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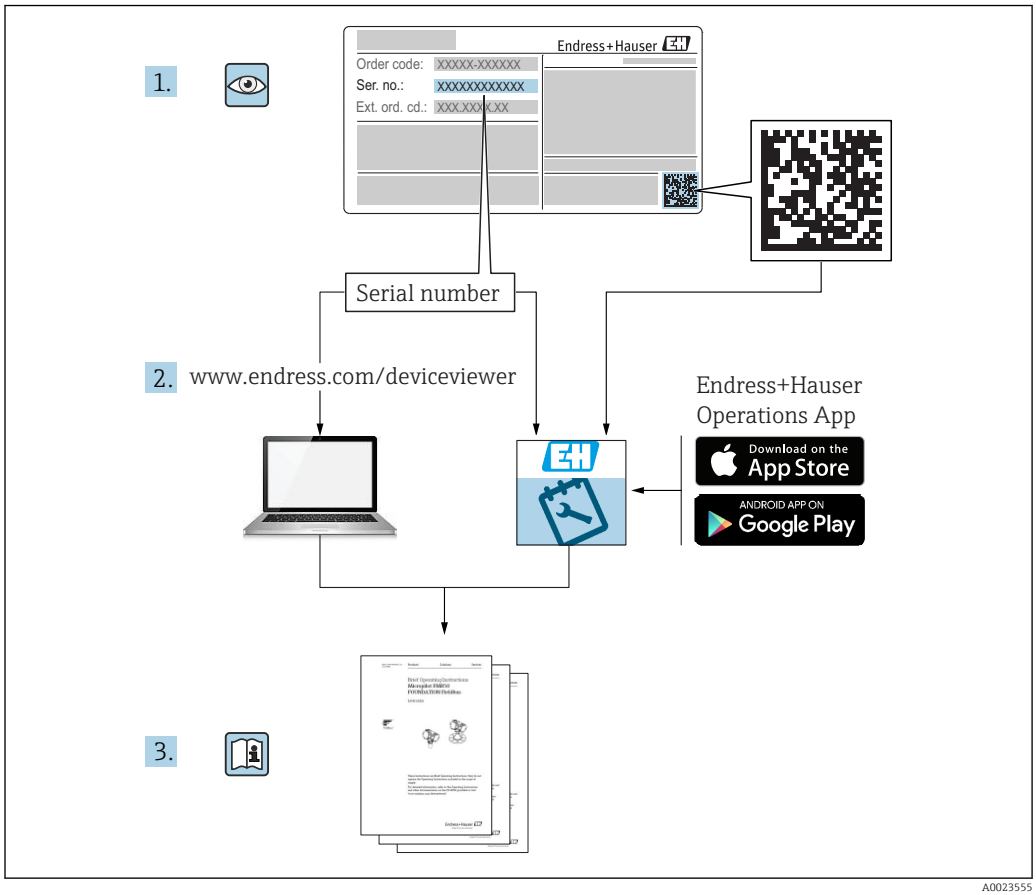
2019-08-01

Operating Instructions
Gammapilot FMG50

Radiometric measurement

Endress+Hauser
People for Process Automation


1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX XXX XX XX
Serial number
2. www.endress.com/deviceviewer
Endress+Hauser
Operations App
Download on the App Store
ANDROID APP ON Google Play
3.
A0023555

Contents of these Operating Instructions

These Operating Instructions describe how to install and commission the radiometric compact transmitter Gammapilot FMG50. All of the functions that are necessary for standard measuring tasks are included. In addition, the Gammapilot FMG50 provides many additional functions for optimizing the measuring point and for converting the measured value. These functions are not described in these Operating Instructions.

Table of contents

1 About this document

1.1 Document function

These Operating Instructions provide all of the information that is required in various phases of the life cycle of the device including:
- Product identification
- Incoming acceptance
- Storage
- Installation
- Connection
- Operation
- Commissioning
- Troubleshooting
- Maintenance
- Disposal

1.2 Symbols used

1.2.1 Safety symbols

⚠ CAUTION

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

⚠ DANGER

This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

NOTICE

This symbol contains information on procedures and other facts which do not result in personal injury.

⚠ WARNING

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

1.2.2 Symbols for certain types of information and graphics

☢
Warns against radioactive substances or ionizing radiation

✓
Permitted
Procedures, processes or actions that are permitted

✓✓
Preferred
Procedures, processes or actions that are preferred

✗
Forbidden
Procedures, processes or actions that are forbidden

ℹ
Tip
Indicates additional information


Reference to documentation


Reference to page


Reference to graphic

▶
Notice or individual step to be observed

1., 2., 3.
Series of steps


Result of a step


Operation via local display


Operation via operating tool


Write-protected parameter

1, 2, 3, ...
Item numbers

A, B, C, ...
Views


Safety instructions
Observe the safety instructions contained in the associated Operating Instructions

1.3 Documentation

The following documentation types are available in the Downloads area of the Endress +Hauser website (www.endress.com/downloads):

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *W@M Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2D matrix code (QR code) on the nameplate

1.3.1 Technical Information (TI)

Planning aid
The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.

1.3.2 Brief Operating Instructions (KA)

Guide that takes you quickly to the 1st measured value
The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.

1.3.3 Safety Instructions (XA)

Depending on the approval, the following Safety Instructions (XA) are supplied with the device. They are an integral part of the Operating Instructions.

The nameplate indicates the Safety Instructions (XA) that are relevant to the device.

1.4 Terms and abbreviations

FieldCare
Scalable software tool for device configuration and integrated plant asset management solutions

DeviceCare
Universal configuration software for Endress+Hauser HART, PROFIBUS, FOUNDATION Fieldbus and Ethernet field devices

DTM
Device Type Manager

Operating tool

The term "operating tool" is used in place of the following operating software:
- FieldCare / DeviceCare, for operation via HART communication and PC
- SmartBlue (app), for operation using an Android or iOS smartphone or tablet

CDI
Common Data Interface

PLC
Programmable logic controller (PLC)

1.5 Registered trademarks

HART®
Registered trademark of the FieldComm Group, Austin, Texas, USA

Apple®
Apple, the Apple logo, iPhone, and iPod touch are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc.

Android®
Android, Google Play and the Google Play logo are trademarks of Google Inc.

Bluetooth®
The *Bluetooth*® word mark and logos are registered trademarks owned by the Bluetooth SIG, Inc. and any use of such marks by Endress+Hauser is under license. Other trademarks and trade names are those of their respective owners.

2 Basic safety instructions

2.1 Requirements for personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- Trained, qualified specialists must have a relevant qualification for this specific function and task
- Are authorized by the plant owner/operator
- Are familiar with federal/national regulations
- Before beginning work, the specialist staff must have read and understood the instructions in the Operating Instructions and supplementary documentation as well as in the certificates (depending on the application)
- Following instructions and basic conditions

The operating personnel must fulfill the following requirements:

- Being instructed and authorized according to the requirements of the task by the facility's owner-operator
- Following the instructions in these Operating Instructions

2.2 Designated use

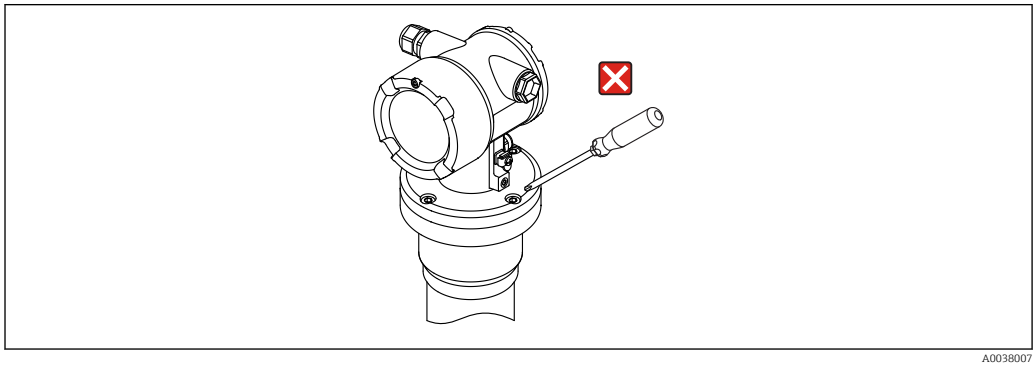
The Gammapilot FMG50 is a compact transmitter for non-contact level, point level, density and concentration measurement. The measuring range is up to 3 m (9.8 ft). The Gammapilot FMG50 is certified according to IEC 61508 for safety-related operation up to SIL 2/3.

2.3 Installation, commissioning and operation

The Gammapilot FMG50 is designed to meet state-of-the-art safety requirements and complies with applicable standards and EU regulations. However, if it is used improperly or for applications for which it is not intended, application-related hazards may arise, e.g. product overflow due to incorrect installation or configuration. Installation, electrical connection, commissioning, operation and maintenance of the measuring system must therefore be carried out exclusively by trained specialists authorized to perform such work by the system operator. Technical personnel must have read and understood these Operating Instructions and must adhere to them. Modifications and repairs to the device may only be carried out if they are expressly permitted in the Operating Instructions.

⚠ WARNING

▶ The four screws connecting the detector pipe to the terminal head may not be opened.



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2.4 Hazardous area

If the measuring system is used in hazardous areas, the corresponding national standards and regulations must be observed. The device is accompanied by separate "Ex documentation", which is an integral part of these Operating Instructions. The installation specifications, connection data and safety instructions listed in this supplementary documentation must be observed.

- Technical personnel must be qualified and trained for the hazardous area.
- Comply with the metrological and safety-related requirements for the measuring point.

⚠ WARNING

▶ Observe the safety instructions associated with the device. These instructions depend on the certificate ordered.

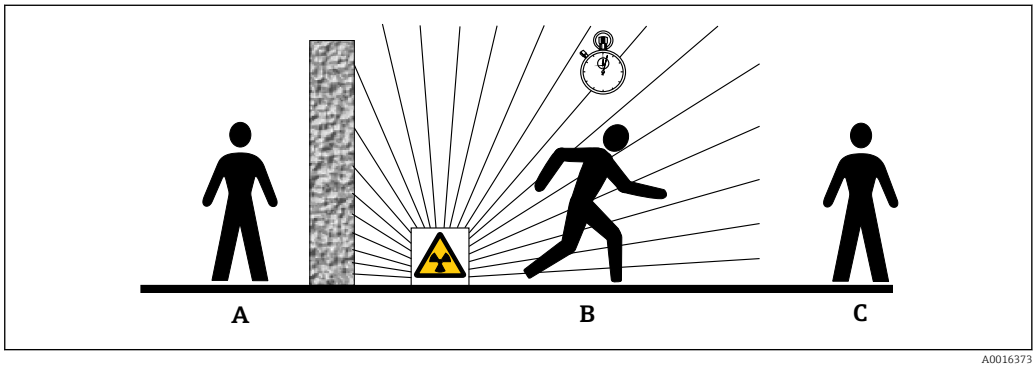
2.5 Radiation protection

The Gammapilot FMG50 is used in conjunction with a radiation source, contained in a source container. When handling radiation sources, the following instructions must be observed:

2.5.1 Basic radiation protection guidelines

⚠ WARNING

▶ When working with radiation sources, avoid any unnecessary exposure to radiation. All unavoidable radiation exposure must be kept to a minimum. Three basic concepts apply to achieve this:



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A Shield
B Time
C Distance

⚠ CAUTION

▶ When working with source containers, all the instructions for mounting and usage outlined in the following documents must be observed:

Source container documentation
- **FQG60:**
  TI00445F
- **FQG61, FQG62:**
  TI00435F
- **FQG63:**
  TI00446F
- **FQG66:**
  - TI01171F
  - BA01327F

Shielding

Ensure the best possible shielding between the radiation source and yourself and all other persons. Effective shielding is provided by source containers (FQG60, FQG61/ FQG62,FQG63, FQG66) and all high-density materials (lead, iron, concrete etc.).

Time

Remain as short as possible in the area exposed to radiation.

Distance

Keep as far away from the radiation source as possible. The radiation intensity decreases in proportion to the square of the distance from the radiation source.

2.6 Workplace safety

For work on and with the device:
- ▶ Wear the required personal protective equipment according to federal/national regulations.
- ▶ Switch off the supply voltage before connecting the device.

2.7 Operational safety

Risk of injury.
- ▶ Operate the device in proper technical condition and fail-safe condition only.
- ▶ The operator is responsible for interference-free operation of the device.

Conversions to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers.
- ▶ If, despite this, modifications are required, consult with the manufacturer.

Repair

To ensure continued operational safety and reliability,
- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to repair of an electrical device.
- ▶ Use original spare parts and accessories from the manufacturer only.

Hazardous area

To eliminate a danger for persons or for the facility when the device is used in the hazardous area (e.g. explosion protection, pressure vessel safety):
- ▶ Based on the nameplate, check whether the ordered device is permitted for the intended use in the hazardous area.
- ▶ Observe the specifications in the separate supplementary documentation that is an integral part of these Instructions.

2.8 Product safety

This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate. It meets general safety standards and legal requirements.

2.8.1 CE mark

The measuring system meets the legal requirements of the applicable EU Directives. These are listed in the corresponding EU Declaration of Conformity along with the standards applied.

Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

2.8.2 EAC conformity

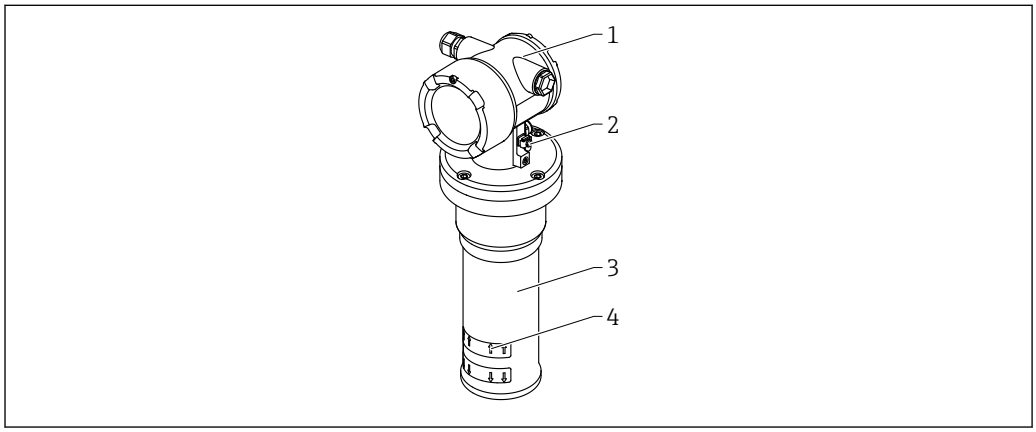
The measuring system meets the legal requirements of the applicable EAC guidelines. These are listed in the corresponding EAC Declaration of Conformity together with the standards applied.

Endress+Hauser confirms successful testing of the device by affixing to it the EAC mark.

3 Product description

3.1 Product design

3.1.1 Components of the FMG50

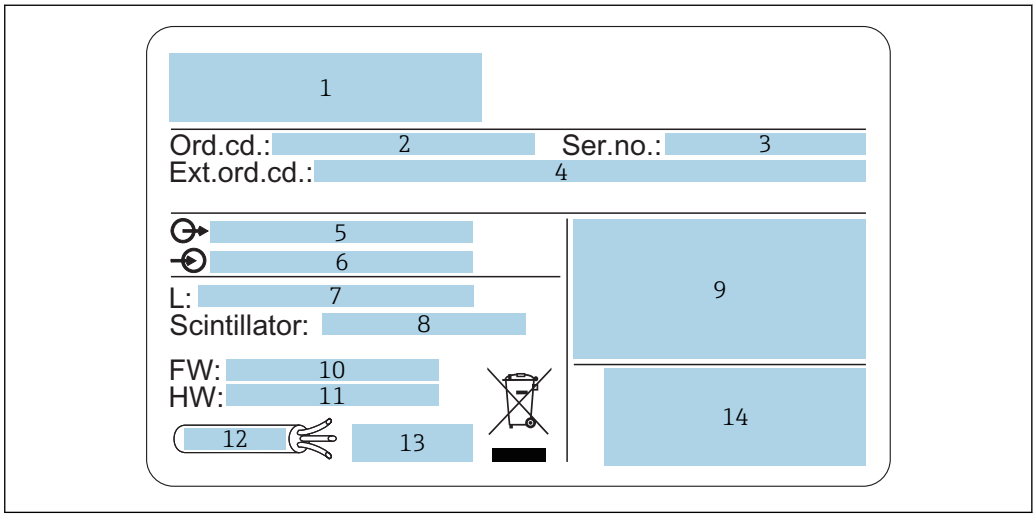


1 *A: Gammapilot FMG50*

1 *Housing*
2 *Potential equalization terminal*
3 *Detector pipe*
4 *Measuring range marking*

3.2 Nameplates

3.2.1 Device nameplate



1 *Manufacturer's address and device name*
2 *Order code*
3 *Serial number (ser. no.)*
4 *Extended order code (ext. ord. cd.)*
5 *Signal outputs*
6 *Supply voltage*
7 *Length of measuring range*
8 *Scintillator type*
9 *Certificate and approval-related data*
10 *Firmware version (FW)*
11 *Device revision (Dev.Rev.)*
12 *Temperature specifications for connecting cable*
13 *Permitted ambient temperature (T_a), reference to documentation*
14 *Date of manufacture: year-month and 2-D matrix code (QR code)*

3.3 Scope of delivery

- Ordered version of the device (including Brief Operating Instructions)
- Endress+Hauser operating program on DVD (optional)
- Accessories as ordered

3.4 Accompanying documentation

3.4.1 Brief Operating Instructions

The Brief Operating Instructions describe how to install and commission the Gammapilot FMG50.

KA01427F

Any additional functions are contained in the Operating Instructions and the "Description of Device Functions" document

3.4.2 Description of Device Functions

The Description of Device Functions document contains a detailed description of all the functions of the Gammapilot FMG50 and applies for all communication versions. Available for download at "www.de.endress.com".

GP01141F

3.4.3 Safety instructions

Additional safety instructions (XA, ZE, ZD) are supplied with certified device versions. Please refer to the nameplate for the safety instructions that apply to your device version.

An overview of the certificates and approvals can be found in the "Certificates and approvals" section.

4 Mounting

4.1 Incoming acceptance, product identification, transport, storage

4.1.1 Incoming acceptance

Check the following during incoming acceptance:

❑ Are the order codes on the delivery note and the product sticker identical?

❑ Are the goods undamaged?

❑ Do the nameplate data match the ordering information on the delivery note?

❑ If required (see nameplate): Are the safety instructions (XA) provided?

If one of these conditions is not met, please contact the manufacturer's sales office.

4.1.2 Product identification

The following options are available for the identification of the measuring device:
- Nameplate specifications
- Extended order code with breakdown of the device features on the delivery note

- ▶ Enter the serial number from the nameplates into *W@M Device Viewer* (www.endress.com/deviceviewer)
  - ↳ All the information about the measuring device and the scope of the associated Technical Documentation are displayed.

- ▶ Enter the serial number from the nameplate into the *Endress+Hauser Operations App* or use the *Endress+Hauser Operations App* to scan the 2-D matrix code (QR Code) provided on the nameplate
  - ↳ All the information about the measuring device and the scope of the associated Technical Documentation are displayed.

4.1.3 Manufacturer address

Endress+Hauser SE+Co. KG
Hauptstraße 1
79689 Maulburg, Germany

Address of the manufacturing plant: See nameplate.

4.1.4 Transporting to the measuring point

⚠ CAUTION

Risk of injury

- ▶ Follow the safety instructions and transport conditions for devices weighing more than 18 kg (39.69 lb).

4.1.5 Storage

Pack the device so that it is protected against impact for storage and transport. The original packaging provides optimum protection. The permitted storage temperature is:

NaI (Tl) crystal
−40 to +80 °C (−40 to +176 °F)

PVT scintillator (standard)
−40 to +60 °C (−40 to +140 °F)

PVT scintillator (high-temperature version)
−20 to +80 °C (−4 to +176 °F)

As the device contains a battery, it is recommended to store the device at room temperature in a location that does not receive direct sunlight

4.2 Installation conditions

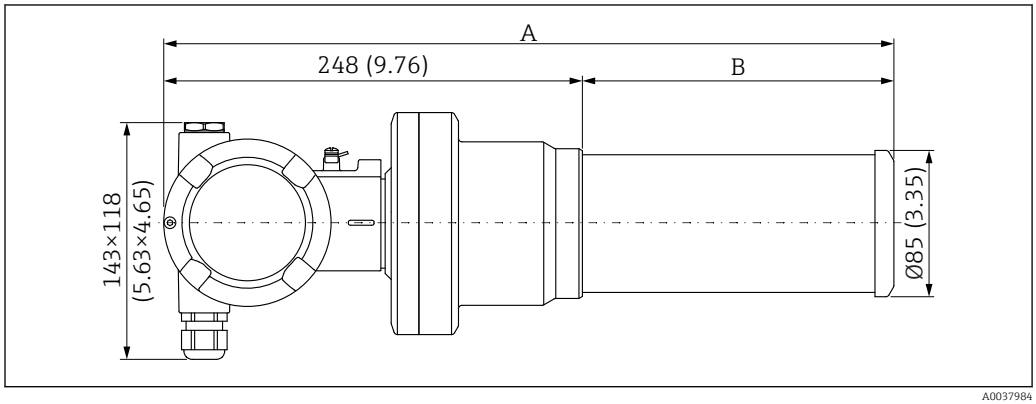
4.2.1 General information

- The angle of emission of the source container must be exactly aligned to the measuring range of the Gammapilot FMG50. Observe the measuring range marks of the device.
- The source container and the Gammapilot FMG50 should be mounted as close to the vessel as possible. Any access to the beam must be blocked to ensure that it is not possible to reach into this area.
- The Gammapilot FMG50 should be protected against direct sunlight or process heat in order to increase its service life.
  - Option: "Weather protection cover"
  - Option: "Heat shield for the sensor"
- Clamps are optionally supplied with the device.
- The mounting device must be installed in such a way as to withstand the weight of the Gammapilot FMG50 under all anticipated operating conditions (e.g. vibrations).

More information with regard to the safety-related use of the Gammapilot FMG50 can be found in the Functional Safety Manual.

4.2.2 Dimensions, weights

Gammapilot FMG50



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- Version NaI (Tl) 2" :
  Total length A: 430 mm (16.93 in), weight: 11.60 kg (25.57 lb)
- Version NaI (Tl) 4" :
  Total length A: 480 mm (18.90 in), weight: 12.19 kg (26.87 lb)
- Version PVT 200 :
  Total length A: 590 mm (23.23 in), weight: 12.10 kg (26.68 lb)
- Version PVT 400 :
  Total length A: 790 mm (31.10 in), weight: 13.26 kg (29.23 lb)
- Version PVT 800 :
  Total length A: 1 190 mm (46.85 in), weight: 15.54 kg (34.26 lb)

- Version PVT 1200 :
  Total length A: 1 590 mm (62.60 in), weight: 17.94 kg (39.55 lb)
- Version PVT 1600 :
  Total length A: 1 990 mm (78.35 in), weight: 20.14 kg (44.40 lb)
- Version PVT 2000 :
  Total length A: 2 390 mm (94.09 in), weight: 22.44 kg (49.47 lb)
- Version PVT 2400 :
  Total length A: 2 790 mm (109.84 in), weight: 24.74 kg (54.54 lb)
- Version PVT 3000 :
  Total length A: 3 390 mm (133.46 in), weight: 28.14 kg (62.04 lb)

The weight data refer to the stainless steel housing versions. The aluminum housing versions are 2.5 kg (5.51 lb) lighter.

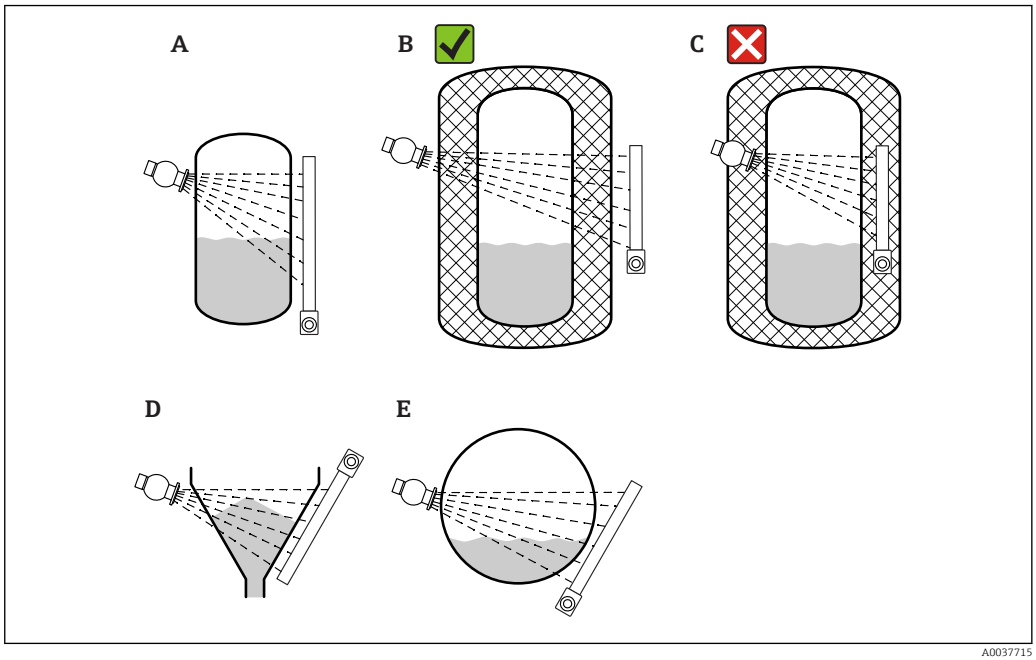
The additional weight for small parts is: 1 kg (2.20 lb)

4.2.3 Installation conditions for level measurement

Conditions

- The Gammapilot FMG50 is mounted vertically for level measurements.
- When the Gammapilot FMG50 is installed upside-down, it can be given additional support (retaining bracket) to prevent damage to the connecting cable or to the unit if it falls.

Examples



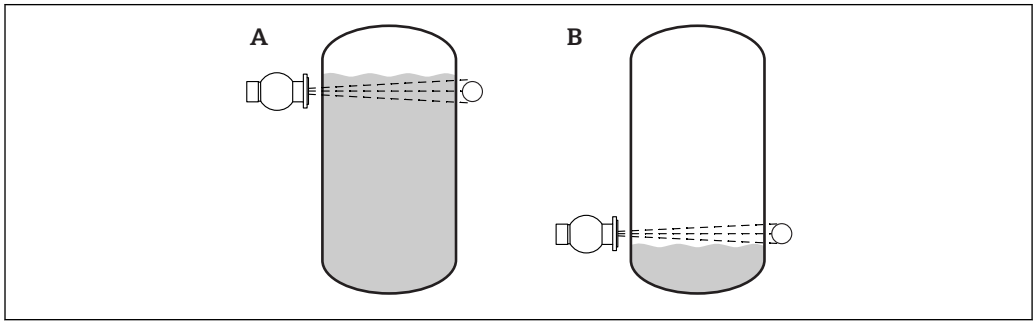
A Vertical cylinder; the Gammapilot FMG50 is mounted vertically with the detector head pointing either downwards or upwards, the gamma ray is aligned to the measuring range.
B Correct: Gammapilot FMG50 mounted outside the tank insulation
C Incorrect: Gammapilot FMG50 mounted inside the tank insulation
D Conical vessel outlet
E Horizontal cylinder

4.2.4 Installation conditions for point level detection

Conditions

For point level detection, the Gammapilot FMG50 is generally mounted horizontally at the height of the desired level limit.

Measuring system arrangement



A Maximum point level detection
B Minimum point level detection

4.2.5 Installation conditions for density measurement

Conditions

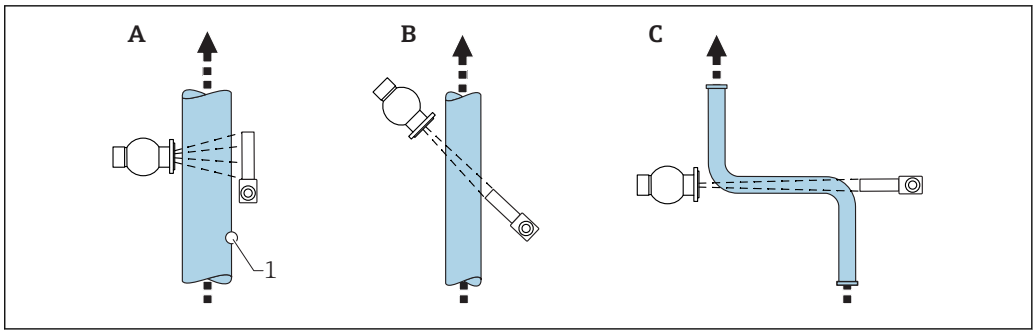
- If possible, density should be measured on vertical pipes with forward flow from bottom to top.
- If only horizontal pipes are accessible, the path of the beam should also be arranged horizontally to minimize the influence of air bubbles and deposits.
- The Endress+Hauser clamping device or an equivalent clamping device should be used to fasten the source container and the Gammapilot FMG50 to the measuring pipe.
  The clamping device itself must be installed in such a way as to withstand the weight of the source container and the Gammapilot FMG50 under all anticipated operating conditions.
- The sample point may not be further than 20 m (66 ft) from the measuring point.
- The distance of the density measurement to pipe bends is ≥3 x pipe diameter, and ≥10 x pipe diameter in the case of pumps.

Measuring system arrangement

The arrangement of the source container and the Gammapilot FMG50 depends on the pipe diameter (or the radiated length) and the density measuring range. These two parameters determine the measuring effect (relative change in the pulse rate). The longer the radiated length, the greater the measuring effect. Therefore, it is advisable to use diagonal irradiation or a measurement section for small pipe diameters.

To select the measuring system arrangement please contact your Endress+Hauser sales organization or use the Applicator™ [1)]

1) configuration software. The Applicator™ is available from your Endress+Hauser sales organization.



A Vertical beam (90°)
B Diagonal beam (30°)
C Measurement section
1 Sample point

- To increase the accuracy of density measurements, the use of a collimator is recommended. The collimator screens the detector against background radiation.
- When planning, the total weight of the measuring system must be taken into consideration.
- A clamping device is available as an accessory
- When the Gammapilot FMG50 is installed upside-down, it can be given additional support (retaining bracket) to prevent damage to the connecting cable or to the unit if it falls.

4.2.6 Installation conditions for interface measurement

Conditions

For interface measurement, the Gammapilot FMG50 is typically mounted horizontally at the upper or lower limit of the interface range. When introducing a radiation source into an immersion tube, it is important to ensure that the measuring range is already filled with medium in order to keep the radiation in the vicinity of the source as low as possible. When a radiation source is used in an immersion tube, the radiation can only be aligned with the measuring range of the Gammapilot FMG50 using a collimator on the immersion tube.

Description

The measuring principle is based on the fact that the radiation source emits radiation which is attenuated when it penetrates a material and the medium to be measured. In radiometric interface measurement, the radiation source is often introduced into a closed, double-wall immersion tube via a cable extension. This excludes the possibility of contact between the radiation source and the medium.

Depending on the measuring range and the application, one or several detectors are mounted on the outside of the vessel. The average density of the medium between the radiation source and the detector is calculated from the radiation received. A direct correlation to the position of the interface can then be derived from this density value.

For more information, see:

CP01205F/00/EN

4.2.7 Installation conditions for density profile measurement (DPS)

Conditions

For density profile measurement, Gammapilot FMG50 devices are installed horizontally at defined distances, depending on the size of the measuring range. In the case of density profile measurement, the radiation source is normally inserted in an immersion tube, preferably one that is double-walled, and introduced into the vessel. When introducing a radiation source into an immersion tube, it is important to ensure that the measuring range is already filled with medium in order to keep the radiation in the vicinity of the source as low as possible.

Description

To obtain detailed information on the distribution of layers of different densities in a vessel, a density profile is measured using a multi-detector solution. Several FMG50 devices are installed next to one another on the outside of the vessel wall for this purpose. The measuring range is divided into zones and each compact transmitter measures the density value in its respective zone. A density profile is derived from these values.

This results in a high-resolution measurement of the distribution of medium layers (e.g. in separators)

For more information, see:

CP01205F/00/EN

4.2.8 Installation conditions for concentration measurement

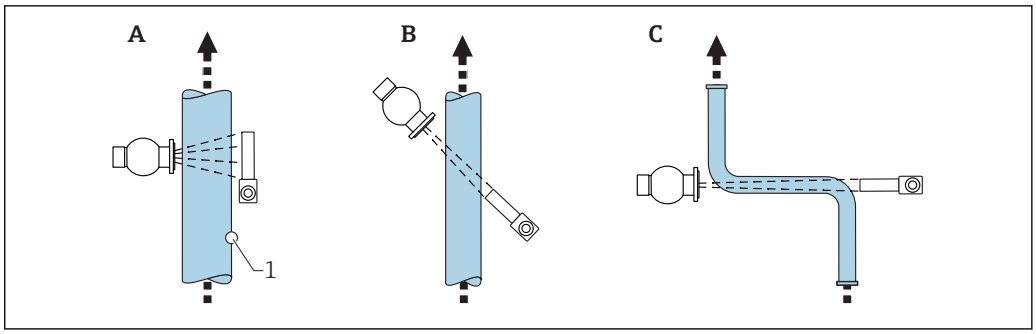
Conditions

- If possible, the concentration should be measured on vertical pipes with forward flow from bottom to top.
- If only horizontal pipes are accessible, the path of the beam should also be arranged horizontally to minimize the influence of air bubbles and deposits.
- The Endress+Hauser clamping device or an equivalent clamping device should be used to fasten the source container and the Gammapilot FMG50 to the measuring pipe.
  The clamping device itself must be installed in such a way as to withstand the weight of the source container and the Gammapilot FMG50 under all anticipated operating conditions.
- When the Gammapilot FMG50 is installed upside-down, it can be given additional support (retaining bracket) to prevent damage to the connecting cable or to the unit if it falls.
- The sample point may not be further than 20 m (66 ft) from the measuring point.
- The distance of the density measurement to pipe bends is ≥3 x pipe diameter, and ≥10 x pipe diameter in the case of pumps.

Measuring system arrangement

The arrangement of the source container and the Gammapilot FMG50 depends on the pipe diameter (or the radiated length) and the density measuring range. These two parameters determine the measuring effect (relative change in the pulse rate). The longer the radiated length, the greater the measuring effect. Therefore, it is advisable to use diagonal irradiation or a measurement section for small pipe diameters.

For the configuration of the measuring system, please contact your Endress+Hauser sales organization or use the Applicator™ [1)] configuration program.



A Vertical beam (90°)
B Diagonal beam (30°)
C Measurement section
1 Sample point

- When planning, the total weight of the measuring system must be taken into consideration.
- The Gammapilot FMG50 can be given additional support (retaining bracket) to secure it against falling or to prevent damage to the connecting cable.
- A clamping device is available as an accessory

4.2.9 Installation conditions for concentration measurement with radiating media

Measurement of the concentration of radiating media in vessels

The concentration of radiating media in vessels can be determined by taking a measurement at the vessel wall. The intensity of the radiation received is proportional to the concentration of the radiating medium in the vessel. It is important to note that the medium in the vessel also absorbs its own radiation. The detected radiation will not increase further with larger diameters and the signal is saturated. This saturation length depends on the half-value layer of the material.

The level in the vessel must be constant in the vicinity of the detector to ensure the measurement is correct.

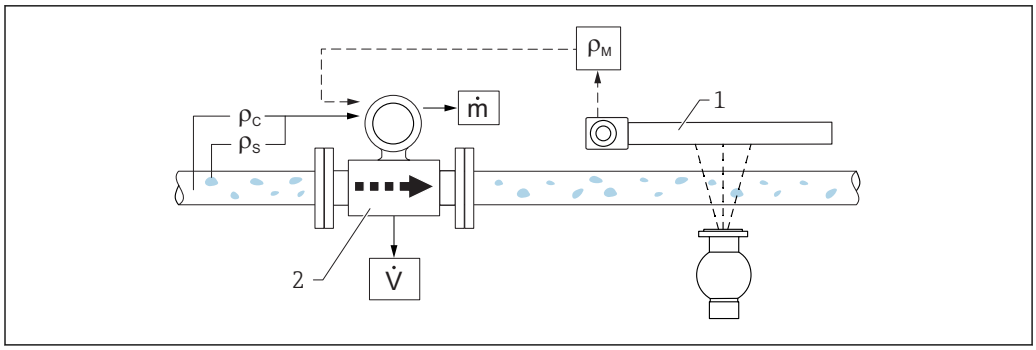
Measurement of the mass flow of radiating media

In the case of belt scales and pipes, the concentration of the radiating medium can be measured in the sample. Here, the device is mounted above or below the conveyor belt so that it is parallel to the belt direction, or is mounted on the pipe. The intensity of the radiation received is proportional to the concentration of the radiating medium in the conveyed material.

4.2.10 Installation conditions for flow measurement

Measurement of mass flow (liquids)

The density signal determined by the Gammapilot FMG50 is transmitted to the Promag 55S. The Promag 55S measures the volume flow; the Promag can determine a mass flow in connection with the calculated density value.



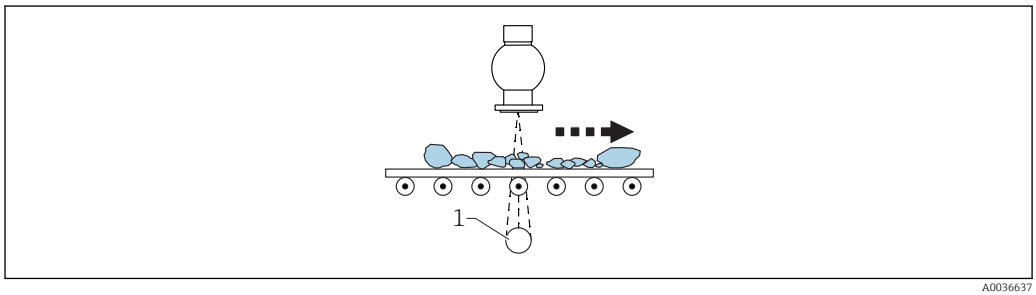
2 *Mass flow measurement (m) using a density meter and a flowmeter. If the density of the solids (ρ_s) and the density of the carrier liquid (ρ_c) are also known, the solids flow rate can be calculated.*

1 Gammapilot FMG50 -> total density (ρ_m) consisting of the carrier liquid and solids
2 Flowmeter (Promag 55S) -> volume flow (V). The solids density (ρ_s) and the density of the carrier liquid (ρ_c) also have to be entered in the transmitter

Measurement of mass flow (solids)

Bulk solids applications on conveyor belts and conveyor screws.

The source container is positioned above the conveyor belt and the Gammapilot FMG50 below the conveyor belt. The radiation is attenuated by the medium on the conveyor belt. The intensity of the radiation received is proportional to the density of the medium. The mass flow is calculated from the belt speed and the radiation intensity.



1 Gammapilot FMG50

4.3 Post-installation check

After installing the measuring device, carry out the following checks:

❑ Is the device damaged (visual inspection)?

❑ Does the device match the measuring point specifications (ambient temperature, measuring range etc.)?

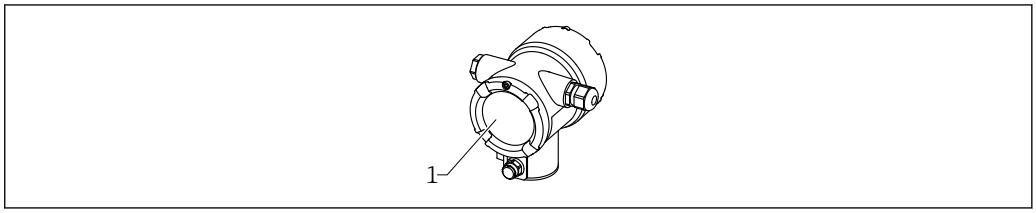
❑ If available: are the measuring point number and labeling correct (visual inspection)?

❑ Is the measuring device sufficiently protected against sunlight?

❑ Are the cable glands tightened correctly?

5 Electrical connection

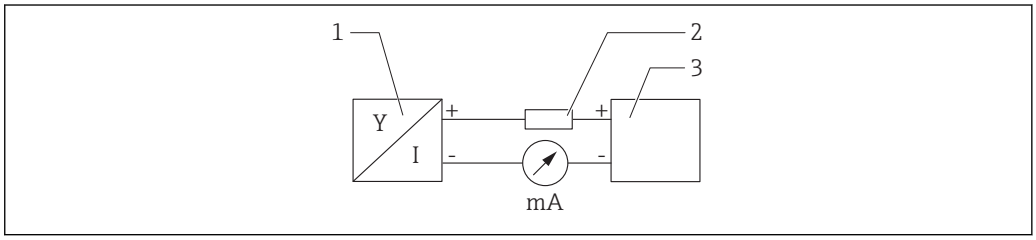
5.1 Connection compartment



1 Connection compartment

5.2 4 to 20 mA HART connection

Connection of the device with HART communication, power source and 4 to 20 mA display



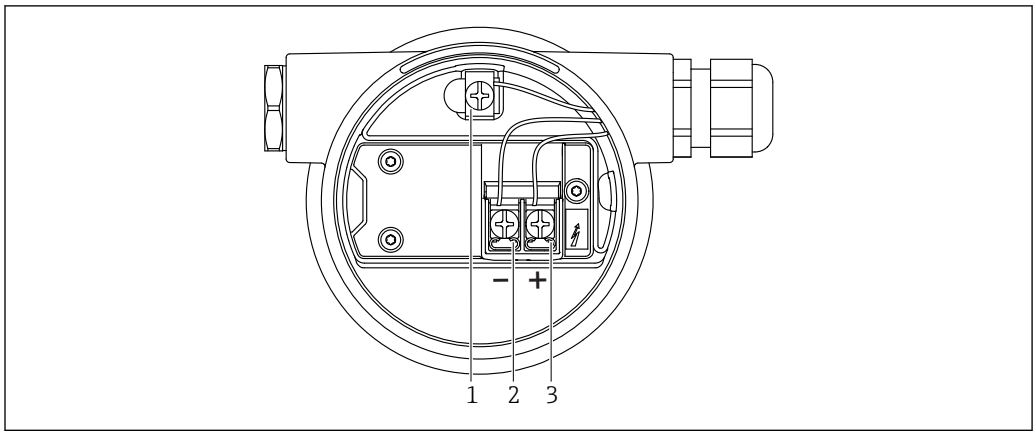
3 Block diagram of HART connection

1 Device with HART communication
2 HART resistor
3 Power supply

The HART communication resistor of 250 Ω in the signal line is always necessary in the case of a low-impedance power supply.

The voltage drop to be taken into account is:
Max. 6 V for 250 Ω communication resistor

5.3 Terminal assignment

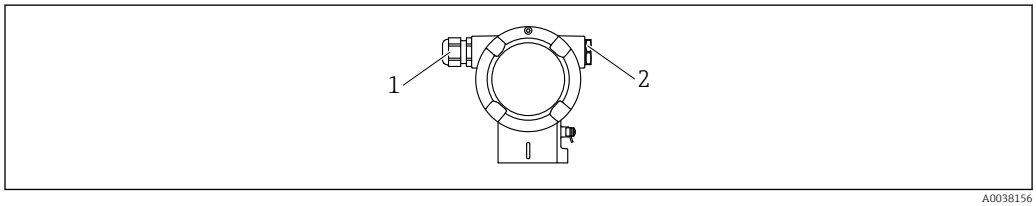


4 *Connection terminals and ground terminal in the connection compartment*

1 Internal ground terminal (to ground the cable shield)
2 Negative terminal
3 Positive terminal

- Non-Ex: supply voltage: 16 to 35 VDC
- Ex-i: supply voltage: 16 to 30 VDC

5.4 Cable entries



1 Cable entry
2 Dummy plug

The number and type of cable entries depend on the device version ordered. The following are possible:

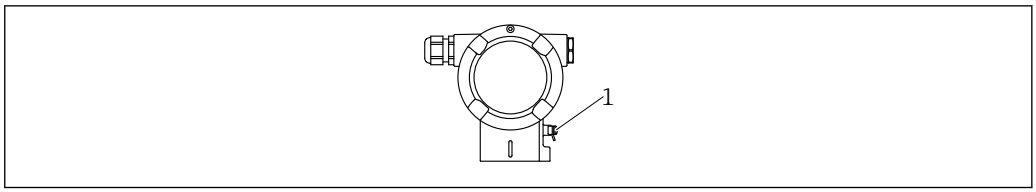
- M20 threaded joint, plastic, IP66/68 NEMA Type 4X/6P
- M20 threaded joint, nickel-plated brass, IP66/68 NEMA Type 4X/6P
- M20 threaded joint, 316L, IP66/68 NEMA Type 4X/6P
- M20 thread, IP66/68 NEMA Type 4X/6P
- G1/2 thread, IP66/68 NEMA Type 4X/6P, with enclosed M20 to G1/2 adapter
- NPT1/2 thread, IP66/68 NEMA Type 4X/6P
- M12 plug, IP66/68 NEMA Type 4X/6P
- HAN7D plug, 90 deg. IP65 NEMA Type 4x

Connecting cables should be routed away from the housing from below to prevent moisture from penetrating the connection compartment. Otherwise, a drip loop should be provided or a weather protection cover should be used.

Please follow the enclosed installation instructions if a G1/2 entry is used.

5.5 Potential equalization

Before wiring, connect the potential matching line to the ground terminal.



1 Ground terminal for connecting the potential matching line

⚠ CAUTION

- Please refer to the separate documentation on applications in hazardous areas for the safety instructions

For optimum electromagnetic compatibility, the potential matching line should be as short as possible and at least 2.5 mm² (14 AWG) in cross-section.

5.6 Rated cross-section

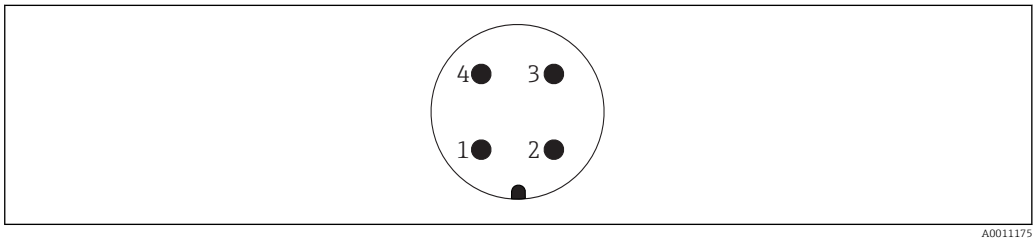
Protective ground or grounding of the cable shield: rated cross-section > 1 mm² (17 AWG)

Rated cross-section of 0.5 mm² (AWG20) to 2.5 mm² (AWG13)

5.7 Fieldbus connectors

In the case of device versions with a fieldbus connector, the housing does not have to be opened to establish the connection.

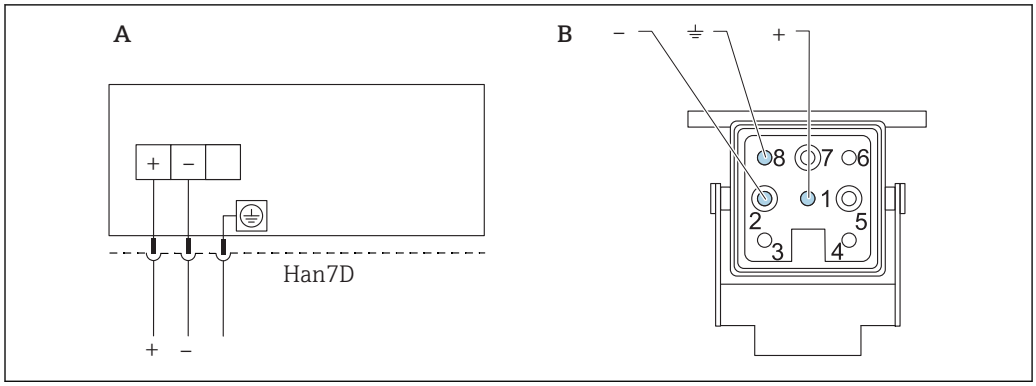
5.7.1 Pin assignment for connector M12-A



Pin 1: Signal +
Pin 2: Not used
Pin 3: Signal –
Pin 4: Ground

Material: CuZn, contacts for plug-in jack and connector are gold-plated

5.7.2 Connection of devices with Harting plug Han7D



A Electrical connection for devices with Harting plug Han7D
B View of the plug-in connection on the device

Material: CuZn, contacts for plug-in jack and connector are gold-plated

5.8 FMG50 with RIA15

The RIA15 remote indicator can be ordered together with the device.

Product structure, feature 620 "Accessory enclosed":
- Option PE "Remote indicator RIA15, non-hazardous area, aluminum field housing"
- Option PF "Remote indicator RIA15, hazardous, aluminum field housing"

Alternatively available as an accessory, for details see Technical Information TI01043K and Operating Instructions BA01170K

⚠ CAUTION

▶ Pay attention to the Safety Instructions (XAs) when using the Gammapilot FMG50 with the remote indicator RIA15 in hazardous environments:

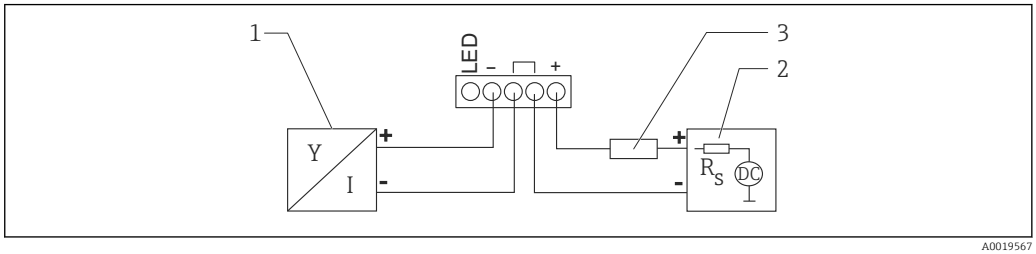
- XA01028R
- XA01464K
- XA01056K
- XA01368K
- XA01097K

Terminal assignment RIA15
- **+**
  Positive connection, current measurement
- **-**
  Negative connection, current measurement (without backlighting)
- **LED**
  Negative connection, current measurement (with backlighting)
- ⏚
  Functional grounding: terminal in housing

The RIA15 process indicator is loop-powered and does not require any external power supply.

The voltage drop to be taken into account is:
- ≤1 V in the standard version with 4 to 20 mA communication
- ≤1.9 V with HART communication
- and an additional 2.9 V if display light is used

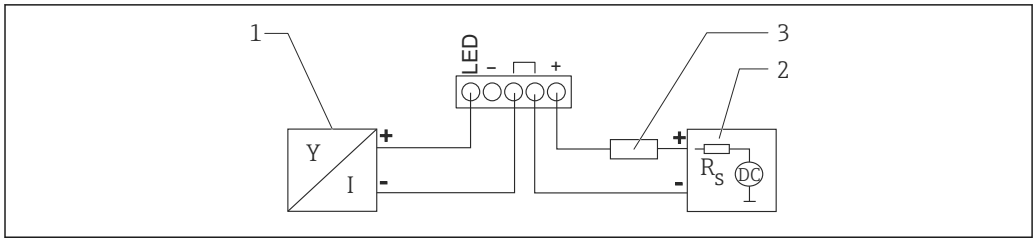
5.8.1 Connection of the HART device and RIA15 without backlighting



5 *Block diagram of HART device with RIA15 process indicator without light*

1 *Device with HART communication*
2 *Power supply*
3 *HART resistor*

5.8.2 Connection of the HART device and RIA15 with backlighting



6 *Block diagram of HART device with RIA15 process indicator with light*

1 *Device with HART communication*
2 *Power supply*
3 *HART resistor*

5.8.3 FMG50, RIA15 with installed HART communication resistor module

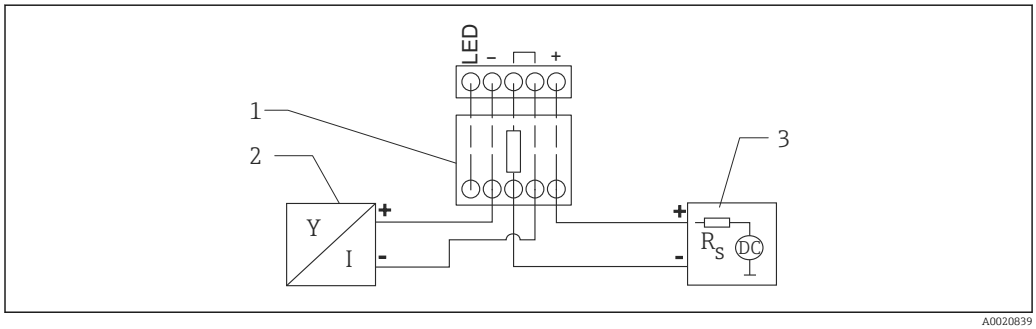
The HART communication module for installation in the RIA15 can be ordered together with the device.

Product structure, feature 620 "Accessory enclosed":
Option PI "HART communication resistor for RIA15"

The voltage drop to be taken into account is:
Max. 7 V

Alternatively available as an accessory, for details see Technical Information TI01043K and Operating Instructions BA01170K

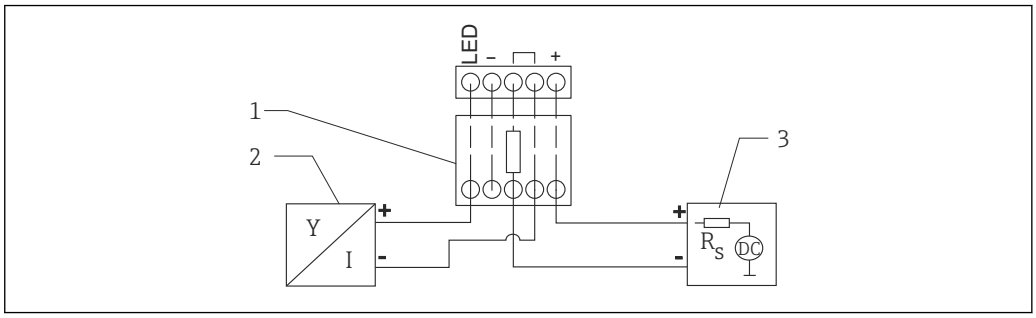
Connection of the HART communication resistor module, RIA15 without backlighting



7 *Block diagram of HART device, RIA15 without light, HART communication resistor module*

1 *HART communication resistor module*
2 *Device with HART communication*
3 *Power supply*

Connection of the HART communication resistor module, RIA15 with backlighting



8 *Block diagram of HART device, RIA15 with light, HART communication resistor module*

1 *HART communication resistor module*
2 *Device with HART communication*
3 *Power supply*

5.9 Wiring

⚠ CAUTION

Note the following before connecting:

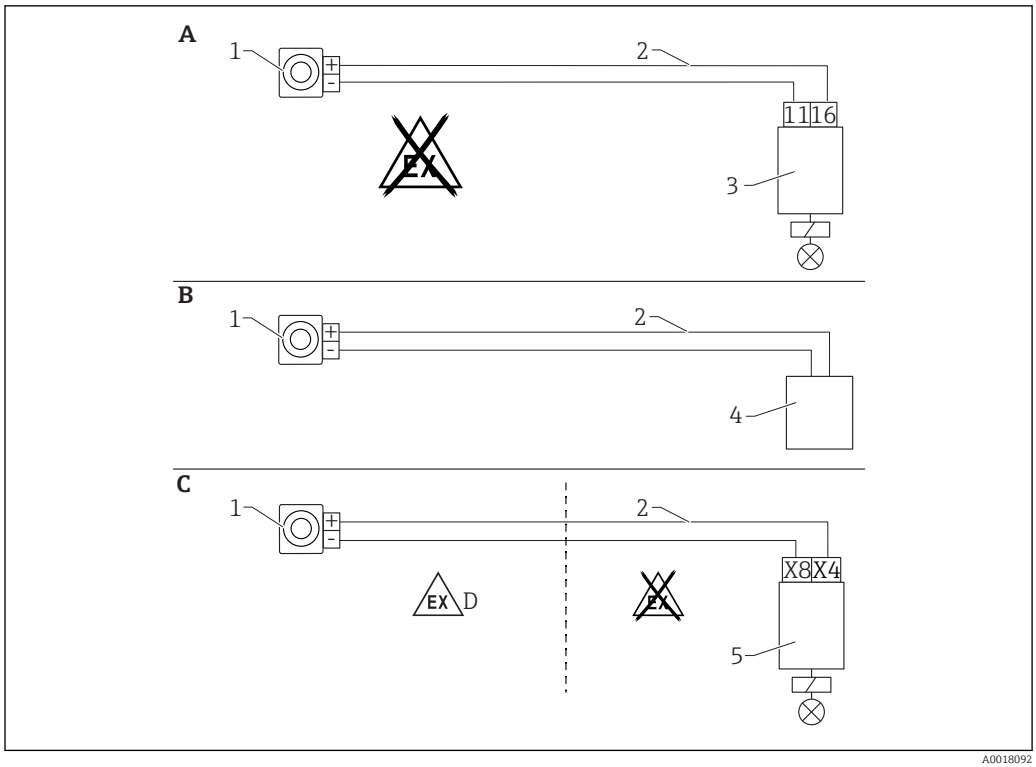
- If the device is used in hazardous areas, make sure to comply with national standards and the specifications in the Safety Instructions (XAs). The specified cable gland must be used.
- The supply voltage must match the specifications on the nameplate.
- Switch off the supply voltage before connecting the device.
- Connect the potential matching line to the external ground terminal of the transmitter before connecting the device.
- Connect the protective ground to the protective ground terminal.
- The cables must be adequately insulated, with due consideration given to the supply voltage and the overvoltage category.
- The connecting cables must offer adequate temperature stability, with due consideration given to the ambient temperature.

1. Release the cover lock
2. Unscrew the cover
3. Guide the cables into the cable glands or cable entries
4. Connect the cables
5. Tighten the cable glands or cable entries so that they are leak-tight
6. Screw the cover securely back onto the connection compartment
7. Tighten the cover lock

5.10 Wiring examples for point level detection

The output signal is linear between free and covered adjustment (e.g. 4 to 20 mA) and can be evaluated in the control system. If a relay output is needed, the following Endress +Hauser process transmitters can be used:

- RTA421: for non-Ex applications, without WHG (German Water Resources Act), without SIL
- RMA42: for Ex-applications, with SIL certificate, with WHG



A Wiring with RTA421 switching unit
B Wiring with control system (pay attention to the explosion protection regulations)
C Wiring with RMA42 switching unit
D When installing in hazardous areas, please observe the corresponding Safety Instructions
1 Gammapilot FMG50
2 4 to 20 mA
3 RTA421
4 PLC (pay attention to the explosion protection regulations)
5 RMA42

5.10.1 Wiring example for cascade mode

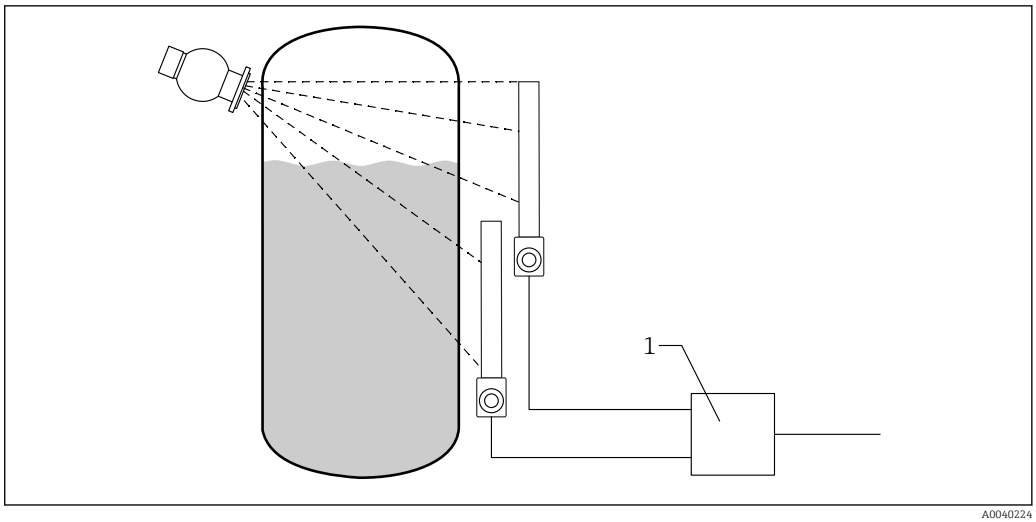
Level measurement: FMG50 with RMA42 process transmitter

Conditions requiring several FMG50 units:
- Large measuring ranges
- Special tank geometry

Two FMG50 units can be interconnected and powered via one RMA42 process transmitter. The individual output currents are added; this gives the total output current.

The internal HART resistor of the RMA42 is used for HART communication. HART communication with the FMG50 is possible via the front terminals of the RMA42.

Avoid overlap between the individual measuring ranges as this can result in an incorrect measured value. The devices can overlap provided this does not affect the measuring ranges.



9 Connection diagram: for two FMG50 units connected to one RMA42

1 RMA42

Settings for cascade mode

▶ FMG50 settings:
↳ All FMG50 units used in cascade must be adjusted individually. For example via the "Commissioning" wizard in the "Level" operating mode

1. Settings for RMA42 (analog input 1):
   ↳ Signal type: current
   Range: 4 to 20 mA
   Lower range value: 0 mm
   Upper range value: 800 mm
   Offset where applicable
2. Settings for RMA42 (analog input 2):
   ↳ Signal type: current
   Range: 4 to 20 mA
   Lower range value: 0 mm
   Upper range value: 400 mm
   Offset where applicable
3. Calculated value 1:
   ↳ Calculation: sum total
   Unit: mm
   Bar graph 0: 0 m
   Bar graph 100: 1.2 m
   Offset where applicable
4. Analog output:
   ↳ Assignment: calculated value 1
   Signal type: 4 to 20 mA
   Lower range value: 0 m
   Upper range value: 1.2 m

Only the current output of the RMA42 supplies the level measured value of the overall system. No HART values available for the entire cascade.

For more information, see:

BA00287R

5.10.2 Ex applications in conjunction with RMA42

Observe the following Safety Instructions:
ATEX II (1) G [Ex ia] IIC, ATEX II (1) D [Ex ia] IIIC for RMA42

XA00095R

5.10.3 SIL applications for Gammapilot in connection with RMA42

The Gammapilot FMG50 meets the requirements of SIL2/3 as per IEC 61508, see:

FY01007F

The RMA42 meets SIL2 as per IEC 61508:2010 (Edition 2.0), see the Functional Safety Manual:

SD00025R

5.11 Post-connection check

After wiring the device, carry out the following checks:

❑ Is the potential matching line connected?

❑ Is the terminal assignment correct?

❑ Are the cable glands and dummy plugs screwed tight?

❑ Are the fieldbus connectors properly secured?

❑ Are the covers screwed down correctly?

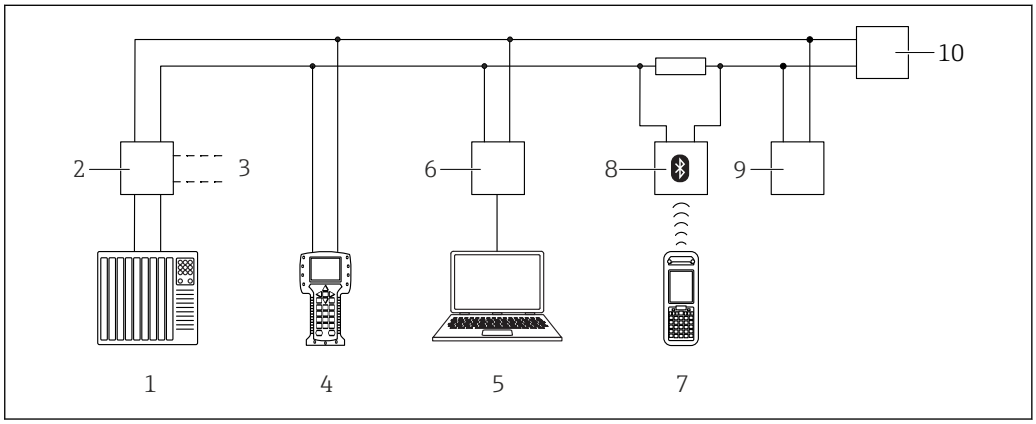
⚠ WARNING

▶ Only operate the device with the covers closed

6 Operation

6.1 Overview of the HART operating options

6.1.1 Via HART protocol



10 Options for remote operation via HART protocol

1 PLC (programmable logic control)
2 Transmitter power supply unit, e.g. RN221N (with communication resistor)
3 Connection for Commubox FXA191, FXA195 and Field Communicator 375, 475
4 Field Communicator 475
5 Computer with operating tool (e.g. DeviceCare/FieldCare , AMS Device Manager, SIMATIC PDM)
6 Commubox FXA191 (RS232) or FXA195 (USB)
7 Field Xpert SFX350/SFX370
8 VIATOR Bluetooth modem with connecting cable
9 RIA15
10 Transmitter

6.1.2 Operation via FieldCare/DeviceCare

FieldCare/DeviceCare is an Endress+Hauser asset management tool based on FDT technology. With FieldCare/DeviceCare you can configure all Endress+Hauser devices as well as devices from other manufacturers that support the FDT standard. Hardware and software requirements can be found on the Internet:

www.de.endress.com -> Search: FieldCare -> FieldCare ->Technical data

FieldCare supports the following functions:
- Configuration of transmitters in online mode
- Loading and saving device data (upload/download)
- Documentation of the measuring point

Connection options:
- HART via Commubox FXA195 and USB interface of a computer
- Commubox FXA291 via the service interface

6.1.3 Operation via RIA 15 (remote display)

Loop-powered process indicator to display HART or 4 to 20 mA signals

6.1.4 Operation via WirelessHART

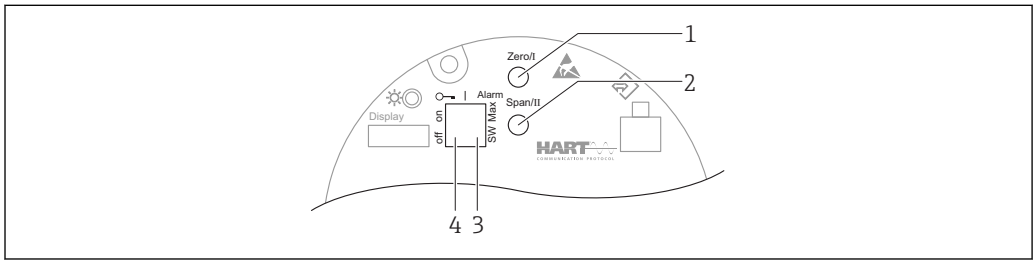
SWA70 WirelessHART adapter with the Commubox FXA195 and the "FieldCare/ DeviceCare" operating program

6.2 Alternative operation options

The measuring device can be configured and query measured values in a variety of ways.

6.2.1 Local operation

The device can also be operated on site using the keys. If operation is locked using the DIP switches on site, parameter entry via communication is not possible.

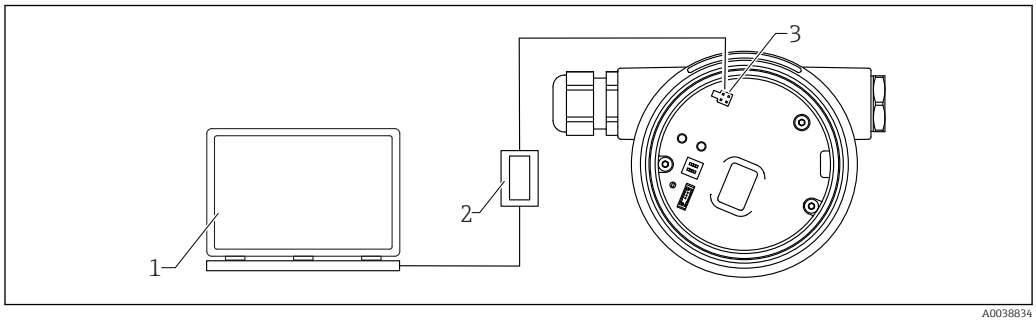


1 *Operating key for empty calibration (function I)*
2 *Operating key for full calibration (function II)*
3 *DIP switch for alarm current (SW-defined/Max. alarm)*
4 *DIP switch for locking and unlocking the measuring device*

Operation via keys is only active if a display is not attached

6.2.2 Operation via the service interface

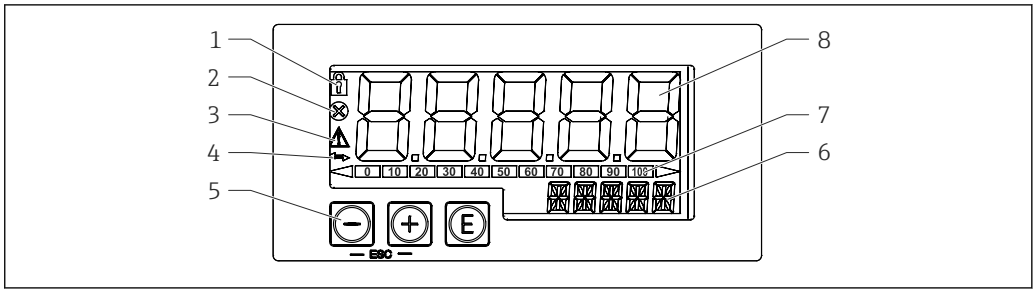
DeviceCare/FieldCare via service interface (CDI)



11 *DeviceCare/FieldCare via service interface (CDI)*

1 *Computer with DeviceCare/FieldCare operating tool*
2 *Commubox FXA291*
3 *Service interface (CDI) of the measuring device (= Endress+Hauser Common Data Interface)*

6.2.3 Operation via RIA15



12 *Display and operating elements of the process indicator*

1 *Symbol: operating menu disabled*
2 *Symbol: error*
3 *Symbol: warning*
4 *Symbol: HART communication active*
5 *Operating keys*
6 *14-segment display for unit/TAG*
7 *Bar graph with indicators for under range and over range*
8 *5-digit 7-segment display for measured value, digit height 17 mm (0.67 in)*

The device is operated using three operating keys on the front of the housing.

Ⓔ
Enter key; for calling up the operating menu, confirming the selection/configuration of parameters in the operating menu

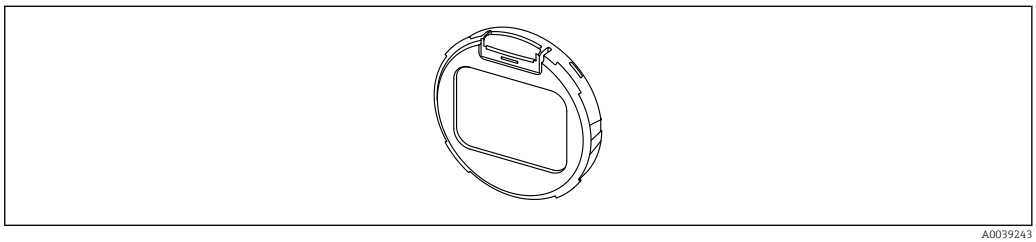
⊕ /⊖
Selection and configuration/changing of values in the operating menu; pressing the '+' and '-' keys simultaneously takes the user back up a menu level. The configured value is not saved.

Additional information is available in the Operating Instructions for the RIA15

6.2.4 Operation via Bluetooth® wireless technology

Requirements

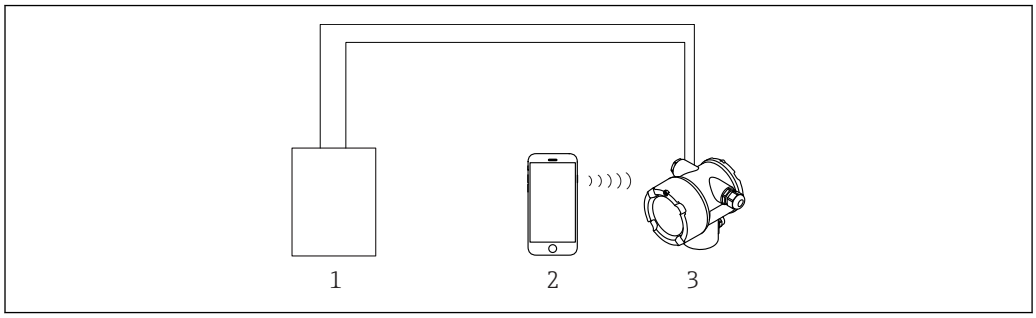
Optional, only for devices with a display with Bluetooth capability:
Feature 030 "Display, operation", option D "Basic display+Bluetooth"



13 *Display with Bluetooth module*

A flashing Bluetooth symbol indicates that a Bluetooth connection is available

Operation via SmartBlue (app)



14 Operation via SmartBlue (app)

1 Transmitter power supply unit
2 Smartphone / tablet with SmartBlue (app)
3 Transmitter with Bluetooth module

6.2.5 Heartbeat Verification/Monitoring

Heartbeat submenu is only available if operating via **FieldCare** or **DeviceCare**. It contains wizards that are available with the **Heartbeat Verification** and **Heartbeat Monitoring** application packages.

SD02414F

6.3 Locking/unlocking configuration

6.3.1 Software locking

Locking via password in FieldCare / DeviceCare / Smartblue

Access to the configuration of the FMG50 can be locked by assigning a password. The "User role" is set to "Maintainer" in the as-delivered state. The device can be fully configured in the "Maintainer" role. Afterwards, access to the configuration can be locked by assigning a password. The "User Role" is now set to "Operator". The configuration can be accessed by entering the password.

The password is defined under:

System -> User management -> Define password

You can switch from the "Maintainer" to "Operator" user role under:

System -> User management -> Logout

Deactivating the lock via FieldCare / DeviceCare / Smartblue

After entering the password, you can enable the configuration of the FMG50 as an "Operator" with the password. The "User role" then changes to "Maintainer"

Navigate to:

System -> User management -> Change user role

6.3.2 Hardware locking

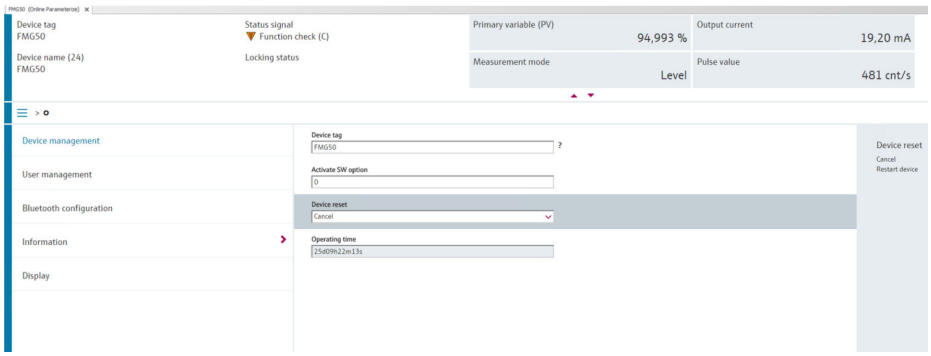
Hardware locking can only be unlocked via the main unit (flip the switch). It is not possible to unlock the hardware by communication.

6.4 Resetting to the default configuration

⚠ CAUTION

- A reset may negatively impact the measurement. As a rule, a basic setup must be performed again after a reset. All calibration data are deleted after a reset. A complete recalibration is needed to put the measurement back into operation.

1. Connect the device with FieldCare or DeviceCare.
2. Open the device in FieldCare or DeviceCare.
   ↳ The dashboard (homepage) of the device is displayed:
   Click "System -> Device management"



3. Reset the device in the "Device reset" parameter

The following types of reset can be selected:

- **Restart device**
  A soft reset is performed here. The device software performs all the diagnostics that would also be performed by a hard reset by switching the device on/off.
- **Reset to factory default**
  It is always advisable to reset the customer parameters if you want to use a device with an unknown history, or if the operating mode is changed. When a reset is performed, all customer parameters are reset to the factory default values
- **Optional: reset to customer settings**
  If the device was ordered with a customized configuration, a reset restores these customer settings configured at the factory.

A reset can also be performed on site via the operating keys (see the "Commissioning via onsite operation" section).

7 Commissioning

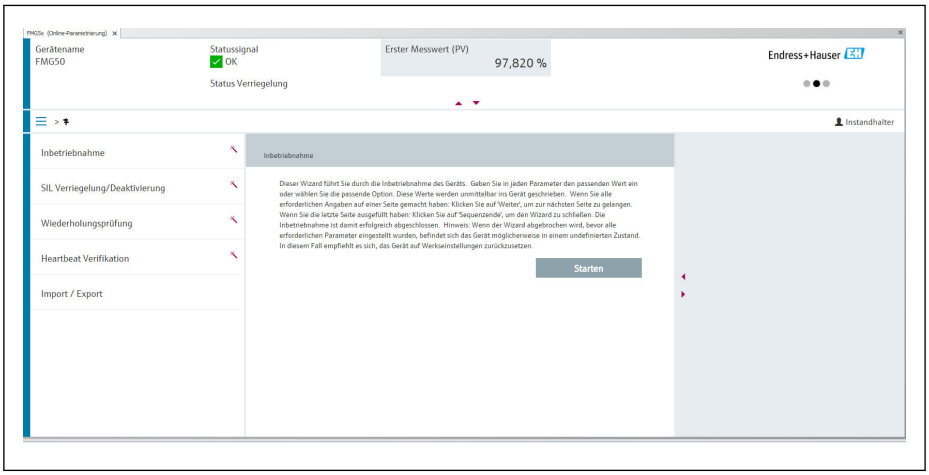
7.1 Post-installation and post-connection check

Perform the post-installation check and the post-connection check for the FMG50 prior to commissioning the measuring point.

7.2 Commissioning using the Commissioning Wizard

A Wizard is provided in FieldCare or DeviceCare [2] that guides the user through the initial commissioning process.

1. Connect the device with FieldCare or DeviceCare.
2. Open the device in FieldCare or DeviceCare.
   ↳ The dashboard (homepage) of the device is displayed:



15 *Screenshot: Commissioning Wizard*

3. Click "Commissioning" to launch the Wizard.
4. Enter the appropriate value in each parameter or select the appropriate option. These values are written directly to the device.
5. Click "Next" to go to the next page.
6. Once all the pages have been completed, click "Finish" to close the Wizard.

If you cancel the Wizard before all the necessary parameters have been entered, the device may be in an undefined state. In such situations, it is advisable to reset the device to the factory default settings.

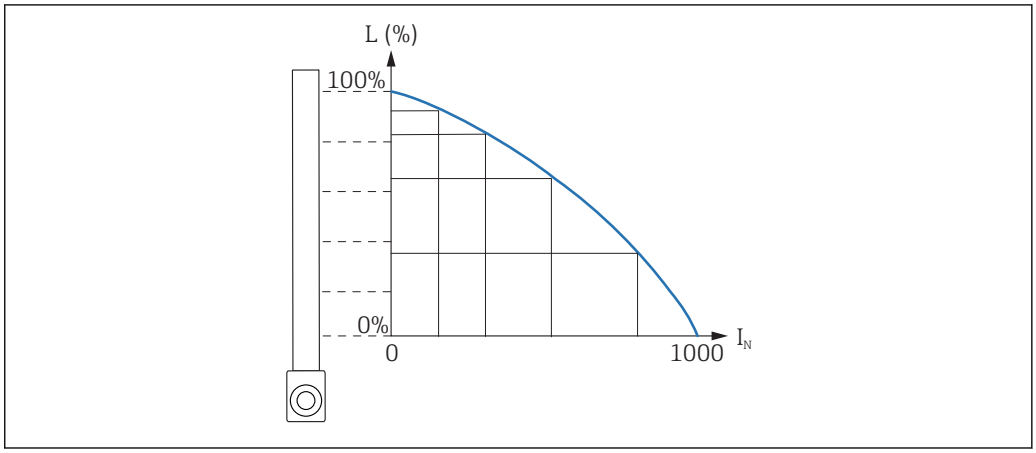
7.2.1 Linearization

Linearization modes, linearization table

In level measurement applications, linearization defines the correlation between the pulse rate and the level (0 to 100%). The FMG50 has a variety of linearization modes. On the one hand, users can choose from pre-programmed linearizations for frequent standard cases ("linear", "standard"). On the other hand, it is possible to enter a user-defined linearization table that is customized for the particular application. The linearization table

2) FieldCare and DeviceCare are available for download at www.software-products.endress.com. To download the software, it is necessary to register in the Endress+Hauser software portal.

consists of up to 32 "normalized pulse rate : level" value pairs. The linearization table must be monotonic decreasing, i.e. a higher pulse rate must always be paired with a lower level.



16 *Example of a linearization table for level measurements (consisting of 6 value pairs); N: number of the value pair; L: level; I: measured pulse rate; I_N : normalized pulse rate*

N	L	I	I_N
1	0	2431	1000
2	35	1935	792
3	65	1283	519
4	83	642	250
5	92	231	77
6	100	46	0

Normalized pulse rate

Note that the normalized pulse rate is entered in the linearization table. The normalized pulse rate is not identical to the pulse rate actually measured. The correlation between these two variables is defined by:

$I_N = (I - I_0) / (I_{MAX} - I_0) \times 1000$

Where:
- I_0 is the minimum pulse rate (i.e. the pulse rate for full calibration)
- I_{MAX} is the maximum pulse rate (i.e. the pulse rate for empty calibration)
- I: the measured pulse rate
- I_N: the normalized pulse rate

The normalized pulse rate is used because it does not depend on the activity of the radiation source used:
- For L = 0 % (empty vessel), I_N always = 1000
- For L = 100 % (full vessel) I_N always = 0

Methods for entering the linearization table

Semi-automatic linearization

For a point in the table to be entered automatically, the vessel must be filled up to the necessary level. Radiation must be switched on. The FMG50 then automatically records the pulse rate. The user only has to enter the corresponding level.

Manual linearization

If the table points cannot be entered automatically during the commissioning of the FMG50 (e.g. because the vessel cannot be sufficiently filled or emptied), the table must be entered manually. This means that both the level and the associated normalized pulse rate must be entered by the user. Please contact the Endress+Hauser sales organization for any questions regarding the calculation of the normalized pulse rate.

7.3 Commissioning via SmartBlue (App)

7.3.1 Requirements

Device requirements
Commissioning via SmartBlue is only possible if the device has a Bluetooth module.

SmartBlue system requirements
SmartBlue is available as download for Android devices from the Google Play Store and for iOS devices from the iTunes Store.

- Devices with iOS:
  iPhone 4S or higher from iOS9.0; iPad2 or higher from iOS9.0; iPod touch 5th generation or higher from iOS9.0
- Devices with Android:
  From Android 4.4 KitKat and *Bluetooth*® 4.0

Initial password
The serial number of the device is used as the initial password when establishing the connection for the first time. The serial number can be found on the nameplate.

7.3.2 SmartBlue app

1. Scan the QR code or enter "SmartBlue" in the search field of the App Store.
   ↳

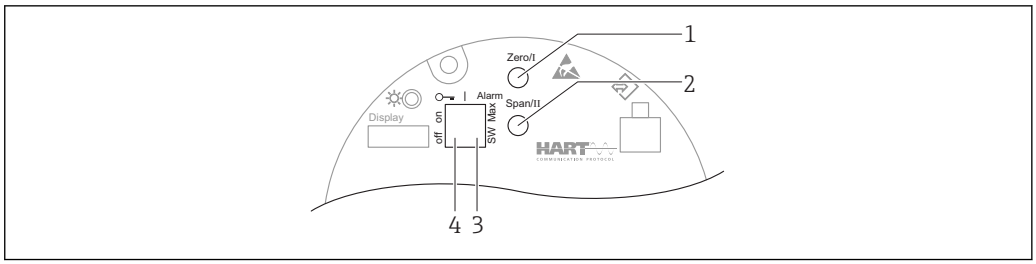
17 *Download link*

2. Start SmartBlue.
3. Select device from livelist displayed.
4. Enter the login data:
   ↳ User name: admin
   Password: serial number of the device
5. Tap the icons for more information.

After logging in for the first time, change the password!

7.4 Commissioning via on-site operation

The device can also be operated on site using the keys. If operation is locked using the DIP switch on site, parameter entry via communication is not possible.



A0039285

1 Operating key for empty calibration (function I)
2 Operating key for full calibration (function II)
3 DIP switch for alarm current (SW-defined/Min. alarm)
4 DIP switch for locking and unlocking the measuring device

- **Empty calibration:** Press and hold the operating key for empty calibration (I) > 3 s
- **Full calibration:** Press and hold the operating key for full calibration (II) > 3 s
- **Background calibration:** Simultaneously press and hold the operating key for empty calibration (I) and the operating key for full calibration (II) > 3 s
- **Reset to factory defaults:** Simultaneously press and hold the operating key for empty calibration (I) and full calibration (II) > 12 s. The LED starts flashing. When the flashing stops, the device is reset to the factory default settings.

A reset deletes all calibrations!

Operation via keys is only active if a display is not attached

7.4.1 Status and power LEDs

A green LED that signals the supply, status and button activation feedback is provided on the electronic insert.

Behavior of the LED
- When the measuring device is started, the LED flashes slowly until the current output corresponds to the measured value
- After commissioning, the LED is lit constantly provided that the main device is switched on and a local display is not attached
- When a key is pressed, the LED flashes to confirm the key activation
- When a reset is performed, the LED flashes as long as both keys are pressed and the reset is not yet active (countdown). The LED stops flashing once the reset is active. This LED is only active if a display is not attached

7.5 Operation and settings via RIA15

See the RIA15 Operating Instructions, BA01170K

7.6 Data access - Security

7.6.1 Locking via password in FieldCare / DeviceCare / Smartblue

The Gammapilot FMG50 can be locked and unlocked via a password (see the "Software locking" section)

7.6.2 Hardware locking

The Gammapilot FMG50 can be locked and unlocked via a switch on the main unit. Hardware locking can only be unlocked via the main unit (flip the switch). It is not possible to unlock the hardware by communication here.

7.6.3 Bluetooth® wireless technology (optional)

Signal transmission via Bluetooth® wireless technology uses a cryptographic technique tested by the Fraunhofer Institute

- The device is not visible via *Bluetooth*® wireless technology without the SmartBlue App.
- Only one point-to-point connection between **one** sensor and **one** smartphone or tablet is established.
- The *Bluetooth*® wireless technology interface can be deactivated via SmartBlue, FieldCare or DeviceCare.
- The *Bluetooth*® wireless technology interface can be reactivated via FieldCare or DeviceCare.
- It is not possible to reactivate the *Bluetooth*® wireless technology interface via the SmartBlue App.

7.6.4 RIA15 locking

The device setup can be locked with a 4-digit user code

Additional information is available in the Operating Instructions for the RIA15

7.7 Overview of the operating menu

A complete overview of the operating menu is provided in the "Description of Device Parameters" documentation.

GP01141F

8 Diagnostics and troubleshooting

8.1 System error messages

8.1.1 Error signal

Errors occurring during commissioning or operation are signaled in the following way:

- Error symbol, display color, error code and error description on the display and operating module.
- Current output, customizable:
  - MAX, 110%, 22 mA
  - MIN, -10%, 3.6 mA

Standard setting: MIN, -10%, 3.6 mA

The max. alarm current can be configured in the 21.5 to 23.0 mA range. The default value is 22.5 mA.

8.1.2 Types of error

- Error-free operation: display is lit green
- Alarm or warning: display is lit red
- Alarm: the output current adopts a value that has been defined beforehand. An error message is displayed
  - MAX, 110%, 22 mA
  - MIN, -10%, 3.8 mA
- Warning: the device continues to measure. An error message is displayed (alternating with the measured value)

Error indication via a display color change only works if the operating voltage is not below 16 V

8.2 Possible calibration errors

Error	Possible causes	Solution
Pulse rate too low with empty vessel	Radiation source switched off	Switch on source at the source container
	Incorrect alignment of angle of emission	Realign angle of emission
	Buildup in the vessel	Clean vessel or Recalibrate (if buildup is stable)
	Fittings in the vessel have not been considered in the activity calculation	Recalculate activity and change radiation source if required
	Pressure in the vessel has not been considered in the activity calculation	Recalculate activity and change radiation source if required
	No radiation source in the source container	Load radiation source in the container
	Radiation source too weak	Use radiation source with higher activity
	If a modulator is used	Modulator is not mounted correctly
		Modulator is not in operation
		Radiation is not set to modulated

Error	Possible causes	Solution
Pulse rate too high with empty vessel	Activity too high	Attenuate radiation, e.g. by mounting a steel plate in front of the source container; or exchange radiation source
	External radiation sources present (e.g. from gammagraphy)	Shield off if possible; repeat calibration without external radiation source
Pulse rate too high with full vessel	External radiation sources present (e.g. from gammagraphy)	Shield off if possible; repeat calibration without external radiation source

8.3 Error - SmartBlue operation

Error	Possible cause	Solution
Device is not visible in the live list	No Bluetooth connection	Enable Bluetooth function on smartphone or tablet
		Bluetooth function of sensor disabled, perform recovery sequence
Device is not visible in the live list	The device is already connected with another smartphone/ tablet	Only **one** point-to-point connection is established between a sensor and a smartphone or tablet
Device is visible in the live list but cannot be accessed via SmartBlue	Android end device	Is the location function permitted for the app, was it approved the first time?
		GPS or positioning function must be activated for certain Android versions in conjunction with Bluetooth
		Activate GPS - close the app fully and restart - enable the positioning function for the app
Device is visible in the live list but cannot be accessed via SmartBlue	Apple end device	Log in as standard Enter user name "admin" Enter initial password (device serial number) paying attention to lower/upper case
Login via SmartBlue not possible	Device is being put into operation for the first time	Enter initial password (device serial number) and change. Pay attention to lower/upper case when entering the serial number.
Device cannot be operated via SmartBlue	Incorrect password entered	Enter correct password
Device cannot be operated via SmartBlue	Password forgotten	Contact the Endress+Hauser Service department
Device cannot be operated via SmartBlue	The sensor temperature is too high	If the ambient temperature results in an elevated sensor temperature of >60 °C (140 °F), Bluetooth communication may be disabled. Shield the device, isolate it and cool it down if necessary.
TAG in SmartBlue and HART do not match	System-related	The device ID (TAG) is transferred to the live list via Bluetooth® to facilitate device identification. The tag is abbreviated in the middle since the HART tag can be up to 32 characters long but Bluetooth® can only use 29 characters as the device name:

8.4 Diagnostic event

8.4.1 Diagnostic event in the operating tool

If a diagnostic event is present in the device, the status signal appears in the top left status area of the operating tool along with the corresponding symbol for the event level in accordance with NAMUR NE 107:

- Failure (F)
- Function check (C)
- Out of specification (S)
- Maintenance required (M)

- Error-free operation: display is lit green
- Alarm or warning: display is lit red

Calling up remedial measures

- ▶ Navigate to the **Diagnostics** menu
  - ↳ In the **Actual diagnostics** parameter the diagnostic event is shown with event text

8.4.2 List of diagnostic events in the operating tool

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
Diagnostic of sensor				
007	Sensor defective	Replace device	F	Alarm
007	Sensor defective		M	Warning
062	Sensor connection	Check sensor connection	F	Alarm
062	Sensor error		F	Alarm
064	Pulse rate out of range	1. Check sensor 2. Replace sensor	C	Warning
082	Data storage	1. Check module connections 2. Contact service	F	Alarm
955	Gammagraphy detected	Gammagraphy detected	C	Warning [1)]
956	Evaluation plateau curve	Evaluation plateau curve	M	Warning
Diagnostic of electronic				
242	Software incompatible	1. Check software 2. Flash or change main electronics module	F	Alarm
252	Modules incompatible	1. Check if correct electronic modul is plugged 2. Replace electronic module	F	Alarm
261	Electronic modules	1. Restart device 2. Check electronic module 3. Replace electronic module	F	Alarm
262	Module connection	1. Check module connections 2. Change main electronics	F	Alarm
262	Module connection	1. Check module connections 2. Change electronic modules	F	Alarm
270	Main electronics defective	Change main electronic module	F	Alarm

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
271	Main electronic failure	1. Restart device 2. Change main electronic module	F	Alarm
271	Sensor module electronic failure		F	Alarm
271	Error Opcode Check	Restart device	F	Alarm
272	Main electronic failure	1. Restart device 2. Contact service	F	Alarm
273	Main electronic failure	1. Emergency operation via display 2. Change main electronics	F	Alarm
275	I/O module defective	Change I/O module	F	Alarm
275	Sensor electronic failure	1. Restart device 2. Replace electronics	F	Alarm
276	I/O module faulty	1. Restart device 2. Change I/O module	F	Alarm
282	Data storage	1. Restart device 2. Contact service	F	Alarm
282	Electronic memory		F	Alarm
283	Memory content	1. Transfer data or reset device 2. Contact service	F	Alarm
311	Electronic failure	Maintenance required! 1. Do not perform reset 2. Contact service	M	Warning
Diagnostic of configuration				
410	Data transfer	1. Check connection 2. Retry data transfer	F	Alarm
411	Up-/download active	Up-/download active, please wait	F	Alarm
411	Up-/download active		C	Warning
412	Processing download	Download active, please wait	C	Warning
431	Trim 1	Carry out trim	C	Warning
434	Real time clock defective	Replace main electronics	C	Warning
434	Real Time Clock battery is empty	Restart device	M	Warning
435	Linearization	Check linearization table	F	Alarm
436	Date/Time incorrect	Check date and time settings.	M	Warning
437	Configuration	1. Check device configuration 2. Up- and download new configuration	F	Alarm
437	Configuration incompatible	1. Restart device 2. Contact service	F	Alarm
438	Dataset	1. Check data set file 2. Check device configuration 3. Up- and download new configuration	M	Warning
439	Configuration Sensor Unit invalid	1. Check device settings 2. Check electronic module type	C	Warning
440	Device not calibrated	Device not calibrated	C	Alarm
441	Current output 1	1. Check process 2. Check current output settings	S	Warning

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
444	Background not calibrated	Background not calibrated	C	Alarm
484	Failure mode simulation	Deactivate simulation	F	Alarm
484	Failure mode simulation		C	Alarm
491	Current output 1 simulation	Deactivate simulation	C	Warning
493	Simulation pulse rate active	Deactivate simulation	C	Warning
494	Output simulation	Deactivate simulation	C	Warning
495	Diagnostic event simulation	Deactivate simulation	C	Warning
586	Calibration active	Recording pulse rate	M	Warning
Diagnostic of process				
801	Low power	Increase supply voltage	F	Alarm
802	Power high	1. Check wiring 2. Change I/O module	S	Warning
803	Current loop	–	F	Alarm
803	Current loop 1	1. Check wiring 2. Change I/O module	M	Warning
803	Current loop		F	Alarm
825	Operating temperature	1. Check ambient temperature 2. Check process temperature	S	Warning
825	Sensor temperature out of range		S	Warning
827	Overexposure detector	Overexposure detected Please check source	C	Warning
861	Process fluid	Check process conditions	F	Alarm
881	Sensor signal path	1. Check process conditions 2. Clean transducer 3. Change transducer	F	Alarm

1) Diagnostic behavior can be changed.

8.4.3 Displaying the diagnostic events

Actual diagnostics

The menu contains the "Actual diagnostics" parameter with a time stamp.

Previous diagnostics

The menu contains the "Previous diagnostics" parameter with a time stamp.

Event logbook

The events are saved in the event logbook.

Navigation

"Diagnostics" menu → Event logbook

8.5 Diagnostic event on the RIA15

A diagnostic event is not directly shown on the RIA15. The fault F911 only appears directly on the RIA15 display in the event of an alarm.

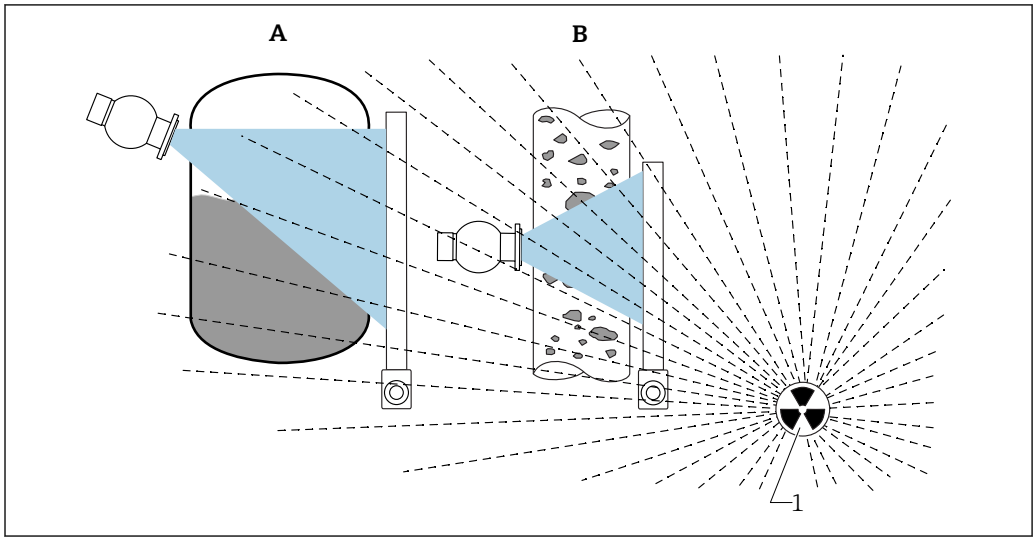
Displaying a diagnostic event on the RIA15

1. Navigate to: DIAG/TERR
2. Press E
3. Press +
4. Press E
5. Press + 3 times
6. Press E
   ↳ The diagnostic event of the field device is shown on the RIA15 display

8.6 Gammagraphy

8.6.1 General principles

This function involves the detection of interference radiation that interrupts the measurement. The aim of gammagraphy detection is to detect interference radiation that typically occurs during nondestructive material testing within the system. Without gammagraphy detection, this interference radiation would result in a low measured value (0% or ρmin). In contrast, when gammagraphy detection is used, the measured value adopts a defined value in this case (alarm current or hold last measured value).



18 *Influence of gammagraphy on radiometric measurements*

1 Interference radiation

8.6.2 Reaction to detected gammagraphy radiation

If the gammagraphy criterion "gammagraphy limit" is met, the device output adopts a value defined by the user (Gammagraphy detection parameter). Furthermore, a warning is also signaled. After a maximum time defined by the user (Hold time parameter), an alarm

current is output and an event is displayed (can be selected via the Gammagraphy detection parameter).

Gammagraphy detection is also available with modulated radiation.

If the Heartbeat option is available, the number of detected gammagraphy events and the total duration of the detected gammagraphy events are available in the Heartbeat Verification Report.

8.6.3 Gammagraphy detection limits and behavior in event of excess radiation

Gammagraphy detection is active in the permitted radiation range of the device, i.e. up to ≤65000 cnt/s. The accuracy of the device can be guaranteed within this range such that the device is ready to measure again immediately once the gammagraphy event no longer applies.

Above the permitted radiation range, an excess radiation alarm is signaled after 5 s, irrespective of the settings for gammagraphy detection. The current output is always set to failure current during the excess radiation alarm.

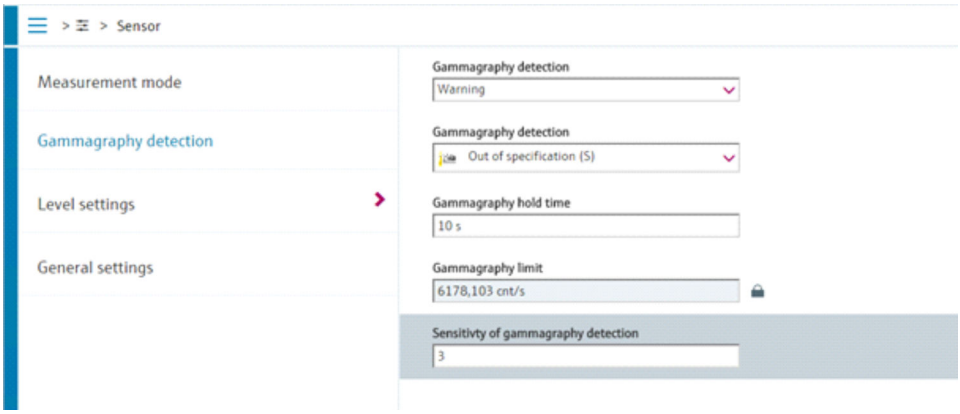
To protect the photomultiplier tube, the high-voltage supply for the tube is switched off while the excess radiation alarm is active and cyclically switched back on again in order to check the radiation intensity. The pause time during which the tube is switched off is 60 s. Therefore the end of a period of excess radiation can be detected after 60 s at the very earliest. When the excess radiation ends, the supply voltage is readjusted. As a result, in addition to the pause time approximately 5 s are also needed until the sensor signal leaves the alarm state.

By cyclically switching off the high-voltage, excess radiation can be present for arbitrarily long periods of time without this affecting the operating life of the photomultiplier or the device overall.

8.6.4 Gammagraphy settings

Gammagraphy detection can be configured under:

Application -> Sensor -> Gammagraphy detection



8.6.5 Gammagraphy detection parameter

Gammagraphy detection can be switched on and off with this parameter.

In addition, the event class can be defined according to NE107

Gammagraphy detection -> Off

Gammagraphy detection is switched off. In a gammagraphy event, the current output will display -10 % measured value (3.8 mA).

Gammagraphy detection -> Alarm

Gammagraphy detection is switched on. In a gammagraphy event, the current output will adopt the failure current (3.6 mA or ≥ 21.5 mA, depending on the configuration of the alarm current).

Gammagraphy detection -> Warning

Gammagraphy detection is switched on. The current output is held at the last valid measured value before gammagraphy detection.

8.6.6 Gammagraphy hold time parameter

This parameter defines how long the measured value is held if gammagraphy radiation has been detected. After this time, the current output adopts the value defined in the Gammagraphy detection parameter.

The hold time should be slightly longer than the maximum duration of a gammagraphy measurement. An alarm is signaled if the maximum pulse rate is still exceeded after the hold time.

An event is only written to the event list once the hold time has elapsed

WARNING

- A change in the measured value is not detected during the hold time. In a safety protection circuit, the selected hold time may not be greater than the permitted process safety time

8.6.7 Gammagraphy limit parameter

Gammagraphy radiation is detected if the pulse rate at the detector exceeds the maximum gammagraphy limit value. This value is determined using the maximum pulse rate from the calibration (generally "upper range value") and the configured gammagraphy sensitivity.

8.6.8 Gammagraphy sensitivity parameter

The suitable sensitivity value largely depends on the process and ambient conditions. Therefore no general rules apply for the choice of sensitivity value. However, the following principles can serve as a guide:

- A small value (between 1 and 3) should be entered for homogeneous products with an even, calm surface. Gammagraphy is then detected with a high degree of sensitivity.
- A large value (between 3 and 7) should be entered for non-homogeneous products and turbulent surfaces, as random variations in the pulse rate would otherwise be wrongly detected as a gammagraphy event.

If the device occasionally reports gammagraphy even though no gammagraphy radiation is present, then it advisable to increase the value slightly. Conversely, the value should be reduced if gammagraphy radiation was not detected.

9 Maintenance and repair

9.1 Cleaning

When cleaning the exterior, always use cleaning agents that do not corrode the surface of the housing and the seals.

9.2 Repair

9.2.1 Repair concept

Under the Endress+Hauser repair concept, devices have a modular design and repairs are carried out by Endress+Hauser Service or by properly trained customers.

Spare parts are grouped into logical kits with the associated replacement instructions.

For more information on service and spare parts, please contact Endress+Hauser Service.

9.2.2 Repairs to Ex- or SIL-certified devices

The following information must also be taken into account when repairing devices with an Ex or SIL certificate:

- Only Endress+Hauser Service can repair devices with an Ex or SIL certificate.
- Comply with the prevailing standards, national Ex-area regulations, Safety Instructions (XA) and certificates.
- Only genuine Endress+Hauser spare parts may be used.
- A certified device may only be converted into a different certified device version by Endress +Hauser Service in Endress+Hauser workshops.
- All repairs and modifications must be documented.

9.3 Replacement

⚠ CAUTION

Data upload/download is not permitted if the device is used for safety-related applications.

- ▶ After an entire device or an electronics module has been replaced, the parameters can be downloaded to the device again via the communication interface. For this, the data must have been uploaded to the PC beforehand using the "FieldCare/DeviceCare" software.

9.3.1 Level measurement and point level detection

You can continue measuring without performing a new calibration. However, the calibration values should be checked as soon as possible since the mounting position may have changed slightly.

9.3.2 Density and concentration measurement

A new calibration must be performed after the replacement.

9.3.3 HistoROM

It is not necessary to perform a new device calibration after replacing the display or transmitter electronics. The parameters are saved in the HistoROM.

After replacing the transmitter electronics, remove the HistoROM and insert it into the new replacement part.

9.4 Spare parts

Enter the serial number into *W@M Device Viewer* (www.endress.com/deviceviewer).

All the spare parts for the measuring device, along with the order code, are listed here and can be ordered. If available, users can also download the associated Installation Instructions.

Serial number:
- Located on the device and spare part nameplate.
- Can be read out via the "Serial number" parameter in the "Device information" submenu.

9.5 Return

The measuring device must be returned if it is in need of repair or a factory calibration, or if the wrong measuring device has been delivered or ordered. Legal specifications require Endress+Hauser, as an ISO-certified company, to follow certain procedures when handling products that are in contact with the medium.

To ensure safe, swift and professional device returns, please refer to the procedure and conditions for returning devices provided on the Endress+Hauser website at http://www.endress.com/support/return-material

9.6 Disposal

Observe the following during disposal:
- Observe valid federal/national regulations.
- Ensure proper separation and reuse of the device components.

If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), our products are marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Such products may not be disposed of as unsorted municipal waste and can be returned to Endress+Hauser for disposal at conditions stipulated in our General Terms and Conditions or as individually agreed.

9.6.1 Battery

The sensor contains a battery.

Batteries are hazardous goods and may be subject to customs duties, depending on the importing country to which the product is supplied

Battery disposal

Dispose of batteries according to local regulations. Recycle used batteries wherever possible.

9.7 Contact addresses at Endress+Hauser

Contact addresses are available at www.endress.com/worldwide or from your local Endress +Hauser branch office.

10 Accessories

10.1 Commubox FXA195 HART

For intrinsically safe HART communication with FieldCare/DeviceCare via the USB interface. For details refer to

TI00404F

10.2 Field Xpert SFX350, SFX370, SMT70

Compact, flexible and robust industrial handheld terminal for remote operation and measured value interrogation of HART devices. For details refer to

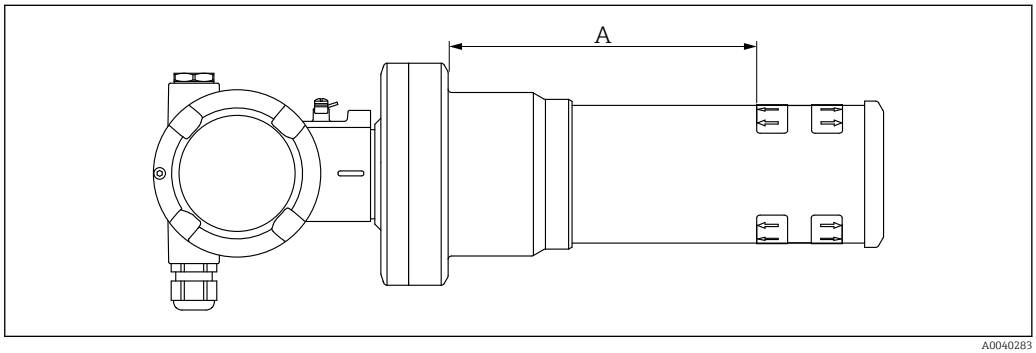
BA01202S

TI01114S

10.3 Mounting device (for level and point level measurement)

10.3.1 Mounting the bracket

Reference dimension A is used to define the mounting location of the bracket depending on the measuring range.

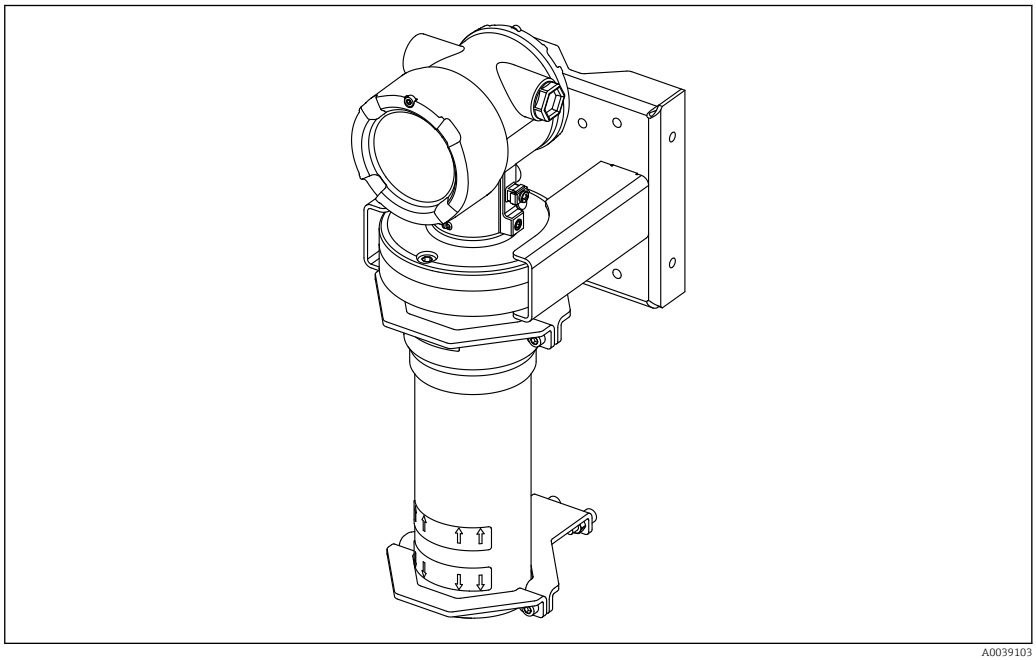


19 *A defines the distance between the device flange and the start of the measuring range. Distance A depends on the material of the scintillator (PVT or NaI).*

PVT Distance A: 172 mm (6.77 in)
NaI Distance A: 180 mm (7.09 in)

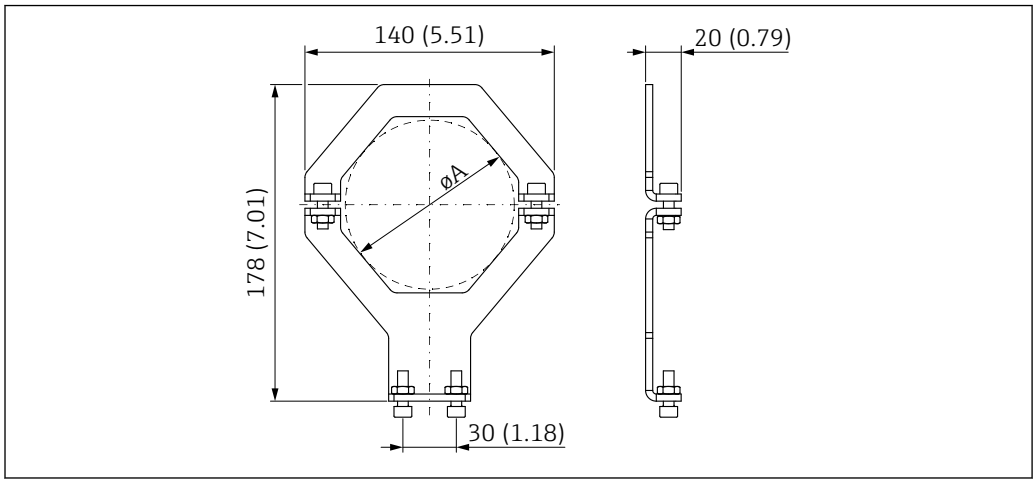
10.3.2 Mounting instructions

Keep the distance between the mounting clamps as large as possible



20 *Installation overview, with mounting clamps and retaining bracket*

Dimensions of mounting clamps



21 *Dimensions of mounting clamp*

Size of the retainers (depending on selected application):

Mounting position on FMG50

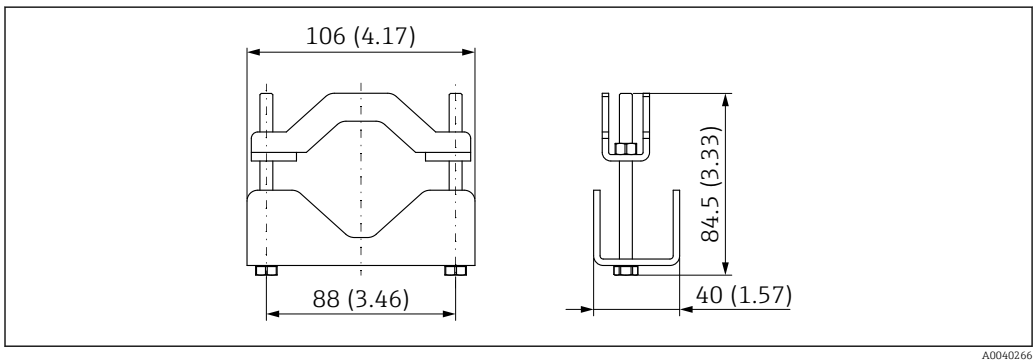
- Scintillator pipe dimensions
  - A [mm (in)]: 198 (7.8)
  - B [mm (in)]: 126 (4.96)
  - øC [mm (in)]: 80 (3.15)
  - øD [mm (in)]: 40 to 65 (1.57 to 2.56)
- Electronic pipe dimensions
  - A [mm (in)]: 210 (8.27)
  - B [mm (in)]: 150 (5.91)
  - øC [mm (in)]: 102 (4.02)
  - øD [mm (in)]: 40 to 65 (1.57 to 2.56)

⚠ CAUTION

Max. torque for the screws of the retainers:

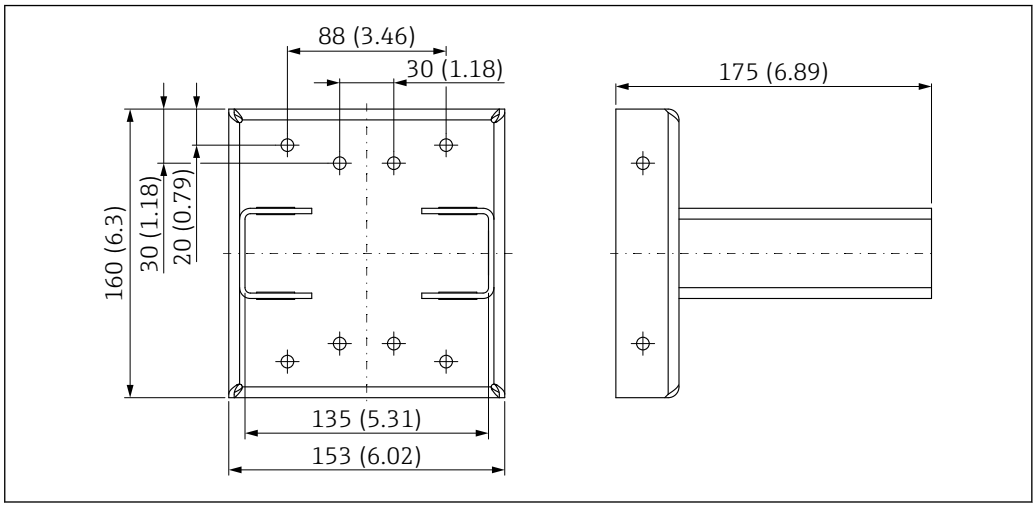
▶ 6 Nm (4.42 lbf ft)

Dimensions of pole mount



22 *Dimensions of pole mount*

Dimensions of retaining bracket

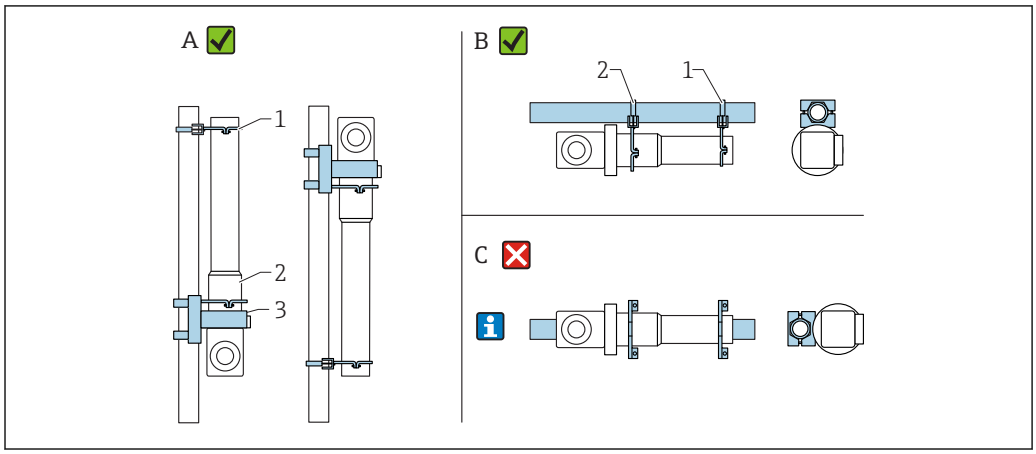


23 Retaining bracket

10.3.3 Use

✓ Permitted

✗ Forbidden



A Level measurement, FMG50
B Point level measurement, FMG50
C Such horizontal mounting not permitted
1 Retainer for pipe diameter 80 mm (3.15 in)
2 Retainer for pipe diameter 102 mm (4.72 in)
3 Retaining bracket

In the case of horizontal installation **(see Figure C)**, the detector pipe must be mounted by the customer. It is important to ensure that the installation clamping power is sufficient to prevent the FMG50 from slipping. The dimensions are provided in the "FHG60 mounting device" section.

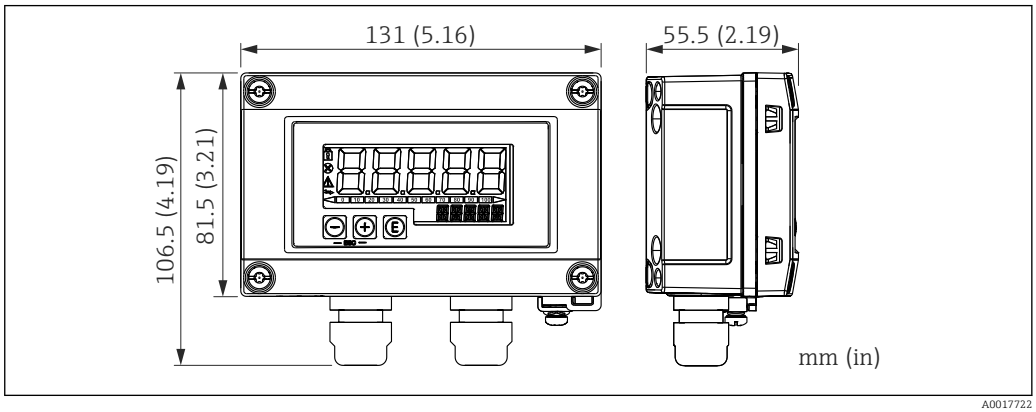
⚠ CAUTION

Note the following when mounting the device

- The mounting device must be installed in such a way as to withstand the weight of the Gammapilot FMG50 under all anticipated operating conditions.
- Three brackets must be used for measuring lengths of 1 600 mm (63 in) and more.
- The retaining bracket or support unit provided by the customer should be used if the device is mounted in a vertical position.
- The customer must provide a clamping solution to mount the pipe. Do not use the enclosed mounting clamps for the pipe. The retainers provided can be used for FMG50 **(see Figure C)**.
- To prevent damage to the measuring pipe of the Gammapilot FMG50, the maximum torque that can be applied to tighten the retainer screws is 6 Nm (4.42 lbf ft).

10.4 Clamping device for density measurement (in preparation)

10.5 Process indicator RIA15



24 *Dimensions of RIA15 in field housing, engineering unit: mm (in)*

The RIA15 remote indicator can be ordered together with the device.

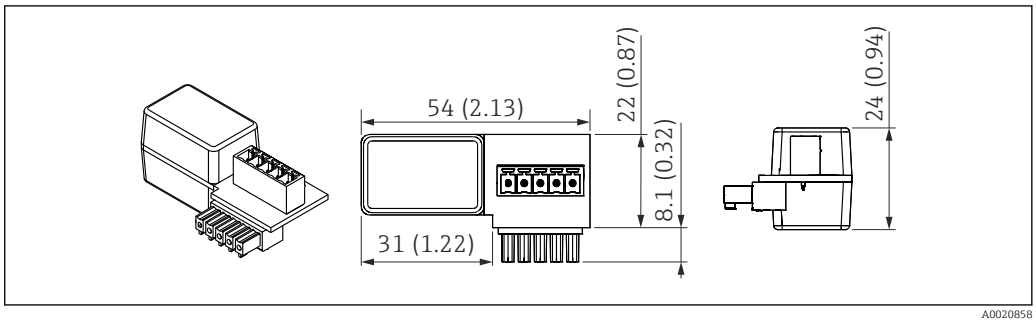
- Option PE "Remote indicator RIA15, non-hazardous area, aluminum field housing"
- Option PF "Remote indicator RIA15, hazardous, aluminum field housing"

Field housing material: aluminum

Other housing versions are available via the RIA15 product structure.

Alternatively available as an accessory, for details see Technical Information TI01043K and Operating Instructions BA01170K

10.5.1 HART communication resistor



25 *Dimensions of HART communication resistor, engineering unit: mm (in)*

A communication resistor is required for HART communication. If this is not already present (e.g. in the power supply RMA42, RN221N, RNS221, ...), it can be ordered with the device via the product structure, feature 620 "Accessory enclosed": option R6 "HART communication resistor hazardous / non-hazardous area".

11 Technical data

11.1 Additional technical data

For additional technical data, see "Technical Information FMG50"

11.2 Supplementary documentation

The supplementary documentation is available on our product pages at **"www.endress.com"**
- Technical Information
- "Description of Device Functions" manual
- Functional Safety Manual:

11.2.1 Modulator FHG65

BA00373F

11.2.2 Source container FQG60

TI00445F

11.2.3 Source container FQG61, FQG62

TI00435F

11.2.4 Source container FQG61, FQG62

TI00446F

11.2.5 Source container FQG66

TI01171F
BA01327F

12 Certificates and approvals

The availability of approvals and certificates can be called up daily via the Product Configurator.

12.1 Safety Manual (SIL 2/3)

SIL 2/3 according to IEC 61508, see:
"Functional Safety Manual"

FY01007F

12.2 Ex approval

The Ex certificates available are listed in the ordering information. Observe the related Safety Instructions (XA) and Control Drawings (ZD).

12.2.1 Explosion-protected smartphones and tablets

Only mobile end devices with Ex approval may be used in hazardous areas.

12.3 Other standards and guidelines

- **IEC 60529**
  Degrees of protection through housing (IP code)
- **IEC 61010**
  Protection measures for electrical equipment for measurement, control, regulation and laboratory procedures
- **IEC 61326**
  Interference emission (Class B equipment), interference immunity (Annex A – Industrial area)
- **IEC 61508**
  Functional safety of safety-related electric/electronic/programmable electronic systems
- **NAMUR**
  Association for Standards for Control and Regulation in the Chemical Industry

12.4 Certificates

The assignment of the versions and the availability of the approvals and certificates can be called up daily via the Product Configurator.

The Product Configurator can be accessed at: www.endress.com -> Select country -> Instruments -> Select device -> Advanced function: Product Configurator

12.5 CE mark

The measuring system meets the legal requirements of the EU Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

12.6 EAC

Approval for EAC is pending

12.7 Overfill protection

WHG for point level detection is pending

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