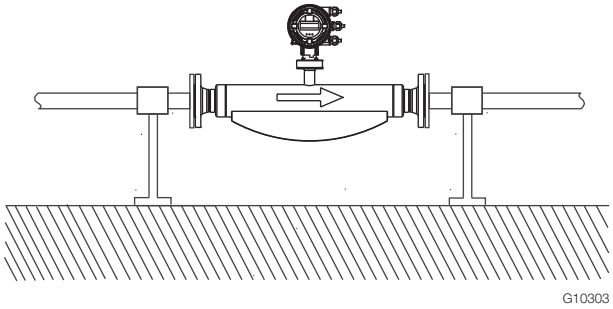


Fig. 9: Horizontal installation (liquids)

4.6.4 Horizontal installation in case of measurement of gases

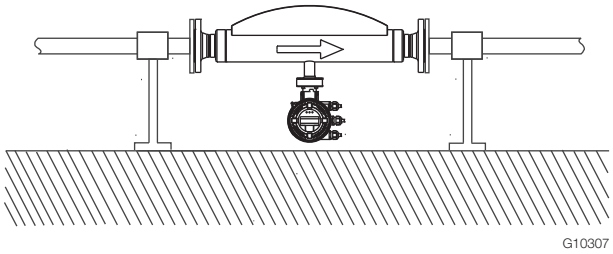


Abb. 10: Horizontal installation (gases)

In case of measurement of gases ensure that the transmitter housing or the terminal box pointing downwards.

4.6.5 Difficult installation locations for liquid measurement

The accumulation of air or gas bubbles in the meter tube will lead to increased inaccuracies.
Avoid the following installation locations in case of liquid measurement:

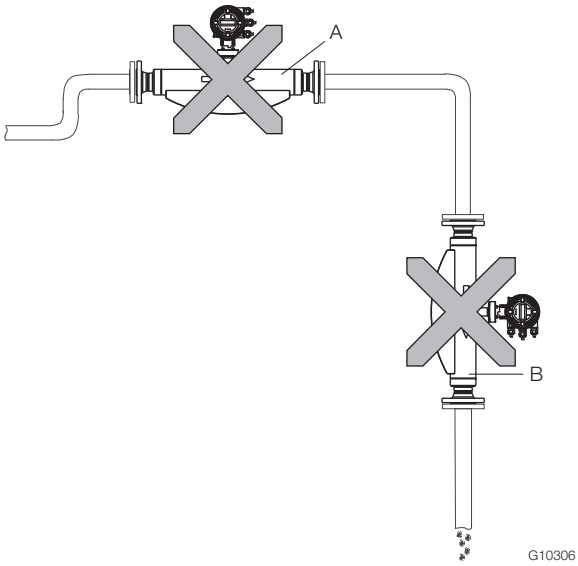


Fig. 11: Difficult installation locations

- **"A":** Installing the flowmeter sensor at the highest point of a pipeline leads to increased inaccuracies due to the accumulation of air or gas bubbles in the meter tube.
- **"B":** Installing the flowmeter sensor in a drop line means that there is no guarantee that the meter tube will be completely full while measurements are being taken and leads to increased inaccuracies.

4.6.6 Installation in the vicinity of pumps

Strong vibrations in the pipeline must be damped using flexible damping devices.
The damping devices must be installed beyond the supported flowmeter section and outside of the section between the shut-off devices.
Do not connect flexible damping devices directly to the flowmeter sensor.

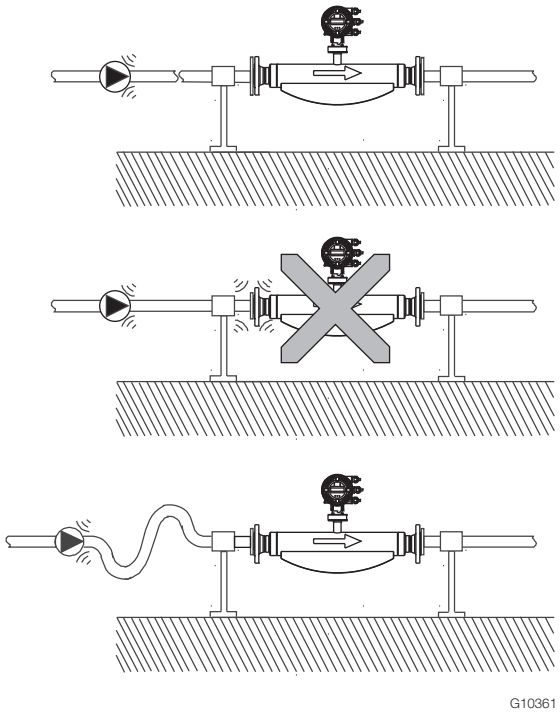


Fig. 12: Vibration damping

4.6.7 Zero balance

Before adjusting the zero under operating conditions, make sure that:

- The meter tube is completely full
- There are no gas bubbles or air in the meter tube (in case of liquid measurements)
- There are no condensates in the meter tube (in case of gas measurements)
- The pressure and temperature in the meter tube are appropriate for normal operating conditions

We recommend installing a bypass line to ensure that these conditions are met. Installing a bypass line means that adjustment can take place while the process is ongoing.

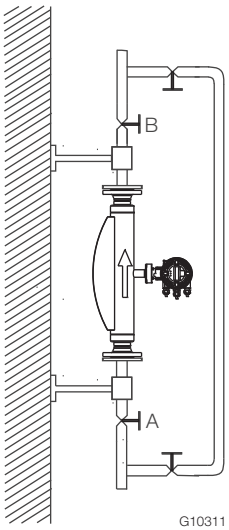


Fig. 13: Bypass line

4.6.8 Installation dependent on the temperature of the medium being measured

The mounting position of the flowmeter sensor is determined by the temperature of the medium being measured T_{medium}. Be aware of the following mounting options!

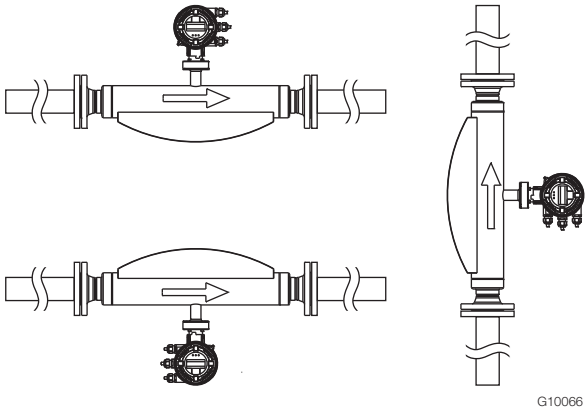


Fig. 14: Installation at T_{medium} -50°... 120 °C (-58 ... 248 °F)

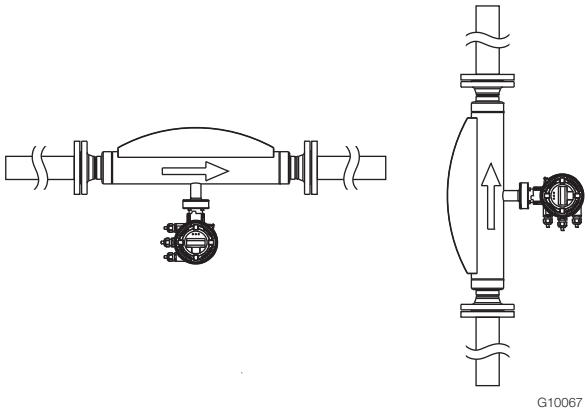


Fig. 15: Installation at T_{medium} -50°... 200 (-58 ... 392 °F)

4.6.9 Installation with option TE1 "extended tower length"

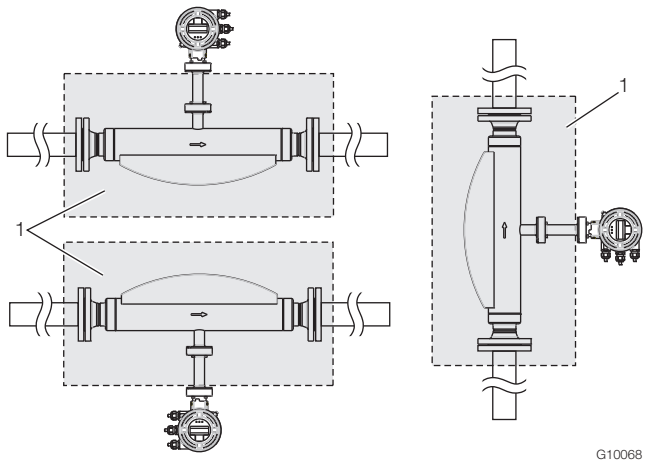


Fig. 16: Installation at T_{medium} -50°... 200 (-58 ... 392 °F)
1 Insulation

With option TE1 "extended tower length", the flowmeter sensor may be insulated up to a thickness of 100 mm (3.94 inches).

4.6.10 Notes about EHEDG conformity

WARNING – Risk of poisoning!
Bacteria and chemical substances can contaminate or pollute pipeline systems and the materials they are made of.
Observe the following instructions in installations conforming to EHEDG requirements.

- The appropriate installation conditions must be observed in order to achieve an installation that complies with EHEDG requirements.
- In order to achieve compliance with EHEDG requirements, the combination of process connection and gaskets selected by the operator must consist solely of EHEDG-compliant parts. Note the information in the latest version of the following document:
  EHEDG Position Paper: "Hygienic process connections to use with hygienic components and equipment".

All weld stub combinations available from ABB are approved for use.
The threaded pipe connection conforming to DIN11851 has been approved for use together with a process gasket accepted by the EHEDG (one made by Siersema, for example).

5 Electrical connections

5.1 Information for connecting the power supply

IMPORTANT (NOTE)

- Observe the limit values for the power supply listed in the "Technical data" section.
- Please remember that there is a voltage drop associated with long lead lengths and small lead cross-sections. The voltage at the terminals of the device may not fall below the minimum value required.
- Complete the electrical connection according to the connection diagram.

The line voltage and power consumption are indicated on the name plate for the transmitter.
A circuit breaker with a maximum rated current of 16 A must be installed in the supply power line of the transmitter.
The wire cross-sectional area of the supply power cable and the circuit breaker used must comply with VDE 0100 and must be dimensioned in accordance with the current consumption of the flowmeter measuring system. The leads must comply with IEC 227 and/or IEC 245.
The circuit breaker should be located near the transmitter and marked as being associated with the device.
The power supply is connected to terminal L (phase), N (neutral), or 1+, 2-, and PE, as stated on the name plate.
Connect the transmitter and flowmeter sensor to functional ground.

5.2 Information for cable installation

Make provision for a drip loop (water trap) when installing the connecting cables for the flowmeter sensor.
If you are installing the flowmeter transmitter vertically, point the cable entry points downwards. (You might need to rotate the transmitter housing accordingly.)

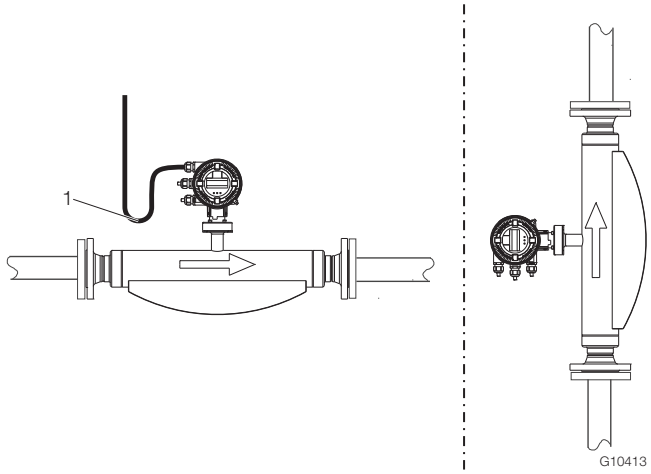


Fig. 17: Installing the connection cables
1 Drip loop

5.3 Integral mount design

On integral mount design devices, the terminals are located behind the cover on the rear of the transmitter housing.
A schematic electrical connection diagram can be found on the inside of the cover. The configuration of the device is marked here.

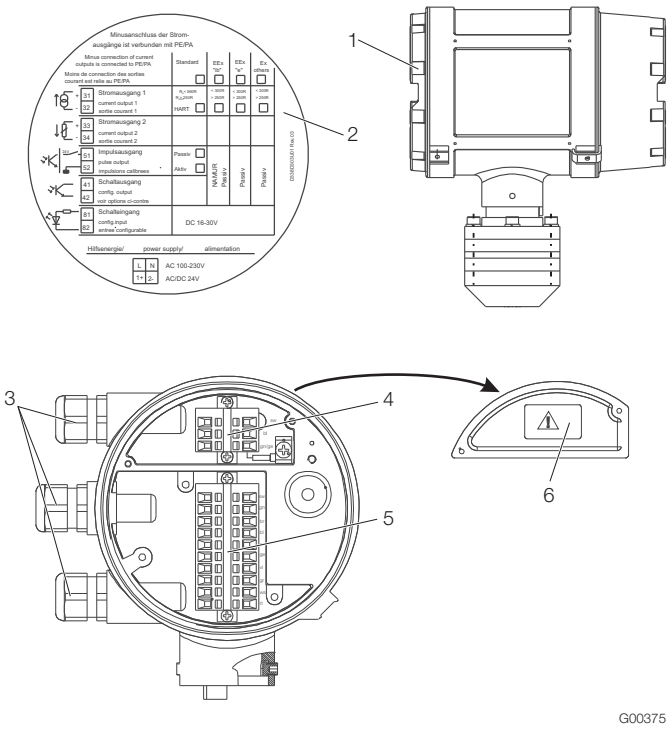


Fig. 18: Terminals
1 Cover for connection area | 2 Pin assignment | 3 Cable entry points | 4 Terminals for power supply | 5 Terminals for signal inputs and signal outputs | 6 Terminal cover

IMPORTANT (NOTE)
Use suitable wire end sleeves when connecting the cables.

Connect the device:

1. Unscrew the cover for the connection area.
2. Prepare the cable ends and feed them into the connection area through the cable entry points.
3. Remove the terminal cover and connect the power supply cables as shown in the connection diagrams.
4. Replace the terminal cover.
5. Connect the signal input and output cables as shown in the connection diagrams. Connect the cable shielding (if used) to the designated grounding clamp.
6. Unscrew the cover for the connection area again.

NOTICE – Potentially adverse effect on housing ingress protection
If the gasket (o-ring) is seated incorrectly or damaged, this may have an adverse effect on the housing ingress protection.
Before closing the housing cover, check the gasket (o-ring) for any damage and replace if necessary. Check that the gasket is properly seated when closing the housing cover.

5.4 Remote mount design

With remote mount design devices, the transmitter is installed separately and connected to the flowmeter sensor via a signal cable.

5.4.1 Cable specification

Signal cable	
Designation	LI2YCY PiMF 5 x 2 x 0.5 mm^2
Shield	Pair shielding with continuity wire and copper braided screen
Temperature range	-30 ... 70 °C (-22 ... 158 °F)
Loop resistance	maximum 78.4 Ω/km
Inductance	0,4 mH/km approx.
Max. cable length	50 m (164 ft)

5.4.2 Routing the signal cable

Observe the following points when routing cables:

— The signal cable carries a voltage signal of only a few millivolts and must, therefore, be routed over the shortest possible distance. The maximum permissible signal cable length is 10 m (33 ft).

— Avoid routing the cable in the vicinity of electrical equipment or switching elements that can create stray fields, switching pulses, and induction. If this is not possible, route the signal cable inside a metal cable conduit and connect the cable conduit to operational ground.

— To shield against magnetic interspersion, the cable contains outer shielding that is attached to operational ground.

— Do not run the signal cable over junction boxes or terminal strips.

5.4.3 Connecting the signal cable

IMPORTANT (NOTE)
Use suitable wire end sleeves when connecting the cables.

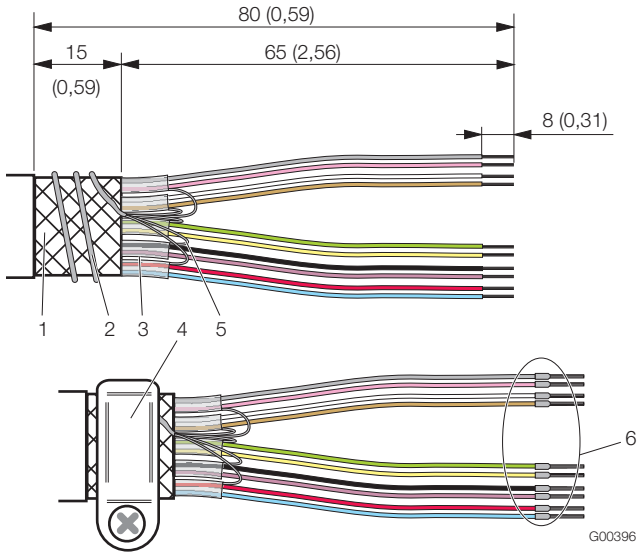


Fig. 19: Signal cable assembly, dimensions in mm (inch)
1 Wire mesh shield | 2 Foil shield continuity wires (twisted) | 3 Foil shield | 4 Grounding clamp | 5 Continuity wire | 6 Wire end sleeves

1. Strip the signal cable as shown.
2. Cut the wire mesh shield to a length of approx. 15 mm (0.59").
3. Remove the cable core and foil shield from the wire pairs.
4. Strip the wires and attach wire end sleeves.
5. Twist the foil shield continuity wires and wrap them around the wire mesh shield. When connecting to the devices, clamp the wire mesh shield and the twisted continuity wires underneath the grounding clamp.
6. Connect the signal cables to the transmitter and flowmeter sensor as shown in the connection diagrams.
7. Connect the signal cables for signal inputs and outputs to the transmitter as shown in the connection diagrams. Connect the cable shields to the designated grounding clamp.
8. Connect the power supply cables to the transmitter as shown in the connection diagrams.
9. Screw all open covers for the transmitter and flowmeter sensor connection areas back into place.

NOTICE – Potentially adverse effect on housing ingress protection
If the gasket (o-ring) is seated incorrectly or damaged, this may have an adverse effect on the housing ingress protection.
Before closing the housing cover, check the gasket (o-ring) for any damage and replace if necessary. Check that the gasket is properly seated when closing the housing cover.

5.5 Digital communication

5.5.1 HART protocol

The device is registered with the HART Communication Foundation.

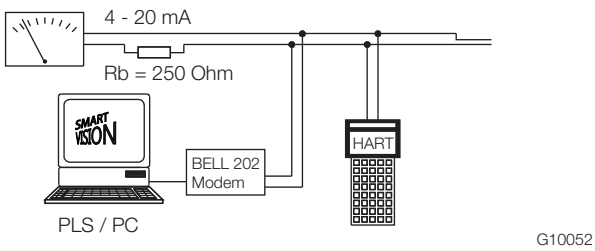


Fig. 20: Communication via HART protocol

HART protocol	
Configuration	— Directly on the device — Via software DSV401 + HART-DTM
Transmission	FSK modulation on voltage output 4 … 20 mA according to Bell 202 standard
Baud rate	1200 baud
Display	Logic 1: 1200 Hz Logic 0: 2200 Hz
Maximum signal amplitude	1.2 mAss
Load at current output	250 … 560 Ω (in hazardous area: maximum 300 Ω)

Cable	
Design	Two-wire cable AWG 24, twisted
Maximum length	1500 m (4921 ft)

See the interface description for detailed information.

System integration:
Communication (configuration, parameterization) can be performed with the DTM (Device Type Manager, software version B.10 and higher) available for the device and the corresponding framework applications as per FDT 0.98 or 1.2 (DSV401 R2).
Other tool/system integrations (e.g., Emerson AMS/Siemens PCS7) are available on request.
The necessary DTMs can also be downloaded from www.abb.com/flow.

5.6 Terminal connection diagrams

5.6.1 Connection of transmitter models to peripherals

Models FCB330, FCB350, FCT330, FCT350

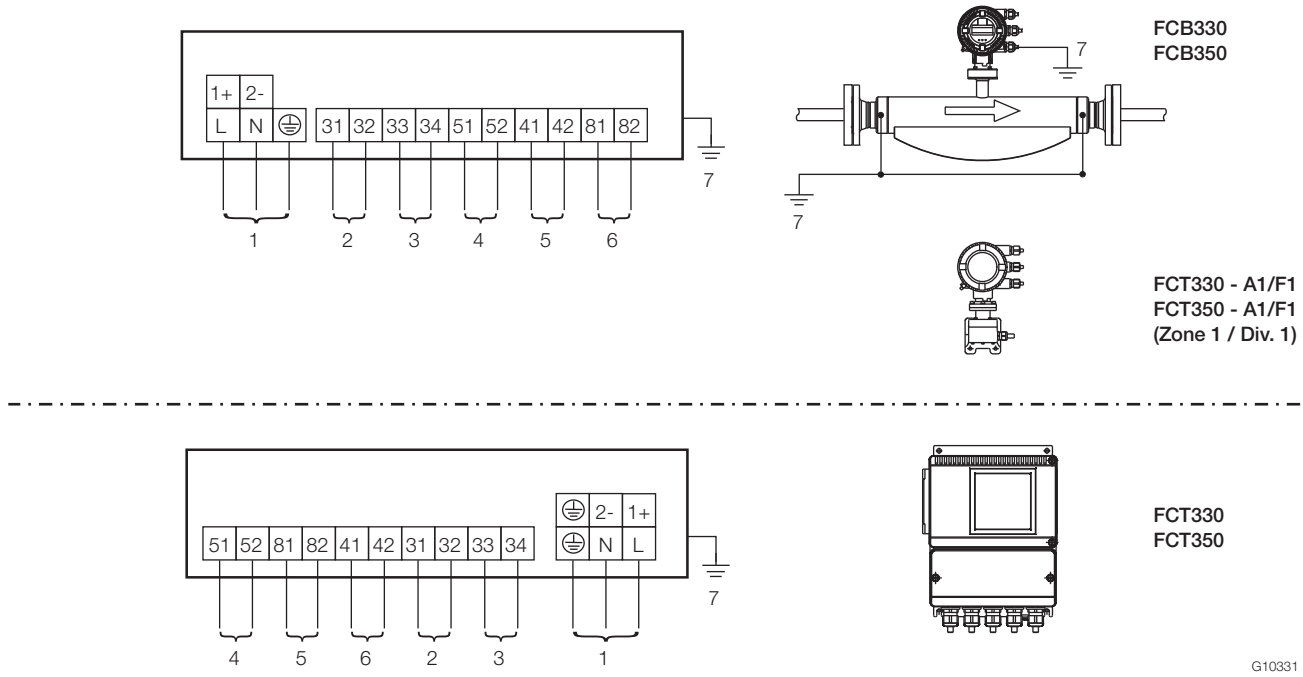


Fig. 21

1 Power supply | 2 Current output 1 | 3 Current output 2 | 4 Pulse output | 5 Digital switching output | 6 Digital switching input | 7 Equipotential bonding (PA)

IMPORTANT (NOTE)

When using the device in hazardous areas, note the additional connection data in the chapter titled "Technical data relevant to hazardous areas"!

Terminal	Function
L / N / PE	Power supply, 100 … 230 V AC, 50/60 Hz
1+ / 2- / PE	Power supply — 24 V AC, 50/60 Hz — 24 V DC
31 / 32	Current output 1, active 0/4 … 20 mA , (0 Ω ≤R_B ≤560 Ω, FCT300-A1/F1:1 0 Ω ≤R_B ≤300 Ω)
	Current output 1, passive 4 … 20 mA (0 Ω ≤R_B ≤600 Ω), source voltage 12 ≤U_q ≤ 30 V
33 / 34	Current output 2, passive 4 … 20 mA (0 Ω ≤R_B ≤600 Ω), source voltage 12 ≤U_q ≤ 30 V
51 / 52	Pulse output, passive fmax = 5 kHz, pulse width = 0.1 … 2000 ms, 0.001 … 1000 pulses/unit — "Closed": 0 V ≤ U_{CEL} ≤ 2 V, 2 mA ≤ I_{CEL} ≤ 220 mA — "Open": 16 V ≤ U_{CEH} ≤ 30 V DC, 0 mA ≤ I_{CEH} ≤ 0.2 mA
	Pulse output active, U = 16 … 30 V, load ≥ 150 Ω, fmax = 5 kHz
41 / 42	Digital switching output, active — "Closed": 0 V ≤ U_{CEL} ≤ 2 V, 2 mA ≤ I_{CEL} ≤ 220 mA — "Open": 16 V ≤ U_{CEH} ≤ 30 V DC, 0 mA ≤ I_{CEH} ≤ 0.2 mA
81 / 82	Digital switching input, passive — Input "On": 16 V ≤ UKL ≤ 30 V — Input "Off": 0 V ≤ UKL ≤ 2 V
-	Equipotential bonding "PA" When the FCT300 transmitter is connected to the FCB300 flowmeter sensor, the transmitter must also be connected to "PA".

5.6.2 Connection examples for the peripherals

Current outputs (including HART communication)

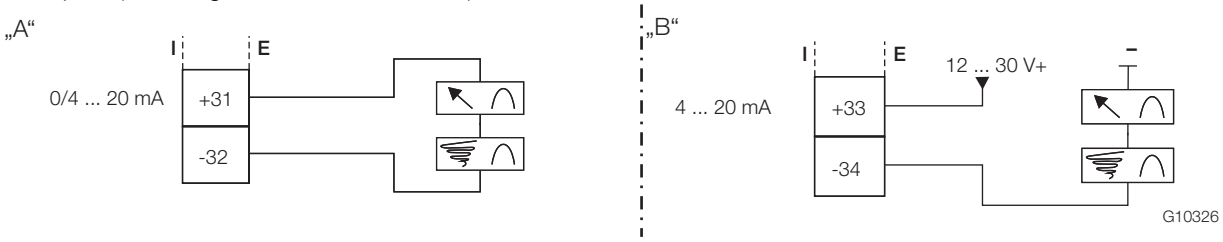


Fig. 22: Active / passive current outputs
"A" Active | "B" Passive | I Internal | E External

Digital switching output and digital switching input

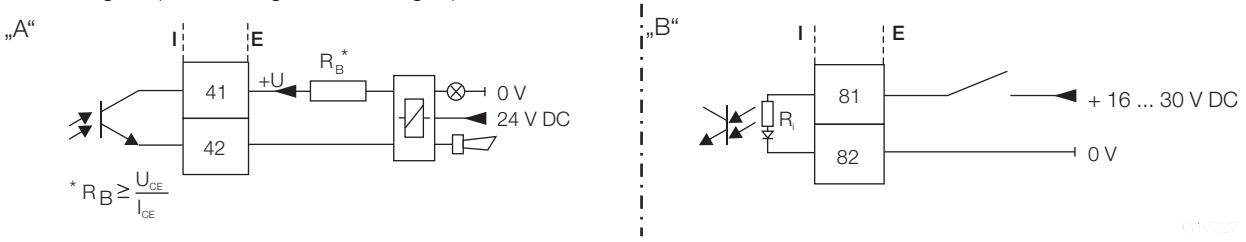


Fig. 23
"A" Output for system monitoring, min. / max. alarm for empty meter tube or forward / reverse signal |
"B" Input for external totalizer reset or external output zero return | I Internal | E External

Pulse output

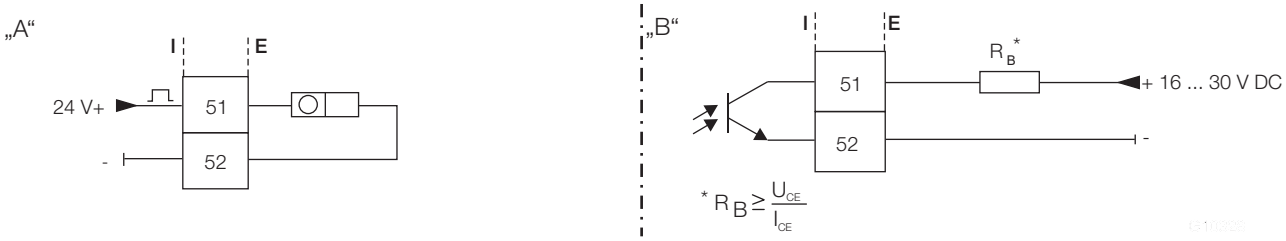


Fig. 24: Active / passive pulse output
"A" Active | "B" Passive (optocoupler) | I Internal | E External

5.6.3 Connection of transmitter to flowmeter sensor

FCT330, FCT350 transmitter to FCB330, FCB350 flowmeter sensor

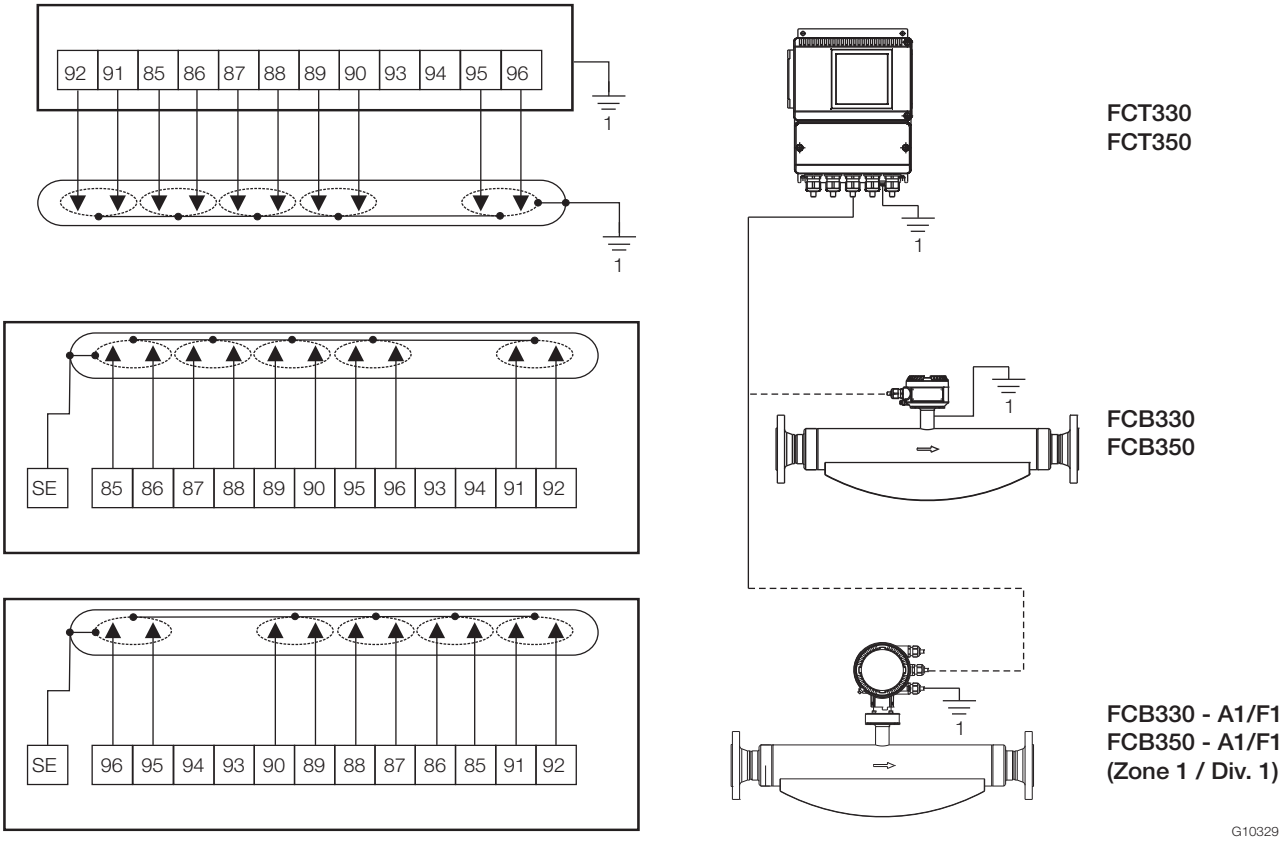


Fig. 25
1 Equipotential bonding (PA)

Terminal	Corresponding wire color	Function
85	White	Sensor 1
86	Brown	Sensor 1
87	Green	Sensor 2
88	Yellow	Sensor 2
89	Black	Temperature
90	Violet	Temperature

Terminal	Corresponding wire color	Function
91	Gray	Driver
92	Pink	Driver
93	-	Not used
94	-	Not used
95	Blue	Temperature
96	Red	Temperature

IMPORTANT (NOTE)

The precise position of the PA terminals may vary according to the device type. Each terminal is marked accordingly. When the FCT330, FCT350 transmitter is connected to the FCB330, FCT350 flowmeter sensor, the transmitter must also be connected to "PA".

The following flowmeter sensor / transmitter combinations are permitted:

— FCB330 flowmeter sensor with FCT330 transmitter
— FCB350 flowmeter sensor with FCT350 transmitter

5.6.4 Connection of transmitter to flowmeter sensor in Zone 1 / Div. 1

FCT330, FCT350 transmitter to FCB330, FCB350 flowmeter sensor

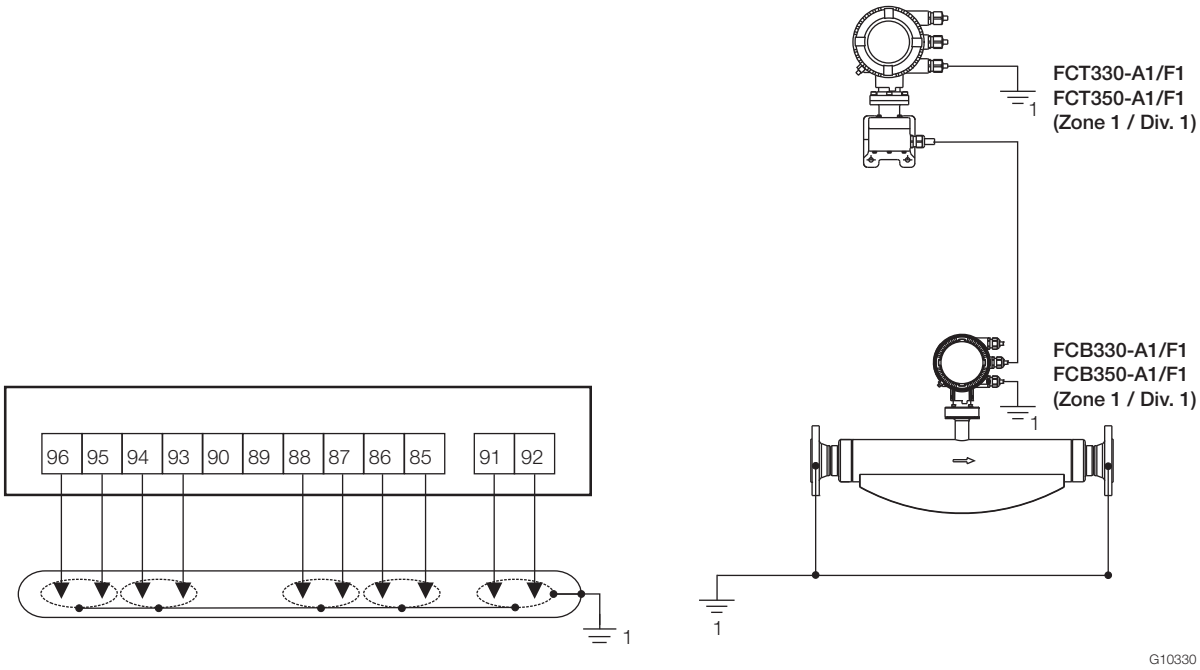


Fig. 26
1 Equipotential bonding (PA)

Terminal	Corresponding wire color	Function
85	White	Sensor 1
86	Brown	Sensor 1
87	Green	Sensor 2
88	Yellow	Sensor 2
89	-	Not used
90	-	Not used

Terminal	Corresponding wire color	Function
91	Gray	Driver
92	Pink	Driver
93	Black	Temperature
94	Violet	Temperature
95	Blue	Temperature
96	Red	Temperature

IMPORTANT (NOTE)

The wires must be connected in pairs in order to ensure EMC protection.
The following flowmeter sensor / transmitter combinations are permitted:

— FCB330 flowmeter sensor with FCT330 transmitter
— FCB350 flowmeter sensor with FCT350 transmitter

6 Commissioning

6.1 Checks prior to commissioning

The following points must be checked before commissioning the device:

- The assignment of the flowmeter sensor to the transmitter must be correct
- The wiring must have been completed as described in the "Electrical connections" section
- The flowmeter sensor must be correctly grounded
- The external data memory module (FRAM) must have the same serial number as the flowmeter sensor
- The external data memory module (FRAM) must be inserted in the correct position (see the "Maintenance / Repairs" section)
- The ambient conditions must meet the requirements set out in the technical data
- The power supply must meet the requirements set out on the name plate

6.2 Switching on the power supply

Switch on the power supply.
After switching on the power supply, the flowmeter data in the external FRAM is compared with the data saved internally.
If the data is not identical, the transmitter data is replaced automatically. Once completed, the message "Ext. Data loaded" is displayed. The flowmeter is now ready for operation.
The LCD display indicates the current flow.

6.2.1 Inspection after switching on the power supply

The following points must be checked after commissioning the device:

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

General information:

- If the flow direction indicated on the display is incorrect, it could mean that the signal lead connections between the sensor and the transmitter have been accidentally reversed
- The position of the fuses and the fuse values are listed in the spare parts list

6.3 Basic Setup

IMPORTANT (NOTE)
For additional information regarding operation of the LCD display, refer to the "Configuration, parameterization / operation" section.
For detailed descriptions of all menus and parameters, see the "Configuration, parameterization / parameter description" section.

The device can be factory calibrated to customer specifications upon request. If no customer information is available, the device is delivered with factory settings.
On-site configuration requires only a few parameter settings.
The following parameters must be checked and/or set when commissioning the device:

Flow range end value
("QmMax" parameter and "Unit" submenu)
The device is factory calibrated to the largest flow range end value, unless customer information to the contrary is available.

Current outputs
("Current output 1" and "Current output 2" submenus)
Select the desired current range (0 … 20 mA or 4 … 20 mA).

Pulse output
("Pulse" parameter and "Unit" submenu)
To set the number of pulses per volume flow unit, a unit for the totalizer (e.g., kg or t) must first be selected in the "Unit" submenu. After this, the number of pulses has to be entered in the "Pulse" parameter.

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

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

6.4 Configuring the pulse output

The configuration (active, passive) for the pulse output is set in the transmitter using a jumper.

To change the configuration, you must remove the transmitter plug-in module from the housing.

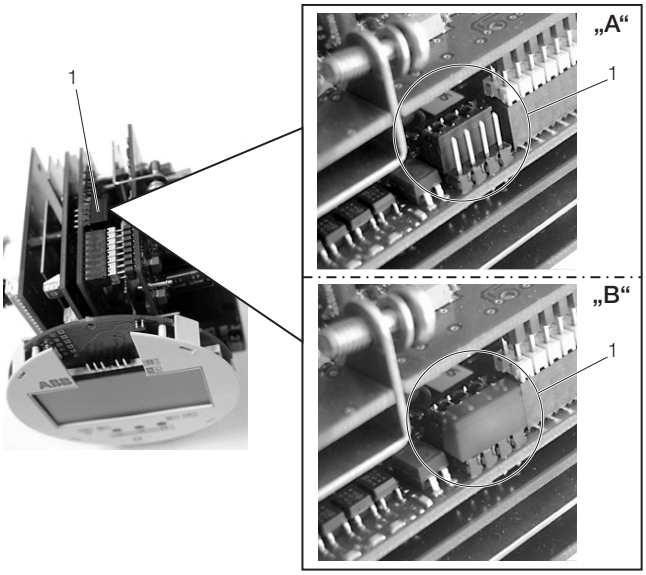


Fig. 27: Plug-in Jumper Location
1 Jumper for configuring the pulse output

Number	Function
"A"	Pulse output 51 / 52 passive
"B"	Pulse output 51 / 52 active (not for hazardous area design)

6.5 Operating protection switch

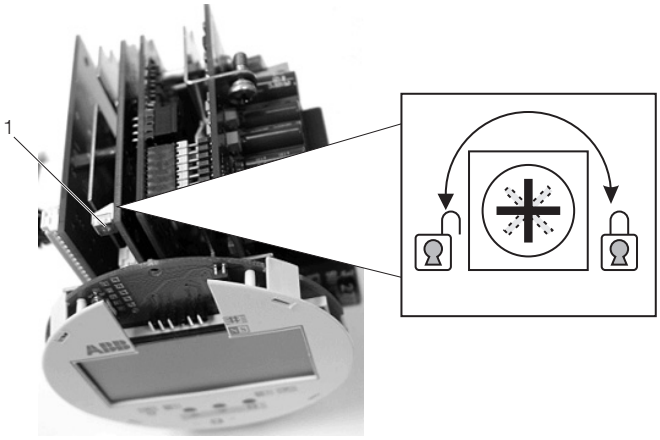


Fig. 28: Operating protection switch

In addition to password protection, it is possible to activate hardware write protection.

Turning the switch (1) clockwise activates the programming protection while turning the switch anti-clockwise deactivates it.

If you attempt to change parameters while the protection is active, the "Operating protection" warning is displayed and the entry is rejected.

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

6.6 Information for safe operation in potentially explosive atmospheres – ATEX / IECEx

6.6.1 Inspection

DANGER – Risk of explosion!
Risk of explosion when opening the housing.
Before opening the housing:
- Check that a valid fire permit is available
- Check that there is no risk of explosion
- Switch off the power supply

CAUTION – Risk of burns!
Risk of burns on the flowmeter sensor posed by hot media for measurement. The surface temperature may exceed 70 °C (158 °F), depending on the temperature of the medium. Before starting work on the flowmeter sensor, make sure that the device has cooled sufficiently.

Flowmeter sensors must be commissioned and operated according to ElexV (German ordinance on electrical installations in potentially explosive atmospheres), EN 60079-14 (setting up electrical installations in potentially explosive atmospheres), and relevant national standards.
In potentially explosive atmospheres, installation, commissioning, maintenance, and servicing must only be performed by properly trained personnel.
The commissioning activities described here are performed after the flowmeter has been installed and the electrical connection has been made.
The supply power must be switched off.
When operating the flowmeter in areas containing combustible dusts, comply with EN 61241-0:2006.

6.6.2 Output circuits

Installation of intrinsically safe "i" or increased safety "e"
The output circuits are designed so that they can be connected to both intrinsically safe and non-intrinsically safe circuits.
It is not permitted to combine intrinsically safe and non-intrinsically safe circuits.
On intrinsically safe circuits, equipotential bonding must be in place along the entire length of the cable used for the current outputs.
The rated voltage of the non-intrinsically safe circuits is Um = 60 V.

IMPORTANT (NOTE)
The cable glands are supplied in black by default. If the signal outputs are wired to intrinsically safe circuits, we recommend that you use the light blue cap supplied, which you will find in the connection area, for the corresponding cable entry.

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

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

6.6.3 NAMUR contact

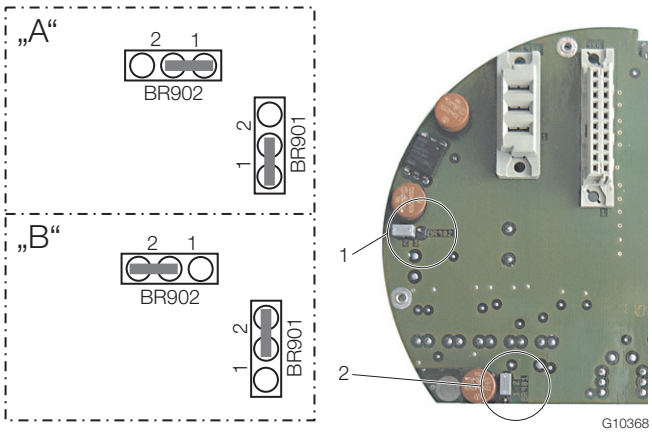


Fig. 29: Positions of jumpers
"A" Standard wiring | "B" NAMUR wiring
1 Jumper BR902 | 2 Jumper BR901

Jumper	Number	Function
BR902	1	Standard configuration, preferred for Ex "e"
BR901	1	(factory default)
BR902	2	NAMUR configuration, preferred for Ex "i"
BR901	2	

The switching output and the pulse output (terminals 41 / 42 and 51 / 52) can be wired internally as a NAMUR contact for the purpose of connecting to a NAMUR amplifier; this is achieved by setting the jumpers accordingly.

6.6.4 Cable entries

The devices are supplied either with cable glands or with 1/2" NPT threads;
you specify which you require in the order number. The cable glands supplied are ATEX-/IECEx-certified. In order to achieve the required tightness, the outer cable diameter must be between 5 mm (0.20 inch) and 9 mm (0.35 inch).

DANGER – Risk of explosion!
Risk of explosion due to the use of unsuitable cable glands.
With ATEX- / IECEx-certified devices with 1/2" NPT threads, the operator must ensure that the cable piping/glands are installed in accordance with the relevant national standards (e.g., NEC, CEC, ATEX137, IEC60079-14. etc.).

Special instructions for devices with CSA certification
Devices certified in accordance with CSA are only ever supplied with 1/2" NPT threads without glands.

6.6.5 Flowmeter sensor insulation

If the flowmeter is to be insulated, follow the instructions in the "Mounting / Installation positions / Installation with option TE1 "extended tower length"" section.

6.6.6 Special information for use in Category 1

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

6.6.7 Operation in Zone 2 with protection class "restricted breathing" (nR)

The transmitter housing (rectangular or round, compact or separate) can be operated in Zone 2 with protection class "restricted breathing" (nR).

WARNING – Potentially adverse effect on protection class
The operator must check the device in accordance with IEC 60079-15 following installation or maintenance, or each time the housing has been opened.

Carrying out the check

1. Switch off the power supply and wait for at least two minutes before opening the housing.
2. Remove a cable gland which is not being used. Cable glands certified to ATEX or IECEx are usually used, e.g., M20 x 1.5 or 1/2" NPT thread.
3. Connect the device being used to test the pressure in place of the cable gland you removed. Check that the test device has been installed and sealed correctly.
4. Carry out the test with the test device.
5. Remove the test device and put the cable gland back in place correctly.

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

IMPORTANT (NOTE)
When selecting a location for the transmitter, make sure that it will not be exposed to direct sunlight.
If exposure to direct sunlight cannot be avoided, a sun shade should be installed.
The limit values for the ambient temperature must be observed.
For FNICO or FISCO installations, the number of devices must be limited as per the applicable standard.

6.6.8 Changing the type of protection

The FCB330/350 and FCT330/350 models can be operated in different types of protection:

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

If a device which is already installed is required to provide a different type of protection, the following measures must be implemented/inspections must be performed in accordance with applicable standards.

1. Type of protection	2. Type of protection	Required step/check
Zone 1: Ex d, non-intrinsically safe circuits	**Zone 1:** Intrinsically safe circuits	— 500 V AC/1 min or 500 x 1,414 = 710 V DC/1 min test between terminals 31 / 32, 33 / 34, 41 / 42, 51 / 52, 81 / 82 and / or 97 / 98 and terminals 31, 32, 33, 34, 41, 42, 51, 52, 81, 82, 97, 98 and the housing. — Visual inspection, particularly of the electronic circuit boards — Visual inspection: No damage or explosion can be detected.
	Zone 2: Non-sparking (nA)	— 500 V AC/1 min or 500 x 1,414 = 710 V DC/1 min test between terminals 31 / 32, 33 / 34, 41 / 42, 51 / 52, 81 / 82 and / or 97 / 98 and terminals 31, 32, 33, 34, 41, 42, 51, 52, 81, 82, 97, 98 and the housing. — Visual inspection, particularly of the electronic circuit boards — Visual inspection: No damage or explosion can be detected.
Zone 1: Intrinsically safe circuits	**Zone 1:** Ex d, non-intrinsically safe circuits	Visual inspection: No damage to the threads (cover, 1/2" NPT cable glands)
	Zone 2: Non-sparking (nA)	No special measures
Zone 2: Non-sparking (nA)	**Zone 1:** Intrinsically safe circuits	— 500 V AC/1 min or 500 x 1,414 = 710 V DC/1 min test between terminals 31 / 32, 33 / 34, 41 / 42, 51 / 52, 81 / 82 and / or 97 / 98 and terminals 31, 32, 33, 34, 41, 42, 51, 52, 81, 82, 97, 98 and the housing. — Visual inspection, particularly of the electronic circuit boards — Visual inspection: No damage or explosion can be detected.
	Zone 1: Ex d, non-intrinsically safe circuits	Visual inspection: No damage to the threads (cover, 1/2" NPT cable glands)

7 Configuration, parameterization

7.1 Operation

7.1.1 Menu navigation

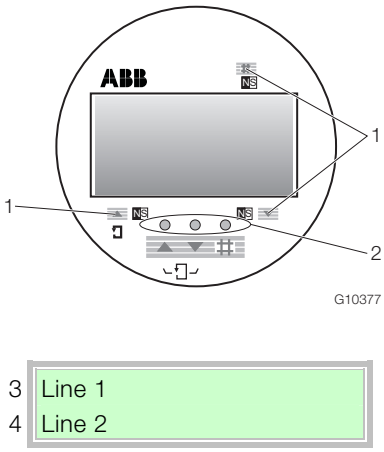


Fig. 30: LCD indicators

1 Points for inserting the magnet stick | 2 Buttons for menu navigation | 3 1st line of the LCD display | 4 2nd line of the LCD display

When setting parameters, the transmitter remains online, i.e., current and pulse outputs still show the current operating mode.

Control button functions

You can browse through the menu or select values from a list using the ▲ or ▼ buttons.

Depending on your position in the menu, the buttons may have other functions.

Symbol	Meaning
⌗	— Toggle between process display and menu — Exit submenu
▲	— Scroll forwards through the menu or a parameter list — For increasing numerical values (increment)
▼	— Scroll backwards through the menu or a parameter list — For reducing numerical values (decrement) — Select the next position for entering numerical and alphanumeric values
▲ + ▼	ENTER function Press the ▲ + ▼ buttons at the same time to execute the ENTER function. — Select a parameter to change — Confirm the entry of a value or parameter — Call up submenu

IMPORTANT (NOTE)

The values entered are checked for plausibility; if they are not plausible, a corresponding message appears on the LCD display.

Magnet stick operation

The magnet stick provides an alternative means of configuring the device even when the housing cover is closed.

To execute the functions, hold the active side of the magnet stick against the corresponding areas on the LCD display. These areas are identified by the NS symbol.

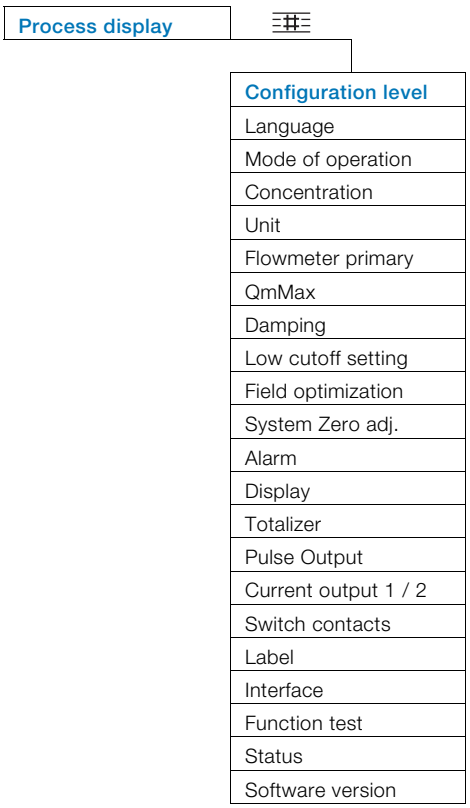
ENTER function with magnet stick operation

It is not possible to use the magnet stick to press two buttons at the same time. To execute the ENTER function when using the magnet stick to operate the device, hold the stick against the ▲ area for more than 3 seconds.

The LCD display flashes to indicate that the ENTER function has been executed successfully.

7.2 Menu levels

The configuration level is located under the process display.



Process display	The process display shows the current process values.
Configuration level	The configuration level contains all the parameters required for device commissioning and configuration. The device configuration can be changed on this level.

7.2.1 Process display

The process display appears on the LCD display when the device is switched on. It shows information about the device and current process values.

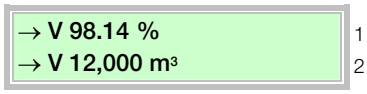


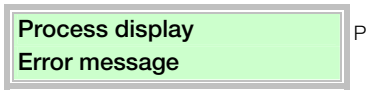
Fig. 31: Process display
1 1st line of the process display |
2 2nd line of the process display

The way in which the current process values are shown in lines 1 and 2 can be adjusted on the configuration level.

Symbol	Description
→	Display in forward direction
←	Display in reverse direction

Error messages on the LCD display

In the event of an error, a message appears on the process display. The text displayed provides information about the area in which the error has occurred.

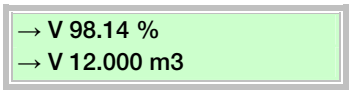


IMPORTANT (NOTE)
For a detailed description of the errors and information on how to remedy them, refer to the 8 "Error messages" section.

7.2.2 Switching to the configuration level (parameterization)

The device parameters can be displayed and changed on the configuration level.

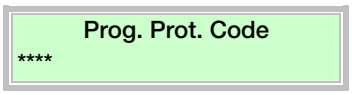
IMPORTANT (NOTE)
If the message "Error – operating protection" appears on the LCD display, hardware write protection has been activated with the operating protection switch.



1. Use ⌗ to switch to the configuration level: A menu option now appears at random on the LCD display.
2. Use ▲ or ▼ to select the "Prog. level" submenu and ▲ + ▼ (ENTER function) to select edit mode.

3. Use ▲ or ▼ to select the "Technician" access level.
4. Use ▲ + ▼ (ENTER function) to confirm your settings.

If a password has been set (Prog. Prot. Code) you must enter it now.



5. Use ▲ to set the required value (the decimal position is incremented every time the button is pressed).
6. Use ▼ to select the next decimal position.
7. Use ▲ + ▼ (ENTER function) to confirm your settings.

After the correct password has been entered, the corresponding access level is opened. If the "Service" programming level was selected, then the service password must be entered.
The LCD display now indicates the first menu item on the configuration level.

8. Use ▲ or ▼ to select a menu.
9. Use ▲ + ▼ (ENTER function) to confirm your selection.

Access levels

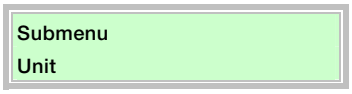
IMPORTANT (NOTE)
There are four access levels: A password can be specified for the "Standard" and "Technician" access levels.
There is no factory default password.

Access levels	Description
Blocked	On the "Locked" level all entries are disabled. Menus / parameters are read only and cannot be modified.
Standard	Display and modify all menus / parameters required for operating the device.
Technician	Display and modify all menus / parameters that can be accessed by the customer.
Service	The service menu can be displayed by entering the correct service password (for ABB Service only).

7.2.3 Selecting and changing parameters

Entry from table

When an entry is made from a table, a value is selected from a list of parameter values.



1. Select the parameters you want to set in the menu.
2. Use + (ENTER function) to call up the parameter for editing.
3. Use oder to select the required value.
4. Use + (ENTER function) to confirm your selection.

Numerical entry

When a numerical entry is made, a value is set by entering the individual decimal positions.

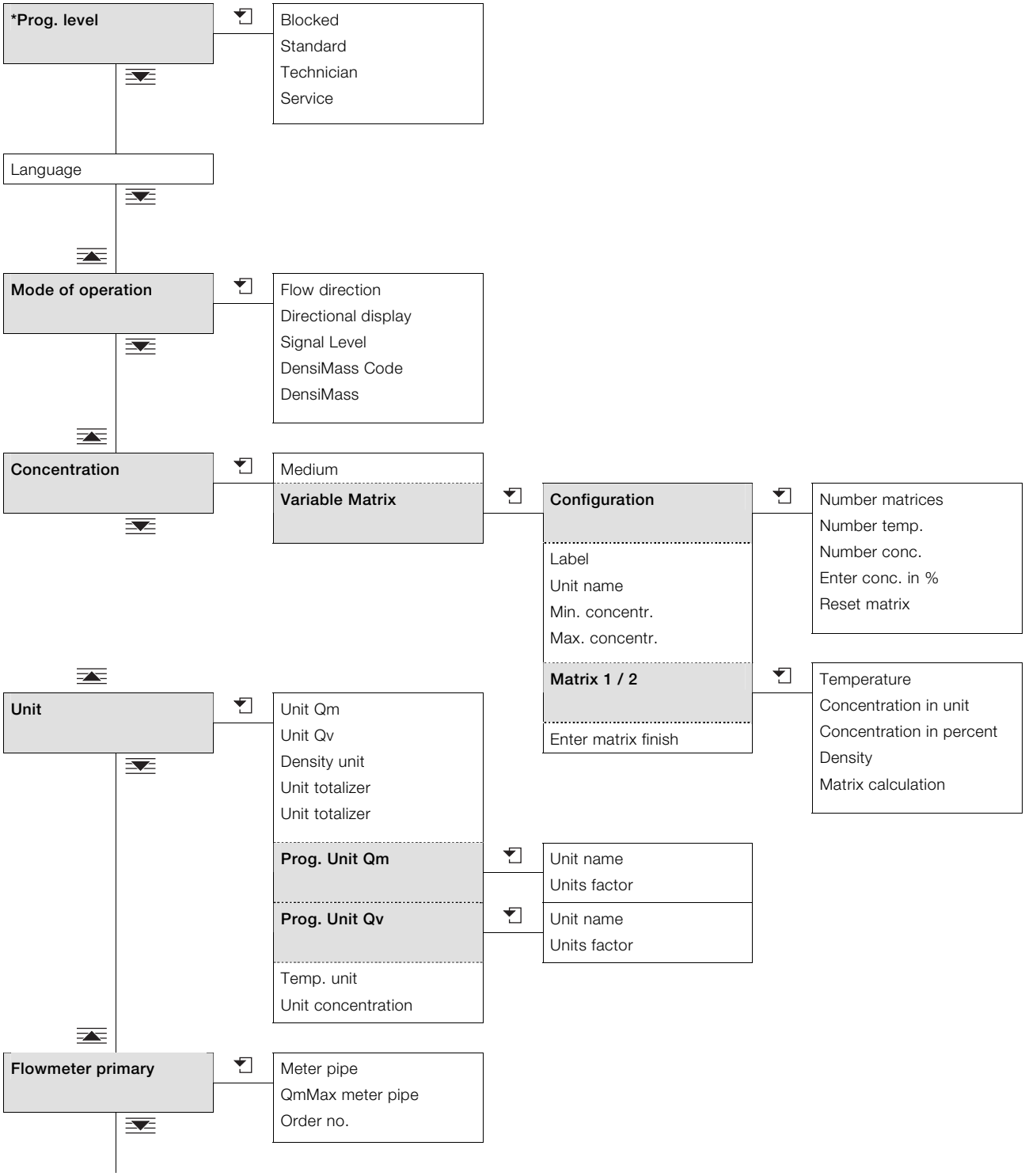
1. Select the parameters you want to set in the menu.
2. Use + (ENTER function) to call up the parameter for editing. The value set previously is deleted and a cursor (_) is displayed in the first position.

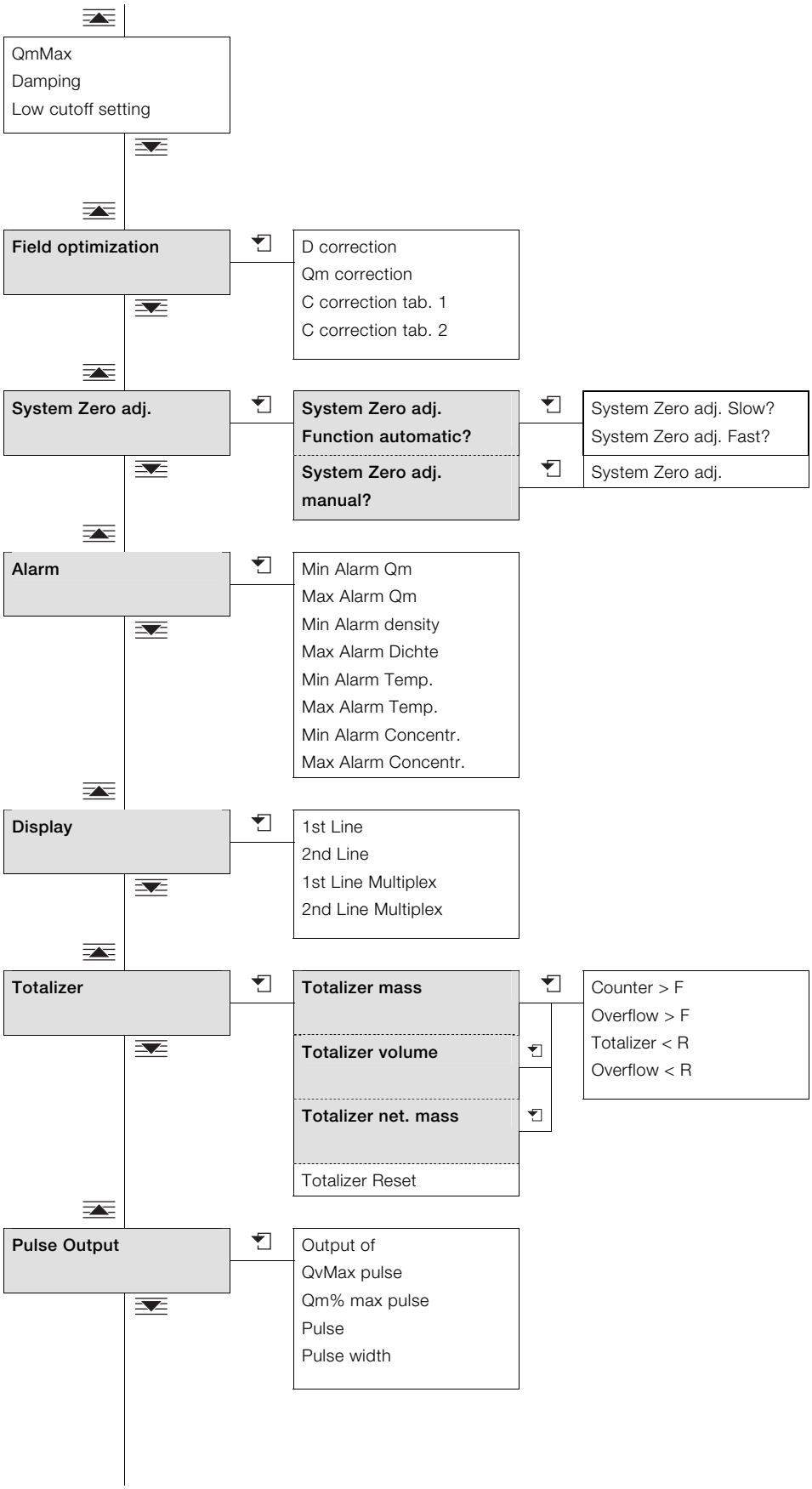
3. Use to set the required value (the decimal place is incremented every time the button is pressed).
4. Use to select the next decimal position.
5. If necessary, select and set other decimal positions using the same procedure as described in steps 3 and 4.
6. Use + (ENTER function) to confirm your settings.

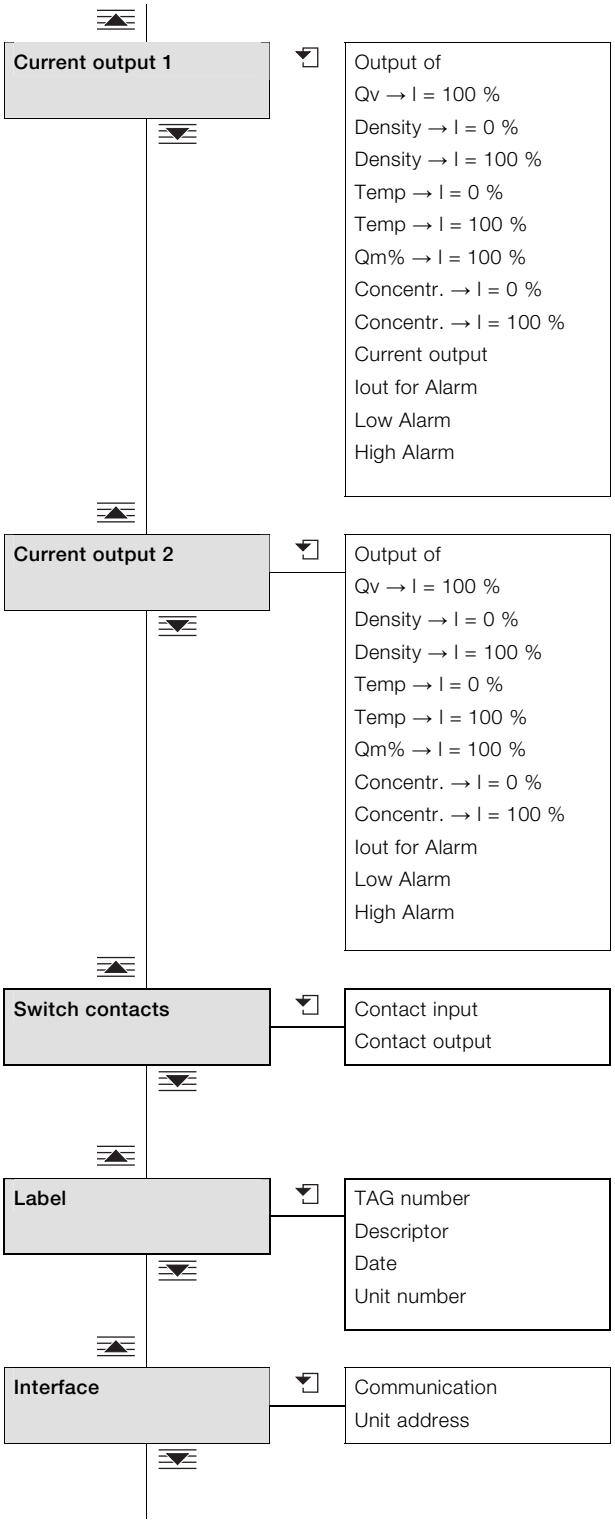
This concludes the procedure for changing a parameter value.

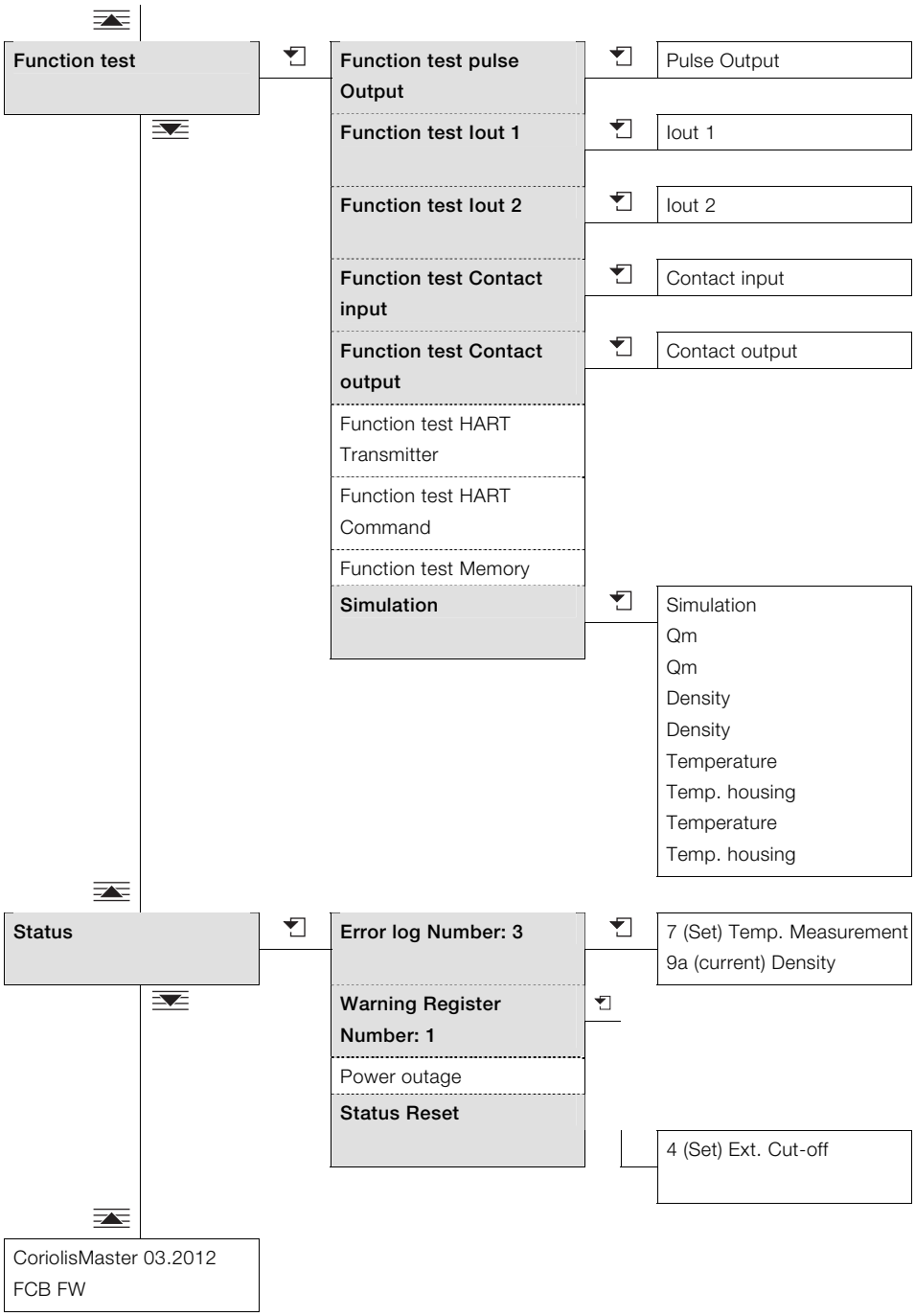
7.3 Overview of parameters on the configuration level

IMPORTANT (NOTE)
This overview of parameters shows all the menus and parameters available on the device. Depending on the version and configuration of the device, not all of the menus and parameters may be visible on it.
In this overview of parameters, the ENTER function ▲ + ▼ is represented by the ↵ symbol for reasons of space.




QmMax
Damping
Low cutoff setting
Field optimization
D correction
Qm correction
C correction tab. 1
C correction tab. 2
System Zero adj.
System Zero adj. Function automatic?
System Zero adj. Slow?
System Zero adj. Fast?
System Zero adj. manual?
System Zero adj.
Alarm
Min Alarm Qm
Max Alarm Qm
Min Alarm density
Max Alarm Dichte
Min Alarm Temp.
Max Alarm Temp.
Min Alarm Concentr.
Max Alarm Concentr.
Display
1st Line
2nd Line
1st Line Multiplex
2nd Line Multiplex
Totalizer
Totalizer mass
Totalizer volume
Totalizer net. mass
Totalizer Reset
Counter > F
Overflow > F
Totalizer < R
Overflow < R
Pulse Output
Output of
QvMax pulse
Qm% max pulse
Pulse
Pulse width

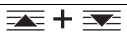

Current output 1
Output of
Qv → I = 100 %
Density → I = 0 %
Density → I = 100 %
Temp → I = 0 %
Temp → I = 100 %
Qm% → I = 100 %
Concentr. → I = 0 %
Concentr. → I = 100 %
Current output
Iout for Alarm
Low Alarm
High Alarm
Current output 2
Output of
Qv → I = 100 %
Density → I = 0 %
Density → I = 100 %
Temp → I = 0 %
Temp → I = 100 %
Qm% → I = 100 %
Concentr. → I = 0 %
Concentr. → I = 100 %
Iout for Alarm
Low Alarm
High Alarm
Switch contacts
Contact input
Contact output
Label
TAG number
Descriptor
Date
Unit number
Interface
Communication
Unit address


Function test
Function test pulse Output
Pulse Output
Function test Iout 1
Iout 1
Function test Iout 2
Iout 2
Function test Contact input
Contact input
Function test Contact output
Contact output
Function test HART Transmitter
Function test HART Command
Function test Memory
Simulation
Simulation
Qm
Qm
Density
Density
Temperature
Temp. housing
Temperature
Temp. housing
Status
Error log Number: 3
7 (Set) Temp. Measurement
9a (current) Density
Warning Register Number: 1
Power outage
Status Reset
4 (Set) Ext. Cut-off
CoriolisMaster 03.2012
FCB FW

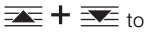
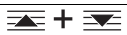
7.4 Parameter descriptions

7.4.1 Menu: *Prog. leel

.../ *Prog. level

Mask contents	Value range	Description
*Prog. level	Blocked Standard Technician Service	Selection of access level. If a password has been set (prog. protection code) you must enter it now. Once the password has been entered, the required access level can be selected. If the password = 0000 (factory setting), the access level can be selected without entering the password. — "Blocked": On the "Locked" level all entries are disabled. Menus / parameters are read only and cannot be modified. — "Standard": Display and modify all menus / parameters required for operating the device. — "Technician":Display and modify all menus / parameters that can be accessed by the customer. — "Service":The service menu can be displayed by entering the correct service password (for ABB Service only).
Prog. Prot. Code		Select the "**Prog.** Prot. Code" submenu.

.../ *Prog. level / Prog. Prot. Code

Mask contents	Value range	Description
Old Prog. Prot. (PS) code?	0 … 9999	Change the password. To change the password, you must start by entering the current password. Press  to confirm your entry.
New Prog. Prot. (PS) code?	0 … 9999	Enter a password. Press  to confirm your entry.

7.4.2 Menu: Language

.../ Language

Mask contents	Value range	Description
Language	German English	Select the menu language.

7.4.3 Menu: Mode of operation

.../ Mode of operation

Mask contents	Value range	Description
Flow direction	Supply/Return Forward	Select the flow direction. — "Supply/Return": Display showing measurement of flow in forward and reverse direction. — "Forward": Display showing measurement of flow in forward direction only. If the medium is flowing through the flowmeter sensor in the reverse direction, ← R flashing is displayed on the LCD display and the flow is indicated as 0 %. The warning "Reverse Q" is also output.
		IMPORTANT (NOTE) In "Supply/Return" operating mode, the pulse output is active for both flow directions.
Directional display	Normal, Inverse	Invert the flow direction display. Note that the accuracy of the flow measurement is dependent upon whether the device has been calibrated in the forward direction only or in the forward and reverse directions. — "Normal": Normal display of flow direction. — "Inverse": Inverted display of flow direction.
Signal Level	automatic, High, Low	Select the signal level response. — "automatic": Determined by density. — "High": Density < 0.4 kg/i -> switch signal level to "High". — "Low": Density > 0.5 kg/l/i -> switch signal level to "Low".
		IMPORTANT (NOTE) Signal level "Low" = 0.5 * signal level "High".
DensiMass Code	-	On devices with the DensiMass option, the device-specific code is displayed here. To retrofit this option, contact the ABB service team or sales organization.
DensiMass	On, Off, Code invalid	Status display of the DensiMass function. If "Code invalid" is displayed, an invalid enable code has been entered.

7.4.4 Menu: Concentration

.../ Concentration

Mask contents	Value range	Description
Medium	Variable Matrix Sodium hydro Alcohol in water Wheat starch Corn starch Sugar in H2O (BRIX)	Selection of the matrix for calculating concentration. For more detailed information, read and follow the instructions in the "DensiMass concentration measurement" section.
Variable Matrix	▲ + ▼	Select the "**Variable Matrix**" submenu.

.../ Concentration / Variable Matrix

Mask contents	Value range	Description
Configuration	▲ + ▼	Select the "**Configuration**" submenu.
Label		A name for the matrix can be entered here.
Unit name	Alphanumeric, max. 20 characters	Entry indicating the unit name for the variable matrix.
Min. concentr.	0 ... 100 %	Entry indicating the minimum permissible concentration for the variable matrix.
Max. concentr.	0 ... 100 %	Entry indicating the maximum permissible concentration for the variable matrix.
Matrix 1 / 2	▲ + ▼	Select the "**Matrix 1 / 2**" submenu.
Enter matrix finish	▲ + ▼	Completes the entry of the matrices. The values entered are saved or rejected.

.../ Concentration / Variable Matrix / Configuration

Mask contents	Value range	Description
Number matrices	1, 2	Entry indicating the number of matrices. Up to 2 different matrices can be created.
Number temp.	2 ... 20	Entry indicating the number of temperature values in a matrix.
Number conc.	2 ... 20	Entry indicating the number of concentration values in a matrix.
Enter conc. in %	Yes, no	Selection of the unit for the concentration. If the concentration unit is something other than %, % can be selected in addition here. This is essential when calculating net mass flows.
Reset matrix	▲ + ▼	Resets the matrix settings to the factory settings.

.../ Concentration / Variable Matrix / Matrix 1 / 2

IMPORTANT (NOTE)
For more detailed information about entering matrices, read and follow the instructions in the "DensiMass concentration measurement" section.

Mask contents	Value range	Description
Temperature		Entry indicating the temperature values for the selected matrix (1 or 2).
Concentration in unit		Entry indicating the concentration values for the selected matrix (1 or 2).
Concentration in percent		Entry indicating the concentration values in % for the selected matrix (1 or 2).
Density		Entry indicating the density values for the selected matrix (1 or 2). Entered values are identified by "E"; values calculated by means of interpolation or extrapolation by "B".
Matrix calculation	▲ + ▼	Calculation of the matrix based on previous entries. Missing values are interpolated or extrapolated.

7.4.5 Menu: Unit

.../ Unit

Mask contents	Value range	Description
Unit Qm	g/s, g/min, g/h, kg/s, kg/min, kg/h, kg/d, t/min, t/h, t/d, lb/s, lb/min, lb/h, lb/d, abc/s, abc/min, abc/h, abc/d	Selection of the unit for the mass flow. The selection is applied for the "QmMax" and "QmMax Meter Tube" parameters as well as for the display of the current mass flow.
Unit Qv	l/s, l/min, l/h, m3/s, m3/min, m3/h, m3/d, ft3/s, ft3/min, ft3/h, ft3/d, ugl/s, ugl/min, ugl/h, mgl/d, igps, igpm, igph, igpd, bbl/s, bbl/min, bbl/h, bbl/d, abc/s, abc/min, abc/h, abc/d	Selection of the unit for the volume flow. The selection is applied, for example, when the volume flow is displayed or the minimum and maximum limits for the current output are entered, if the volume flow is to be output at the current output.
Density unit	g/ml, g/l, g/cm3, kg/l, kg/m3, lb/ft3, lb/ugl	Selection of the unit for the density.
Unit totalizer	g, kg, t, lb, abc, l, m3, ft3, ugl, igl, bbl	Selection of the unit for the volume totalizer.
Prog. Unit Qm	+	Select the "**Prog. Unit Qm**" submenu (programmed mass unit).
Prog. Unit Qv	+	Select the "**Prog. Unit Qv**" submenu (programmed volume unit).
Temp. unit	°C, K, °F	Selection of the unit for the temperature.
Unit concentration	%, BRIX, Baumé, etc.	Selection of the unit for the concentration. See also the "**Concentration**" menu.

.../ Unit / Prog. Unit Qm

A user-defined (programmed) mass unit can be defined in this menu. This unit is available for selection in the corresponding menus and parameters.

Mask contents	Value range	Description
Unit name	ASCII, maximum 3 characters	Entry indicating the name of the user-defined mass unit.
Units factor	0.00001 ... 5000000 kg	Entry indicating the kg/unit factor of the user-defined mass unit.

.../ Unit / Prog. Unit Qv

A user-defined (programmed) volume unit can be defined in this menu. This unit is available for selection in the corresponding menus and parameters.

Mask contents	Value range	Description
Unit name	ASCII, maximum 3 characters	Entry indicating the name of the user-defined volume unit.
Units factor	0.00001 ... 5000000 l	Entry indicating the l/unit factor of the user-defined mass unit.

7.4.6 Menu: Flowmeter primary

.../ Flowmeter primary

Mask contents	Value range	Description
Meter pipe	Read only	Displays the device's nominal diameter setting.
QmMax meter pipe	Read only	Displays the QmMax (maximum mass flow) for the corresponding device nominal diameter.
Order no.	Read only	Display of the order number. The order number displayed matches the information on the name plate and in the external data memory.

7.4.7 Menu: QmMax

.../ QmMax

Mask contents	Value range	Description
QmMax	0.01 ... 1.0 x QmMax meter pipe	Entry indicating the flow range. The flow range can be set between the limits 0.01 ... 1.0 QmMax Meter Tube and applies to both flow directions. QmMax is the value used as the basis for the Qm current value, the low flow cutoff value, and the Qm alarm limits. (QmMax = 20 mA for Qm current output) **IMPORTANT (NOTE)** When a new nominal diameter is entered, the value of the QmMax parameter is automatically set to 1.0 x QmMax meter pipe.

7.4.8 Menu: Damping

.../ Damping

Mask contents	Value range	Description
Damping (5 tau)	1 ... 100 s	Entry indicating the damping. The damping represents the time required for the transmitter to reach 99 % of the end value in one unit step.

7.4.9 Menu: Low cutoff setting

.../ Low cutoff setting

Mask contents	Value range	Description
Low cutoff setting	0 ... 10 %	Entry indicating the low flow as a % of QmMax. The maximum low flow cutoff setting is 10 %. The switching hysteresis is 0.1 %. If a value of 0 % is entered for the low flow cutoff, then the switching hysteresis is also deactivated.

7.4.10 Menu: Field optimization

.../ Field optimization

Mask contents	Value range	Description
D correction	-50 … 50 g/l	Entry indicating the correction factor for the density. In order to attain an accuracy in the density measurement which comes close to the reproducibility of 0.0001 g/ml, this factor can be used to perform an optimization in the field. The limits of this correction are ±50 g/l (± 0.05 g/ml).
Qm correction	-5 … 5 %	Entry indicating the correction factor for flow measurement. In order to attain an accuracy in the flow measurement which comes close to or even exceeds a reproducibility of at least 0.1 % of the measured value, this factor can be used to undertake an optimization in the field. This value acts as a correction value for the current mass flow rate. It is given as a percentage of the current measured value. The limits of this entry are ±5 % of the measured value.
C correction tab. 1 C correction tab. 2	-1000 … 1000 %	Entry indicating the correction factor for concentration measurement. In order to attain an accuracy in the concentration measurement which comes close to or even exceeds reproducibility, this factor can be used to undertake an optimization in the field. This value acts as a correction value for the current concentration measured value. It is given in the unit that is currently set for concentration. The correction value is based on the concentration matrix currently selected. In the case of one fixed matrix, only one correction value is available. If variable matrices are used, 2 values are available.

7.4.11 Menu: System Zero adj.

IMPORTANT (NOTE)

Prior to starting the zero adjustment, make sure that:

- The flowmeter sensor must be filled completely with medium for measurement.
- There is no flow through the flowmeter sensor (close all valves, shut-off devices, etc.)
- No pressure surges in the medium for measurement.
- The flowmeter sensor must be vibration-free.
- There must be no gas bubbles in the medium for measurement.
- Zero point adjustment must be performed under normal operating conditions (operating temperature, operating pressure, etc.).

.../ System Zero adj.

Mask contents	Value range	Description
System Zero adj. Function automatic?	+	Select the "**System Zero adj.** Function automatic?" submenu.
System Zero adj. manual?	+	Select the "**System Zero adj.** manual?" submenu.

.../ System Zero adj. / System Zero adj. Function automatic?

Mask contents	Value range	Description
System Zero adj. Slow?	+	Start slow adjustment of the system zero point.
System Zero adj. Fast?	+	Start fast adjustment of the system zero point.

.../ System Zero adj. / System Zero adj. manual?

Mask contents	Value range	Description
System Zero adj.	x.xxx %	Entry indicating the value for manual zero point adjustment.

7.4.12 Menu: Alarm

Entry of limit values (minimum and maximum) for the mass flow, density, concentration, and temperature variables. The entry of values above or below the limit values can be signaled with the digital switching output 41 / 41. The settings are configured via the "**... / Switch contacts / Contact output**" menu.

.../ Alarm

Mask contents	Value range	Description
Min Alarm Qm	0 ... 105 %	Entry indicating the lower limit for mass flow. The value must be less than "Max Alarm Qm".
Max Alarm Qm	0 ... 105 %	Entry indicating the upper limit for mass flow. The value must be greater than "Min Alarm Qm".
Min Alarm density	0.5 ... 3.5 kg/l	Entry indicating the lower limit for density. The value must be less than "Max Alarm Dichte".
Max Alarm Dichte	0.5 ... 3.5 kg/l	Entry indicating the upper limit for density. The value must be greater than "Min Alarm density".
Min Alarm Temp.	-50 ... 200 °C	Entry indicating the lower temperature limit. The value must be less than "Max Alarm Temp.".
Max Alarm Temp.	-50 ... 200 °C	Entry indicating the upper temperature limit. The value must be greater than "Min Alarm Temp.".
Min Alarm Concentr.	-5 ... 105,0 %	Entry indicating the lower limit for concentration. The value must be less than "Max Alarm Concentr.".
Max Alarm Concentr.	-5 ... 105,0 %	Entry indicating the upper limit for concentration. The value must be greater than "Min Alarm Concentr.".

7.4.13 Menu: Display

Configuration of the flowmeter sensor process display. There are two lines for the independent display of two values. Multiplex mode can also be activated. When multiplex mode is activated, two values which change automatically (every 3 seconds) are displayed on each line.

.../ Display

Mask contents	Value range	Description
1st Line	See the following table	Selection of the value displayed.
2nd Line		
1st Line Multiplex		
2nd Line Multiplex		

Value	Description
Q [Bargraph]	Displays the flow as bars.
Qm	Displays the mass flow in the configured unit.
Qv	Displays the volume flow in the configured unit.
Q [%]	Displays the mass flow in percent.
Temperature	Displays the medium temperature in the configured unit.
Density	Displays the density in the configured unit.
Concentr. Unit	Displays the concentration in the configured unit.
Concentr. Percent	Displays the concentration in percent.
Qm Concentration	Displays the net mass flow according to the current concentration.
TAG Nummer	Displays the configured TAG number.
Totalizer Mass	Displays the mass forward or reverse flow totalizer dependent on the present flow direction
Totalizer Mass>F	Displays the mass forward flow totalizer.
Totalizer Mass<R	Displays the mass reverse flow totalizer.
Totalizer Volumes	Displays the volume forward or reverse flow totalizer dependent on the current flow direction.
Totalizer Vol.>V	Displays the volume forward flow totalizer.
Totalizer Vol.<R	Displays the volume reverse flow totalizer.
Totalizer Net Mass	Displays the net mass totalizer according to the net mass flow.
Total. Net Mass >F	Displays the net mass forward flow totalizer.
Total. Net Mass <R	Displays the net mass reverse flow totalizer.
Pipe frequency	Frequency of the meter pipe.
Blank	-
Off	Multiplex mode deactivate (multiplex mode only).

IMPORTANT (NOTE)

The units of the displayed values correspond to the units configured in the "**... / Unit**" menu.

7.4.14 Menu: Totalizer

All four to six totalizers count up to 10 million (in the selected totalizer unit). After a value of 10 million is reached, the corresponding overflow counter is incremented by one and the totalizer value reset to zero to continue counting the flow.
In order to indicate in the process display that an overflow has occurred, a warning is displayed. Up to 65,535 overflows can be registered per totalizer.
A value for each totalizer can be individually set or reset (by entering a zero value) in the appropriate menu. When a totalizer is set (or reset), the relevant overflow counter automatically resets to zero.
If the "**Mode** of operation" setting has been selected in the "**... / Flow direction / Forward**" menu, the "**Totalizer**" menu will only contain the parameters for the forward totalizer.

... / Totalizer

Mask contents	Value range	Description
Totalizer mass	+	Select the "**Totalizer mass**" submenu.
Totalizer volume	+	Select the "**Totalizer volume**" submenu.
Totalizer net. mass	+	Select the "**Totalizer net.** mass" submenu.
Totalizer Reset	+	Resets all totalizers once the security prompt has been confirmed with + . All totalizers are reset at the same time. To clear an individual totalizer, set the corresponding parameters to zero.

... / Totalizer / Totalizer mass
... / Totalizer / Totalizer volume
... / Totalizer / Totalizer net. mass

Mask contents	Value range	Description
Counter > F	0 ... 10.000.000	Entry and display of the totalizer reading in the forward direction for the corresponding totalizer.
Overflow > F	Read only	Displays the totalizer overflows in the forward direction for the corresponding totalizer. An overflow is equivalent to a totalizer reading of 10,000,000. A maximum of 65, 636 overflows can be displayed.
Totalizer < R	0 ... 10.000.000	Entry and display of the totalizer reading in the reverse direction for the corresponding totalizer.
Overflow < R	Read only	Displays the totalizer overflows in the reverse direction for the corresponding totalizer. An overflow is equivalent to a totalizer reading of 10,000,000. A maximum of 65, 636 overflows can be displayed.

7.4.15 Menu: Pulse Output

... / Pulse Output

Mask contents	Value range	Description
Output of	Mass Volume Qm Concentration	Selection of the measured value output at the pulse output. — Mass: Output of mass flow — Volume: Output of volume flow — Qm Concentration: Output of net mass flow
QvMax pulse		Displays the flow rate per pulse (only with output of volume flow).
Qm% max pulse		Displays the mass per pulse (only with output of mass flow).
Pulse	0.001 ... 1000 pulse/unit	Entry indicating pulses per unit (pulse factor). This entry may be corrected by the flowmeter sensor as the limit frequency of the pulse output is 5000 Hz. **IMPORTANT (NOTE)** An increase in the pulse factor can result in a reduction of the pulse width!
Pulse width	0.1 ... 2000 ms	Entry indicating the pulse width. The pulse factor and pulse width are interdependent and may be corrected by the flowmeter sensor.

Examples

Example 1

Settings	Entry	Result
QmMax = 24 kg/min = 0.4 kg/s Totalizer unit kg Pulse factor: 100 pulses/kg	New pulse width: 10 ms	0.4 kg/s x 100 pulses/kg = 40 pulses/s = 40 Hz Period = 25 ms Maximum pulse width = Period/2 = 12.5 ms Result: The entered pulse width of 10 ms is acceptable.

Example 2

Settings	Entry	Result
QmMax = 6 kg/min = 0.1 kg/s = 100 g/s Totalizer unit g Pulse width: 10 ms	New pulse factor: 60 pulses/g	100g/s x 60 pulses/g = 6000 pulses/s = 6000 Hz The limit frequency of 5000 Hz has been exceeded. The flowmeter sensor automatically set the pulse factor to 50 pulses/g and the period to 0.2 ms (5 kHz), which corresponds to exactly 5000 Hz. Maximum pulse width = Period /2 = 0.1 ms Result: The entered pulse factor and also the pulse width had to be reduced.

IMPORTANT (NOTE)
If you are using a mechanical totalizer, we recommend setting a pulse width of ≥ 30 ms and a maximum frequency of fmax ≤ 3 kHz.

7.4.16 Menu: Current output 1

... / Current output 1

Mask contents	Value range	Description
Output of	Qm,, Qv,, Density,, Temperature,, Concentration,	Selection of the measured value output at current output 1 (31 / 32).
Qv → I = 100 %	0.1 … 10.000.000	Entry indicating the volume flow at which the current output reaches its maximum value (20 mA) (only visible if the volume flow is output via the current output).
Density → I = 0 %	0.5 ... 3.5 g/cm³	Entry indicating the density at which the current output reaches its minimum value (0 mA) (only visible if the density is output via the current output).
Density → I = 100 %	0.5 ... 3.5 g/cm³	Entry indicating the density at which the current output reaches its maximum value (20 mA) (only visible if the density is output via the current output).
Temp → I = 0 %	-50 … 200 °C	Entry indicating the temperature at which the current output reaches its minimum value (0 mA) (only visible if the temperature is output via the current output).
Temp → I = 100 %	-50 … 200 °C	Entry indicating the temperature at which the current output reaches its maximum value (20 mA) (only visible if the temperature is output via the current output).
Qm% → I = 100 %	-	Entry indicating the net mass flow at which the current output reaches its maximum value (20 mA) (only visible if the net mass flow is output via the current output).
Concentr. → I = 0 %		Entry indicating the concentration at which the current output reaches its minimum value (0 mA) (only visible if the concentration is output via the current output).
Concentr. → I = 100 %		Entry indicating the concentration at which the current output reaches its maximum value (20 mA) (only visible if the concentration is output via the current output).
Current output	0 … 20 mA, 4 … 20 mA	Select the operating mode for the current output. 4 … 20 mA must be selected for active HART communication. **IMPORTANT (NOTE)** HART communication takes place via current output 1. If HART communication is to be used, 4 … 20 mA MUST be selected as the operating mode. — If HART communication is activated in 0 … 20 mA operating mode, an error message is displayed and the communication mode does not change. — If 0 … 20 mA operating mode is activated when HART communication is activated, an error message is displayed and HART communication is deactivated.
Iout for Alarm	Low, High	Select the status of current output 1 in error condition. The output "Low" or "High" current is set in the subsequent menus.
Low Alarm	2 … 3.6 mA	Select the current for Low alarm. The value is a function of the current output range selected. For the current output range 0 ... 20 mA, the alarm current is 0 ma. For the current output range 4 ... 20 mA, the low alarm current can be set between the limits of 2 ... 3.6 mA. When the current output range is changed, the transmitter automatically adjusts the low alarm current to the new current output range (current output range 0 ... 20 mA to 0 mA and 4 ... 20 mA to 2 mA).
High Alarm	21 … 26 mA	Select the current for High alarm. The value for the alarm current is independent of the current output range selected, since all range end values are 20 mA. The high alarm current can be set between the limits of 21 mA and 26 mA.

7.4.17 Menu: Current output 2

In contrast to current output 1, current output 2 is not HART-enabled and has a fixed current output range (4 ... 20 mA).

... / Current output 2

Mask contents	Value range	Description
Output of	Qm,, Qv,, Density,, Temperature,, Concentration,	Selection of the measured value output at current output 1 (31 / 32).
Qv → I = 100 %	0.1 ... 10.000.000	Entry indicating the volume flow at which the current output reaches its maximum value (20 mA). (only visible if the volume flow is output via the current output).
Density → I = 0 %	0.5 ... 3.5 g/cm³	Entry indicating the density at which the current output reaches its minimum value (0 mA). (only visible if the density is output via the current output).
Density → I = 100 %	0.5 ... 3.5 g/cm³	Entry indicating the density at which the current output reaches its maximum value (20 mA) (only visible if the density is output via the current output).
Temp → I = 0 %	-50 ... 200 °C	Entry indicating the temperature at which the current output reaches its minimum value (0 mA) (only visible if the temperature is output via the current output).
Temp → I = 100 %	-50 ... 200 °C	Entry indicating the temperature at which the current output reaches its maximum value (20 mA) (only visible if the temperature is output via the current output).
Qm% → I = 100 %	-	Entry indicating the net mass flow at which the current output reaches its maximum value (20 mA) (only visible if the net mass flow is output via the current output).
Concentr. → I = 0 %		Entry indicating the concentration at which the current output reaches its minimum value (0 mA) (only visible if the concentration is output via the current output).
Concentr. → I = 100 %		Entry indicating the concentration at which the current output reaches its maximum value (20 mA) (only visible if the concentration is output via the current output).
Iout for Alarm	Low, High	Select the status of current output 1 in error condition. The output "Low" or "High" current is set in the subsequent menus.
Low Alarm	2 ... 3.6 mA	Select the current for Low alarm.
High Alarm	21 ... 26 mA	Select the current for High alarm.

7.4.18 Menu: Switch contacts

... / Switch contacts

Mask contents	Value range	Description
Contact input	No function, Totalizer reset. Concentr. Table, Ext. output Shut-off, Totalizer reset.	Selection of the function for the digital switching input (81 / 82). — No function: Switching input without function. — Totalizer reset. Concentr. Table: Switchover of tables (matrix 1 / 2) for concentration measurement. — Ext. output Shut-off: Current and pulse outputs are set to 0, the totalizers are stopped. — Totalizer reset.: Resets all totalizers to zero.
Contact output	See the following table	Selection of the function for the digital switching output (41 / 42). The output can be configured for the selected function as either a normally open contact or a normally closed contact.

Function Contact output	Description
No function	No function, output open.
F/R-Signal _	Output of flow direction, output closed when flow is in reverse direction.
F/R-Signal /	Output of flow direction, output open when flow is in reverse direction.
General alarm _	Output closed unless a general alarm is pending. Output opens in the event of a fault.
General alarm /	Output open unless a general alarm is pending. Output closes in the event of a fault.
MAX/MIN Alarm _	Output closed unless a min./max. alarm is pending. Output opens in the event of a min./max. alarm.
MAX/MIN Alarm /	Output open unless a min./max. alarm is pending. Output closes in the event of a min./max. alarm.
MIN Alarm _	Output closed unless a min. alarm is pending. Output opens in the event of a min. alarm.
MIN Alarm /	Output open unless a min. alarm is pending. Output closes in the event of a min. alarm.
MAX Alarm _	Output closed unless a max. alarm is pending. Output opens in the event of a max. alarm.
MAX Alarm /	Output open unless a max. alarm is pending. Output closes in the event of a max. alarm.

7.4.19 Menu: Label

.../ Label

Mask contents	Value range	Description
TAG number	ASCII, maximum 8 characters	Entry of a TAG number identifying the measuring point in the HART protocol.
Descriptor	ASCII, maximum 16 characters	Entry of a HART descriptor.
Date	1.1.1900 ... 31.12.2155	Date of the HART file.
Unit number	Read only	Display indicating the device number.

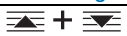
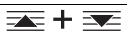
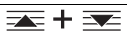
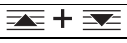
7.4.20 Menu: Interface

.../ Interface

Mask contents	Value range	Description
Communication	Off, HART	Selection of the communication mode for digital communication. — Off: No digital communication. — HART: HART communication active via current output 1. The operating mode for current output 1 must first be set to 4 ... 20 mA.
Unit address	0 ... 15	Entry indicating the HART address. The HART protocol has provisions for creating a bus with up to 15 devices (1 ... 15). **IMPORTANT (NOTE)** If an address greater than 0 is set, the device operates in multidrop mode. The current output is fixed at 4 mA. Apart from that, the current output is only used for HART communication.

7.4.21 Menu: Function test

... / Function test

Mask contents	Value range	Description
Function test pulse Output		Select the "**Function test** pulse Output" submenu.
Function test Iout 1		Select the "**Function test Iout** 1" submenu.
Function test Iout 2		Select the "**Function test Iout** 2" submenu.
Function test Contact input		Select the "**Function test** Contact input" submenu.
Function test Contact output		Select the "**Function test** Contact output" submenu.
Function test HART Transmitter	1200 Hz, 2200 Hz	Selection of the HART frequency to be simulated.
Function test HART Command	Read only	Display of the most recently received HART command.
Function test Memory		Activation of the memory function test.
Simulation		Select the "**Simulation**" submenu.

... / Function test / Function test pulse Output

Mask contents	Value range	Description
Pulse Output	0.001 ... 5000 Hz	Entry indicating the pulse rate for testing the pulse output. Press any button to abort.

... / Function test / Function test Iout 1
... / Function test / Function test Iout 2

Mask contents	Value range	Description
Iout 1	0 ... 26 mA	Entry indicating the output current for testing current output 1. Press any button to abort.
Iout 2	3.5 ... 26 mA	

... / Function test / Function test Contact input

Mask contents	Value range	Description
Contact input	On, off	Test of the switching input. Press any button to abort.

... / Function test / Function test Contact output

Mask contents	Value range	Description
Contact output	On, off	Test of the switching output. Press any button to abort.

… / Function test / Simulation

The Simulation menu contains a number of options which can be used to set individual or even all measured variables of the transmitter to programmable values. When simulation is turned on, additional menu items become available in the submenu Simulation.

They enable you to determine for every variable whether it should be measured or simulated and what value should be assigned to it. Therefore a selection can be made from the following:

Value	Description
Measure	The true measured value of the variable is output.
Enter	The value of the variable is simulated and can be set to a fixed value using the appropriate menu.
Step	The variable is simulated and can be increased or decreased in steps using the STEP and DATA keys if the process display is shown.

Mask contents	Value range	Description
Simulation	On, off	Activation of the simulation functions.
Qm	Measure, enter, step	Selection of the simulation function.
Qm	-115 … +115 %	Entry indicating of the mass flow rate to be simulated in %.
Density	Measure, enter, step	Selection of the simulation function.
Density	0.001 g/ml	Entry indicating the density to be simulated in g/ml.
Temperature	Measure, enter, step	Selection of the simulation function.
Temp. housing	Measure, enter, step	Selection of the simulation function.
Temperature	-60 … 210 °C	Entry indicating the temperature to be simulated in °C.
Temp. housing	-60 … 210 °C	Entry indicating the temperature to be simulated in °C.

7.4.22 Menu: Status

... / Status

Mask contents	Value range	Description
Error log Number: 3	+	Display indicating the number of error messages saved and selection of the "**Error log**" submenu.
Warning Register Number: 1	+	Display indicating the number of warnings saved and selection of the "**Warning register**" submenu.
Power outage	Read only	Display indicating the number of power outages.
Status Reset	+	To reset the error log, warning register, and power outage log, confirm the prompt and press + . All three are reset at the same time.

... / Status / Error log

Mask contents	Value range	Description
7 (Set) Temp. Measurement 9a (current) Density measurement	Read only (example)	Displays the last error that occurred with error number and status (current or set). If more errors are pending, you can scroll through the list with or . **IMPORTANT (NOTE)** The errors are not listed in order of priority!

... / Status / Warning register

Mask contents	Value range	Description
4 (Set) Ext. Cut-off	Read only (example)	Displays the last error that occurred with error number and status (current or set). If more errors are pending, you can scroll through the list with or . **IMPORTANT (NOTE)** The errors are not listed in order of priority!

7.4.23 Menu: Software version

.../ Software version

Mask contents	Value range	Description
CoriolisMaster 03.2012 FCB FW	Read only (example)	Displays the software version. The device ID and the software revision date are displayed on the first line. The software ID and the revision level are displayed on the second line.

In addition to the software identification in the menu, the identification can also be found on the information tag on the transmitter module.

7.5 DensiMass concentration measurement (FCB350 only)

The transmitter can calculate the current concentration from the measured density and temperature using concentration matrices.
The following concentration matrices are preconfigured in the transmitter as standard:

- Concentration of sodium hydroxide in water
- Concentration of alcohol in water
- Concentration of sugar in water
- Concentration of corn starch in water
- Concentration of wheat starch in water

The user can enter two more user-defined matrices containing up to 100 values.

7.5.1 Accuracy of concentration measurement

The accuracy of the concentration measurement is determined in the first instance by the quality of the matrix data entered. However, as the calculation is based on temperature and density (the input variables), the accuracy of the concentration measurement is ultimately determined by the measuring accuracy of temperature and density.

Example:
Density of 0 % alcohol in water at 20 °C (68 °F): 998.23 g/l
Density of 100 % alcohol in water at 20 °C (68 °F): 789.30 g/l

Concentration	Density
100 %	208.93 g/l
0.48 %	1 g/l
0.69 %	2 g/l

The accuracy class of the density measurement thus directly determines the accuracy of the concentration measurement. See the device operating instructions for detailed information.

7.5.2 Entering the concentration matrix

The concentration matrix is entered via the "**... / Concentration / Variable Matrix**" menu. The data for the matrix must be available as described in the "Structure of the concentration matrix" section.

Step 1:
Menu "**... / Concentration / Variable Matrix**".
Enter the unit name for the variable matrix, enter the upper and lower concentration limits.

Step 2:
Enter the basic settings for the matrix in the "**... / Concentration / Variable Matrix / Configuration**" menu.
The number of matrices (1 or 2), the number of temperature values, and the number of concentration values are specified here.

Step 3:
Enter the matrix data in the "**... / Concentration / Variable Matrix / Matrix 1 / 2**" menu.
The temperature values, the concentration values (in the required unit or in %), and the density values are entered here. Once the data has been entered, select "**Matrix calculation**" from the menu to calculate the matrix. Missing values are interpolated or extrapolated.

Step 4:
Save the matrices by selecting the "**Concentration**" option from the "**... / Variable Matrix / Enter matrix** finish" menu.

This completes the process to enter the matrices.

7.5.3 Structure of the concentration matrix

The software supports two different concentration values:

1. Concentration in unit (e.g., % or °Bé)
   The range of values is not restricted, the value can be output at the current output, the value can be selected in the Units submenu.

2. Concentration in percent (%)
   The range of values is restricted to 0 ... 103.125 %. This value is only used for the internal calculation of the net mass flow. The net mass flow can be output at the current and pulse outputs.

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

The matrix for calculating the concentration looks like this:

		Temperature 1	**...**	**Temperature n**
Value 1 concentration in %	**Value 1 concentration in unit (e.g., % or°Bé)**	Value 1,1 density	…	Value n,1 density
....	**...**	…	…	…
Value m concentration in %	**Value m concentration in unit (e.g., % or°Bé)**	Value 1, m density	…	Value n,m density

The following rules apply when entering values in the matrix:

— One matrix: 2 ≤ N ≤ 20; 2 ≤ M ≤ 20; N * M ≤ 100
— Two matrices: 2 ≤ N ≤ 20; 2 ≤ M ≤ 20; N * M ≤ 50

The density values in a column must be in ascending order due to the algorithm used in the transmitter software.
Density x,1 < … < Density x,2 <…< Density x,M for 1 ≤ x ≤ M

The temperature values must be in ascending order from left to right due to the algorithm used in the transmitter software.
Temperature 1 <…< Temperature x <…< Temperature N for 1 ≤ x ≤ N

The concentration values must be monotonically nondecreasing or monotonically nonincreasing from top to bottom due to the algorithm used in the transmitter software.
Concentr. 1 <…< Concentr. x <…< Concentr. N for 1 ≤ x ≤ N
or
Concentr. 1 >…> Concentr. x > … > Concentr. N for 1 ≤ x ≤ N

Example:

		10 °C (50 °F)	**20 °C (68 °F)**	**30 °C (86 °F)**
0 %	**0 °BRIX**	0,999 kg/l	0,982 kg/l	0,979 kg/l
10 %	**10 °BRIX**	1,010 kg/l	0,999 kg/l	0,991 kg/l
40 %	**30 °BRIX**	1,016 kg/l	1,009 kg/l	0,999 kg/l
80 %	**60 °BRIX**	1,101 kg/l	1,018 kg/l	1,011 kg/l

7.6 Software history

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

Standard and HART version

Software FCB FW

Software version	Revision date	Type of change	Description
00.01.00	03.2012	New release	-

8 Error messages

8.1 General remarks

The tables on the following pages are an overview of the alarm program and describe the response of the converter when errors are detected.
Listed are all the possible errors together with a description of their effects on the measurements as well as the status of the current and alarm outputs.
If the entry in the column is blank there is no effect on the measurement variable or no alarm signal for the particular output. If in the current output column only Alarm is listed, then an alarm output is transmitted based on the High- or Low-Alarm selections made in the current output menus.
The sequence of the errors in the tables corresponds to the error priorities.
The first entry has the highest priority and the last the lowest.
If multiple errors are detected simultaneously, the error with the highest priority determines the alarm status of the measurement variable and the current output. If an error with a higher priority does not affect the measurement variable or the output status, then the error with the next highest priority determines the status of the measurement variable and the outputs.

Example:
If the error 7a “T Pipe measurement“ is active, the table indicates that this affects the value of the temperature measurement variable (constant 20 °C [68 °F]).
Since the temperature measurement is absolutely necessary in order to calculate the density and thus also to calculate the Qv value, the current outputs that are assigned to these parameters will enter the programmed alarm state (high or low alarm).

8.2 Overview

Priority	Error no.	Error text	Measurements							Totalizer			Current output						
			Qm [%]	Qv [%]	Density [g/cm³]	Temperature [°C]	Concentration [%]	Concentration [unit]	Net mass flow	Mass	Volume	Net mass	Qm	Qv	Density	Temperature	Concentration [unit]	Net mass flow	Alarm output
1	5a	Internal FRAM	0	0	1	20	0	0	0	–	–	–	⚠	⚠	⚠	⚠	⚠	⚠	⚠
2	5b	External FRAM	0	0	1	20	0	0	0	–	–	–	⚠	⚠	⚠	⚠	⚠	⚠	⚠
3	10	DSP communication	0	0	1	20	0	0	0	–	–	–	⚠	⚠	⚠	⚠	⚠	⚠	⚠
4	1	AD Transmitter	0	0	1	20	0	0	0	–	–	–	⚠	⚠	⚠	⚠	⚠	⚠	⚠
5	11d	Sensor	0	0	1	–	0	0	0	–	–	–	⚠	⚠	⚠	–	⚠	⚠	⚠
6	0	Sensor amplitude	0	0	1	–	0	0	0	–	–	–	⚠	⚠	⚠	–	⚠	⚠	⚠
7	2a	Driver	0	0	1	–	0	0	0	–	–	–	⚠	⚠	⚠	–	⚠	⚠	⚠
8	2b	Driver current	0	0	1	–	0	0	0	–	–	–	⚠	⚠	⚠	–	⚠	⚠	⚠
9	9a	Density measurement	–	0	4	–	0	0	0	–	–	–	–	⚠	⚠	–	⚠	⚠	⚠
11	7a	T Pipe measurement	–	–	–	20	0	0	0	–	–	–	–	⚠	⚠	⚠	⚠	⚠	⚠
12	7b	T Housing measurement	–	–	–	20	–	–	–	–	–	–	–	–	–	⚠	–	–	⚠
13	3	Flowrate >103.25 %	103	Qm = 103	–	–	–	–	Qm = 103	–	–	–	⚠↑	⚠↑	–	–	–	⚠↑	⚠
14	12	Concentration (Percent)	–	–	–	–	0	–	0	–	–	–	–	–	–	–	–	⚠	⚠
15	4	Ext. zero return	–	–	–	–	–	–	–	STOP	STOP	STOP	⚠	⚠	–	–	–	⚠	⚠
16	8a	Iout 1 to large	–	–	–	–	–	–	–	–	–	–	⚠↑	⚠↑	⚠↑	⚠↑	⚠↑	⚠↑	⚠
17	8b	Iout 1 to small	–	–	–	–	–	–	–	–	–	–	⚠↓	⚠↓	⚠↓	⚠↓	⚠↓	⚠↓	⚠
18	8c	Iout 2 to large	–	–	–	–	–	–	–	–	–	–	⚠↑	⚠↑	⚠↑	⚠↑	⚠↑	⚠↑	⚠
19	8d	Iout 2 to small	–	–	–	–	–	–	–	–	–	–	⚠↓	⚠↓	⚠↓	⚠↓	⚠↓	⚠↓	⚠
20	6a	Totalizer Mass -> V	–	–	–	–	–	–	–	1)	–	–	–	–	–	–	–	–	⚠
21	6b	Totalizer Mass <- R	–	–	–	–	–	–	–	1)	–	–	–	–	–	–	–	–	⚠
22	6c	Totalizer Vol.-> V	–	–	–	–	–	–	–	–	1)	–	–	–	–	–	–	–	⚠
23	6d	Totalizer Vol.<- R	–	–	–	–	–	–	–	–	1)	–	–	–	–	–	–	–	⚠
24	6e	Totalizer Net Mass -> V	–	–	–	–	–	–	–	–	–	1)	–	–	–	–	–	–	⚠
25	6f	Totalizer Net Mass <- R	–	–	–	–	–	–	–	–	–	1)	–	–	–	–	–	–	⚠
26	11a	Sensor A	0	0	1	–	0	0	0	–	–	–	⚠	⚠	⚠	–	⚠	⚠	⚠
27	11b	Sensor B	0	0	1	–	0	0	0	–	–	–	⚠	⚠	⚠	–	⚠	⚠	⚠

The totalizer readings and the states of the current outputs and the alarm output are represented by symbols; please see the table below.

Symbol	Description
STOP	Totalizer stop
–	No change
1)	In the event of an error, the corresponding totalizer is reset to 0.
⚠	Alarm (general)
⚠↑	High Alarm
⚠↓	Low Alarm

8.3 Error messages

Error message	Priority	Description	Possible causes	Corrective action
Error: 0 Sensor amplitude	6	The nominal-diameter-specific sensor amplitude is less than 10 mV.	Does the error only occur when the flowmeter sensor is full? "Energy absorbent" fluid in meter (e.g., high gas content, highly viscous liquids), so that the driver current is insufficient	Reduce gas content, change fluid
			Very strong mechanical or hydraulic disturbances in the pipeline	Decouple flowmeter sensor from disturbances
			Hazardous area design and remote mount design: Electrical resistance for driver cable is too high	Reduce cable length, lower resistance by connecting in parallel or using a lower-resistance cable.
Error: 1 AD Transmitter	4	The AD converter is overloaded and is not responding.	Sensor voltage is too large	Check sensor amplitudes, check if the setting for the sensor amplitude is correct
			The AD converter is defective	Exchange DSP board
Error: 2a Driver	7	Flowmeter sensor does not vibrate	Control circuit is interrupted, flowmeter sensor is incompatible with converter	For remote design: Check wiring between flowmeter sensor and converter
Error: 2b Driver current	8	The current limiter in the driver has responded because the driver current is insufficient	see error 0	see error 0
Error: 3 Flowrate >103.25 %	13	The value set in QmMax was exceeded by more that 5%	Flow range setting too small	Increase flow range (QmMax)
			Flow too large	Reduce flow rate
Error: 4 Ext. zero return	14	The flow rate is set to zero; the totalizers are halted	The external switching input is set to "High"	Set external switching input to "Low"
Error: 5b External FRAM	2	Loss of the external database	Database is corrupted	Turn unit off and on again, call up functional test for converter
			Ext. memory module missing	Ext. memory module must be installed
			Ext. memory module is empty	Ext. memory module must be loaded
Error: 6a Totalizer Mass -> V	19	The forward mass totalizer is damaged beyond repair.		Reprogram the totalizer
Error: 6b Totalizer Mass <- R	20	The reverse mass totalizer is damaged beyond repair.		Reprogram the totalizer
Error: 6c Totalizer Vol.-> V	21	The forward volume totalizer is damaged beyond repair.		Reprogram the totalizer
Error: 6d Totalizer Vol.<- R	22	The reverse volume totalizer is damaged beyond repair.		Reprogram the totalizer
Error: 6e Totalizer Net Mass -> V		The net mass totalizer is damaged beyond repair.		Reprogram the totalizer
Error: 6f Totalizer Net Mass <- R		The net mass totalizer is damaged beyond repair.		Reprogram the totalizer

Error message	Priority	Description	Possible Causes	Corrective action
Error: 7a T Pipe measurement	11	Error during temperature measurement. For the temperature compensation of the measurement variable Qm a density of 20°C is used, i.e. for a fluid temperature near 20 °C the measurements will be correct	Incorrect wiring (only for remote mount design)	Check wiring between flowmeter sensor and converter
			Pt 100 is defective	Check the resistance of PT100 on the flowmeter sensor
Error: 7b T Housing measurement	12	Error during temperature measurement. For the temperature compensation of the measurement variable Qm a density of 20°C is used, i.e. for a fluid temperature near 20 °C the measurements will be correct	Incorrect wiring (only for remote mount design)	Check wiring between flowmeter sensor and converter
			Pt 1000 is defective	Check the resistance of PT100 on the flowmeter sensor
Error: 8a Iout 1 to large	15	The current value is above the programmed range for current output 1.	Range setting is too small	Increase range setting
Error: 8b Iout 1 to small	16	The current value is below the programmed range for current output 1	Range setting is too small	Increase range setting
Error: 8c Iout 2 to large	17	The current value is above the programmed range for current output 2.	Range setting is too small	Increase range setting
Error: 8d Iout 2 to small	18	The current value is below the programmed range for current output 2	Range setting is too small	Increase range setting
Error: 9a Density measurement	9	The measured density of the fluid in the flowmeter sensor is outside of the specifications	This error usually occurs together with errors 1 and 9. See errors 1 and 9	See errors 1 and 9
Error: 11a Sensor A	23	The signal from Sensor A is missing	Sensor A is defective, or the amplitude control circuit is open	Measure resistance of Sensor A Remote mount design: Check wiring between flowmeter sensor and converter
Error: 11b Sensor B	24	The signal from Sensor B is missing	Sensor B is defective, or the amplitude control circuit is open	Measure resistance of Sensor B. Remote mount design: Check wiring between flowmeter sensor and converter
Error: 11d Sensor	5	The signal from at least two sensors is missing	At least two sensors are faulty, or the amplitude control circuit is open.	Measure resistance of the sensors. Remote mount design: Check wiring between flowmeter sensor and converter
Error: 12 Concentration (Percent)		Concentration in percent < 0 % or > 103.125 %.	Concentration in percent < 0 % or > 103.125 %.	Adjust the matrix data in the Concentration submenu
Errors Operating protection		Parameters cannot be changed	The operating protection switch is active	Deactivate the hardware protection switch.

8.4 Warnings

Warning	Priority	Description	Possible Causes	Corrective action
Warning: 1 **Simulation**	16	The Simulation is turned on	The Simulation is turned on in the submenu Self Check	Turn off Simulation
Warning: 2 totalizer reset	1	A totalizer was reset	-	-
Warning: 3 Min Alarm Qm	3	The value is below the MIN Alarm setting for Qm	The value is below the MIN Alarm setting for Qm	Reduce the MIN Alarm
Warning: 4 Min Alarm Density	5	The value is below the MIN Alarm setting for the density	The value is below the MIN Alarm setting for the density	Reduce the MIN Alarm
Warning: 5 Min Alarm Temp.	7	The value is below the MIN Alarm setting for the temperature	The value is below the MIN Alarm setting for the temperature	Reduce the MIN Alarm
Warning: 6 Min Alarm Conc.		The value is below the MIN Alarm setting for the concentration. The switching hysteresis is ± 0.1 of the set concentration unit.	The value is below the MIN Alarm setting for the concentration.	Reduce the MIN Alarm
Warning: 7 Max Alarm Qm	2	The value is above the MAX Alarm setting for Qm	The value is above the MAX Alarm setting for Qm	Increase the MAX Alarm
Warning: 8 Max Alarm Density	4	The value is above the MAX Alarm setting for the density	The value is above the MAX Alarm setting for the density	Increase the MAX Alarm
Warning: 9 Max Alarm Temp.	6	The value is above the MAX Alarm setting for the temperature	The value is above the MAX Alarm setting for the temperature	Increase the MAX Alarm
Warning: 10 Max Alarm Conc.		The value is above the MAX Alarm setting for the concentration. The switching hysteresis is ± 0.1 of the set concentration unit.	The value is above the MAX Alarm setting for the concentration.	Increase the MAX Alarm
Warning: 11 Ext. Data loaded	9	Is displayed for 1 minute after the supply power is turned on	Ext. data memory (FRAM) was replaced	-
Warning: 12 Update int. data	10	Is displayed for 1 minute after the supply power is turned on	The software was updated Ext. data memory (FRAM) was replaced	-
Warning: 13 Update ext. data	11	Is displayed for 1 minute after the supply power is turned on	The software was updated Ext. data memory (FRAM) was replaced	-

Warning	Priority	Description	Possible Causes	Corrective action
Warning: 14 Overflow -> F Mass	12	Totalizer overflow of the mass forward totalizer	Totalizer overflow of the mass forward totalizer	Reset totalizer Note: A larger unit increases the time until the next overflow.
Warning: 15 Overflow <- R Mass	13	Totalizer overflow of the mass return totalizer	Totalizer overflow of the mass return totalizer	
Warning: 16 Overflow -> F Volume	14	Totalizer overflow of the mass forward totalizer	Totalizer overflow of the mass forward totalizer	
Warning: 17 Overflow <- R Volume	14	Totalizer overflow of the volume return totalizer	Totalizer overflow of the volume return totalizer	
Warning: 18 Overflow -> F %M		Totalizer overflow of the net mass forward flow totalizer	Totalizer overflow of the net mass forward flow totalizer	
Warning: 19 Overflow <- R %M		Totalizer overflow of the net mass return flow totalizer	Totalizer overflow of the net mass return flow totalizer	
Warning: 20 Reverse Q	17	Flow rate is in the reverse direction	The operating mode of the device is set to forward but the medium is flowing through the flowmeter sensor in the reverse direction.	-

9 Maintenance / Repair

9.1 General remarks

WARNING – Electrical dangers!
When the housing is open, EMC protection is impaired and there is no longer any protection against accidental contact.
Switch off the power supply before opening the housing.

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.

Repair and maintenance activities may only be performed by authorized customer service personnel.
When replacing or repairing individual components, use original spare parts.

9.2 Cleaning

When cleaning the exterior of meters, make sure that the cleaning agent used does not corrode the housing surface and the seals.
To avoid static charge, a damp cloth must be used for cleaning.

9.3 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 power supply feed, the lightning protection, and the station ground.

Repairs to the flowmeter sensor

Should the flowmeter sensor need to be repaired, follow the instructions in the "Safety / Sending back devices" section.

9.4 Transmitter

9.4.1 Replacement

All parameter settings are stored in an external memory module. If the electronic system is replaced, the external data memory is changed in order to keep all the setting parameters.
Data specific for the flowmeter sensor and customer setting parameters are kept automatically.
When replacing the transmitter, make sure that the serial number on the external data memory matches the serial number on the flowmeter sensor.
If you replace the transmitter, please do not hesitate to contact our service team if you have any queries.
When changing a transmitter to a transmitter with a lower software level, please always contact our service team.

Position of the external data memory (FRAM)

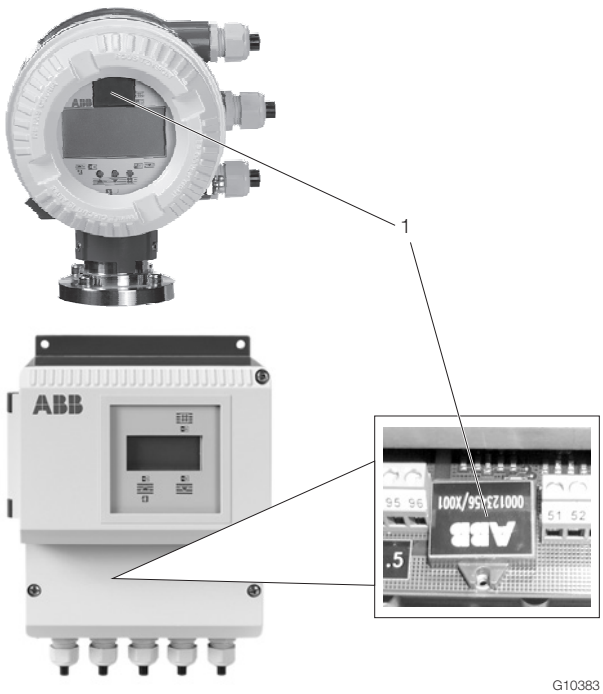


Fig. 32: Position of the FRAM module
1 FRAM (plug-in)

The location of the transmitter's external data memory (FRAM) is determined by its design (integral mount or remote mount) as shown.

WARNING – Electrical dangers!
When the housing is open, EMC protection is impaired and there is no longer any protection against accidental contact.
Switch off the power supply before opening the housing.

10 Flowmeter sensor specifications

10.1 Designs

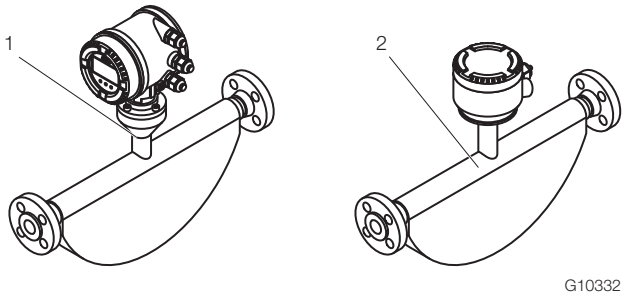


Fig. 33: FCB300 flowmeter sensor
1 Integral mount design |
2 Remote mount design (without transmitter)

10.2 Nominal diameter and measuring range

Nominal diameter	Q_{max} in kg/h (lb/h)
DN 15 (1/2“)	0 … 8.000 (0 … 17637)
DN 25 (1“)	0 … 35.000 (0 … 77162)
DN 50 (2“)	0 … 90.000 (0 … 198416)

10.2.1 Recommended flow range

Fluids:

— The recommended flow range is 5 … 100 % of Q_{max}.
— Flows < 1 % of Q_{max} should be avoided.

Gases:

— The flow velocity of gases in the meter tube should not exceed 0.3 Mach (approx. 100 m/s (328 ft/s))
— The maximum flow range of gases is determined by the operating density. Dimensioning guidelines are available at www.abb.com/flow.

10.3 Measuring accuracy

10.3.1 Reference conditions

Calibration fluid	Water — Temperature: 25 °C (77 °F) ±5 K — Pressure: 2 … 4 bar (29 … 58 psi)
Ambient temperature	25 °C (77 °F) +10 K / -5 K
Power supply	Line voltage according to name plate U_N ±1 %
Warm-up phase	30 minutes
Installation	— Installation according to chapter titled “Installation instructions” and “Mounting positions” — No visible gas phase — No external mechanical or hydraulic disturbances, particularly cavitation
Output calibration	Pulse output
Effect of the analog output on measuring accuracy	As pulse output ±0.1 % of measurement

10.3.2 Measured error

The measured error is calculated as follows for the flow:

Scenario 1:
If

$$\text{Flow} \geq \frac{\text{Zero stability}}{(\text{base accuracy} / 100)}$$

Then:

— Maximum measured error:
± base accuracy as % of measured value
— Reproducibility:
± 1/2 x base accuracy as % of measured value

Scenario 2:
If

$$\text{Flow} < \frac{\text{Zero stability}}{(\text{base accuracy} / 100)}$$

Then:

— Maximum measured error:
± (zero stability / measured value) x 100 % of measured value
— Reproducibility:
± 1/2 x (zero stability / measured value) x 100% of measured value

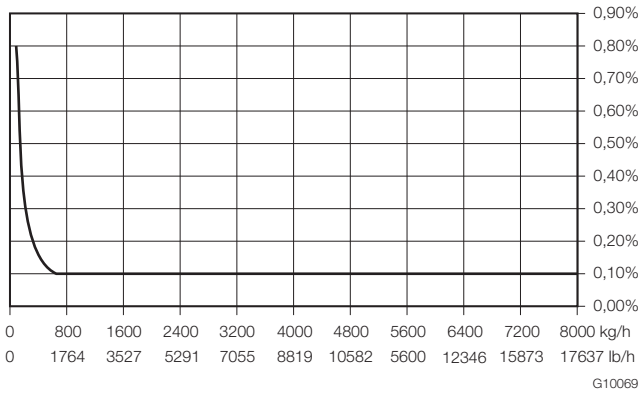


Fig. 34: Calculation of measured error FCB350 DN15 (example)

Measurement dynamic	Flow	Maximum measured error
100:1	80 kg/h (176.4 lb/h)	0.8 % o.r.
50:1	160 kg/h (352.7 lb/h)	0.4 % o.r.
10:1	800 kg/h (1763.7 lb/h)	0.1 % o.r.
2:1	4000 kg/h (8818.5 lb/h)	0.1 % o.r.
1:1	8000 kg/h (17637 lb/h)	0.1 % o.r.

Measured error and base accuracy for liquids

	FCB330	FCB350
Mass flow	± 0.4 % of rate ± 0.25 % of rate	± 0.15 % of rate ± 0.1 % of rate (option)
Volume flow	± 0.4 % of rate ± 0.25 % of rate	± 0.15 % of rate
Density	0.010 kg/l [1]	0.002 kg/l [1] 0.001 kg/l [2] 0.0005 kg/l (option) [3]
Reproducibility for density	0.002 kg/l	0.002 kg/l [1] 0.001 kg/l [2] 0.00025 kg/l (option) [3]
Temperature	0.5 K	0.5 K

1 For the density range from 0.5 … 1.8 kg/dm³
2 As 1 and for the medium temperature range from -10 … 50 °C (14 … 122 °F)
3 As 2 and following field adjustment under operating conditions

Measured error and base accuracy for gases

	FCB330	FCB350
Mass flow	± 1 % of rate	± 0.5 % of rate
Temperature	0.5 K	0.5 K

10.3.3 Zero stability

Nominal diameter	kg/h (lb/h)
DN 15 (1/2“)	0.64 (1.41)
DN 25 (1“)	2.16 (4.76)
DN 50 (2“)	7.20 (15.87)

10.3.4 Effect of the temperature of the medium being measured

For the flow, less than ± 0.0015 % of Q_{max} / 1 K.
For the density, less than 0.0001 kg/dm³ / 1 K.

10.3.5 Effect of the operating pressure

Nominal diameter	Flow [% of measurement / bar]	Density [kg/dm³ / bar]
DN 15 (1/2“)	No effect	No effect
DN 25 (1“)	No effect	No effect
DN 50 (2“)	0.01 %	0.0004

10.4 Technical data

10.4.1 Pressure loss

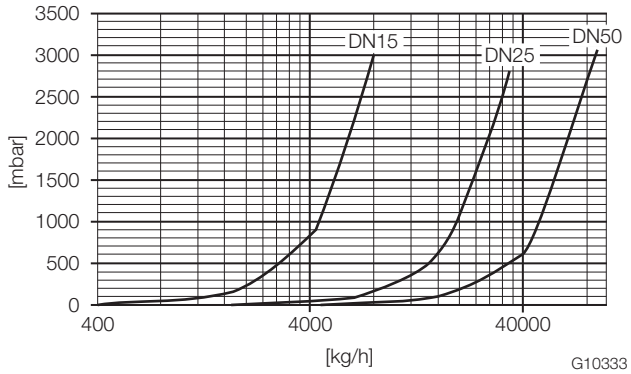


Fig. 35: Pressure loss curve (measured with water, viscosity: 1 mPas)

10.4.2 Viscosity range

Maximum dynamic viscosity:
≤ 1 Pas (1000 mPas = 1000 cP)

If you are working with higher viscosities, contact ABB.

10.4.3 Temperature limits °C (°F)

IMPORTANT (NOTE)
When using the device in hazardous areas, note the additional temperature data in the chapter titled "Technical data relevant to hazardous areas"!

Temperature range of the medium being measured
FCB350: -50 … 160 °C (-58 … 320 °F)
FCB350: -50 … 200 °C (-58 … 392 °F)

Ambient temperature range
Standard: -20 … 60 °C (-4 … 140 °F)
Optional: -40 … 60 °C (-40 … 140 °F)

10.4.4 Process connections

- Flange design according to DIN / ASME
- Tri-Clamp according to DIN 32676 (ISO 2852)
- DN 15 … 50 (1/2 … 2“): Series 3
- BPE Tri-Clamp
- DN 15 … 50 (1/2 … 2“)

10.4.5 Pressure rating

PN 16, PN 40, PN 100
CL 150, CL 300, CL 600

The maximum permissible operating pressure is determined by the respective process connection, the temperature of the medium to be measured, the screws, and the gasket material.

10.4.6 Enclosure as protective device (optional)

Maximum 40 bar (580 psi)

10.4.7 Pressure Equipment Directive

Conformity assessment according to Category III, fluid group 1, gas
Check the corrosion resistance of the meter tube materials against the measuring medium.

10.4.8 Notes about EHEDG conformity

Bacteria and chemical substances can contaminate or pollute pipeline systems and the materials they are made of.
The appropriate installation conditions must be observed in order to achieve an installation that complies with EHEDG requirements.
In order to achieve compliance with EHEDG requirements, the combination of process connection and gaskets selected by the operator must consist solely of EHEDG-compliant parts.
Note the information in the latest version of the following document:
EHEDG Position Paper: "Hygienic process connections to use with hygienic components and equipment".

10.4.9 Materials for transmitters

Enclosure	
Varnished alloy casting	
Enclosure color	
— Mid-section:	RAL 7012
— Cover:	RAL 9002
Varnish layer thickness:	80 … 120 µm

10.4.10 Materials for flowmeter sensors

Wetted parts
Stainless steel — 1.4404 (AISI 316L), 1.4571 (AISI 316Ti) — 1.4435 (AISI 316L) (certified to EHEDG with flowmeter sensor material 1.4435 (AISI 316L))
Hastelloy C4 (2.4610) in preparation
Optional: Manufacture in accordance with NACE MR0175 and MR0103 (ISO 15156)

Enclosure
Stainless steel 1.4404 (AISI 316L), 1.4301 (AISI 304), 1.4308 (ASTM CF8)

10.4.11 Material load for process connections

Design	Nominal diameter	PS_{max}	TS_{max}	TS_{min}
Threaded pipe connection (DIN 11851)	DN 15 … 40 (1/2 … 1 1/2“)	40 bar (580 psi)	140 °C (284 °F)	-40 °C (-40 °F)
	DN 50 … 100 (2 … 4“)	25 bar (363 psi)	140 °C (284 °F)	-40 °C (-40 °F)
Tri-Clamp (DIN 32676)	DN 15 … 50 (1/2 … 2“)	16 bar (232 psi)	120 °C (248 °F)	-40 °C (-40 °F)
	DN 65 … 100 (2 1/2 … 4“)	10 bar (145 psi)	120 °C (248 °F)	-40 °C (-40 °F)

10.4.12 Material load curves for flange devices

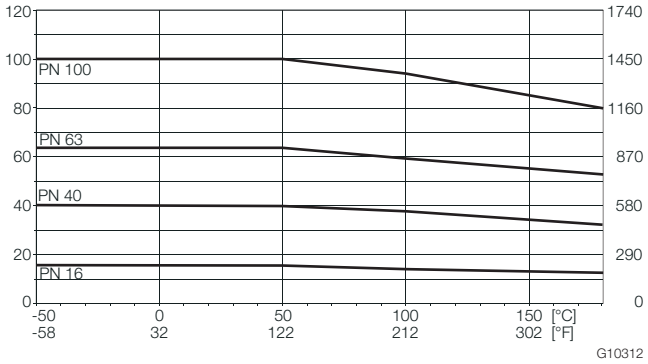


Fig. 36: Stainless steel DIN flange 1.4571 / 1.4404 (316Ti / 316L) up to DN 150 (6“)

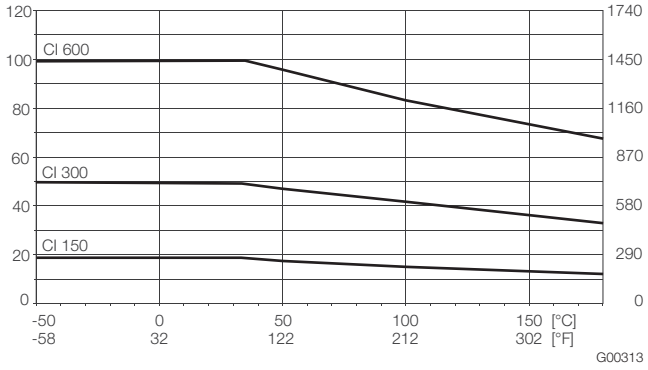


Fig. 37: Stainless steel ASME flange 1.4571 / 1.4404 (316Ti / 316L) up to DN 150 (6“)

11 Transmitter specifications

11.1 General remarks

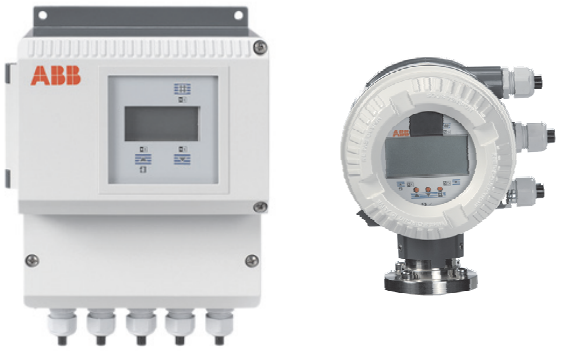


Fig. 38: FCB300 transmitter in field enclosure

11.2 Technical data

11.2.1 Measuring range

The measuring range can be set at will between 0.01 … 1 Qmax.

11.2.2 Degree of protection

IP 65 / IP 67, NEMA 4X

11.2.3 Electrical connections

Cable gland M20 x 1.5 or 1/2" NPT
The maximum signal cable length for the remote mount design is 50 m (164 ft) (longer lengths on request).

11.2.4 Power supply

Supply voltage	100 … 230 V AC, 47 … 63 Hz (tolerance -15 % / +10 %)
	20.4 … 26.4 V AC, 47 … 63 Hz
	20.4 … 31.2 V DC (ripple: ≤ 5 %)
Power consumption	S ≤ 25 VA

11.2.5 Response time

As step function 0 … 99 % (corr. to 5 τ) ≥ 1 s

11.2.6 Ambient temperature

Standard: -20 … 60 °C (-4 … 140 °F)
Optional: -40 … 60 °C (-40 … 140 °F)

At operation below -20 °C (-4 °F), the LCD can no longer be read and the electronic unit should be operated with as few vibrations as possible.
Full functionality is assured at temperatures above -20 °C (-4 °F).

11.2.7 Housing design

Enclosure	
Varnished alloy casting	
Enclosure color	
— Mid-section:	RAL 7012
— Cover:	RAL 9002
Varnish layer thickness:	80 … 120 µm

11.2.8 Forward/reverse flow metering

The flow direction is indicated by the arrows on the transmitter LCD and via the digital switching output (if configured).

11.2.9 LCD display

LCD, 2 lines, backlit
Both lines of the LCD are freely configurable.
The following values can be displayed:

- Mass flow
- Volume flow
- Density or temperature
- Flow count, 7-digit with overflow counter and specification of physical unit for mass or volume.

On integral mount design devices, the transmitter enclosure can be rotated through approx. 180° in any direction. The LCD can be rotated to four positions to ensure optimum readability.

11.2.10 Operation

Three buttons on the transmitter are used to operated the device and enter parameters. Alternatively, if the enclosure cover on the transmitter is closed, operators can use a magnetic pen.

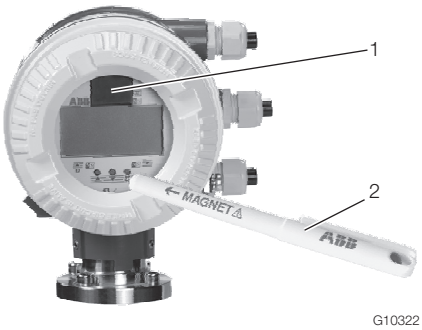


Fig. 39: Operation with magnetic pen
1 FRAM (plug-in) | 2 Magnetic pen

11.2.11 Data backup

Data is backed up to an FRAM integrated in the transmitter. Data is saved for a period of 10 years without power supply. Hardware and software are identified according to NAMUR recommendation NE53.

IMPORTANT (NOTE)

The device meets the requirements of the EMC directive 2004/108/EC (EN 61326) and the low-voltage directive 2006/95/EC (EN 61010-1).

11.3 Electrical data

11.3.1 Current outputs

Current output 1, active	
Output signal	Active, 0 … 20 mA or 4 … 20 mA switchable
Load	0 Ω ≤ R_B ≤560 Ω
Measurement uncertainty	< 0.1 % of measured value
Terminals	31 / 32
Measured values	Mass flow, volume flow, density, and temperature (freely configurable via software)

Current output 1, passive	
Output signal	4 ... 20 mA passive
Load	0 Ω ≤ R_B ≤600 Ω
Source voltage	12 V ≤ U_q ≤ 30 V
Measurement uncertainty	< 0.1 % of measured value
Terminals	31 / 32
Measured values	Mass flow, volume flow, density, and temperature (freely configurable via software)

Current output 2, passive	
Output signal	4 ... 20 mA passive
Load	0 Ω ≤ R_B ≤600 Ω
Source voltage	12 V ≤ U_q ≤ 30 V
Measurement uncertainty	< 0.1 % of measured value
Terminals	33 / 34
Measured values	Mass flow, volume flow, density, and temperature (freely configurable via software)

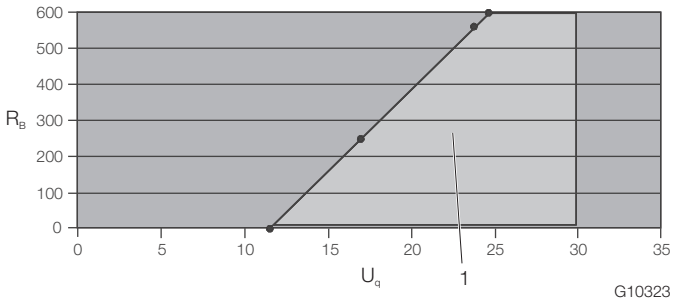


Fig. 40: Permissible source voltage as a function of load resistance, where I_{max} = 22 mA
1 Permissible range

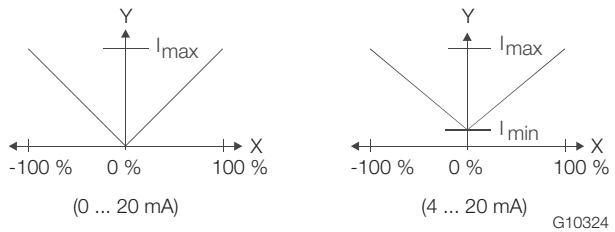


Fig. 41:

IMPORTANT (NOTE)

Failure information according to NAMUR recommendation NE43.

11.3.2 Pulse output

Scaled pulse output (maximum 5 kHz) with configurable pulse factor between 0.001 and 1000 pulses per unit. The pulse width is configurable from 0.1 … 2000 ms. The output is electrically isolated from the current outputs.

	Passive	Active
Operating voltage	16 V ≤ U_{CEH} ≤ 30 V DC 0 V ≤ U_{CEL} ≤ 2 V	16 V ≤ U ≤ 30 V DC Load ≥ 150 Ω
Operating current	0 mA ≤ I_{CEH} ≤ 0.2 mA 2 mA ≤ I_{CEL} ≤ 220 mA	-
fmax	5 kHz	5 kHz
Pulse width	0.1 … 2000 ms	0.1 … 2000 ms
Terminals	51 / 52	51 / 52

IMPORTANT (NOTE)

If you are using a mechanical totalizer, we recommend setting a pulse width of ≥ 30 ms and a maximum frequency of fmax ≤ 3 kHz.

11.3.3 Digital switching outputs

The switching function can be selected via the software.

Switching function	— System monitoring (normally closed contact or normally open contact) — Forward / reverse (closed for forward) — Min. /max. alarm (normally closed contact or normally open contact)
Output "closed"	0 V ≤ U_{CEL} ≤ 2 V 2 mA ≤ I_{CEL} ≤ 220 mA
Output "open"	16 V ≤ U_{CEH} ≤ 30 V DC 0 mA ≤ I_{CEH} ≤ 0.2 mA
Terminals	41 / 42

11.3.4 Digital switching inputs

The switching function can be selected via the software.

Switching function	— External output zero return — External totalizer reset
Input "On"	16 V ≤ U_{KL} ≤ 30 V
Input "Off"	0 V ≤ U_{KL} ≤ 2 V
Internal resistance	Ri = 2 kΩ
Terminals	81 / 82

All inputs and outputs are electrically isolated from one other.

12 Technical data relevant to hazardous areas acc. to ATEX / IECEx

IMPORTANT (NOTE)
The data and specifications listed in this chapter are preliminary.

12.1 Safety-related data ATEX / IECEx

12.1.1 Overview of the different output options

Versions	ATEX / IECEx Zone 2	ATEX / IECEx Zone 1
Version I Output option A / B in the order number	— Current output 1: Active — Current output 2: Passive — Pulse output: Active / passive, switchable — Switching input and output: Passive	— Current output 1: Active — Current output 2: Passive — Pulse output: Active / passive, switchable — Switching input and output: Passive
Version II Output option D in the order number		— Current output 1: Passive — Current output 2: Passive — Pulse output: Active / passive, switchable — Switching input and output: Passive

12.1.2 Version I: Active / passive current outputs

Types: FCB330-A2, FCB350-A2, FCT330-A2, FCT350-A2				
	Type of protection "nA" (Zone 2)		**General operating values**	
	U (V)	I (mA)	U_b (V)	I_b (mA)
Current output 1, active Terminals 31 / 32	30	30	30	30
Current output 2, passive Terminals 33 / 34	30	30	30	30
Pulse output, active or passive Terminals 51 / 52	30	220	30	220
Switching output, passive Terminals 41 / 42	30	220	30	220
Switching input, passive Terminals 81 / 82	30	10	30	10

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

Types: FCB330-A1, FCB330-A1, FCT330-A1, FCT350-A1

	Type of protection "nA" (Zone 2)		General operating values		Type of protection "e" (Zone 1)		Type of protection "ib" (Zone 1)					
Current output 1, active	U_i (V)	I_i (mA)	U_b (V)	I_b (mA)	U (V)	I (mA)	U_o (V)	I_o (mA)	P_o (mW)	C_o (nF)	C_o pa (nF)	L_o (mH)
Terminals 31 / 32 Terminal 32 is connected to "PA"	30	30	30	30	60	35	20	100	500	217	0	3,8
							U_i (V)	I_i (mA)	P_i (mW)	C_i (nF)	C_i pa (nF)	L_i (mH)
							60	100	500	2,4	2,4	0,17
Current output 2, passive Terminals 33 / 34 Terminal 34 is connected to "PA"	30	30	30	30	60	35	30	100	760	2,4	2,4	0,17
Pulse output, passive Terminals 51 / 52	30	220	30	220	60	35	15	30	115	2,4	2,4	0,17
Switching output, passive Terminals 41 / 42	30	10	30	10	60	35	30	250	1100	2,4	2,4	0,17
Switching input, passive Terminals 81 / 82	30	220	30	220	60	35	15	30	115	2,4	2,4	0,17

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

12.1.3 Version II: Passive / passive current outputs

Types: FCB330-A1, FCB330-A1, FCT330-A1, FCT350-A1

	Type of protection "nA" (Zone 2)		General operating values		Type of protection "e" (Zone 1)		Type of protection "ib" (Zone 1)					
	U_i (V)	I_i (mA)	U_b (V)	I_b (mA)	U (V)	I (mA)	U_i (V)	I_i (mA)	P_i (mW)	C_i (nF)	C_i pa (nF)	L_i (mH)
Current output 1, passive Terminals 31 / 32	30	30	30	30	60	35	60	68	1000	0,47	0,47	0,17
Current output 2, passive Terminals 33 / 34	30	30	30	30	60	35	60	68	1000	0,47	0,47	0,17
Pulse output, passive Terminals 51 / 52	30	220	30	220	60	35	60	425	6370	0,47	0,47	0,17
Switching output, passive Terminals 41 / 42	30	10	30	10	60	35	60	85	1270	0,47	0,47	0,17
Switching input, passive Terminals 81 / 82	30	220	30	220	60	35	60	425	6370	0,47	0,47	0,17

All inputs and outputs are electrically isolated from one other and from the auxiliary power.

12.1.4 Special connection conditions

The output circuits are designed so that they can be connected to both intrinsically-safe and non-intrinsically-safe circuits.
It is not permitted to combine intrinsically safe and non-intrinsically safe circuits.
On intrinsically-safe circuits, equipotential bonding must be in place along the entire length of the cable used for the current outputs.
The rated voltage of the non-intrinsically safe circuits is U_M = 60 V.
The switching output and the pulse output (terminals 41 / 42 and 51 / 52) can be wired internally as a NAMUR contact for the purpose of connecting a NAMUR amplifier.

The cable glands are supplied in black by default. If the signal outputs are wired to intrinsically-safe circuits, we recommend that you use the light blue caps supplied for the appropriate cable entries.

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

12.2 Hazardous area approval ATEX / IECEx

12.2.1 EC type examination certificate according to ATEX and IECEx

Approval pending.

12.2.2 Flowmeter sensor model FCB300

Model FCB330-A1Y, FCB350-A1Y Zone 1			
Ambient temperature	≤40 °C (≤104 °F)	≤50 °C (≤122 °F)	≤60 °C (≤140 °F)
Temperature class			
T1	200 °C (392 °F)	200 °C (392 °F)	200 °C (392 °F)
T2	200 °C (392 °F)	200 °C (392 °F)	200 °C (392 °F)
T3	185 °C (365 °F)	180 °C (356 °F)	180 °C (356 °F)
T4	125 °C (257 °F)	120 °C (248 °F)	120 °C (248 °F)
T5	85 °C (185 °F)	85 °C (185 °F)	75 °C (167 °F)
T6	65 °C (149 °F)	65 °C (149 °F)	60 °C (140 °F)

Model FCB330-A2Y, FCB250-A2Y Zone 2			
Ambient temperature	≤40 °C (≤104 °F)	≤50 °C (≤122 °F)	≤60 °C (≤140 °F)
Temperature class			
T1	200 °C (392 °F)	200 °C (392 °F)	180 °C (356 °F)
T2	200 °C (392 °F)	200 °C (392 °F)	180 °C (356 °F)
T3	180 °C (356 °F)	180 °C (356 °F)	180 °C (356 °F)
T4	115 °C (239 °F)	115 °C (239 °F)	115 °C (239 °F)
T5	80 °C(176 °F)	80 °C(176 °F)	75 °C (167 °F)
T6	60 °C (140 °F)	60 °C (140 °F)	60 °C (140 °F)

Ambient and process conditions:

T_{amb} -20 ... 60 °C (-4 ... 140 °F)
$T_{amb, optional}$ -40 ... 60 °C (-40 ... 104 °F) (only for integral mount design devices)
T_{medium} -50 ... 200 °C (-58 ... 392 °F)
Protection class IP 65, IP 67, and NEMA 4X / Type 4X

Specific coding according to ATEX and IECEx applies depending on the design of the flowmeter sensor (integral or remote mount design).

Design FCB330-A2A..., FCB350-A2A...		
Zone 2	**Designation**	**Comment**
ATEX	II 3 G Ex nA II T6 ... T2 II 2 D Ex tD A21 IP6X T115 °C ... T_{medium}	-
IECEx	Ex nA II T6 ... T2 Ex tD A21 IP6X T115 °C ... T_{medium}	-

Design FCB330-A2Y, FCB350-A2Y		
Zone 2	**Designation**	**Comment**
ATEX	II 3 G Ex nA nR II T6 ... T2 II 3 G Ex nA nR [nL] IIC T6 ... T2 II 2 D Ex tD A21 IP6X T115°C ... T_{medium}	No fieldbus, no M12 plug FNICO fieldbus, no M12 plug FNICO fieldbus, no M12 plug
IECEx	Ex nA nR II T6 ... T2 Ex nA nR [nL] IIC T6 ... T2 Ex tD A21 IP6X T115 °C ... T_{medium}	No fieldbus, no M12 plug FNICO fieldbus, no M12 plug No M12 plug

Design FCB330-A1A, FCB350-A1A		
Zone 1	**Designation**	**Comment**
ATEX	II 2 G Ex e mb [ia] IIC T6 ... T2 II 2 D Ex tD A21 IP6X T115 °C ... T_{medium}	≤ DN 40 (1 1/2“)
IECEx	Ex e mb [ia] IIC T6 ... T2 Ex tD A21 IP6X T115 °C ... T_{medium}	-

Design FCB330-A1Y, FCB350-A1Y		
Zone 1	**Designation**	**Comment**
ATEX		
Version II	II 2 G Ex d e [ia] [ib] IIC T6 ... T2	≤ DN 40 (1 1/2“) 2 passive analog outputs, outputs "ia" / "e", depending on user wiring, or FISCO fieldbus
Version I	II 2 G Ex d e [ib] IIC T6 ... T2	≤ DN 40 (1 1/2“) Active / passive analog outputs, outputs "ib" / "e", depending on user wiring
Version II	II 1/2 G Ex d e [ia] [ib] IIC T6 ... T2	≥ DN 50 (2“) 2 passive analog outputs, outputs "ia" / "e", depending on user wiring, or FISCO fieldbus
Version I	II 1/2 G Ex d e [ib] IIC T6 ... T2	≥ DN 50 (2“) Active / passive analog outputs, outputs "ib" / "e", depending on user wiring
Version I / II	II 2 D Ex tD A21 IP6X T115 °C ... T_{medium}	Outputs "e"
Version II	II 2 D Ex tD [iaD] A21 IP6X T115 °C ... T_{medium}	2 passive analog outputs, outputs "ia" / "e", depending on user wiring, or FISCO fieldbus
Version I	II 2 D Ex tD [ibD] A21 IP6X T115 °C ... T_{medium}	Active / passive analog outputs, outputs "ib" / "e", depending on user wiring
IECEx		
Version II	Ex d e [ia] [ib] IIC T6 ... T2	2 passive analog outputs, outputs "ia" / "e", depending on user wiring, or FISCO fieldbus
Version I	Ex d e [ib] IIC T6 ... T2	Active / passive analog outputs, outputs "ib" / "e", depending on user wiring
Version I / II	Ex tD A21 IP6X T115 °C ... T_{medium}	Outputs "e"
Version II	Ex tD [iaD] A21 IP6X T115 °C ... T_{medium}	2 passive analog outputs, outputs "ia" / "e", depending on user wiring, or FISCO fieldbus
Version I	Ex tD [ibD] A21 IP6X T115 °C ... T_{medium}	Active / passive analog outputs, outputs "ib" / "e", depending on user wiring

12.2.3 Transmitter model FCT300 in remote mount design

Ambient and process conditions:

T_{amb}	-20 ... 60 °C (-4 ... 140 °F)
$T_{amb, optional}$	-40 ... 60 °C (-40 ... 104 °F) (only for integral mount design devices)
T_{medium}	-50 ... 200 °C (-58 ... 392 °F)
Protection class	IP 65, IP 67, and NEMA 4X / Type 4X

Specific coding according to ATEX and IECEx applies depending on the design of the flowmeter sensor (integral or remote mount design).

Design FCT330-A2, FCT350-A2		
Zone 2	**Designation**	**Comment**
ATEX	II 3 G Ex nR II T6	No fieldbus, no M12 plug
	II 3 G Ex nR [nL] IIC T6	FNICO fieldbus, no M12 plug
	II 2 D Ex tD A21 IP6X T115 °C	No M12 plug
	FNICO field device	FNICO fieldbus
IECEx	Ex nR II T6	No fieldbus, no M12 plug
	Ex nR [nL] IIC T6	FNICO fieldbus, no M12 plug
	Ex tD A21 IP6X T115 °C	No M12 plug
	FNICO field device	FNICO fieldbus

Design FCT330-A1, FCT350-A1		
Zone 1	**Designation**	**Comment**
ATEX		
Version II	II 2 G Ex d e [ia] [ib] IIC T6	2 passive analog outputs, outputs "ia" / "e", depending on user wiring, or FISCO fieldbus
Version I	II 2 G Ex d e [ib] IIC T6	Active / passive analog outputs, outputs "ib" / "e", depending on user wiring
Version I / II	II 2 D Ex tD A21 IP6X T115 °C	Outputs "e"
Version II	II 2 D Ex tD [iaD] A21 IP6X T115 °C	2 passive analog outputs, outputs "ia" / "e", depending on user wiring, or FISCO fieldbus
Version I	II 2 D Ex tD [ibD] A21 IP6X T115 °C	Active / passive analog outputs, outputs "ib" / "e", depending on user wiring
IECEx		
Version II	Ex d e [ia] [ib] IIC T6	2 passive analog outputs, outputs "ia" / "e", depending on user wiring, or FISCO fieldbus
Version I	Ex d e [ib] IIC T6	Active / passive analog outputs, outputs "ib" / "e", depending on user wiring
Version I / II	Ex tD A21 IP6X T115 °C	Outputs "e"
Version II	Ex tD [iaD] A21 IP6X T115 °C	2 passive analog outputs, outputs "ia" / "e", depending on user wiring, or FISCO fieldbus
Version I	Ex tD [ibD] A21 IP6X T115 °C	Active / passive analog outputs, outputs "ib" / "e", depending on user wiring

13 Technical data relevant to hazardous areas acc. to cFMus

IMPORTANT (NOTE)
The data and specifications listed in this chapter are preliminary.

13.1 General information

Type of protection	Designation	Comment
Explosion-proof	XP-IS/I, II, III/1/BCD/T* TA=*; type NEMA 4x	-
Dust-ignition-proof	DIP/II, III/1 EFG/T* TA=*; type NEMA 4x	-
Intrinsically safe	IS/I, II, III/I/BCDEFG/T* TA = *; type NEMA 4x	-
Non-incendive	NI/I, II, III/2/ABCDFG/T* TA = *; type NEMA 4x	-

(T* = see FM temperature classes)

In the case of the remote mount design, the signal cable between the flowmeter sensor and the transmitter must measure at least 5 m (16.4 ft) in length.

Ambient and process conditions:

T_{amb} -20 ... 60 °C (-4 ... 140 °F)
$T_{amb, optional}$ -40 ... 60 °C (-40 ... 104 °F) (only for integral mount design devices)
T_{medium} -50 ... 200 °C (-58 ... 392 °F)
Protection class IP 65, IP 67, and NEMA 4X/Type 4X

Specific FM coding applies depending on the design of the flowmeter sensor (integral or remote mount design).

13.2 Temperature data

Model FCB330-F1, FCB350-F1 in Class I Div. 1			
Ambient temperature	≤40 °C (≤104 °F)	≤50 °C (≤122 °F)	≤60 °C (≤140 °F)
Temperature class			
T1	200 °C (392 °F)	200 °C (392 °F)	200 °C (392 °F)
T2	200 °C (392 °F)	200 °C (392 °F)	200 °C (392 °F)
T3	185 °C (365 °F)	180 °C (356 °F)	180 °C (356 °F)
T4	125 °C (257 °F)	120 °C (248 °F)	120 °C (248 °F)
T5	85 °C (185 °F)	85 °C (185 °F)	75 °C (167 °F)
T6	65 °C (149 °F)	65 °C (149 °F)	60 °C (140 °F)

Model FCB330-F2, FCB350-F2 in Class I Div. 2			
Ambient temperature	≤40 °C (≤104 °F)	≤50 °C (≤122 °F)	≤60 °C (≤140 °F)
Temperature class			
T1	200 °C (392 °F)	200 °C (392 °F)	180 °C (356 °F)
T2	200 °C (392 °F)	200 °C (392 °F)	180 °C (356 °F)
T3	180 °C (356 °F)	180 °C (356 °F)	180 °C (356 °F)
T4	115 °C (239 °F)	115 °C (239 °F)	115 °C (239 °F)
T5	80 °C (176 °F)	80 °C (176 °F)	75 °C (167 °F)
T6	60 °C (140 °F)	60 °C (140 °F)	60 °C (140 °F)

13.3 Overview of the different output options

Versions	Class I Div. 2	Class I Div. 1
Version I Output option A / B in the order number	— Current output 1: Active — Current output 2: Passive — Pulse output: Active / passive, switchable — Switching input and output: Passive	— Current output 1: Active — Current output 2: Passive — Pulse output: Active / passive, switchable — Switching input and output: Passive
Version II Output option D in the order number		— Current output 1: Passive — Current output 2: Passive — Pulse output: Active / passive, switchable — Switching input and output: Passive

13.4 Electrical data for Div. 1

13.4.1 Version I: Active / passive current outputs

Types: FCB330-F1, FCB350-F1, FCT330-F1, FCT350-F1: HART active						
	Type of protection IS					
	$Vmax_o$ (V)	$Imax_o$ (mA)	P_o (mW)	C_o (nF)	$C_{o\ PA}$ (nF)	L_0 (mH)
Current output 1, active	20	100	500	217	0	3,8
Terminals 31 / 32	V_{Max} (V)	I_{Max} (mA)	P_i (mW)	C_i (nF)	$C_{i\ PA}$ (nF)	L_i (mH)
	60	100	500	2,4	2,4	0,17
Current output 2, passive Terminals 33 / 34	30	100	760	2,4	2,4	0,17
Pulse output, active or passive Terminals 51 / 52	15	30	115	2,4	2,4	0,17
Switching output, passive Terminals 41 / 42	15	30	115	2,4	2,4	0,17
Switching input, passive Terminals 81 / 82	30	250	1100	2,4	2,4	0,17

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

13.4.2 Version II: Passive / passive current outputs

Types: FCB330-F1, FCB350-F1, FCT330-F1, FCT350-F1: HART passive						
	Type of protection IS					
	Umax (V)	Imax (mA)	P_i (mW)	C_i (nF)	$C_{i\ PA}$ (nF)	L_i (mH)
Current output 1, passive Terminals 31 / 32	60	300	2000	0,47	0,47	0,17
Current output 2, passive Terminals 33 / 34	60	300	2000	0,47	0,47	0,17
Pulse output, active or passive Terminals 51 / 52	60	300	2000	0,47	0,47	0,17
Switching output, passive Terminals 41 / 42	60	300	2000	0,47	0,47	0,17
Switching input, passive Terminals 81 / 82	60	300	2000	0,47	0,47	0,17

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

13.4.3 Special connection conditions

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

Provided that rated voltage UM = 60 V is not exceeded if connections are established to non-intrinsically-safe external circuits, intrinsic safety is retained.

IMPORTANT (NOTE)
The transmitter and flowmeter sensor enclosures must be connected to equipotential bonding PA. The operator must ensure that when connecting the protective conductor PE no potential differences can occur between the protective conductor PE and the equipotential bonding PA.

13.5 Electrical data for Div. 2

13.5.1 Version II: Active / passive current outputs

Types: FCB330-F2, FCB350-F2, FCT330-F2, FCT350-F2: HART		
	Type of protection IS	
	$Vmax_o$ (V)	$Imax_o$ (mA)
Current output 1 Terminals 31 / 32	30	30
Current output 2 Terminals 33 / 34	30	30
Pulse output Terminals 51 / 52	30	65
Switching output Terminals 41 / 42	30	65
Switching input Terminals 81 / 82	30	10

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

13.5.2 Special connection conditions

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

Provided that rated voltage UM = 60 V is not exceeded if connections are established to non-intrinsically-safe external circuits, intrinsic safety is retained.

IMPORTANT (NOTE)
The transmitter and flowmeter sensor enclosures must be connected to equipotential bonding PA. The operator must ensure that when connecting the protective conductor PE no potential differences can occur between the protective conductor PE and the equipotential bonding PA.

14 Spare parts list

IMPORTANT (NOTE)
Spare parts can be ordered from ABB Service:
Please contact Customer Center Service acc. to page 2 for nearest service location.

14.1 Transmitter in field-mount housing

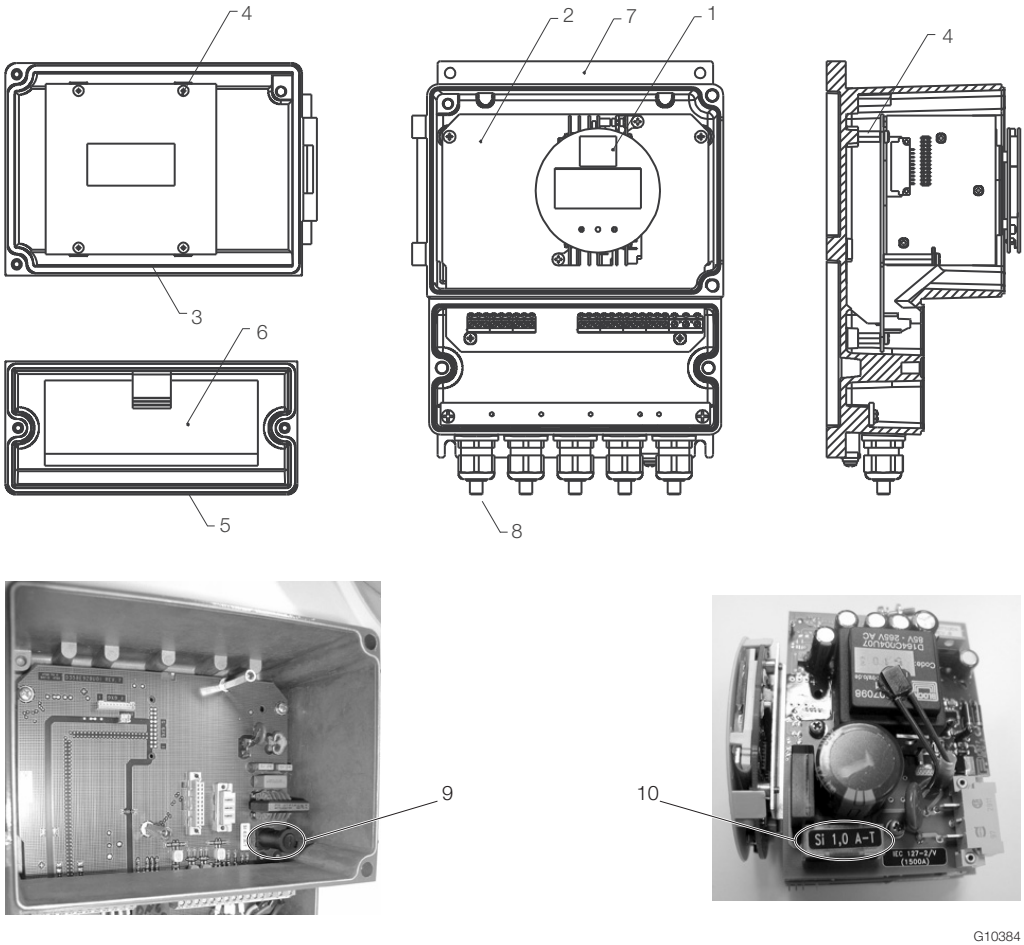


Fig. 42: Spare parts for field-mount housing

Number	Name of part	Order number
1	Transmitter module or backplane (please contact ABB Service)	-
2	Contact board (standard)	D685A1020U10
3	Cover for field-mount housing, large	D641A030U01
4	Fillister head screw cross recessed, M3 x 5 mm, 7985 SS	D085D020AU20
5	Cover for field-mount housing, small	D641A029U01
6	Connection diagram	D338D314U01
7	Lower section of field-mount housing	D641A031U01
8	Cable gland M20 x 1.5	D150A008U15
9	Fuse insert for contact board in field-mount housing, 4 A	D151B002U07
10	Fuse insert for transmitter module, 24 V, 2 A	D151B002U08
	Fuse insert for transmitter module, 100 … 230 V, 1 A	D151B002U06
-	Magnet stick	D614L537U01

15 Appendix

15.1 Approvals and certifications

The version of the device as provided by us meets the requirements of the following EU directives:

- EMC Directive 2004/108/EC
- Low Voltage Directive 2006/95/EC

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

EG-Konformitätserklärung
EC Declaration of Conformity

CE

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: *Manufacturer:*	ABB Automation Products GmbH, Dransfelder Straße 2, 37079 Göttingen - Germany
Gerät: *Device:*	CoriolisMaster
Modelle.: *Models:*	FCB330_ ; FCB350_
Richtlinie: *Directive:*	2004/108/EG * (EMV) *2004/108/EC * (EMC)*
Europäische Norm: *European Standard:*	EN 61326-1, 10/2006 * EN 61326-2-3, 05/2007 *EN 61326-1, 10/2006 * EN 61326-2-3, 05/2007*
Richtlinie: *Directive:*	2006/95/EG * (Niederspannungsrichtlinie) *2006/95/EC * (Low voltage directive)*
Europäische Norm: *European Standard:*	EN 61010-1, 08/2002 * *EN 61010-1, 08/2002 **

* einschließlich Nachträge / *including alterations*

Göttingen, 06. February 2012

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

i.V. Klaus Schäfer
(QM Manager)

3KXF002000G0021
Rev.1, 21242

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Geschäftsführung:
Tilt Schneider
Daniel Huber

Bankverbindung:
Commerzbank AG Frankfurt
Konto: 589 635 200
BLZ: 500 400 00

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:

Typ:	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	☐	Explosiv	☐	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

Notes

Notes

Contact us

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