



**HART**   
COMMUNICATION PROTOCOL

---

# Metal Cone Variable Area Flowmeter

## VA Master FAM540

### Operating Instruction

OI/FAM540-EN

01.2010

Rev. C

#### Manufacturer:

**ABB Automation Products GmbH**

Dransfelder Straße 2

D-37079 Göttingen

Germany

Tel.: +49 551 905-534

Fax: +49 551 905-555

CCC-support.deapr@de.abb.com

**Customer service center**

Phone: +49 180 5 222 580

Fax: +49 621 381 931-29031

automation.service@de.abb.com

© Copyright 2010 by ABB Automation Products GmbH

Subject to changes without notice

This document is protected by copyright. It assists the user in safe and efficient operation of the device. The contents of this document, whether whole or in part, may not be copied or reproduced without prior approval by the copyright holder.

<b>1</b>	<b>Safety</b> .....	<b>5</b>
1.1	General information and notes for the reader .....	5
1.2	Intended use.....	5
1.3	Improper use .....	6
1.4	Technical limit values .....	6
1.5	Allowed Fluids .....	7
1.6	Warranty provisions.....	7
1.7	Plates and symbols .....	8
1.7.1	Safety-/ warning symbols, note symbols.....	8
1.7.2	Name Plate / Factory Tag .....	9
1.8	Target groups and qualifications .....	12
1.9	Returning devices.....	12
1.10	Disposal.....	13
1.10.1	Information on WEEE Directive 2002/96/EC (Waste Electrical and Electronic Equipment).....	13
1.10.2	RoHS Directive 2002/95/EC .....	13
1.11	Transport safety information.....	14
1.12	Installation safety information.....	14
1.13	Safety instructions for electrical installation .....	15
1.14	Safety instructions for operation.....	15
1.15	Safety information for maintenance and inspection .....	16
<b>2</b>	<b>Design and function</b> .....	<b>17</b>
2.1	Device designs .....	18
<b>3</b>	<b>Transport</b> .....	<b>19</b>
3.1	Inspection .....	19
3.2	General information on transport .....	19
<b>4</b>	<b>Installation</b> .....	<b>20</b>
4.1	Installation Requirements.....	20
4.2	Operating conditions .....	21
4.3	Installation .....	22
4.3.1	General information on installation .....	22
4.3.2	Mounting the meter tube .....	23
4.3.3	Material loads for process connections.....	24
4.4	Electrical connection .....	25
4.4.1	Analog display with / without limit signal transmitter.....	25
4.4.2	Analog indicator with transmitter with / without LCD display .....	26
4.4.3	Digital communication .....	27
<b>5</b>	<b>Ex relevant specifications</b> .....	<b>28</b>
5.1	Basic requirements.....	28
5.2	Specific requirements FM / cCSAus .....	29
5.3	Special installation instructions for devices with limit signal transmitter or transmitter.....	30
5.3.1	Later change of Ex protection classes .....	30
5.3.2	Cable glands and signal cables .....	32
5.3.3	Information about the housing ground .....	33
5.3.4	Special installation instructions for explosion protection types flame proof (enclosure) / Explosionproof 34	
5.4	Safety-relevant information ATEX / IECEx.....	35
5.4.1	Approved installation sites .....	35

## Contents

5.4.2	Identification and protection classes .....	35
5.4.3	Limit value tables .....	37
5.5	Safety specifications FM / CSA .....	41
5.5.1	Identification codes and protection types FM and cCSAus .....	42
5.5.2	Limit value tables FM .....	43
5.5.3	Limit value tables cCSAus .....	47
5.6	Intrinsic Safety Drawing (FM / cCSAus).....	51
<b>6</b>	<b>Commissioning .....</b>	<b>52</b>
6.1	General information.....	52
6.2	Inspection .....	53
6.3	Information for safe operation – ATEX / IECEx.....	53
6.4	Setting the limit signal transmitter .....	54
6.5	Configuring the programmable output.....	55
<b>7</b>	<b>Parameterization .....</b>	<b>56</b>
7.1	User levels.....	57
7.1.1	Changing the user level .....	57
7.2	Parameter overview .....	58
7.2.1	Programmable output.....	62
7.2.2	Operating mode .....	62
7.2.3	Standard and operating densities .....	63
7.2.4	Low flow cut off .....	64
7.2.5	Current output .....	64
7.2.6	Function test.....	65
7.2.7	Counter and counter overflow .....	66
7.2.8	Damping.....	66
<b>8</b>	<b>Error messages .....</b>	<b>67</b>
8.1	Status register .....	67
8.2	Status messages .....	68
<b>9</b>	<b>Maintenance / Repair .....</b>	<b>69</b>
9.1	Cleaning .....	69
9.2	Special information for replacing display units.....	69
<b>10</b>	<b>Appendix .....</b>	<b>71</b>
10.1	Additional documents.....	71
10.2	Approvals and certifications .....	71
<b>11</b>	<b>Index .....</b>	<b>76</b>

## 1 Safety

### 1.1 General information and notes for the reader

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

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

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

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

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

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

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

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

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

### 1.2 Intended use

This device is intended for the following uses:

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

The following items are included in the intended use:

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

### 1.3 Improper use

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

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

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

### 1.4 Technical limit values

The device is designed for use exclusively within the stated values on the model plate and within the technical limit values specified in the data sheets.

The following technical limit values must be observed:

- The permissible pressure (PS) in the permissible temperature (TS) may not exceed the pressure-temperature ratings.
- The maximum operating temperature may not be exceeded.
- The permitted operating temperature may not be exceeded.
- The housing protection system must be observed.

## 1.5 Allowed Fluids

When measuring fluids, the following points must be observed:

- Fluids may only be used if, based on state-of-the-art technology or the operating experience of the user, it is assured that chemical and physical properties of the components coming into contact with the fluids (signal electrodes, ground electrodes, liners and, possibly, process connections, protective plates or protective flanges) are not affected during the operating life.
- Fluids with unknown properties or abrasive fluids may only be used if the operator can perform regular and suitable tests to ensure the safe condition of the device.
- Observe the information on the name plate.

## 1.6 Warranty provisions

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

1.7 Plates and symbols

1.7.1 Safety-/ warning symbols, note symbols



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

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



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

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



**WARNING – <Bodily injury>**

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



**WARNING – <Bodily injury>**

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



**CAUTION – <Minor injury>**

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



**ATTENTION – <Property damage>!**

The symbol indicates a potentially damaging situation.

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



**IMPORTANT (NOTICE)**

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

**1.7.2 Name Plate / Factory Tag**

**1.7.2.1 Name plates**

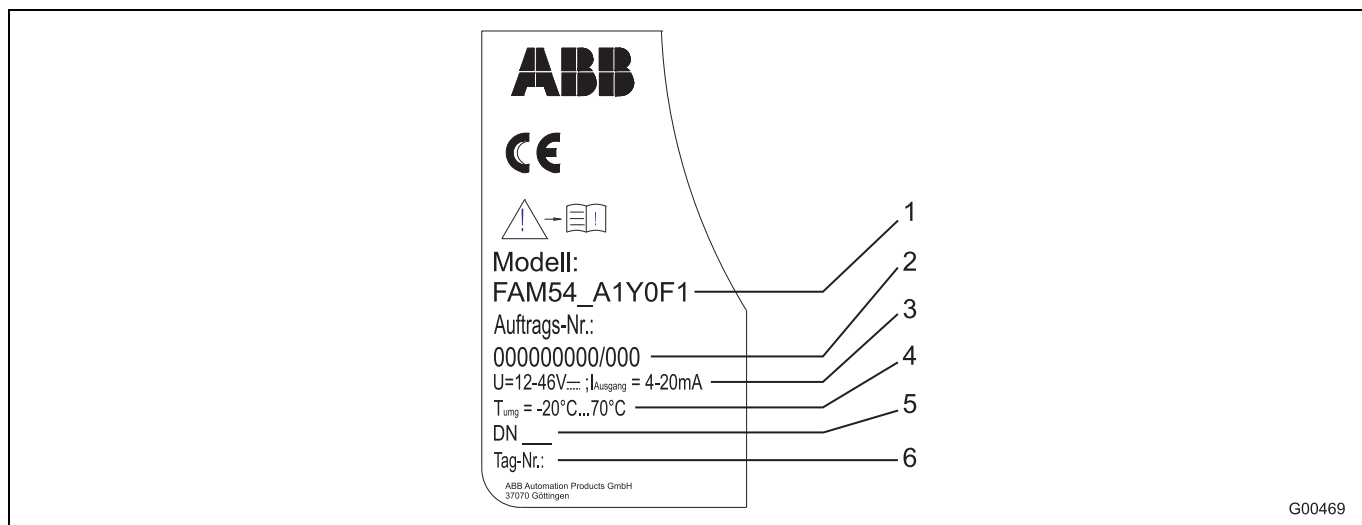


Fig. 1: Standard

- |                                      |                                   |
|--------------------------------------|-----------------------------------|
| 1 Model number                       | 4 Ambient temperature             |
| 2 Order no.                          | 5 Meter size and protection class |
| 3 Auxiliary voltage + output current | 6 TAG number                      |

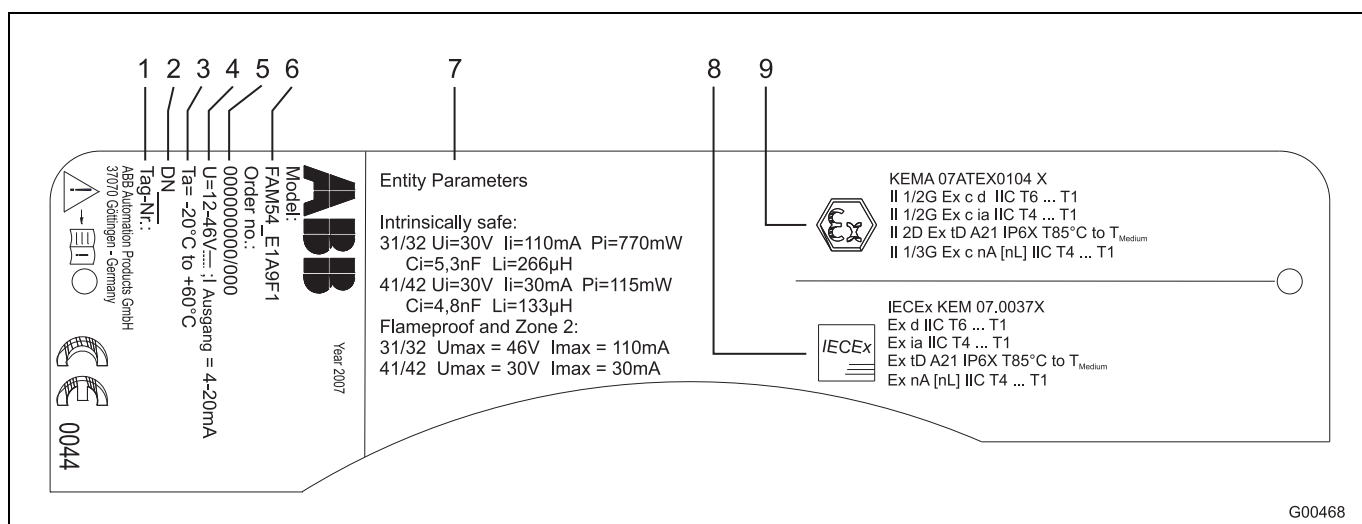


Fig. 2: ATEX / IECEx

- |                                      |  |
|--------------------------------------|--|
| 1 TAG number                         | 6 Model number                             |
| 2 Meter size and protection class    | 7 Electrical data and output circuits      |
| 3 Ambient temperature                | 8 IEC Ex approvals and temperature classes |
| 4 Auxiliary voltage + output current | 9 ATEX approvals and temperature classes   |
| 5 Order no.                          |  |

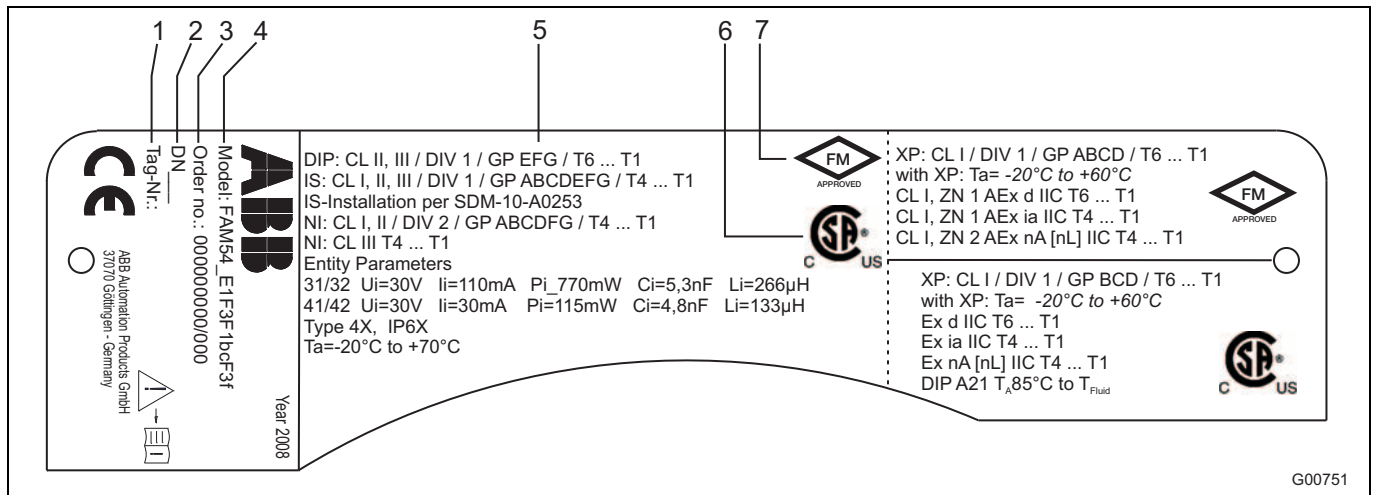


Fig. 3: FM / cCSAus

- 1 TAG number
- 2 Meter size and protection class
- 3 Order no.
- 4 Model number
- 5 Electrical data and output circuits
- 6 IEC Ex approvals and temperature classes
- 7 ATEX approvals and temperature classes

**1.7.2.2 Factory Tag**

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

**Pressure equipment subject to PED**

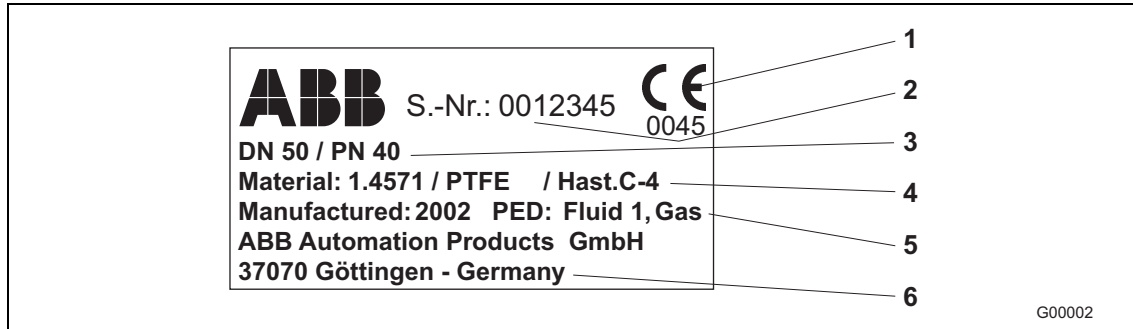


Fig. 4

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>1 CE mark (with number of labeled location) to confirm the device meets the requirements of pressure equipment directive 97/23/EC.</li> <li>2 Serial number for identification of the pressure equipment by the manufacturer.</li> <li>3 Nominal size and nominal pressure rating of pressure equipment.</li> </ul> | <ul style="list-style-type: none"> <li>4 Flange material, liner material and electrode material (wetted parts).</li> <li>5 Year of manufacture and specification of fluid group as per the pressure equipment directive (PED). Fluid group 1 = hazardous liquids, gaseous.</li> <li>6 Manufacturer of the pressure equipment.</li> </ul> |
|--|--|

**Pressure equipment outside the applicable range of the PED**



Fig. 5

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

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

**i**

**Important**

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

## **1.8 Target groups and qualifications**

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

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

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

## **1.9 Returning devices**

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

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

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

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

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

## 1.10 Disposal

ABB Automation Products GmbH actively promotes environmental awareness and has an operational management system that meets the requirements of ISO 9001:2008, ISO 14001:2004, and BS OHSAS18001:2008. Our products and solutions are intended to have minimum impact on the environment and persons during manufacturing, storage, transport, use, and disposal.

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

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

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

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

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

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

### 1.10.2 RoHS Directive 2002/95/EC

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

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

## 1.11 Transport safety information

- Depending on the device, the center of gravity may not be in the center of the equipment.
- The protection plates or protective caps installed on the process connections of devices lined with PTFE / PFA must not be removed until just before installation; to prevent possible leakage, make sure that the liner on the flange is not cut or damaged.

## 1.12 Installation safety information

Observe the following instructions:

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

### 1.13 Safety instructions for electrical installation

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

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

Ground the measurement system according to requirements.

### 1.14 Safety instructions for operation

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

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

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

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

If pressure shocks exceeding the device's permissible nominal pressure occur continuously during operation, this can have a detrimental effect on the device's service life.



#### **Warning – Risk to persons!**

Bacteria and chemical substances can contaminate or pollute pipeline systems and the materials they are made of.

The appropriate installation conditions must be observed in order to achieve an installation that complies with EHEDG requirements.

For an installation to comply with EHEDG requirements, the process connection/gasket combinations created by the operator must always be made of parts that conform to EHEDG stipulations (EHEDG Position Paper: "Hygienic Process connections to use with hygienic components and equipment").



#### **Important**

- In general when operating the device, the details on electric safety and electromagnetic compatibility of this manual are to be observed.
- For operation in potentially explosive areas, observe the relevant information in this manual.
- For use in hygienic applications (EHEDG design), observe the hygienically suitable process connection.

### 1.15 Safety information for maintenance and inspection

**Warning – Risk to persons!**

When the housing cover is open, EMC and protection against contact are suspended. There are electric circuits within the housing that pose a contact risk.

The auxiliary power must be switched off before opening the housing cover.

Corrective maintenance work may only be performed by trained personnel.

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

**2 Design and function**

FAM540 armored variable area flowmeters have a proven design and are equipped with an analog, mechanical indicator or an intelligent 2-wire transmitter, i.e. the supply voltage and the flow signal utilize the same leads.

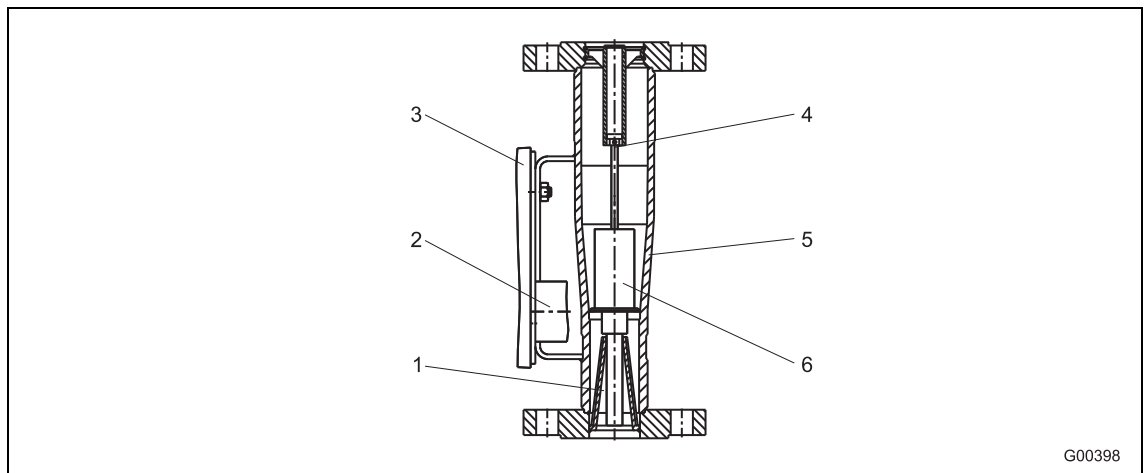
FAM540 meters can be used to measure the flow of gases, liquids and steam, e.g., in process engineering, the chemical and pharmaceutical industries as well as the food and beverage industry. They are also suited for use with aggressive or opaque fluids, and are ideal when glass tube flowmeters cannot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

Key features of the meter include the ability to subsequently adjust meters onsite 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 process 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 feature can be used to modify existing meters for new metering applications. In addition, meters in temporary storage can be modified for a variety of uses.

The main section consists of a conical metal meter pipe with welded flanges, see Fig. 6. A magnet in the float translates the height of the float in terms of flowrate to the flowmeter's decouple-proof magnet follower system.

The flowrate value is indicated on a scale by a pointer mounted on a rotating shaft. As an optional feature a modular 2-wire transmitter can be added to convert the flowrate value into a proportional, linear 4-20 mA current output signal. It is also possible to display the flowrate value on a 2-line display, independent of the pointer position. The plaintext dialog can be used to display the real-time flowrate and cumulative totalizer value, as well as to conveniently configure parameters.






G00398

Fig. 6

- |   |                        |   |                    |
|---|------------------------|---|--------------------|
| 1 | Float guide            | 4 | Gas damping        |
| 2 | Magnet follower system | 5 | Conical meter pipe |
| 3 | Indicator housing      | 6 | Float              |

2.1 Device designs

	FAM541	FAM544	FAM545	FAM546
	 G00448	 G00449	 G00450	 G00451
<b>Design</b>	Standard	Hygienic	PTFE liner	Heating jacket
Measured value error	1.6 % qg = 50 % VDE / VDI 3513	1.6 % qg = 50 % VDE / VDI 3513	2.5 % qg = 50 % VDE / VDI 3513	1.6 % qg = 50 % VDE / VDI 3513
Reproducibility	0.25 % of measured value			
Process connection	Flange acc. to DIN, ASME, JIS, female thread	Thread DIN 11851, SMS 1145	Flange acc. to DIN, ASME, JIS	Flange acc. to DIN, ASME, JIS
Connection meter sizes	DN 15 (1/2") ... DN 100 (4")	DN 25 (1") ... DN 100 (4")	DN 25 (1") ... DN 80 (3")	DN 25 (1") ... DN 100 (4")
Max. temperature of measured medium	400 °C (752 °F)	140 °C (284 °F)	120 °C (248 °F)	400 °C (752 °F)
Max. pressure rating	PN 400 / class 2500	PN 40	PN 40 / class 300	PN 100 / class 600
<b>Indicator / transmitter</b>				
Degree of protection acc. to EN 60529	IP 65 / 67; NEMA 4X			
Indicator, mechanical	Analog indicator without limit signal transmitter; analog indicator with limit signal transmitter			
Indicator, electronic	Analog indicator with transmitter (4 ... 20 mA), with / without LCD display			
Communication	HART protocol (with transmitter only)			
Supply power	Without, for analog indicator without limit signal transmitter 8 V DC via isolated switch amplifier, for analog indicator with limit signal transmitter 10 ... 46 V DC (Ex: 10 ... 30 V DC), for analog indicator with transmitter			
Paint	Epoxy finish 80 ... 100 µm; color, bottom: RAL 7012, color, cover: RAL 9002 (No paint applied to stainless steel indicator housings.)			
<b>Approvals / certificates</b>				
Explosion protection acc. to ATEX / IECEx	Zone 0 / 1 / 2 / 21, see section Ex relevant specifications			
Explosion protection to FM / CSA <sub>US</sub>	XP, IS, DIP, NI, FM Zone 1 + 2, see "Ex relevant specifications"			
EMC protection	The devices comply with both EU Directive 2004/08/EC (EMC Directive) and NAMUR recommendation NE21.			
Sealing concept	Dual sealing acc. to ANSI/ISA-12.27.01			
SIL approvals	Analog display with limit signal transmitter SIL 2 Analog indicator with transmitter: FMEDA rating		None	see model FAM541 / FAM544
<b>Materials</b>				
Materials in contact with fluid	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)
Meter housing	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)
Gaskets	Viton A (DN 15 only)	Viton A (DN 25 only)	PTFE	Viton A (DN 25 only)
Indicator housing	Al Si 12 ; material number 3.2582 (copper content 0.1%) CrNi steel 1.4408			
Ordering information	See data sheet			

### 3 Transport

#### 3.1 Inspection

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

#### 3.2 General information on transport

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

- The center of gravity may not be in the center of the device.
- The protective panes or dust caps mounted at the process connections of devices equipped with PTFE (FAM545) may only be removed immediately before installation. Make sure that small internal parts such as floats or cones do not fall out and become damaged.

## 4 Installation

### 4.1 Installation Requirements

VA Master FAM540 variable area flowmeters are installed vertically in a pipeline. The flow must travel in an upward direction.

Keep the meter as far as possible from pipeline vibrations and powerful magnetic fields. The pipeline should be the same size as the connection size of the flowmeter. Inlet and outlet straight pipe length are not required.

#### Installation recommendations

Refer to VDI/VDE Directive 3513 sheet 3, Selection and Installation Recommendations for variable area flowmeters.

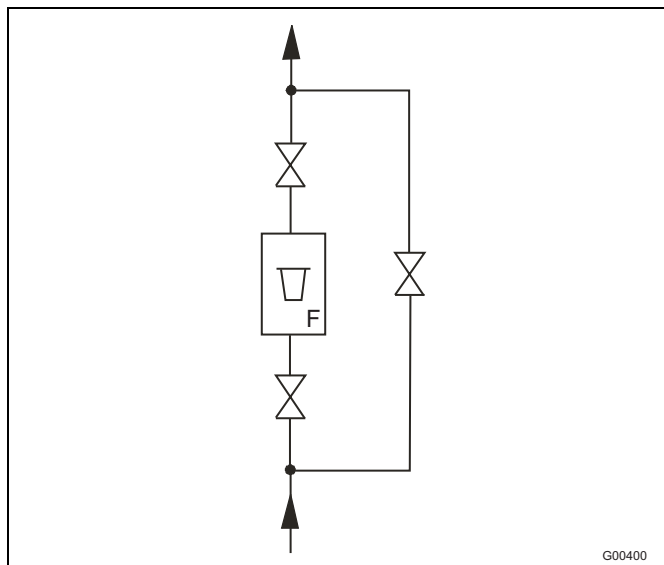


Fig. 7: Flowmeter installation

#### Float shape "S":

Basic shape of float.

Lower flowrates, minimal pressure drops, essentially independent of viscosity; when metering gases, lower upstream pressure required.

#### Float shape "N":

Basic shape of float with "N" float head.

Higher flow ranges, medium pressure drops, suitable for liquids with minimum viscosity; when metering gases, higher minimum upstream pressure requirements.

#### Float shape "X":

Basic shape of float with "X" float head.

Highest flowrates, highest pressure drops, suitable for liquids with minimum viscosity; when metering gases, higher minimum upstream pressure requirements.

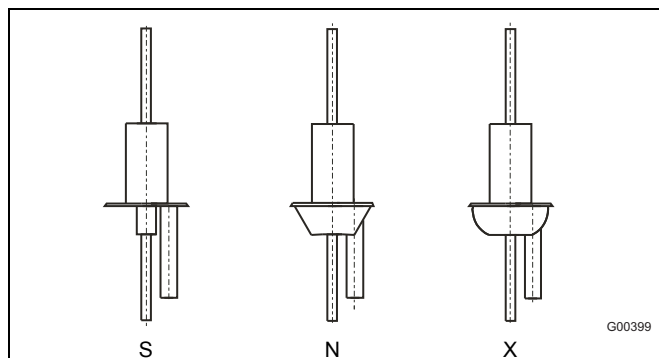


Fig. 8: Float shape overview

For range limits, based on meter size and float type, refer to the flow range tables.

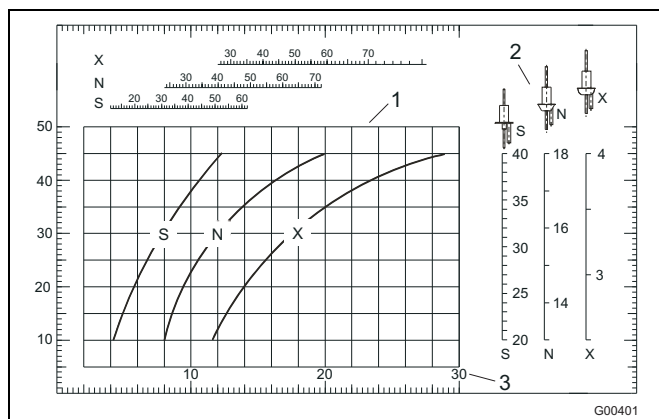


Fig. 9: Flowrate as a function of float shape and weight (example)

- 1 Pressure drop (dP in mbar)
- 2 Diameter of the float weight (mm)
- 3 x 1000 l/h water

## 4.2 Operating conditions

A variable area flowmeter is specified for a defined set of operating conditions. 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 pressure and temperature. The specified accuracy of the instrument is always based on these operating conditions.

### Pressure drop

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

### Damping and compression oscillations when metering gases

If a specific critical volume is exceeded between the closest throttling locations up and downstream of the flowmeter, compression oscillations (float bounce) may occur when the operating pressure is low. If the minimum required upstream pressure listed in this specification is not maintained, then the flowmeter must include a gas damping option (see Fig. 10).

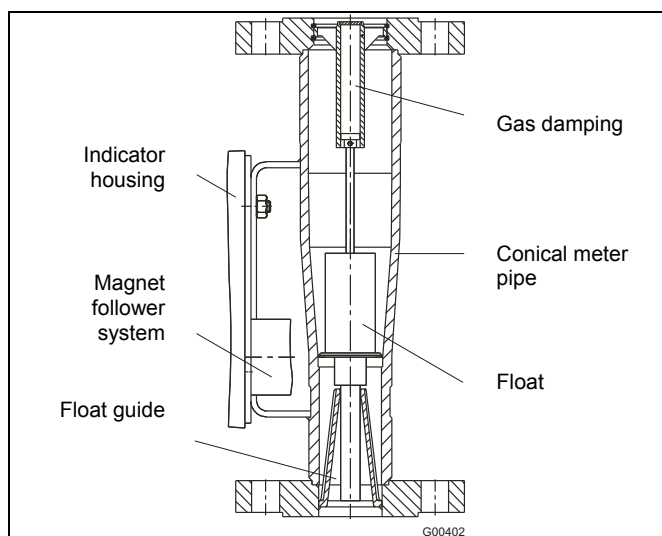


Fig. 10: Flowmeter with gas damping

To prevent self-generated compression oscillations, the following information should be taken into consideration:

- Select a flowmeter with the lowest possible pressure drop.
- Minimize the pipeline length between the flowmeter and the closest up or downstream throttling location.
- Increase the operating pressure, and consider its effect on the flowrate values due to the change in the gas density at the new operating conditions.

### Pressure shocks

Especially when metering gases, it is possible that pressure shock waves can occur when fast opening solenoid valves are employed and the pipeline volume is not throttled, or if there are gas bubbles in a liquid. As a result of the sudden expansion of the gas in the pipeline, the float is forcibly driven against the upper float stop. Under certain conditions, this can lead to destruction of the instrument. The installation of gas dampers will not compensate for such pressure shocks.

### Solids in the fluid

Variable area flowmeters can only be used under certain conditions for metering fluids containing solids. As a function of the concentration, particle size and type of solid, increased mechanical abrasion may occur especially at the critical metering edge of the float. In addition, solidified deposits on the float can change its weight and shape. These effects can, as a function of the float type, lead to erroneous measurement results. In general, the use of appropriate filters is recommended in such applications.

When metering fluids containing magnetic particles, we recommend the installation of a magnetic separator upstream of the flowmeter.

### Temperature diagram

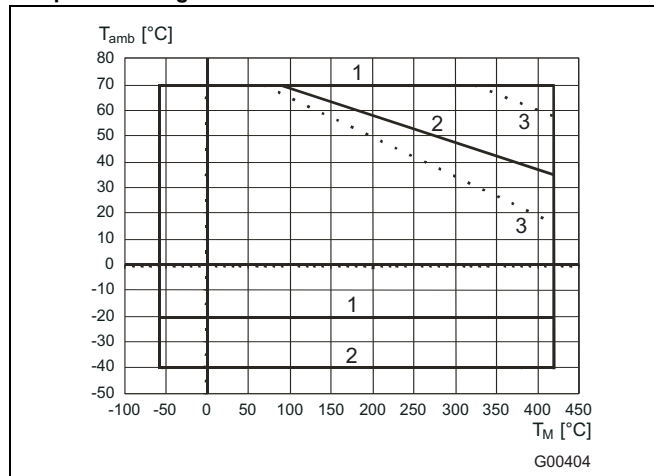


Fig. 11: Max. medium temperature ( $T_M$ ) and ambient temperature ( $T_{amb}$ )

- 1 Alarm output -20 ... 70 °C (-4 ... 158 °F)
- 2 Current output -40 ... 70 °C (-40 ... 158 °F)
- 3 With insulation

For Ex design, see chapter "Ex relevant specifications".

### Insulation

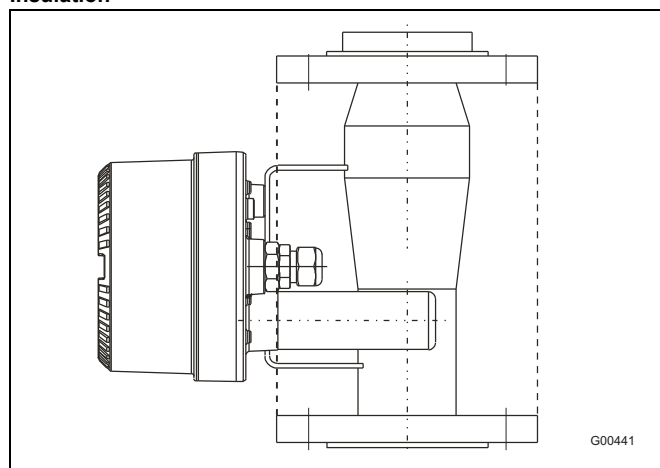


Fig. 12: Maximum insulation = Flange diameter

### 4.3 Installation

#### 4.3.1 General information on installation

The following points must be observed for the installation:

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

4.3.2 Mounting the meter tube

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



**Warning - Potential damage to device!**

Use of graphite with the flange or process connection gaskets is prohibited. In some instances, an electrically conductive coating may form on the inside of the measuring tube. For meters with PTFE liners (FAM545), vacuum shocks in the pipelines should be avoided to prevent damage to the liners. Vacuum shocks can destroy the meter.

1. Remove protective plates, if present, above and below the meter tube. Make sure that small internal parts such as floats or the conical meter pipe do not fall out and become damaged.
2. Position the meter tube coplanar and centered between the pipes.
3. Install gaskets between the surfaces.



**Important**

For best results, make sure the flowmeter primary gaskets fit concentrically with the measuring tube.

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



**Important**

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

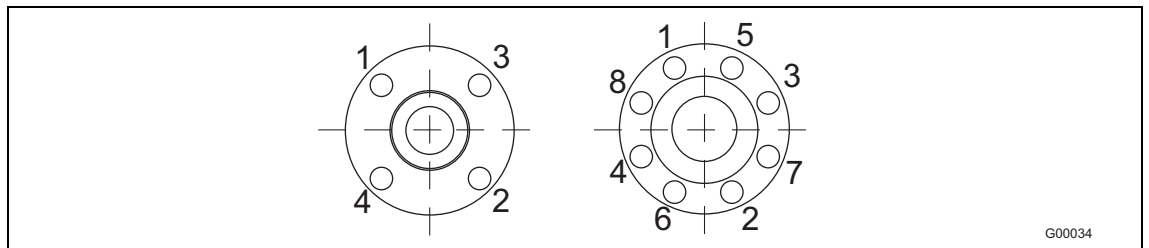


Fig. 13

# Installation

## 4.3.3 Material loads for process connections



### Warning - General hazards!

Exceeding the allowable fluid temperatures can damage the gaskets and meter. Do not exceed the maximum allowable fluid temperature specified on the factory and model plate as well as in the following tables.

### FAM541 (Standard)

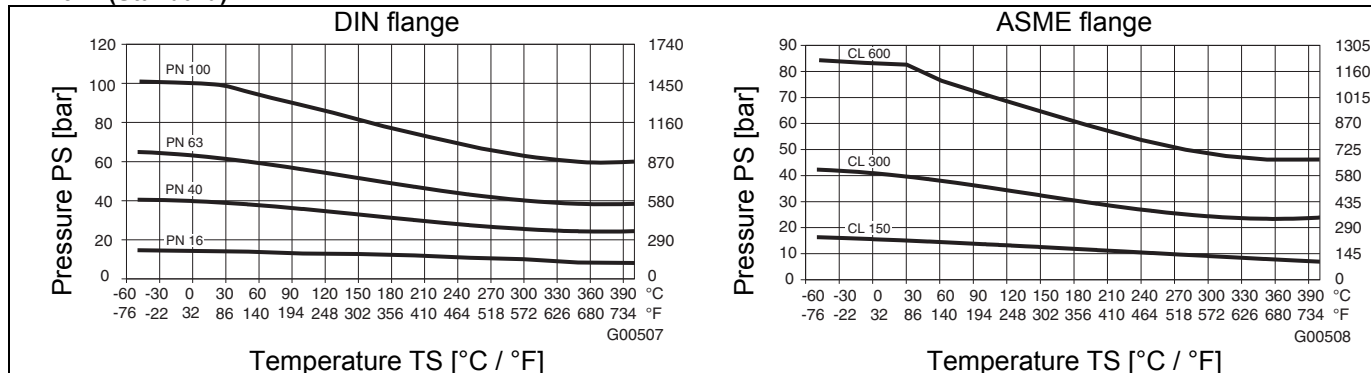


Fig. 14

### FAM544 (Sanitary)

Process Connection	Meter size DN	PS <sub>max</sub>	TS <sub>max</sub>	TS <sub>min</sub>
Threaded pipe connection DIN 11851	15 ... 40 (1/2 ... 1 1/2")	40 bar (580 psi)	140 °C (284 °F)	-40 °C (-40 °F)
	50 ... 100 (2 ... 4")	25 bar (362 psi)	140 °C (284 °F)	-40 °C (-40 °F)

### FAM545

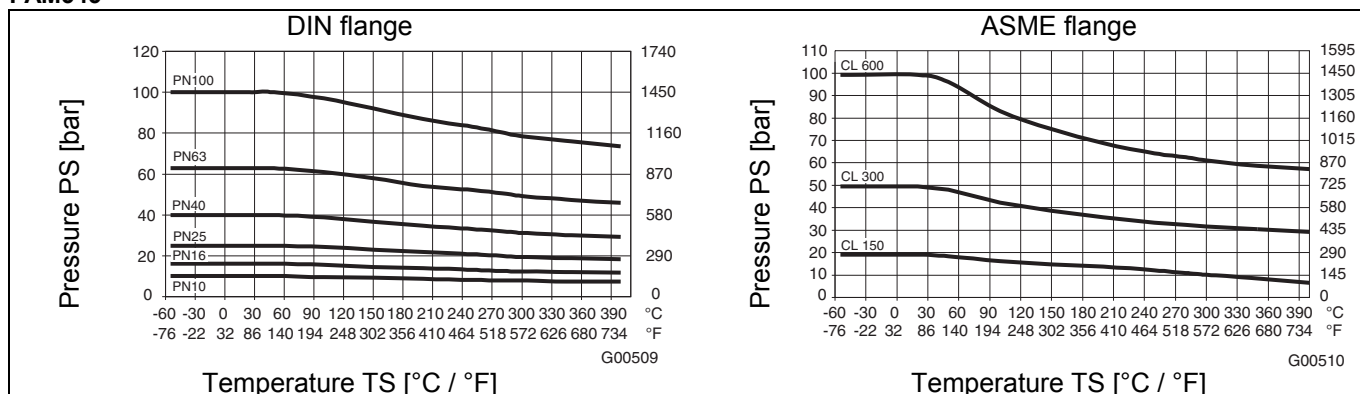


Fig. 15

### FAM546

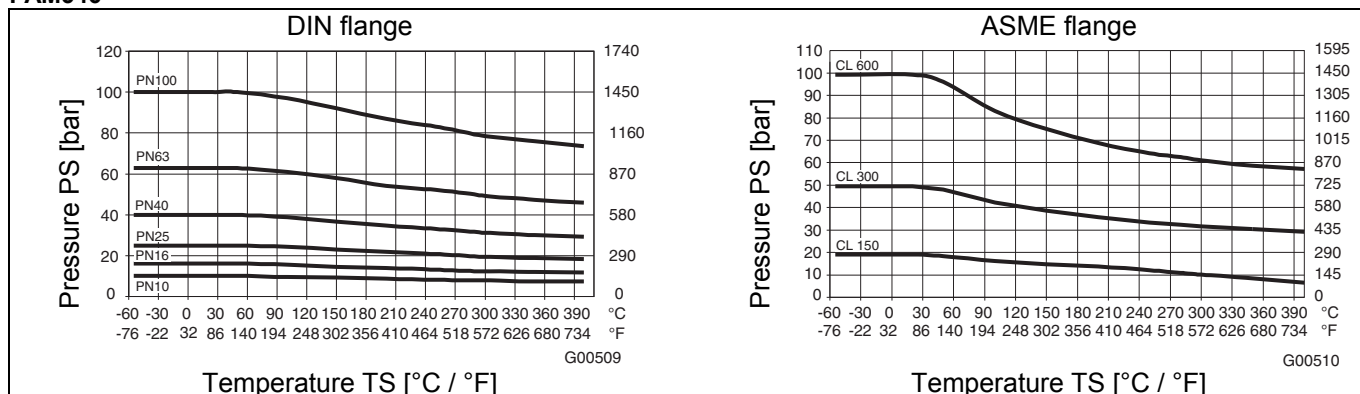


Fig. 16

### 4.4 Electrical connection

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, which is directly connected to the indicator pointer. For analog indicators, the flowrate is shown on the scale. For displays with intelligent dual wire converter, the indicator position is measured directly at the axis. A standard eddy-current brake is used to dampen indicator vibrations and ensure outstanding readability. The indicator/converter unit is attached to the flowmeter with two screws in a reproducible manner. To facilitate installation, the indicator can be removed. A model plate on the flowmeter bracket allows you to assign the meter unique identifier.

#### 4.4.1 Analog display with / without limit signal transmitter

The mechanical analog indicators are available with or without limit signal transmitter. The limit signal transmitters are housed on an alarm module that can be subsequently added. It is available as single (min. or max. alarm) or dual alarm.



Fig. 17

#### Product highlights

- Limit signal transmitter can be added via compact slide-in module.
- The position of the limit signal settings is visible externally.
- Limit signals can be set on the scale.
- Decouple-proof and hysteresis-free magnet follower system.
- Meter conforms to NAMUR Recommendations NE43, NE53, NE107
- Install and deinstall the secondary portion on the primary flowmeter without opening the indicator housing.
- Reproducibility  $\pm 0.25\%$  of scale end value.

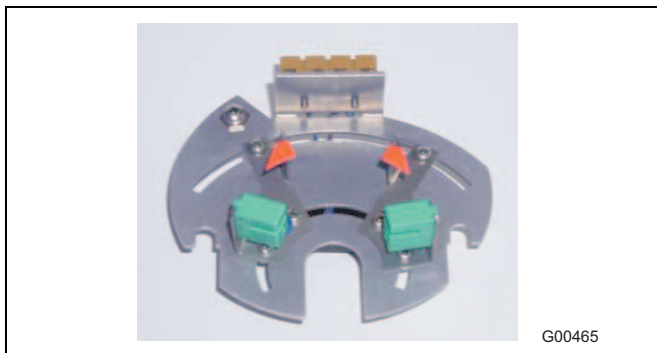


Fig. 18: Alarm module

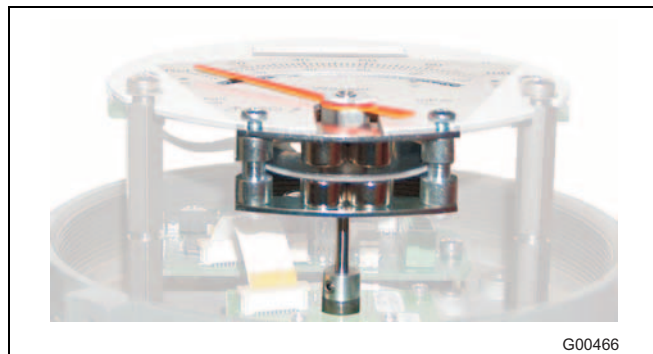


Fig. 19: Standard eddy-current brake

#### Version with limit signal transmitter

The alarm signal is triggered when the contact disc enters the slot initiator (contact opens). The alarms can be shifted without repositioning or removing the scale and are visible from the front.

Operating mode	bistable
Reproducibility	$\pm 0.5\%$ of scale end value
Nominal voltage	8 V DC (Ri approx. 1 k $\Omega$ )
Operating voltage	5 ... 25 V DC
Switching frequency, max	3 kHz

An isolated switch amplifier is required for limit signal transmitters:

Type	Auxiliary power	Channel
KFD2-SR2-Ex1.W No. D163A011U03	24 V, DC	1
KFA5-SR2-Ex1.W No. D163A011U01	115 V, AC	1
KFA6-SR2-Ex1.W No. D163A011U02	230 V, AC	1
KFD5-SR2-Ex2.W No. D163A011U06	24 V, DC	2
KFA5-SR2-Ex2.W No. D163A011U04	115 V, AC	2
KFA6-SR2-Ex2.W No. D163A011U05	230 V, AC	2

The isolated switch amplifiers from Pepperl & Fuchs are provided as examples; other amplifiers can also be used.

#### Terminal connection diagram

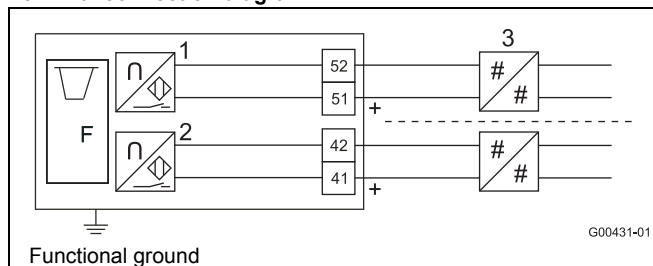


Fig. 20

- 1 Max. limit signal transmitter
- 2 Min. limit signal transmitter
- 3 Isolated switch amplifier
- F Flowmeter

## 4.4.2 Analog indicator with transmitter with / without LCD display

The electronic indicator with intelligent microprocessor transmitter is designed for 2-wire operation. An optional LCD display enables users to make local adjustments based on new measurement parameters. For models with LCD display, ABB recommends that you use a bar graph scale to avoid differences between a product scale and the flowrate shown on the display.



Fig. 21

### Product highlights

- Display can be added later.
- Electronic min/max device alarms or pulse output.
- Configuration using HART communication via handheld terminal or DSV401 (SMART VISION).
- Measurement parameters can be made at any time (pressure and temperature influence, density, units, etc.).

### Design with LCD display:

- flowrate and flow totalizer value display.
- Menu-guided configuration.
- Configuration using a magnet stick without opening the housing.

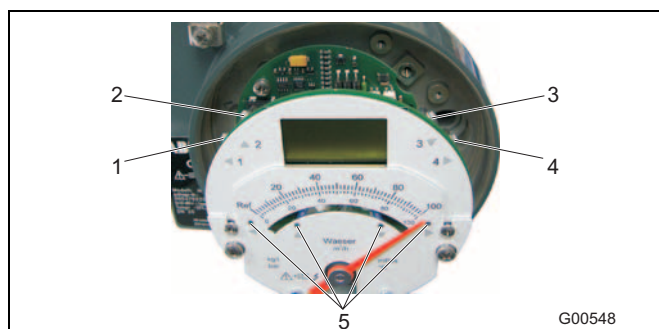


Fig. 22: Display with control buttons and magnet stick markings

- 1 Control button ◀
- 2 Control button ▲
- 3 Control button ▼
- 4 Control button ▶
- 5 Position for magnet stick operation

### Note:

When the housing cover is open, the EMC protection is suspended.

### Replacing the electronic unit

The electronic unit can be replaced in the event of a malfunction. Settings are updated immediately when the device is turned on.

### LCD display

High contrast LCD display provides real-time flowrate and totalized flow.

Use 4 control buttons on device or externally via magnet stick with closed housing.

Enter information in the plain text dialog screen of the LCD display or by digital communication using HART protocol.

### Current output terminals 31 / 32

The auxiliary power is connected to these terminals (10 ... 46 V DC). The 4 ... 20 mA output signal is also routed over these terminals.

In addition, terminals 31 / 32 support digital communication. An AC signal is superimposed on the analog output signal.

### Programmable output terminals 41 / 42

The programmable output can be assigned a variety of functions.

The following options can be selected via the "Prog Output" software:

#### 1. Pulse output

The scaled pulse output (passive) can be designed either as a NAMUR contact (DIN 19234) or standard optocoupler ( $U_H = 16 \dots 30 \text{ V DC}$ ). The internal resistance for an open contact  $> 10 \text{ k}\Omega$  NAMUR. The pulse width can be configured between 5 ... 256 ms, but with max. 50% of the period. Max. frequency  $f_{max} = 50 \text{ Hz}$ .

#### 2. General Alarm

The error status for the meter and min/max alarms are collected and output. Configurable as normally closed or normally open contacts.

#### 3. Max-Min alarm

Configurable as normally closed or normally open contacts.

#### 4. No function (factory default)

This output has no function.

The following limits apply:

Max. allowable switching current 15 mA

Min. output voltage  $U_S 2 \text{ V DC}$

$U_S =$  Voltage for auxiliary power source

### Damping

Configurable from 1 ... 100 s, corresponds to 5  $\tau$ .

### Low flow cutoff

0 ... 5 % for current and pulse output.

### Function tests

Function tests can be used to test individual internal components. For commissioning and inspection, the current output can be simulated to match selected flowrates (manual process control). The binary output can also be controlled for functional checks.

### Current output for alarm

Set the current output in case of alarm using the menu item "I out at Alarm" to 21 ... 23 mA (NAMUR NE43).

**Error message on the LCD display**

Automatic system monitoring with error diagnostics in plain text on the LCD display.

**Data security**

Automatic saving of the totalizer values and application conditions using EEPROM at shutdown or when supply voltage fails (over 10 years).

**Terminal connection diagram**

**a) Auxiliary power from central power supply**

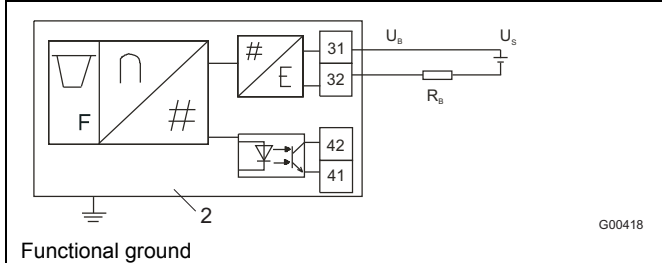


Fig. 23

**b) Auxiliary power from power supply**

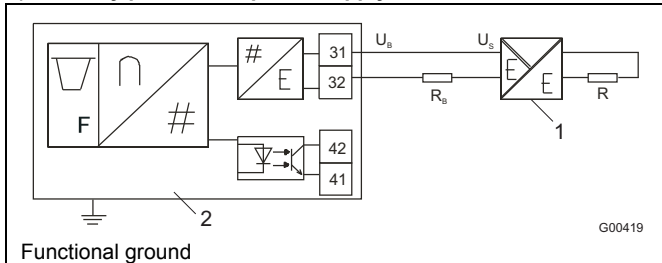


Fig. 24

- 1 Power supply unit
- 2 FAM540
- $U_B$  = Operating voltage
- $U_S$  = Supply voltage
- $R_B$  = Max. allowable load for power supply (e.g., indicator)
- $R$  = Max. allowable load for output circuit is determined by the power supply

**Auxiliary power (supply voltage)**

Standard: 10 ... 46 V DC  
 Ex design: 10 ... 30 V DC (see chapter "Ex relevant specifications").  
 Residual ripple: max. 5% or  $\pm 1.5 V_{SS}$

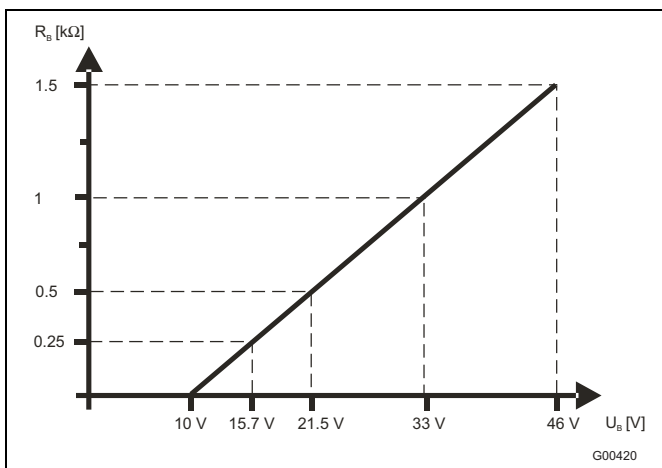


Fig. 25: Current output load diagram

**Current output load**

Min. > 250 Ω, max. 1500 Ω (with I on alarm = 23.0 mA)

**Cable**

Max. cable length 1500 m, AWG 24 twisted and shielded. To ensure full EMC protection, the cable shield must be connected to the internal ground terminal as shown in Fig. 26:

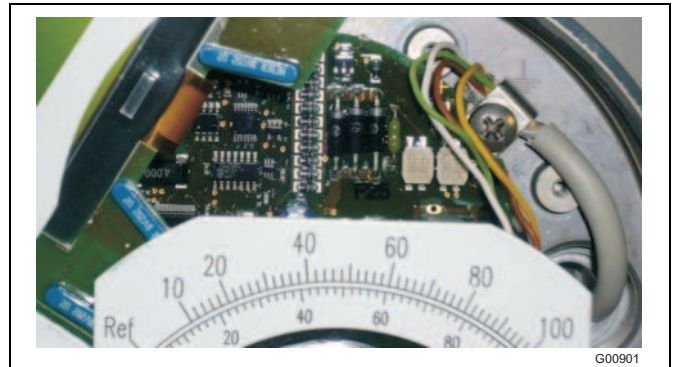


Fig. 26

**Power consumption**

< 1 W

**Temperature influence on current output**

$\leq 8 \mu A/K$

For the hazardous area design, see chapter "Ex relevant specifications".

**4.4.3 Digital communication**

**Communication HART protocol**

The HART protocol is used for digital communication between a process control system or PC, a handheld terminal and the FAM540. All meter and measuring point parameters can be transmitted. In reverse direction, the integrated converter can also be configured in this manner.

The digital communication utilizes an AC signal superimposed on the analog current output (4 ... 20 mA) that does not affect any meters connected to the output.

HART communication is performed via FSK modem with point-to-point or multidrop operation.

**Transmission method**

FSK modulation at current output of 4 ... 20 mA based on the Bell 202 standard. Max. signal amplitude 1.2 mA<sub>SS</sub>.

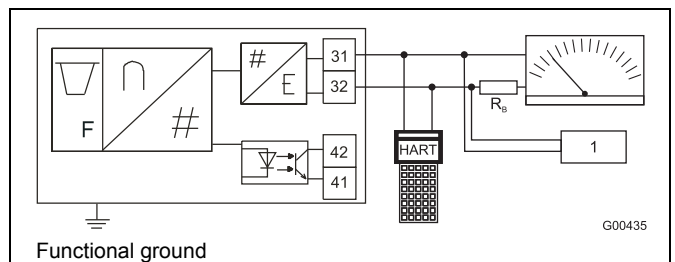


Fig. 27

- 1 Bell 202 modem
- $R_B$  Min. = 250 Ω, max. = 1500 Ω

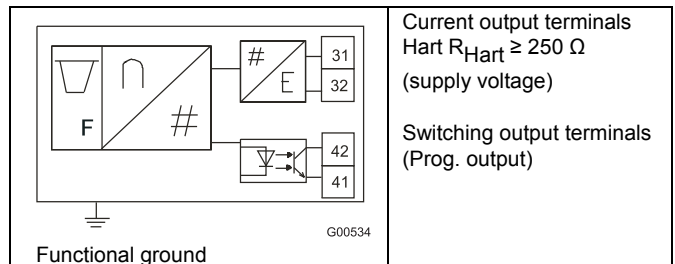


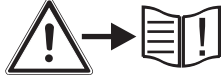
Fig. 28

Current output terminals  
 Hart  $R_{Hart} \geq 250 \Omega$   
 (supply voltage)  
 Switching output terminals  
 (Prog. output)

## 5 Ex relevant specifications

### 5.1 Basic requirements

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



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

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

### i

#### Important

- For explosion-proof devices/devices with flameproof enclosures, remove the locking device before opening the housing cover and reattach it after closing the housing!
- The max. ambient temperature for use with combustible dusts (category II 2D) is always  $T_{amb} = +60\text{ °C}$ .
- After switching off the power supply, wait  $t > 2$  minutes before opening the converter housing. Observe the "DELAY BEFORE OPENING > 2 MINUTES" warning message on the housing cover.
- When commissioning the flowmeter, refer to EN50281-1-2 regarding use in areas with combustible dusts.
- For Ex devices in PTFE design, the minimum conductivity of the medium must be  $> 10^{-8}$  S/m.
- When selecting the medium, take into consideration the chemical resistance of the materials for the meter housing, the liner and the gaskets for the process connection.
- If zone 0 is present in the metering tube, the meters may only be installed in an area close by to ensure 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 an explosion-proof/flameproof enclosed zone 1 (see section "5.3.1 Later change of Ex protection classes").
- Use only a damp cloth to clean the window in order to avoid electrostatic charging.
- For information about installation conditions for thermal insulation, see chapter "Operating conditions", page 21 .
- Use slow opening valves.
- Comply with installation conditions as per VDI/VDE 3513.
- Avoid gas inclusions when using the meter with fluids.
- Avoid pulsating flow. A float damper is available as an option.
- Avoid gas impurities (see Federal Institute for Geosciences and Natural Resources (BGR) 132-7.3.2.2.2).

## 5.2 Specific requirements FM / cCSAus

### Information about power supply lines

Installations shall comply with the relevant 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.

Installations shall comply with the latest edition of the manufacturer's instruction manual.

### Information for explosion protected installations

For FAM540-instruments installed in hazardous areas classified as Group A (FM) and B, an ignition block must be provided within a distance of 46 cm (18 inch) from the instrument.

### Intrinsic Safety Control Drawing (SDM-10-A0253)

For intrinsically safety installations, the FAM540 must be installed as illustrated in the Intrinsic Safety Control Drawing which appears on page 51. The drawing is also included in the packaging information supplied with the instrument.

The FAM540 Variable Area Flowmeters power supplies are SELV (Safety Extra Low Voltage) with LPS (Limited Power Source) and double or reinforced insulation from mains with a maximum current available of 8 A, and the external power supply must be connected to limited output NEC Class 2 circuits, as outlined in the National Electric Code® (ANSI / NFPA70).

Tampering and replacement with non-factory components may adversely affect the safe use of the system.

Insertion or withdrawal of removable electric connectors is to be accomplished only when the area is known to be free of flammable vapors.

For ambient temperatures below 5 °C (41 °F) and above 40 °C (104 °F) use field wiring suitable for both minimum and maximum ambient temperatures.

Use copper, copper-clad aluminium or aluminium conductors only.

The recommended tightening torque for field wiring terminals is 0.8 Nm (7 in. lb) or greater, as specified.

A dust tight conduit seal shall be used when installed in Class II & III environments.

Control room equipment connected to intrinsically safe associated apparatus should not use or generate more than 250 V<sub>rms</sub> or VDC.

See ANSI/ISA-RP12.06.01, Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations, for guidance on the installation of intrinsically safe apparatus and systems.

## Ex relevant specifications

### 5.3 Special installation instructions for devices with limit signal transmitter or transmitter

All installation instructions and safety requirements are contained in the respective chapters of the operating instructions.

The meters can be used in a variety of applications:

- As an intrinsically safe meter in zone 1, if connected to an intrinsically safe circuit.
- As a pressure resistant meter in zone 1, if connected to a non-intrinsically safe circuit.
- As a non-incendive meter in zone 2, if connected to a non-intrinsically safe circuit.

#### 5.3.1 Later change of Ex protection classes

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

Measures for exchange Ex protection classes for analog indicator with limit signal transmitter FAM540-B/C/D.

1. Protection class	2. Protection class	Measures
XP or Ex d $U_M = 60 \text{ V}$	IS or Ex ia *)	<ul style="list-style-type: none"> <li>• 500 Vac<sub>/1min</sub> Test between terminals 51/52 and 41/42 and terminals 51/52/41/42 and the housing.</li> <li>• Visual inspection: no explosion, no damage.</li> </ul>
	NI or Ex nA	<ul style="list-style-type: none"> <li>• 500 Vac<sub>/1min</sub> Test between terminals 51/52 and 41/42 and terminals 51/52/41/42 and the housing</li> <li>• Visual inspection: no explosion, no damage.</li> </ul>
IS or Ex ia	XP or Ex d	<ul style="list-style-type: none"> <li>• Visual inspection: No damage to threads (cover, surface, 1/2" NPT cable input), cable gland, glass, housing, locking device for cover, proper cable, etc.</li> </ul>
	NI or Ex nA	<ul style="list-style-type: none"> <li>• Special precautions are not necessary.</li> </ul>
NI or Ex nA $U_M = 60 \text{ V}$	IS or Ex a *)	<ul style="list-style-type: none"> <li>• 500 Vac<sub>/1min</sub> Test between terminals 51/52 and 41/42 and terminals 51/52/41/42 and the housing.</li> <li>• Visual inspection: no damage.</li> </ul>
	XP or Ex	<ul style="list-style-type: none"> <li>• Visual inspection: No damage to threads (cover, surface, 1/2" NPT cable input), cable gland, glass, housing, locking device for cover, proper cable, etc.</li> </ul>

\*) possible only if the max. signal levels of  $U_M \leq 60 \text{ V}$  (e.g., PELV or SELV circuits) were not previously exceeded.

Measures for exchange Ex protection classes for analog indicator with transmitter with or without LCD display FAM540-E/F.

1. Protection class	2. Protection class	Measures
XP or Ex d $U_M = 60\text{ V}$	IS or Ex ia *)	<ul style="list-style-type: none"> <li>• 500 Vac<sub>/1min</sub> Test between terminals 31/32 and 41/42 and terminals 31/32/41/42 and the housing.</li> <li>• Visual inspection: no damage, especially to electronics boards.</li> <li>• Visual inspection: no explosion, no damage.</li> </ul>
	NI or Ex nA	<ul style="list-style-type: none"> <li>• 500 Vac<sub>/1min</sub> Test between terminals 31/32 and 41/42 and terminals 31/32/41/42 and the housing.</li> <li>• Visual inspection: no damage, especially to electronics boards.</li> <li>• Visual inspection: no explosion, no damage.</li> </ul>
IS or Ex ia	XP or Ex d	<ul style="list-style-type: none"> <li>• Visual inspection: No damage to threads (cover, surface, 1/2" NPT cable input), cable gland, glass, housing, locking device for cover, proper cable, etc.</li> </ul>
	NI or Ex nA	<ul style="list-style-type: none"> <li>• Special precautions are not necessary.</li> </ul>
NI or Ex nA $U_M = 60\text{ V}$	IS or Ex ia *)	<ul style="list-style-type: none"> <li>• 500 Vac<sub>/1min</sub> Test between terminals 31/32 and 41/42 and terminals 31/32/41/42 and the housing.</li> <li>• Visual inspection: no damage, especially to electronics boards.</li> </ul>
	XP or Ex d	<ul style="list-style-type: none"> <li>• Visual inspection: No damage to threads (cover, surface, 1/2" NPT cable input), cable gland, glass, housing, locking device for cover, proper cable, etc.</li> </ul>

\*) possible only if the max. signal levels of  $U_M \leq 60\text{ V}$  (e.g., PELV or SELV circuits) were not previously exceeded.

5.3.2 Cable glands and signal cables

**Cable glands**

The meters are shipped with cable glands or 1/2" NPT threads with dust protection plugs. The different types of cable glands depend on the configuration of the Ex protection and can be selected via the model key.

Approved pressure-resistant cable glands are provided in combination with the ATEX and IECEx Ex d "pressure-resistant design". All other ATEX and IECEx models are shipped with approved plastic glands.

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

- "Ex d" design: 7.2 ... 11.7 mm (0.28 ... 0.46 inch)
- non-"Ex d" design: 5.0 ... 9.0 mm (0.20 ... 0.35 inch)



**Warning - General hazards!**

In conjunction with FM and CSA approval, the meters are shipped with 1/2" NPT threads and dust protection plugs. Approved conduit fittings or cable fittings must be used in compliance with national guidelines (NEC, CEC).

Observe the the special instructions for Ex d cable fittings in section Special installation instructions for explosion protection types flame proof (enclosure) / Explosionproof.

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

**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.

The following applies for cables that are limited to 70 °C (158 °F):

The maximum ambient temperature  $T_{amb} = 60 \text{ °C}$  (140 °F).

The resulting, new maximum temperatures of the medium are determined as follows:

- Calculate a new ambient temperature:  $T_{amb \text{ new}} = T_{amb} + 10 \text{ °C}$  (18 °F).
- Use the new ambient temperature  $T_{amb \text{ new}}$  to determine in the tables the new associated allowable temperatures for the medium.
- Please refer to the tables with the original ambient temperature  $T_{amb}$  to determine the relevant temperature class.

Example:

- $T_{amb} = 50 \text{ °C}$  (122 °F) becomes  $T_{amb \text{ new}} = 60 \text{ °C}$  (140 °F).
- Determine the fluid temperature for  $T_{amb} = 60 \text{ °C}$  (140 °F).
- Determine the temperature class for  $T_{amb} = 50 \text{ °C}$  (122 °F).

### 5.3.3 Information about the housing ground

The FAM540 housing must be correctly grounded in order to ensure proper function and safe operation. Use copper wires with a rating of at least AWG 10 for the ground connection between the ground screw and the protective conductor.

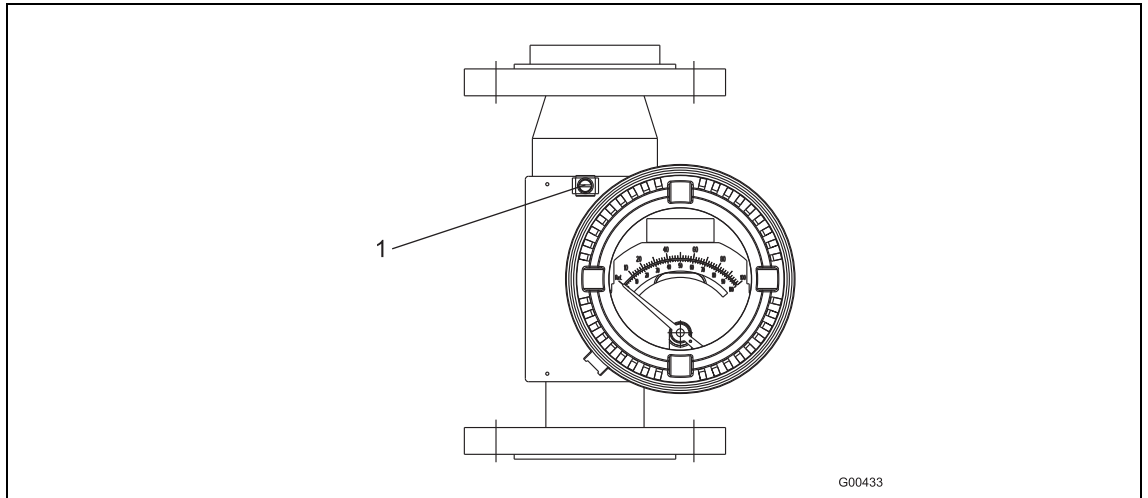


Fig. 29

1 Potential equalization per EN 60079-0



#### Important

The operator must ensure that when connecting the protective conductor (PE) no potential differences exist between protective conductor and potential equalization (PA), even in fault condition.

### 5.3.4 Special installation instructions for explosion protection types flame proof (enclosure) / Explosionproof

#### ATEX / IECEx

The electrical connection for the flowmeter is made via the cable gland on the unit (observe Fig. 30). The connection can also be made via an approved threaded conduit connection with flame arrester (located directly on the meter). First remove the cable gland, but leave the 1/2" NPT adapter on the meter. Comply with requirements in EN 60079-1. There must be a separate examination certificate for the threaded conduit connection. Use of cable and wire entries as well as plugs of simple design is prohibited. Close unused openings in accordance with EN 60079. When using pipeline systems, install the ignition blocks directly on the housing.

#### Connection via pressure-resistant cable gland

The outer diameter of the unshielded connecting cable must be between 7.2 ...11.7 mm (0.28... 0.46 inch). After installing the cable in the fitting, tighten the lock nut using a torque of 32.5 Nm. Use an additional strain relief device in the housing to secure the connecting cable.

#### FM / cCSAus

The electrical connection for the flowmeter can be made via approved threaded conduit connections with a flame arrester (located directly on the meter). First remove the plastic protection cap, but leave the 1/2" NPT adapter on the meter.



#### Important

There must be a separate examination certificate for the threaded conduit connection. Use of cable and wire entries as well as plugs of simple design is prohibited. The conduit fittings are not included in the meter's scope of supply.

#### Electrical connection for protection type Encapsulated device / Explosion-proof

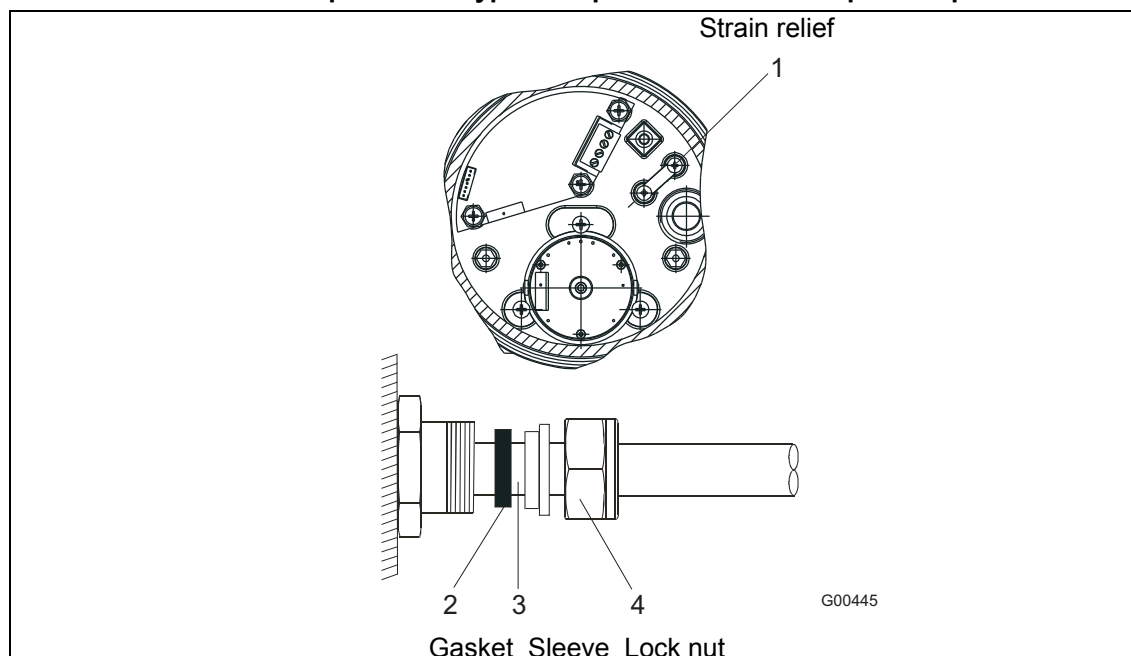


Fig. 30

**5.4 Safety-relevant information ATEX / IECEx**

The meters are designed for maximum versatility. Each meter provides a combination of explosion protection types. All meters are suitable for use in areas with combustible dust.

**5.4.1 Approved installation sites**

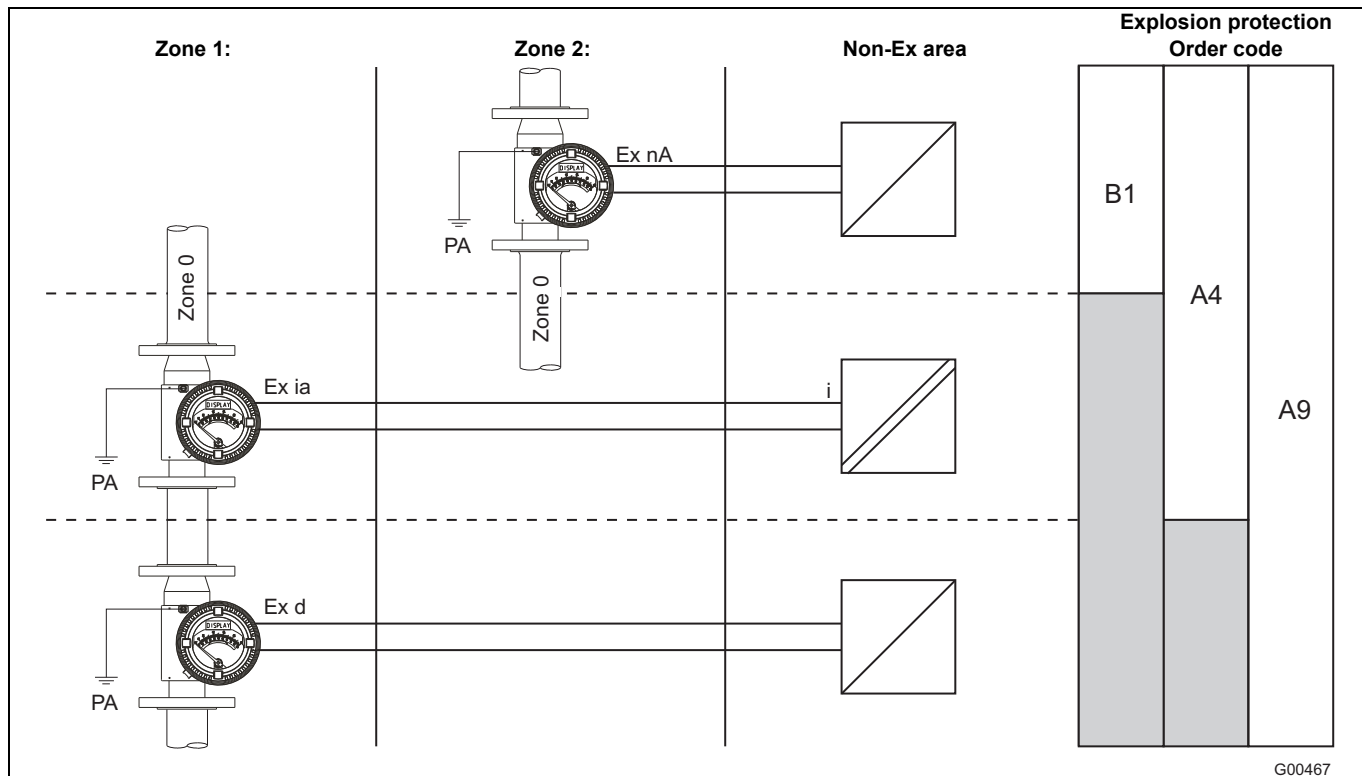


Fig. 31  
PA Potential equalization

For detailed information and terminal assignments, see chapters Analog display with / without limit signal transmitter, Page 25 and Analog indicator with transmitter with / without LCD display, page 26.

**5.4.2 Identification and protection classes**

**Analog indicator without limit signal transmitter**

**FAM54\_A\_**

	Designation	Explosion protection type	Certificate	Ignition protection Order code	Limit value table no.
ATEX	II 1/2G Ex c II T6 ... T1	Mechanical safety	KEMA 07ATEX0104X	A4 A9 B1	4
	II 2 D Ex c T85 °C ... T <sub>Medium</sub>	Mechanical safety			
	II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	Encapsulated device (dust-ignition proof)			

T<sub>amb</sub> = -40 °C ... 60 °C (combustible dusts)

T<sub>amb</sub> = -40 °C ... 70 °C

Analog indicator with limit signal transmitter

FAM54\_B/C/D\_

	Designation	Explosion protection type	Certificate	Ignition protection Order code	Limit value table no.
ATEX	II 1/2G Ex c ia IIC T6 ... T1	Intrinsic safety	KEMA 07ATEX0104X	A4	2
	II 1/3G Ex c nA II T6 ... T1	nA (non-incendive component)			4
	II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	Encapsulated device (dust-ignition proof)			2, 4
IECEx	Ex ia IIC T6 ... T1	Intrinsic safety	IECEx KEM07.0037X	A4	2
	Ex nA II T6 ... T1	nA (non-incendive component)			4
	Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	Encapsulated device (dust-ignition proof)			2, 4
ATEX	II 1/2G Ex c d IIC T6 ... T1	Flameproof protection	KEMA 07ATEX0104X	A9	3
	II 1/2G Ex c ia IIC T6 ... T1	Intrinsic safety			2
	II 1/3G Ex c nA II T6 ... T1	nA (non-incendive component)			4
	II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	Encapsulated device (dust-ignition proof)			2, 3, 4
IECEx	Ex d IIC T6 ... T1	Flameproof protection	IECEx KEM07.0037X	A9	3
	Ex ia IIC T6 ... T1	Intrinsic safety			2
	Ex nA II T6 ... T1	nA (non-incendive component)			4
	Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	Encapsulated device (dust-ignition proof)			2, 3, 4
ATEX	II 1/3G Ex c nA II T6 ... T1	nA (non-incendive component)	KEMA 07ATEX0104X	B1	4
	II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	Encapsulated device (dust-ignition proof)			4
IECEx	Ex nA II T6 ... T1	nA (non-incendive component)	IECEx KEM07.0037X	B1	4
	Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	Encapsulated device (dust-ignition proof)			4

T<sub>amb</sub> = - 20 °C (-40 °C) ... 60 °C (combustible dusts)

T<sub>amb</sub> = - 20 °C (-40 °C) ... 70 °C

Analog indicator with transmitter with or without LCD display

FAM54\_E/F\_

	Designation	Explosion protection type	Certificate	Ignition protection Order code	Limit value Table no.
ATEX	II 1/2G Ex c ia IIC T4 ... T1	Intrinsic safety	KEMA 07ATEX0104X	A4	1
	II 1/3G Ex c nA [nL] IIC T6 ... T1	nA (non-incendive component)			
	II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	Encapsulated device (dust-ignition proof)			
IECEx	Ex ia IIC T4 ... T1	Intrinsic safety	IECEx KEM07.0037X	A4	1
	Ex nA [nL] IIC T6 ... T1	nA (non-incendive component)			
	Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	Encapsulated device (dust-ignition proof)			
ATEX	II 1/2G Ex c d IIC T6 ... T1	Flameproof protection	KEMA 07ATEX0104X	A9	1
	II 1/2G Ex c ia IIC T4 ... T1	Intrinsic safety			
	II 1/3G Ex c nA [nL] IIC T6 ... T1	nA (non-incendive component)			
	II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	Encapsulated device (dust-ignition proof)			
IECEx	Ex d IIC T6 ... T1	Flameproof protection	IECEx KEM07.0037X	A9	1
	Ex ia IIC T4 ... T1	Intrinsic safety			
	Ex nA [nL] IIC T6 ... T1	nA (non-incendive component)			
	Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	Encapsulated device (dust-ignition proof)			
ATEX	II 1/3G Ex c nA [nL] IIC T6 ... T1	nA (non-incendive component)	KEMA 07ATEX0104X	B1	1
	II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	Encapsulated device (dust-ignition proof)			
IECEx	Ex nA [nL] IIC T6 ... T1	nA (non-incendive component)	IECEx KEM07.0037X	B1	1
	Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	Encapsulated device (dust-ignition proof)			

T<sub>amb</sub> = -40 °C ... 60 °C (combustible dusts)

T<sub>amb</sub> = -40 °C ... 70 °C

**5.4.3 Limit value tables**

**Table 1: Analog indicator with converter with or without LCD display**

Explosion protection type: Hermetically sealed, intrinsically safe "nA" (non-incendive component), encapsulated device (dust-ignition proof)

Order code	Designation	Connection terminals	Input values	T <sub>amb</sub>	Temp. class	Max. Medium temp.	Therm. isolation	Heating jacket
				-20 °C (-40 °C) ...				
A4 A9	ATEX: II 1/2G Ex c ia IIC T4 ... T1 II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	31 / 32 for connection with an intrinsically safe circuit	U <sub>i</sub> = 30 V I <sub>i</sub> = 110 mA P <sub>i</sub> = 770 mW C <sub>i</sub> = 5.3 nF L <sub>i</sub> = 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
	IECEX: Ex ia IIC T4 ... T1 Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	41 / 42 for connection with an intrinsically safe circuit	U <sub>i</sub> = 30 V I <sub>i</sub> = 30 mA P <sub>i</sub> = 115 mW C <sub>i</sub> = 4,8 nF L <sub>i</sub> = 133 µH	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
A9	ATEX: II 1/2G Ex c d IIC T6 ... T1 II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	31 / 32 for connection with a non-intrinsically safe circuit <sup>1)</sup>	V <sub>max</sub> = 46 V	70 °C	T3	150 °C	yes	no
				70 °C	T3	125 °C	yes	yes
				40 °C	T1	440 °C	no	no
				40 °C	T1	375 °C	yes	no
				40 °C	T1	260 °C	yes	yes
	IECEX: Ex d IIC T6 ... T1 Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	41 / 42 for connection with a non-intrinsically safe circuit <sup>1)</sup>	V <sub>max</sub> = 30 V I <sub>max</sub> = 30 mA P <sub>max</sub> = 115 mW	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
A4 A9 B1	ATEX: II 1/3G Ex c nA [nL] IIC T6 ... T1 II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	31 / 32 for connection with a non-intrinsically safe circuit <sup>1)</sup>	V <sub>max</sub> = 46 V	60 °C	T4	130 °C	yes	yes
				60 °C	T5	95 °C	yes	yes
				60 °C	T6	80 °C	yes	yes
				40 °C	T1	440 °C	no	no
				40 °C	T1	375 °C	yes	no
	IECEX: Ex nA [nL] IIC T6 ... T1 Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	41 / 42 for connection with a non-intrinsically safe circuit <sup>1)</sup>	V <sub>max</sub> = 30 V I <sub>max</sub> = 30 mA P <sub>max</sub> = 115 mW	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
A4 A9 B1	IECEX: Ex nA [nL] IIC T6 ... T1 Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	41 / 42 for connection with a non-intrinsically safe circuit <sup>1)</sup>	V <sub>max</sub> = 30 V I <sub>max</sub> = 30 mA P <sub>max</sub> = 115 mW	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
A4 A9 B1	IECEX: Ex nA [nL] IIC T6 ... T1 Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	41 / 42 for connection with a non-intrinsically safe circuit <sup>1)</sup>	V <sub>max</sub> = 30 V I <sub>max</sub> = 30 mA P <sub>max</sub> = 115 mW	30 °C	T6	25 °C	yes	yes

Special conditions for explosion protection type "Encapsulated device" (dust-ignition proof) for the models with Ex protection (A4 and B1):

T<sub>Medium</sub> ≤ 250 °C at T<sub>amb</sub> = -40 ... 60 °C

T<sub>Medium</sub> ≤ 340 °C at T<sub>amb</sub> = -40 ... 40 °C

T<sub>Medium</sub> ≤ 430 °C at T<sub>amb</sub> = -40 ... 20 °C

1) If the meter will be operated subsequently with explosion protection type "intrinsically safe", then U<sub>max</sub> = 60 V may not be exceeded.

**Table 2: Analog indicator with limit signal transmitter**

Explosion protection type: Intrinsic safety, encapsulated device (dust-ignition proof)

Order code	Designation	Connection terminals	Input values	T <sub>amb</sub> -20 °C (-40 °C) ...	Temp. class	Max. Medium temp.	Therm. isolation	Heating jacket
A4 A9	ATEX: II 1/2G Ex c ia IIC T6 ... T1 II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>  IECEX: Ex ia IIC T6 ... T1 Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	41 / 42 and 51 / 52 for connection with an intrinsically safe circuit	For each circuit  U <sub>i</sub> = 16 V I <sub>i</sub> = 25 mA P <sub>i</sub> = 64 mW C <sub>i</sub> = 50 nF L <sub>i</sub> = 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 and 51 / 52 for connection with an intrinsically safe circuit	For each circuit  U <sub>i</sub> = 16 V I <sub>i</sub> = 52 mA P <sub>i</sub> = 169 mW C <sub>i</sub> = 50 nF L <sub>i</sub> = 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 and 51 / 52 for connection with an intrinsically safe circuit	For each circuit  U <sub>i</sub> = 16 V I <sub>i</sub> = 76 mA P <sub>i</sub> = 242 mW C <sub>i</sub> = 50 nF L <sub>i</sub> = 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		

Special conditions for explosion protection type "Encapsulated device" (dust-ignition proof) for the models with Ex protection (A4 and A9):

T<sub>Medium</sub> ≤ 250 °C at T<sub>amb</sub> = -20 ... 60 °C

T<sub>Medium</sub> ≤ 340 °C at T<sub>amb</sub> = -20 ... 40 °C

T<sub>Medium</sub> ≤ 430 °C at T<sub>amb</sub> = -20 ... 20 °C

**Table 3: Analog indicator with limit signal transmitter**

Explosion protection type: Hermetically sealed, encapsulated device (dust-ignition proof)

Order code	Designation	Connection terminals	Input values	T <sub>amb</sub> -20 °C (-40 °C) ...	Temp. class	Max. Medium temp.	Therm. isolation	Heating jacket
A9	ATEX: II 1/2G Ex c d IIC T6 ... T1 II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>  IECEx: Ex d IIC T6 ... T1 Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	41 / 42 and 51 / 52 for connection with a non-intrinsically safe circuit <sup>1)</sup>	For each circuit  U <sub>max</sub> = 16 V I <sub>max</sub> = 25 mA P <sub>max</sub> = 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 and 51 / 52 for connection with a non-intrinsically safe circuit <sup>1)</sup>	For each circuit  U <sub>max</sub> = 16 V I <sub>max</sub> = 52 mA P <sub>max</sub> = 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 and 51 / 52 for connection with a non-intrinsically safe circuit <sup>1)</sup>	For each circuit  U <sub>max</sub> = 16 V I <sub>max</sub> = 76 mA P <sub>max</sub> = 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		

Special conditions for explosion protection type "Encapsulated device" (dust-ignition proof) for the models with Ex protection (A9):

 T<sub>Medium</sub> ≤ 250 °C at T<sub>amb</sub> = -20 ... 60 °C

 T<sub>Medium</sub> ≤ 340 °C at T<sub>amb</sub> = -20 ... 40 °C

 T<sub>Medium</sub> ≤ 430 °C at T<sub>amb</sub> = -20 ... 20 °C

 1) If the meter will be operated subsequently with explosion protection type "intrinsically safe", then U<sub>max</sub> may not be exceeded.

**Table 4: Analog display with/without limit signal transmitter**

Explosion protection type: "nA" (non-incendive component), encapsulated device (dust-ignition proof)

Order code	Designation	Connection terminals	Input values	T <sub>amb</sub> -20 °C (-40 °C) ...	Temp. class	Max. Medium temp.	Therm. isolation	Heating jacket
A4 A9 B1	ATEX: II 1/3G Ex c nA II T6 ... T1 II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>  IECEX: Ex nA II T6 ... T1 Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>	41 / 42 and 51 / 52 for connection with a non-intrinsically safe circuit <sup>1)</sup>	For each circuit  U <sub>max</sub> = 16 V I <sub>max</sub> = 25 mA P <sub>max</sub> = 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 and 51 / 52 for connection with a non-intrinsically safe circuit <sup>1)</sup>	For each circuit  U <sub>max</sub> = 16 V I <sub>max</sub> = 52 mA P <sub>max</sub> = 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 and 51 / 52 for connection with a non-intrinsically safe circuit <sup>1)</sup>	For each circuit  U <sub>max</sub> = 16 V I <sub>max</sub> = 76 mA P <sub>max</sub> = 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		
A4 A9 B1	ATEX: II 1/2G Ex c II T6 ... T1 II 2D Ex c T85 °C ... T <sub>Medium</sub> II 2D Ex tD A21 IP6X T85 °C ... T <sub>Medium</sub>			n.a.	n.a.	70 °C	T1	440 °C
		70 °C	T2			290 °C	yes	yes
		70 °C	T3			190 °C	yes	yes
		70 °C	T4			130 °C	yes	yes
		70 °C	T5			95 °C	yes	yes
		70 °C	T6			80°C	yes	yes

Special conditions for explosion protection type "Encapsulated device" (dust-ignition proof) for the models with Ex protection (A4, A9 and B1):

T<sub>Medium</sub> ≤ 250°C at T<sub>amb</sub> = -40 ... 60 °C

T<sub>Medium</sub> ≤ 340°C at T<sub>amb</sub> = -40 ... 40 °C

T<sub>Medium</sub> ≤ 430°C at T<sub>amb</sub> = -40 ... 20 °C

1) If the meter will be operated subsequently with explosion protection type "intrinsically safe", then U<sub>max</sub> may not be exceeded.

## 5.5 Safety specifications FM / CSA

The meters are designed for maximum versatility. Each meter provides a combination of explosion protection types. All meters are suitable for use in areas with combustible dust.



### **Warning! Risk of explosion!**

Changing equipment accessories can affect suitability for use for Class I, Div 1 and Class I, Div 2. Meters installed as NI rather than XP or IS are only suitable for use in Class I, Div 2, Group A,B,C,D or in non-hazardous locations.



### **Warning! Risk of explosion!**

- Substitution of components may impair intrinsic safety.
- Substitution of components may impair suitability for division 1 & 2 and zone 0, 1 & 2.
- Keep cover tight while circuit is alive.
- Do not disconnect equipment unless area is known to be non hazardous.
- Do not open when an explosive gas atmosphere is present.
- Do not open when energized.
- After de-energized, delay 2 minutes before opening.
- For connection only to non-flammable processes.



### **Important**

For group A & B applications, seal all conduits within 46 cm (18 inch).

## Ex relevant specifications

### 5.5.1 Identification codes and protection types FM and cCSAus

Analog indicator without limit signal transmitter FAM54\_A\_

Analog indicator with limit signal transmitter FAM54\_B/C/D\_

	Designation	Explosion protection type	Explosion protection Order code	Limit value table no.	Certificate no.
FM	XP / CL I / DIV 1 / GP ABCD / T6...T1	Explosionproof	F3	FM2	Project ID 3033042
	CL I, ZN 1 AEx d IIC T6...T1				
	IS / CL I,II,III / DIV 1 / GP ABCDEFG / T6..T1	Intrinsic Safety	F3 F4	FM1 FM2	
	CL I, ZN 1 AEx ia IIC T6...T1				
	DIP / CL II, III / DIV 1 / GP EFG / T6...T1	Dust-ignition-proof			
	NI / CL I,II / DIV 2 / GP ABCDFG / T5...T1	Non-incendive	F3 F4	FM1 FM2 FM3	
	NI / CL III T5...T1				
CL II, ZN 2 AEx nA II T5...T1					
cCSAus	XP / CL I / DIV 1 / GP BCD / T6...T1	Explosionproof	F3	CSA2	1931925
	Ex d IIC T6...T1				
	IS / CL I,II,III / DIV 1 / GP ABCDEFG / T6..T1	Intrinsic Safety	F3 F4	CSA1	
	Ex ia IIC T6...T1				
	DIP / CL II, III / DIV 1 / GP EFG / T6...T1	Dust-ignition-proof	F3 F4	CSA1 CSA2 CSA3	
	DIP A21 T <sub>A</sub> 85°C to T <sub>Medium</sub>				
	NI / CL I,II / DIV 2 / GP ABCDFG / T5...T1	Non-incendive	F3 F4	CSA3	
NI / CL III T5...T1					
Ex nA II T5...T1					

Analog indicator with transmitter with or without LCD display FAM54\_E/F\_

	Designation	Explosion protection type	Explosion protection Order code	Limit value table no.	Certificate no.
FM	XP / CL I / DIV 1 / GP ABCD / T6...T1	Explosionproof	F3	FM4	Project ID 3033042
	CL I, ZN 1 AEx d IIC T6...T1				
	IS / CL I,II,III / DIV 1 / GP ABCDEFG / T4..T1	Intrinsic Safety	F3 F4	FM4	
	CL I, ZN 1 AEx ia IIC T4...T1				
	DIP / CL II, III / DIV 1 / GP EFG / T6...T1	Dust-ignition-proof			
	NI / CL I,II / DIV 2 / GP ABCDFG / T4...T1	Non-incendive	F3 F4	FM4	
	NI / CL III T4...T1				
CL II, ZN 2 AEx nA [nL] IIC T6...T1					
cCSAus	XP / CL I / DIV 1 / GP BCD / T6...T1	Explosionproof	F3	CSA4	1931925
	Ex d IIC T6...T1				
	IS / CL I,II,III / DIV 1 / GP ABCDEFG / T4..T1	Intrinsic Safety	F3 F4	CSA4	
	Ex ia IIC T4...T1				
	DIP / CL II, III / DIV 1 / GP EFG / T6...T1	Dust-ignition-proof	F3 F4	CSA4	
	DIP A21 T <sub>A</sub> 85°C to T <sub>Medium</sub>				
	NI / CL I,II / DIV 2 / GP ABCDFG / T4...T1	Non-incendive	F3 F4	CSA4	
NI / CL III T4...T1					
Ex nA [nL] IIC T6...T1					

XP: T<sub>amb</sub> = -40 °C ... 70 °C (-40 °F ... 158 °F)

DIP, IS, NI: T<sub>amb</sub> = -40 °C ... 60 °C (-40 °F ... 140 °F)

IS-Installation per drawing SDM-10-A0253

**5.5.2 Limit value tables FM**
**Table FM1: Analog indicator with limit signal transmitter**

Order code	Designation	Connection terminals	Input values	T <sub>amb</sub> -58 °F ...	Temp. class	Max. Medium temp.	Therm. isolation	Heating jacket
<b>F3</b> 1) or <b>F4</b> 1)	IS / CL I,II,III / DIV 1 / GP ABCDEFG / T6...T1 2) IS installation per drawing SDM-10-A0253 DIP / CL II, III / DIV 1 / GP EFG / T6...T1 CL I, ZN 1 AEx ia IIC T6...T1	41 / 42 and 51 / 52 if connected to an intrinsically safe circuit	For each circuit U <sub>i</sub> = 16 V I <sub>i</sub> = 25 mA P <sub>i</sub> = 64 mW C <sub>i</sub> = 50 nF L <sub>i</sub> = 250 μH	104 °F	T1	824 °F	no	no
				104 °F	T1	707 °F	yes	no
				104 °F	T1	500 °F	yes	yes
				122 °F	T1	572 °F	yes	no
				122 °F	T2	554 °F	yes	no
				122 °F	T2	428 °F	yes	yes
				140 °F	T2	608 °F	no	no
				140 °F	T2	446 °F	yes	no
				140 °F	T3	338 °F	yes	yes
				158 °F	T3	383 °F	no	no
				158 °F	T3	302 °F	yes	no
				158 °F	T4	266 °F	yes	yes
				158 °F	T5	203 °F	yes	yes
				140 °F	T6	176 °F	yes	yes
		41 / 42 and 51 / 52 if connected to an intrinsically safe circuit	For each circuit U <sub>i</sub> = 16 V I <sub>i</sub> = 52 mA P <sub>i</sub> = 169 mW C <sub>i</sub> = 50 nF L <sub>i</sub> = 250 μH	104 °F	T1	824 °F	no	no
				104 °F	T1	707 °F	yes	no
				104 °F	T1	500 °F	yes	yes
				122 °F	T1	572 °F	yes	no
				122 °F	T2	554 °F	yes	no
				122 °F	T2	428 °F	yes	yes
				140 °F	T2	608 °F	no	no
				140 °F	T2	446 °F	yes	no
				140 °F	T3	338 °F	yes	yes
				158 °F	T3	383 °F	no	no
				158 °F	T3	302 °F	yes	no
				158 °F	T4	266 °F	yes	yes
				140 °F	T5	140 °F	yes	yes
				122 °F	T5	194 °F	no	yes
		104 °F	T6	140 °F	yes	yes		
		41 / 42 and 51 / 52 if connected to an intrinsically safe circuit	For each circuit U <sub>i</sub> = 16 V I <sub>i</sub> = 76 mA P <sub>i</sub> = 242 mW C <sub>i</sub> = 50 nF L <sub>i</sub> = 250 μH	104 °F	T1	824 °F	no	no
				104 °F	T1	590 °F	yes	no
				104 °F	T2	374 °F	yes	yes
				122 °F	T2	644 °F	no	no
				122 °F	T2	446 °F	yes	yes
				140 °F	T2	446 °F	no	no
				140 °F	T3	320 °F	yes	yes
158 °F	T4			248 °F	no	no		
158 °F	T4			212 °F	yes	yes		
104 °F	T5			140 °F	yes	yes		
86 °F	T6	86 °F	yes	yes				

1) If connected to an intrinsically safe circuit  
 2) IS installation per drawing SDM-10-A0253

Table FM2: Analog indicator with limit signal transmitter

Order code	Designation	Connection terminals	Input values	T <sub>amb</sub> -58 °F ...	Temp. class	Max. Medium temp.	Therm. isolation	Heating jacket
F3 1)	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	41 / 42 and 51 / 52 if connected to a non-intrinsically safe circuit	For each circuit U <sub>max</sub> = 16 V I <sub>max</sub> = 25 mA P <sub>max</sub> = 64 mW	104 °F	T1	824 °F	no	no
				104 °F	T1	707 °F	yes	no
				104 °F	T1	500 °F	yes	yes
				122 °F	T1	572 °F	yes	no
				122 °F	T2	554 °F	yes	no
				122 °F	T2	428 °F	yes	yes
				140 °F	T2	608 °F	no	no
				140 °F	T2	446 °F	yes	no
				140 °F	T3	338 °F	yes	yes
				158 °F	T3	383 °F	no	no
				158 °F	T3	302 °F	yes	no
				158 °F	T4	266 °F	yes	yes
		158 °F	T5	203 °F	yes	yes		
		140 °F	T6	176 °F	yes	yes		
		41 / 42 and 51 / 52 if connected to a non-intrinsically safe circuit	For each circuit U <sub>max</sub> = 16 V I <sub>max</sub> = 52 mA P <sub>max</sub> = 169 mW	104 °F	T1	824 °F	no	no
				104 °F	T1	707 °F	yes	no
				104 °F	T1	500 °F	yes	yes
				122 °F	T1	572 °F	yes	no
				122 °F	T2	554 °F	yes	no
				122 °F	T2	428 °F	yes	yes
				140 °F	T2	608 °F	no	no
				140 °F	T2	446 °F	yes	no
				140 °F	T3	338 °F	yes	yes
				158 °F	T3	383 °F	no	no
				158 °F	T3	302 °F	yes	no
				158 °F	T4	266 °F	yes	yes
		140 °F	T5	140 °F	yes	yes		
		122 °F	T5	194 °F	no	yes		
		104 °F	T6	140 °F	yes	yes		
		41 / 42 and 51 / 52 if connected to a non-intrinsically safe circuit	For each circuit U <sub>max</sub> = 16 V I <sub>max</sub> = 76 mA P <sub>max</sub> = 242 mW	104 °F	T1	824 °F	no	no
				104 °F	T1	590 °F	yes	no
				104 °F	T2	374 °F	yes	yes
				122 °F	T2	644 °F	no	no
				122 °F	T2	446 °F	yes	yes
				140 °F	T2	446 °F	no	no
				140 °F	T3	320 °F	yes	yes
158 °F	T4			248 °F	no	no		
158 °F	T4			212 °F	yes	yes		
104 °F	T5			140 °F	yes	yes		
86 °F	T6			86 °F	yes	yes		

1) If connected to an intrinsically safe circuit

**Table FM3: Analog display with/without limit signal transmitter**

Order code	Designation	Connection terminals	Input values	T <sub>amb</sub> -58 °F ...	Temp. class	Max. Medium temp.	Therm. isolation	Heating jacket
<b>F4</b> 1) or <b>F3</b> 1)	NI / CL I,II / DIV 2 / GP ABCDFG / T5...T1 or NI / CL III / T5...T1	41 / 42 and 51 / 52 if connected to a non-intrinsically safe circuit <sup>1)</sup>	For each circuit  U <sub>max</sub> = 16 V I <sub>max</sub> = 25 mA P <sub>max</sub> = 64 mW	104 °F	T1	824 °F	no	no
				104 °F	T1	707 °F	yes	no
				104 °F	T1	500 °F	yes	yes
				122 °F	T1	572 °F	yes	no
				122 °F	T2	554 °F	yes	no
				122 °F	T2	428 °F	yes	yes
				140 °F	T2	608 °F	no	no
				140 °F	T2	446 °F	yes	no
				140 °F	T3	338 °F	yes	yes
				158 °F	T3	383 °F	no	no
				158 °F	T3	302 °F	yes	no
				158 °F	T4	266 °F	yes	yes
				158 °F	T5	203 °F	yes	yes
				104 °F	T1	824 °F	no	no
				104 °F	T1	707 °F	yes	no
	104 °F	T1	500 °F	yes	yes			
	122 °F	T1	572 °F	yes	no			
	122 °F	T2	554 °F	yes	no			
	122 °F	T2	428 °F	yes	yes			
	140 °F	T2	608 °F	no	no			
	140 °F	T2	446 °F	yes	no			
	140 °F	T3	338 °F	yes	yes			
	158 °F	T3	383 °F	no	no			
	158 °F	T3	302 °F	yes	no			
	158 °F	T4	266 °F	yes	yes			
	140 °F	T5	140 °F	yes	yes			
	122 °F	T5	194 °F	no	yes			
	CL II, ZN 2 AEx nA II T5...T1	41 / 42 and 51 / 52 if connected to a non-intrinsically safe circuit <sup>1)</sup>	For each circuit  U <sub>max</sub> = 16 V I <sub>max</sub> = 52 mA P <sub>max</sub> = 169 mW	104 °F	T1	824 °F	no	no
				104 °F	T1	590 °F	yes	no
				104 °F	T2	374 °F	yes	yes
122 °F				T2	644 °F	no	no	
122 °F				T2	446 °F	yes	yes	
140 °F				T2	446 °F	no	no	
140 °F				T3	320 °F	yes	yes	
158 °F				T4	248 °F	no	no	
158 °F				T4	212 °F	yes	yes	
104 °F				T5	140 °F	yes	yes	

1) For connection in Division 2 or Zone 2

Table FM4: Analog indicator with converter with or without LCD display

Order code	Designation	Connection terminals	Input values	T <sub>amb</sub> -58 °F ...	Temp. class	Max. Medium temp.	Therm. isolation	Heating jacket
F3 1) or F4 1)	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 if connected to an intrinsically safe circuit 2)	U <sub>i</sub> = 30 V I <sub>i</sub> = 110 mA P <sub>i</sub> = 770 mW C <sub>i</sub> = 5.3 nF L <sub>i</sub> = 266 µH	104 °F	T1	824 °F	no	no
				104 °F	T1	707 °F	yes	no
				104 °F	T1	500 °F	yes	yes
				122 °F	T1	572 °F	yes	no
				122 °F	T2	554 °F	yes	no
		122 °F	T2	428 °F	yes	yes		
		140 °F	T2	608 °F	no	no		
		140 °F	T2	446 °F	yes	no		
		140 °F	T3	338 °F	yes	yes		
		158 °F	T3	383 °F	no	no		
158 °F	T3	302 °F	yes	no				
158 °F	T4	257 °F	yes	yes				
F3 3)	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 if connected to a non-intrinsically safe circuit	V <sub>max</sub> = 46 V	104 °F	T1	824 °F	no	no
				104 °F	T1	707 °F	yes	no
				104 °F	T1	500 °F	yes	yes
				122 °F	T1	572 °F	yes	no
				122 °F	T2	554 °F	yes	no
		122 °F	T2	428 °F	yes	yes		
		140 °F	T2	608 °F	no	no		
		140 °F	T2	446 °F	yes	no		
		140 °F	T3	338 °F	yes	yes		
		140 °F	T4	266 °F	yes	yes		
140 °F	T5	203 °F	yes	yes				
140 °F	T6	176 °F	yes	yes				
F4 4) or F3 4)	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	31 / 32 if connected to a non-intrinsically safe circuit	V <sub>max</sub> = 46 V	104 °F	T1	824 °F	no	no
				104 °F	T1	707 °F	yes	no
				104 °F	T1	500 °F	yes	yes
				122 °F	T1	572 °F	yes	no
				122 °F	T2	554 °F	yes	no
		122 °F	T2	428 °F	yes	yes		
		140 °F	T2	608 °F	no	no		
		140 °F	T2	446 °F	yes	no		
		140 °F	T3	338 °F	yes	yes		
		158 °F	T3	383 °F	no	no		
158 °F	T3	302 °F	yes	no				
158 °F	T4	266 °F	yes	yes				
158 °F	T5	203 °F	yes	yes				
86 °F	T6	77 °F	yes	yes				

- 1) If connected to an intrinsically safe circuit
- 2) IS installation per drawing SDM-10-A0253
- 3) If connected to a non-intrinsically safe circuit
- 4) For connection in Division 2 or Zone 2

**5.5.3 Limit value tables cCSAus**
**Table CSA1: Analog indicator with limit signal transmitter**

Order code	Designation	Connection terminals	Input values	T <sub>amb</sub> -50 °C ...	Temp. class	Max. Medium temp.	Therm. isolation	Heating jacket
<b>F3</b> 1) or <b>F4</b> 1)	IS / CL I,II,III / DIV 1 / GP ABCDEFG / T6...T1 2)	41 / 42 and 51 / 52 if connected to an intrinsically safe circuit	For each circuit  U <sub>i</sub> = 16 V I <sub>i</sub> = 25 mA P <sub>i</sub> = 64 mW C <sub>i</sub> = 50 nF L <sub>i</sub> = 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			
	DIP / CL II, III / DIV 1 / GP EFG / T6...T1	41 / 42 and 51 / 52 if connected to an intrinsically safe circuit	For each circuit  U <sub>i</sub> = 16 V I <sub>i</sub> = 52 mA P <sub>i</sub> = 169 mW C <sub>i</sub> = 50 nF L <sub>i</sub> = 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			
	Ex ia IIC T6...T1  DIP A21 TA 85°C to T <sub>Medium</sub>	41 / 42 and 51 / 52 if connected to an intrinsically safe circuit	For each circuit  U <sub>i</sub> = 16 V I <sub>i</sub> = 76 mA P <sub>i</sub> = 242 mW C <sub>i</sub> = 50 nF L <sub>i</sub> = 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) If connected to an intrinsically safe circuit  
 2) IS installation per drawing SDM-10-A0253

Table CSA2: Analog indicator without limit signal transmitter

Order code	Designation	Connection terminals	Input values	T <sub>amb</sub> -50 °C ...	Temp. class	Max. Medium temp.	Therm. isolation	Heating jacket
F3 1)	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 <sub>Medium</sub>	41 / 42 and 51 / 52 if connected to a non-intrinsically safe circuit	For each circuit U <sub>max</sub> = 16 V I <sub>max</sub> = 25 mA P <sub>max</sub> = 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 and 51 / 52 if connected to a non-intrinsically safe circuit	For each circuit U <sub>max</sub> = 16 V I <sub>max</sub> = 52 mA P <sub>max</sub> = 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 and 51 / 52 if connected to a non-intrinsically safe circuit	For each circuit U <sub>max</sub> = 16 V I <sub>max</sub> = 76 mA P <sub>max</sub> = 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) If connected to an intrinsically safe circuit

**Table CSA3: Analog display with/without limit signal transmitter**

Order code	Designation	Connection terminals	Input values	T <sub>amb</sub> -50 °C ...	Temp. class	Max. Medium temp.	Therm. isolation	Heating jacket
<b>F4</b> 1) or <b>F3</b> 1)	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 <sub>Medium</sub>	41 / 42 and 51 / 52 if connected to a non-intrinsically safe circuit <sup>1)</sup>	For each circuit  U <sub>max</sub> = 16 V I <sub>max</sub> = 25 mA P <sub>max</sub> = 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		
		41 / 42 and 51 / 52 if connected to a non-intrinsically safe circuit <sup>1)</sup>	For each circuit  U <sub>max</sub> = 16 V I <sub>max</sub> = 52 mA P <sub>max</sub> = 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		
		41 / 42 and 51 / 52 if connected to a non-intrinsically safe circuit <sup>1)</sup>	For each circuit  U <sub>max</sub> = 16 V I <sub>max</sub> = 76 mA P <sub>max</sub> = 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		

1) For connection in Division 2 or Zone 2

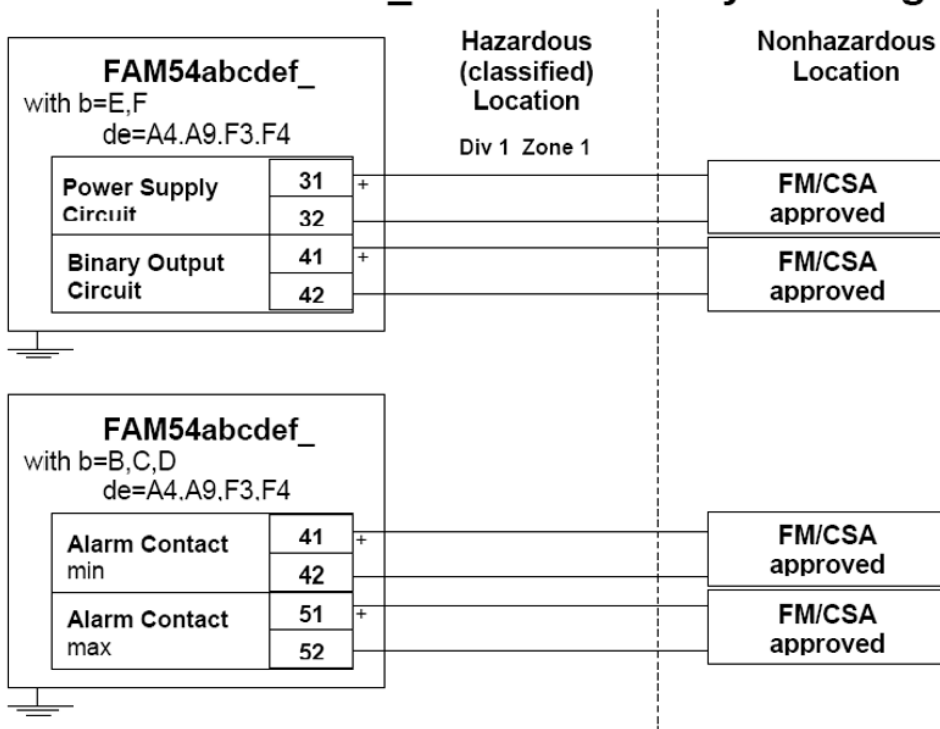
Table CSA4: Analog indicator with converter with or without LCD display

Order code	Designation	Connection terminals	Input values	T <sub>amb</sub> -50 °C ...	Temp. class	Max. Medium temp.	Therm. isolation	Heating jacket	
F3 1) or F4 1)	IS / CL I,II,III / DIV 1 / GP ABCDEFG / T4...T1 2) DIP / CL II, III / DIV 1 / GP EFG / T6...T1	31 / 32 if connected to an intrinsically safe circuit 2)	U <sub>i</sub> = 30 V I <sub>i</sub> = 110 mA P <sub>i</sub> = 770 mW C <sub>i</sub> = 5.3 nF L <sub>i</sub> = 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	
	Ex ia IIC T6...T1 DIP A21 TA 85°C to T <sub>Medium</sub>	41 / 42 if connected to an intrinsically safe circuit	U <sub>i</sub> = 30 V I <sub>i</sub> = 30 mA P <sub>i</sub> = 115 mW C <sub>i</sub> = 4.8 nF L <sub>i</sub> = 133 µH	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	
F3 3)	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 <sub>Medium</sub>	31 / 32 if connected to a non-intrinsically safe circuit	V <sub>max</sub> = 46 V	70 °C	T3	150 °C	yes	no	
				70 °C	T3	150 °C	yes	no	
				70 °C	T4	125 °C	yes	yes	
				40 °C	T1	440 °C	no	no	
				40 °C	T1	375 °C	yes	no	
	F4 4) or F3 4)	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 <sub>Medium</sub>	31 / 32 if connected to a non-intrinsically safe circuit	V <sub>max</sub> = 46 V	40 °C	T1	260 °C	yes	yes
					40 °C	T1	260 °C	yes	yes
					40 °C	T1	260 °C	yes	yes
					50 °C	T1	300 °C	yes	no
					50 °C	T2	290 °C	yes	no
			41 / 42 if connected to a non-intrinsically safe circuit	V <sub>max</sub> = 30 V I <sub>max</sub> = 30 mA P <sub>max</sub> = 115 mW	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
					60 °C	T4	130 °C	yes	yes
				60 °C	T5	95 °C	yes	yes	
				60 °C	T6	80 °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	T3	150 °C	yes	no	
				70 °C	T4	130 °C	yes	yes	
				70 °C	T5	95 °C	yes	yes	
				30 °C	T6	25 °C	yes	yes	

- 1) If connected to an intrinsically safe circuit
- 2) IS installation per drawing SDM-10-A0253
- 3) If connected to a non-intrinsically safe circuit
- 4) For connection in Division 2 or Zone 2

5.6 Intrinsic Safety Drawing (FM / cCSAus)

### FAM54abcdef\_ : Intrinsic Safety Drawing



**CAUTION:**

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

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

**LA SUBSTITUTION DE COMPOSANTES PEUT COMPROMETTRE LA SÉCURITÉ INTRINSÈQUE**



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" and 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

## 6 Commissioning

### 6.1 General information

#### **General information**

- When using meter with fluids carefully remove the air to prevent gas bubbles.
- When using meter with gases increase the flow pressure slowly.
- Vary the flow with help of adjustable valves (control valves) to protect the float from pressure shock waves. Otherwise, the flowmeter may be damaged.
- The optional use of gas damping may not be used to compensate for shock waves.

#### **Inspection prior to switching on auxiliary power**

Prior to commissioning the unit, check the following:

- The wiring is correctly implemented according to the connection diagram, see chapter Electrical connection,
- The flowmeter is grounded properly,
- The ambient conditions meet specifications,
- The auxiliary power must match information on the model plate.

#### **Inspection after switching on auxiliary power**

After commissioning perform the following step:

- Check and configure the measurement parameters according to operating conditions.

## 6.2 Inspection

Before installing the flowmeter primary, check whether possible damage has occurred due to improper transport. All claims for damages must be submitted to the shipper without delay and before installation. Comply with installation conditions. Meters must be commissioned and operated according to ElexV (Standard on electrical equipment in potentially explosive areas) and EN 60079-14 (Installation of equipment in potentially explosive atmospheres), or relevant national standards. Installation and commissioning as well as maintenance or service in the Ex area may be performed by properly trained personnel only. The commissioning activities described here are performed after installing and electrically connecting the flowmeter. The auxiliary power is switched off. When operating the meter with combustible dusts, comply with EN 50281-1.



### Warning - General hazards!

Comply with the following instructions when opening the housing:

- Make sure there is no explosion hazard.
- A fire permit is required.
- Power to all connecting cables must be switched off.
- When the housing is open, EMC protection is suspended.

The surface temperature of the flowmeter may exceed 70 °C (158 °F) depending on the fluid temperature.

## 6.3 Information for safe operation – ATEX / IECEx



### Important

Commissioning and operation must be performed in accordance with ATEX 137 or BetrSichV (EN60079-14). Only properly trained personnel are authorized to carry out commissioning in Ex areas.

## 6.4 Setting the limit signal transmitter

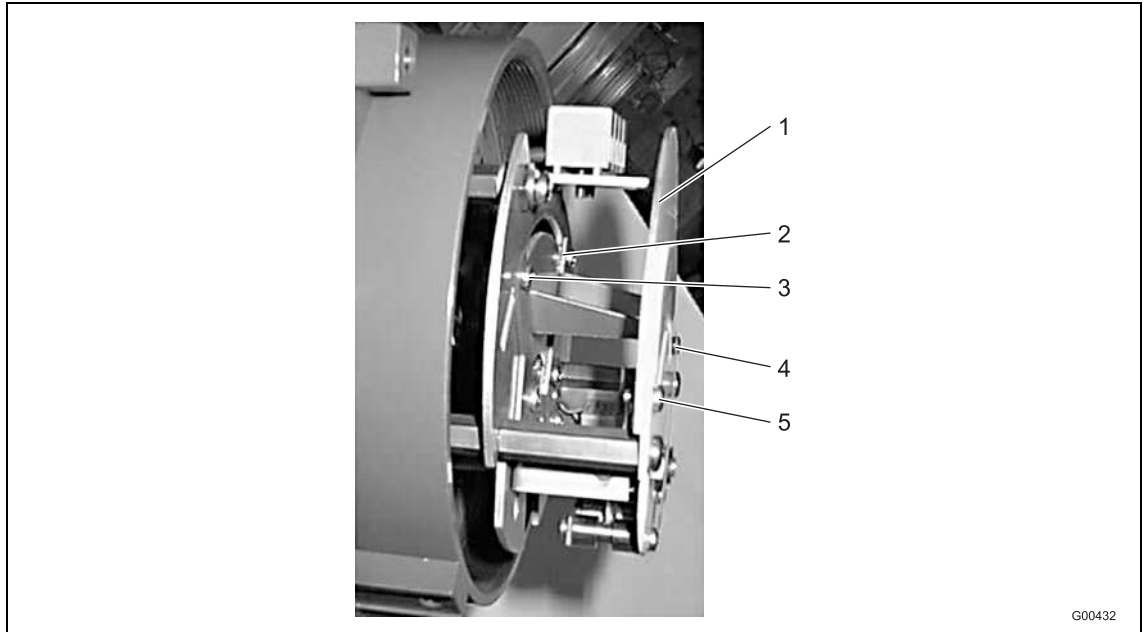


Fig. 32

1. Screw off housing cover.
2. Loosen screws (1) and remove cover plate (2).
3. Loosen screws (3 + 4).
4. Move the limit signal transmitter (5) into the desired position.
5. Tighten screws (3 + 4).
6. Replace cover plate (2) and tighten screws (1).
7. Screw on housing cover.

**Important**

For explosion-proof devices, remove the safety locking device when opening the cover and reattach it after closing the housing.

**6.5 Configuring the programmable output**

The contact output of the transmitter is configured by default as a NAMUR contact:  
 The contact can be changed, if necessary.

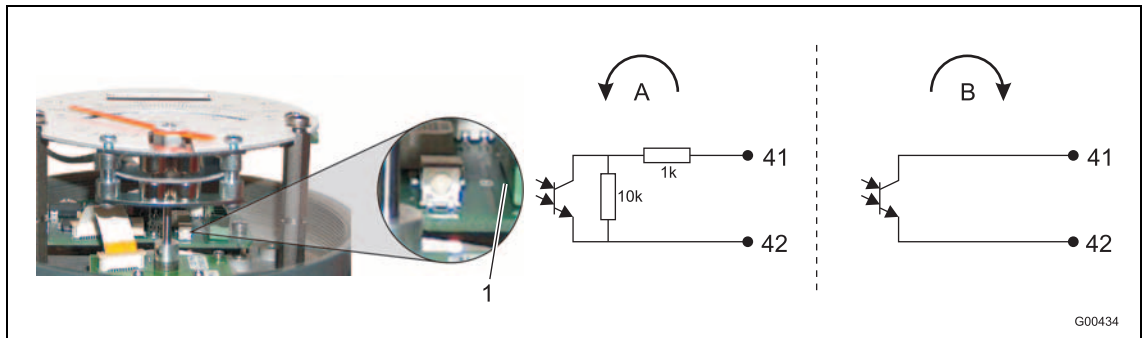


Fig. 33

- 1 Contact for switching the output configuration
- A Switch on left stop: NAMUR contact
- B Switch on right stop: Optocoupler function



**Important**

For explosionproof devices, remove the safety locking device when opening the cover and reattach it after closing the housing.

## 7 Parameterization

Information can be entered in several languages using the four keys on the transmitter. The magnet stick can also be used to configure the meter with the housing cover closed.

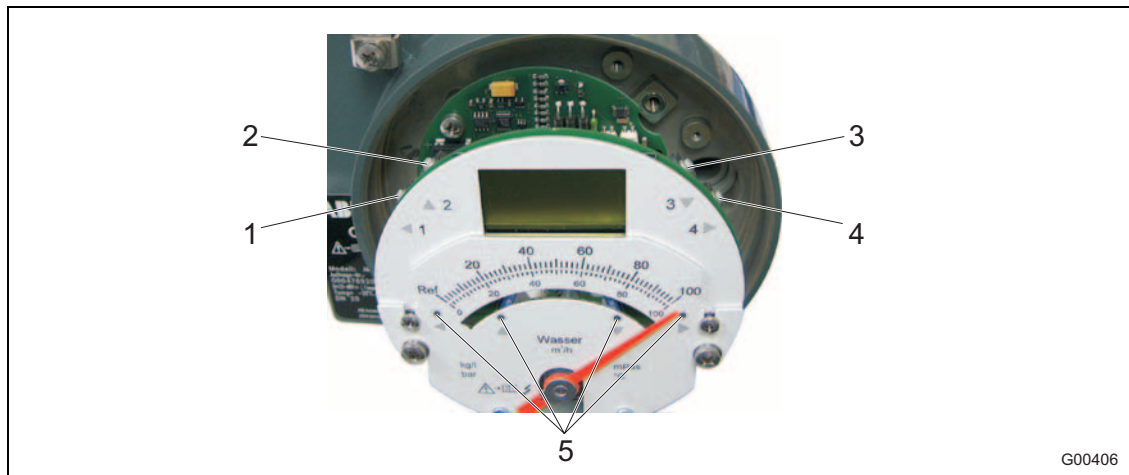


Fig. 34: Display with control buttons and magnet stick markings

The ◀ (1), ▶ (4), ▲ (2) and ▼ (3) buttons are available for the menu-controlled configuration. The positions for magnet stick operation (5) are marked on the scale plate. The same arrangement also applies here.

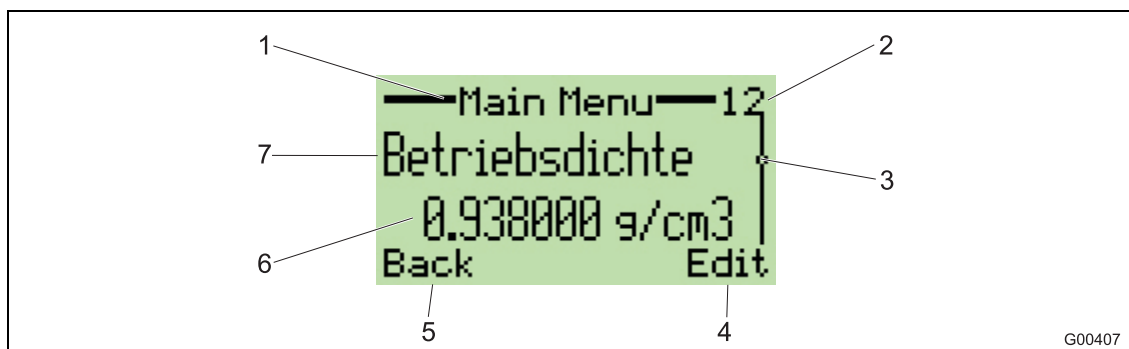


Fig. 35: Display view (example)

- |                           |                     |
|---------------------------|---------------------|
| 1 Name of menu or submenu | 5 Function of ◀ key |
| 2 Number or line of menu  | 6 Parameter value   |
| 3 Scroll bar              | 7 Parameter name    |
| 4 Function of ▶ key       |                     |

The menu / submenu name is displayed above in the LCD display. The number / line of the currently selected menu item is displayed in the upper right of the LCD display.

A scroll bar is located on the right edge of the LCD display which shows the relative position of the currently selected menu item within the menu.

The functions of the ◀ and ▶ keys depend on the menu and are indicated by the symbols in the lower corners of the display.

The ▲ and ▼ keys are used to scroll forwards and backwards in the menu and change numerical values.

After 20 seconds without any operation, the display returns to the current flow value. Pressing the ▶ key calls up the menu item previously selected.

## 7.1 User levels

The unit has 4 user levels (Menu "Prog. Level"):

### 1. Level: Standard

The standard menu is used for the quick parametrization of the unit. All of the customer-specific menu settings that are required for the use of the unit can be configured here.

### 2. Level: Specialist

Unlike in the standard menu, all of the customer-relevant menu parameters are displayed.

### 3. Level: Service

The service menu is exclusively reserved for the after-sales-service of ABB Automation Products. It includes the default settings of the unit. It can only be accessed through the service code. Changes may cause the device to display incorrect information.

### 4. Level: Locked

The menus of the standard level are visible, but they cannot be edited. After an interruption of the power supply, this user level is active.

### 7.1.1 Changing the user level

Before changing parameters, select the proper user level.

1. Press the ▶ key to jump to the Main Menu.
2. Use the ▲ or ▼ key to select the Prog. Level.
3. Press the ▶ key to jump to the Prog. Level.
4. Use the ▲ and ▼ keys to select the desired user level and press ▶ (OK) to confirm.

You can now parametrize the meter according to the selected user level.

# Parameterization

## 7.2 Parameter overview

Parameters	Value range / Input type	User level	Comment
<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Main Menu 0</b> Prog.Level Standard</p> <p>Back Edit</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Prog.Level 1</b> <b>Standard</b> Specialist</p> <p>Cancel OK</p> </div> </div>	Standard Specialist Service Locked	Standard	Use the ▲ and ▼ keys to select the user level and press ► to confirm.
<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Language 1</b> English</p> <p>Back Edit</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Language 0</b> <b>English</b> English</p> <p>Cancel OK</p> </div> </div>	German English	Standard	
<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Main Menu 2</b> Prog.Output No function</p> <p>Back Edit</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Prog.Output 0</b> <b>No function</b> Pulse output</p> <p>Cancel OK</p> </div> </div>	No function Pulse output Min/Max alarm _ _; / _ General alarm _ _; / _	Specialist	Alarms can be configured as normally closed or normally open contacts. See chapter Programmable output.
<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Main Menu 3</b> Min. alarm 0,0%</p> <p>Back Edit</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Min. alarm 0</b> 0,0% Min 0% Max 105%</p> <p>Next OK</p> </div> </div>	Numerical	Specialist	Only active if an alarm type is selected.
<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Main Menu 4</b> Max. alarm 0,0%</p> <p>Back Edit</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Max. alarm 0</b> 0,0% Min 0% Max 105%</p> <p>Next OK</p> </div> </div>	Numerical	Specialist	Only active if an alarm type is selected.
<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Main Menu 5</b> Pulse factor 1.000 1/l</p> <p>Back Edit</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Pulse factor 0</b> 1.000 1/l Min 0.001 Max 1000.00</p> <p>Next OK</p> </div> </div>	Numerical	Specialist	Only active if a pulse output is selected. Enter as pulse per unit
<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Main Menu 6</b> Pulse width 5 ms</p> <p>Back Edit</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Pulse width 0</b> 5 ms Min 5 ms Max 256 ms</p> <p>Next OK</p> </div> </div>	Numerical	Specialist	Only active if a pulse output is selected.
<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Main Menu 7</b> Operating mode Fluid Qv</p> <p>Back Edit</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> <p><b>Operating mode 0</b> <b>Fluid Qv</b> Fluid Qm</p> <p>Next OK</p> </div> </div>	Fluid Qv, Qm Gas Qv, Qm Gas standard Qn, Qs	Standard	Qm = mass flow units Qv = actual volume units Qn, Qs = standard volume units See chapter Operating mode.

Parameters		Value range / Input type	User level	Comment
<b>Main Menu 8</b> Unit Qvol l/h Back Edit	<b>Unit Qvol</b> <b>l/h</b> m <sup>3</sup> /sec Next OK	l/s, l/m, l/h, m <sup>3</sup> /s, m <sup>3</sup> /m, m <sup>3</sup> /h, m <sup>3</sup> /d, ft <sup>3</sup> /s, ft <sup>3</sup> /m, ft <sup>3</sup> /h, ft <sup>3</sup> /d, usgpm, usgph, usmgd, igpm, igph, igpd, bbl/s, bbl/m, bbl/h, bbl/d	Standard	Only active if a volume unit is selected for the operating mode.
<b>Main Menu 9</b> Unit Qm kg/h Back Edit	<b>Unit Qm 5</b> <b>kg/h</b> m <sup>3</sup> /sec Next OK	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	Specialist	Only active if a mass unit is selected for the operating mode.
<b>Main Menu 10</b> Unit of density g/cm <sup>3</sup> Back Edit	<b>Unit of density 1</b> <b>g/cm<sup>3</sup></b> Pulse output Next OK	g/ml, g/cm <sup>3</sup> , g/l, kg/l, kg/m <sup>3</sup> , lb/ft <sup>3</sup> , lb/ugl	Specialist	Unit of the measurement medium density.
<b>Main Menu 11</b> Standard density 0.001293 g/cm <sup>3</sup> Back Edit	<b>Standard density</b> 0.001293 Min 0.000001 Max 0.100000 Next OK	Numerical	Specialist	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.
<b>Main Menu 12</b> Operating density 1.000000 g/cm <sup>3</sup> Back Edit	<b>Operating density</b> 1.000000 Min 0.000001 Max 8.020000 Next OK	Numerical	Specialist	The density of the fluids has an influence on the moving force of the float. A precise unit is essential for an exact measurement.
<b>Main Menu 13</b> Viscosity 20.00 mPas Back Edit	<b>Viscosity</b> 1.00 mPas Min 0.10 Max 100.0 Next OK	Numerical	Specialist	Used for a comparison with the device-dependent maximum viscosity (stored) for this device.
<b>Main Menu 14</b> Qmax Medium 100.000 l/h Back Edit			Standard	For information. Indicates the maximum measured value as a function of the operating mode and the density values for this device.
<b>Main Menu 15</b> Qmax 100.000 l/h Back Edit	<b>Qmax</b> 100.000 l/h Min 90.000 Max 102.000 Next OK	Numerical	Standard	The 20mA-value of the current output can be set within the limits that are shown.

# Parameterization

Parameters	Value range / Input type	User level	Comment
<p><b>Main Menu 16</b> Low flow cut off 5% Back Edit</p> <p><b>Low flow cut off</b> 5% Min 1.0 Max 10.0 Next OK</p>	Numerical	Specialist	See chapters Low flow cut off and Current output.
<p><b>Main Menu 17</b> Damping 1.0 sec Back Edit</p> <p><b>Damping</b> 1.0 sec Min 0.5 Max 100.0 Next OK</p>	Numerical	Standard	See chapter Damping.
<p><b>Main Menu 18</b> Current output mA Back Select</p> <p><b>Current output 0</b> lout for alarm High (21 ... 23 mA) Next OK</p>	Numerical High 21 ... 23 mA Low 3 ... 3.6 mA	Standard	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 (3). See chapter Current output.
<p><b>Current output 2</b> High Alarm level 22 mA Back Edit</p>	Numerical High 21 ... 23 mA Low 3 ... 3.6 mA	Specialist	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.
<p><b>Main Menu 19</b> Totalizer Σ Back Select</p> <p><b>Totalizer 0</b> 5382.200 l Min 1.0 Max 10.0 Next OK</p>	Numerical	Standard	See chapter Counter and counter overflow.
<p><b>Totalizer 1</b> Overflow 0 Back Edit</p>			Number of counter overflows.
<p><b>Totalizer 3</b> Unit l Back Edit</p>			The selectable units depend on the operating mode.
<p><b>Totalizer 4</b> Counter reset 0 Back Edit</p>			Edit resets the counter. Before resetting, you will be prompted to confirm.

Parameters	Value range / Input type	User level	Comment
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <b>Main Menu 20</b>                      Display                      Back      Select                 </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <b>Display</b>                      Display first line                      Q Operating mode                      Next      OK                 </div>	Q Operating mode Percent	Standard	
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <b>Main Menu 21</b>                      Function test                      Back      Edit                 </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <b>Display</b>                      Contrast                      Back      Edit                 </div>	Numerical 0 ... 100%	Specialist	0% : Display bright 100% : Display black
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <b>Main Menu 22</b>                      Status register                      Back      Edit                 </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <b>Function test</b>                      Simulation                      Off                      Back      Edit                 </div>	off, on	Specialist	For various function tests, see chapter Function test.
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <b>Main Menu 23</b>                      Unit address                      0                      Back      Edit                 </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <b>Status register</b>                      Error register                      No. 2                      Back      Edit                 </div>	Error register Warning register Mains interrupt	Specialist	The entries in the error and warning register are explained in chapter Status register.
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <b>Main Menu 24</b>                      TAG number                      ABB AM54                      Back      Edit                 </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <b>Unit address</b>                      0                      Min 0                      Back      Edit                 </div>		Specialist	<b>Note:</b> Setting the unit address $\geq 0$ sets the current output to 4 mA; this setting is only effective in HART multidrop mode.
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <b>Main Menu 25</b>                      ABB                      20.04.2007                      06:39:59                      Back      Edit                 </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <b>TAG number</b>                      ABB AM54                      Back      Edit                 </div>		Standard	Enter a separate, 8-digit TAG number.
<div style="border: 1px solid black; padding: 5px;"> <b>Main Menu 25</b>                      ABB                      20.04.2007                      06:39:59                      Back      Edit                 </div>		Specialist	

### 7.2.1 Programmable output

In this menu, the output is parametrized to terminals 41 / 42. The following settings are available:

Function		Description
Pulse output	=	Pulses with the parametrized pulse factor (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.



#### Important

When parametrizing the output as a general alarm, the error states and min/max alarms are output cumulatively.

### 7.2.2 Operating mode

The instrument has been calculated and rated for a specific application.

The instrument can be adapted to a different, new application through the operating mode and the associated parameters, such as the operating density or the standard density of the measurement medium.

The instrument uses the new parameters to calculate its new maximum flow 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.

**7.2.3 Standard and operating densities**

The system inquires the standard density or the operating density of the measurement medium depending on the operating mode. As far as liquids are concerned, the density in the operating state has to be stated.

Standard densities for a few selected gases:

<b>Gas</b>	<b>Standard densities [kg/m<sup>3</sup>]</b>
Acetylenes	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

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

**Conversion standard density ( ρ<sub>n</sub> ) → operating density ( ρ )**

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

ρ = Operating densities [kg/m<sup>3</sup>]

ρ<sub>n</sub> = Standard densities [kg/m<sup>3</sup>]

p = Operating pressure [bar]

T = Operating temperature [°C]

7.2.4 Low flow cut off

Input range: 1 ... 10 %

The low flow value is needed for the low flow cut off.

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.

7.2.5 Current output

Configure the behavior of the current output in the event of instrument alarms in the current output submenu.

The settings High and Low are available.

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



**Important**

A single "Error 3" (overshooting of the measuring range) always leads to high alarms, regardless of the setting!

The current output behavior follows the NAMUR recommendation NE43.

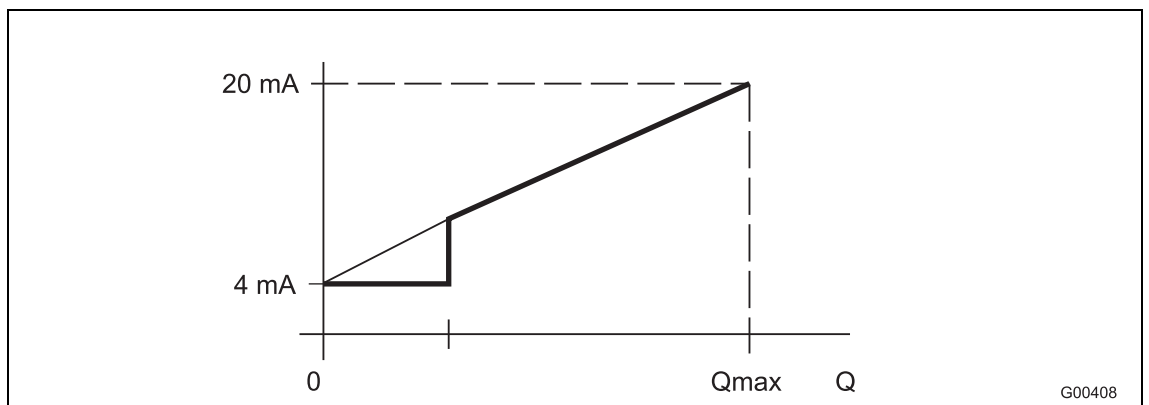


Fig. 36 Current output behavior

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  $Q_{max} = 0$  and 20 mA at  $Q = Q_{max}$  operating mode.

Because of the low flow cutoff, the flow is set to 0, i.e. 4 mA current, below x % of  $Q_{max}$  or of the low flow.

**7.2.6 Function test**

The functional test menu allows you to send defined signals to the current and switching outputs in order to check the connection to the system.

Submenu	Adjustable values	Description
Iout	numerical	A set value for the current output can be predefined between 4 and 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 and 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 the operation. An incorrect result would lead to Error 9.
Prog. Output	open	Switching output at terminals 41 / 42 open.
	close	Switching 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 with 1200 Hz or 2200 Hz.
HART reception	confirm	It is indicated when signals are received.
Voltages	confirm	Shows the current voltage at the terminals.

### 7.2.7 Counter and counter 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 zero.

The total counter count can be calculated as follows:

**Example:**

Status of overflow counter = 12

Current counter status = 12345 m<sup>3</sup>

$$\begin{array}{r}
 12 \times 10\,000\,000 = \quad 120\,000\,000 \text{ m}^3 \\
 + \quad \quad \quad \quad \quad \quad \quad \quad 12\,345 \text{ m}^3 \\
 \hline
 120\,012\,345 \text{ m}^3
 \end{array}$$

### 7.2.8 Damping

The response time of the measuring instrument can be set as desired with the Damping parameter.

It corresponds to a first-order low-pass filter.

Typical value: 3 ... 5 s.

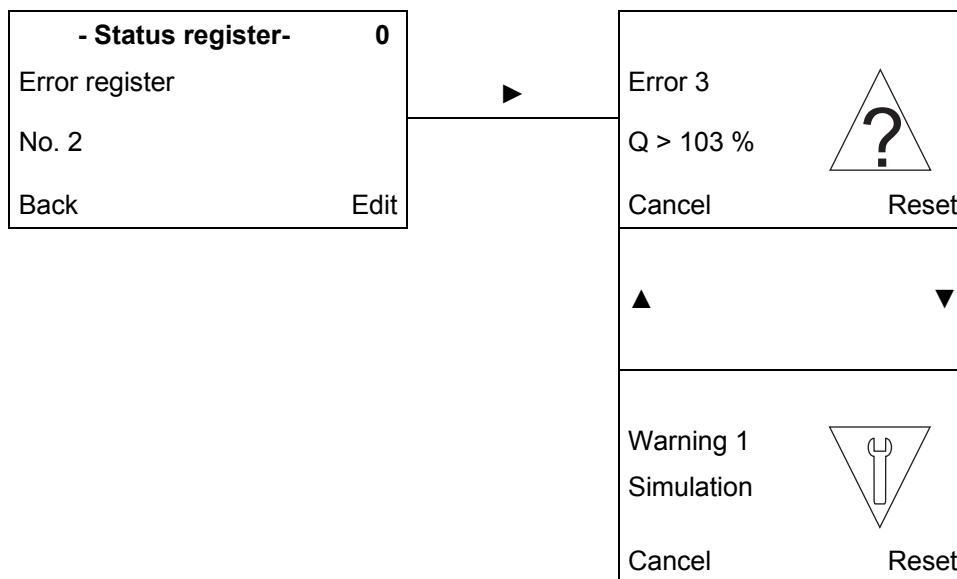
## 8 Error messages

### 8.1 Status register

In accordance with the NAMUR recommendation NE107, a distinction is made between error messages and warnings.

Errors and warnings are saved in the register. Errors have direct effects on the current output (see also 8.3.4). Warnings can be read out and processed via the HART communication system.

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.



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.

8.2 Status messages

Message	NE 107 classification	Cause	Remedy
Error 1 Front End	Failure	Hardware error on the Front-End-Board	Contact the service department
Error 3 Q > 103%	Out of Spec.	Overshoot of the measuring range of the instrument	Reduce the flow rate, check the application
Error 5a Int. database	Failure	A data loss has occurred. The instrument is reset to its factory or default settings.	The error is eliminated in the instrument itself. Clear the error register and check the settings.
Error 5b Ext. database	Failure		
Error 6 Totalizer	Failure	Loss of 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 $\mu$ -processor differs from the stored checksum.	Contact the service department
Error 10 Hardware	Failure	Self-check functions have detected an internal HW error.	Contact the service department
Error 12 Viscosity	Out of Spec.	The viscosity entered for the fluid is too high with regard to the viscosity insensitivity number of the instrument.	Reduce the viscosity or have the instrument recalculated for a higher viscosity. Please contact service.
Warning 1 Simulation	Check function	The unit is in the simulation mode	Quit the simulation mode (off)

Additional symbols in accordance with Namur NE107:

Symbol	Description
	Maintenance required
	Out of Specification
	Functional check
	Failure

**9 Maintenance / Repair**

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

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



**Notice - Potential damage to parts!**

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

**9.1 Cleaning**

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

**9.2 Special information for replacing display units**

If you are carrying out repair work or changing to a different type of display, it is possible to replace entire display 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:

Original device	New device	Possible	Not possible	Customer measure
FAM540, non-Ex	FAM540-Ex		X	
FAM540-Ex	FAM540-Ex (same type of display as original)	X		None
FAM540A/B/C/D-Ex	FAM540E/F-Ex	X		Safety engineering: Re-evaluation of measuring point due to different display type
FAM540E/F-Ex	FAM540A/B/C/D-Ex	X		Safety engineering: Re-evaluation of measuring point due to different display type
AM54-Ex	FAM540-Ex	X		Safety engineering: Re-evaluation of measuring point due to new approval and, where applicable, different display type

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

To replace the display, release the two Allen head screws on the inside of the bracket. The old display can now be removed. To make sure you use a display that is compatible with the flowmeter sensor, the bracket has a plate bearing the original serial number.

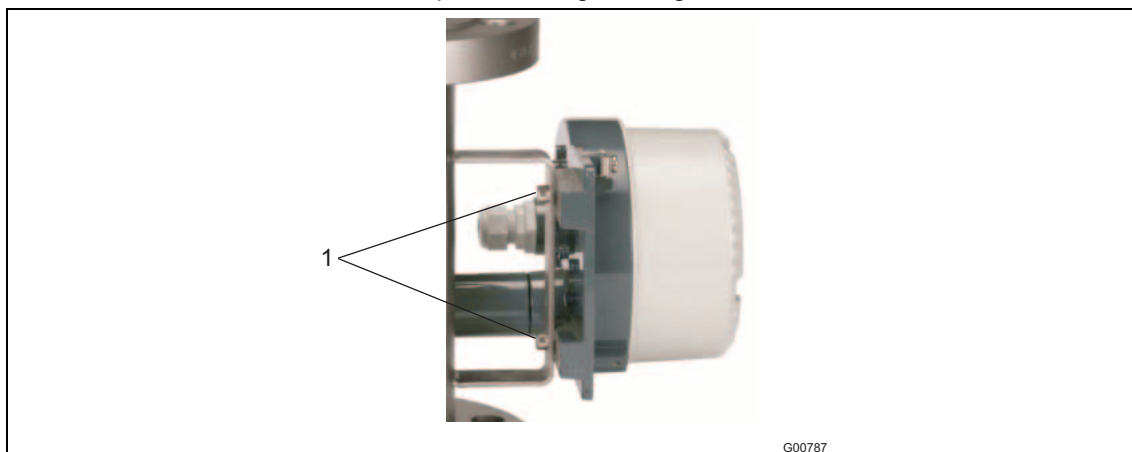


Fig. 37

1 Allen head screws






The new display is centered using 2 metal bushings that are firmly connected to the display. These must not be moved. Once the display has been successfully replaced, retighten the flowmeter sensor screws.

**10 Appendix**

**10.1 Additional documents**

- Data Sheet (DS/FAM540)
- Commissioning Instruction (CI/FAM540)
- Interface description for devices with HART communication (D184B080U05)

**10.2 Approvals and certifications**

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



**Important**

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

[www.abb.com/flow](http://www.abb.com/flow)



## EG-Konformitätserklärung EC-Certificate of Compliance



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: <i>EC-Type Examination Certificate:</i>	KEMA 07 ATEX 0104 X		
Benannte Stelle: <i>Notified Body:</i>	KEMA Quality B.V., Kennnummer 0034		
Geräte-Kennzeichnung: <i>Apparatus code:</i>	II 1/2G Ex c ia IIC T6 ... T1 und/oder Ex c d IIC T6 ... T1 und/oder c T6 ... T1 und/oder II 1/3G Ex c nA [nL] IIC T6 ... T1 oder Ex c nA II T6 ... T1 und II 2D c T85°C ... Tmedium oder Ex tD A21 IP6X T85°C ... Tmedium		
Sicherheitstechnische Daten: <i>Safety values:</i>	siehe EG-Baumusterprüfbescheinigung <i>refer to EC-Type Examination Certificate</i>		
Angewandte Normen: <i>Standards:</i>	EN 60079-0: 2006 EN 60079-15: 2005 EN 13463-1: 2001	EN 60079-1: 2004 EN 61241-0: 2006 EN 13463-5: 2003	EN 60079-11: 2007 EN 61241-1: 2004

Göttingen, 20. September 2007

  
i.V. Klaus Hablbas  
(Site Manager)

  
i.A. Karl-Heinz Rackebrandt  
(R&D Manager Sensors)

BZ-13-8017, Rev.01, 198

### ABB Automation Products GmbH

Postanschrift:  
Dransfelder Str. 2  
D-37079 Göttingen

Besuchsanschrift:  
Dransfelder Str. 2  
D-37079 Göttingen  
Telefon +49 551 905 0  
Telefax+49 551 905 777  
Internet: <http://www.abb.com/de>

Sitz der Gesellschaft:  
Ladenburg  
Registerrichter:  
Amtsgericht Mannheim  
Handelsregister:  
HRB 700229  
USt-IdNr.: DE 115 300 097

Vorsitz des Aufsichtsrates:  
Heinz-Peter Paffenholz  
Geschäftsführung:  
Christian Wendler

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



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

Hiermit bestätigen wir die Übereinstimmung 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

Postanschrift:  
 Dransfelder Str. 2  
 D-37079 Göttingen

Besuchanschrift:  
 Dransfelder Str. 2  
 D-37079 Göttingen  
 Telefon +49 551 905 0  
 Telefax+49 551 905 777  
 Internet: <http://www.abb.com/de>

Sitz der Gesellschaft:  
 Ladenburg  
 Registergericht:  
 Amtsgericht Mannheim  
 Handelsregister:  
 HRB 700229  
 USt-IdNr.: DE 115 300 097

Vorsitz des Aufsichtsrates:  
 Hans-Georg Krabbe  
 Geschäftsführung:  
 Christian Wendler

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



## EG-Konformitätserklärung EC-Declaration of Conformity



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

Hersteller: <i>manufacturer:</i>	ABB Automation Products GmbH, 37070 Göttingen - Germany
Modell: <i>model:</i>	FAM54__ FAM54__
Richtlinie: <i>directive:</i>	Druckgeräterichtlinie 97/23/EG <i>pressure equipment directive 97/23/EC</i>
Einstufung: <i>classification:</i>	Ausrüstungsteile von Rohrleitungen <i>pipng accessories</i>
Normengrundlage: <i>technical standard:</i>	AD 2000
Konformitätsbewertungsverfahren: <i>conformity assessment procedure:</i>	B1 (EG-Entwurfsprüfung) + D (Qualitätssicherung Produktion) <i>B1 (EC design-examination) + D (production quality assurance)</i>
EG-Entwurfsprüfbescheinigungen: <i>EC design-examination certificates:</i>	Nr. 07 202 0124 Z 0052/2/0005 Nr. 07 202 0124 Z 0678/2/0001 Nr. 07 202 STK1 Z 0905/8/D/01
benannte Stelle: <i>notified body:</i>	TÜV NORD Systems GmbH & Co.KG Große Bahnstraße 31 22525 Hamburg - Germany
Kennnummer: <i>identification no.</i>	0045

Göttingen, den 06.10.2008

ppa.

(Dr. D. Binz, R&D Manager)

i.A.

(K.-H. Rackebrandt, R&D Manager Sensors)

BZ-25-0005 Rev.04

**Statement on the contamination of devices and components**

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

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

**Customer details:**

Company: \_\_\_\_\_

Address: \_\_\_\_\_

Contact person: \_\_\_\_\_

Telephone: \_\_\_\_\_

Fax: \_\_\_\_\_

E-mail: \_\_\_\_\_

**Device details:**

Type: \_\_\_\_\_

Serial no.: \_\_\_\_\_

Reason for the return/description of the defect: \_\_\_\_\_

**Was this device used in conjunction with substances which pose a threat or risk to health?** Yes       No

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

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

Which substances have come into contact with the device?

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

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

\_\_\_\_\_  
Town/city, date\_\_\_\_\_  
Signature and company stamp

**11 Index**

<b>A</b>	
Additional documents .....	71
Allowed Fluids.....	5, 7
Appendix.....	71
Approvals and certifications.....	71
<b>C</b>	
Changing the user level .....	57
Cleaning.....	69
Commissioning .....	52
Configuring the programmable output .....	55
Contamination of devices .....	75
Counter and counter overflow.....	66
Current output.....	60, 64
<b>D</b>	
Damping.....	66
Design and function .....	17
Device designs.....	18
Disposal .....	13
Disposal .....	13
<b>E</b>	
Electrical connection.....	25
Error messages.....	67
Ex relevant specifications .....	18, 21, 27, 28
<b>F</b>	
Factory Tag.....	9
Factory Tag.....	11
Function test .....	61, 65
<b>G</b>	
Gaskets.....	23
General information .....	52
General information and notes for the reader.....	5
General information on installation .....	22
General information on transport.....	19
<b>H</b>	
Hazardous materials.....	12
<b>I</b>	
Improper use.....	6
Information about the housing ground.....	33
Inspection.....	19, 53
Installation.....	20, 22
Installation Requirements .....	20
Installation safety information .....	14
Intended use .....	5
Intrinsic Safety Drawing (FM / cCSAus) .....	51
<b>L</b>	
Low flow cut off .....	60, 64
<b>M</b>	
Maintenance / Repair.....	69
Maintenance safety information.....	16
Mounting the measuring tube .....	23
<b>N</b>	
Name plate.....	9
Name Plate .....	9
Note symbols .....	8
<b>O</b>	
Operating mode .....	62
<b>P</b>	
Parameterization.....	56
Plates and symbols.....	8
Programmable output .....	62
Protective plates .....	23
<b>R</b>	
Repairs, alterations, and enhancements .....	6
Returning devices .....	12
RoHS Directive 2002/95/EC .....	13
<b>S</b>	
Safety.....	5
Safety instructions for electrical installation.....	15
Safety instructions for operation .....	15
Safety specifications FM / CSA .....	41
Setting the limit signal transmitter.....	54
SIL (Functional safety).....	16
Special installation instructions.....	30
Specific requirements FM / cCSAus .....	29
Standard and operating densities .....	63
Status messages .....	68
Status register.....	61, 67
<b>T</b>	
Target groups and qualifications.....	12
Technical limit values.....	6
Transport.....	19
Transport safety information .....	14
<b>U</b>	
User levels .....	57
<b>W</b>	
Warranty .....	7
Warranty provisions .....	7
WEEE Directive .....	13



---

ABB has Sales & Customer Support expertise in over 100 countries worldwide.

[www.abb.com/flow](http://www.abb.com/flow)

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

Printed in the Fed. Rep. of Germany (01.2010)

© ABB 2010

3KXF154001R4201



**ABB Limited**

Oldends Lane, Stonehouse  
Gloucestershire, GL10 3TA  
UK

Tel: +44 (0)1453 826661  
Fax: +44 (0)1453 829671

**ABB Inc.**

125 E. County Line Road  
Warminster, PA 18974  
USA

Tel: +1 215 674 6000  
Fax: +1 215 674 7183

**ABB Automation Products GmbH**

Dransfelder Str. 2  
37079 Goettingen  
Germany

Tel: +49 551 905-534  
Fax: +49 551 905-555  
CCC-support.deapr@de.abb.com