Operating Instruction OI/FAM540-EN Rev. D

VA Master FAM540
Metal Cone Variable Area Flowmeter

Measurement made easy

Power and productivity
for a better world™

Short product description

Metal Cone Variable Area Flowmeter for measuring the flow rate of the operating volume or mass flow units (at constant pressure / temperature), if a physical mass flow unit is selected.

Device firmware: Version B.20 or higher

Further information

Additional documentation on VA Master FAM540 is available to download free of charge at www.abb.com/flow.
Alternatively simply scan this code:

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Contents

1 Safety

1.1 General information and instructions

These instructions are an important part of the product and must be retained for future reference.
Installation, commissioning, and maintenance of the product may only be performed by trained specialist personnel who have been authorized by the plant operator accordingly. The specialist personnel must have read and understood the manual and must comply with its instructions.
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 nor an amendment to any previous or existing agreement, promise or legal relationship.
Modifications and repairs to the product may only be performed if expressly permitted by these instructions.
Information and symbols on the product must be observed. These may not be removed and must be fully legible at all times.
The operating company must strictly observe the applicable national regulations relating to the installation, function testing, repair and maintenance of electrical products.

1.2 Warnings

The warnings in these instructions are structured as follows:

⚠ DANGER

The signal word "DANGER" indicates an imminent danger. Failure to observe this information will result in death or severe injury.

⚠ WARNING

The signal word "WARNING" indicates an imminent danger. Failure to observe this information may result in death or severe injury.

⚠ CAUTION

The signal word "CAUTION" indicates an imminent danger. Failure to observe this information may result in minor or moderate injury.

i NOTE

The signal word "NOTE" indicates useful or important information about the product.
The signal word "NOTE" is not a signal word indicating a danger to personnel. The signal word "NOTE" can also refer to material damage.

1.3 Intended use

This device is intended for the following uses:

- To transmit fluid or gaseous measuring media.
- To measure the flow rate of the operating volume or mass flow units (at constant pressure / temperature), if a physical unit is selected.

The device has been designed for use exclusively within the technical limit values indicated on the identification plate and in the data sheets.

When using media for measurement the following points must be observed:

- Measuring 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 the chemical and physical properties necessary for safe operation of the materials of transmitter components coming into contact with these 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 measuring medium escaping. It is the operator's responsibility to check the suitability of these materials for the respective application.
- Measuring media with unknown properties or abrasive measuring media may only be used if the operator can perform regular and suitable tests to ensure the safe condition of the meter.

The operator bears sole responsibility for the use of the devices in relation to suitability, intended use and corrosion resistance of the materials in relation to the measuring medium.
The manufacturer is not liable for damage arising from improper or non-intended use.

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

1.4 Improper use

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

- For operating as a flexible adapter in piping, e.g. for compensating pipe offsets, pipe vibrations, pipe expansions, etc.
- For use as a climbing aid, e.g. for mounting purposes
- For use as a support for external loads, e.g. as a support for piping, etc.
- Material application, e.g. by painting over the name plate or welding/soldering on parts
- Material removal, e.g. by spot drilling the housing

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.

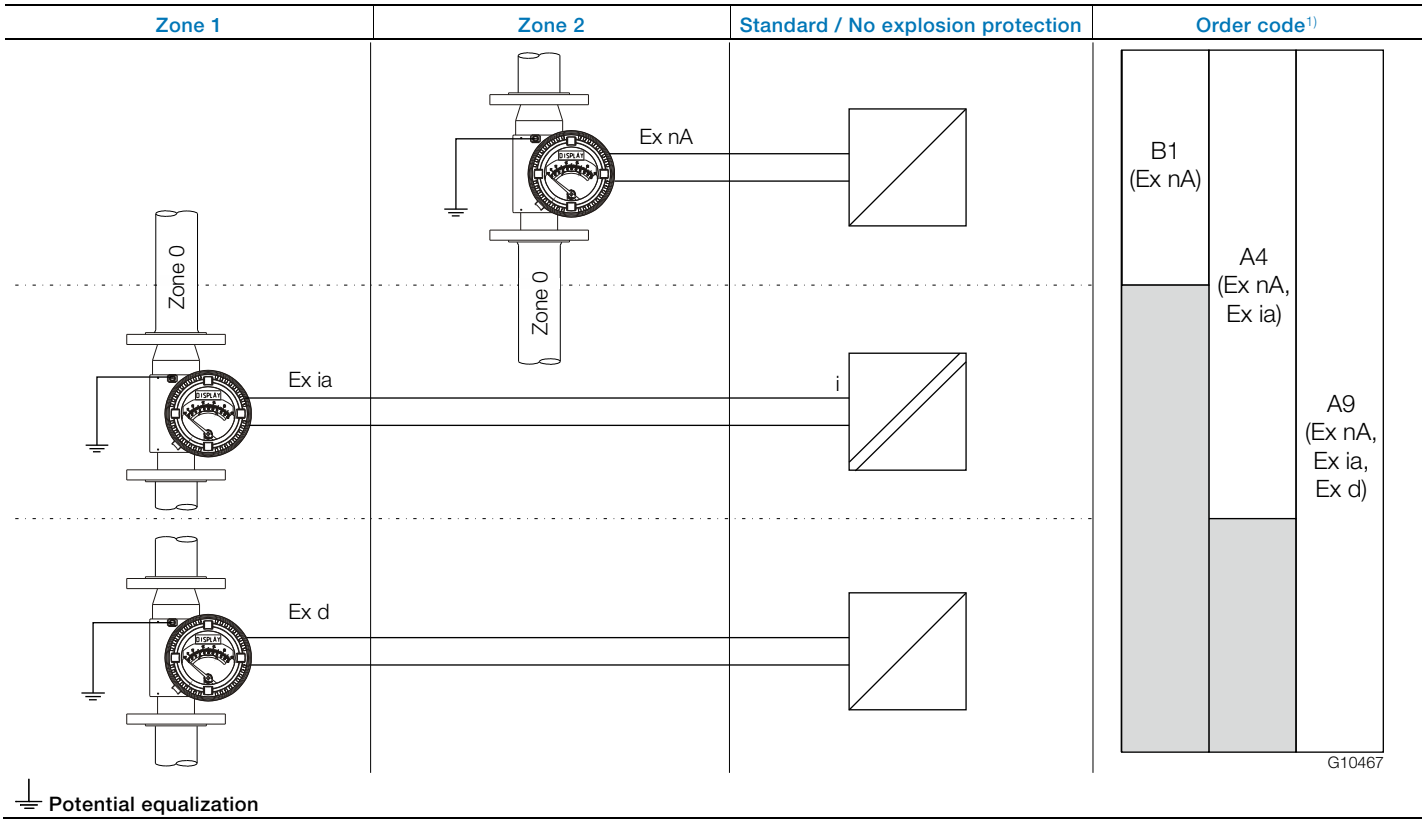
2 Use in potentially explosive atmospheres according to ATEX and IECEx

NOTE

For further information on the approval of devices for use in potentially explosive atmospheres, refer to the type-examination certificates or the relevant certificates at www.abb.com/flow.

2.1 Device overview

The devices are designed for maximum versatility. This is achieved through a combination of several types of protection within each device. All devices are suitable for use in potentially explosive atmospheres with combustible dust. For detailed installation instructions and terminal assignments, refer to chapter „Electrical connections“ on page 11.



1) Order code "Explosion protection and approvals“ (versions 9, 10); refer to chapter Ordering information in the data sheet.

2.1.1 Ex-marking

NOTE

- Depending on the design, a specific marking in accordance with ATEX or IECEx applies.
- ABB reserves the right to modify the Ex-marking. Refer to the name plate for the exact marking.

Model FAM54xAx (analog indicator without alarm signaling unit)				
Labeling		Type of protection	Order code[1)]	Limit value table
ATEX	II 1/2 G c II T6…T1	Constructional safety	A4, A9, B1	„Table 5“ on page 16
	II 2D c T85 °C to T_{medium} Db	Constructional safety		
	II 2D Ex tb IIIC T85 °C… T_{medium} Db	Dust-explosion protection		

1) Order code "Explosion protection and approvals“ (versions 9, 10); refer to chapter Ordering information in the data sheet.

Model FAM54xB/C/Dx (analog indicator with alarm signaling unit)				
Labeling		**Type of protection**	**Order code**[1]	**Limit value table**
ATEX	II 1/2G Ex c ia IIC T6 … T1 Ga/Gb	Intrinsic Safety	A4	„Table 2“ on page 13
	II 1/3G Ex c nA IIC T6 ... T1 Ga/Gc	Non-sparking materials		„Table 4“ on page 15
	II 2D Ex tb IIIC T85 °C… T_{medium} Db	Dust-explosion protection		„Table 2“ on page 13, „Table 4“ on page 15
IECEx	Ex ia IIC T6 ... T1 Ga/Gb	Intrinsic Safety		„Table 2“ on page 13
	Ex nA II T6 ... T1	Non-sparking materials		„Table 4“ on page 15
	Ex tb IIIC T85 °C ... T_{medium} Db	Dust-explosion protection		„Table 2“ on page 13, „Table 4“ on page 15
ATEX	II 1/2G Ex c d IIC T6 … T1 Ga/Gb	Flameproof (enclosure)	A9	„Table 3“ on page 14
	II 1/2G Ex c ia IIC T6 … T1 Ga/Gb	Intrinsic Safety		„Table 2“ on page 13
	II 1/3G Ex c nA IIC T6 ... T1 Ga/Gc	Non-sparking materials		„Table 4“ on page 15
	II 2D Ex tb IIIC T85 °C… T_{medium} Db	Dust-explosion protection		„Table 2“ on page 13, „Table 3“ on page 14, „Table 4“ on page 15
IECEx	Ex d IIC T6 ... T1 Ga /Gb	Flameproof (enclosure)		„Table 3“ on page 14
	Ex ia IIC T6 ... T1 Ga /Gb	Intrinsic Safety		„Table 2“ on page 13
	Ex nA IIC T6 ... T1 Ga /Gb	Non-sparking materials		„Table 4“ on page 15
	Ex tb IIIC T85 °C ... Tmedium Db	Dust-explosion protection		„Table 2“ on page 13, „Table 3“ on page 14, „Table 4“ on page 15
ATEX	II 1/3G Ex c nA IIC T6 ... T1 Ga/Gc	Non-sparking materials	B1	„Table 4“ on page 15
	II 2D Ex tb IIIC T85 °C… T_{medium} Db	Dust-explosion protection		„Table 4“ on page 15
IECEx	Ex nA IIC T6 ... T1 Ga / Gc	Non-sparking materials		„Table 4“ on page 15
	Ex tb IIIC T85 °C ... Tmedium Db	Dust-explosion protection		„Table 4“ on page 15

1) Order code "Explosion protection and approvals“ (versions 9, 10); refer to chapter Ordering information in the data sheet.

Model FAM54xE/Fx (analog indicator with transmitter and with or without LCD indicator)				
Labeling		**Type of protection**	**Order code**[1]	**Limit value table**
ATEX	II 1/2 G Ex c ia IIC T4 … T1 Ga/Gb	Intrinsic Safety	A4	„Table 1“ on page 12
	II 1/3G Ex c nA ic IIC T6 … T1 Ga/Gc	Non-sparking materials		
	II 2 D Ex tb IIIC T85 °C… T_{medium} Db	Dust explosion protection		
IECEx	Ex ia IIC T4 ... T1 Ga / Gb	Intrinsic Safety		
	Ex nA ic IIC T6 ... T1 Ga / Gc	Non-sparking materials		
	Ex tb IIIC T85 °C ... T_{medium} Db	Dust explosion protection		
ATEX	II 1/2G Ex c d IIC T6 … T1 Ga/Gb	Flameproof (enclosure)	A9	„Table 1“ on page 12
	II 1/2 G Ex c ia IIC T4 … T1 Ga/Gb	Intrinsic Safety		
	II 1/3G Ex c nA ic IIC T6 … T1 Ga/Gc	Non-sparking materials		
	II 2 D Ex tb IIIC T85 °C… T_{medium} Db	Dust explosion protection		
IECEx	Ex d IIC T6 ... T1 Ga / Gb	Flameproof (enclosure)		
	Ex ia IIC T4 ... T1 Ga / Gb	Intrinsic Safety		
	Ex nA ic IIC T6 ... T1 Ga / Gc	Non-sparking materials		
	Ex tb IIIC T85 °C ... T_{medium} Db	Dust explosion protection		
ATEX	II 1/3G Ex c nA ic IIC T6 … T1 Ga/Gc	Non-sparking materials	B1	„Table 4“ on page 15
	II 2 D Ex tb IIIC T85 °C… T_{medium} Db	Dust explosion protection		
IECEx	Ex nA ic IIC T6 ... T1 Ga / Gc	Non-sparking materials		
	Ex tb IIIC T85 °C ... T_{medium} Db	Dust explosion protection		

1) Order code "Explosion protection and approvals“ (versions 9, 10); refer to chapter Ordering information in the data sheet.

2.2 Installation instructions

The installation, commissioning, maintenance and repair of devices in areas with explosion hazard must only be carried out by appropriately trained personnel.
The safety instructions for electrical apparatus in potentially explosive areas must be complied with, in accordance with Directive 94/9/EC (ATEX) and IEC60079-14 (Installation of electrical equipment in potentially explosive areas).
To ensure safe operation, the requirements of EU Directive ATEX 118a (minimum requirements concerning the protection of workers) must be met.

When using in potentially explosive atmospheres, please note:

- Observe the information in chapter „Installation conditions“ on page 31 during installation of the device.
- The maximum ambient temperature for use with combustible dusts (category II 2D) is T_{amb} = +60 °C.
- When commissioning the flowmeter, refer to EN 60079-0 regarding use in areas with combustible dust.
- For explosion proof apparatus with PTFE liners, a minimum medium conductivity of > 10^{-8} S/m must be guaranteed.
- If zone 0 is present in the meter tube, the devices may only be installed in an environment ensuring sufficient ventilation of zone 1.
- Variable area flowmeters used in accordance with maximum electrical values for a category 3 device (zone 2) can also be used without modification as category 2 devices in zone 1 (see chapter „“ on page 17).

2.2.1 Protection against electrostatic discharges

⚠ DANGER

Risk of explosion!

The painted surface of the device can store electrostatic charges. As a result, the housing can form an ignition source due to electrostatic discharges in the following conditions:

- The device is operated in environments with a relative humidity of ≤ 30 %.
- This painted surface of the device is therefore relatively free from impurities such as dirt, dust or oil.

The instructions on avoiding the ignition of hazardous areas due to electrostatic discharges in accordance with the EN TR50404 and IEC 60079-32-1 standards must be observed!

Instructions on cleaning

The painted surface of the device may be cleaned only using a moist cloth.

2.2.2 Sensor insulation

The device may be insulated. The maximum permissible thickness of the insulation corresponds to the flange diameter. See chapter „Sensor insulation“ on page 32.

2.2.3 Opening and closing the transmitter housing

⚠ DANGER

Danger of explosion if the device is operated with the transmitter housing open!

Before opening the transmitter housing, bear in mind the following:

- Check that a valid fire permit is available.
- Make sure that there is no explosion hazard.
- Before opening the device, switch off the power supply and wait for t > 2 minutes.

⚠ WARNING

Risk of injury due to live parts!

When the housing is open, contact protection is not provided and EMC protection is limited.
Before opening the housing, switch off the power supply.

Before opening the housing cover, remove the cover protector, and reattach it after closing the housing cover.

For sealing original spare parts should be used only.

i NOTE

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

2.2.4 Cable entries

The devices are connected electrically using a cable gland or alternatively by using conduit systems with pipe fittings. For this purpose, the devices are delivered with cable glands or alternatively with 1/2" NPT connection threads for pipe fittings.

ATEX / IECEx-approved flameproof cable glands made from metal are supplied with device versions that have type of protection Ex-d "Flameproof enclosure" (order code A9). ATEX / IECEx-approved cable glands made from plastic are supplied with device versions that have type of protection Ex-ia and Ex-nA.

The various connection possibilities depend on the device-specific configuration of the explosion protection and the "Housing material / cable connection" option in accordance with the ordering information in data sheet DS/FAM540.

To ensure proper routing of cables, the following cable diameters are required:

— Ex d design: 7.2 ... 11.7 mm (0.28 ... 0.46 inch)
— Other designs: 5.0 ... 9.0 mm (0.20 ... 0.35 inch)

Devices with 1/2" NPT threads and ATEX and IECEx approvals (except for "Ex d") can be ordered and operated without cable glands. The operator is responsible for properly installing threaded conduit connections in accordance with national regulations (e.g., NEC, CEC, ATEX137, IEC60079-14, etc.).

2.2.5 Type of protection Ex d - flameproof enclosure

Model FAM540, order code A9

The flowmeter is electrically connected via the ATEX / IECEx-approved cable gland with type of protection Ex-d (see Fig. 1) located on the device.

Alternatively, the flowmeter can be connected using conduit systems. In type of protection Ex-d, the connection must be made with an ATEX / IECEx-approved pipe fitting with a flame barrier. The mechanical ignition barrier must be installed directly on the housing.

The preinstalled cable gland must be removed before connecting a pipe fitting. The M25 x 1.5 / 1/2" NPT adapter remains unchanged on the device.

NOTE

Pipe fittings with flame barriers are not included in the scope of supply.
Only ATEX /IECEx-approved pipe fittings with a flame barrier may be used with type of protection Ex-d. The use of cable and wire entries, pipe fittings or sealing plugs without an Ex-d type examination certificate is prohibited.

Unused openings must be closed with Ex-d-approved sealing plugs.

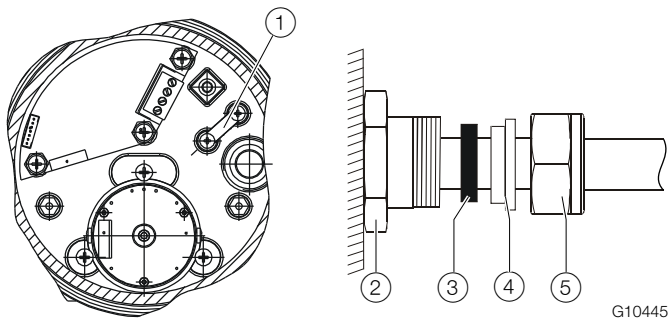


Fig. 1: Connection using a flameproof cable gland
(1) Strain relief (2) M25 x 1.5 / 1/2"-NPT adapter (3) Gasket (4) Sleeve (5) Union nut

The outside diameter of the unshielded connection cable must be between 7.2 ... 11.7 mm (0.3 ... 0.5 inch). After installing the cable in the fitting, tighten the union nut using a torque of 3.25 Nm (2.40 lb/ft). Use additional strain relief in the housing to secure the connection cable.

2.2.6 Electrical connections

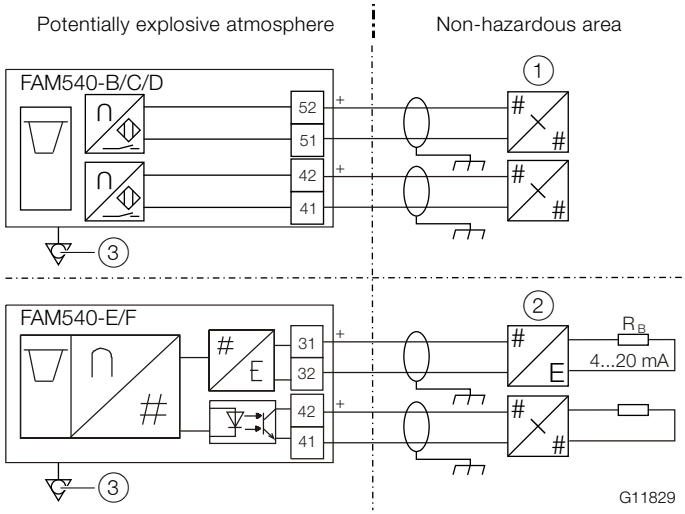


Fig. 2: ATEX / IECEx electrical connection
(1) NAMUR switching amplifier (2) Safety barrier
(3) Potential equalization

Terminal	Function
31 / 32	Power supply / current output / HART output
41 / 42	Programmable binary output
	Alarm signaling unit (min.)
51 / 52	Alarm signaling unit (max.)

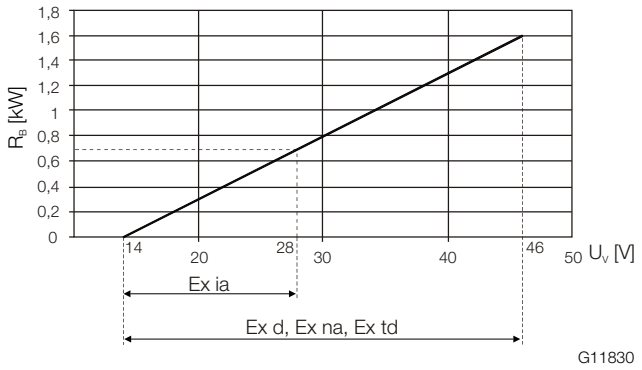


Fig. 3: Terminals 31 / 32, power supply / load
U_V Power supply
R_B Maximum permissible load in the power supply (e.g. indicator)

The minimum voltage U_V = 0 V is based on a load of 0 Ω.

Signal cable

The Ex calculations are based on temperatures of 80 °C (176 °F) at the cable input. For this reason, cables with a specification of 80 °C (176 °F) must be used.
For cables limited to 70 °C (158 °F), a maximum ambient temperature of T_{amb} = 60 °C (140 °F) applies.
The resulting new maximum measuring medium temperatures are determined as follows:

- Calculate a new ambient temperature: T_{amb} new = T_{amb} + 10 °C (18 °F).
- Use the calculated ambient temperature T_{amb} new to determine the new associated permissible measuring medium temperatures in the tables.
- Please use the limit value tables with the original ambient temperature T_{amb} to determine the relevant temperature class. See chapter „Safety specifications ATEX / IECEx“ on page 12, Tables 1 through 5.

Example:

- T_{amb} = 50 °C (122 °F) becomes T_{amb} new = 60 °C (140 °F).
- Determine the measuring medium temperature T_{amb} = 60 °C (140 °F).
- Determine the temperature class for T_{amb} = 50 °C (122 °F).

Earthing

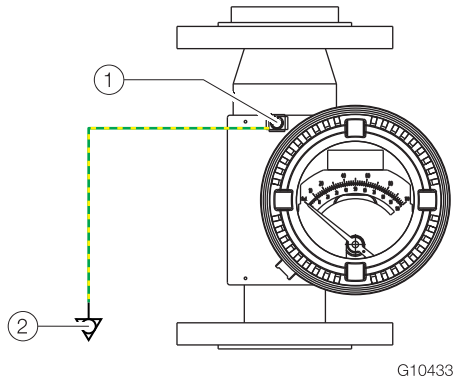


Fig. 4: Earthing
(1) Earthing terminal
(2) Potential equalization in accordance with EN 60079-0

The FAM540 housing must be correctly earthed in order to ensure proper function and safe operation.
Copper wires with a minimum cross-section of 6 mm^2 (AWG 10) must be used to connect to the potential equalization.

NOTE

The operator must ensure that when connecting the protective earth (PE), there are no potential differences between protective earth (PE) and potential equalization, even in the event of a fault.

2.3 Safety specifications ATEX / IECEx

2.3.1 Special conditions for type of protection "Ex td" (dust explosion protection)

Model FAM54xB/C/D/E/Fx

The following differing temperature data applies to usage in areas with combustible dust.

Order code	Ambient temperature T_{amb}	Maximum permissible measuring medium temperature T_{medium}
A4, A9, B1	-50°C... +60°C	250 °C
	-50°C... +40°C	340 °C
	-50°C... +20°C	430 °C

Table 1: Analog indicator with transmitter, with or without LCD indicator

Model FAM54xE/Fx

Type of protection: flameproof enclosure, intrinsic safety, non-sparking equipment, dust explosion protection.

Order code[1]	Labeling	Terminals	Electrical values	T_{amb} -20 °C ... (-50 °C ...)	Temp. class	T_{medium} Maximum	Insulation	Heating jacket
A4, A9	**ATEX:** II 1/2 G Ex c ia IIC T4 ... T1 Ga/Gb II 2 D Ex tb IIIC T85 °C... T_{medium} Db **IECEx:** Ex ia IIC T4 ... T1 Ga / Gb Ex tb IIIC T85 °C ... T_{medium} Db	31 / 32[2]	U_i = 30 V I_i = 110 mA P_i = 770 mW C_i = 5.3 nF L_i = 266 µH	40 °C	T1	440 °C	No	No
				40 °C	T1	375 °C	yes	No
				40 °C	T1	260 °C	yes	yes
				50 °C	T1	300 °C	yes	No
				50 °C	T2	290 °C	yes	No
				50 °C	T2	220°C	yes	yes
		41 / 42[2]	U_i = 30 V I_i = 30 mA P_i = 115 mW C_i = 4.8 nF L_i = 133 µH	60 °C	T2	320 °C	No	No
				60 °C	T2	230 °C	yes	No
				60 °C	T3	170 °C	yes	yes
				70 °C	T3	195 °C	No	No
				70 °C	T3	150 °C	yes	No
				70 °C	T4	125 °C	yes	yes
A9	**ATEX:** II 1/2G Ex c d IIC T6 ... T1 Ga/Gb II 2 D Ex tb IIIC T85 °C... T_{medium} Db **IECEx:** Ex d IIC T6 ... T1 Ga / Gb Ex tb IIIC T85 °C ... T_{medium} Db	31 / 32[3]	U_{max} = 46 V	40 °C	T1	440 °C	No	No
				40 °C	T1	375 °C	yes	No
				40 °C	T1	260 °C	yes	yes
				50 °C	T1	300 °C	yes	No
				50 °C	T2	290 °C	yes	No
				50 °C	T2	220°C	yes	yes
		41 / 42[3]	U_{max} = 30 V I_{max} = 30 mA P_{max} = 115 mW	60 °C	T2	320 °C	No	No
				60 °C	T2	230 °C	yes	No
				60 °C	T3	170 °C	yes	yes
				60 °C	T4	130 °C	yes	yes
				60 °C	T5	95 °C	yes	yes
				60 °C	T6	80 °C	yes	yes
A4, A9, B1	**ATEX:** II 1/3G Ex c nA ic IIC T6 ... T1 Ga/Gc II 2 D Ex tb IIIC T85 °C... T_{medium} Db **IECEx:** Ex nA ic IIC T6 ... T1 Ga / Gc Ex tb IIIC T85 °C ... T_{medium} Db	31 / 32[3]	U_{max} = 46 V	40 °C	T1	440 °C	No	No
				40 °C	T1	375 °C	yes	No
				40 °C	T1	260 °C	yes	yes
				50 °C	T1	300 °C	yes	No
				50 °C	T2	290 °C	yes	No
				50 °C	T2	220°C	yes	yes
		41 / 42[3]	U_{max} = 30 V I_{max} = 30 mA P_{max} = 115 mW	60 °C	T2	320 °C	No	No
				60 °C	T2	230 °C	yes	No
				60 °C	T3	170 °C	yes	yes
				70 °C	T3	195 °C	No	No
				70 °C	T3	150 °C	yes	No
				70 °C	T4	130 °C	yes	yes

1) Order code "Explosion protection and approvals" (versions 9, 10); refer to chapter Ordering information in the data sheet.
2) For connection to an intrinsically safe circuit.
3) For connection to a non-intrinsically safe circuit. If the device is to be operated subsequently with type of protection "intrinsically safe", then U_{max} = 60 V may not be exceeded.

Table 2: Analog indicator with alarm signaling unit

Model FAM54xB/C/Dx

Type of protection: intrinsic safety, dust explosion protection.

Order code[1]	Labeling	Terminals	Electrical values	T_{amb} -20 °C ... (-50 °C ...)	Temp. class	T_{medium} Maximum	Insulation	Heating jacket
A4, A9	**ATEX:** II 1/2G Ex c ia IIC T6 ... T1 Ga/Gb II 2D Ex tb IIIC T85 °C... T_{medium} Db **IECEx:** Ex ia IIC T6 ... T1 Ga / Gb Ex tb IIIC T85 °C ... T_{medium} Db	41 / 42[2] 51 / 52[2]	U_i = 16 V I_i = 25 mA P_i = 64 mW C_i = 50 nF L_i = 250 µH	40 °C	T1	440 °C	No	No
				40 °C	T1	375 °C	yes	No
				40 °C	T1	260 °C	yes	yes
				50 °C	T1	300 °C	yes	No
				50 °C	T2	290 °C	yes	No
				50 °C	T2	220°C	yes	yes
				60 °C	T2	320 °C	No	No
				60 °C	T2	230 °C	yes	No
				60 °C	T3	170 °C	yes	yes
				70 °C	T3	195 °C	No	No
				70 °C	T3	150 °C	yes	No
				70 °C	T4	130 °C	yes	yes
				70 °C	T5	95 °C	yes	yes
				60 °C	T6	80 °C	yes	yes
		41 / 42[2] 51 / 52[2]	U_i = 16 V I_i = 52 mA P_i = 169 mW C_i = 50 nF L_i = 250 µH	40 °C	T1	440 °C	No	No
				40 °C	T1	375 °C	yes	No
				40 °C	T1	260 °C	yes	yes
				50 °C	T1	300 °C	yes	No
				50 °C	T2	290 °C	yes	No
				50 °C	T2	220°C	yes	yes
				60 °C	T2	320 °C	No	No
				60 °C	T2	230 °C	yes	No
				60 °C	T3	170 °C	yes	yes
				70 °C	T3	195 °C	No	No
				70 °C	T3	150 °C	yes	No
				70 °C	T4	130 °C	yes	yes
				60 °C	T5	60 °C	yes	yes
				50 °C	T5	90 °C	No	yes
				40 °C	T6	60 °C	yes	yes
		41 / 42[2] 51 / 52[2]	U_i = 16 V I_i = 76 mA P_i = 242 mW C_i = 50 nF L_i = 250 µH	40 °C	T1	440 °C	No	No
				40 °C	T1	310 °C	yes	No
				40 °C	T2	190 °C	yes	yes
				50 °C	T2	340 °C	No	No
				50 °C	T2	230 °C	yes	yes
				60 °C	T2	230°C	No	No
				60 °C	T3	160 °C	yes	yes
				70 °C	T4	120 °C	No	No
				70 °C	T4	100 °C	yes	yes
				40 °C	T5	60 °C	yes	yes
				30 °C	T6	30 °C	yes	yes

1) Order code "Explosion protection and approvals" (versions 9, 10); refer to chapter Ordering information in the data sheet.
2) For connection to an intrinsically safe circuit.

Table 3: Analog indicator with alarm signaling unit

Model FAM54xB/C/Dx

Type of protection: flameproof enclosure, dust explosion protection.

Order code[1]	Labeling	Terminals	Electrical values	T_{amb} -20 °C ... (-50 °C ...)	Temp. class	T_{medium} Maximum	Insulation	Heating jacket
A9	**ATEX:** II 1/2G Ex c d IIC T6 ... T1 Ga/Gb II 2D Ex tb IIIC T85 °C... T_{medium} Db **IECEx:** Ex d IIC T6 ... T1 Ga / Gb Ex tb IIIC T85 °C ... T_{medium} Db	41 / 42[2] 51 / 52[2]	U_{max} = 16 V I_{max} = 25 mA P_{max} = 64 mW	40 °C	T1	440 °C	No	No
				40 °C	T1	375 °C	yes	No
				40 °C	T1	260 °C	yes	yes
				50 °C	T1	300 °C	yes	No
				50 °C	T2	290 °C	yes	No
				50 °C	T2	220°C	yes	yes
				60 °C	T2	320 °C	No	No
				60 °C	T2	230 °C	yes	No
				60 °C	T3	170 °C	yes	yes
				70 °C	T3	195 °C	No	No
				70 °C	T3	150 °C	yes	No
				70 °C	T4	130 °C	yes	yes
				70 °C	T5	95 °C	yes	yes
				60 °C	T6	80 °C	yes	yes
		41 / 42[2] 51 / 52[2]	U_{max} = 16 V I_{max} = 52 mA P_{max} = 169 mW	40 °C	T1	440 °C	No	No
				40 °C	T1	375 °C	yes	No
				40 °C	T1	260 °C	yes	yes
				50 °C	T1	300 °C	yes	No
				50 °C	T2	290 °C	yes	No
				50 °C	T2	220°C	yes	yes
				60 °C	T2	320 °C	No	No
				60 °C	T2	230 °C	yes	No
				60 °C	T3	170 °C	yes	yes
				70 °C	T3	195 °C	No	No
				70 °C	T3	150 °C	yes	No
				70 °C	T4	130 °C	yes	yes
				60 °C	T5	60 °C	yes	yes
				50 °C	T5	90 °C	No	yes
				40 °C	T6	60 °C	yes	yes
		41 / 42[2] 51 / 52[2]	U_{max} = 16 V I_{max} = 76 mA P_{max} = 242 mW	40 °C	T1	440 °C	No	No
				40 °C	T1	310 °C	yes	No
				40 °C	T2	190 °C	yes	yes
				50 °C	T2	340 °C	No	No
				50 °C	T2	230 °C	yes	yes
				60 °C	T2	230°C	No	No
				60 °C	T3	160 °C	yes	yes
				70 °C	T4	120 °C	No	No
				70 °C	T4	100 °C	yes	yes
				40 °C	T5	60 °C	yes	yes
				30 °C	T6	30 °C	yes	yes

1) Order code "Explosion protection and approvals" (versions 9, 10); refer to chapter Ordering information in the data sheet.
2) For connection to a non-intrinsically safe circuit. If the device is to be operated subsequently with type of protection "intrinsically safe", then U_{max} = 60 V may not be exceeded.

Table 4: Analog indicator with alarm signaling unit

Model FAM54xB/C/Dx

Type of protection: non-sparking materials, dust explosion protection.

Order code[1]	Labeling	Terminals	Electrical values	T_{amb} -20 °C ... (-50 °C ...)	Temp. class	T_{medium} Maximum	Insulation	Heating jacket
A4, A9, B1	**ATEX:** II 1/3G Ex c nA IIC T6 ... T1 Ga/Gc II 2D Ex tb IIIC T85 °C... T_{medium} Db **IECEx:** Ex nA IIC T6 ... T1 Ga / Gc Ex tb IIIC T85 °C ... T_{medium} Db	41 / 42[2] 51 / 52[2]	U_{max} = 16 V I_{max} = 25 mA P_{max} = 64 mW	40 °C	T1	440 °C	No	No
				40 °C	T1	375 °C	yes	No
				40 °C	T1	260 °C	yes	yes
				50 °C	T1	300 °C	yes	No
				50 °C	T2	290 °C	yes	No
				50 °C	T2	220°C	yes	yes
				60 °C	T2	320 °C	No	No
				60 °C	T2	230 °C	yes	No
				60 °C	T3	170 °C	yes	yes
				70 °C	T3	195 °C	No	No
				70 °C	T3	150 °C	yes	No
				70 °C	T4	130 °C	yes	yes
				70 °C	T5	95 °C	yes	yes
				60 °C	T6	80 °C	yes	yes
		41 / 42[2] 51 / 52[2]	U_{max} = 16 V I_{max} = 52 mA P_{max} = 169 mW	40 °C	T1	440 °C	No	No
				40 °C	T1	375 °C	yes	No
				40 °C	T1	260 °C	yes	yes
				50 °C	T1	300 °C	yes	No
				50 °C	T2	290 °C	yes	No
				50 °C	T2	220°C	yes	yes
				60 °C	T2	320 °C	No	No
				60 °C	T2	230 °C	yes	No
				60 °C	T3	170 °C	yes	yes
				70 °C	T3	195 °C	No	No
				70 °C	T3	150 °C	yes	No
				70 °C	T4	130 °C	yes	yes
				60 °C	T5	60 °C	yes	yes
				50 °C	T5	90 °C	No	yes
				40 °C	T6	60 °C	yes	yes
A4, A9, B1	**ATEX:** II 1/3G Ex c nA IIC T6 ... T1 Ga/Gc II 2D Ex tb IIIC T85 °C... T_{medium} Db **IECEx:** Ex nA IIC T6 ... T1 Ga / Gc Ex tb IIIC T85 °C ... T_{medium} Db	41 / 42[2] 51 / 52[2]	Umax= 16 V Imax = 76 mA Pmax = 242 mW	40 °C	T1	440 °C	No	No
				40 °C	T1	310 °C	yes	No
				40 °C	T2	190 °C	yes	yes
				50 °C	T2	340 °C	No	No
				50 °C	T2	230 °C	yes	yes
				60 °C	T2	230°C	No	No
				60 °C	T3	160 °C	yes	yes
				70 °C	T4	120 °C	No	No
				70 °C	T4	100 °C	yes	yes
				40 °C	T5	60 °C	yes	yes
				30 °C	T6	30 °C	yes	yes

1) Order code "Explosion protection and approvals" (versions 9, 10); refer to chapter Ordering information in the data sheet.
2) For connection to a non-intrinsically safe circuit. If the device is to be operated subsequently with type of protection "intrinsically safe", then U_{max} = 60 V may not be exceeded.

Table 5: Analog indicator without alarm signaling unit

Model FAM54xAx

Type of protection: constructional safety, dust explosion protection

Order code[1)]	Labeling	Terminals	Electrical values	T_{amb} -20 °C ... (-50 °C ...)	Temp. class	T_{medium} Maximum	Insula-tion	Heating jacket
A4, A9, B1	**ATEX:**	n.a.	n.a	70 °C	T1	440 °C	yes	yes
	II 1/2 G c II T6...T1			70 °C	T2	290 °C	yes	yes
	II 2D c T85 °C to T_{medium}			70 °C	T3	190 °C	yes	yes
	II 2D Ex tb IIIC T85 °C... T_{medium} Db			70 °C	T4	130 °C	yes	yes
	IECEx:			70 °C	T5	95 °C	yes	yes
	Ex tb IIIC T85 °C ... T_{medium} Db			70 °C	T6	80°C	yes	yes

2.4 Operating instructions

2.4.1 Protection against electrostatic discharges

⚠ DANGER

Risk of explosion!

The painted surface of the device can store electrostatic charges. As a result, the housing can form an ignition source due to electrostatic discharges in the following conditions:

— The device is operated in environments with a relative humidity of ≤ 30 %.

— This painted surface of the device is therefore relatively free from impurities such as dirt, dust or oil.

The instructions on avoiding the ignition of hazardous areas due to electrostatic discharges in accordance with the EN TR50404 and IEC 60079-32-1 standards must be observed!

Instructions on cleaning

The painted surface of the device may be cleaned only using a moist cloth.

2.4.2 Changing the type of protection

Depending on the model, the device may be designed to be installed in one of the applications listed. If you plan to use a device that was installed in one type of protection rating in a different type of protection rating, some measures must be taken before connecting voltage to the device.

Measures for devices with alarm signaling unit FAM540-B/C/D:

Original installation	New installation	Necessary test steps
XP or Ex d U_M = 60 V	**IS or Ex ia**[1)]	— 500 V AC / 1min test between terminals 51 / 52 and 41 / 42 and terminals 51 / 52 / 41 / 42 and the housing. — Visual inspection: no explosion, no damage.
	NI or Ex nA	— 500 V AC / 1min test between terminals 51 / 52 and 41 / 42 and terminals 51 / 52 / 41 / 42 and the housing. — Visual inspection: no explosion, no damage.
IS or Ex ia	**XP or Ex d**	— Visual inspection: no damage to threads (cover, surface, 1/2" NPT cable input), cable gland, glass, housing, locking device for cover, suitable cable, etc.
	NI or Ex nA	No special measures required.
NI or Ex nA U_M = 60 V	**IS or Ex ia**[1)]	— 500 V AC / 1min test between terminals 51 / 52 and 41 / 42 and terminals 51 / 52 / 41 / 42 and the housing. — Visual inspection: no explosion, no damage.
	XP or Ex d	— Visual inspection: no damage to threads (cover, surface, 1/2" NPT cable input), cable gland, glass, housing, locking device for cover, suitable cable, etc.

1) Possible only if the maximum signal levels of $U_M \leq 60$ V (e.g., PELV or SELV circuits) were not previously exceeded.

Measures for devices with transmitter with or without LCD display FAM540-E/F.

Original installation	New installation	Necessary test steps
XP or Ex d U_M = 60 V	**IS or Ex ia**[1)]	— 500 V AC / 1min test between terminals 31 / 32 and 41 / 42 and terminals 31 / 32 / 41 / 42 and the housing. — Visual inspection: No damage, especially to electronics boards. — Visual inspection: no explosion, no damage.
	NI or Ex nA	— 500 V AC / 1min test between terminals 31 / 32 and 41 / 42 and terminals 31 / 32 / 41 / 42 and the housing. — Visual inspection: No damage, especially to electronics boards. — Visual inspection: no explosion, no damage.
IS or Ex ia	**XP or Ex d**	— Visual inspection: no damage to threads (cover, surface, 1/2" NPT cable input), cable gland, glass, housing, locking device for cover, suitable cable, etc.
	NI or Ex nA	No special measures required.
NI or Ex nA U_M = 60 V	**IS or Ex ia**[1)]	— 500 V AC / 1min test between terminals 31 / 32 and 41 / 42 and terminals 31 / 32 / 41 / 42 and the housing. — Visual inspection: No damage, especially to electronics boards.
	XP or Ex d	— Visual inspection: no damage to threads (cover, surface, 1/2" NPT cable input), cable gland, glass, housing, locking device for cover, suitable cable, etc.

1) Possible only if the maximum signal levels of $U_M \leq 60$ V (e.g., PELV or SELV circuits) were not previously exceeded.

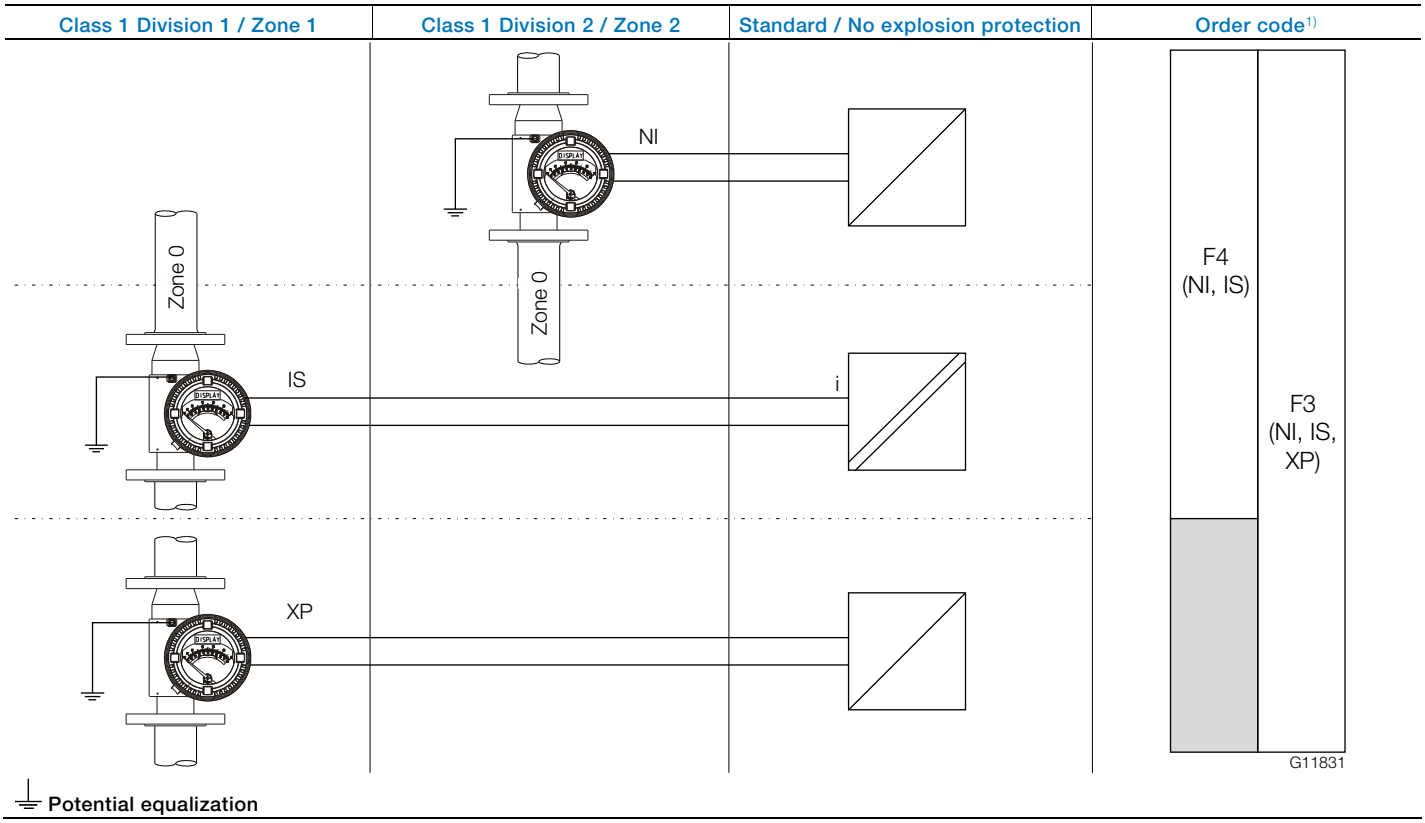
3 Use in potentially explosive atmospheres in accordance with FM and cCSAus

NOTE

For further information on the approval of devices for use in potentially explosive atmospheres, refer to the type-examination certificates or the relevant certificates at www.abb.com/flow.

3.1 Device overview

The devices are designed for maximum versatility. This is achieved through a combination of several types of protection within each device. All devices are suitable for use in potentially explosive atmospheres with combustible dust. For detailed installation instructions and terminal assignments, refer to chapter „Electrical connections“ on page 21.



1) Order code "Explosion protection and approvals“ (versions 9, 10); refer to chapter „Ordering information in the data sheet“ on page 53.

3.1.1 Ex-marking

NOTE

— Depending on the design, a specific marking in accordance with FM applies.
— ABB reserves the right to modify the Ex-marking. Refer to the name plate for the exact marking.

Model FAM54xAx (analog indicator without alarm signaling unit and model FAM54xB/C/Dx (analog indicator with alarm signaling unit)

Labeling		Type of protection	Order code[1)]	Limit value table
FM	XP / CL I / DIV 1 / GP ABCD / T6…T1 CL I, ZN 1 AEx d IIC T6…T1	Explosionproof	F3	„Table 2“ on page 24
	IS / CL I,II,III / DIV 1 / GP ABCDEFG / T6..T1 CL I, ZN 1 AEx ia IIC T6…T1	Intrinsic Safety	F3, F4	„Table 1“ on page 23, „Table 2“ on page 24
	DIP / CL II, III / DIV 1 / GP EFG / T6...T1	Dust-Ignitionproof		
	NI /CL I,II / DIV 2 / GP ABCDFG / T5...T1 NI / CL III T5...T1 CL II, ZN 2 AEx nA II T5...T1	Non-Incendive	F3, F4	„Table 1“ on page 23, „Table 2“ on page 24, „Table 3“ on page 25
cCSAus	XP / CL I / DIV 1 / GP BCD / T6…T1 Ex d IIC T6...T1	Explosionproof	F3	„Table 2“ on page 24
	IS / CL I,II,III / DIV 1 / GP ABCDEFG / T6..T1 Ex ia IIC T6...T1	Intrinsic Safety	F3, F4	„Table 1“ on page 23,
	DIP / CL II, III / DIV 1 / GP EFG / T6...T1 DIP A21 TA 85°C to T_{medium}	Dust-Ignitionproof	F3, F4	„Table 1“ on page 23, „Table 2“ on page 24, „Table 3“ on page 25
	NI /CL I,II / DIV 2 / GP ABCDFG / T5...T1 NI / CL III T5...T1 Ex nA II T5...T1	Non-Incendive	F3, F4	„Table 3“ on page 25

1) Order code "Explosion protection and approvals“ (version digit No. 9, 10); refer to chapter Ordering information in the data sheet.

Model FAM54xE/Fx (analog indicator with transmitter / with or without LCD display)

Labeling		Type of protection	Order code[1)]	Limit value table
FM	XP / CL I / DIV 1 / GP ABCD / T6…T1 CL I, ZN 1 AEx d IIC T6…T1	Explosionproof	F3	„Table 4“ on page 26
	IS / CL I,II,III / DIV 1 / GP ABCDEFG / T4..T1 CL I, ZN 1 AEx ia IIC T4…T1	Intrinsic Safety	F3, F4	
	DIP / CL II, III / DIV 1 / GP EFG / T6...T1	Dust-Ignitionproof		
	NI /CL I,II / DIV 2 / GP ABCDFG / T4...T1 NI / CL III T4...T1 CL II, ZN 2 AEx nA [nL] IIC T6...T1	Non-Incendive		
cCSAus	XP / CL I / DIV 1 / GP BCD / T6…T1 Ex d IIC T6...T1	Explosionproof	F3	
	IS / CL I,II,III / DIV 1 / GP ABCDEFG / T4..T1 Ex ia IIC T4...T1	Intrinsic Safety	F3, F4	
	DIP / CL II, III / DIV 1 / GP EFG / T6...T1 DIP A21 TA 85°C to T_{medium}	Dust-Ignitionproof		
	NI /CL I,II / DIV 2 / GP ABCDFG / T4...T1 NI / CL III T4...T1 Ex nA [nL] IIC T6...T1	Non-Incendive		

1) Order code "Explosion protection and approvals“ (version digit No. 9, 10); refer to chapter Ordering information in the data sheet.

3.2 Installation instructions

The installation, commissioning, maintenance and repair of devices in areas with explosion hazard must only be carried out by appropriately trained personnel.
The operator must strictly observe the applicable national regulations with regard to installation, function tests, repairs, and maintenance of electrical devices. (e.g. NEC, CEC).

Intrinsic Safety Control Drawing

NOTE

For intrinsically safe installations, the FAM540 must be installed as illustrated in the "Intrinsic Safety Control Drawing".
See chapter "Intrinsic Safety Control Drawing SDM-10-A0253" on page 58.

3.2.1 Sensor insulation

The device may be insulated. The maximum permissible thickness of the insulation corresponds to the flange diameter.
See chapter „Sensor insulation“ on page 32.

3.2.2 Opening and closing the transmitter housing

DANGER

Danger of explosion if the device is operated with the transmitter housing open!
Before opening the transmitter housing, bear in mind the following:

- Check that a valid fire permit is available.
- Make sure that there is no explosion hazard.
- Before opening the device, switch off the power supply and wait for t > 2 minutes.

WARNING

Risk of injury due to live parts!
When the housing is open, contact protection is not provided and EMC protection is limited.
Before opening the housing, switch off the power supply.

Before opening the housing cover, remove the cover protector, and reattach it after closing the housing cover.

For sealing original spare parts should be used only.

NOTE

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

3.2.3 Cable entries

Devices with FM and CSA approval are delivered for electrical connection using conduit systems that have 1/2" NPT connection threads and are sealed with dust protection plugs. Alternatively, cable glands with 1/2" NPT thread can be used for the connection. National guidelines (NEC, CEC) must be observed.
For operation with type of protection XP "Explosionproof", the installation instructions in chapter "Type of protection XP "Explosion proof"" must be observed.

3.2.4 Type of protection XP "Explosion proof"

For operation with type of protection XP "Explosion proof", the connection is made using Ex-approved pipe fittings with a flame barrier with type of protection XP.
In Group A and B hazardous areas, the flame barriers must be installed within a distance of 46 cm (18.1 inch) from the device.

When using cable glands for the connection, Ex-approved cable glands with type of protection XP or Ex-d must be used (see Fig. 5).

NOTE

There must be a separate XP type examination certificate for the pipe fitting.
The use of standard cable and wire entries and sealing plugs is prohibited.
The pipe fitting is not included in the scope of supply.

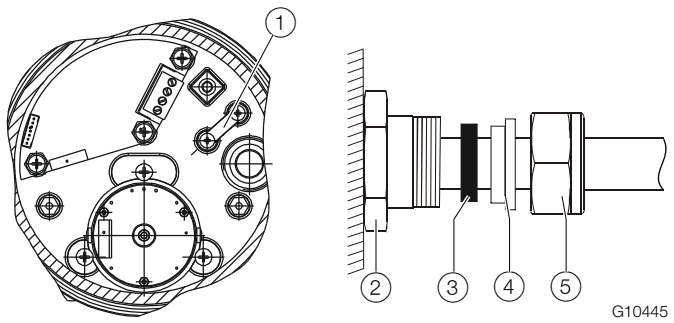


Fig. 5: Connection using a flameproof cable gland
(1) Strain relief (2) M25 x 1.5 / 1/2"-NPT adapter (3) Gasket (4) Sleeve (5) Union nut

The outside diameter of the unshielded connection cable must be between 8.0 ...11.7 mm (0.3 ... 0.5 inch).
The cable gland must be dimensioned accordingly.
After installing the cable in the gland, tighten the union nut to a torque of 3.25 Nm (2.40 lbf/ft).
Use an additional strain relief device in the housing to secure the connection cable.

3.2.5 Electrical connections

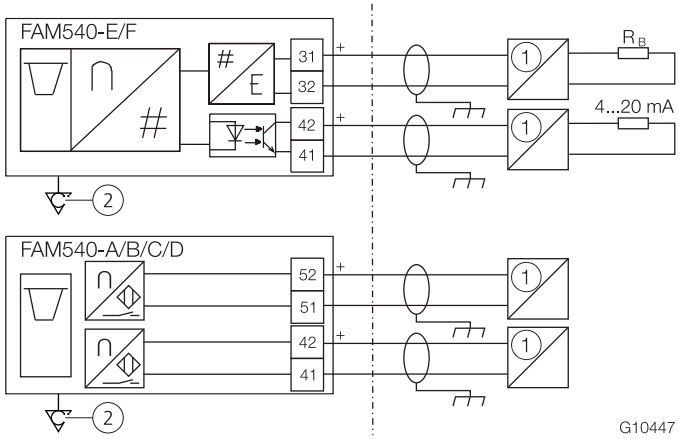


Fig. 6: FM / cCSAus electrical connection
(1) FM Approved IS Barrier (2) Potential equalization

Terminal	Function
31 / 32	Power supply / current output / HART output
41 / 42	Binary output
	Alarm signaling unit (min.)
51 / 52	Alarm signaling unit (max.)

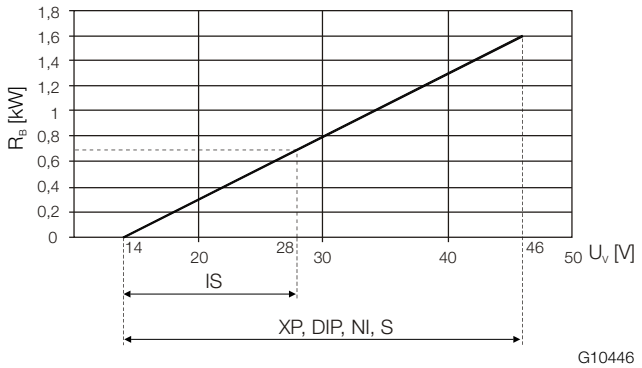


Fig. 7: Terminals 31 / 32, power supply / load
U_V Power supply
R_B Maximum permissible load in the power supply (z. B. indicator)

The minimum voltage U_V = 0 V is based on a load of 0 Ω.

Installation instructions

The concept of intrinsic safety enables multiple intrinsic safety devices with FM or CSA approval to be interconnected, without entity parameters being examined specifically, subject to observation of the following conditions:

- U_o or V_{oc} or $V_t \leq 0$ V max, I_o or I_{sc} or $I_t \leq I_{max}$, C_a or $C_o \geq C_i + C_{cable}$, L_a or $L_o \geq L_i + L_{cable}$, $P_o \leq P_i$.
- For installation in Class II and III environments, dust-proof ignition blocks must be used.
- Devices connected to such apparatus must not use or generate rms or direct voltages in excess of 250 V.
- Installation must meet the requirements of ANSI / ISA RP 12.6 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations" and the National Electrical Code (ANSI / NFPA 70) sections 504, 505 and CEC.
- The configuration of the associated apparatus must have Factory Mutual Research and CSA approval in accordance with the entity concept.
- Devices must be installed in compliance with the manufacturer-supplied installation drawing of the associated apparatus.
- Changes to drawings are only permitted subject to prior approval from Factory Mutual Research and CSA.
- Only shielded twisted pair cables may be used (see above).

NOTE

For intrinsically safe installations, the FAM540 must be installed as illustrated in the "Intrinsic Safety Control Drawing".
See chapter "Intrinsic Safety Control Drawing SDM-10-A0253" on page 58.

Earthing

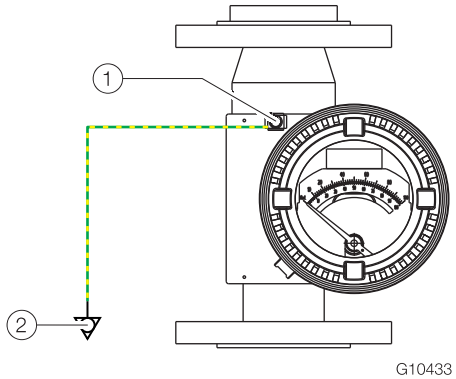


Fig. 8: Earthing
(1) Earthing terminal
(2) Potential equalization in accordance with EN 60079-0

The FAM540 housing must be correctly earthed in order to ensure proper function and safe operation.
Copper wires with a minimum cross-section of 6 mm^2 (AWG 10) must be used to connect to the potential equalization.

NOTE

The operator must ensure that when connecting the protective earth (PE), there are no potential differences between protective earth (PE) and potential equalization, even in the event of a fault.

Signal cable

For ambient temperatures below 5 °C (41 °F) or above 40 °C (104 °F), signal cables that are suited for the minimum/maximum ambient temperatures in question must be used.
Only use signal cables made from copper, copper-coated aluminum, or aluminum.
The recommended tightening torque for the terminals is 0.8 Nm (7 in. lb) or higher, in accordance with the specification.

Power supply

Installation must comply with the requirements of the National Electric Code® (ANSI / NFPA70).
Unless specified otherwise in regional or national standards, power supply lines must be dimensioned to AWG 20.
Installation must be carried out as outlined in the latest edition of the manufacturer's instruction manual.

A power supply with the following requirements must be used to provide power:

- SELV (safety extra-low voltage) with LPS (current-limited source) and double or reinforced insulation.
- Maximum output current of 8 A (current-limited output).
- In accordance with National Electric Code® (ANSI / NFPA70) connected to NEC class 2.

3.3 Safety specifications FM, cCSAus

Table 1: Analog indicator with alarm signaling unit (temperature data for FM in °F, for cCSAus in °C)

Order code[1]	Labeling	Terminals	Electrical values	T_{amb} -58 °F ...	T_{amb} -50 °C ...	Temp. class	T_{medium} Maximum		Insulation	Heating jacket
F3, F4	**FM** IS / CL I,II,III / DIV 1 / GP ABCDEFG / T6…T1[2] DIP / CL II, III / DIV 1 / GP EFG / T6…T1 CL I, ZN 1 AEx ia IIC T6…T1 **cCSAus** IS / CL I,II,III / DIV 1 / GP ABCDEFG / T6…T1[2] DIP / CL II, III / DIV 1 / GP EFG / T6…T1 Ex ia IIC T6…T1 DIP A21 TA 85°C to T_{medium}	41 / 42[3] 51 / 52[3]	U_i = 16 V I_i = 25 mA P_i = 64 mW C_i = 50 nF L_i = 250 µH	104 °F	40 °C	T1	824 °F	440 °C	No	No
				104 °F	40 °C	T1	707 °F	375 °C	yes	No
				104 °F	40 °C	T1	500 °F	260 °C	yes	yes
				122 °F	50 °C	T1	572 °F	300 °C	yes	No
				122 °F	50 °C	T2	554 °F	290 °C	yes	No
				122 °F	50 °C	T2	428 °F	220°C	yes	yes
				140 °F	60 °C	T2	608 °F	320 °C	No	No
				140 °F	60 °C	T2	446 °F	230 °C	yes	No
				140 °F	60 °C	T3	338 °F	170 °C	yes	yes
				158 °F	70 °C	T3	383 °F	195 °C	No	No
				158 °F	70 °C	T3	302 °F	150 °C	yes	No
				158 °F	70 °C	T4	266 °F	130 °C	yes	yes
				158 °F	70 °C	T5	203 °F	95 °C	yes	yes
				140 °F	60 °C	T6	176 °F	80 °C	yes	yes
		41 / 42[3] 51 / 52[3]	U_i = 16 V I_i = 52 mA P_i = 169 mW C_i = 50 nF L_i = 250 µH	104 °F	40 °C	T1	824 °F	440 °C	No	No
				104 °F	40 °C	T1	707 °F	375 °C	yes	No
				104 °F	40 °C	T1	500 °F	260 °C	yes	yes
				122 °F	50 °C	T1	572 °F	300 °C	yes	No
				122 °F	50 °C	T2	554 °F	290 °C	yes	No
				122 °F	50 °C	T2	428°F	220°C	yes	yes
				140 °F	60 °C	T2	608 °F	320 °C	No	No
				140 °F	60 °C	T2	446 °F	230 °C	yes	No
				140 °F	60 °C	T3	338 °F	170 °C	yes	yes
				158 °F	70 °C	T3	383 °F	195 °C	No	No
				158 °F	70 °C	T3	302 °F	150 °C	yes	No
				158 °F	70 °C	T4	266 °F	130 °C	yes	yes
				140 °F	60 °C	T5	140 °F	60 °C	yes	yes
				122 °F	50 °C	T5	194 °F	90 °C	No	yes
				104 °F	40 °C	T6	140 °F	60 °C	yes	yes
		41 / 42[3] 51 / 52[3]	U_i = 16 V I_i = 76 mA P_i = 242 mW C_i = 50 nF L_i = 250 µH	104 °F	40 °C	T1	824 °F	440°C	No	No
				104 °F	40 °C	T1	590 °F	310 °C	yes	No
				104 °F	40 °C	T2	374 °F	190 °C	yes	yes
				122 °F	50 °C	T2	644 °F	340 °C	No	No
				122 °F	50 °C	T2	446 °F	230 °C	yes	yes
				140 °F	60 °C	T2	446 °F	230 °C	No	No
				140 °F	60 °C	T3	320 °F	160 °C	yes	yes
				158 °F	70 °C	T4	248 °F	120 °C	No	No
				158 °F	70 °C	T4	212 °F	100 °C	yes	yes
				104 °F	40 °C	T5	140 °F	60 °C	yes	yes
				86 °F	30 °C	T6	86 °F	30 °C	yes	yes

1) Order code "Explosion protection and approvals" (versions 9, 10); refer to chapter Ordering information in the data sheet.
2) "IS" installation in accordance with Installation Drawing SDM-10-A0253.
3) For connection to an intrinsically safe circuit.

Table 2: Analog indicator with alarm signaling unit (temperature data for FM in °F, for cCSAus in °C)

Order code[1]	Labeling	Terminals	Electrical values	T_{amb} -58 °F ...	T_{amb} -50 °C ...	Temp. class	T_{medium} Maximum		Insulation	Heating jacket
F3	**FM** XP / CL I / DIV 1 / GP ABCD / T6…T1 DIP / CL II, III / DIV 1 / GP EFG / T6…T1 CL I, ZN 1 AEx d IIC T6…T1 **cCSAus** XP / CL I / DIV 1 / GP BCD / T6…T1 DIP / CL II, III / DIV 1 / GP EFG / T6…T1 Ex d IIC T6…T1 DIP A21 TA 85°C to T_{medium}	41 / 42[2] 51 / 52[2]	U_{max} = 16 V I_{max} = 25 mA P_{max} = 64 mW	104 °F	40 °C	T1	824 °F	440 °C	No	No
				104 °F	40 °C	T1	707 °F	375 °C	yes	No
				104 °F	40 °C	T1	500 °F	260 °C	yes	yes
				122 °F	50 °C	T1	572 °F	300 °C	yes	No
				122 °F	50 °C	T2	554 °F	290 °C	yes	No
				122 °F	50 °C	T2	428 °F	220°C	yes	yes
				140 °F	60 °C	T2	608 °F	320 °C	No	No
				140 °F	60 °C	T2	446 °F	230 °C	yes	No
				140 °F	60 °C	T3	338 °F	170 °C	yes	yes
				158 °F	70 °C	T3	383 °F	195 °C	No	No
				158 °F	70 °C	T3	302 °F	150 °C	yes	No
				158 °F	70 °C	T4	266 °F	130 °C	yes	yes
				158 °F	70 °C	T5	203 °F	95 °C	yes	yes
				140 °F	60 °C	T6	176 °F	80 °C	yes	yes
		41 / 42[2] 51 / 52[2]	U_{max} = 16 V I_{max} = 52 mA P_{max} = 169 mW	104 °F	40 °C	T1	824 °F	440 °C	No	No
				104 °F	40 °C	T1	707 °F	375 °C	yes	No
				104 °F	40 °C	T1	500 °F	260 °C	yes	yes
				122 °F	50 °C	T1	572 °F	300 °C	yes	No
				122 °F	50 °C	T2	554 °F	290 °C	yes	No
				122 °F	50 °C	T2	428°F	220°C	yes	yes
				140 °F	60 °C	T2	608 °F	320 °C	No	No
				140 °F	60 °C	T2	446 °F	230 °C	yes	No
				140 °F	60 °C	T3	338 °F	170 °C	yes	yes
				158 °F	70 °C	T3	383 °F	195 °C	No	No
				158 °F	70 °C	T3	302 °F	150 °C	yes	No
				158 °F	70 °C	T4	266 °F	130 °C	yes	yes
				140 °F	60 °C	T5	140 °F	60 °C	yes	yes
				122 °F	50 °C	T5	194 °F	90 °C	No	yes
				104 °F	40 °C	T6	140 °F	60 °C	yes	yes
		41 / 42[2] 51 / 52[2]	U_{max} = 16 V I_{max} = 76 mA P_{max} = 242 mW	104 °F	40 °C	T1	824 °F	440°C	No	No
				104 °F	40 °C	T1	590 °F	310 °C	yes	No
				104 °F	40 °C	T2	374 °F	190 °C	yes	yes
				122 °F	50 °C	T2	644 °F	340 °C	No	No
				122 °F	50 °C	T2	446 °F	230 °C	yes	yes
				140 °F	60 °C	T2	446°F	230 °C	No	No
				140 °F	60 °C	T3	320 °F	160 °C	yes	yes
				158 °F	70 °C	T4	248 °F	120 °C	No	No
				158 °F	70 °C	T4	212 °F	100 °C	yes	yes
				104 °F	40 °C	T5	140 °F	60 °C	yes	yes
				86 °F	30 °C	T6	86 °F	30 °C	yes	yes

1) Order code "Explosion protection and approvals" (versions 9, 10); refer to chapter Ordering information in the data sheet.
2) For connection to a non-intrinsically safe circuit.

Table 3: Analog indicator with / without alarm signaling unit (temperature data for FM in °F, for cCSAus in °C)

Order code[1]	Labeling	Terminals	Electrical values	T_{amb} -58 °F ...	T_{amb} -50 °C ...	Temp. class	T_{medium} Maximum		Insulation	Heating jacket
F3[2], F4[2]	**FM** NI /CL I,II / DIV 2 / GP ABCDFG / T5…T1 NI / CL III / T5…T1 CL II, ZN 2 AEx nA II T5…T1 **cCSAus** NI /CL I,II / DIV 2 / GP ABCDFG / T5…T1 NI / CL III / T5…T1 Ex nA II T6…T1 DIP A21 TA 85°C to T_{medium}	41 / 42[3] 51 / 52[3]	U_{max} = 16 V I_{max} = 25 mA P_{max} = 64 mW	104 °F	40 °C	T1	824 °F	440 °C	No	No
				104 °F	40 °C	T1	707 °F	375 °C	yes	No
				104 °F	40 °C	T1	500 °F	260 °C	yes	yes
				122 °F	50 °C	T1	572 °F	300 °C	yes	No
				122 °F	50 °C	T2	554 °F	290 °C	yes	No
				122 °F	50 °C	T2	428°F	220°C	yes	yes
				140 °F	60 °C	T2	608 °F	320 °C	No	No
				140 °F	60 °C	T2	446 °F	230 °C	yes	No
				140 °F	60 °C	T3	338 °F	170 °C	yes	yes
				158 °F	70 °C	T3	383 °F	195 °C	No	No
				158 °F	70 °C	T3	302 °F	150 °C	yes	No
				158 °F	70 °C	T4	266 °F	130 °C	yes	yes
				158 °F	70 °C	T5	203 °F	95 °C	yes	yes
		41 / 42[3] 51 / 52[3]	U_{max} = 16 V I_{max} = 52 mA P_{max} = 169 mW	104 °F	40 °C	T1	824 °F	440 °C	No	No
				104 °F	40 °C	T1	707 °F	375 °C	yes	No
				104 °F	40 °C	T1	500 °F	260 °C	yes	yes
				122 °F	50 °C	T1	572 °F	300 °C	yes	No
				122 °F	50 °C	T2	554 °F	290 °C	yes	No
				122 °F	50 °C	T2	428°F	220°C	yes	yes
				140 °F	60 °C	T2	608 °F	320 °C	No	No
				140 °F	60 °C	T2	446 °F	230 °C	yes	No
				140 °F	60 °C	T3	338 °F	170 °C	yes	yes
				158 °F	70 °C	T3	383 °F	195 °C	No	No
				158 °F	70 °C	T3	302 °F	150 °C	yes	No
				158 °F	70 °C	T4	266 °F	130 °C	yes	yes
				140 °F	60 °C	T5	140 °F	60 °C	yes	yes
				122 °F	50 °C	T5	194 °F	90 °C	No	yes
		41 / 42[3] 51 / 52[3]	Umax= 16 V Imax = 76 mA Pmax = 242 mW	104 °F	40 °C	T1	824 °F	440°C	No	No
				104 °F	40 °C	T1	590 °F	310 °C	yes	No
				104 °F	40 °C	T2	374 °F	190 °C	yes	yes
				122 °F	50 °C	T2	644 °F	340 °C	No	No
				122 °F	50 °C	T2	446 °F	230 °C	yes	yes
				140 °F	60 °C	T2	446°F	230 °C	No	No
				140 °F	60 °C	T3	320 °F	160 °C	yes	yes
				158 °F	70 °C	T4	248 °F	120 °C	No	No
				158 °F	70 °C	T4	212 °F	100 °C	yes	yes
				104 °F	40 °C	T5	140 °F	60 °C	yes	yes

1) Order code "Explosion protection and approvals" (versions 9, 10); refer to chapter Ordering information in the data sheet.
2) For connection in Division 2 or Zone 2.
3) For connection to a non-intrinsically safe circuit.

Table 4: Analog indicator with transmitter, with or without LCD indicator (temperature data for FM in °F, for cCSAus in °C)

Order code[1]	Labeling	Terminals	Electrical values	T_{amb} -58 °F ...	T_{amb} -50 °C ...	Temp. class	T_{medium} Maximum		Insulation	Heating jacket
F3, F4	**FM** IS / CL I,II,III / DIV 1 / GP ABCDEFG / T4…T1 DIP / CL II, III / DIV 1 / GP EFG / T6…T1 CL I, ZN 1 AEx ia IIC T4…T1	31 / 32[2) 3)]	U_i = 30 V I_i = 110 mA P_i = 770 mW C_i = 5.3 nF L_i = 266 µH	104 °F	40 °C	T1	824 °F	440 °C	No	No
				104 °F	40 °C	T1	707 °F	375 °C	yes	No
				104 °F	40 °C	T1	500 °F	260 °C	yes	yes
				122 °F	50 °C	T1	572 °F	300 °C	yes	No
				122 °F	50 °C	T2	554 °F	290 °C	yes	No
				122 °F	50 °C	T2	428°F	220°C	yes	yes
	cCSAus IS / CL I,II,III / DIV 1 / GP ABCDEFG / T4…T1 [2)] DIP / CL II, III / DIV 1 / GP EFG / T6…T1 Ex ia IIC T6…T1 DIP A21 TA 85°C to T_{medium}	41 / 42[2)]	U_i = 30 V I_i = 30 mA P_i = 115 mW C_i = 4.8 nF L_i = 133 µH	140 °F	60 °C	T2	608 °F	320 °C	No	No
				140 °F	60 °C	T2	446 °F	230 °C	yes	No
				140 °F	60 °C	T3	338 °F	170 °C	yes	yes
				158 °F	70 °C	T3	383 °F	195 °C	No	No
				158 °F	70 °C	T3	302 °F	150 °C	yes	No
				158 °F	70 °C	T4	257 °F	125 °C	yes	yes
F3	**FM** XP / CL I / DIV 1 / GP ABCD / T6…T1 DIP / CL II, III / DIV 1 / GP EFG / T6...T1 CL I, ZN 1 AEx d IIC T6...T1	31 / 32[4)]	U_{max} = 46 V	104 °F	40 °C	T1	824 °F	440 °C	No	No
				104 °F	40 °C	T1	707 °F	375 °C	yes	No
				104 °F	40 °C	T1	500 °F	260 °C	yes	yes
				122 °F	50 °C	T1	572 °F	300 °C	yes	No
				122 °F	50 °C	T2	554 °F	290 °C	yes	No
				122 °F	50 °C	T2	428°F	220 °C	yes	yes
	cCSAus XP / CL I / DIV 1 / GP BCD / T6…T1 DIP / CL II, III / DIV 1 / GP EFG / T6…T1 Ex d IIC T6…T1 DIP A21 TA 85°C to T_{medium}	41 / 42[4)]	U_{max} = 30 V I_{max} = 30 mA P_{max} = 115 mW	140 °F	60 °C	T2	608 °F	320 °C	No	No
				140 °F	60 °C	T2	446 °F	230°C	yes	No
				140 °F	60 °C	T3	338 °F	170 °C	yes	yes
				140 °F	60 °C	T4	266 °F	130 °C	yes	yes
				140 °F	60 °C	T5	203 °F	95 °C	yes	yes
				140 °F	60 °C	T6	176 °F	80 °C	yes	yes

1) Order code "Explosion protection and approvals" (versions 9, 10); refer to chapter Ordering information in the data sheet.
2) For connection to an intrinsically safe circuit.
3) Installation in accordance with Installation Drawing SDM-10-A0253.
4) For connection to a non-intrinsically safe circuit.

Continuation of Table 4: Analog indicator with transmitter, with or without LCD indicator (temperature data for FM in °F, for cCSAus in °C)

Order code[1]	Labeling	Terminals	Electrical values	T_{amb} -58 °F ...	T_{amb} -50 °C ...	Temp. class	T_{medium} Maximum		Insulation	Heating jacket
F3[5], F4[5]	**FM** NI /CL I,II / DIV 2 / GP ABCDFG / T4...T1 NI / CL III / T4...T1 CL II, ZN 2 AEx nA [nL] IIC T4...T1 **cCSAus** NI /CL I,II / DIV 2 / GP ABCDFG / T4…T1 NI / CL III / T4…T1 Ex nA [nL] IIC T4…T1 DIP A21 TA 85°C to T_{medium}	31 / 32[4]	U_{max} = 46 V	104 °F	104 °F	T1	824 °F	440 °C	No	No
				104 °F	104 °F	T1	707 °F	375 °C	yes	No
				104 °F	104 °F	T1	500 °F	260 °C	yes	yes
				122 °F	122 °F	T1	572 °F	300 °C	yes	No
				122 °F	122 °F	T2	554 °F	290 °C	yes	No
				122 °F	122 °F	T2	428°F	220 °C	yes	yes
				140 °F	140 °F	T2	608 °F	320 °C	No	No
		41 / 42[4]	U_{max} = 30 V I_{max} = 30 mA P_{max} = 115 mW	140 °F	60 °C	T2	446 °F	230 °C	yes	No
				140 °F	60 °C	T3	338 °F	170 °C	yes	yes
				158 °F	70 °C	T3	383 °F	195 °C	No	No
				158 °F	70 °C	T3	302 °F	150 °C	yes	No
				158 °F	70 °C	T4	266 °F	130 °C	yes	yes
				158 °F	70 °C	T5	203 °F	95 °C	yes	yes
				86 °F	30 °C	T6	77 °F	25 °C	yes	yes

1) Order code "Explosion protection and approvals" (version digit No. 9, 10); refer to chapter Ordering information in the data sheet.
2) For connection to an intrinsically safe circuit.
3) Installation in accordance with Installation Drawing SDM-10-A0253.
4) For connection to a non-intrinsically safe circuit.
5) For connection in Division 2 or Zone 2.

3.4 Operating instructions

3.4.1 Protection against electrostatic discharges

⚠ DANGER

Risk of explosion!

The painted surface of the device can store electrostatic charges. As a result, the housing can form an ignition source due to electrostatic discharges in the following conditions:

- The device is operated in environments with a relative humidity of ≤ 30 %.
- This painted surface of the device is therefore relatively free from impurities such as dirt, dust or oil.

The instructions on avoiding the ignition of hazardous areas due to electrostatic discharges in accordance with the EN TR50404 and IEC 60079-32-1 standards must be observed!

Instructions on cleaning

The painted surface of the device may be cleaned only using a moist cloth.

3.4.2 Changing the type of protection

The device can be operated with various types of protection:

- When connecting to an intrinsically safe circuit in CL 1 Div. 1 or Zone 1, with type of protection "Intrinsic Safety (IS)".
- When connecting to a non-intrinsically safe circuit in CL 1 Div. 1 or Zone 1, with type of protection "Explosion proof (XP)".
- When connecting to a non-intrinsically safe circuit in CL 1 Div. 2 or Zone 2, with type of protection "Non-Incendive (NI)".

Depending on the model, the device may be designed to be installed in one of the applications listed. If you plan to use a device that was installed for one Ex type of protection with a different Ex type of protection, some measures must be taken before connecting voltage to the device.

When changing the type of protection, chapter „“ on page 17 must be adhered to.

Special information

Replacing components can affect the device's approval for use in Class I, Div. 1 and Class I, Div. 2.
If the device was not operated with type of protection XP or IS, but with type of protection NI, the device is only suitable for use in Class I, Div. 2, Group A, B, C, D or in non-hazardous areas.

4 Function and System Design

4.1 General remarks

FAM540 metal cone variable area flowmeters have a proven design and are equipped with an analog, mechanical indicator or an intelligent two-wire transmitter, i.e. the power supply and the flow signal utilize the same leads.

FAM540 metal cone variable area flowmeters can be used to measure the flow of gases, liquids and steam, e.g., in process engineering, the chemical and pharmaceutical industries as well as the food and beverage industry. They are especially suited for use with aggressive or opaque measuring media, and are ideal when glass tube variable area flowmeters cannot be used due to safety considerations. For high pressures and temperatures, a metal cone variable area flowmeter is often an essential requirement.

Key features of the device with transmitter include the ability to subsequently adjust devices on site to changed operating conditions, support for the HART® protocol, and an integrated contact output that can be configured via software. The HART protocol is used for digital communication between a distributed control system or PC, a handheld terminal and the flowmeter.

The modular design of the float enables, within specific limits, the measuring range to be changed subsequently. This permits devices already in use to be used for different measurement tasks. It also permits devices in temporary storage to be modified swiftly for a variety of measurement tasks.

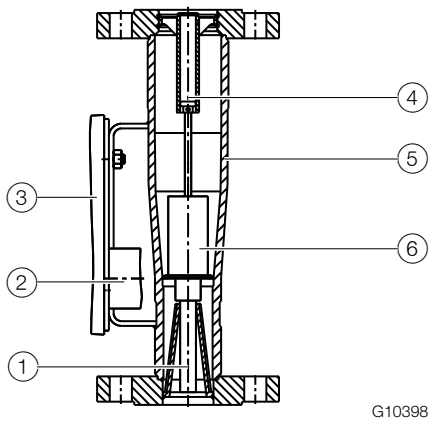


Fig. 9: Structure (example)
(1) Float guide (2) Magnet follower system (3) Indicator housing
(4) Gas damping (5) Conical meter pipe (6) Float

The main section consists of a conical metal meter pipe with welded flanges.

A magnet in the float translates the height of the float as a measurement for the flow to the decouple-proof magnet follower system of the flowmeter.

The flow rate value is indicated on a scale by a pointer mounted on a rotating shaft.

As an optional feature a modular two-wire transmitter can be added to convert the flow rate value into a proportional, linear 4 ... 20 mA output signal. It is also possible to display the flow rate value on a two-line LCD indicator, independent of the pointer position.

The LCD indicator, which can be configured in a plain text dialog, can be used to display the real-time flow rate and cumulative totalizer value, as well as to conveniently configure parameters.

4.2 Device overview

Model	FAM541	FAM544	FAM545	FAM546
	Standard design  G10448	Hygienic design  G10449	With PTFE liner  G10450	With heating jacket  G10451
Measured error in accordance with VDE / VDI 3513	1.6 % qg = 50 %	1.6 % qg = 50 %	2.5 % qg = 50 %	1.6 % qg = 50 %
Reproducibility	0.25 % of measured value	0.25 % of measured value	0.25 % of measured value	0.25 % of measured value
Process connection	Flange in accordance with DIN, ASME, JIS, female thread	Thread DIN 11851, SMS 1145	Flange in accordance with DIN, ASME, JIS	Flange in accordance with DIN, ASME, JIS
Nominal connection diameters	DN 15 (1/2") ... DN 100 (4")	DN 25 (1") ... DN 100 (4")	DN 25 (1") ... DN 100 (4")	DN 25 (1") ... DN 100 (4")
Maximum measuring medium temperature	400 °C (752 °F)	140 °C (284 °F)	120 °C (248 °F)	400 °C (752 °F)
Maximum pressure rating	PN 400 / class 2500	PN 40	PN 40 / class 300	PN 100 / class 600
Wetted material	Stainless steel 1.4404 (316L), 1.4571 (316Ti)	Stainless steel 1.4404 (316L), 1.4571 (316Ti)	PTFE	Stainless steel 1.4404 (316L), 1.4571 (316Ti)
Housing material	Stainless steel 1.4404 (316L), 1.4571 (316Ti)	Stainless steel 1.4404 (316L)	Stainless steel 1.4571 (316Ti)	Stainless steel 1.4404 (316L), 1.4571 (316Ti)
Gasket material	Viton A (DN 15 only)	Viton A (DN 25 only)	PTFE	Viton A (DN 25 only)

Indicator / transmitter	
IP degree of protection in accordance with EN 60529	IP 66, IP 67, NEMA 4X
Mechanical indicator	Analog indicator with or without alarm signaling unit
Electronic indicator	Analog indicator with transmitter 4 ... 20 mA, with or without LCD indicator
Communication	HART protocol (only for analog indicators with transmitters)
Power supply	Without alarm signaling unit: no power supply Analog indicator with alarm signaling unit: 8 V DC via switch amplifier Analog indicator with transmitter: 10 … 46 V DC (Ex: 10 …30 V DC)
Indicator housing material	Al Si 12 material number 3.2582 (copper content 0.1 %), stainless steel 1.4408
Paint	Epoxy paint 80 ... 100 µm; Bottom color: RAL 7012, cover color: RAL 9002 (No housing paint for stainless steel indicator housing)

Approvals	
Ex-approvals	ATEX / IECEx: Zone 0 / 1 / 2 / 21 FM / cCSAus: XP, IS, DIP, NI, FM Zone 1 + 2
Sealing concept	Dual sealing in accordance with ANSI / ISA-12.27.01
SIL approval (not for FAM545)	Analog indicator with alarm signaling unit: SIL 2 Analog indicator with transmitter: FMEDA evaluation

5 Product identification

5.1 Name plate

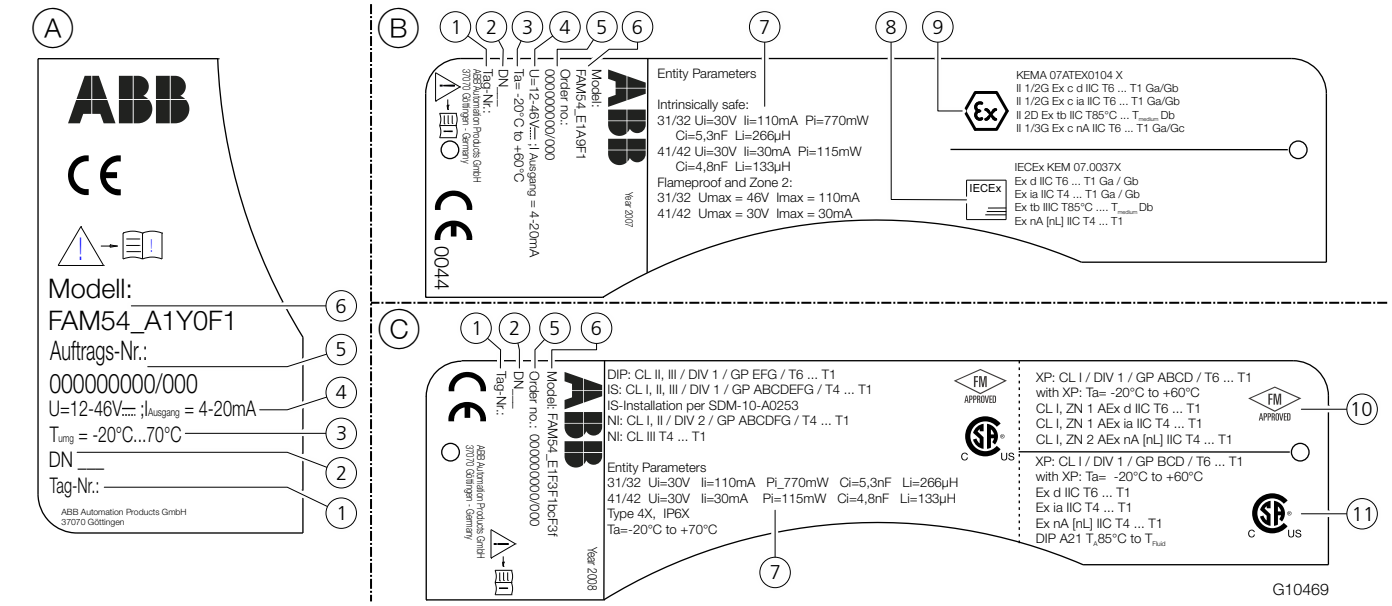


Fig. 10: Name plates (examples)
(A) **Standard** (B) **ATEX / IECEx** (C) **FM / cCSAus**
(1) **TAG number** (2) **Nominal size and degree of protection** (3) **Ambient temperature** (4) **Power supply / output current** (5) **Order number**
(6) **Model number** (7) **Electrical data (Ex)** (8) **IECEx approval** (9) **ATEX approval** (10) **FM approval** (11) **cCSAus approval**

NOTE

The name plates displayed are examples. The device identification plates affixed to the device can differ from this representation.

5.2 Factory plate

The factory plate is on the flowmeter in addition to the name plate. Depending on the nominal size of the flowmeter (> DN 25 or ≤ DN 25), it is identified with two different factory plates (also refer to article 3, paragraph 3 Pressure Equipment Directive 97/23/EC):

Pressure equipment within the scope of the Pressure Equipment Directive

Fig. 11: Factory plate for meter tube size > DN 25 (example)
(1) **Nominal size and nominal pressure rating** (2) **Material**
(3) **Year of manufacture** (4) **Address of the manufacturer**
(5) **Serial number** (6) **CE mark** (7) **Specification of the fluid group in accordance with Pressure Equipment Directive**

Below the CE mark, the number of the designated authority to confirm that the device meets the requirements of Pressure Equipment Directive is specified. The respective fluid group in accordance with the Pressure Equipment Directive is indicated under PED.
Example: Fluid group 1 = hazardous fluids, gaseous.

Pressure equipment within the scope of the Pressure Equipment Directive

Fig. 12: Factory plate for meter tube size ≤ DN 25 (example)
(1) **Nominal size and nominal pressure rating** (2) **Material**
(3) **Year of manufacture** (4) **Address of the manufacturer**
(5) **Serial number** (6) **Reason for exception under article 3, paragraph 3 of the Pressure Equipment Directive**

Under PED, the reason for the exception in article 3, paragraph 3 of the Pressure Equipment Directive is specified. The pressure equipment is classified in the SEP (= Sound Engineering Practice) "Good Engineering Practice" category.

NOTE

If the factory plate is not present, the device is not in compliance with Directive 97/23/EC. Networks for the supply, distribution and discharge of water and related specific accessories are classed as an exception in accordance with guideline 1/16 of Art. 1, Para. 3.2 of the Pressure Equipment Directive.

6 Transport and storage

6.1 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.

6.2 Transport

⚠ DANGER

Life-threatening danger due to suspended loads.
In the case of suspended loads, a danger of the load falling exists.
Remaining under suspended loads is prohibited.

When transporting the device, please note:
- The center of gravity of some devices is not at the center of the equipment.
- The protection plates or dust caps mounted at the process connections of devices equipped with PTFE/PFA may only be removed immediately before installation. To prevent possible leakage, ensure that the liner on the flange is not cut or damaged.
- Ensure that small internal parts such as floats or cones do not fall out and become damaged.

6.3 Storage

Bear the following points in mind when storing devices:
- Store the device in its original packaging in a dry and dust-free location.
- Observe the permitted ambient conditions for transport and storage.
- Avoid storing the device in direct sunlight.
- In principle, the devices may be stored for an unlimited period. However, the warranty conditions stipulated in the order confirmation of the supplier apply.

The ambient conditions for the transport and storage of the device correspond to the ambient conditions for operation of the device.
Adhere to the device data sheet!

6.4 Returning devices

For the return of devices, follow the instructions in the chapter „Repair“ on page 51.

7 Installation

7.1 Installation conditions

- The installation recommendations of VDI / VDE Directive 3513 must be observed.
- The flowmeter is installed vertically in the piping. The measuring media must flow from bottom to top.
- Keep the device as far as possible from pipe vibrations and powerful magnetic fields.
- The piping should be the same size as the connection size of the flowmeter.
- Inlet and outlet sections are generally not required. Care should be taken to avoid flow turbulence, pulsations, pressure shocks and other flow instabilities in order to prevent measuring inaccuracies, increased wear or damage.
- When selecting devices, pay close attention to the chemical resistance of the wetted parts of the device and the process connection gaskets in relation to the measuring medium.
- Avoid pulsating flow of the measuring medium. Use the optional float damping if necessary.
- For gaseous measuring media we recommend an undisturbed inlet length of five times the inside diameter of the piping in accordance with VDI / VDE Directive 3513 sheet 3. Additional measures such as flow straighteners or perforated plates may be necessary for highly unbalanced flow profiles.
- Avoid contamination of gaseous measuring media (refer to BGR 132-7.3.2.2.2).
- For liquid measuring media, the nominal size of the piping should be dimensioned as large as possible (if economically viable).
- Avoid gas inclusions in liquid measuring media.
- Use slow opening valves.
- If the flowmeter is installed in a pipeline where decommissioning is impossible or inexpedient, a bypass line should be provided.

— Shut-off and throttle valves should preferably be attached to the outlet of the flowmeter.

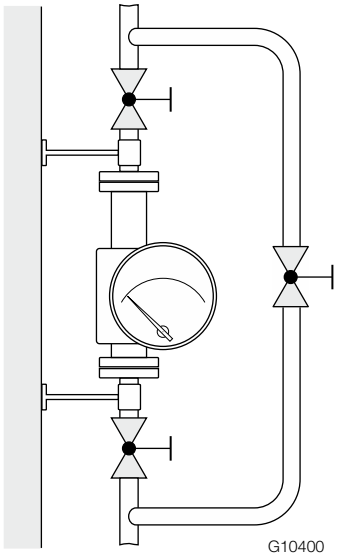


Fig. 13: Installation of the flowmeter (example)

Refer to VDI/VDE Directive 3513 sheet 3, Selection and Installation Recommendations for Variable Area Flowmeters.

7.1.1 Sensor insulation

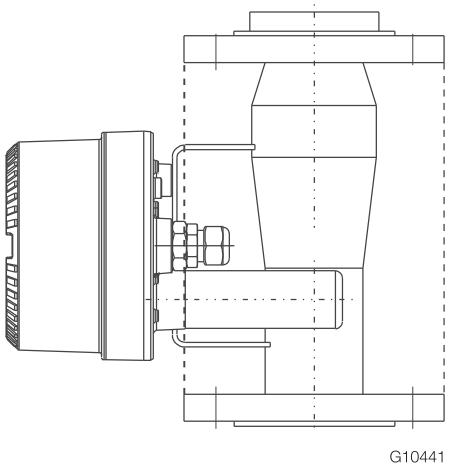


Fig. 14: Insulation of the flowmeter

As shown in Fig. 14, the flowmeter may only be insulated up to the flange diameter.

7.2 Operating conditions

A variable area flowmeter is specified for a defined set of operating conditions of the measuring medium. For liquids and gases, these are pressure and temperature-related properties (density and viscosity) under operating conditions.
For gases, in particular, this means operating at a specific operating pressure and operating temperature. The specified accuracy of the device always refers to the operating conditions underlying the specification.

7.2.1 Temperature data

The following diagram shows the maximum permissible measuring medium temperature depending on the ambient temperature.

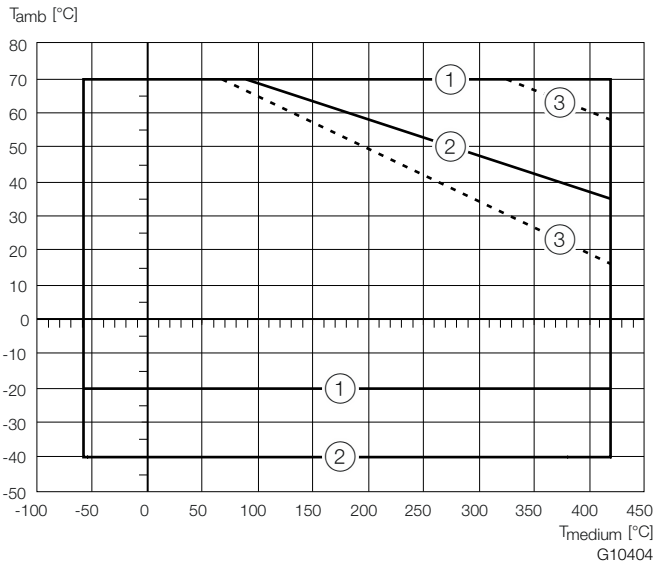


Fig. 15: Medium temperature (T_{medium}), ambient temperature (T_{amb})
(1) Devices with alarm output -20 ... 70 °C (-4 ... 158 °F)
(2) Devices with current output -40 ... 70 °C (-40 ... 158 °F)
(3) With insulation

NOTE

When using in potentially explosive atmospheres, observe the temperature information in the ATEX / IECEx limit values starting from „Safety specifications ATEX / IECEx“ on page 12 and the FM / cCSAus limit values tables starting from „Safety specifications FM, cCSAus“ on page 23!

7.2.2 Pressure loss

The available operating pressure at the measuring point must be higher than the pressure loss listed for the flowmeter in the specifications.
It is important to also consider the pressure loss downstream from the flowmeter due to losses in the piping and other fittings.

7.2.3 Prevention of compression oscillations when measuring gases

With low flow amounts and low operating pressure, so-called compression oscillations of the float can occur.
If the maximum upstream pressure listed in the specifications is not reached, the flowmeter can optionally be equipped with a gas damper.

To prevent self-generated compression oscillations, note the following information from VDI / VDE 3513 Sheet 3:

- Select a flowmeter with the lowest possible pressure loss.
- Minimize the piping length between the flowmeter and the closest up or downstream throttling location.
- Restrict the usual measuring range from the usual 10 … 100 % to 25 … 100 %.
- When setting the flow rate value, always start assuming larger values.
- Increase the operating pressure and consider its effect on the flow rate values due to the change in gas density at the new operating conditions.
- Minimize non-throttled, free volumes upstream and downstream of the device.

7.2.4 Pressure shocks

Especially when measuring gases, it is possible that pressure or shock waves can occur when fast opening solenoid valves are employed and the piping cross-sections are not throttled, or if there are gas bubbles in liquids.
As a result of the sudden expansion of the gas in the piping, the float is forcibly driven against the upper floatstop.
Under certain conditions, this can lead to destruction of the device.
Gas damping is not suited to compensating for pressure shocks!

7.2.5 Solids content in the measuring medium

Variable area flowmeters have only limited suitability for measuring media containing solids.
Depending on the concentration, particle size and type of solid, increased mechanical abrasion may occur, especially at the critical measuring edge of the float.
In addition, solidified deposits on the float can change its weight and shape.
These effects can lead to erroneous measurement results, depending on the float type.
In general, the use of appropriate filters is recommended in such applications.
For the flow measurement of measuring media containing magnetic particles, we recommend the installation of a magnetic separator upstream of the variable area flowmeter.

7.3 Float designs

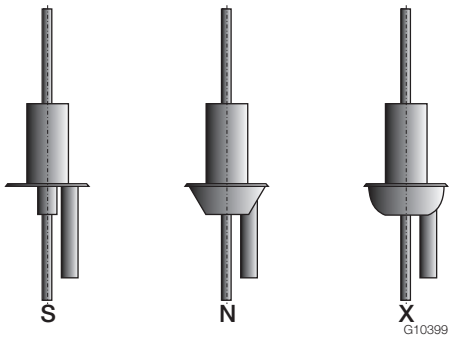


Fig. 16: Float designs

Float "S":
Basic shape of float.
Low flow rates, minimal pressure losses, essentially independent of viscosity; lower upstream pressure required for gas measurement.

Float "N":
Higher flow ranges, average pressure losses, well suited to liquids with minimum viscosity; higher minimum upstream pressure requirements for gas measurements.

Float "X":
Highest flow rates, maximum pressure losses, well suited to liquids with minimum viscosity; higher minimum upstream pressure requirements for gas measurements.

7.3.1 Measuring range limits

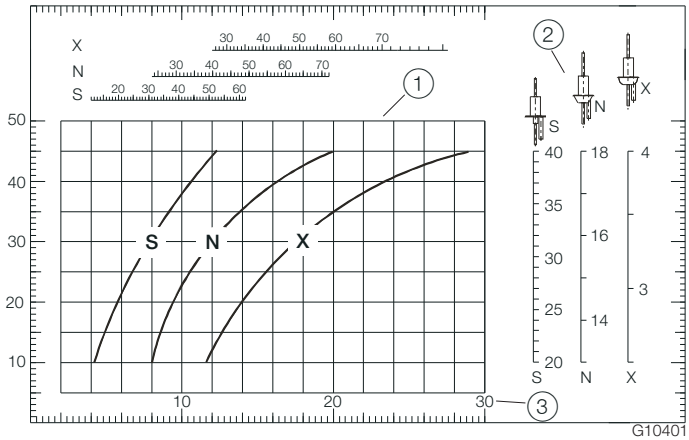


Fig. 17: Flow rate depending on float shape and weight (example)
(1) Pressure loss (dP in mbar) (2) Diameter of the float weight (mm) (3) x 1000 l/h water

For measuring range limits depending on nominal size and float type, refer to the measuring range tables.

7.4 Installation

The following points must be observed during installation:

- The flow direction must correspond to the direction indicated on the device, if labeled.
- The maximum torque must not be exceeded for all flange connections.
- The devices must be installed without mechanical tension (torsion, bending)
- Install flange devices with coplanar counter flanges and only use appropriate gaskets.
- Only gaskets made from a material that is compatible with the measuring medium and the measuring medium temperature may be used.
- Gaskets must not extend into the flow area since possible turbulence could influence device accuracy.
- The piping may not exert any impermissible forces or torques on the device.
- Do not remove the sealing plugs in the cable glands until you are ready to install the electrical cable.
- Make sure the gaskets for the housing cover are seated correctly Carefully seal the cover. Tighten the cover fittings
- Do not expose the transmitter to direct sunlight; where necessary, provide appropriate sun protection.

7.4.1 Flowmeter installation

NOTE

Potential damage to the device!

- Vacuum shocks in the piping must be prevented for devices with PTFE liners (FAM545). Vacuum shocks can destroy the device.

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

1. Remove protective plates, if present, from above and below the meter tube. Ensure that internal parts such as floats or the conical meter pipe do not fall out and become damaged.
2. Remove the wooden stick serving as a transport securing device from the meter tube.
3. Position the meter tube coplanar and centered between the piping.
4. Install gaskets between the sealing surfaces.

NOTE

For achieve the best results, ensure the gaskets fit concentrically with the meter tube

5. Use the appropriate screws for the holes.
6. Slightly grease the threaded nuts.
7. Tighten the nuts in a crosswise manner as shown in the figure.

NOTE

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

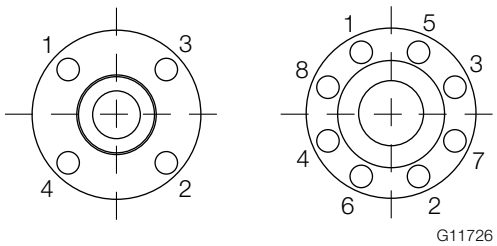


Fig. 18: Tightening sequence for the flange screws

7.4.2 Material loads for process connections

NOTE

Potential damage to the device!

Exceeding the permissible measuring medium temperature can damage the gaskets and the device.

Do not exceed the maximum permissible measuring medium temperature specified on the factory and name plate as well as in the following tables.

Model FAM541 - Standard design

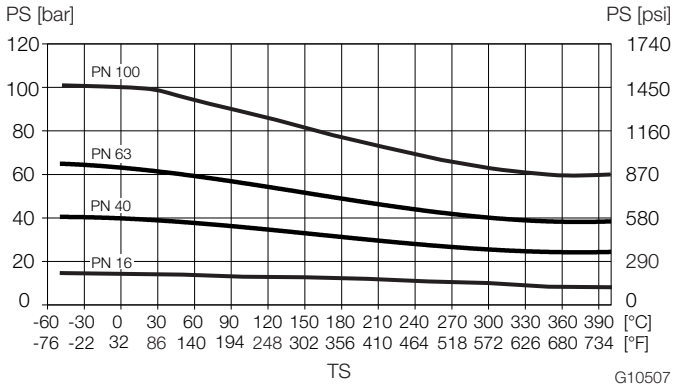


Fig. 19: DIN flange made from stainless steel

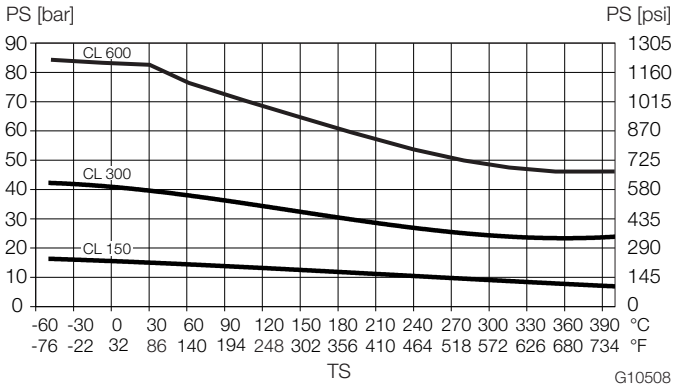


Fig. 20: ASME flange made from stainless steel

Model FAM544 - Hygienic design

Process connection	Nominal Diameter	PS_{max}	TS_{min}	TS_{max}
DIN 11851	DN 15 ... 40 (1/2 ... 1 1/2“)	40 bar (580 psi)	-40 °C (-40 °F)	140 °C (284 °F)
	DN 50 ... 100 (2 ... 4“)	25 bar (362 psi)	-40 °C (-40 °F)	140 °C (284 °F)
	DN 125 (5")	16 bar (232 psi)	-40 °C (-40 °F)	140 °C (284 °F)
SMS 1145	DN 38 ... 102 (1 1/2 ... 4“)	6 bar (87 psi)	-40 °C (-40 °F)	140 °C (284 °F)

Model FAM545 - With PTFE liner and Model FAM546 - With heating jacket

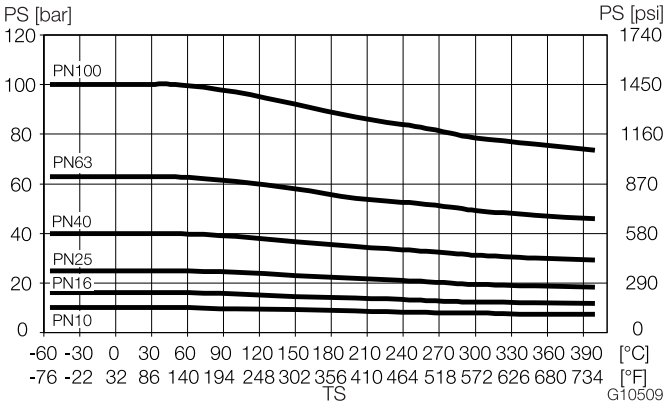


Fig. 21: DIN flange made from stainless steel

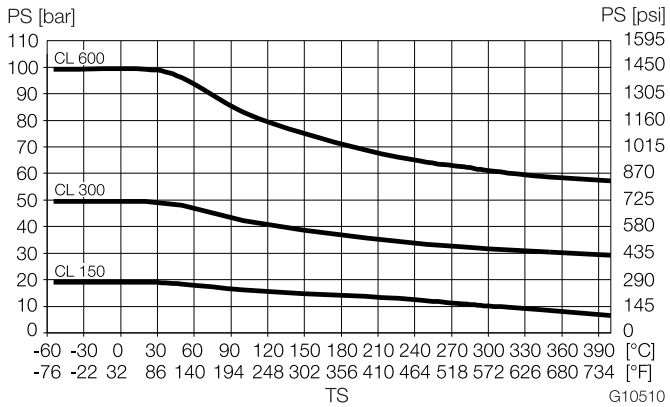


Fig. 22: ASME flange made from stainless steel

7.5 Electrical connections

⚠ DANGER

Improper installation and commissioning of the device carries a risk of explosion.

For use in potentially explosive atmospheres, observe the information in chapter „Use in potentially explosive atmospheres according to ATEX and IECEx“ on page 7 and „Use in potentially explosive atmospheres in accordance with FM and cCSAus“ on page 18!

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.

7.5.1 Analog indicator with alarm signaling unit

Model FAM54xB/C/Dx

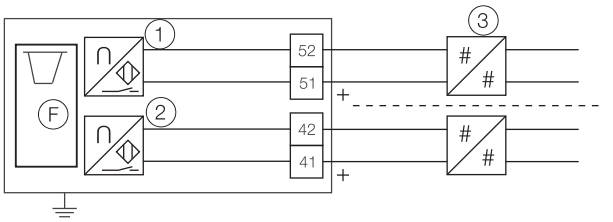


Fig. 23: Alarm signaling unit
(1) Maximum alarm signaling unit (2) Minimum alarm signaling unit
(3) Switch amplifier (F) Flowmeter

Additional switching amplifiers are needed to operate the alarm signaling units.
See chapter „Switching amplifier“ on page 36 and the "Ordering information" section of the data sheet for further information.

Alarm signaling unit specifications	
Operating mode	bistable
Reproducibility	±0.5% of scale end value
Nominal voltage	8 V DC (Ri approx. 1 kΩ)
Operating voltage	5 ... 25 V DC
Switching frequency, max.	3 kHz

7.5.2 Switching amplifier

For analog indicators with alarm signaling units (model FAM54xB/C/Dx)

Specifications	
Power supply	230 V AC, +10 % / -15 %, 45 … 60 Hz 115 V AC, +10 % / -15 %, 45 … 60 Hz 24 V DC, +10 % / -15 %
Output	1 or 2 switching relays with potential-free changeover contacts
Switching capacity	Maximum 250 V, maximum 4 A, maximum 500 VA
Maximum permissible cable length	Between switch amplifier and alarm signaling unit: 300 m (984 ft)
Permissible ambient temperature	-20 … 60 °C (-4 … 140 °F)
Electrical connection	Screw terminals, maximum 2.5 mm² (14 AWG)
Type of assembly	35 mm top-hat rail in accordance with EN 60715:2001
IP rating	IP20 in accordance with EN 60529
Weight	Approx. 150 g (0.3 lb)

7.5.3 Analog indicator with transmitter

Model FAM54xE/Fx

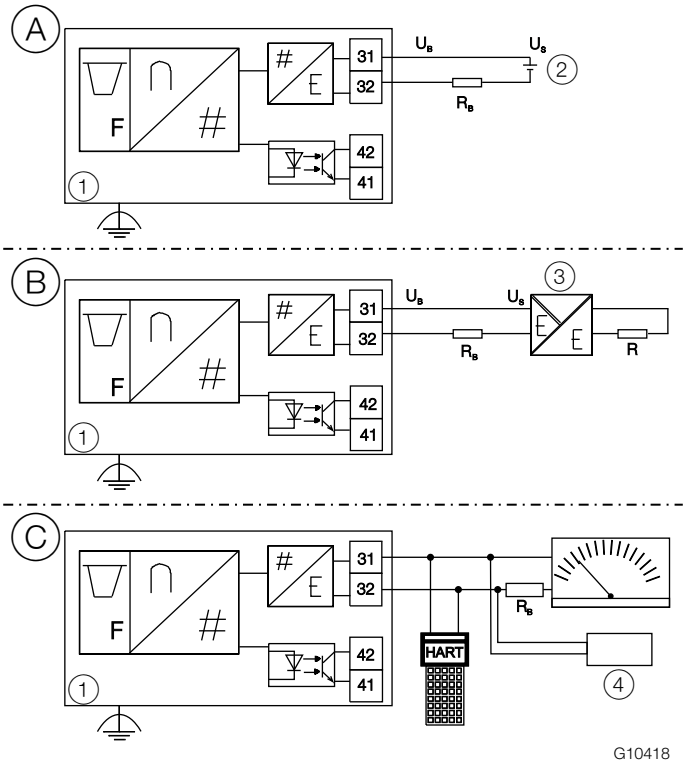


Fig. 24: Analog indicator with transmitter
(A) Central power supply (B) Power supply via power supply unit
(C) HART output
(1) Flowmeter (2) Power supply (3) Power supply unit
(4) HART modem

Legend	
U_B	Operating voltage
U_S	Input terminal voltage
R_B	Maximum permissible load for power supply unit (e.g. indicator)
R	Maximum permissible load for output circuit; is determined by power supply unit
⏚	Functional earth

Cables

Maximum cable length 1500 m, AWG 24 twisted and shielded.

Power supply / current output

Terminals 31 / 32 serve both as a connection for the power supply and as a 4 ... 20 mA current output for the transmitter. The current output is also used for HART communication.

Power supply	
Terminals	31 / 32
Voltage	Standard: 10 ... 46 V DC Explosion-proof design: 10 ... 30 V DC.
Residual ripple	Maximum 5 % or ± 1.5 V_{SS}
Power consumption	< 1 W

Current output	
Terminals	31 / 32
Output	4 ... 20 mA, can be configured to 21 ... 23 mA for an alarm (in accordance with NAMUR NE43)
Load	Minimum > 250 Ω, maximum 1500 Ω (for I at alarm = 23.0 mA)
Temperature effect	≤ 8 µ A/K
Power consumption	< 1 W

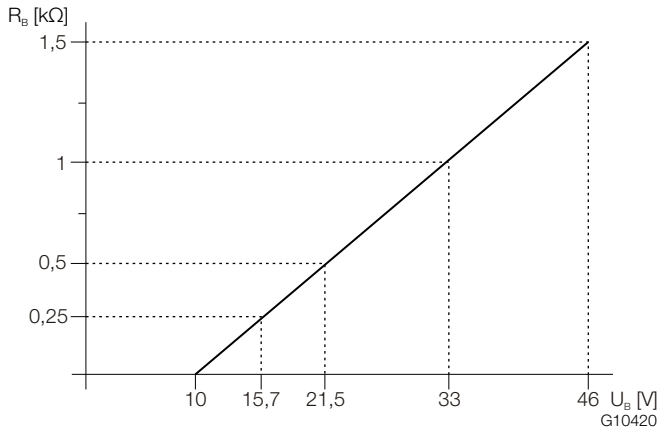


Fig. 25: Load diagram of the current output

7.5.4 HART output

Model FAM54xE/Fx

Specifications	
Terminals	31 / 32
Configuration	— Directly on the device — Using DAT200 Asset Vision Basic software and HART-DTM
Transmission	FSK modulation on current output 4 ... 20 mA in accordance with Bell 202 standard
Baud rate	1200 baud
Display	Logic 1: 1200 Hz Logic 0: 2200 Hz
Maximum signal amplitude	1.2 mA_{ss}
Load (R_B)at current output	250 ... 1500 Ω

See the separate interface description for detailed information.

System integration

In conjunction with the DTM (Device Type Manager) available for the device, the corresponding framework applications in accordance with FDT 0.98 or 1.2 (DAT200 Asset Vision Basic) can be used for communication (configuration, parameterization).
Other tool/system integrations (e.g., Emerson AMS/Siemens PCS7) are available on request.
The necessary DTMs and additional files can also be downloaded from www.abb.com/flow.

Programmable binary output

Terminals 41 / 42 are used as a primary programmable binary output. The pulse output, general alarm, min./max. alarm and general alarm functions, as well as "no function" can be configured using the software.

Binary output	
Terminals	41 / 42
Output	— NAMUR contact (DIN 19234) or — Standard optoelectronic coupler (U_H = 16 ... 30 V DC)
Switching behavior	Configurable as normally closed or normally open contacts
Internal resistance	With contact open > 10 kΩ
Switching current	Maximum 15 mA
Output voltage	Minimum U_s 2 V DC

Pulse output	
Terminals	41 / 42
Pulse width	5 ... 256 ms, maximum 50 % of the period
Frequency f_{max}	Maximum 50 Hz

8 Commissioning

⚠ DANGER

Improper installation and commissioning of the device carries a risk of explosion.

For use in potentially explosive atmospheres, observe the information in chapter „Use in potentially explosive atmospheres according to ATEX and IECEx“ on page 7 and „Use in potentially explosive atmospheres in accordance with FM and cCSAus“ on page 18!

⚠ DANGER

Danger of explosion if the device is operated with the transmitter housing open!

Before opening the transmitter housing, bear in mind the following:

— Check that a valid fire permit is available.
— Make sure that there is no explosion hazard.
— Before opening the device, switch off the power supply and wait for t > 2 minutes.

8.1 General information

The commissioning activities described here are performed after the device has been installed and electrically connected.

Bear in mind the following during commissioning:

— The power supply must be switched off.
— When using liquid measuring media, the piping must be vented carefully to avoid pressure shocks due to gas bubbles.
— When using gaseous measuring media, increase the flow pressure slowly.
— Vary the flow with help of adjustable valves (control valves) to protect the float from shock waves. Otherwise, the flowmeter may be damaged.
— If fast opening solenoid valves are used, pressure shocks on the float must be prevented by using suitable damping measures.

8.2 Switching on the power supply

The following points must be checked before commissioning the device:

— The wiring must have been completed as described in the chapter „Electrical connections“ on page 36.
— The correct grounding of the sensor.
— The ambient conditions must meet the requirements set out in the technical data.
— The power supply must meet the requirements set out on the identification plate.

8.2.1 Inspection after switching on the power supply

The configuration of the measuring medium parameters (standard and operating density) must be checked after commissioning the device. The measuring medium parameters must be adapted to the measuring medium being used if necessary.

See chapter ""Standard density" and "Operating density" menu" on page 46.

8.3 Setting the alarm signaling unit

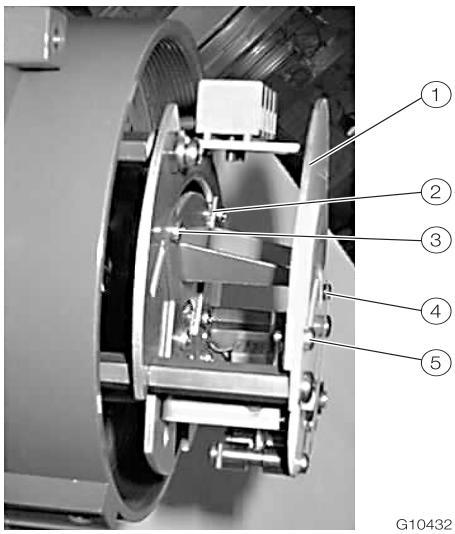


Fig. 26

1. Unscrew the housing cover.
2. Loosen screws ① and remove cover plate ②.
2. Loosen screws ③ + ④.
3. Move the alarm signaling unit ⑤ into the desired position.
4. Tighten screws ③ + ④.
5. Replace cover plate 2 and tighten screws ①.
6. Screw on housing cover.

i NOTE

For explosion proof apparatus, remove the safety locking device before opening the housing cover and reattach it after closing the housing!

8.4 Configuring the programmable output

The switch output of the transmitter is configured by default as a NAMUR contact.

The contact can also be configured as an optoelectronic coupler output.

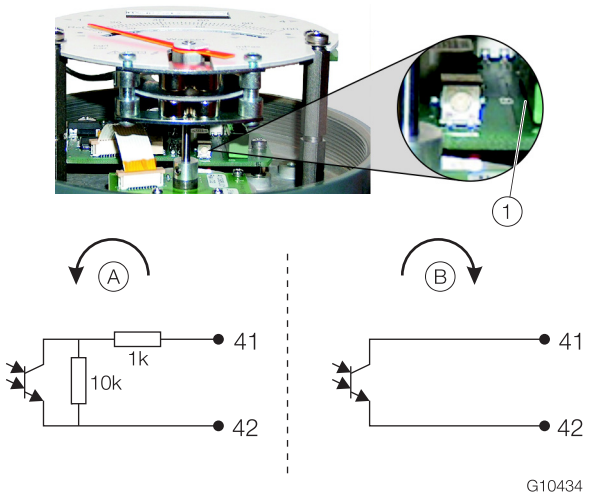


Fig. 27
(A) Switch to left stop: NAMUR contact
(B) Switch to right stop: optoelectronic coupler function
(1) Rotary switch for output configuration

1. Unscrew the housing cover.
2. Bring rotary switch into the desired position.
3. Screw on housing cover.

NOTE

For explosion proof apparatus, remove the safety locking device when opening the housing cover and reattach it after closing the housing!

8.5 Operating instructions

Observe the following points when operating the device:

— 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.

If there is a chance that safe operation is no longer possible, take the device out of operation and secure it against unintended startup.

9 Operation

DANGER

Danger of explosion if the device is operated with the transmitter housing open!

Before opening the transmitter housing, bear in mind the following:

— Check that a valid fire permit is available.
— Make sure that there is no explosion hazard.
— Before opening the device, switch off the power supply and wait for t > 2 minutes.

9.1 Menu navigation

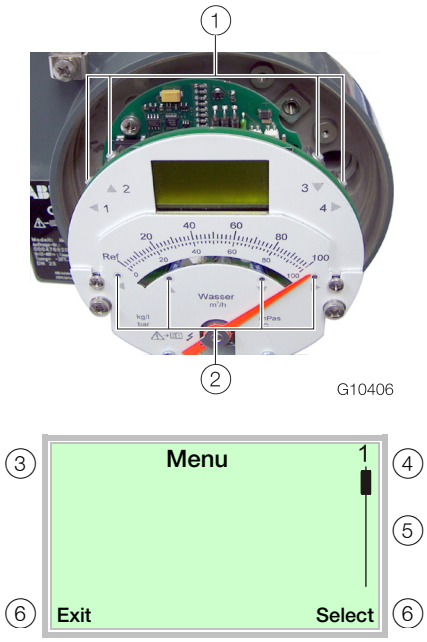


Fig. 28: LCD display
(1) Operating buttons for menu navigation
(2) Points for magnet stick operation (3) Menu name display
(4) Menu number display
(5) Marking to display the relative position within the menu
(6) Display of the function of the ▲ and ▼ operating buttons

You can use the ▲ or ▼ operating buttons to browse through the menu or select a number or character within a parameter value.

Different functions can be assigned to the ◄ and ► operating buttons. The function that is currently assigned (6) is shown on the LCD display.

Operating button functions

◄	Meaning
Exit	Exit menu
Back	Go back one submenu
Cancel	Cancel parameter entry
Next	Select the next position for entering numerical and alphanumeric values

►	Meaning
Select	Select submenu / parameter
Edit	Edit parameter
OK	Save parameter entered

Magnet stick operation

The magnet stick provides an alternative means of parameterizing 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 indicator.

9.1.1 User levels

The device features four user levels. The user levels are selected in the "Prog. level" menu.

The following user levels are available.

User level	Description
Standard	This user level is used for quick parameterization of the device. All of the customer-specific menus / parameters required for device operation can be configured here.
Specialist	In this user level, all menus / parameters are visible.
Service	The service menu is reserved exclusively for the after-sales-service of ABB Automation Products. It includes the default settings of the device. It can only be accessed with the service code. Changes may cause the device to display incorrect information.
Locked	In the "Specialist" user level, all menus / parameters of the "Standard" are visible, but cannot be edited. After an interruption of the power supply, this user level is active

Changing the user level

Before changing parameters, select the proper user level.

1. Press the button to jump to the Main Menu.
2. Use the ▲ or ▼ buttons to select the Prog.Level entry.
3. Press the button to jump to the Prog.Level.
4. Use the ▲ and ▼ buttons to select the desired user level and press ► (OK) to confirm.

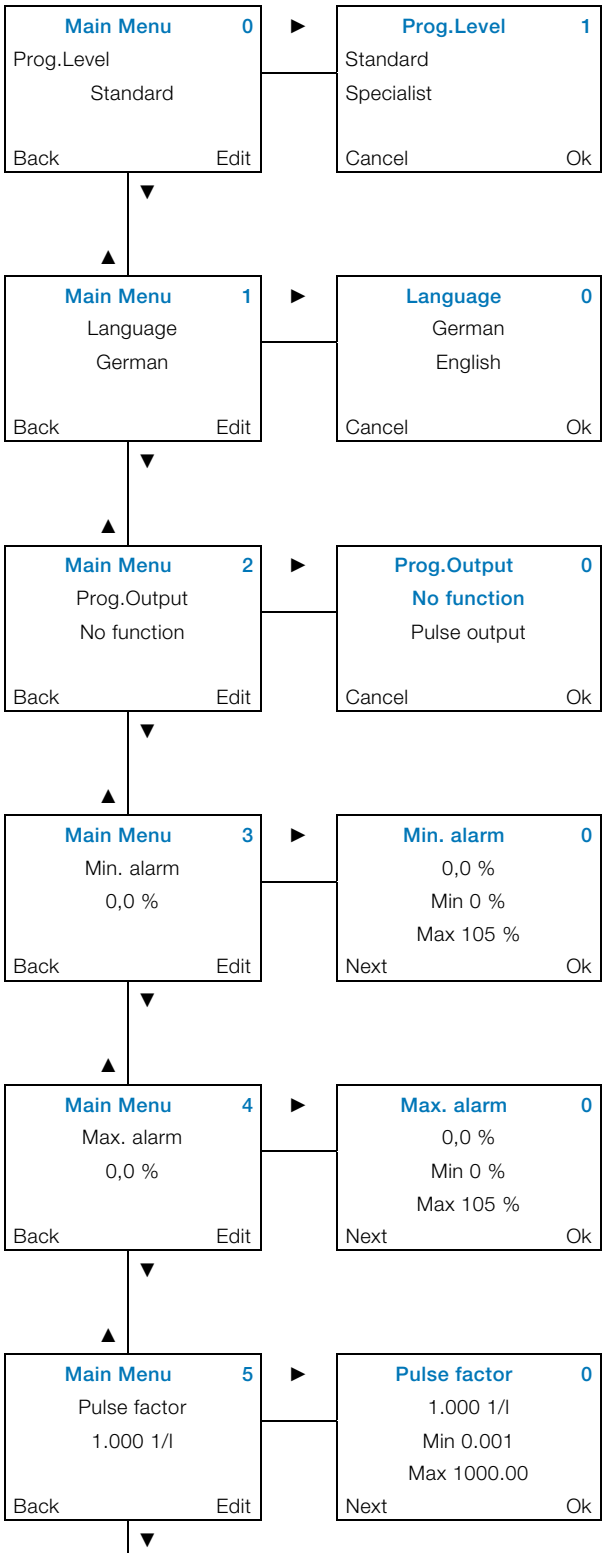
You can now complete parameterization in accordance with the selected user level.

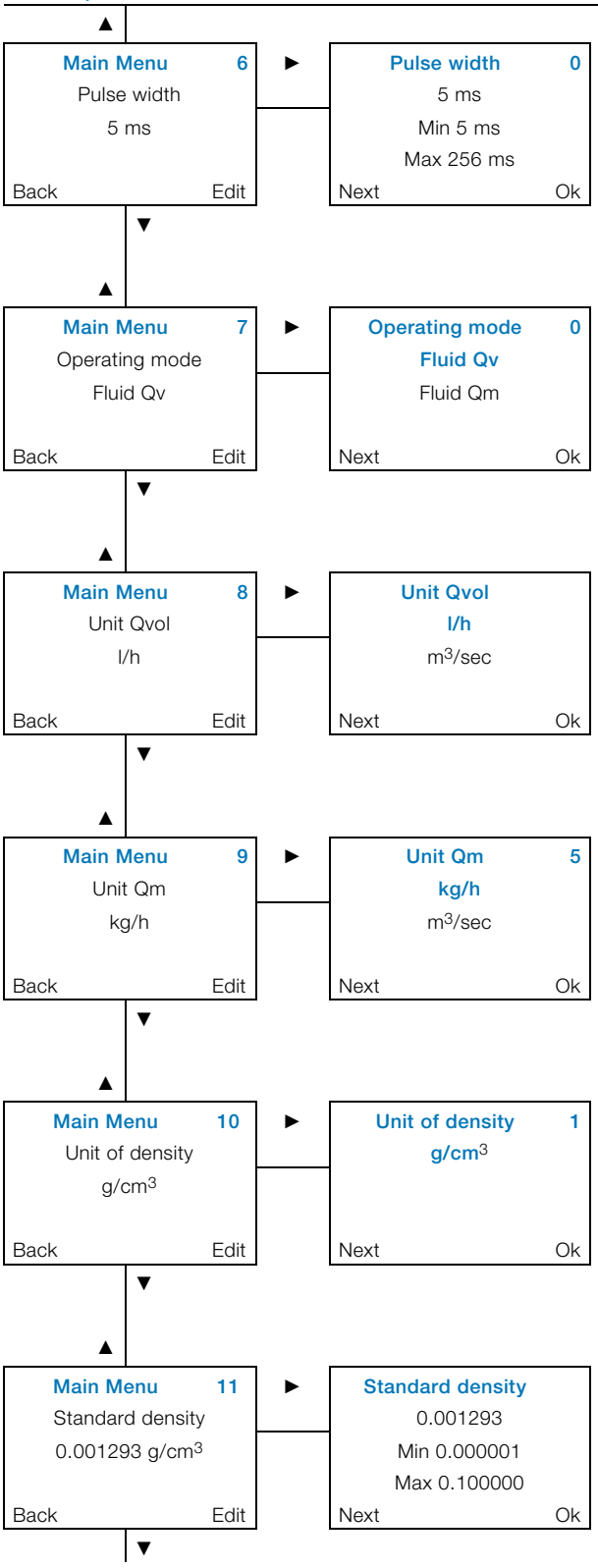
9.2 Parameterization of the device

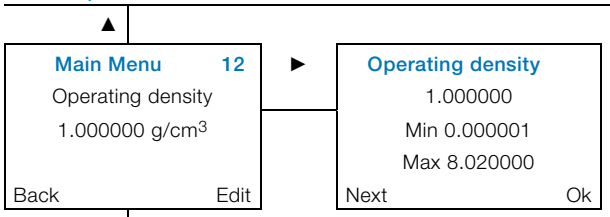
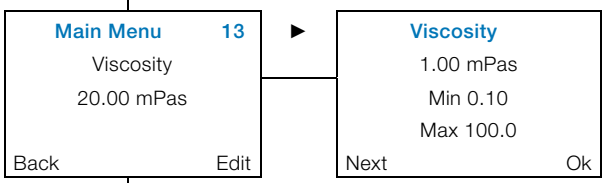
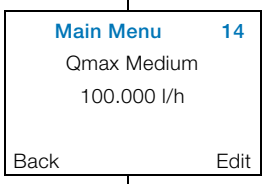
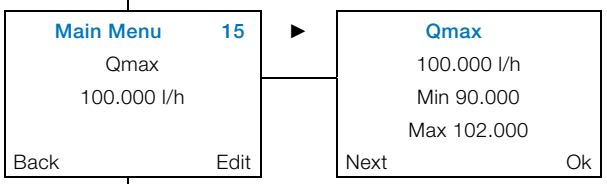
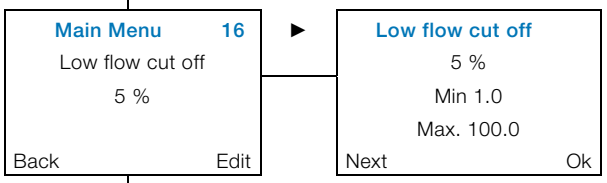
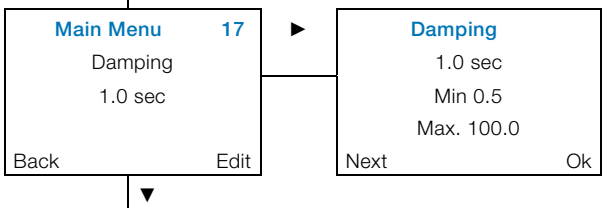
9.2.1 Parameter overview

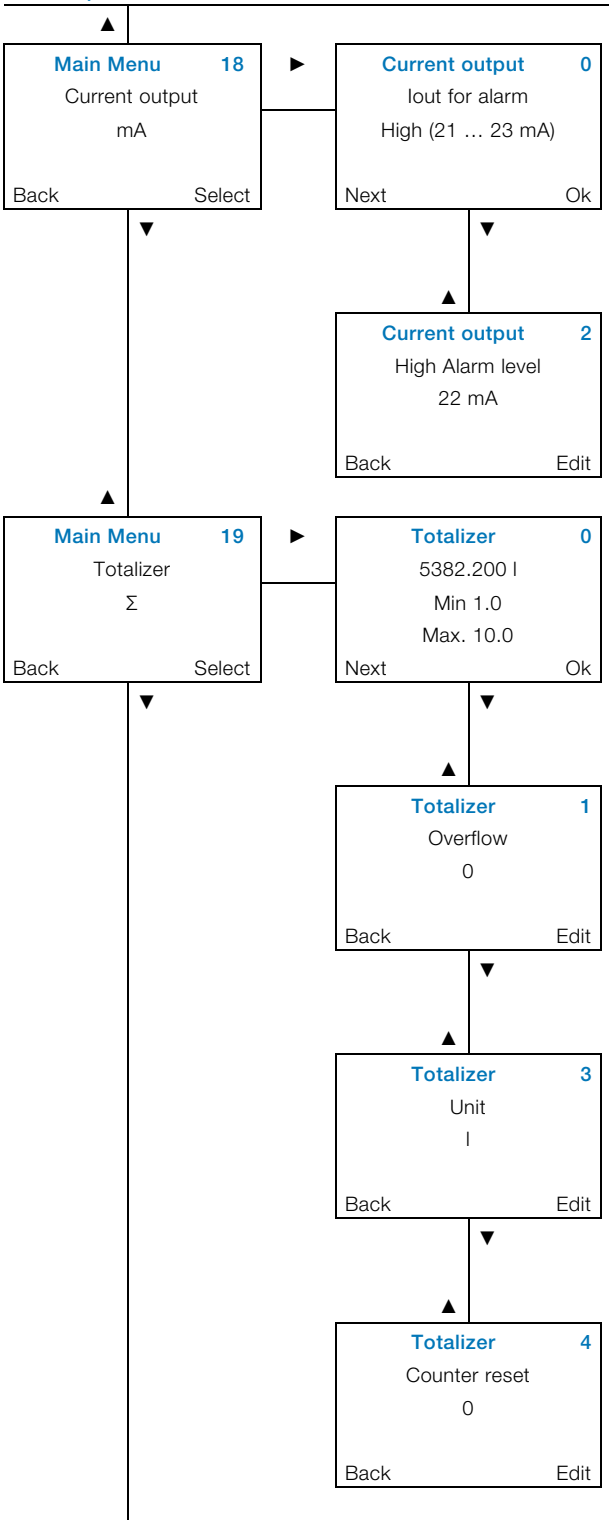
NOTE

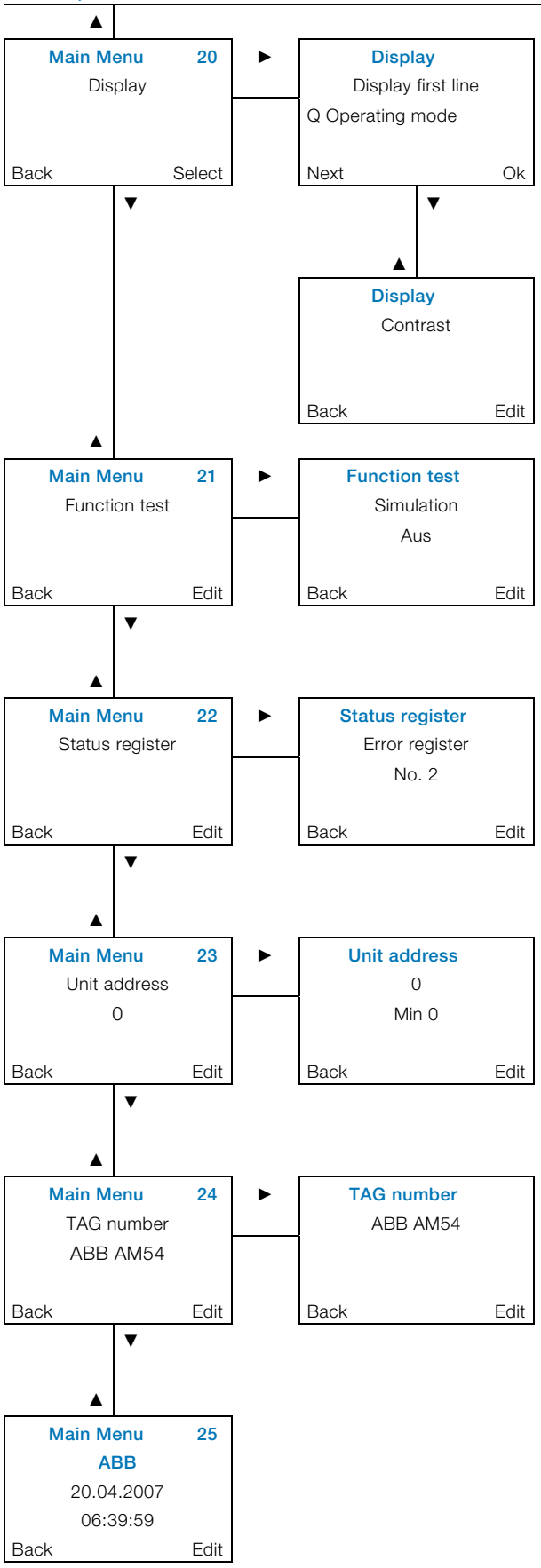
This overview of parameters shows all the menus and parameters available on the device. Depending on the version and configuration of the device, not all of the menus and parameters may be visible in it.

Menu / parameter	Value range / Input type	Comments
	Standard Specialist Service Locked German English No function Pulse output Min/Max alarm _ _; /_ General alarm _ _; /_ Numerical Numerical Numerical	Use the ▲ and ▼ buttons to select the user level and press the ► button to confirm. Alarms can be configured as normally closed or normally open contacts. See chapter „"Prog.Output"menu“ on page 46. Only active if an alarm type is selected. Only active if an alarm type is selected. Only active if a pulse output is selected. Enter as pulse per unit.

Menu / parameter	Value range / Input type	Comments
	Numerical Liquid: Qv, Qm Gas: Qv, Qm Gas standard: Qn, Qs l/s, l/m, l/h, m³/s, m³/m, m³/h, m³/d, ft³/s, ft³/m, ft³/h, ft³/d, usgps, usgpm, usgph, usmgd, igps, igpm, igph, igpd, bbl/s, bbl/m, bbl/h, bbl/d g/s, g/m, g/h, kg/s, kg/m, kg/h, kg/d, t/m, t/h, t/d, lb/s, lb/m, lb/h, lb/d g/ml, g/cm3, g/l, kg/l, kg/m3, lb/ft3, lb/ugl Numerical	Only active if a pulse output is selected. Qm = mass flow units Qv = operating volume units Qn, Qs = standard volume units See chapter „"Operating mode" menu“ on page 46. Only active if a volume unit is selected for the operating mode. Only active if a mass flow unit is selected for the operating mode. Density of the measuring medium Only active if a standard volume unit is selected for the operating mode. The standard density and the operating density are used to calculate the measuring span of the device.

Menu / parameter	Value range / Input type	Comments
	Numerical	The density of the measuring medium has an influence on the moving force of the float. Precise input is essential for an exact measurement.
	Numerical	Used for a comparison with the device-dependent maximum viscosity (stored) for this device.
		For information. Indicates the maximum measured value depending on the operating mode and density values for this device.
		The 20 mA value of the current output can be set within the limits that are shown.
	Numerical	Also refer to chapters „"Low flow cut off" menu“ on page 46 and „"Current output" menu“ on page 47.
	Numerical	See chapter „"Damping" menu“ on page 48.

Menu / parameter	Value range / Input type	Comments
	Numerical High 21 … 23 mA Low 3 … 3.6 mA Numerical High 21 … 23 mA Low 3 … 3.6 mA	Edit can be used to set the behavior of the current output. The corresponding high or low alarm output can be specified with the ▼ **key**. Also refer to chapter „"Current output" menu“ on page 47. If High is selected, the high alarm level can be set here, and if Low is selected, the corresponding low alarm level can be set. See chapter „"Totalizer" and "Overflow"“ on page 48. Number of counter overflows. The selectable units depend on the operating mode. Edit resets the counter. Before resetting, you will be prompted to confirm.

Menu / parameter	Value range / Input type	Comments
	Q Operating mode Percent Numerical 0 … 100 % ON, Off Error register Warning register Mains interrupt	 Contrast setting for the LCD display. For the various function tests, also refer to chapter „"Function test" menu“ on page 47. The entries in the error and warning register are explained in chapter „Diagnosis / error messages“ on page 48. **Notice:** Setting the device address > 0 sets the current output to 4 mA; this setting is only effective in HART multidrop mode. Enter a separate, 8-digit TAG number.

9.3 Description of menus and parameters

9.3.1 "Prog.Output"menu

In this menu, the programmable binary output (terminals 41 / 42) is parameterized .
The following settings are available:

Function	Description
Pulse output	Pulses with the parametrized pulse value (pulses / unit) are output
Max / Min alarm _ _	The contact is closed in the event of an alarm
Min / Max alarm / _	The contact is opened in the event of an alarm
General alarm _ _	The contact is closed in the event of an alarm
General alarm / _	The contact is opened in the event of an alarm

NOTE

If the output is parameterized as a general alarm, the error states and min-max alarms are output cumulatively.

9.3.2 "Operating mode" menu

The device has been calculated and rated for a specific application.
The device can be adapted to a different, new application using the operating mode and the associated parameters, such as the operating density or the standard density of the measuring medium.
The device uses the new parameters to calculate its new maximum measuring range end value (Q_{max} Medium). The current position of the float is automatically converted into the correct flow value. It may be necessary to adapt the Q_{max} value.

9.3.3 "Standard density" and "Operating density" menu

Depending on the operating mode, the system requests the standard density or the operating density of the measuring medium.
The density of liquids always has to be stated in the operating condition.

Standard densities for a few selected gases:

Gas	Standard density [kg/m3]
Acetylene	1.172
Ammonia	0.771
Argon	1.780
Ethane	1.350
Ethylene	1.260
Butane	2.700
Natural gas	0.828
Carbon dioxide	1.970
Carbon monoxide	1.250
Air	1.290
Methane	0.717
Neon	0.890
Propane	2.020
Propylene	1.915
Oxygen	1.430
Nitrogen	1.250
Hydrogen	0.0899

To convert the standard (normal) density to the operating density, use the following formula for ideal gases (based on Gay-Lussac and Boyle-Mariotte):

Standard density (ρ_η) → to operating density (ρ) conversion

$$\rho = \rho_\eta \times \frac{1{,}013 + p}{1{,}013} \times \frac{273}{273 + T}$$

Legend	
ρ	Operating density [kg/m3]
ρ_n	Standard density [kg/m3]
p	Operating pressure [bar]
T	Operating temperature [°C]

9.3.4 "Low flow cut off" menu

Input range: 1 ... 10 %
The low flow value is needed for the low flow cutoff.
If the measured flow falls below the set value, the measured value is set to zero, i.e. the current output indicates 4 mA and the flow count is interrupted.
For variable area flowmeters, this value should be set to 5% because of the physical conditions.

9.3.5 "Current output" menu

Configure the current output behavior for device alarms in the current output submenu.

The settings High and Low are available.

— If the setting is High, a value between 21 ... 23 mA can be set for the current output.
— If the setting is Low, a value between 3.0 ... 3.6 mA can be set for the current output.

NOTE

A single "Error 3" (overshooting of the measuring range) always results in a high alarm, regardless of the setting!

The current output behavior follows the NAMUR recommendation NE43.

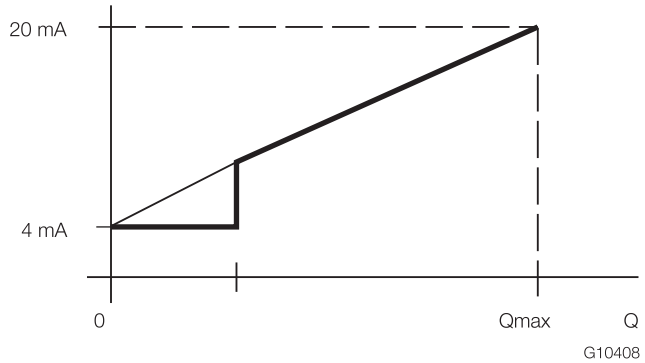


Fig. 29: Current output behavior

The measurement value output at the current output is as shown in the diagram:

Above the low flow, the current is a straight line that would have 4 mA at Q = 0 and 20 mA at Q = Q_{max} operating mode. Because of the low flow cutoff, the flow rate is set below x% of Q_{max} or the low flow is set to 0, i.e. 4 mA.

9.3.6 "Function test" menu

Submenu	Adjustable values	Description
Iout	Numerical	A set point value for the current output can be predefined between 4 ... 20 mA. When the menu is quit, the current output immediately returns to the current flow value.
Simulation	Off	The simulation is switched off (flow mode)
	on	The simulation is active (simulation mode). Values between 0 ... 110 % can be simulated with the help of a submenu.
Int. database	confirm	The internal database of the transmitter (FRAM) is checked and confirmed with "OK".
Ext. database	confirm	The checksum of the transmitter software is checked manually and confirmed with "OK". The checksum is checked routinely every 30 seconds during operation. An incorrect result would result in Error 9.
Prog. Output	open	Switch output at terminals 41 / 42 open
	close	Switch output at terminals 41 / 42 closed
	5 Hz	Outputs a 5-Hz-signal at terminals 41 / 42
	100 Hz	Outputs a 100-Hz signal at terminals 41 / 42
HART transmission	confirm	The transmission can be executed at 1200 or 2200 Hz
HART reception	confirm	Shown when signals are received
Voltages	confirm	Shows the current voltage at the terminals.

9.3.7 "Totalizer" and "Overflow"

The number of counter overflows is indicated here. The maximum number of counter overflows is 65535.
The overflow counter also overflows thereafter and resets to 0.
The total counter count can be calculated as follows:

Example:
Status of overflow counter: 12
Current counter status = 12345 m^3

12 x 10 000 000	=	120 000 / 000 m^3
+		12 345 m^3
	=	120 012 / 345 m^3

9.3.8 "Damping" menu

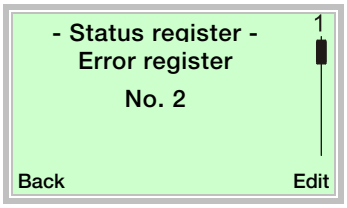
The response time of the measuring device can be set as desired using the Damping parameter.
Damping corresponds to a first-order low-pass filter.
Typical value 3 ... 5 s.

10 Diagnosis / error messages

10.1 Calling up the error description

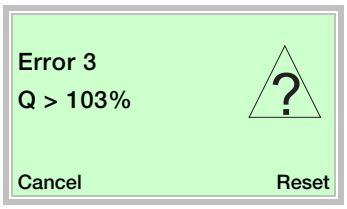
In accordance with NAMUR recommendation NE 107, a distinction is made between error messages and warnings.
Errors and warnings are saved in the register.
Errors directly affect the current output.
Warnings can be read via the HART-protocol and processed.
Errors and warnings that have occurred can be called up by using the "Status register" menu. When the menu is opened, the number of errors and warnings is displayed. When the error (warning) register is called up, the type of warning or error is indicated.

1. Select the "Status register" menu in the main menu by using ▼ or ▲.
2. Confirm the selection with ►.



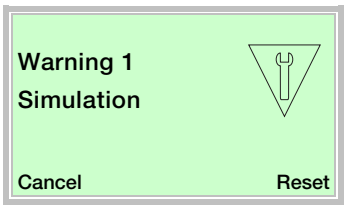
3. Open the first pending message with ►.

— The message can be reset with ►.



4. Open the additional pending messages with ▼ or ▲.

— The message can be reset with ►.



NOTE

— Warning and error registers can be cleared on the "„Standard" user level in order to be able to see when they occur again.
— On the "Specialist" user level, there is an additional "Mains interrupt" submenu, which saves the number of power outages. The power outage counter can only be reset by the ABB after-sales service.

10.2 Error messages

Message	NE 107 classification	Cause	Remedy
Error 1 Front End	Failure	Hardware error on the front-end board.	Please contact the service department.
Error 3 Q > 103%	Out of Spec	Overshoot of the device measuring range.	Reduce the flow rate, check the application.
Error 5a Int. database	Failure	A data loss has occurred. The device is reset to its factory or default settings.	The error is repaired in the device itself. Clear the error register and check the settings.
Error 5b Ext. database	Failure		
Error 6 Counter	Failure	Loss by the counter. The counter and the overflow counter are reset to 0.	Clear the error register and observe the situation.
Error 8 Voltage	Out of Spec	Terminal voltage too low (< 9.5 V).	Increase the voltage at the terminals (> 10 V).
Error 9 Checksum	Failure	The checksum of the software in the µ-processor differs from the stored checksum.	Please contact the service department.
Error 10 Hardware	Failure	Self-check functions have detected an internal HW-error.	Please contact the service department.
Error 12 Viscosity	Out of Spec	The viscosity entered for the fluid is too high in relation to the viscosity insensitivity number of the device.	Reduce the viscosity or have the device recalculated for a higher viscosity. Please contact the service department.
Warning 1 Simulation	Check function	The device is in simulation mode.	Quit simulation mode (off).

Additional symbols in accordance with Namur NE107:

Symbol	Description
	Maintenance required
	Outside of the specification
	Function check
	Breakdown

11 Maintenance

11.1 Safety instructions

⚠ DANGER

Danger of explosion if the device is operated with the transmitter housing open!

Before opening the transmitter housing, bear in mind the following:

- Check that a valid fire permit is available.
- Make sure that there is no explosion hazard.
- Before opening the device, switch off the power supply and wait for t > 2 minutes.

⚠ WARNING

Risk of injury due to live parts!

When the housing is open, contact protection is not provided and EMC protection is limited.

Before opening the housing, switch off the power supply.

⚠ CAUTION

Risk of burns due to hot measuring media.

The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!

Before starting work on the device, make sure that it has cooled sufficiently.

ℹ NOTE

Damage to components!

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.

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)

11.2 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.

11.3 Flowmeter sensor

Essentially no maintenance is required for the 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.

12 Repair

12.1 Safety instructions

⚠ DANGER

Danger of explosion if the device is operated with the transmitter housing open!

Before opening the transmitter housing, bear in mind the following:

— Check that a valid fire permit is available.
— Make sure that there is no explosion hazard.
— Before opening the device, switch off the power supply and wait for t > 2 minutes.

⚠ WARNING

Risk of injury due to live parts!

When the housing is open, contact protection is not provided and EMC protection is limited.
Before opening the housing, switch off the power supply.

⚠ CAUTION

Risk of burns due to hot measuring media.

The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!
Before starting work on the device, make sure that it has cooled sufficiently.

i NOTE

Damage to components!

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.

12.2 Replacing the analog indicator

If you are carrying out repair work or converting to a different indicator type, it is possible to replace entire indicator units. To make sure of obtaining traceable units that are in perfect working order, you can order them from ABB by specifying the original serial number.

Please note the following measures to be taken:

Provided	New	Conversion possible	Customer actions
FAM540, non-Ex	FAM540, Ex	No	—
FAM540, Ex	FAM540, Ex	yes	None
FAM540 A/B/C/D-Ex	FAM540 E/F-Ex	yes	Safety re-evaluation of measuring point due to different indicator model
FAM540 E/F-Ex	FAM540 A/B/C/D-Ex	yes	
AM54-Ex	FAM540, Ex	yes	Safety re-evaluation of measuring point due to new approval and, where applicable, different indicator model

Please observe the installation information provided in the operating instructions.
Depending on the application, operators must comply with relevant national installation specifications. (e.g. NEC, CEC, ATEX 137, IEC60079-14, etc.).

Installation / uninstallation of the analog indicator

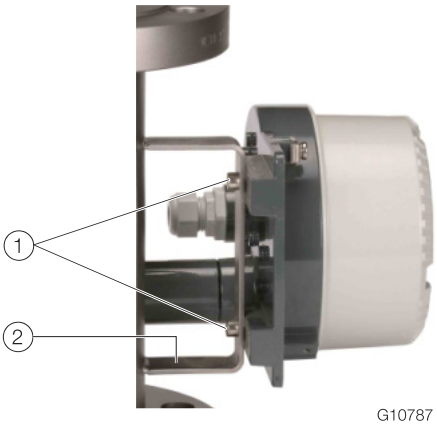


Fig. 30:
(1) **Hexagon socket screws** (2) **Mounting bracket**

The analog indicator is fastened to the mounting bracket with two hexagon socket screws.
To facilitate the use of an analog indicator that is compatible with the meter tube, the bracket has a plate bearing the serial number.
The analog indicator is centered using 2 metal bushings that are permanently bonded to the indicator and must not be moved.

Dismounting

1. Detach hexagon socket screws.
2. Remove analog indicator.

Assembly

1. Install analog indicator, paying attention to proper centering of the metal bushings.
2. Tighten hexagon socket screws.

12.3 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.

13 Recycling and disposal

13.1 Disposal

This product and its packaging are manufactured from materials that can be recycled by specialist recycling companies.

Bear the following points in mind when disposing of them:

- This product is not subject to WEEE Directive 2002/96/EC or relevant national laws (e.g. ElektroG in Germany).
- The product must be surrendered to a specialist recycling company. Do not use municipal garbage collection points. According to WEEE Directive 2002/96/EC, only products used in private applications may be disposed of at municipal garbage collection points.
- If it is not possible to dispose of old equipment properly, ABB Service can take receipt of and dispose of returns for a fee.

NOTE

Products that are marked with this symbol may not be disposed of through municipal garbage collection points.

13.2 Information on ROHS Directive 2011/65/EC

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.

14 Specifications

NOTE

The detailed device data sheet is available in the download area at www.abb.com/flow.

Trademarks

® HART is a registered trademark of FieldComm Group, Austin, Texas, USA

® Buna-N is a registered trademark of DuPont Dow Elastomers.

™ Hastelloy C-2 is a Haynes International trademark

15 Appendix

15.1 Return form

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

15.2 Declarations of conformity

NOTE

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

ABB

EG-Konformitätserklärung
EC-Declaration of Conformity

CE Ex

Hiermit bestätigen wir die Übereinstimmung der
Herewith we confirm that our

Schwebekörper Durchflussmesser
Variable Area Flowmeter

Modell Serie FAM54
Model Series FAM54

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

Die Schwebekörper -Durchflußmesser dienen zur Messung des Durchflusses von Gasen, Dämpfen und Flüssigkeiten.
The Variable Area Flowmeters are utilized to meter the flowrate of gases steam or liquids.

EG-Baumusterprüfbescheinigung: *EC-Type Examination Certificate:*	KEMA 07 ATEX 0104 X
Benannte Stelle: *Notified Body:*	DEKRA Certification B.V. , Kennummer 0034
Geräte-Kennzeichnung: *Apparatus code:*	II 1/2 G Ex c ia IIC T6...T1 Ga/ Gb and/or Ex c d IIC T6...T1 Ga/Gb and /or c T6...T1 and / or II 1/3 G Ex c nA ic IIC T6...T1 Ga/Gc or Ex c nA IIC T6...T1 Ga/Gc and II 2 D c T85°C...Tmedium Db or Ex tb IIIC T85°C...Tmedium Db
Sicherheitstechnische Daten: *Safety values:*	siehe EG-Baumusterprüfbescheinigung *refer to EC-Type Examination Certificate*
Angewandte Normen: *Standards:*	EN 60079-0: 2012, EN60079-11: 2012, EN 60079-1: 2007 EN 60079-26:2007, EN 60079-31: 2009, EN 60079-15: 2010, EN 13 463-1: 2009, EN 13463.5: 2011

Göttingen, 07.01.2015

i.V. Thorsten Bauer
(Operation Manager)

i.V. Dr. Philipp Nenninger
(R&D Manager)

BZ-13-8017, Rev.03

ABB Automation Products GmbH

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:*	Metallkonus–Schwebekörper-Durchflussmesser *Metall Cone Variable Area Flowmeter*
Modelle.: *Models.:*	FAM54X *FAM54X*
Richtlinie: *Directive:*	2004/108/EG * (EMV) *EMC directive 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 **

* einschließlich Nachträge / *including alterations*

Göttingen, 03. Juli 2009

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

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

ABB Automation Products GmbH

BZ-13-5030, Rev.02, 12936

EG-Konformitätserklärung
EC-Declaration of Conformity

CE
0045

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

Hersteller: *manufacturer:*	ABB Automation Products GmbH, 37070 Göttingen - Germany
Modell: *model:*	Ganzmetall-Schwebekörperdurchflussmesser FAM54... *Metal Cone Variable Area Flowmeter FAM...*
Richtlinie: *directive:*	Druckgeräterichtlinie 97/23/EG *pressure equipment directive 97/23/EC*
Einstufung: *classification:*	Ausrüstungsteile von Rohrleitungen *piping accessories*
Normengrundlage: *technical standard:*	AD 2000 Merkblätter und EN 12516 *AD 2000 Merkblätter and EN 12516*
Konformitätsbewertungsverfahren: *conformity assessment procedure:*	B (EG-Baumusterprüfung) + D (Qualitätssicherung Produktion) *B (EC-type-examination) + D (production quality assurance)*
EG-Baumusterprüfbescheinigung: Entwurfsprüfbericht: *EC type-examination certificate:* *Design-examination report:*	Nr. 1045 Z 0094 / 2 / D / 0004 Nr. STK1 P 0651 2 01 *No. 1045 Z 0094 / 2 / D / 0004* *No. STK1 P 0651 2 01*
benannte Stelle: *notified body:*	TÜV Nord Systems GmbH & Co. KG Große Bahnstr. 31 22525 Hamburg
Kennnummer: *identification no.*	0045

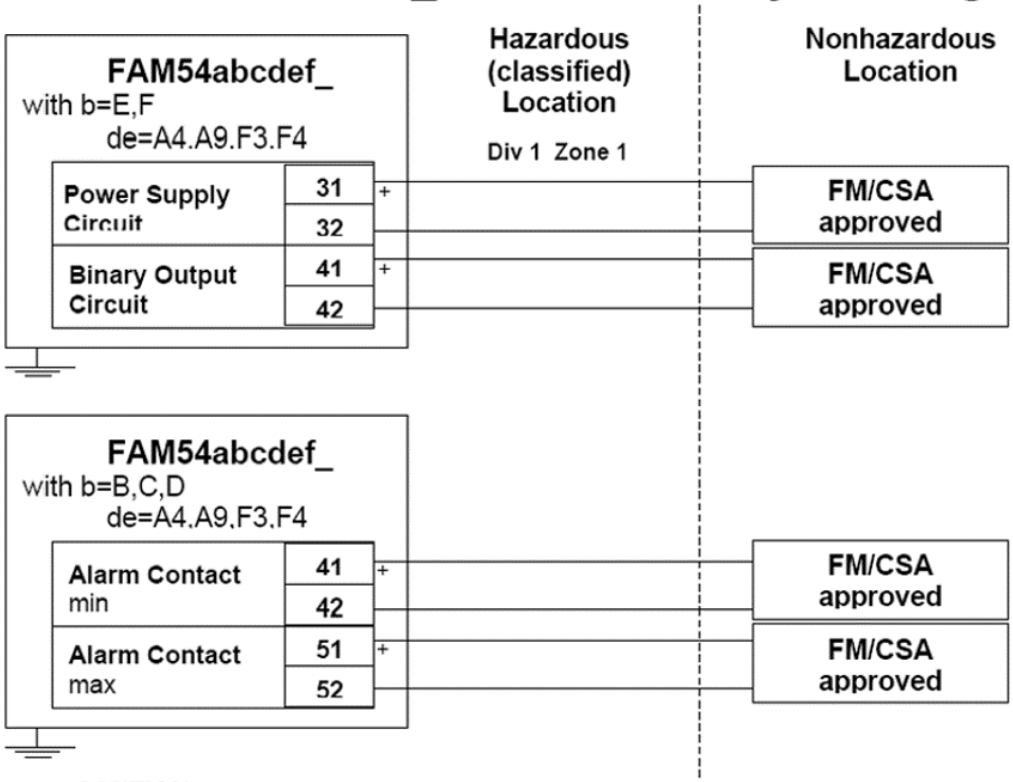
Göttingen, den 20.07.2012

ppa .....
(Klaus Halbfas, Plant Manager)

BZ-25-0016 Rev.01 / 22775

15.3 Intrinsic Safety Control Drawing SDM-10-A0253

FAM54abcdef_: Intrinsic Safety Drawing



CAUTION:

$U_i \geq U_0$; $I_i \geq I_0$; $C_0 \geq C_i + C_{Cable}$; $L_0 \geq L_i + L_{Cable}$

SUBTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY:
DO NOT DICONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS:

LA SUBSTITUTION DE COMPOSANTES PEUT COMPROMETTRÉ LA SÉCURITÉ INTRINSÉQUE

additional informations see instruction manual

Notes:

1. The Intrinsic Safety Entity concept allows the interconnection of FM and CSA Approved Intrinsically safe devices with entity parameters not specifically examined in combination as a system when:
2. Dust-tight conduit seal must be used when installed in Class II and Class III environments.
3. Control equipment connected to the Associated Apparatus must not use or generate more than 250Vrms of Vdc.
4. Installation should be in accordance with the ANSI/ISA RP12.6 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations" an the National Electrical Code® (ANSI/NFPA 70) Section 504, 505 and CEC.
5. The configuration of the associated Apparatus must be Factory Mutual Research or CSA Approved under Entity Concept.
6. Associated Apparatus manufacturer's installation drawing must be followed when installing this equipment.
7. No revision do drawing without prior Factory Mutual Research and CSA Approval

EX CERTIFICATED PRODUCT NO MODIFIKATIONS PERMITTED WITHOUT REFERENCE TO THE CERTIFICATION BODY

Intrinsic Safety Control Drawing
SDM-10-A0253, Rev. 02, 20.07.2007

Page 1/1

Notes

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3KXF154001R4201
Translation of the original instruction

OI/FAM540-EN Rev. D 09.2015

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