Technical Information
Gammapilot M FMG60

Radiometric measurement

Compact transmitter for non-contact level, point level and density detection

Application

- Continuous, non-contact measurement in liquids, solids, suspensions or sludges
- Applications under extreme measuring conditions, e.g. high pressure, high temperature, corrosiveness, toxicity, abrasion
- All kinds of process vessels, e.g. reactors, autoclaves, separators, acid tanks, mixers, cyclones, cupola furnaces
- Applications in the food processing industry without additional requirements or approvals
- System integration via HART, PROFIBUS PA and FOUNDATION Fieldbus
- Use in safety functions for max. point level detection and min. point level detection

Advantages

- Compact transmitter: one device for all measuring tasks
- Highest availability, reliability and safety, even for extreme process and ambient conditions
- Highest sensitivity and accuracy at lowest radiation doses (ALARA principle)
- Variety of detectors ensure optimum adaptation to the individual applications and measuring ranges:
  - point detector
  - rod detectors of various lengths
- Ex d, Ex e or Ex i current output for simple plant integration
- 316L stainless steel housing for heavy-duty operation
- SIL2/3 approval in accordance with IEC 61508 for max. point level detection and min. point level detection
- WHG approval
- Temperature compensation for density measurements
- Gammagraphy detection
- Easy menu-guided local operation via four-line plain-text display
- Easy commissioning, documentation and maintenance/diagnostics with the FieldCare operating program

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People for Process Automation

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Important document information

Symbols for certain types of information

Symbol	Meaning
☑	**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
👁	Visual inspection
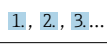
Safety symbols

Symbol	Meaning
⚠ DANGER	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
⚠ WARNING	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
⚠ CAUTION	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
NOTICE	**NOTE!** This symbol contains information on procedures and other facts which do not result in personal injury.

Electrical symbols

Symbol	Meaning
⎓	Direct current
∼	Alternating current
⎓∼	Direct current and alternating current
⏚	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
⏚	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.
∇	**Equipotential connection** A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of practice.

Symbols in graphics

Symbol	Meaning
1, 2, 3 ...	Item numbers
1. , 2. , 3. ...	Series of steps
A, B, C, ...	Views

Symbol	Meaning
A-A, B-B, C-C, ...	Sections
⚠EX	**Hazardous area** Indicates a hazardous area.
⚠EX	**Safe area (non-hazardous area)** Indicates the non-hazardous area.

Function and system design

Measuring principle

The radiometric measuring principle is based on the fact that gamma radiation is attenuated when it penetrates a material. Radiometric measurement can be used for a variety of measuring tasks:
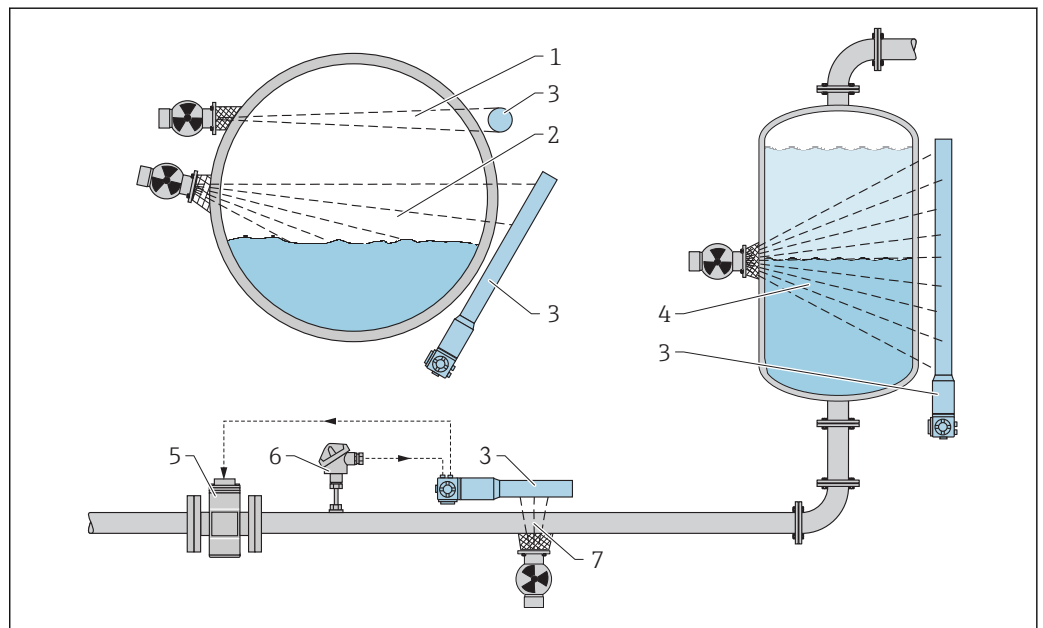
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1   Point level detection
2   Continuous level measurement
3   Gammapilot M
4   Interface measurement
5   Volume flowmeter
6   Temperature sensor
7   Density or concentration measurement

Point level detection

A gamma radiation source and a Gammapilot M are mounted on opposite sides of the vessel at the height of the desired level limit. The Gammapilot M converts the radiation intensity received into a percentage signal. "0%" means that the radiation path is free, i.e. the level is below the limit. "100%" means that the radiation path is completely covered, i.e. the level is above the limit.

Continuous level measurement

A gamma radiation source and a Gammapilot M are mounted on opposite sides of the vessel. The Gammapilot M calculates the level (as a percentage) from the intensity of the radiation received. Detectors of different lengths are available to adapt the system to the measuring range. Multiple detectors can also be interconnected (cascading).

Interface measurement

A gamma radiation source and a Gammapilot M are mounted on opposite sides of the vessel so radiation passes through both liquids. The radiation source may also be mounted inside the vessel.

The Gammapilot M calculates the position of the interface layer from the intensity of the radiation received. Its value is between 0% (lowest possible position) and 100% (highest possible position).

Density or concentration measurement

A gamma radiation source and a Gammapilot M are mounted on opposite sides of a measuring tube. The Gammapilot M calculates the density or concentration of the medium from the intensity of the radiation received. Any unit can be selected. If a temperature sensor is also connected, the Gammapilot M takes the thermal expansion of the medium into consideration. In this case, the Gammapilot M does not output the measured density directly. Instead it uses the measured density to calculate the density which the medium would have at a standard temperature selected by the user. Furthermore, the density signal of the Gammapilot M can be combined with the signal of a volume flowmeter, e.g. Promag 55S, and the mass flow can be calculated from these two signals.

Measuring system

A radiometric measuring system typically consists of the following components:

Gamma radiation source

A ^{137}Cs or ^{60}Co source acts as the gamma radiation source. Gamma radiation sources with different activities are available to adapt the system to the specific application. The "Applicator" selection and configuration program can be used to calculate the required activity [1]. For additional information on the gamma radiation source, refer to TI00439F/00/EN.

Source container

The radiation source is enclosed in a source container, which allows the radiation to be emitted only in one direction and screens it off in any other direction. Source containers are available in different sizes and with different radiation emission angles. The "Applicator" program can be used to select the source container that suits your application [2]. For more information on source containers, see TI00445F/00/EN (FQG60), TI00435F/00/EN (FQG61, FQG62), TI00446F/00/EN (FQG63) and TI00346F/00/EN (QG2000).

Gammapilot M compact transmitter

The Gammapilot M compact transmitter contains a scintillator, a photomultiplier and the electronic evaluation unit. Incident gamma radiation generates light flashes within the scintillator. These pass to the photomultiplier, where they are converted into electrical pulses and amplified. The pulse rate (number of pulses per second) is an indicator of the intensity of the radiation. Depending on the calibration, the pulse rate is converted into a level, limit switch, density or concentration signal by the electronic evaluation unit. The Gammapilot M is available with a NaI crystal or with plastic scintillators of different lengths. This makes it possible to optimally adapt the system to each individual application.
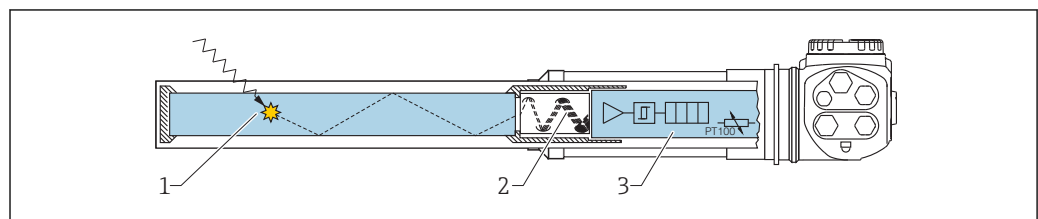
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1   Gamma rays generate light flashes in the scintillator
2   The photomultiplier converts the flashes into electrical pulses and amplifies them
3   The electronic evaluation unit calculates the measured value from the pulse rate

Gamma modulator FHG65 (optional)

In a radiometric measuring point with a Gammapilot M FMG60, the gamma modulator FHG65 is mounted in front of the radiation emission channel of the source container. It contains a shaft slotted along the longitudinal axis. This shaft rotates continuously and alternately screens off the gamma beam at a frequency of 1 Hz or allows it through. Due to this frequency, the useful beam differs from fluctuating ambient interference radiation and from interference radiation occurring sporadically (e.g. from nondestructive material testing). Using a frequency filter, the Gammapilot M

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1)   The "Applicator" CD-ROM is available from your E+H sales organization
2)   The "Applicator" CD-ROM is available from your E+H sales organization

FMG60 can therefore separate the useful signal from interference radiation. In this way, it is possible to continue measuring even if interference radiation occurs. This significantly increases the measuring certainty and system availability.

For additional information, refer to TI00423F/00/EN.

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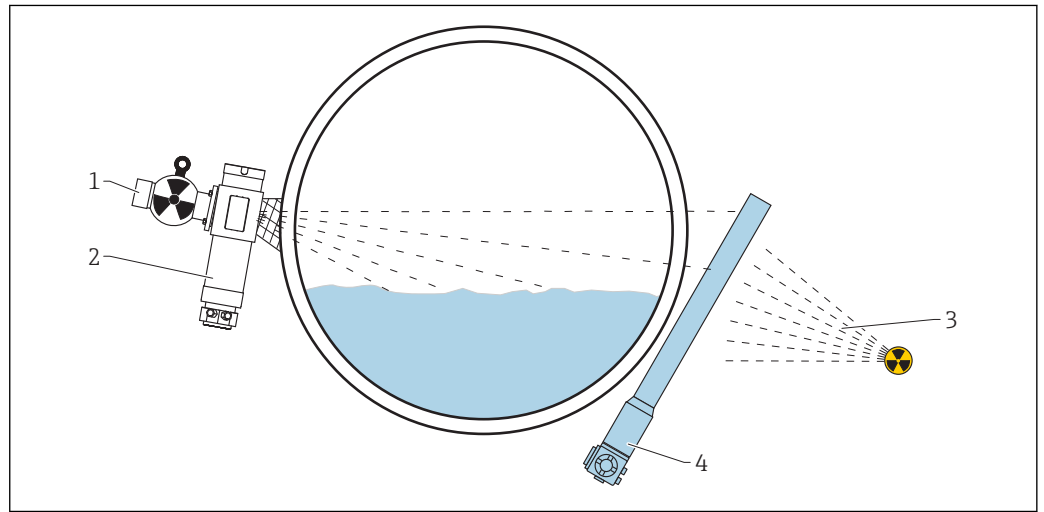
1   FQG61, FQG62
2   FHG65
3   Interference radiation
4   Gammapilot M FMG60

The gamma modulator FHG65 and the Gammapilot FMG60 are not interconnected electrically. When calibrating the Gammapilot FMG60, the "Beam type" (*02) parameter must be set to "Modulated".

Signal evaluation

Level measurement

A standard linearization curve for calculating the level in vertical cylinders is preprogrammed into the Gammapilot M. For other situations, a linearization curve consisting of up to 32 points can be entered manually or semi-automatically (by gauging the capacity by liters). The linearization curve and the associated table are calculated using the "Applicator" selection and configuration software [3].

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3)   The "Applicator" CD-ROM is available from your E+H sales organization.
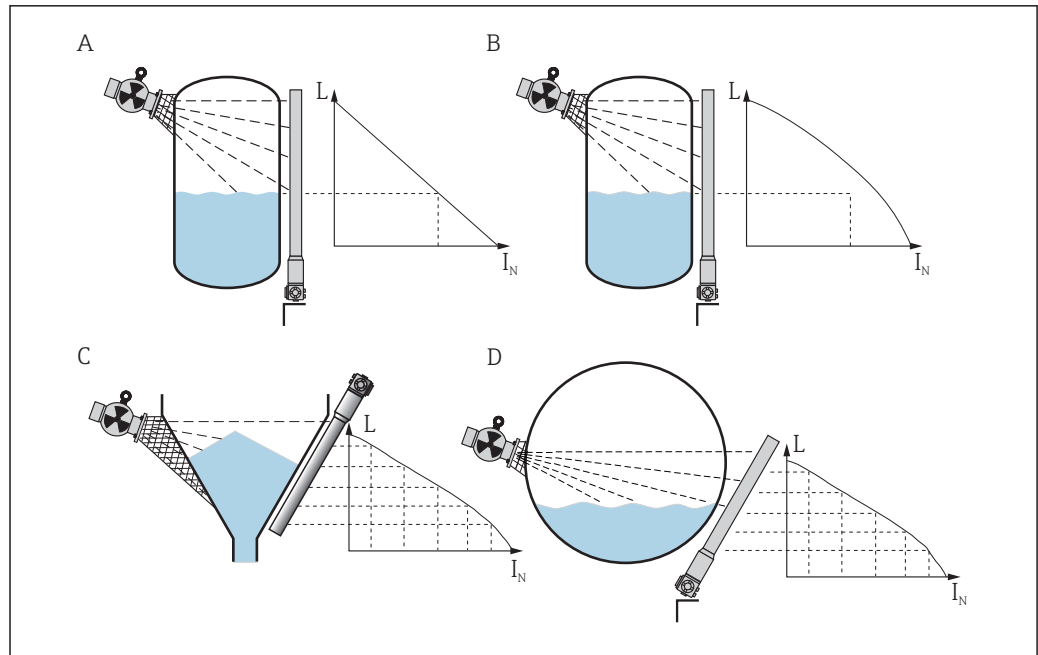
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A   Linear
B   Standard
C, D   Linearization table entered by the user
I_N Pulse rate (pulses per second, c/s)
L   Level (%)

Wiring examples for point level detection 200/400mm

The output signal is linear between free and covered calibration (e.g. 4 to 20 mA) and can be evaluated in the control system. If a relay output is required, 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
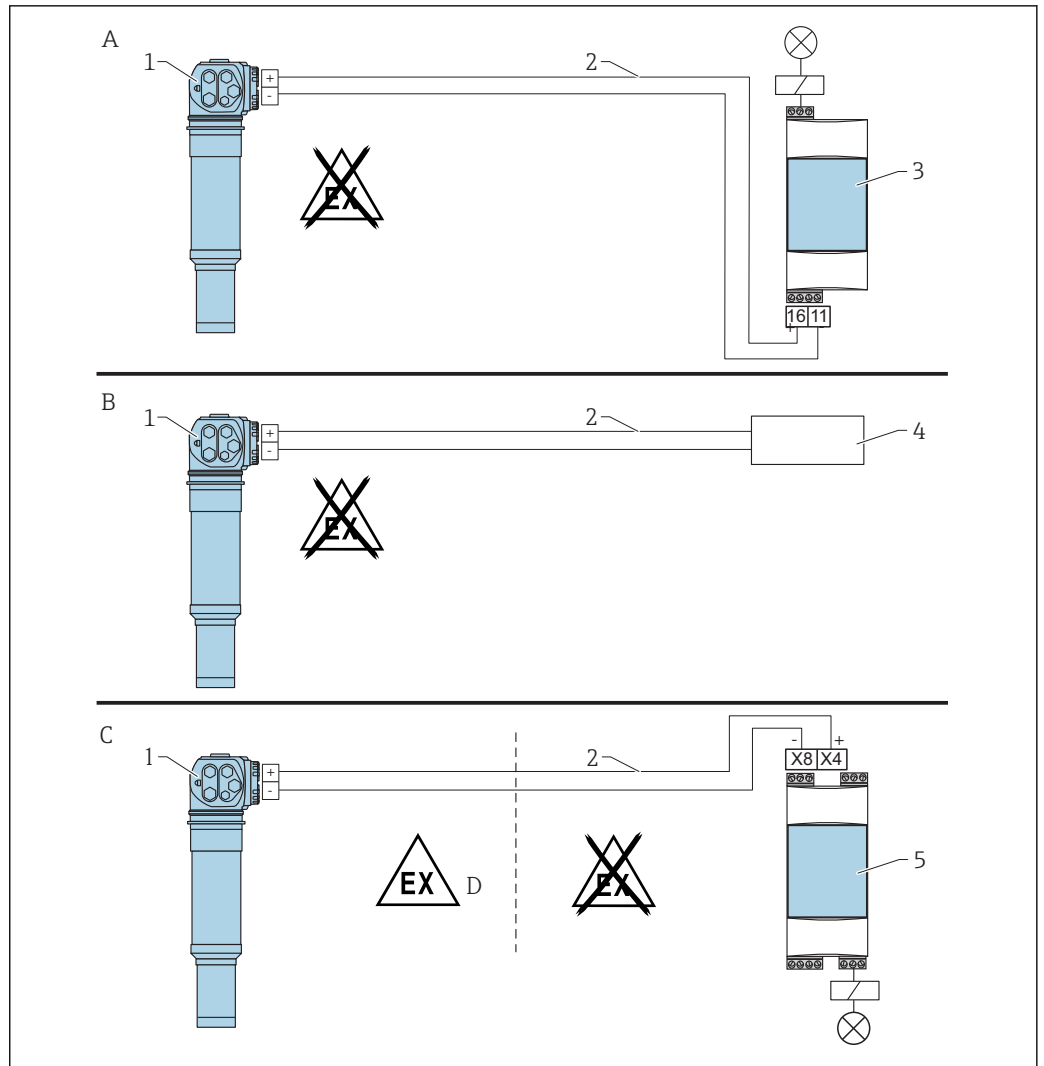
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A   Wiring with RTA421 switching unit
B   Wiring with process control system
C   Wiring with RMA42 switching unit
D   When installing in hazardous areas, please observe the corresponding Safety Instructions
1   Gammapilot M
2   4 to 20 mA
3   RTA421
4   PLC
5   RMA42

Ex applications in conjunction with RMA42

Observe the following Safety Instructions:
- XA00303F/00/A3: ATEX II 2 (1) G for Gammapilot M
- XA00304F/00/A3: ATEX II 2 (1) D for Gammapilot M
- XA00095R/09/A3: ATEX II (1) G [Ex ia] IIC, ATEX II (1) D [Ex ia] IIIC for RMA42

SIL applications for Gammapilot M FMG60 in conjunction with RMA42 (for point level detection 200/400 mm PVT scintillator)

- The Gammapilot M meets SIL2/3 as per IEC 61508, see:
  – Functional safety manual SD00230F/00/EN (Maximum point level detection)
  – Functional safety manual SD00324F/00/EN (Minimum point level detection)
- The RMA42 meets SIL2 as per IEC 61508:2010 (Edition 2.0), see functional safety manual SD00025R/09/EN.

Density measurement

The measured values of up to nine samples of known density can be stored in the Gammapilot M and used for the calibration of density measurements. The Gammapilot M calculates the absorption coefficient µ and the linearization curve automatically from these values. It then uses these parameters to calculate the density from the pulse rate. In the case of a one-point calibration, a default value is used for the absorption coefficient µ. This value can be changed manually, however.

$$F_S = e^{-\mu\rho D}$$
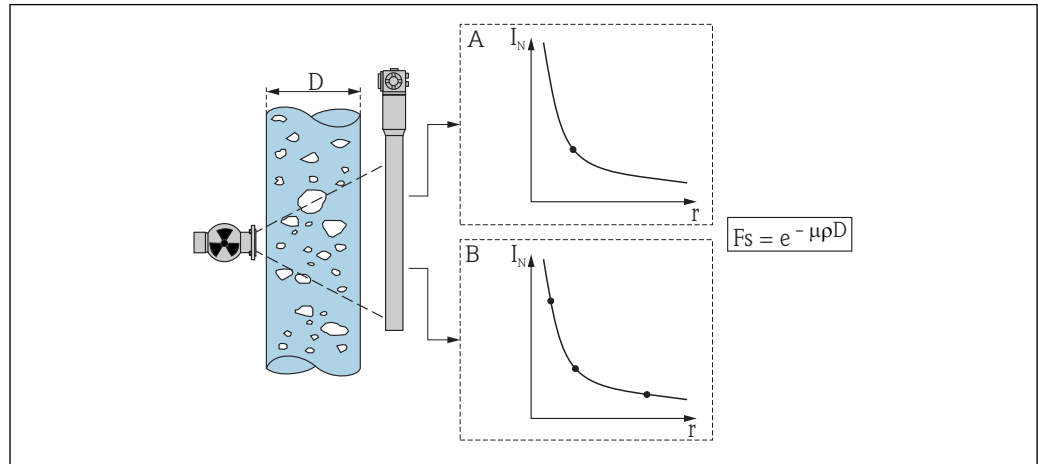
A   One-point calibration
B   Multiple-point calibration
D   Pipe diameter or irradiated measuring path
I_N Pulse rate (pulses per second)
F_S Attenuation factor
ρ   Density
µ   Absorption coefficient

Concentration measurement

The Gammapilot M determines the concentration indirectly via a density measurement. A linearization table consisting of up to 32 "density - concentration" value pairs can be entered for this calculation. The solids content of liquids, for example, can be measured in this way (percentage of volume or weight).
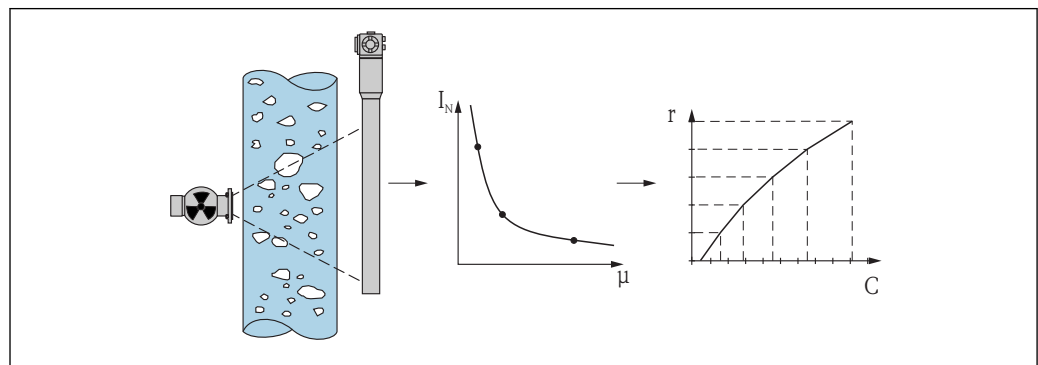
I_N Pulse rate (pulses per second)
ρ   Density
C   Concentration

General functions

Decay compensation

The automatic decay compensation function of the Gammapilot M compensates for the decrease in the activity of the gamma radiation source as a result of radioactive decay. Accurate measurements are therefore possible over the entire operating time of the gamma radiation source.

Gammagraphy detection

The Gammapilot M has a function to detect short-term interference radiation. This function displays a message if the measurement is affected by non-destructive gammagraphic material tests in the vicinity of the measuring point.

Measurement of solids flow

In conjunction with a density measuring device, such as Endress+Hauser's Gammapilot M, Promag 55S also determines the rate of solids in terms of mass, volume or percentage. The following order information is required for this purpose for Promag 55S: Order option for the "Solids flow" software option (F-CHIP) and order option for a current input.

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🖾 *1   Solids flow measurement (m) using a density meter and 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   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
2   Density meter (e.g. "Gammapilot M") -> total density (ρ_m) consisting of the carrier liquid and solids

Measurement of mass flow

Bulk solids applications on conveyor belts and conveyor screws.

The source container is positioned above the conveyor belt and the Gammapilot M FMG60 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.

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1   Gammapilot M

System integration

4 to 20 mA with HART protocol
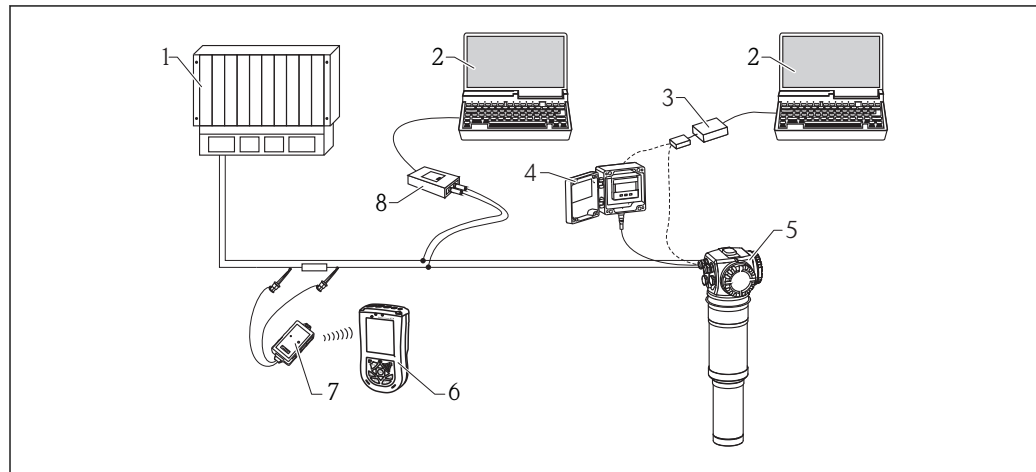
A0018095

1   PLC (programmable logic controller)
2   Computer with operating tool (e.g. FieldCare)
3   Commubox FXA291 with ToF Adapter FXA291
4   FHX40 with display VU331
5   Gammapilot M
6   Field Xpert SFX100
7   VIATOR Bluetooth modem with connecting cable
8   Commubox FXA195 (USB)

If the HART communication resistor is not built into the supply unit, a 250 Ω communication resistor must be incorporated into the 2-wire line.

Operation via the service interface

- With the display and operating unit FHX40
- With a personal computer, Commubox FXA291 with ToF Adapter FXA291 (USB) and the "FieldCare" operating program. FieldCare is a graphical operating software for measuring devices from Endress+Hauser. It assists with commissioning, data backup, signal analysis and documentation of the measuring point.

Operation via HART

- With Field Xpert SFX100
- With the Commubox FXA195 and the "FieldCare" operating program

PROFIBUS PA

A maximum of 32 transmitters (8 in hazardous area Ex ia IIC according to the FISCO model) can be connected to the bus. The segment coupler (1) provides the voltage to the bus. For further information on the PROFIBUS-PA standard, refer to Operating Instructions BA0034S/00/EN "PROFIBUS-DP/-PA: Guidelines for planning and commissioning" and to PROFIBUS-PA Specification EN 50170 (DIN 19245).
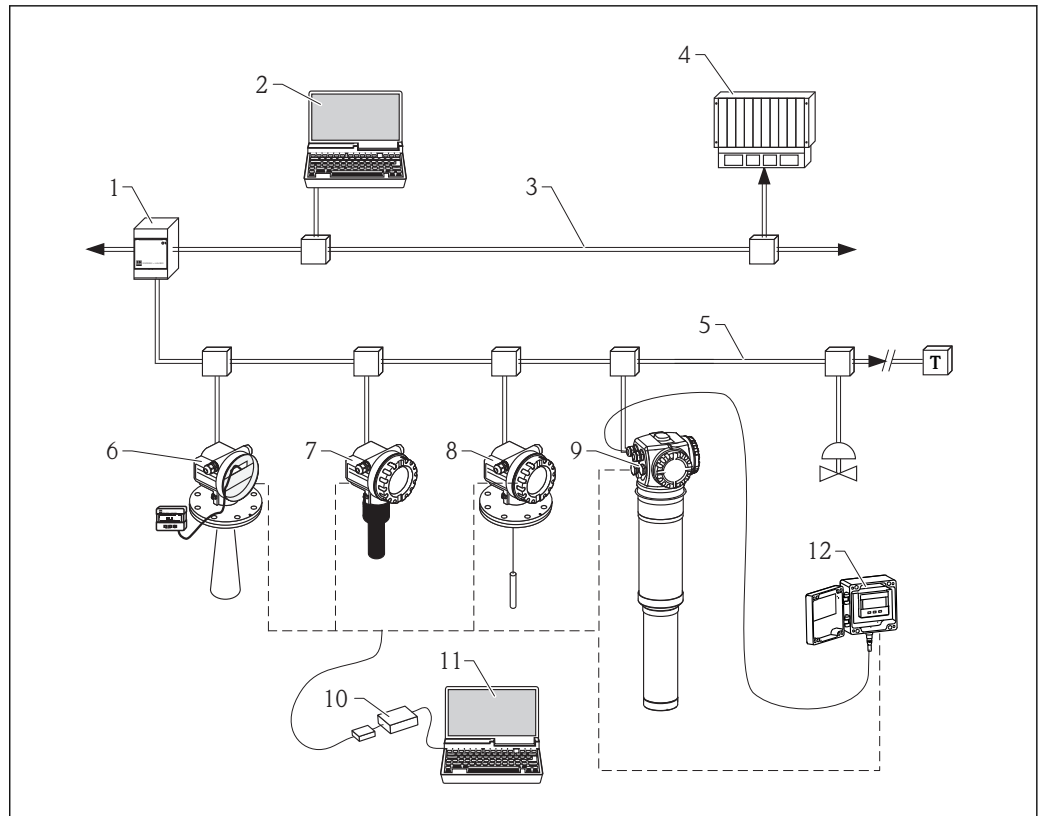
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1   Segment coupler
2   Fieldcare, Profiboard/Proficard
3   PROFIBUS DP
4   PLC
5   PROFIBUS PA
6   Micropilot M with display VU331
7   Prosonic M
8   Levelflex M
9   Gammapilot M
10   Commubox FXA291 with ToF Adapter FXA291
11   Computer with operating tool (e.g. FieldCare)
12   FHX40 with display VU331

Operation via the service interface

- With the display and operating unit FHX40
- With a personal computer, Commubox FXA291 with ToF Adapter FXA291 (USB) and the "FieldCare" operating program. FieldCare is a graphical operating program for measuring devices from Endress+Hauser. It assists with commissioning, data backup, signal analysis and documentation of the measuring point.

Operation via PROFIBUS

With Profiboard or Proficard and the "FieldCare" operating program.

FOUNDATION Fieldbus (FF)

A maximum of 32 transmitters (standard or Ex d) can be connected to the bus. For explosion protection Ex ia, the maximum number of transmitters is governed by the established rules and standards for interconnecting intrinsically safe circuits (IEC/EN 60079-14) with proof of intrinsic safety.
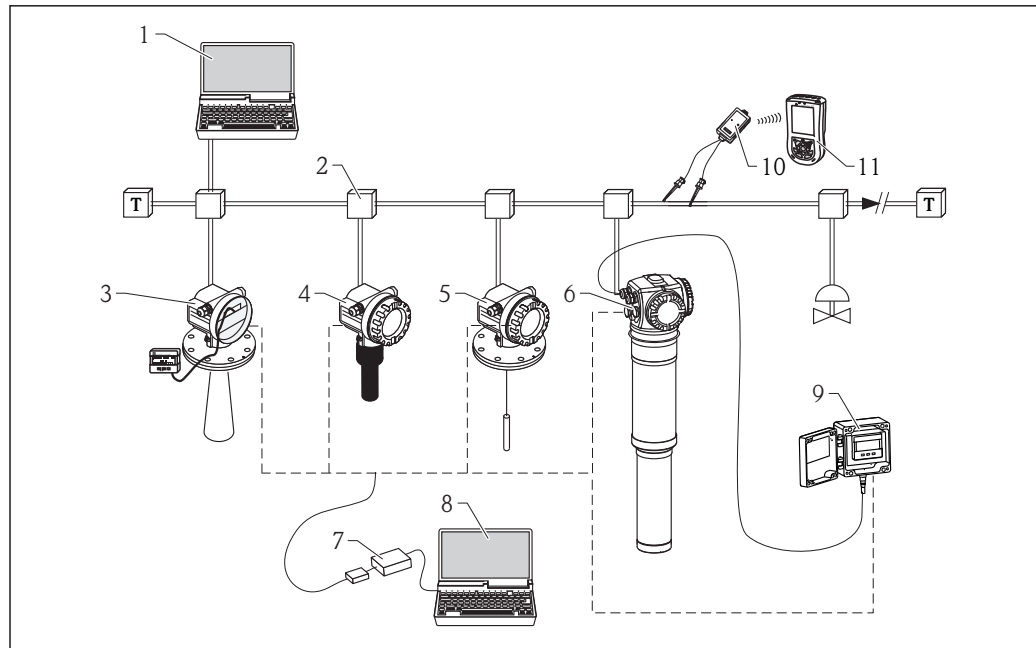
A0018251

1   Fieldcare, Profiboard/Proficard
2   FF link
3   Micropilot M with display VU331
4   Prosonic M
5   Levelflex M
6   Gammapilot M
7   Commubox FXA291 with ToF Adapter FXA291
8   Computer with operating tool (e.g. FieldCare)
9   FHX40 with operating module VU331
10 VIATOR Bluetooth modem with connecting cable
11 Field Xpert SFX100

Operation via the service interface

- With the display and operating unit FHX40
- With a personal computer, Commubox FXA291 with ToF Adapter FXA291 (USB) and the "FieldCare" operating program. FieldCare is a graphical operating software for measuring devices from Endress+Hauser. It assists with commissioning, data backup, signal analysis and documentation of the measuring point.

Operation via FOUNDATION Fieldbus

- With Field Xpert SFX100
- With a configuration program, e.g. NI-FBUS Configurator.

Input

Measured variable	The Gammapilot M measures the pulse rate (number of pulses per second). This rate is proportional to the intensity of radiation at the detector. The Gammapilot M calculates the desired measured value from this rate:

- Point level (0% = "radiation path free"; 100% = "radiation path covered")
- Level (in %)
- Position of interface (in %)
- Density (selectable unit)
- Concentration (selectable unit)

Pulse rate:
- Max. 45000 c/s per individual device
- Max. 65000 c/s cascade

Sensitivity

The sensitivity indicates which pulse rate occurs at a local dose rate of 1 µSv/h. The sensitivity depends on the following parameters:
- Type of scintillator
- Measuring range
- Isotope used

Scintillator	Measuring range[mm (in)]	Sensitivity for ^{137}Cs[(c/s)/(µSv/h)]	Sensitivity for ^{60}Co[(c/s)/(µSv/h)]
NaI	50 (1.97)	1250	350
PVT	200 (7.87)	2000	1000
	400 (15.7)	4000	2000
	800 (31.5)	8000	4000
	1200 (47.2)	12000	6000
	1600 (63)	16000	8000
	2000 (78.7)	20000	10000

Increasing the sensitivity by cascading

The sensitivity can be increased by interconnecting multiple transmitters (parallel cascade mode). Only one transmitter (the "Master") must be calibrated.
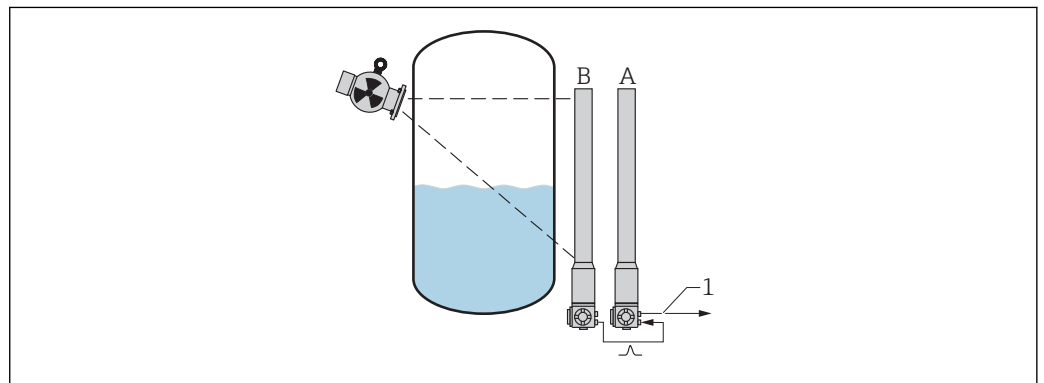
⊡ 2   Double sensitivity achieved by cascading two Gammapilot M devices. They are assigned different roles:

A   Master
B   End slave
1   4 to 20 mA HART; PROFIBUS PA; FOUNDATION Fieldbus

Typical pulse rates

A radiometric measuring point should be designed in a way such that the following pulse rates, approximately, are obtained:

Level measurement (with empty vessel)
- 2500 c/s for ^{137}Cs
- 5000 c/s for ^{60}Co

Point level detection (with free radiation path)
- 1000 c/s for ^{137}Cs
- 2000 c/s for ^{60}Co

Density and concentration measurements
Depends on the application; for more information contact Endress+Hauser Service or the "Gamma Project Team" (gamma@pcm.endress.com)

Necessary pulse rates for SIL applications. See Functional Safety Manual:
- SD00230F/00/EN (for max. point level detection)
- SD00324F/00/EN (for min. point level detection)

> An application can deliver satisfactory measurement results even if the pulse rate is higher or lower than the values specified here. For more information contact Endress+Hauser Service or the "Gamma Project Team" (gamma@pcm.endress.com)

Measuring range

Level measurement

Transmitters with a measuring range of up to 2 m (6.6 ft)are available. To increase the measuring range, any number of transmitters can be connected in series (cascade mode). The first transmitter in the series is defined as the "master", while the other transmitters are referred to as "slaves". The last transmitter in the series is known as the "end slave". Only the "master" needs to be calibrated.
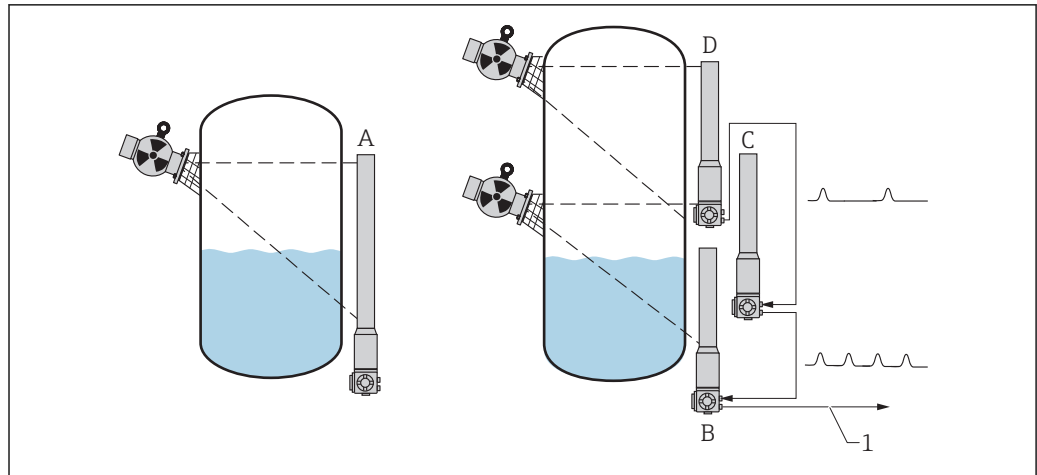
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A Stand alone.
Only one Gammapilot M is required for measuring ranges up to 2 m (6.6 ft)
For larger measuring ranges, any number of Gammapilot M devices can be interconnected (cascade mode).
The devices are defined by software settings as:
B Master
C Slave(s) or
D End slave
1 4 to 20 mA HART; PROFIBUS PA; FOUNDATION Fieldbus

Max. point level detection

In the case of point level detection, the measuring range is essentially at one specific point. It is determined by the thickness of the scintillator (approx. 40 mm (1.57 in)).
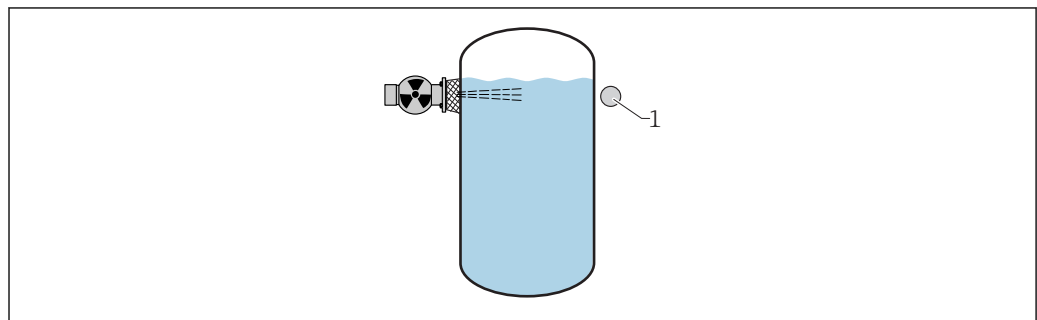
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1 Gammapilot M

Min. point level detection

In the case of point level detection, the measuring range is essentially at one specific point. It is determined by the thickness of the scintillator (approx. 40 mm (1.57 in)).
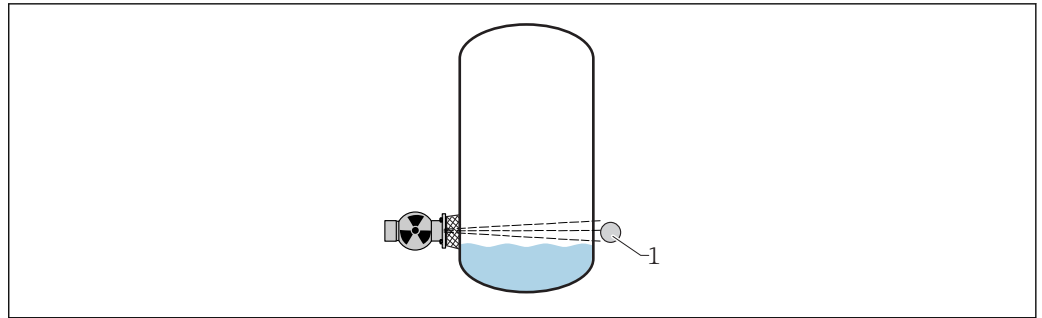
1   Gammapilot M

Density measurement

In the case of density measurements, the measuring range is determined by the user.
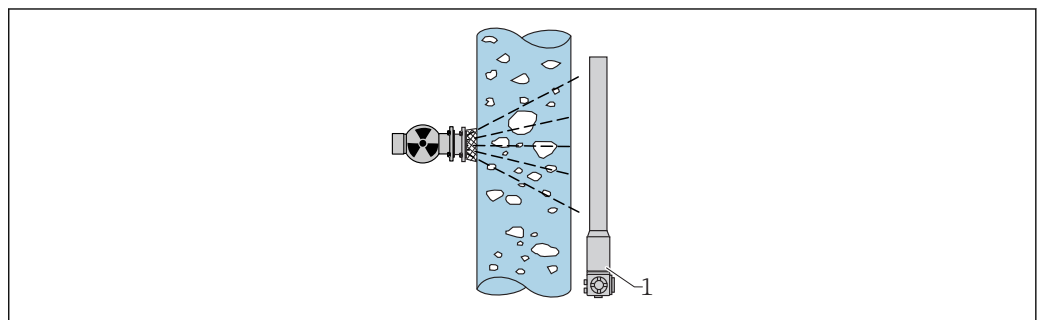
1   Gammapilot M

Conditions/prerequisites for applications in safety-related operation

See Functional Safety Manual:
- SD00230F/00/EN (for max. point level detection)
- SD00324F/00/EN (for min. point level detection)

Temperature input (Pt100)	A temperature sensor Pt100 (4-wire connection) can be connected to compensate for temperature influences during density measurements. • Measuring range:–40 to +200 ℃ (–40 to 392 ℉) • Accuracy: ± 1K

Output

Output signal	• 4 to 20mA (active; invertible) with HART protocol, max. load 500 Ω • PROFIBUS PA • FOUNDATION Fieldbus (FF) • Pulses for cascade mode Non-intrinsically safe current output and bus interface guarantees additional galvanic isolation up to max. 253 V_{AC}
Error signal	Errors occurring during commissioning or operation are signaled in the following way: • Error symbol, error code and error description on the display and operating module. • Current output, configurable ("Output on alarm (*20) function): – MAX, 110%, 22 mA – MIN, -10%, 3.6 mA – Hold (the last value is held) – User-specific value

Load	• Max. load: 500 Ω • Min. load for HART communication: 250 Ω

Output damping	User-defined, 1 to 999 s

Power supply

Supply voltage	• 90 to 253 V_{AC}; 50/60Hz • 18 to 35 V_{DC}; protected again reversed polarity The detector guarantees safe galvanic isolation up to max. 253 V_{AC} between the power supply circuit and all other detector circuits.

Power consumption	• AC power supply: approx. 8.5 VA • DC power supply: approx. 3.5 W

Overvoltage category	• Overvoltage category II • The power supply and signal output are galvanically isolated from one another

Protection class	Class 1

Potential equalization	The device must be included in the local potential equalization system.

Electrical connection

Connection compartments	The Gammapilot M has two connection compartments
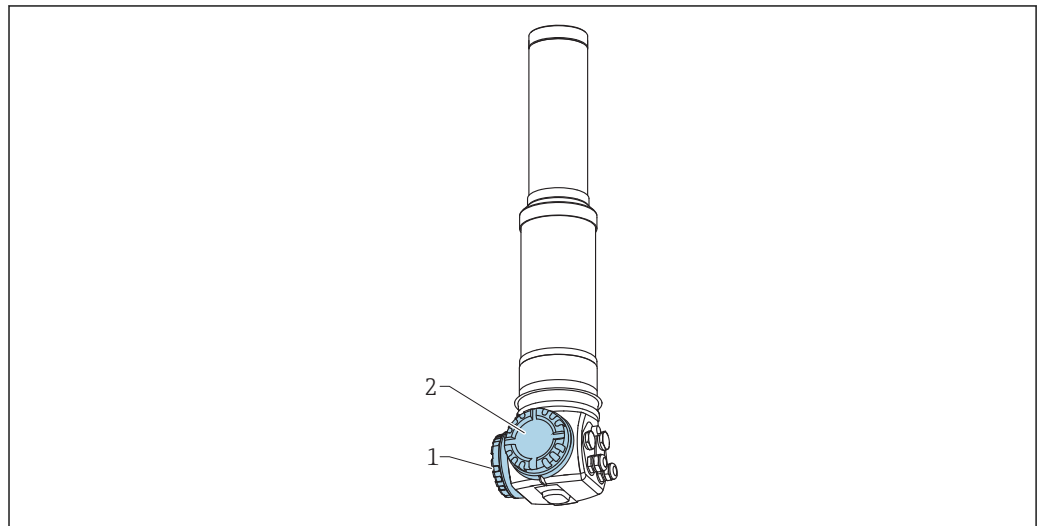
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1   Connection compartment 1
2   Connection compartment 2

Connection compartment 1

Connection compartment for:

• Power supply
• Signal output (depending on the device version)

Connection compartment 2

Connection compartment for:

- Signal output (depending on the device version)
- Pt-100 input (4-wire)
- Pulse input for cascade mode
- Pulse output for cascade mode
- Display and operating module FHX40 (or VU331)

ℹ️ Depending on the device version, the signal output is located in connection compartment 1 or 2.

Maximum cable length:

- For cascade, 20 m (66 ft) per device
- For Pt-100 2 m (6.6 ft). Temperature measurement should be performed as close as possible to density measurement.

Cable entries

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

- Coupling M20x1.5. sealing range 7 to 10.5 mm (0.28 to 0.41 in)
- Cable entry M20x1.5
- Cable entry G1/2
- Cable entry NPT1/2
- M12 connector (see "Fieldbus connectors")
- 7/8" connector (see "Fieldbus connectors")

In addition, the Gammapilot M also has a socket to connect the separate display and operating unit FHX40. The housing of the Gammapilot M does not have to be opened to connect the FHX40.
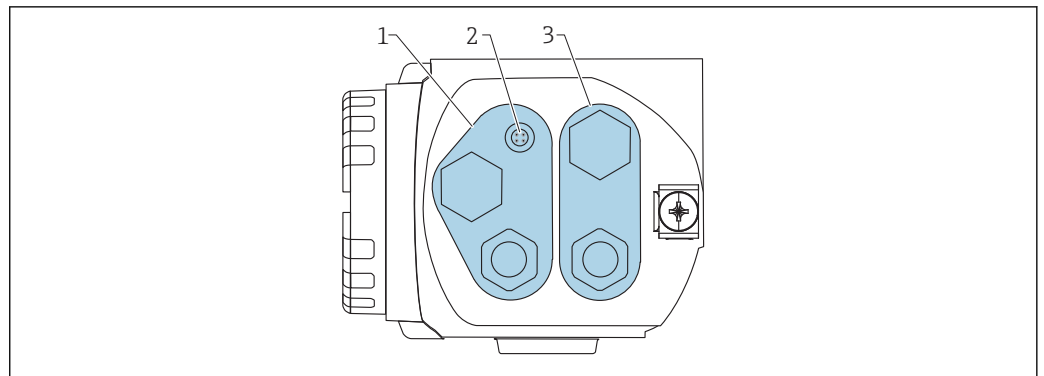
A0018083

1   Cable entry for connection compartment 2
2   Socket for FHX40
3   Cable entry for connection compartment 1

ℹ️ Cable entries
- A maximum of one cable gland is provided for each of the connection compartments upon delivery. If additional cable glands are required (e.g. for cascade mode), they must be supplied by the user.
- 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 the Gammapilot M should be fitted with a weather protection cover.

Potential equalization

Before wiring, connect the potential matching line to the external ground terminal of the transmitter. If a water cooling jacket is provided, it must be connected separately to the potential matching line.
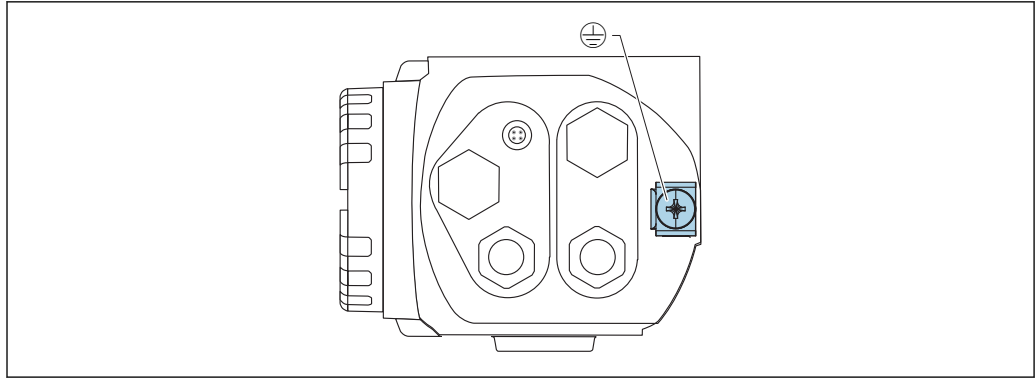
⊞ 3 *Ground terminal for connecting the potential matching line*

⚠ CAUTION

In Ex applications, the device may only be grounded on the sensor side

▶ Please refer to the separate documentation on applications in hazardous areas for further safety instructions.

ℹ 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.

Terminal assignment   **Connection compartment 1**
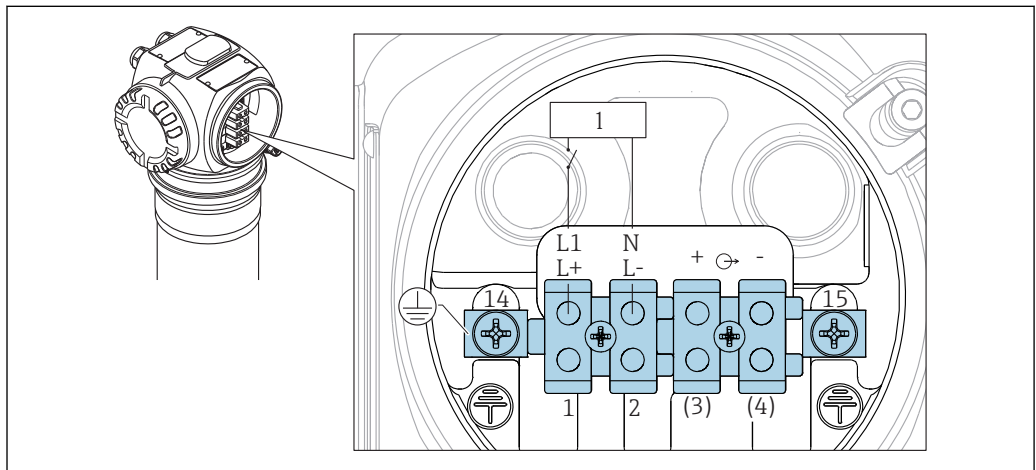
⊞ 4 *For the terminal assignment, see the table below*

1 *Power supply: 90 to 253VAC, 18 to 35 VDC*

Connection compartment 2
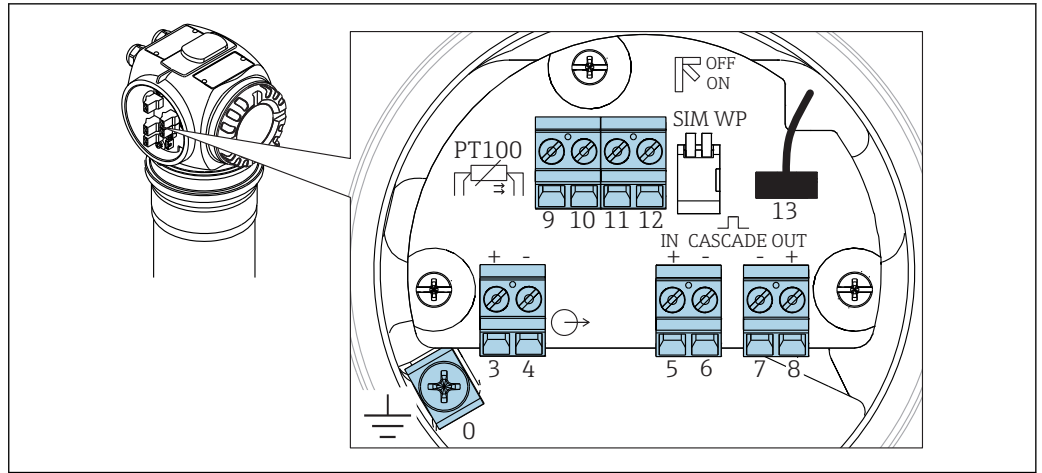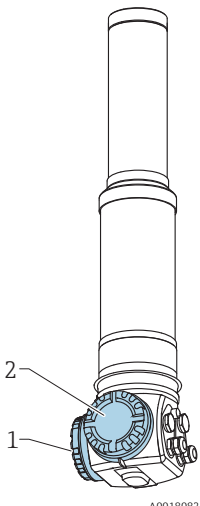
⚞ 5   For the terminal assignment, see the table below

Terminal	Meaning
0	Grounding of the cable shield [1]
1, 2	Power supply [2]
Connection compartment 2: 3, 4 **Connection compartment 1:** 3 [1], 4 [1]	Signal output, depending on communication version: • 4-20mA with HART • PROFIBUS PA • FOUNDATION Fieldbus Depending on the device version ordered, the signal output is located in connection compartment 1 or 2 (see below). ℹ For the versions of the Gammapilot M with a fieldbus connector (M12 or 7/8"), the signal output is wired in connection compartment 2 on delivery and connected to the fieldbus connector (see the "Fieldbus connectors" section). In this case, the housing does not need to be opened to connect the signal cable.
5, 6	Pulse input (for cascade mode; is used for master and slave)
7, 8	Pulse output (for cascade mode; is used for slave and end slave)
9, 10, 11, 12	Pt-100 input (4-wire)
13	Connection for display and operating module VU331 (from FHX40); is wired on delivery and connected to the FHX40 plug.
14	Protective ground [1]
15	Protective ground or grounding of the cable shield [1]

1) Rated cross-section > 1 mm^2 (17 AWG)

2) Rated cross-section max. 2.5 mm^2 (14 AWG)
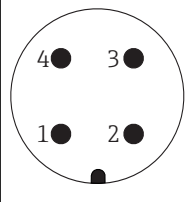
ℹ The cables used at terminals 14 and 15 must at least have the same cross-section as the cables at terminals 1 and 2.

Feature 30 of the ordering information: power supply wiring/output wiring		Connection compartment with terminals for		
		Supply voltage	Signal output	
A	Non-Ex; non-Ex	1	2	
B	Ex e; Ex ia	1	2	
C	Ex e; Ex e	1	1	
D	Ex d (XP); Ex d (XP)	1	1	
E	Ex d (XP); Ex ia (IS)	1	2	
F	Dust-Ex; Dust-Ex	1	1	
G	Ex e, Dust-Ex; Ex e, Dust-Ex	1	1	
H	Ex d, Dust-Ex; Ex d, Dust-Ex	1	1	
J	Ex e, Dust-Ex; Ex ia, Dust-Ex	1	2	
K	Ex d, Dust-Ex; Ex ia, Dust-Ex	1	2	
L	Dust-Ex; Ex ia	1	2	

A0018082
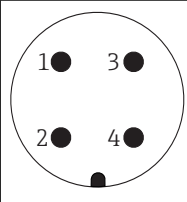
Fieldbus connectors

For the versions with a fieldbus connector M12 or 7/8", the housing does not need to be opened to connect the signal cable.

Pin assignment for connector M12

A0011175

PIN	Meaning
1	Signal +
2	Not assigned
3	Signal −
4	Ground

Pin assignment for connector 7/8"

A0011176

PIN	Meaning
1	Signal −
2	Signal +
3	Shielding
4	Not assigned

Performance characteristics/stability

Response time	Depends on the configuration, min. 2 s
Reference operating conditions	• Temperature: 20 ℃ (68 ℉), ±10 ℃ (±50 ℉) • Pressure: 1013 mbar (15 psi), ±20 mbar (±0.29 psi) • Humidity: not relevant
Measured value resolution	Depends on the measurement mode; up to 4 decimal places

Influence of ambient temperature	Scintillator	Temperature range	Influence of ambient temperature
	PVT	−40 to +60 ℃ (−40 to +140 ℉)	±0.5%, typical long-term stability < 1%/a
	NaI crystal	−40 to +60 ℃ (−40 to +140 ℉)	±0.5%
		0 to +50 ℃ (32 to +122 ℉)	±0.1%

Statistical fluctuation of the radioactive decay

The radioactive decay of the radiation source is subject to statistical fluctuation. For this reason, the pulse rate displayed fluctuates around its mean value. The standard deviation σ is an indicator of the intensity of these fluctuations. It is calculated as follows:

$$\sigma = \sqrt{I_N} / \sqrt{\tau}$$

Where:
- I_N is the pulse rate
- τ is the output damping (can be selected by the user)

Various confidence intervals can be calculated from the standard deviation. The 2σ confidence interval is usually used for the planning of radiometric measuring systems. Approx. 95% of all pulse rates displayed deviate by less than 2σ from the mean. The deviation is greater than 2σ in only about 5% of all cases.
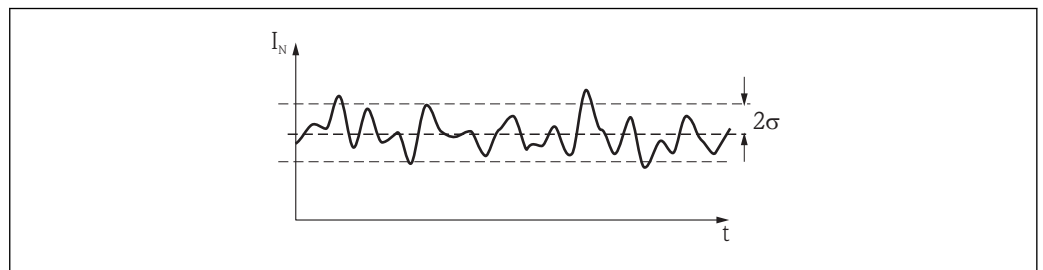
 6 95% of all measured values are within the 2σ confidence interval.

In order to calculate the relative (%) statistical measured error, the standard deviation is divided by the pulse rate:

$$2\sigma_{rel} = 2\sigma / I_N = 2 / \sqrt{(I_N \tau)}$$

Example:
- $I_N = 1000/s$
- $\tau = 10$ s

Þ $2\sigma_{rel} = 0.02 = 2 \%$

ℹ As a general rule, the statistical signal fluctuation can be reduced by increasing the output damping value.

Installation conditions

Installation conditions for level measurement

Conditions

- For level measurements the Gammapilot M is mounted vertically; if possible the detector head should point downwards
- The angle of emission of the source container must be exactly aligned to the measuring range of the Gammapilot M. Observe the measuring range marks of the Gammapilot M.
- If several Gammapilot M devices are connected in cascade mode, there should not be any gap between the individual measuring ranges.

- The source container and the Gammapilot M 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 M should be protected against direct sunlight in order to increase its service life. Use a protective cover if necessary.
- The mounting device FHG60 or an equivalent mounting device should be used to secure the Gammapilot M → 🖹 43
  The mounting device must be installed in such a way as to withstand the weight of the Gammapilot M under all operating conditions to be expected (e.g. vibrations). → 🖹 32

ℹ️ The Gammapilot M should be given additional support to prevent damage to the connecting cable or to the unit if it falls.

Examples
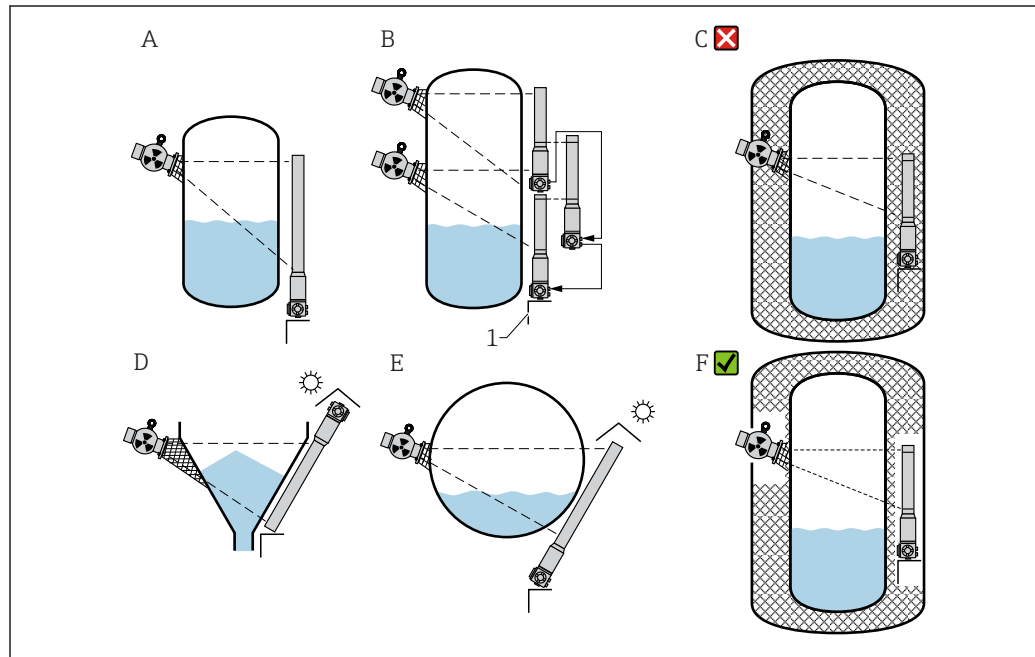
A0018074

A   *Vertical cylinder; the Gammapilot M is mounted vertically with the detector head pointing downwards, the gamma ray is aligned to the measuring range.*
B   *Cascading of multiple Gammapilot M devices; there is no gap between the measuring ranges*
C   *Incorrect: Gammapilot M mounted inside the tank insulation*
D   *Conical vessel outlet (here with sun protection cover)*
E   *Horizontal cylinder (here with sun protection cover)*
F   *Correct: tank insulation removed for Gammapilot M*
1   *Support*

| Installation conditions for point level detection | **Conditions** |

- For point level detection, the Gammapilot M is generally mounted horizontally at the height of the desired level limit.
- The angle of emission of the source container must be exactly aligned to the measuring range of the Gammapilot M. Observe the measuring range marks of the Gammapilot M.
- The source container and the Gammapilot M 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 M should be protected against direct sunlight in order to increase its service life. Use a protective cover if necessary.
- The mounting device FHG60 or an equivalent mounting device should be used to secure the Gammapilot M → 🖹 43
  The mounting device must be installed in such a way as to withstand the weight of the Gammapilot M under all operating conditions to be expected (e.g. vibrations). → 🖹 32

ℹ️ More information with regard to the safety-related use of the Gammapilot M can be found in the Functional Safety Manual SD00230F/00/EN and SD00324F/00/EN.

Examples
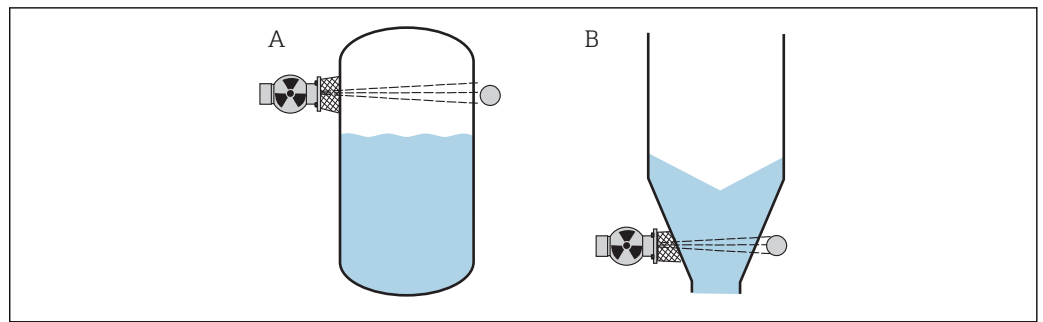
A   Maximum fail-safe mode
B   Minimum point level detection

Installation conditions for density and concentration measurements	**Density and concentration measurement**

Conditions

- If possible, density and 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 FHG61 or an equivalent clamping device should be used to fasten the radiation source container and the Gammapilot M to the measuring tube. → 🕮 44
  The clamping device itself must be installed in such a way as to withstand the weight of the source container and the Gammapilot M under all anticipated operating conditions. → 🕮 32
- 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 M depends on the pipe diameter (or the length of the irradiated measuring path) and the density measuring range. These two parameters determine the measuring effect (relative change in the pulse rate). The measuring effect increases with the length of the radiation path through the medium. Therefore, it is advisable to use diagonal irradiation or a measurement section for small pipe diameters.

To select the measuring system arrangement, please contact an Endress+Hauser representative or use the Applicator™ configuration program [4]

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[4]   The Applicator™ is available from your Endress+Hauser sales organization.
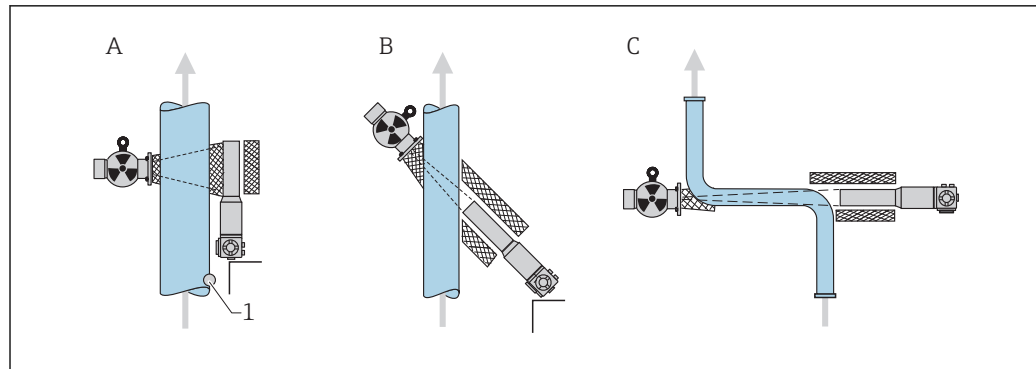
A0018076

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 environmental radiation.
> - When planning, the total weight of the measuring system must be taken into consideration.
> - The Gammapilot M should be given additional support to secure it against falling or to prevent damage to the connecting cable.
> - A clamping device (FHG61) and a measurement section (FHG62) are available as accessories → 🖺 44

Interface measurement	The measuring principle is based on the fact that the radioactive isotope (emitter) emits radiation which is attenuated when it penetrates a material and the medium to be measured. In radiometric interface measurement, the source is inserted into a closed immersion pipe via a rope extension, thus preventing any contact between the 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 interface can then be derived from this density value.

For more information, see:

📖 CP01205F/00/EN

Density profile measurement (DPS)

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 compact transmitters 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

Empty pipe detection
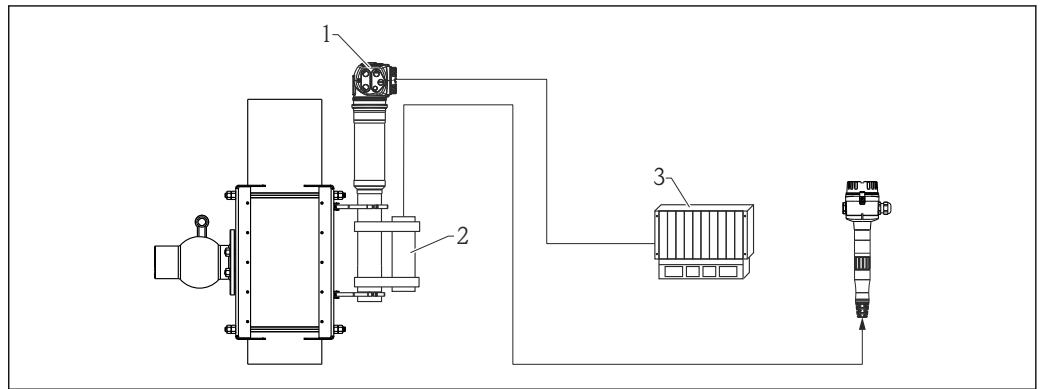
A0018077

1   Gammapilot M
2   Monitoring detector FTG20 or FMG60
3   PLC

Mounting the FTG20 or FMG60 on the FMG60 for empty pipe detection

If the pipe becomes empty as a result of operational processes, the level of radiation on the detector side can reach dangerous levels.

- In such cases, the radiation emission channel must be closed immediately for reasons of radiation protection.
- A high local dose rate also causes the detector unit (scintillator and photomultiplier) to age quickly.

The best way to avoid such a situation is to mount a second radiometric measuring system that monitors the radiation intensity. If high radiation levels occur, an alarm is output and/or the source container is automatically switched off through pneumatic action for example.

Installation conditions for flow measurement

Measurement of solids flow

In conjunction with a density measuring device, such as Endress+Hauser's Gammapilot M, Promag 55S also determines the rate of solids in terms of mass, volume or percentage. The following order information is required for this purpose for Promag 55S: Order option for the "Solids flow" software option (F-CHIP) and order option for a current input.
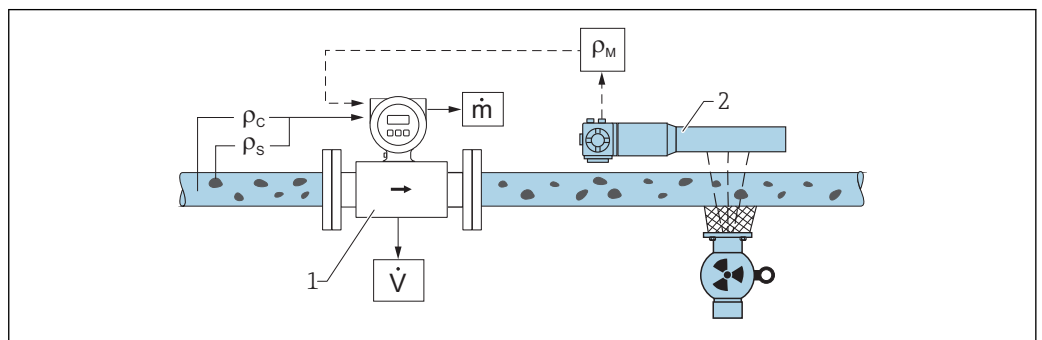
A0018093

🖾 *7   Solids flow measurement (m) using a density meter and 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   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
2   Density meter (e.g. "Gammapilot M") -> total density (ρ_m) consisting of the carrier liquid and solids

Measurement of mass flow

Bulk solids applications on conveyor belts and conveyor screws.

The source container is positioned above the conveyor belt and the Gammapilot M FMG60 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 M

Environment

Ambient temperature

Device version	Ambient temperature		Storage temperature
	Without water cooling	With water cooling	
PVT scintillator	−40 to +60 ℃ (−40 to +140 ℉)	0 to +120 ℃ (32 to +248 ℉) [1]	−40 to +50 ℃ (−40 to +122 ℉)
NaI crystal	−40 to +60 ℃ (−40 to +140 ℉)	0 to +120 ℃ (32 to +248 ℉) [1]	−40 to +60 ℃ (−40 to +140 ℉)

1) Max. 75 ℃ (167 ℉) at the terminal housing

The temperature range may be restricted for applications in hazardous areas. Observe the maximum ambient temperature indicated in the relevant approval. Avoid exposure to direct sunlight; use a protective cover if necessary.

Climate class   DIN EN 60068-2-38 test Z/AD

Installation height as per IEC 61010-1 Ed.3   2 000 m (6 600 ft)

Degree of protection   IP 66/67; TYPE 4x/6

Vibration resistance   DIN EN 60068-2-64; test Fh; 10 to 2000Hz, $1(m/s^2)^2/Hz$

Shock resistance   DIN EN 60068-2-27; test Ea; 30g, 18ms, 3 shocks/direction/axis

Electromagnetic compatibility
- Interference emission according to IEC/EN 61326, Class B equipment
- Interference emission according to IEC/EN 61326, Appendix A (Industrial) and NAMUR Recommendation NE21

Water cooling   The following applies for the versions of the Gammapilot M with a water cooling jacket:

- Material: 316L
- Water connection: 2 x G 1/4", DIN ISO 228
- Inlet temperature: max. 40 ℃ (104 ℉)
- Outlet temperature: max. 50 ℃ (122 ℉)(temperature monitoring recommended)
- Water pressure: 4 to 6 bar (60 to 90 psi)

A *T < 75 ℃ (167 ℉)*
B *T < 120 ℃ (248 ℉)*
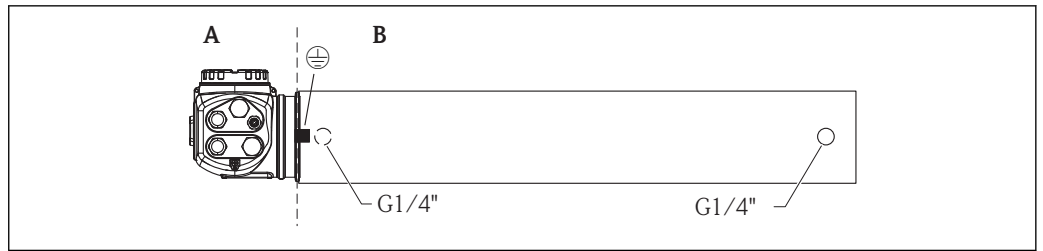
> ⚠️ **CAUTION**
>
> **The detector or cooling jacket can become damaged if the cooling water freezes.**
> ▶ Empty the cooling jacket or protect against freezing.

> ⚠️ **WARNING**
>
> **Pressurized water cooling system!**
> ▶ Do not open the cylinder screws (see diagram below) when pressurized.
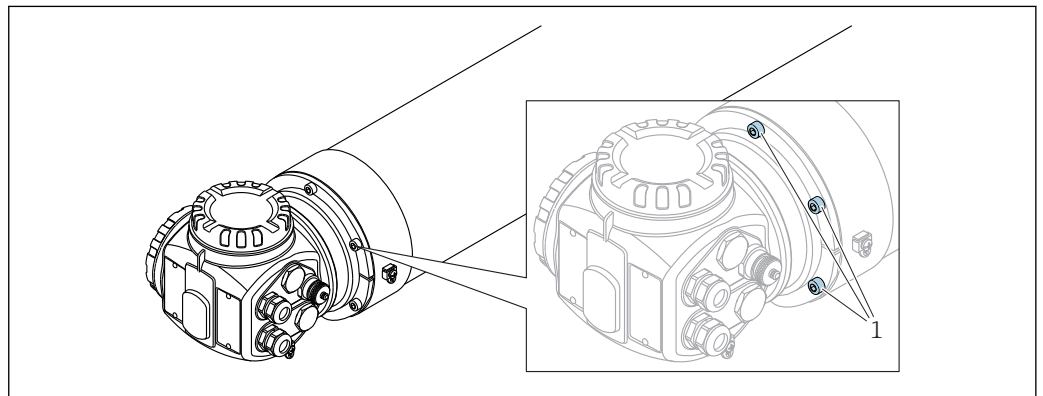
1 Cylinder screws

> ⚠️ **CAUTION**
>
> **Consider the following when using the water cooling jacket**
> ▶ It is recommended to ground the water cooling jacket separately at the protective ground connection provided for this purpose.
> ▶ The ambient temperature of the terminal housing may not exceed 75 ℃ (167 ℉). This also applies if water cooling is used.
> ▶ The three screws (see graphic below) connecting the detector pipe to the terminal housing may **not** be opened.
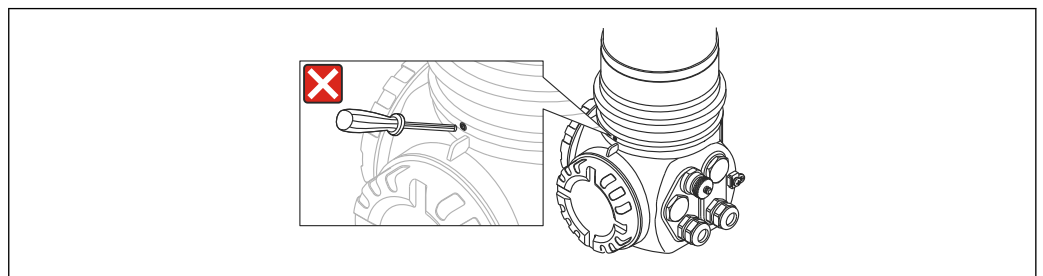
🖼 *8 The three screws connecting the detector pipe to the terminal housing may not be opened.*

Mounting position and position of the cooling water nozzles
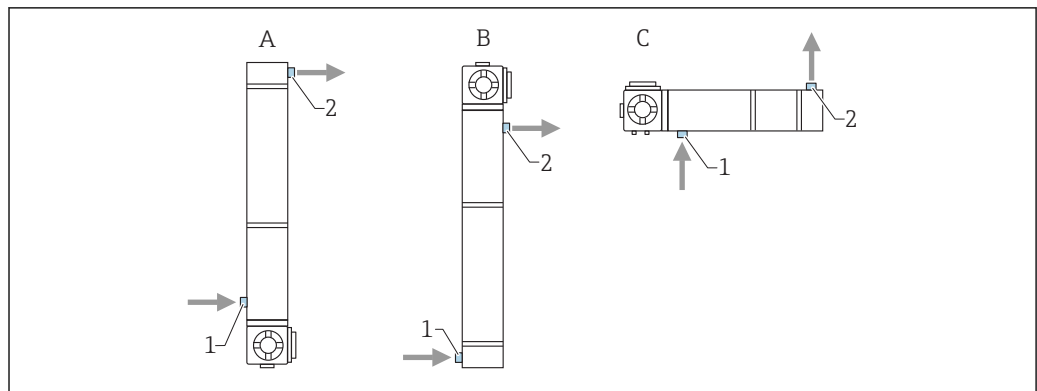
A0018079

A Recommended mounting position for level measurement: the terminal housing is at the bottom
B In exceptional cases (e.g. shortage of space) the terminal housing may be located at the top
C Mounting position for point level detection and density measurement
1 Cooling water inlet (always at bottom)
2 Cooling water outlet (always at top)

> ⚠ **CAUTION**
> ▸ The water must always be introduced from the bottom to ensure that the water cooling jacket is completely filled.

Required flow

The required flow rate depends on:

- The ambient temperature at the water cooling jacket
- The inlet temperature
- The measuring length of the Gammapilot M

Typical values are given in the following tables:

Ambient temperature T_A = 75 ℃ (167 ℉)

Inlet temperature ℃ (℉)	Measuring length in mm (in)						
	50 (1.97)	200 (7.87)	400 (15.7)	800 (31.5)	1200 (47.2)	1600 (63)	2000 (78.7)
20 (68)	30 l/h	30 l/h	30 l/h	41 l/h	55 l/h	70 l/h	84 l/h
25 (77)	30 l/h	30 l/h	30 l/h	45 l/h	61 l/h	77 l/h	93 l/h
30 (86)	30 l/h	30 l/h	33 l/h	50 l/h	68 l/h	86 l/h	104 l/h
35 (95)	30 l/h	30 l/h	38 l/h	59 l/h	80 l/h	101 l/h	122 l/h
40 (104)	30 l/h	30 l/h	47 l/h	72 l/h	98 l/h	124 l/h	149 l/h

Ambient temperature T_A = 100 ℃ (212 ℉)

Inlet temperature ℃ (℉)	Measuring length in mm (in)						
	50 (1.97)	200 (7.87)	400 (15.7)	800 (31.5)	1200 (47.2)	1600 (63)	2000 (78.7)
20 (68)	30 l/h	30 l/h	38 l/h	59 l/h	80 l/h	101 l/h	122 l/h
25 (77)	30 l/h	30 l/h	42 l/h	64 l/h	87 l/h	110 l/h	133 l/h
30 (86)	30 l/h	30 l/h	47 l/h	73 l/h	98 l/h	124 l/h	150 l/h
35 (95)	30 l/h	30 l/h	54 l/h	84 l/h	113 l/h	143 l/h	173 l/h
40 (104)	33 l/h	33 l/h	66 l/h	101 l/h	137 l/h	173 l/h	210 l/h

Ambient temperature T_A = 120 °C (248 °F)

Inlet temperature °C (°F)	Measuring length in mm (in)						
	50 (1.97)	200 (7.87)	400 (15.7)	800 (31.5)	1200 (47.2)	1600 (63)	2000 (78.7)
20 (68)	30 l/h	30 l/h	45 l/h	70 l/h	94 l/h	119 l/h	144 l/h
25 (77)	30 l/h	30 l/h	50 l/h	77 l/h	104 l/h	131 l/h	158 l/h
30 (86)	30 l/h	30 l/h	55 l/h	85 l/h	115 l/h	146 l/h	176 l/h
35 (95)	32 l/h	32 l/h	64 l/h	98 l/h	133 l/h	168 l/h	203 l/h
40 (104)	38 l/h	38 l/h	75 l/h	116 l/h	157 l/h	199 l/h	240 l/h

Collimator

Collimator
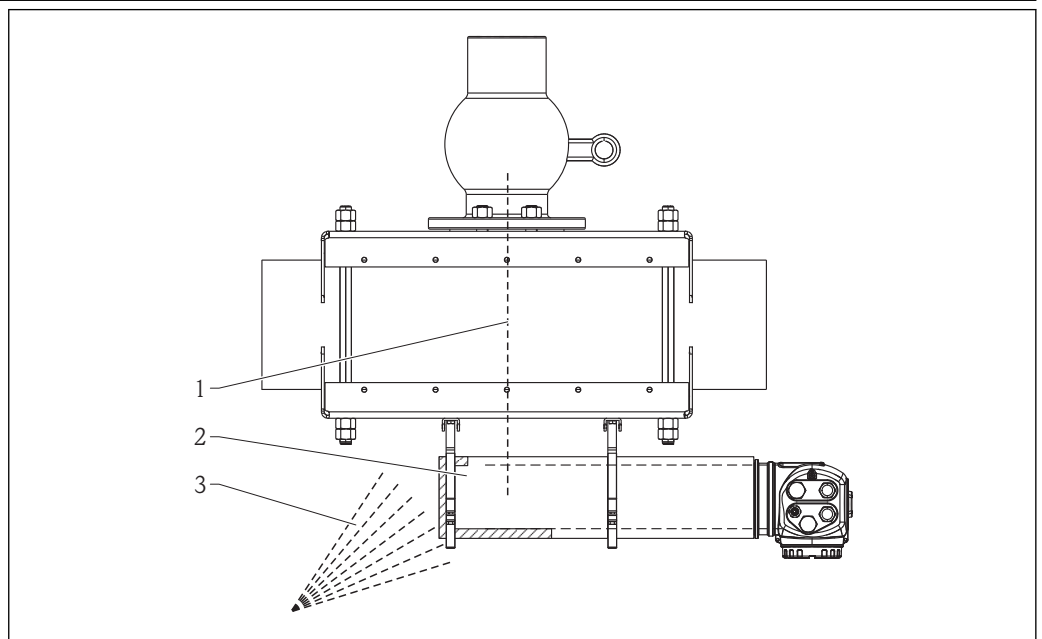
A0018263

1   Radiation path
2   Collimator
3   Background radiation

Process conditions

Process temperature

In the event of high process temperatures, sufficient insulation must be ensured between the process vessel and detector (see -> "Ambient temperature").

Process pressure

The influence of pressure must be considered when calculating the required activity and during calibration.

Mechanical construction

Dimensions, weight

Gammapilot M (without water cooling jacket)
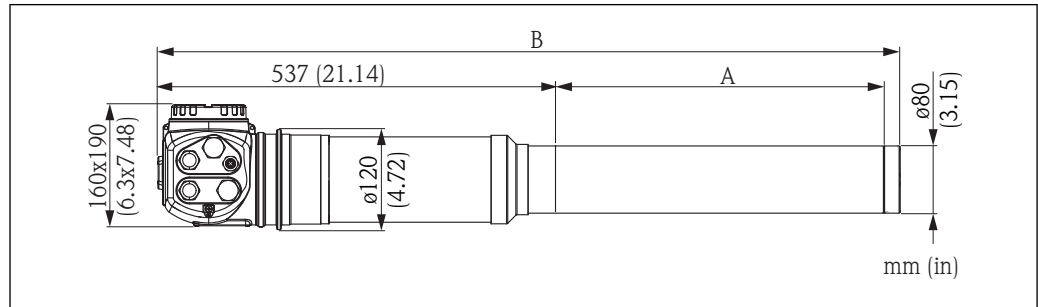
Gammapilot M with water cooling jacket or collimator
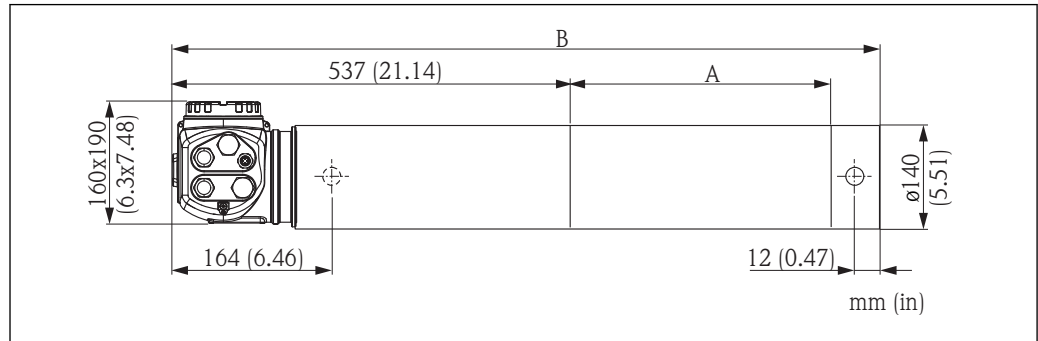
Type	Measuring length A [mm (in)]	Without water cooling jacket		With water cooling jacket		
		Total length B [mm (in)]	Weight [kg (lbs)][1]	Total length B [mm (in)]	Weight without water [kg (lbs)][1]	Weight with water [kg (lbs)][1]
NaI	50 (1.97)	621 (24.4)	14 (30.87)	631 (24.8)	18 (39.69)	20 (44.10)
NaI with collimator	50 (1.97)	663 (26.1)	35 (77.18)	-	-	-
PVT	200 (7.87)	780 (30.7)	15 (33.08)	790 (31.1)	20 (44.10)	24 (52.92)
PVT	400 (15.7)	980 (38.6)	16 (35.28)	990 (39)	23 (50.72)	29 (63.95)
PVT	800 (31.5)	1380 (54.3)	20 (44.10)	1390 (54.7)	31 (68.36)	40 (88.20)
PVT	1200 (47.5)	1780 (70.1)	24 (52.92)	1790 (70.5)	37 (81.59)	50 (110.25)
PVT	1600 (63)	2180 (85.8)	28 (61.74)	2190 (86.2)	45 (99.23)	61 (134.51)
PVT	2000 (7.87)	2580 (102)	31 (68.36)	2590 (102)	51 (112.46)	72 (158.76)

1) The weight data indicated are for the 316L version. The weight of the aluminum version is reduced by 5.3 kg (11.69 lb)

Materials

Stainless steel and aluminum housing (seawater resistant*, powder-coated, corrosion resistant)
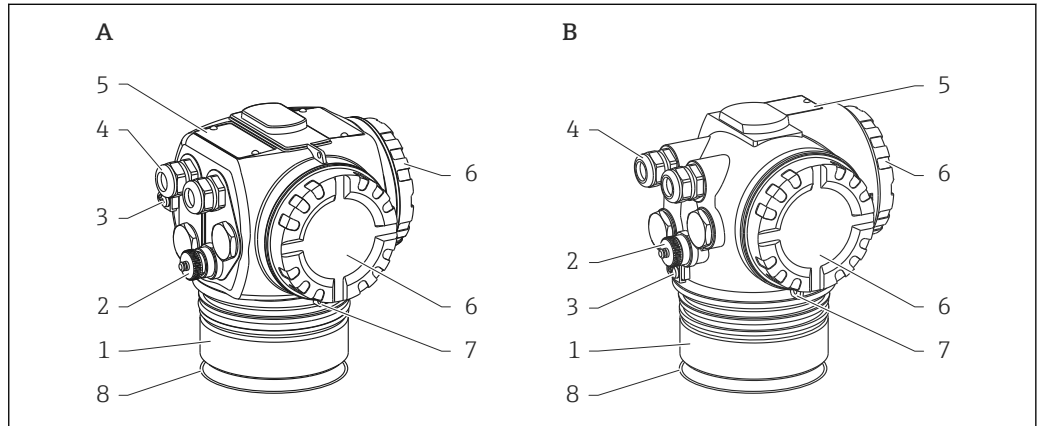
A0018264

A   Stainless steel housing
B   Aluminum housing

Item	Component part	Material
1	Stainless steel housing	316L (1.4404/1.4435)
	Aluminum housing	Aluminum (AlSi12), RAL7035 coating
2	FHX40 connector	316L (1.4435)
3	Ground terminal*	Screw: A2; spring washer: A4; clamp: 304 (1.4301); bracket: 1.4310
4	Adapter*	304 (1.4301)
	Cable gland	Nickel-plated brass
	Blind plug	NPT1/2": 316L (1.4435); M20x1.5: 316L (1.4435); G½": 316L (1.4435)
	PA connector	Nickel-plated brass
	FF connector	316L (1.4435)
	Seal	EPDM-70 + PTFE
5	Nameplate*	304 (1.4301)
	Grooved pin*	A2
6	Cover	316L (1.4435)
	Cover	Aluminum (AlSi12), RAL7035 coating
	Cover seal	FKM70GLT
	Clamp	Screw: A4; clamp: 316L (1.4581)
7	Wired-on tag plate*	304 (1.4301)
	Retaining ring for wired-on tag plate*	304 (1.4301)
8	Sealing ring	FKM70GLT

* Seawater resistant on request (completely in 316L (1.4404))

Housing, water cooling jacket, collimator
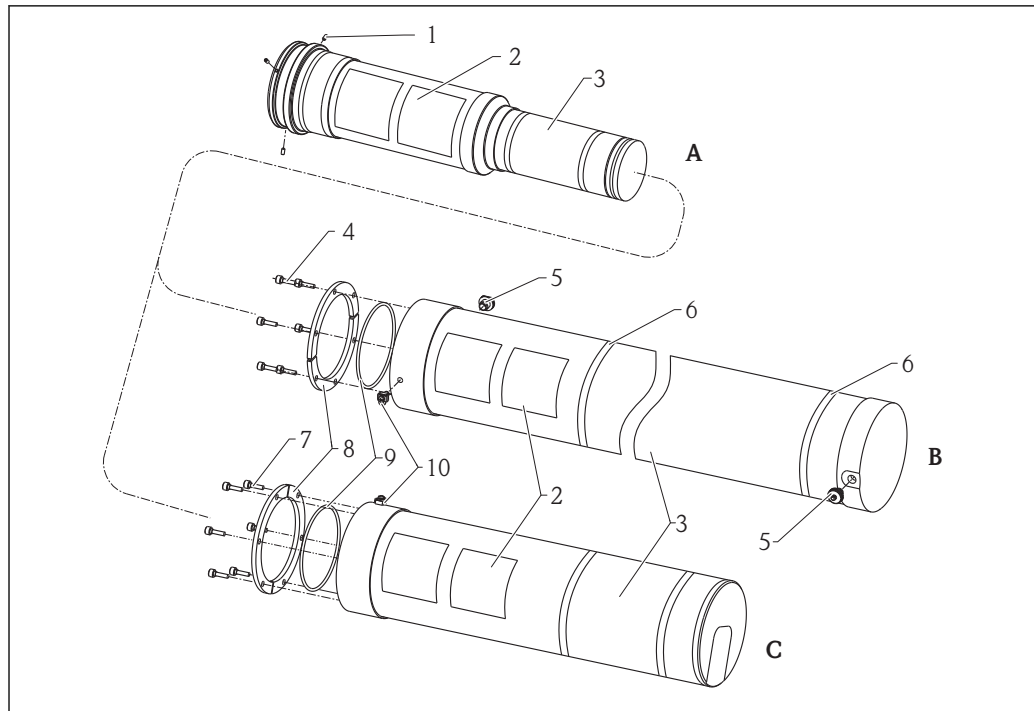
A0018265

A   Housing
B   Water cooling jacket
C   Collimator

Item	Component part	Material
1	Threaded pin	A4-70
2	Nameplate	Self-adhesive paper label
3	Detector pipe/water jacket	316L (1.4404/1.4435)
4	Screw*	A2-70
5	Plug G1/4"	PE-HD yellow
6	Measuring range label	Aluminum, self-adhesive
7	Screw*	A2-70
8	Ring	316L (1.4404)
9	Seal	FKM70GLT
10	Ground terminal*	Screw: A2; spring washer: A4; clamp: 304 (1.4301); bracket: 1.4310; press-fit bushing: 316Ti (1.4571)

* Seawater resistant on request (completely in 316L (1.4404))

Human interface

Display and operating unit FHX40

Connection

The remote display and operating unit FHX40 is available as an accessory. It is connected to the Gammapilot M via the cable (20 m (66 ft)) and plug supplied. The display and operating module VU331 is located in the operating unit.
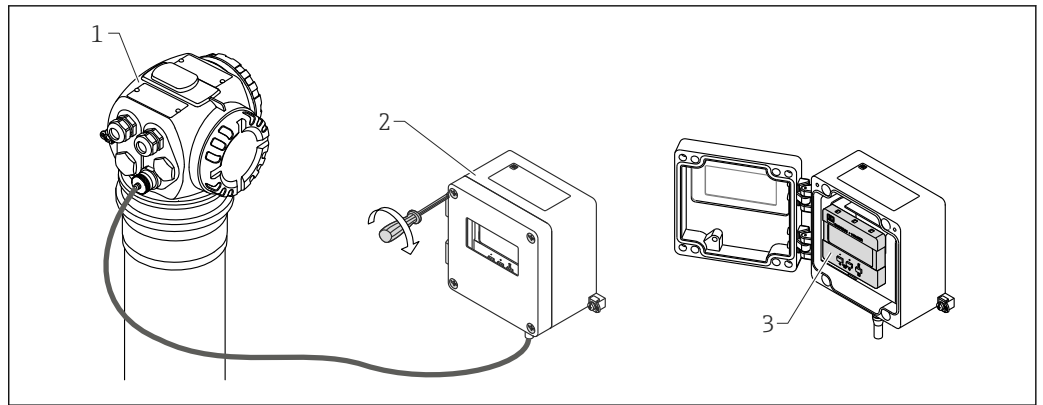
A0018096

1   Gammapilot M
2   FHX40
3   Operating module VU331

Operation

The device is operated using the 3 keys on the display and operating module VU331. All the device functions can be configured through a menu system. The menu consists of function groups and functions. Application parameters can be read or configured in the functions. The user is guided through the entire configuration procedure via the plain text display.
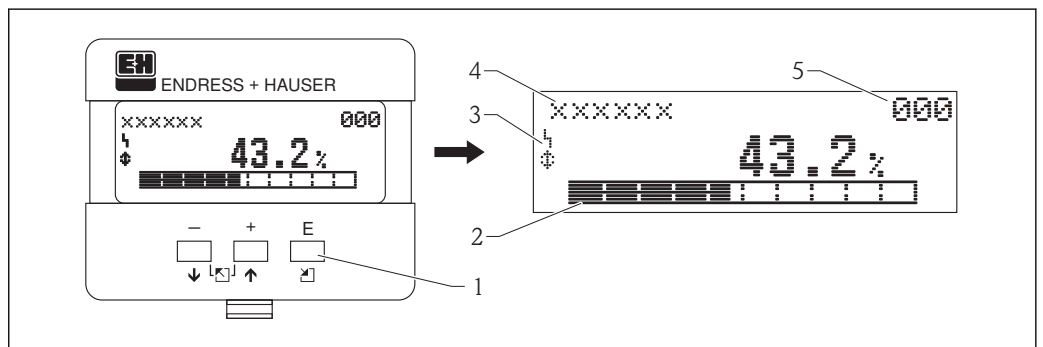
A0018097

1   Operating keys
2   Bargraph
3   Symbols
4   Function name
5   Parameter ID number

Users can choose from one of seven languages for display and operation:
• English
• German
• French
• Italian
• Dutch
• Spanish
• Japanese

Remote operation

Operation via Field Xpert SFX100

Field Xpert is an industrial PDA with integrated 3.5" touchscreen from Endress+Hauser based on Windows Mobile. It offers wireless communication via the optional VIATOR Bluetooth modem as a point-to-point connection to a HART device, or via WiFi and Endress+Hauser's Fieldgate FXA42 to one or more HART devices. Field Xpert can also be used as a stand-alone device for asset management applications.

For details, see:

📖 BA00060S/04/EN

Operation with FieldCare

FieldCare is an Endress+Hauser asset management tool based on FDT technology. With FieldCare, 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 at: 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
- PROFIBUS PA via segment coupler and PROFIBUS interface card
- Commubox FXA291 with ToF Adapter FXA291 (USB) via service interface

NI-FBUS Configurator (only Foundation Fieldbus)

The NI-FBUS Configurator is an easy-to-use graphical environment for creating linkages, loops, and a schedule based on the fieldbus concepts. The NI-FBUS Configurator can be used for the following network configurations:

- Set block and device tags
- Set device addresses
- Create and edit function block control strategies (function block applications)
- Configure vendor-defined function and transducer blocks
- Create and edit schedules
- Read and write to function block control strategies (function block applications)
- Invoke Device Description (DD) methods (e.g. basic device settings)
- Display DD menus (e.g. tab for calibration data)
- Download a configuration
- Verify a configuration and compare it to a saved configuration
- Monitor a downloaded configuration
- Replace devices
- Save and print a configuration

Certificates and approvals

Safety Manual (SIL 2/3)	**SIL2/3 in accordance with IEC61508 see:**

"Functional Safety Manual" (for max. point level detection)

📖 SD00230F/00/EN

"Functional Safety Manual" (for min. point level detection)

📖 SD00324F/00/EN

ℹ️ When using the Gammapilot M for minimum point level detection, a reference radiation source contained in the FQG60 source container must additionally be mounted on the detector pipe.

- Isotope: ^{137}Cs
- Activity: 0.74 MBq (0.02 mCi)

For additional information see: "Mounting the FQG60 as a reference radiation source"

📖 SD00343F/A2

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

Other standards and guidelines	• **IEC 60529** Degrees of protection provided by enclosures (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

Certificates

For the allocation of the approval to the device version, see the Product Configurator on the Endress+Hauser website: www.endress.com -> Select country -> Instruments -> Select device -> Product page function: Configure this product

General

Approval feature 010	Type of protection	Power supply wiring/output wiring, option 030	Output (communication), option 040	Safety instructions
A	Non-hazardous area	A	1,2,3	-
F	Non-hazardous area, WHG	A	1	-
N	CSA General Purpose	A	1,2,3	-

Approval number: NEPSI GYJ15.1144

Approval feature 010	Type of protection	Power supply wiring/output wiring, option 030	Output (communication), option 040	Safety instructions
C	Ex de [ia] IIC T6	C	1	XA00536F
		C	2,3	XA01706F
		B	1	XA00536F
		B	2,3	XA00537F
D	Ex d [ia] IIC T6	D	1	XA00536F
		D	2,3	XA01706F
		E	1	XA00536F
		E	2,3	XA00537F

Approval number: IECEx DEK 13.0071X

Approval feature 010	Type of protection	Power supply wiring/output wiring, option 030	Output (communication), option 040	Safety instructions
G	Ex de [ia Ga] IIC T6 Gb	B	1	XA00449F
		B	2,3	XA00450F
		C	1	XA00449F
		C	2,3	XA00451F
H	Ex d [ia Ga] IIC T6 Gb	E	1	XA00449F
		E	2,3	XA00450F

Approval feature 010	Type of protection	Power supply wiring/output wiring, option 030	Output (communication), option 040	Safety instructions
		D	1	XA00449F
		D	2,3	XA00451F

Approval number: KEMA 04 ATEX 1153

Approval feature 010	Type of protection	Power supply wiring/ output wiring, option 030	Output (communication), option 040	Safety instructions
1	II 2(1) G Ex de [ia Ga] IIC T6 Gb	B	1	XA00303F
		B	2,3	XA00332F
		C	1	XA00303F
		C	2,3	XA00334F
2	II 2(1) G Ex de [ia Ga] IIC T6 Gb, WHG	B	1	XA00303F
		C	1	XA00303F
3	II 2(1) G Ex d [ia Ga] IIC T6 Gb	E	1	XA00303F
		E	2,3	XA00332F
		D	1	XA00303F
		D	2,3	XA00334F
4	II 2(1) G Ex d [ia Ga] IIC T6 Gb, WHG	E	1	XA00303F
		D	1	XA00303F
5	II 2(1) D Ex tb [ia Da] IIIC T80°C Db	F	1	XA00304F
		F	2,3	XA00335F
		L	1	XA00304F
		L	2,3	XA00333F
6	II 2(1) G Ex de [ia Ga] IIC T6 Gb II 2(1) D Ex tb [ia Da] IIIC T80°C Db	J	1	XA00303F XA00304F
		J	2,3	XA00332F XA00333F
		G	1	XA00303F XA00304F
		G	2,3	XA00334F XA00335F
7	II 2(1) Ex de [ia Ga] IIC T6 Gb, WHG II 2(1) D Ex tb [ia Da] IIIC T80°C Db, WHG	J	1	XA00303F XA00304F
		G	1	XA00303F XA00304F
8	II 2(1) G Ex d [ia Ga] IIC T6 Gb II 2(1) D Ex tb [ia Da] IIIC T80°C Db	K	1	XA00303F XA00304F
		K	2,3	XA00332F XA00304F
		H	1	XA00303F XA00304F

Approval feature 010	Type of protection	Power supply wiring/ output wiring, option 030	Output (communication), option 040	Safety instructions
		H	2,3	XA00334F XA00335F
M	II 2(1) G Ex d [ia Ga] IIC T6 Gb, WHG II 2(1) D Ex tb [ia Da] IIIC T80°C Db, WHG	K	1	XA00303F XA00304F
		H	1	XA00303F XA00304F

Approval number: ID 3022785

Approval feature 010	Type of protection	Power supply wiring/ output wiring, option 030	Output (communication), option 040	Safety instructions
S	FM Cl. 1 Gp. A-D, Cl. II Gp. E-G, Cl. III, Cl. I Zone 1 Ex d [ia] IIC t6	D	1	XA01100F
		D	2,3	XA01108F
		E	1	XA01102F
		E	2,3	XA01109F

Approval number: CSA 1653884

Approval feature 010	Type of protection	Power supply wiring/ output wiring, option 030	Output (communication), option 040	Safety instructions
P	CSA Cl. I Gp. A-D, Cl. II Gp. E-G, Cl. III, Cl. I Zone 1 Ex d [ia] IIC T6	D	1	XA01099F
		D	2,3	XA01110F
		E	1	XA01101F
		E	2,3	XA01111F

Approval number: TC17525, TC19557 (NaI scintillator)

Approval feature 010	Type of protection	Power supply wiring/output wiring, option 030	Output (communication), option 040	Safety instructions
K	TIIS Ex d [ia] IIC T6	D	1	BA00236F

Approval number: TC17524, TC19556 (PVT scintillator)

Approval feature 010	Type of protection	Power supply wiring/output wiring, option 030	Output (communication), option 040	Safety instructions
K	TIIS Ex d [ia] IIC T6	D	1	BA00236F

CE mark

The measuring system meets the legal requirements of the EC Directives. Endress+Hauser confirms that the device has been successfully tested by applying the CE mark.

GOST

Approval for GOST available

Overfill prevention

- WHG (German Water Resources Act) for point level detection
- SIL2/3 in accordance with IEC61508 see:
  - For max. point level detection (SD00230F/00/EN)
  - For min. point level detection (SD00324F/00/EN)

Ordering information

| Ordering information | Detailed ordering information is available from the following sources: |

- In the Product Configurator on the Endress+Hauser website: www.endress.com -> Select country -> Instruments -> Select device -> Accessories for FMG60
- From an Endress+Hauser Sales Center: www.endress.com/worldwide

> **Product Configurator - the tool for individual product configuration**
> - Up-to-the-minute configuration data
> - Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
> - Automatic verification of exclusion criteria
> - Automatic creation of the order code and its breakdown in PDF or Excel output format
> - Ability to order directly in the Endress+Hauser Online Shop

Accessories

| Commubox FXA195 HART | For intrinsically safe HART communication with FieldCare via the USB interface. For details refer to |

TI00404F/00/EN

| Commubox FXA291 | The Commubox FXA291 connects Endress+Hauser field devices with a CDI interface (Endress+Hauser Common Data Interface) and the USB port of a personal computer or laptop. For details refer to |

TI00405C/07/EN

> For Gammapilot M, the "ToF Adapter FXA291" accessory is also needed

| ToF Adapter FXA291 | The ToF Adapter FXA291 connects the Commubox FXA291 with the Gammapilot M via the USB port of a computer or laptop. For details refer to |

KA00271F/00/A2

| Field Xpert SFX100 | Compact, flexible and robust industrial handheld terminal for remote operation and measured value interrogation via the HART current output or FOUNDATION Fieldbus. For details refer to |

BA00060S/04/EN

| Remote display and operating unit FHX40 | **Dimensions** |
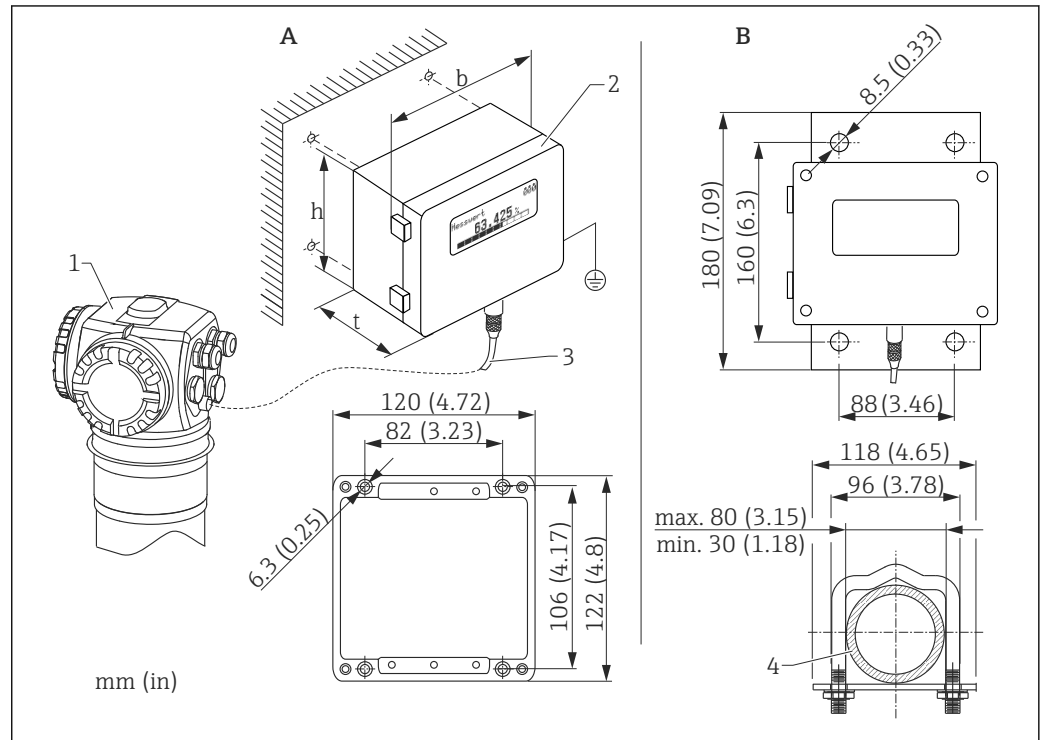
A   *Wall mounting (without mounting bracket)*
B   *Pipe mounting (mounting bracket/plate supplied optionally)*
1   *Gammapilot M*
2   *Separate housing FHX40*
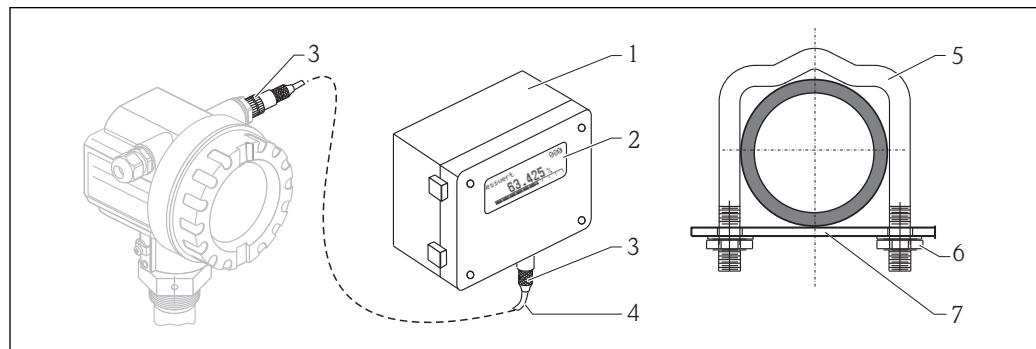*3*   *Cable*
4   *Pipe*

Ordering information

010	Approval
A	Non-hazardous area
2	ATEX II 2G Ex ia IIC T6
3	ATEX II 2D Ex ia IIIC T80℃
H	ATEX II 3G Ex ic IIC T6, T5 Gc (in preparation)
G	IECEx Zone1 Ex ia IIC T6/T5
S	FM IS Cl.I Div.1 Gr.A-D, Zone0
U	CSA IS Cl.I Div.1 Gr.A-D, Zone0
N	CSA General Purpose
K	TIIS Ex ia IIC T6
C	NEPSI Ex ia IIC T6/T5 Gb
Y	Special version, TSP-no. to be spec.

020	Cable
1	20m (> HART)
5	20m (> PROFIBUS PA/FOUNDATION Fieldbus)
9	Special version, TSP-no. to be spec.

030	Additional options
A	Basic version
B	Mounting bracket, pipe 1"/2"
Y	Special version, TSP-no. to be spec.

995	Marking
1	Measuring point (TAG), see additional specifications

Use the cables provided for the corresponding communication version of the device to connect the remote display FHX40.

Technical data (cable and housing)

|	
Cable length	20 m (66 ft) (fixed length including attached plugs)
Temperature range	Temperature class T5: −40 to +75 °C (−40 to +167 °F) Temperature class T6: −40 to +60 °C (−40 to +140 °F)
Degree of protection	IP65/67 (housing); IP65/67 (cable) according to IEC 60529
Materials	Housing: AlSi12; cable gland: nickel-plated brass
Dimensions [mm (in)]	122x150x80 (4.72x5.91x3.15) / HxWxD

Materials

A0019282

🖎 *9   Materials (see table below)*

Position	Component part	Material
1	Housing/cover	AlSi12, screw: V2A
	Ground terminal	CuZn nickel-plated, screw: V2A
2	Display	Glass
3	Cable gland	CuZn nickel-plated
4	Cable	PVC
5	Mounting bracket	316 Ti (1.4571) or 316 L (1.4435) or 316 (1.4401)
6	Nut	V4A
7	Plate screw set (M5)	316 Ti (1.4571) spring washer: 301 (1.431) or V2A, screw: V4A, nut: V4A

Mounting device FHG60 (for level and point level measurement)

Dimensions
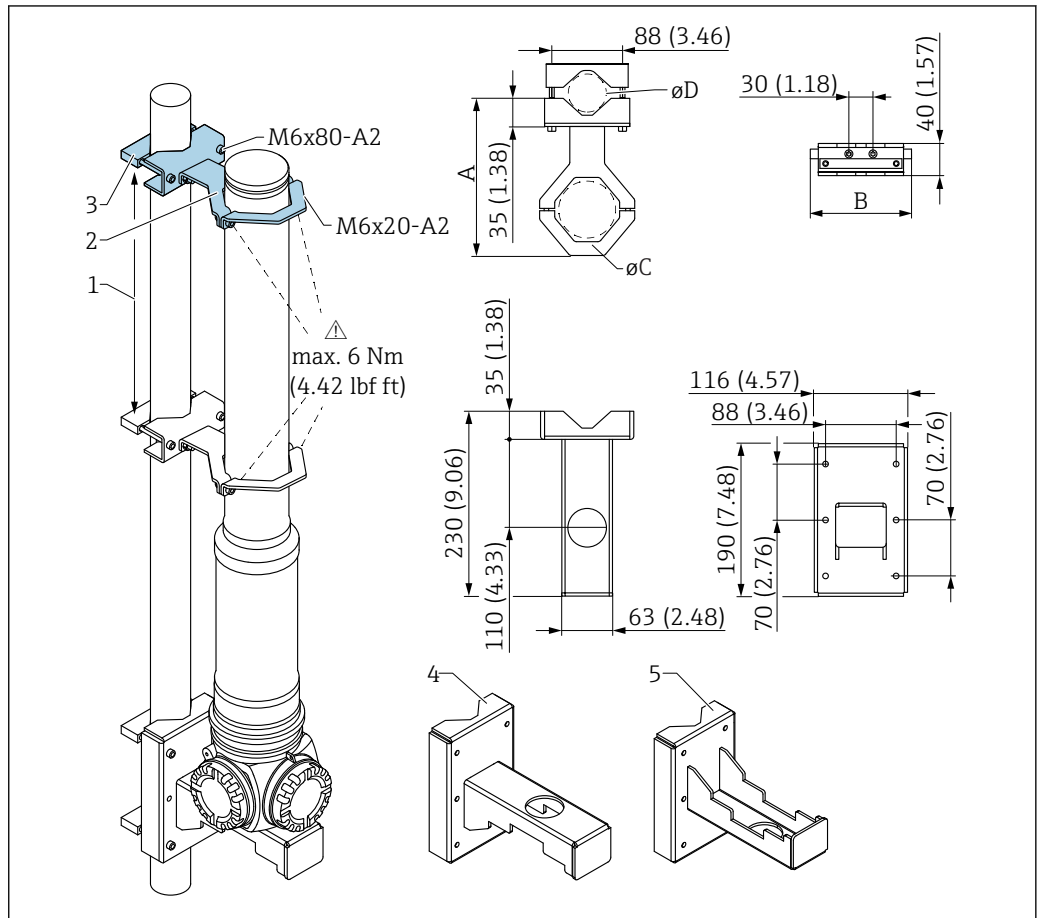
A0018139

1 Distance as large as possible
2 Retainers (number and size depending on selected application); Allen screws to ISO 4762 are supplied
3 Mounting clamps (number depending on selected application)
4 With preferred mounting method "housing head down" - bracket (for "level" application only)
5 With alternative mounting method "housing head up" - bracket (for "level" application only)

Size of the retainers (depending on selected application):

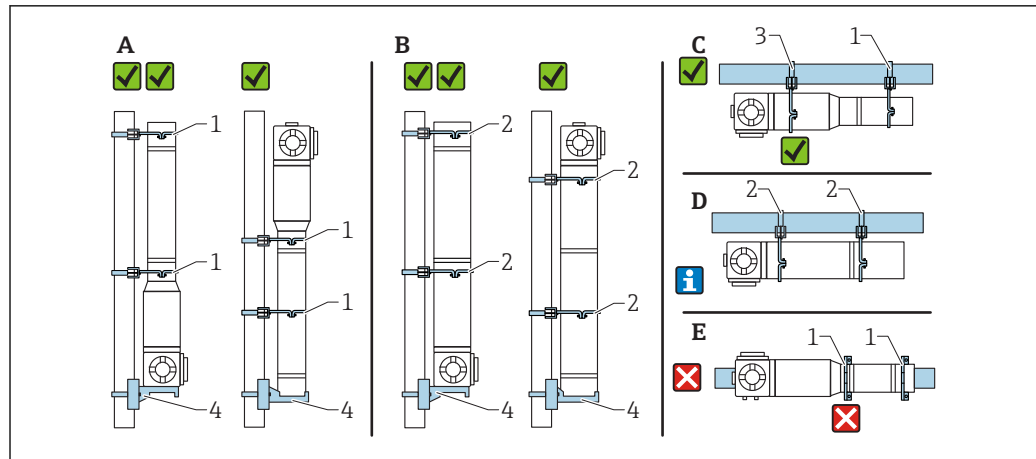| Mounting position on FMG60	A [mm (in)]	B [mm (in)]	øC [mm (in)]	øD [mm (in)]	Installation
Scintillator pipe dimensions	198 (7.8)	126 (4.96)	80 (3.15)	40...65 (1.57...2.56)	(a)
Electronic pipe dimensions	210 (8.27)	150 (5.91)	102 (4.02)		(b)
Water cooling jacket dimensions	230 (9.06)	200 (7.87)	140 (5.51)		(c)

⚠ CAUTION

Max. torque for the screws of the retainers:
▶ 6 Nm (4.42 lbf ft)

Use

☑ Permitted

☑☑ Preferred

A0018141

A   *Level measurement, FMG60 without cooling jacket*
B   *Level measurement, FMG60 with cooling jacket*
C   *Point level measurement, FMG60 without cooling jacket*
D   *Point level measurement, FMG60 with cooling jacket*
E   *Such horizontal mounting not permitted*
1   *Retainer for pipe diameter 80 mm (3.15 in)*
2   *Retainer for water cooling jacket diameter 140 mm (5.51 in)*
3   *Retainer for pipe diameter 102 mm (4.72 in)*
4   *Bracket*

For horizontal installation with cooling jacket or collimator, the installation must be carried out by the customer.

⚠ 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 M under all anticipated operating conditions.
▸ For measuring lengths of 1 600 mm (63 in) or more, two retainers (vertical) or three retainers (horizontal) must be used.
▸ The use of the bracket or a support unit fitted by the customer is mandatory if the device is mounted in a vertical position. Otherwise sufficient stability and support for the Gammapilot M is not ensured.
▸ For stability reasons the mounting version with the terminal housing positioned at the top should only be used in exceptional cases.
▸ To prevent damage to the tube of the Gammapilot M, the maximum torque that can be applied to tighten the retainer screws is 6 Nm (4.42 lbf ft).

Ordering information

Detailed ordering information is available from the following sources:

• In the Product Configurator on the Endress+Hauser website: www.endress.com -> Select country -> Instruments -> Select device -> Accessories for FMG60
• From an Endress+Hauser Sales Center: www.endress.com/worldwide

Product Configurator - the tool for individual product configuration
  • Up-to-the-minute configuration data
  • Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
  • Automatic verification of exclusion criteria
  • Automatic creation of the order code and its breakdown in PDF or Excel output format
  • Ability to order directly in the Endress+Hauser Online Shop

| **Clamping device for density measurement FHG61** | For details, see:

📖 SD01221F/00/EN |

Measurement section for density measurement FHG62	For drawings and description, see: 📖 SD00540F/00/EN
Memograph M, RSG45	**Measuring principle** Electronic acquisition, display, recording, analysis, remote transmission and archiving of analog and digital input signals as well as calculated values. The device is intended for installation in a panel or cabinet door. There is also the option of operating it in a desktop housing or field housing. **Measuring system** Multichannel data recording system with multicolor TFT display (178 mm / 7" screen size), internal memory, external memory (SD card and USB stick), galvanically isolated universal inputs (U, I, TC, RTD, pulse, frequency), HART® inputs, digital inputs, transmitter power supply, limit relays, digital and analog outputs, communication interfaces (USB, Ethernet, RS232/485), optionally available with Modbus, Profibus DP or PROFINET I/O or EtherNet/IP. An Essential Version of the Field Data Manager (FDM) software is included for SQL-supported data analysis at the PC. ℹ The number of inputs available in the basic device can be individually increased using a maximum of 5 plug-in cards. The device supplies power directly to connected two-wire transmitters. The device is configured and operated via the navigator (jog/shuttle dial) or by touchscreen (optional) using the integrated web server and a PC, an external USB keyboard or mouse or with the FieldCare/Device Care configuration software. Online help supports the user during local operation. ℹ Ex version: • The hazardous area version (Ex version) is only available in conjunction with the stainless steel front and touch control. • In this version, the SD card is integrated in the device and cannot be removed. The card can be read out using the Field Data Manager (FDM) software supplied via USB or Ethernet or via WebDAV. For more information, see: 📖 TI01180R 📖 BA01338R
RMA42, process transmitter with control unit	**Measuring principle** The RMA42 process transmitter powers the transmitter and processes analog signals from transmitters, particularly from the area of process instrumentation. These signals are monitored, evaluated, calculated, saved, separated, linked, converted and displayed. The signals, intermediate values and the results of calculations and analysis are transmitted by digital or analog means. **Measuring system** The RMA42 is a process transmitter that is controlled by a microcontroller and features a display, analog inputs for process and status signals, analog and digital outputs, as well as a configuration interface. Connected sensors can be powered by the integrated transmitter power supply system. The signals to be measured are converted from analog to digital signals, processed digitally in the device, and then converted from digital to analog signals and made available at the various outputs. All measured values, and values calculated in any way, are available as a signal source for the display, all outputs, relays and the interface. It is possible to make multiple use of the signals and results (e.g. a signal source is used as an analog output signal and as a limit value for a relay). For more information, see: 📖 TI00150R 📖 BA00287R

Supplementary documentation for Gammapilot M

The supplementary documentation is available on our product pages at **"www.endress.com"**

Fields of activity	**Product overview for applications in liquids and bulk solids** FA00001F/00/EN
Operating Instructions	**Gammapilot M, FMG60** *HART* BA00236F/00/EN *PROFIBUS PA* BA00329F/00/EN *FOUNDATION Fieldbus* BA00330F/00/EN *Description of Device Functions* BA00287F/00/EN **PROFIBUS PA planning instructions** Guidelines for planning and commissioning BA00034S/04/EN
Safety Manual	Functional Safety Manual for Gammapilot M SD00230F/00/EN SD00324F/00/EN
Clamping device for level and point level detection FHG60	For details refer to SD01202F/00/EN
Clamping device for density measurement FHG61	For details refer to SD01221F/00/EN
Measurement section for density measurement FHG62	For drawings and description, see SD00540F/00/EN

Supplementary documentation for gamma radiation source, source containers and modulator

Gamma radiation source FSG60, FSG61	• Technical Information for gamma radiation source FSG60/FSG61 • Returning source containers • Type A packaging 📖 TI00439F/00/EN
Source container FQG60	Technical Information for source container FQG60 📖 TI00445F/00/EN
Source container FQG61, FQG62	Technical Information for source containers FQG61 and FQG62 📖 TI00435F/00/EN
Source container FQG61, FQG62	Technical Information for source container FQG63 📖 TI00446F/00/EN
Gammapilot FTG20	Technical Information for Gammapilot FTG20 📖 TI01023F/00/EN Operating Instructions for Gammapilot FTG20 📖 BA01035F/00/EN
Source container QG2000	Technical Information for source container QG2000 📖 TI00346F/00/EN Operating Instructions for source container QG2000 📖 BA00223F/00/EN
Gamma modulator FHG65	Technical Information for gamma modulator FHG65 and synchronizer FHG66 📖 TI00423F/00/EN Operating Instructions for gamma modulator FHG65 and synchronizer FHG66 📖 BA00373F/00/EN

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