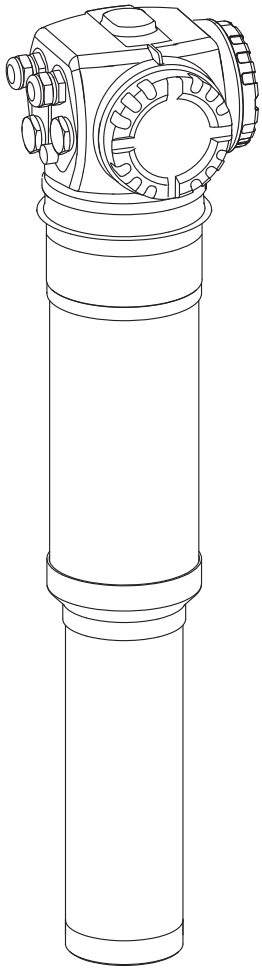
BA00236F/00/EN/14.14
71253004

Valid for software version:
V01.03.06

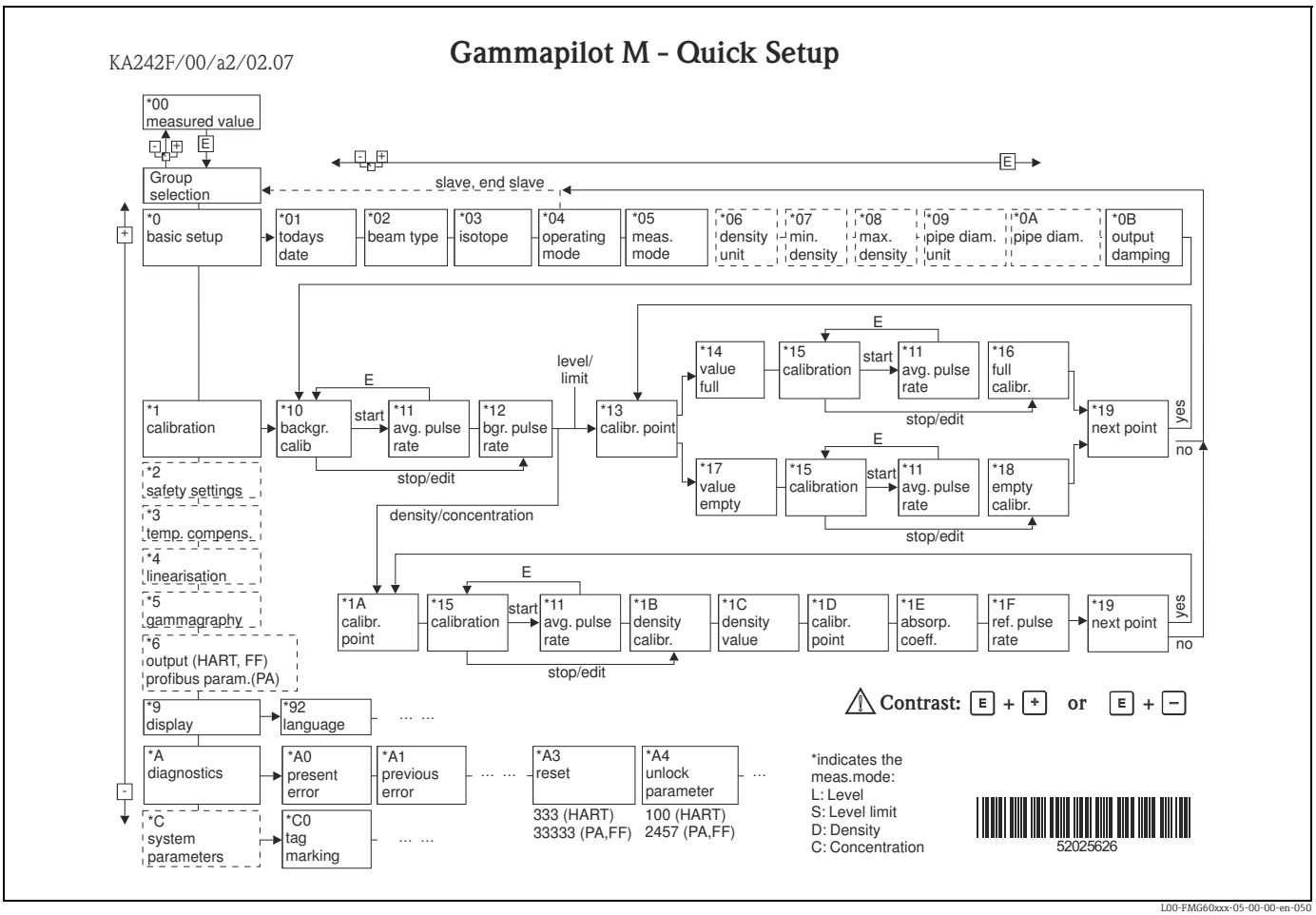
Operating Instructions
Gammapilot M FMG60
Radiometric Measurement

HART COMMUNICATION PROTOCOL



Endress+Hauser
People for Process Automation

Short instructions



Contents of the Operating Instructions

These Operating Instructions describe how to install and commission the radiometric compact transmitter Gammapilot M (communication version 4-20 mA with HART). All the functions that are required for standard measuring tasks have been included. Also, the Gammapilot M provides additional functions for optimizing the measuring point and for converting the measured value. These functions are not included in these Operating Instructions.

You can find an **overview of all the device functions** in the Appendix.

A **detailed description of all the instrument functions** is given in Operating Instructions BA00287F/00/EN "Gammapilot M - Description of Device Functions" which can be found on the CD-ROM supplied.

Table of contents

1 Safety instructions

1.1 Designated use

The Gammapilot M is a compact transmitter for non-contact level, level limit, density and concentration measurement. The measuring range of a single Gammapilot M extends up to 2 m (6.6 ft). Large measuring ranges of any size can be implemented, however, by cascading several Gammapilot M devices. When used for level limit detection, the Gammapilot M is certified according to IEC 61508 for safety-related operation up to SIL 2/3.

1.2 Installation, commissioning, operation

The Gammapilot M is fail-safe and is constructed to the state-of-the-art. It meets the appropriate standards and EC directives. However, if you use it improperly or other than for its designated use, it may pose application-specific hazards, e.g. product overflow due to incorrect installation or configuration. Installation, electrical connection, startup, operation and maintenance of the measuring device must therefore be carried out exclusively by trained specialists authorized by the system operator. Technical personnel must have read and understood these Operating Instructions and must adhere to them. You may only undertake modifications or repair work to the device when it is expressly permitted by the Operating Instructions.

1.3 Hazardous area

Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an integral part of these Operating Instructions. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory.

- Ensure that all personnel are suitably qualified.
- Observe the specifications in the certificate as well as national and local standards and regulations.

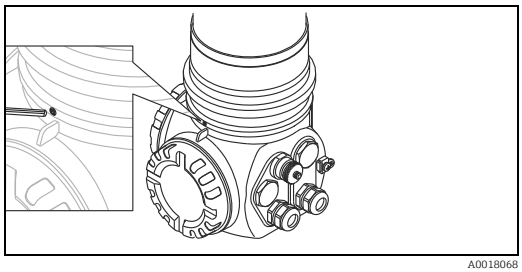
⚠ CAUTION

Detector or cooling jacket can be damaged if the cooling water freezes.

▶ Empty cooling jacket or protect against freezing.

⚠ WARNING

The three screws, connecting the pipe housing to the compartment housing, must not be opened.



A0018068

⚠ WARNING

Depending on the certificate version observe the associated Safety Instructions (→ 🖹 83).

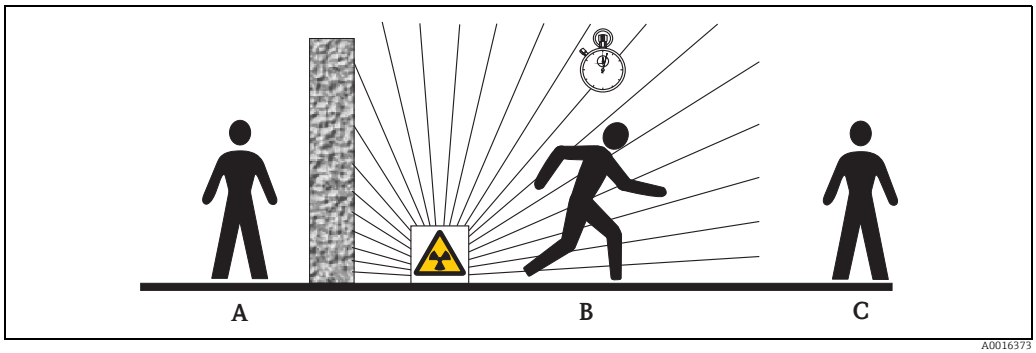
1.4 Radiation protection

The Gammapilot M is used in conjunction with a radioactive source, contained in a source container. When handling radioactive sources, the following instructions have to be observed:

1.4.1 Basic regulations on radiation protection

⚠ WARNING

When handling radioactive sources, all unnecessary radiation exposure should be avoided. All unavoidable radiation exposure should be kept as low as possible. Three measures are used for this:



A Screening
B Time
C Distance

Shielding

Ensure the best possible shielding between the radiation source and yourself as well as all other individuals. Effective shielding is provided by source containers (FQG60, FQG61/ FQG62, FQG63, QG2000) and all high-density materials (lead, iron, concrete).

⚠ CAUTION

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

Source Container	Document
FQG60	TI00445F/00/EN
FQG61, FQG62	TI00435F/00/EN
FQG63	TI00446F/00/EN
QG2000	TI00346F/00/EN BA00223F/00/EN

Time

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

Distance

Keep as far away as possible from the radiation source. The local radiation intensity decreases as the square-root of the distance from the radiation source.

1.5 Symbols

1.5.1 Safety symbols

Symbol	Meaning
 A0011189-DE	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
 A0011190-DE	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
 A0011191-DE	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
 A0011192-DE	**NOTICE!** This symbol contains information on procedures and other facts which do not result in personal injury.

1.5.2 Electrical symbols

Symbol	Meaning
 A0018338	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system..
 A0018339	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.

1.5.3 Tool symbols

Symbol	Meaning
 A0011221	Allen key

1.5.4 Symbols for certain types of information

Symbol	Meaning
 A0011182	**Allowed** Indicates procedures, processes or actions that are allowed.
 A0011183	**Preferred** Indicates procedures, processes or actions thar are preferred.
 A0011184	**Forbidden** Indicates procedures, processes or actions that are forbidden.
 A0011193	**Tip** Indicates additional information.
 A0015484	**Reference to page** Refers to the corresponding page number.
1. , 2. , ...	Series of steps

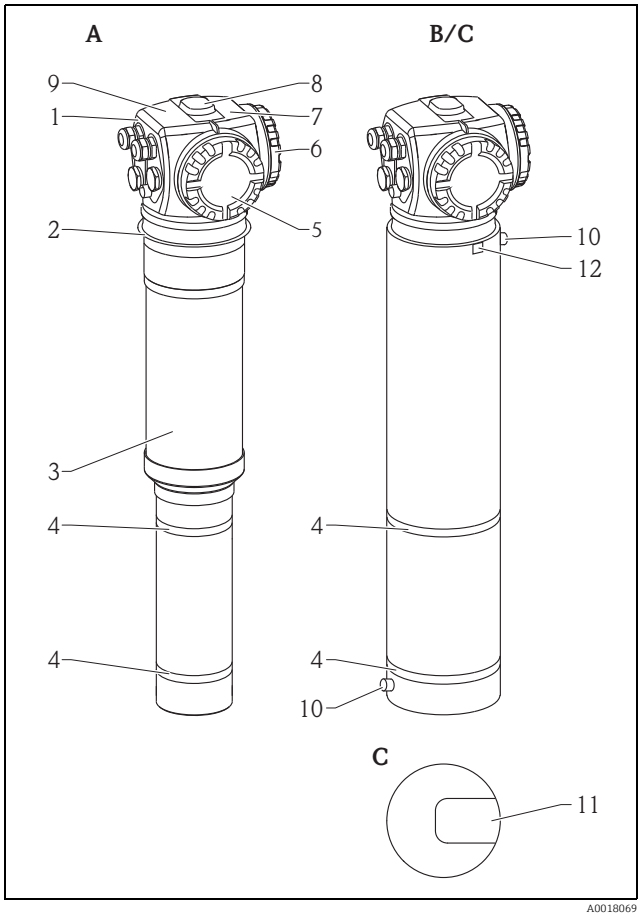
1.5.5 Symbols in graphics

Symbol	Meaning
1, 2, 3, 4, ...	Item numbers
1. , 2. , ...	Series of steps
A, B, C, D, ...	Views
 A0011187	**Hazardous area** Indicates a hazardous area.
 A0011188	**Safe area (non-hazardous area)** Indicates a non-hazardous location.

2 Identification

2.1 Parts of the Gammapilot M

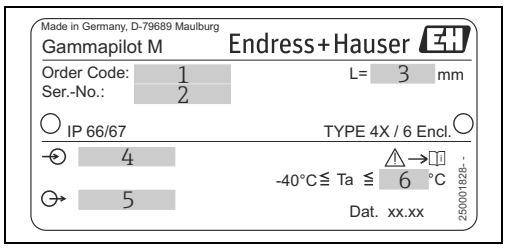
1. Terminal head
2. Mounting collar
3. Detector pipe
4. Measuring range marks
5. Terminal compartment 2
6. Terminal compartment 1
7. Supplementary nameplate
8. Centering knob
9. Instrument nameplate
10. Cooling water connections
11. Marking of the radiation window (only for versions with collimator)
12. Potential equalization terminal of the water cooling jacket



A *Gammapilot M without water cooling jacket*
B *Gammapilot M with water cooling jacket*
C *Gammapilot M with collimator*

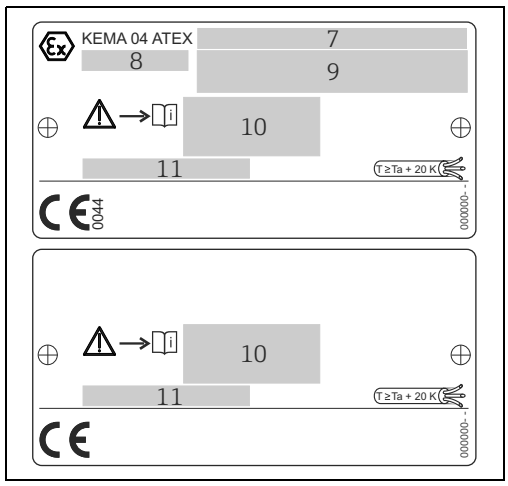
2.2 Nameplates

Device nameplate



1 Order code (as defined by the Ordering information)
2 Serial number
3 Measuring range
4 Power supply
5 Output signal
6 Max. ambient temperature

Supplementary nameplate (Examples)



7 No. of certificate
8 Equipment group and category
9 Type of protection
10 Reference to additional safety-relevant information
11 Reference to additional certificates (e.g. WHG, SIL)
12 Specification of required temperature resistance of the connected cables (only for instrument versions with water cooling jacket)

2.3 Scope of delivery

- Ordered version of the device (including Operating Instructions)
- Endress+Hauser operating program (on the CD-ROM supplied)
- Accessories as ordered

2.4 Supplied documentation

2.4.1 Operating Instructions (BA00236F/00/EN)

Describe how to install and commission the Gammapilot M (communication version 4-20 mA HART). Those functions of the operating menu are included, which are required for standard measuring tasks. Any additional functions are contained in the "Description of Device Functions" (BA00287F/00/EN).

2.4.2 Description of Device Functions (BA00287F/00/EN)

Contains a detailed description of all the functions of the Gammapilot M and applies for all communication versions. This document can be found as a PDF file on the CD-ROM supplied and can be downloaded from the Internet under "www.de.endress.com" (→ download).

2.4.3 Safety instructions

Additional safety instructions (XA, ZE, ZD) are supplied with certified device versions. Refer to the nameplate for the names of the safety instructions that apply to your device variant. An overview of the certificates and approvals can be found in TI00363F/00/EN, chapter "Certificates and approvals".

2.5 Certificates and approvals

CE mark, declaration of conformity
The device is designed 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. The device takes into account applicable standards and regulations which are listed in the EC declaration of conformity and thus meets the legal requirements of the EC Directives. Endress+Hauser confirms the successful testing of the instrument by affixing to it the CE mark.

2.6 Registered trademarks

HART®
Registered trademark of the HART Communication Foundation, Austin, USA

ToF®
Registered trademark of Endress+Hauser GmbH+Co. KG, Maulburg, Germany

3 Installation

3.1 Incoming acceptance, transport, storage

3.1.1 Incoming acceptance

Check the packing and contents for any signs of damage.
Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

3.1.2 Transport

⚠ CAUTION
Follow the safety instructions and transport conditions for devices of more than 18 kg (39.69 lbs).

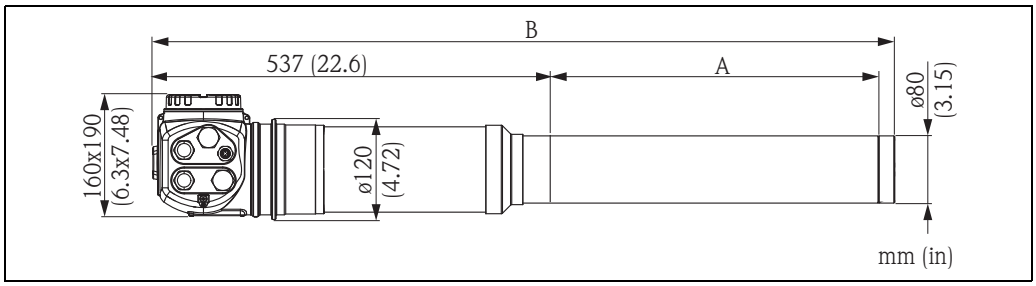
3.1.3 Storage

Pack the measuring instrument so that it is protected against impacts for storage and transport. The original packing material provides the optimum protection for this.
The permissible storage temperature is:
- -40 to +50 °C (-40 to +122 °F) for devices with PVT scintillator
- -40 to +60 °C (-40 to +140 °F) for devices with NaI crystal

3.2 Installation conditions

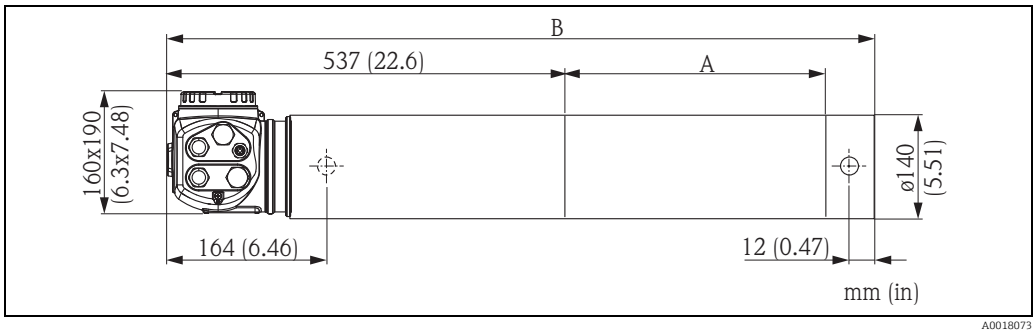
3.2.1 Dimensions, weight

Gammapilot M (without water cooling jacket)



A0018072

Gammapilot M with water cooling jacket or collimator



A0018073

Type	Measuring length A [mm (in)]	Without water cooling jacket		With water cooling jacket		
		Overall length B [mm (in)]	Weight [kg (lbs)][1)]	Overall length B [mm (in)]	Weight without water [kg (lbs)][1)]	Weight including 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 given weight data are for 316L version. The weight of the aluminium version is reduced by 5,3 kg (11.69 lbs).

3.2.2 Installation conditions for level measurement

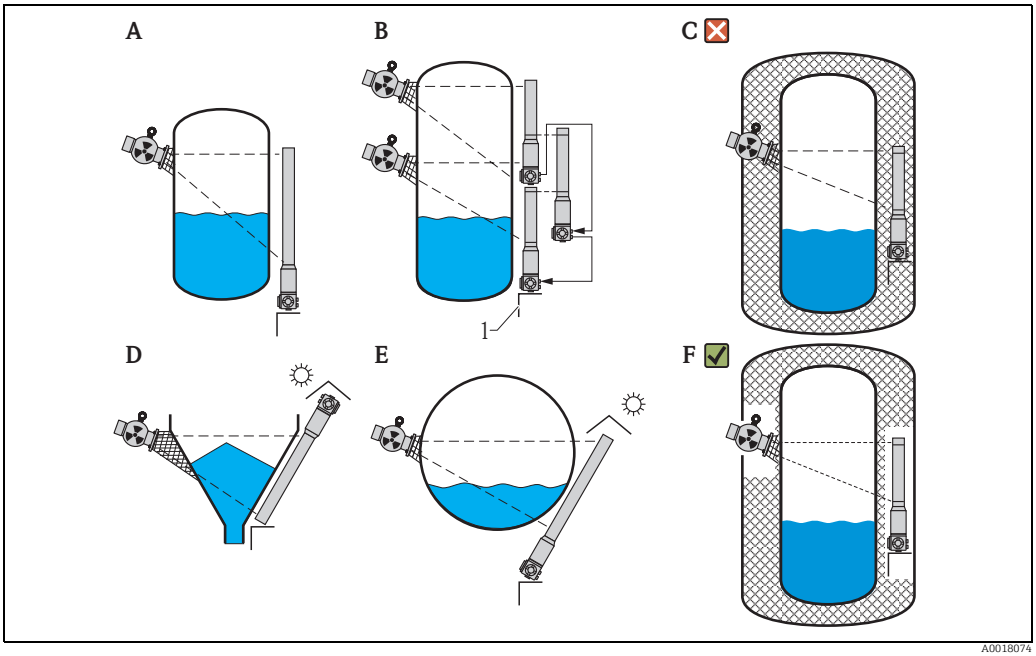
Conditions

- For level measurements the Gammapilot M is mounted vertically; if possible the detector head should point downwards.
- The exit angle 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.
- In cascading mode no gap should occur between the measuring ranges of the different Gammapilot M.
- The source container and the Gammapilot M must be mounted as close to the vessel as possible. Any access to the beam must be blocked so that no persons or part of their body (hand, arm, head) may come into the area of the beam.
- In order to enlarge the lifetime, the Gammapilot M should be protected against direct sun. If necessary, a protective cover should be applied.
- The mounting device FHG60 (→ 72, "Accessories") or an equivalent mounting device should be used for fastening the Gammapilot M.
  The mounting device must be installed in a way such that it can withstand the weight of the Gammapilot M[1)] under all operating conditions (e.g. vibrations).

NOTICE

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

Examples



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; there is no gap between the measuring ranges*
C *Wrong: Gammapilot M mounted inside the tank insulation*
D *Conical tank outlet (here with sun protection cover)*
E *Horizontal cylinder (here with sun protection cover)*
F *Right: Tank insulation removed for Gammapilot M*

1 *Support*

1) The weights of the various versions of the Gammapilot M are summarized in the section "Dimensions, weight".

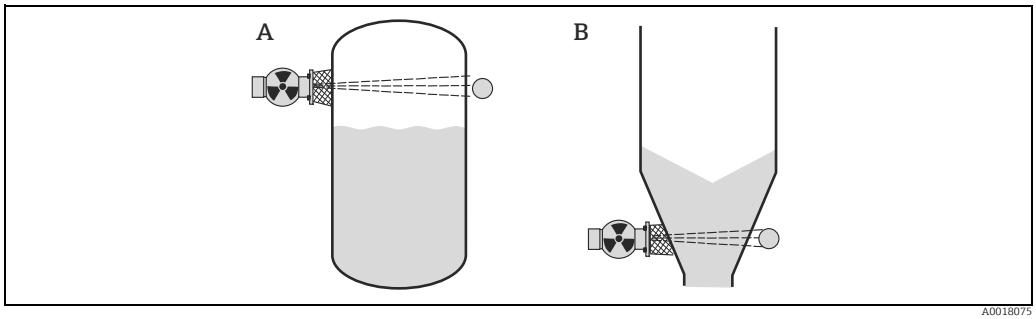
3.2.3 Installation conditions for level limit detection

Conditions

- For level limit detection, the Gammapilot M should be mounted horizontally at the height of the desired level limit.
- The exit angle 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 must be mounted as close to the vessel as possible. Any access to the beam must be blocked so that no persons or part of their body (hand, arm, head) may come into the area of the beam.
- In order to enlarge the lifetime, the Gammapilot M should be protected against direct sun. If necessary, a protective cover should be applied.
- The mounting device FHG60 (→ 72, "Accessories") or an equivalent mounting device should be used for fastening the Gammapilot M.
  The mounting device itself must be fitted in a way such that it can withstand the weight of the Gammapilot M[2)] under all operating conditions to be expected.

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

Examples



A Maximum fail-safe mode
B Minimum point level detection

2) The weights of the various versions of the Gammapilot M are summarized in the section "Dimensions, weight".

3.2.4 Installation conditions for density and concentration measurement

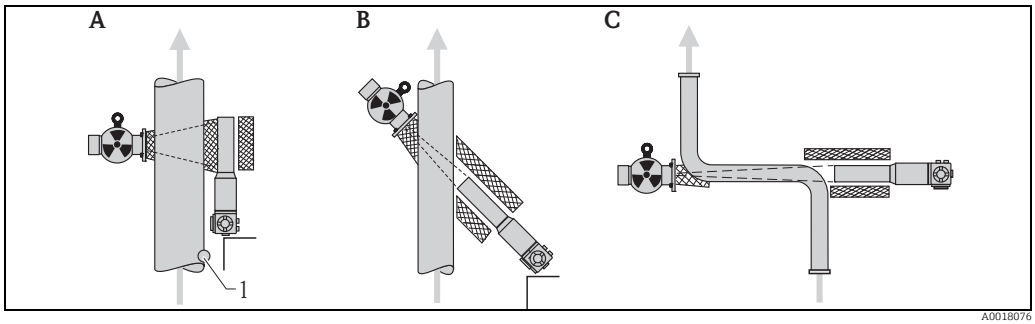
Conditions

- If possible, density and concentration should be measured at vertical pipes with a feed direction from bottom to top.
- If only horizontal pipes are accessible, the path of the ray should also be arranged horizontally to reduce the influence of air bubbles and sediments.
- The Endress+Hauser clamping device (→ 72, "Accessories") or an equivalent clamping device should be used for fastening the radiation source container and the Gammapilot M to the measuring tube.The clamping device itself must be installed in a way such that it can withstand the weight of the source container[3] and the Gammapilot M[4] under all 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 for pumps.

Configuration of the measuring system

The configuration of the source container and the Gammapilot M depends on the pipe diameter (or the length of the irradiated measuring path respectively) and the measuring range. These two parameters determine the measuring effect (relative change of the pulse rate). The measuring effect increases with the length of the radiation path through the medium. Therefore, diagonal irradiation or the use of a measurement section is necessary for small pipe diameters.

For the configuration of the measuring system please contact your Endress+Hauser sales organization or use the "Applicator" ™ [5] configuration software.



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

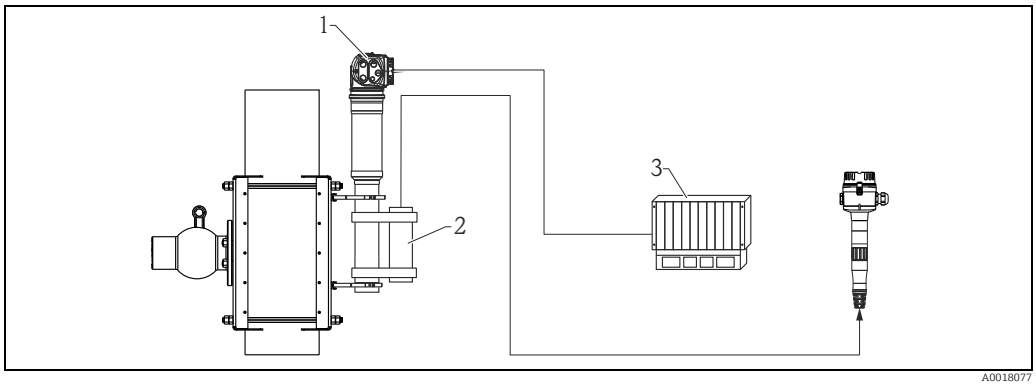
NOTICE

General

- ▶ To increase the accuracy for 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 prevent damage to the connecting cable.
- ▶ A clamping device and a measurement section are available as accessories (→ 72, "Accessories").

3) The weights of the source containers are specified in TI00445F/00/EN (FQG60), TI00435F/00/EN (FQG61, FQG62), TI00446F/00/EN (FQG63) or TI00346F/00/EN (QG2000).
4) The weights of the various versions of the Gammapilot M are summarized in the section "Dimensions, weight".
5) The "Applicator"™ is available from your Endress+Hauser sales organization.

3.2.5 Empty pipe detection



1 Gammapilot M
2 Monitoring detector FTG20 or FMG60
3 SPS

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

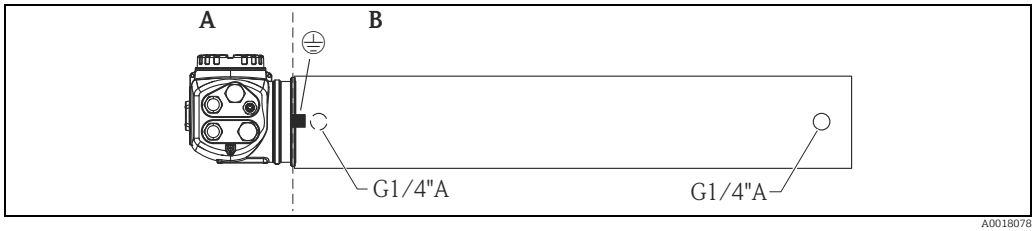
If the pipe becomes empty as a result of operational processes, the radiation on the detector side can hit dangerous levels.

- In such instances, the irradiation 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 of avoiding 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.

3.3 Water cooling

For the versions of the Gammapilot with water cooling jacket, the following applies:
- Material: 316L
- Water connection: 2 x G 1/4"A, DIN ISO 228
- Inlet temperature: max. 40 °C (104 °F)
- Outlet temperature: max. 50 °C (122 °F) (temperature monitoring recommended)
- Water pressure: 4 to 6 bar (60 to 90 psi)



A T <75 °C (167 °F)
B T <120 °C (248 °F)

⚠ CAUTION

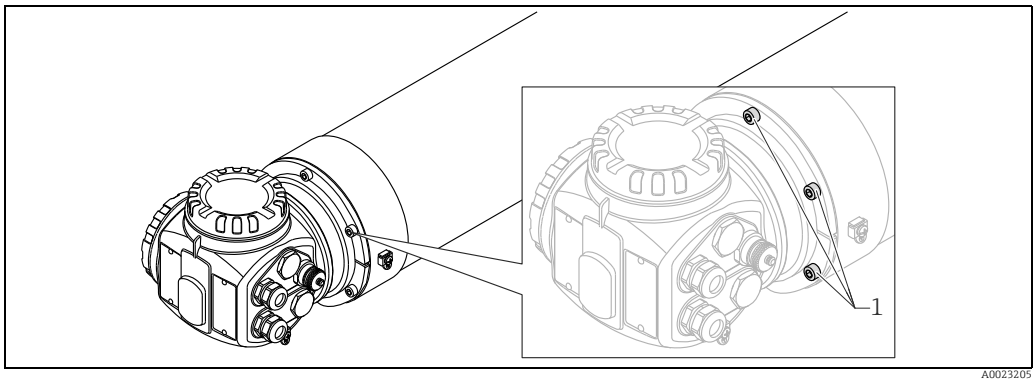
Detector or cooling jacket can be damaged if the cooling water freezes.

▶ Empty cooling jacket or protect against freezing.

⚠ WARNING

Pressurized water cooling system!

▶ Do not open the cylinder screws (see figure below) when pressurized.



1 Cylinder screws

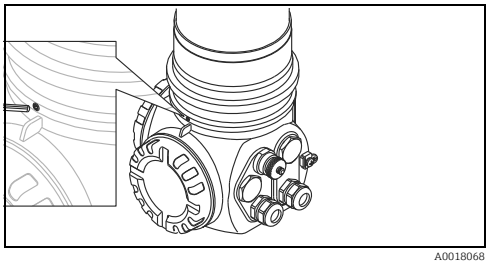
⚠ CAUTION

To consider when using the water cooling jacket

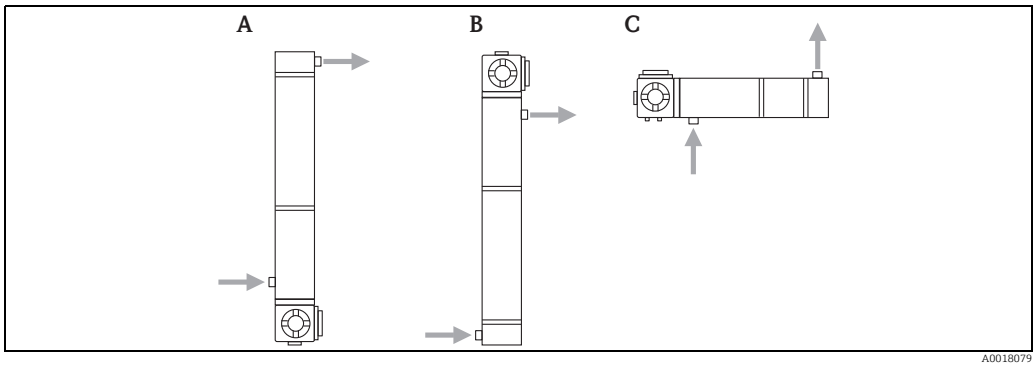
▶ It is recommended to ground the water cooling jacket separately at the provided earth terminal (see picture above)

▶ The ambient temperature of the compartment housing must not exceed 75 °C (167 °F). This is also valid, if water cooling is applied.

▶ The three screws, connecting the pipe housing to the compartment housing, must **not** be opened.



3.3.1 Mounting versions



A *Recommended mounting position for level measurement: compartment housing at the bottom*
B *In exceptional cases (e.g. shortage of space) the compartment housing may be located at the top*
C *Mounting position for point level detection and density measurement*

⚠ CAUTION

The water inlet must always be at the bottom to ensure that the water cooling jacket is completely filled.

3.3.2 Required flow rate

The required flow rate depends on
- the ambient temperature at the water cooling jacket
- the inlet temperature
- the measuring range of the Gammapilot M

Typical values are given in the following tables:

Ambient temperature T_A = 75 °C (167 °F)

Inlet temperature °C (°F)	Measuring range 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 °C (212 °F)

Inlet temperature °C (°F)	Measuring range 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 range 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

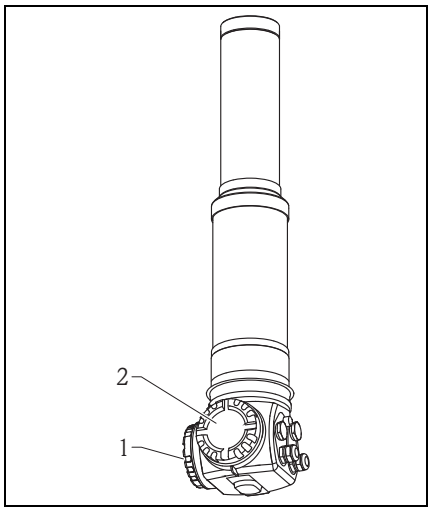
3.4 Installation check

After installing the device, carry out the following checks:
- Is the device damaged (visual inspection)?
- Does the device correspond to the measuring point specifications for ambient temperature, measuring range etc.?
- If available: Are the measuring point number and labeling correct (visual inspection)?
- Is the measuring device sufficiently protected against direct sunlight?
- Are the cable glands tightened correctly?

4 Wiring

4.1 Terminal compartments

The Gammapilot M has got two terminal compartments:
- Terminal compartment 1, for
  - Power supply
  - Signal output (depending on the instrument version)
- Terminal compartment 2, for
  - Signal output (depending on the instrument version)
  - PT-100 input (4-wire)
  - Pulse input for cascading mode
  - Pulse output for cascading mode
  - Display and operating module FHX40 (or VU331)



A0018082

NOTICE

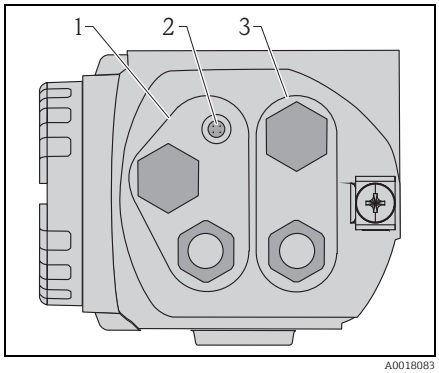
Depending on the instrument version, the signal output is located in the terminal compartment 1 or 2.

Maximum cable length:
- For cascade, 20 m (66 ft) each
- For PT-100 2 m (6.6 ft) (temperature should be measured as close as possible to density measurement)

4.2 Cable entries

The number and type of cable entries depend on the instrument version ordered. The following types may occur:
- Gland M20x1.5
  tightening diameter (clamping range):
  7.0 to 10.5 mm
- 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, Gammapilot M 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

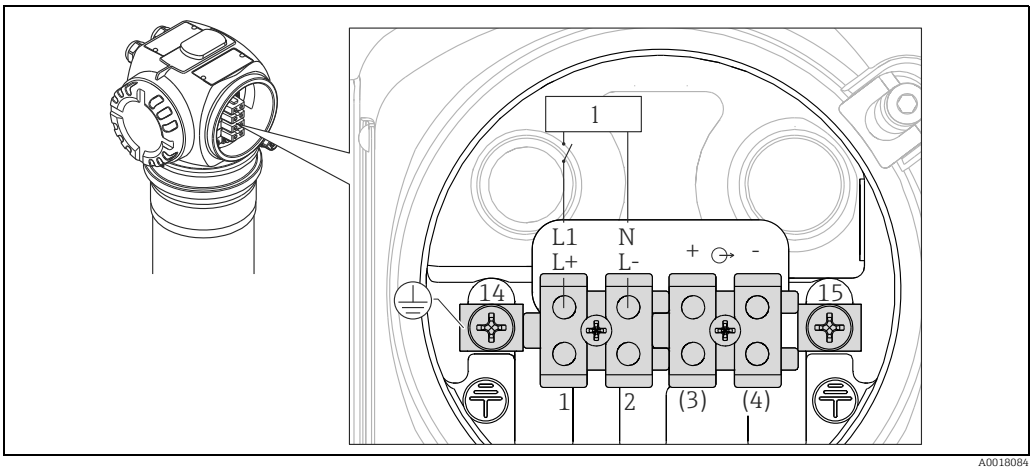
1 Cable entries for terminal compartment 2
2 Socket for FHX40
3 Cable entries for terminal compartment 1

NOTICE

Cable entries
- ▶ On delivery, not more than one cable gland is present for each of the terminal compartments. If further cable glands are required (e.g. for cascading 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 drain loop should be provided or the Gammapilot M should be fitted with a weather protection cover.

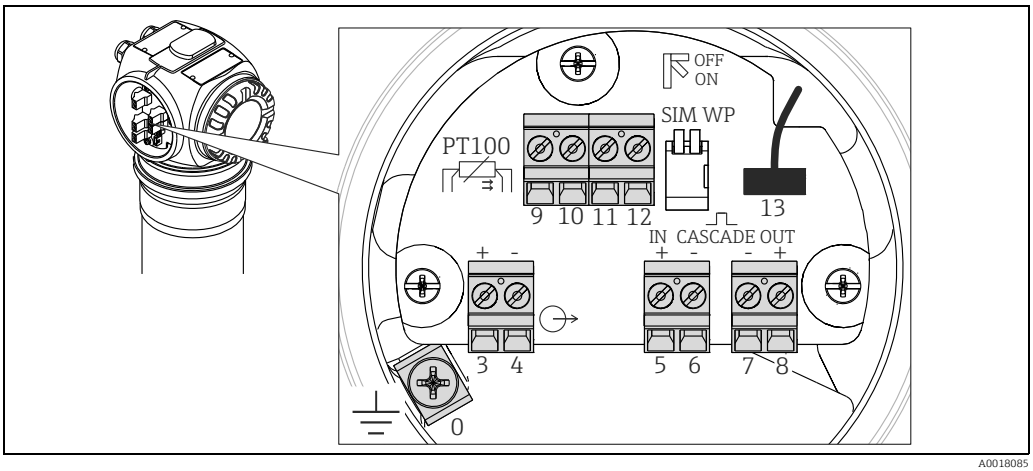
4.3 Terminal assignment

Terminal compartment 1



1 90 to 253VAC, 18 to 36 VDC

Terminal compartment 2

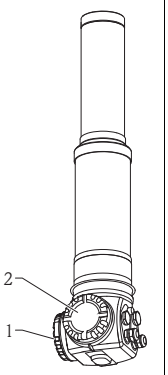


Terminal(s)	Meaning
0	Grounding of the cable screen[1)]
1, 2	Power supply[2)]
Compartment 2: 3, 4 **Compartment 1:** (3)[1],(4)[1]	Signal output, depending on communication version: ▪ 4-20mA with HART ▪ PROFIBUS PA ▪ Foundation Fieldbus (Depending on the device version ordered, the signal output is in connection compartment 1 or 2, see below) **NOTICE** **For the versions of the Gammapilot M with fieldbus plug connectors (M12 or 7/8"), the signal output is wired in compartment 2 on delivery and connected to the fieldbus plug connector (see below, section "Fieldbus connectors"). In this case, the housing needs not to be opened for connecting the signal line.**
5, 6	Pulse input (for cascading mode; is used for master and slave)
7, 8	Pulse output (for cascading mode; is used for slave and end slave)
9, 10, 11, 12	PT-100 input (4-wire)
13	Plug for display and operating module VU331 (normally in FHX40); is wired on delivery and connected to the FHX40 plug
14	Protective earth[1)]
15	Protective earth or grounding of the cable screen[1)]

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

2) Rated cross section max. 2.5 mm^2 (14 AWG)

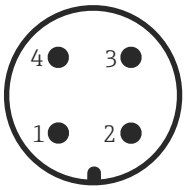
The cables used at terminals 14 or 15 must at least have the same cross section as the cables at terminals 1 and 2.

Feature 30 of the ordering information: Power supply wiring/output wiring		Terminal compartment 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	

4.4 Fieldbus connectors

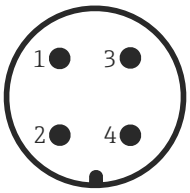
For the versions with a connector M12 or 7/8", the housing does not have to be opened for connecting the signal line.

4.4.1 Pin assignment for M12 connector



PIN	Meaning
1	Signal +
2	Not assigned
3	Signal –
4	Earth

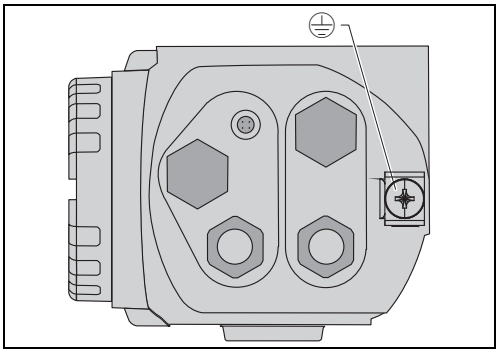
4.4.2 Pin assignment for 7/8" connector



PIN	Meaning
1	Signal –
2	Signal +
3	Shield
4	Not assigned

4.5 Potential equalization

Before wiring, connect the potential matching line to the external ground terminal of the transmitter. If a water cooling jacket is present, it must be separately connected to the potential matching line.


A0018086

⚠ CAUTION

In Ex applications, the instrument must only be grounded on the sensor side. Further safety instructions are given in the separate documentation for applications in explosion hazardous areas.

NOTICE

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.

4.6 Wiring in terminal compartment 1

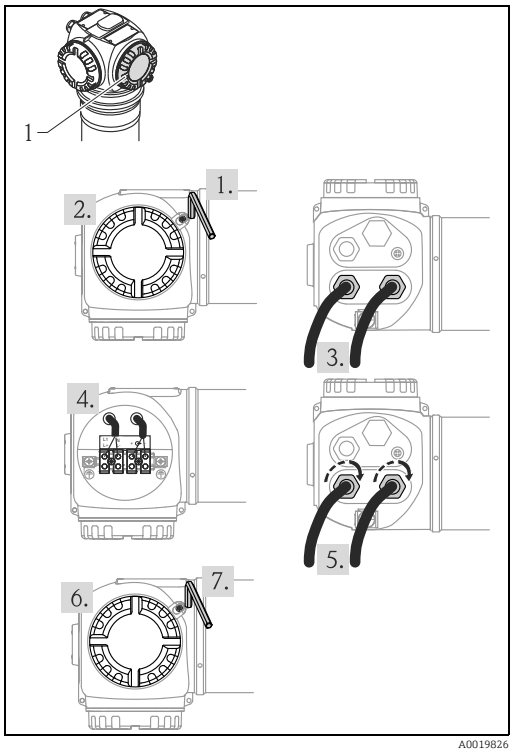
⚠ CAUTION

Before connection please note the following:

- When using the instrument in hazardous areas, make sure to comply with national standards and the specifications in the Safety Instructions (XAs). Make sure you use the specified cable gland.
- The supply voltage must comply to the data on the nameplate.
- Switch off power supply before connecting the instrument.
- Connect potential matching line to the outer transmitter ground terminal and to the ground terminal of the water cooling jacket (if present) before connecting up the instrument (see "Potential equalization", → 24).
- Connect protective earth to the protective earth terminal (see "Terminal compartments", → 20).
- According to IEC/EN 61010 a suitable power switch has to be provided for the instrument.
- The cable isolations must comply with the supply voltage and the overvoltage category.
- The temperature resistance of the connecting cable must comply with the ambient temperature.

The procedure

1. Using a 3 mm Allen key, loosen the cover clamp for the connection compartment cover.
2. Unscrew the cover of the terminal compartment.
3. Push the power cable and (if required) the signal cable) through the appropriate cable glands or cable threads.
4. Wire up according to the terminal assignment diagram.
5. Tighten the cable glands or threads.
6. Screw the cover securely back onto the terminal compartment..
7. Adjust the cover clamp so it is set over the cover and tighten.



A0019826

4.7 Wiring in terminal compartment 2

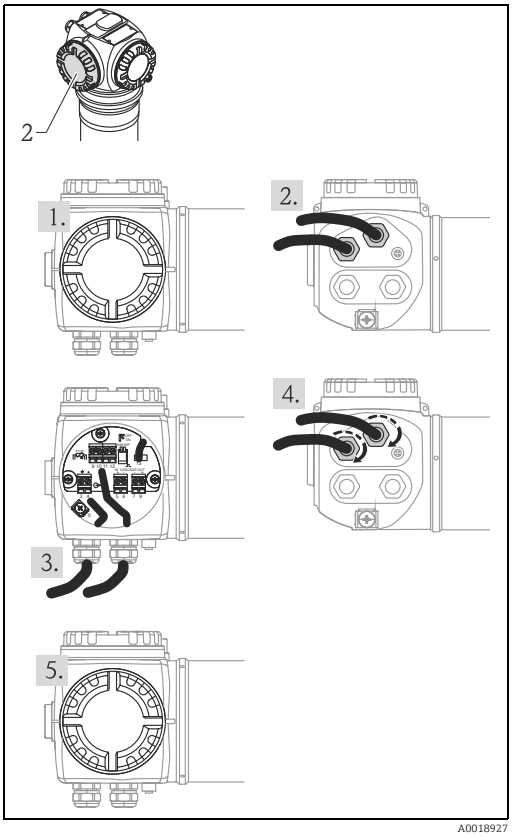
⚠ CAUTION

Before connection please note the following:

- Connect potential matching line to transmitter ground terminal and to the ground terminal of the water cooling jacket (if present) before connecting up the instrument ("Potential equalization", → 24).
- The cable isolations must comply with the supply voltage and the overvoltage category.
- The temperature resistance of the connecting cable must comply with the ambient temperature.

The procedure

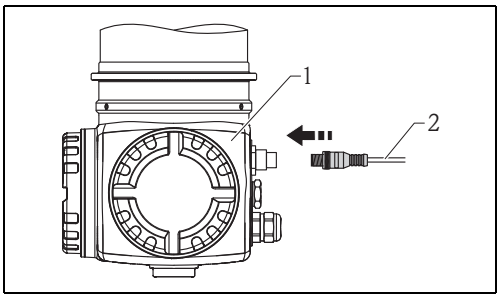
1. Unscrew the cover of the terminal compartment.
2. Push the following cables through the appropriate cable glands or threads:
   - signal cable (if the signal output is located in terminal compartment 2)
   - PT-100 cable (if present)
   - cascading cables (input and/or output, if required)
3. Wire up according to the terminal assignment diagram.
4. Tighten the cable glands or threads.
5. Screw the cover securely back onto the terminal compartment.



A0018927

4.8 Connecting the remote display and operation FHX40

The remote display and operating unit FHX40 is available as accessory. It is connected to the FHX40-connector of the Gammapilot M via the supplied cable. To do this, the housing of the Gammapilot M needs not to be opened.

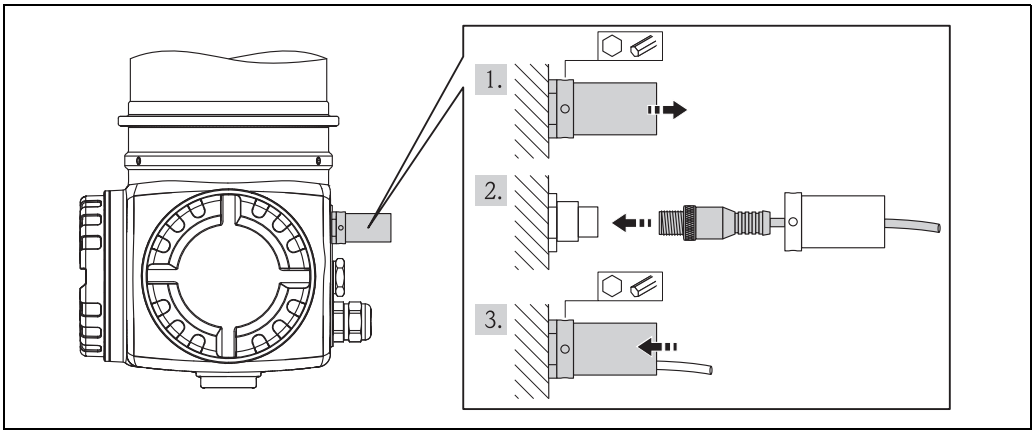


A0018089

1 Gammapilot M FMG60
2 Cable of the display and operating unit FHX40

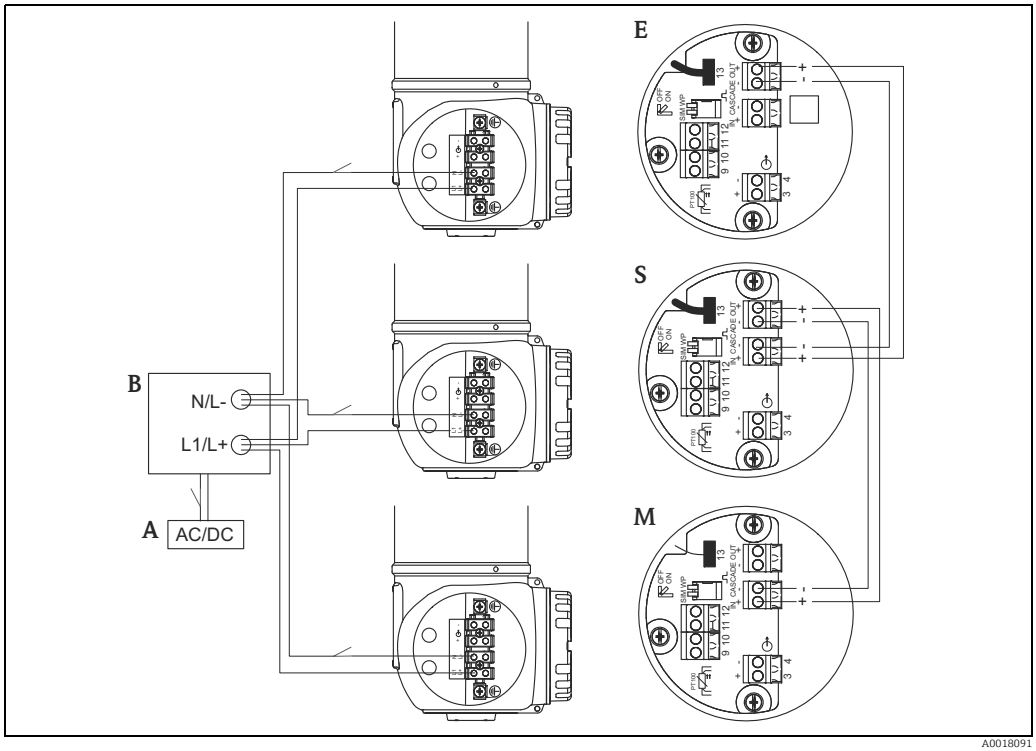
For some Dust-Ex versions of the Gammapilot M, the FHX40 connector is protected by a metal sleeve.

1. Loosen and remove the sleeve with an Allen wrench.
2. Connect the display and operating unit FHX40
3. Attach the sleeve and fasten the Allen screw.



A0018090

4.9 Wiring in cascading mode



A *Power supply (90 to 253V_{AC} or 18 to 36V_{DC})*
B *Junction box*
M *Master*
S *Slave*
E *End-Slave*

NOTICE

For the positioning of the power switch according to IEC/EN 61010, there are two options:

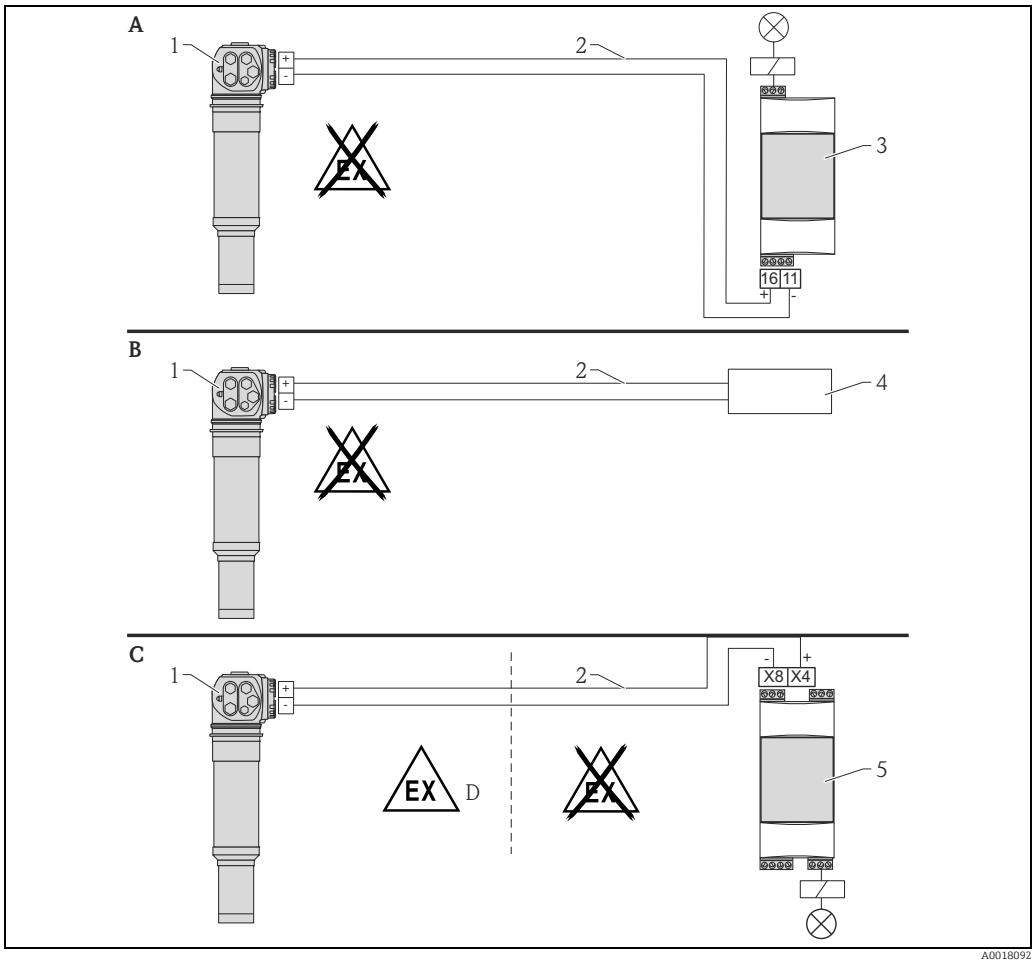
- **At the side of the** power supply (one switch for all transmitters)
- **At the side of the** transmitters (an individual switch for every transmitter)

⚠ WARNING

For applications in hazardous areas it is not allowed to interconnect the HART signal circuits for multidrop operation.

4.10 Wiring example for level limit detection 200/400 mm

The output signal is linear between the free and covered calibration (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, without SIL
- RMA42: for Ex-applications; with WHG and SIL certificates



A0018092

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 SPS
5 RMA42

4.10.1 Ex applications in connection with RMA42

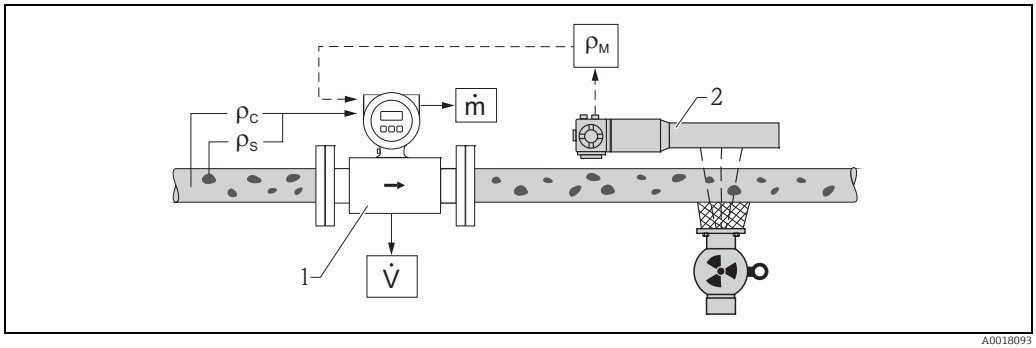
Observe the following Safety Instructions:
- XA00303F/00/A3: ATEX II 2 (1) G for Gammapilot M
- XA00304F/00/A3: ATEX II 2 (1) D for Gammapilot M
- XA00095R/09/A3: ATEX II (1) G [Ex ia] IIC, ATEX II (1) D [Ex ia] IIIC for RMA42

4.10.2 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.

4.11 Measuring solids flow

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



Solids flow measurement (m) with the aid of a density and flow measuring device. If the density of the solids (ρ_S) and the density of the transporting liquid (ρ_C) are also known, the solids flow rate can be calculated.

1 Flow measuring device (Promag 55S) → Volume flow (V). The solids density (ρ_S) and the density of the transporting liquid (ρ_C) also have to be entered in the transmitter
2 Density measuring device (e.g. "Gammapilot M") → Total density ρ_M (transporting liquid and solids)

4.12 Post-connection check

After wiring the device, carry out the following checks:
- Is the protective earth connected?
- Is the Potential Equalization Line connected?
- Are the terminals correctly assigned?
- Are the cable glands and dummy plugs tight?
- Are the fieldbus connectors and the FHX40 connector fixed securely?
- Are the lids screwed tightly onto the terminal compartments?
- For dust ignition-proof devices: Is the protective sleeve for the FHX40 socket correctly attached?
- Is the cover of the terminal compartment 1 secured by the cover clamp?

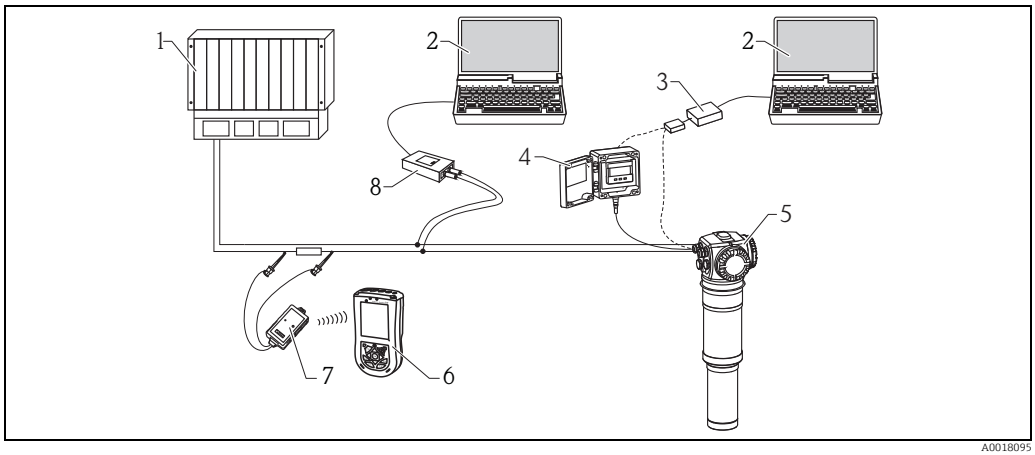
⚠ WARNING

The Gammapilot M may only be operated, if the cover of the terminal compartment 1 is tightly closed.

5 Operation

5.1 Overview over the operating options

5.1.1 4 to 20mA with HART protocol



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

If the HART communication resistor is not built into the supply unit, it is necessary to insert a communication resistor of 250 Ω 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 operating program "FieldCare". FieldCare is a graphical operating software for devices from Endress+Hauser. It assists with commissioning, securing data, signal analysis and documentation of the measuring point.

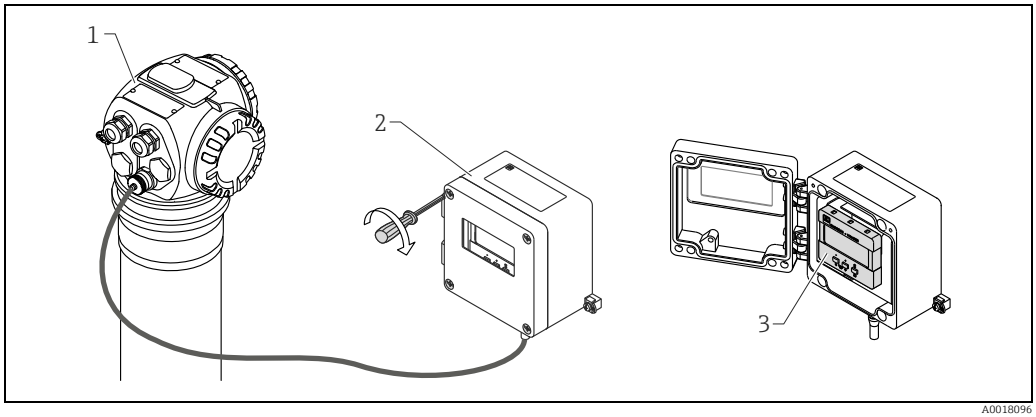
Operation via HART

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

5.2 Display operation

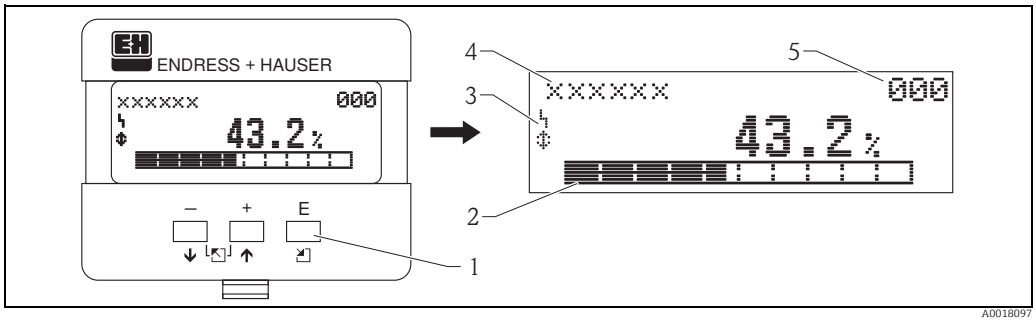
5.2.1 Display and operating elements

The LCD module VU331 for displaying and operating is inside the remote display and operating unit FHX40. The measured value can be read off through the FHX40 sight glass. In order to operate the instrument, the FHX40 must be opened by removing the four screws.



1 Gammapilot M
2 FHX40
3 Operating module VU331

Display and operating module VU331



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

Display symbols

The following table describes the symbols that appear on the liquid crystal display:

Symbol	Meaning
	ALARM_SYMBOL This alarm symbol appears when the instrument is in an alarm state. If the symbol flashes, this indicates a warning.
	LOCK_SYMBOL This lock symbol appears when the instrument is locked, i.e. if no input is possible.
	COM_SYMBOL This communication symbol appears when data transmission via HART, PROFIBUS PA or FOUNDATION Fieldbus, for example, is in progress.
	SIMULATION_SWITCH_ENABLE This communication symbol appears when simulation in FOUNDATION Fieldbus is enabled via the DIP switch.

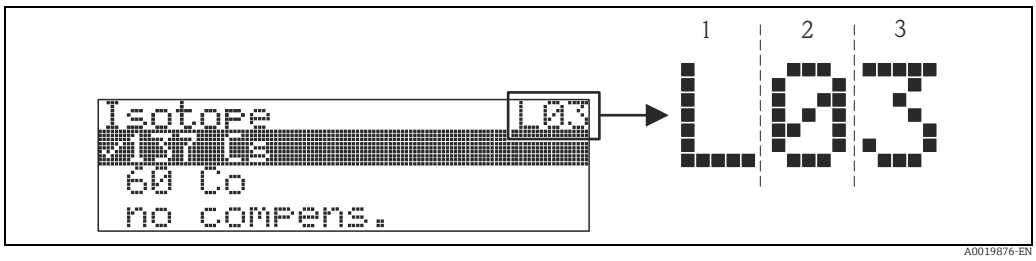
Function of the keys

Key(s)	Meaning
+ or ↑	Navigate upwards in the selection list. Edit numeric value within a function.
− or ↓	Navigate downwards in the selection list. Edit numeric value within a function.
Esc − + or ←	Navigate to the left within a function group.
E	Navigate to the right within a function group, confirmation.
+ and E or − and E	Contrast settings of the LCD.
+ and − and E	Hardware lock / unlock After a hardware lock, an operation of the instrument via display or communication is not possible! The hardware can only be unlocked via the display. An unlock parameter must be entered to do so.

5.2.2 The operating menu

Function code

The functions of the Gammapilot M are arranged in an operating menu. To ensure easy orientation within the menu, a unique position code is indicated on the display for each function. This code consists of one alphabetic and two numeric characters.



1 Measuring mode
2 Function group
3 Function

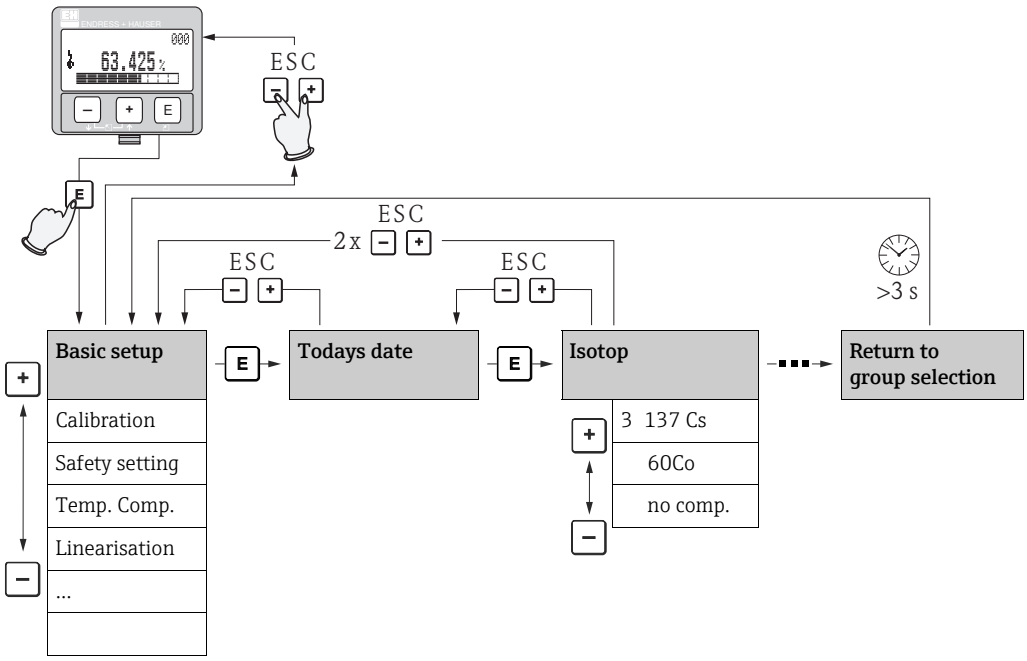
- The alphabetic character specifies the current measuring mode of the Gammapilot M:
  - **L**: level
  - **S**: limit (switch)
  - **D**: density
  - **C**: concentration
  - *****: no measuring mode selected yet

- The first numeric character identifies the function group:
  - **basic setup *0**
  - **calibration *1**
  - **Safety settings *2**
  - **...**

- The second numeric character numbers the individual functions within the function group:
  basic setup *0
  - **today's date *01**
  - **beam type *02**
  - **isotope *03**
  - **operating mode *04**
  - **...**

Hereafter, the position is always given in brackets after the function name. "*****" (not yet selected) is always indicated as the measurement method, e.g. **"present date" (*01)**.

Operation using the onsite display VU331



Selection and configuration in Operation menu:

1. Change from Measured Value Display to **Group Selection** by pressing E.
2. Press − or + to select the required **Function Group** and confirm by pressing E.
   The active selection is marked by a ✔ in front of the menu text.
3. Activate Edit mode with + or −.
   Selection menus
   a. Select the required parameter in the **function** selected with − or +.
   b. E confirms selection; ✔ appears in front of the selected parameter.
   c. E confirms the edited value; system quits edit mode.
   d. Simultaneous pressing of + and − interrupts selection; system quits edit mode.

   Typing in numerals and text
   a. Press + or − to edit the first character of the numeral / text.
   b. E positions the cursor at the next character; continue with a. until you have completed your input.
   c. If a ↵ symbol appears at the cursor, press E to accept the value entered; system quits edit mode.
   d. If a ← symbol appears at the cursor, press E to return to the previous character (e.g. for correction of entries).
   e. Simultaneous pressing of + and − interrupts selection; system quits edit mode.
4. Press E to select the next function.
5. Press + and − simultaneously once; return to previous **function**.
   Press + and − simultaneously twice; return to **Group Selection**.
6. Press + and − simultaneously to return to **Measured value display**.

5.3 Alternative operation options

Apart from local operation, you can also parameterise the measuring instrument and view measured values by means of a HART protocol. There are two options available for operation:
- Operation via the universal handheld operating unit Field Xpert SFX100
- Operation via the Personal Computer (PC) using the operating program FieldCare

NOTICE

The device can also be operated locally using the keys. If operation is prevented by the keys being locked locally, parameter entry via communication is not possible either.

5.3.1 Operation via Field Xpert SFX100

Compact, flexible and robust industry handheld terminal for remote parametrization and measured value inspection via the HART current output or FOUNDATION Fieldbus. For details refer to BA00060S/04/EN.

5.3.2 FieldCare operating program

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 you can find on the internet:
www.endress.com → select your country → search: FieldCare → FieldCare → Technical Data.

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

Connection options:
- HART via Commubox FXA195 and the USB port on a computer
- Commubox FXA291 with ToF Adapter FXA291 via service interface

5.4 Lock/unlock configuration

5.4.1 Software security locking

Enter a number ≠ 100 into the **"unlock parameter" (*A4)** function in the **"diagnostics" (*A)** function group. The symbol appears on the display. Inputs are no longer possible.

If you try to change a parameter, the device jumps to the **"unlock parameter" (*A4)** function. Enter "100". Now change the parameters.

5.4.2 Hardware security locking

Press −, + and E simultaneously. Inputs are no longer possible.
If you try to change a parameter, the following appears:

On-site display	
unlock parameter	0A4
Hardware locked	

Press −, + and E simultaneously. The **"unlock parameter" (*A4) function** appears. Enter "100". Now change the parameters.

NOTICE
A hardware locking can only be unlocked again via the display by pressing the +, − and E keys at the same time again. It is not possible to unlock the hardware by communication.

5.5 Reset to the default configuration

It is advisable to reset the customer parameters if you want to use a device with an unknown history. Effects of resetting:
- All customer parameters are reset to their default values.
- Linearization is switched to **"linear"**, but the table values are kept. The table can be switched back on in the **"linearization" (*4)** function group in the **"linearization" (*40/*46)** function.

In order to carry out the reset, enter "333" in the **"reset" (*A3)** function in the **"diagnostics" (*A)** function group.

⚠ CAUTION
A reset may lead to impairment of the measurement. As a rule, a basic calibration is required after a reset. All the calibration data are deleted after a reset. A complete calibration is needed to put the measurement back into operation.

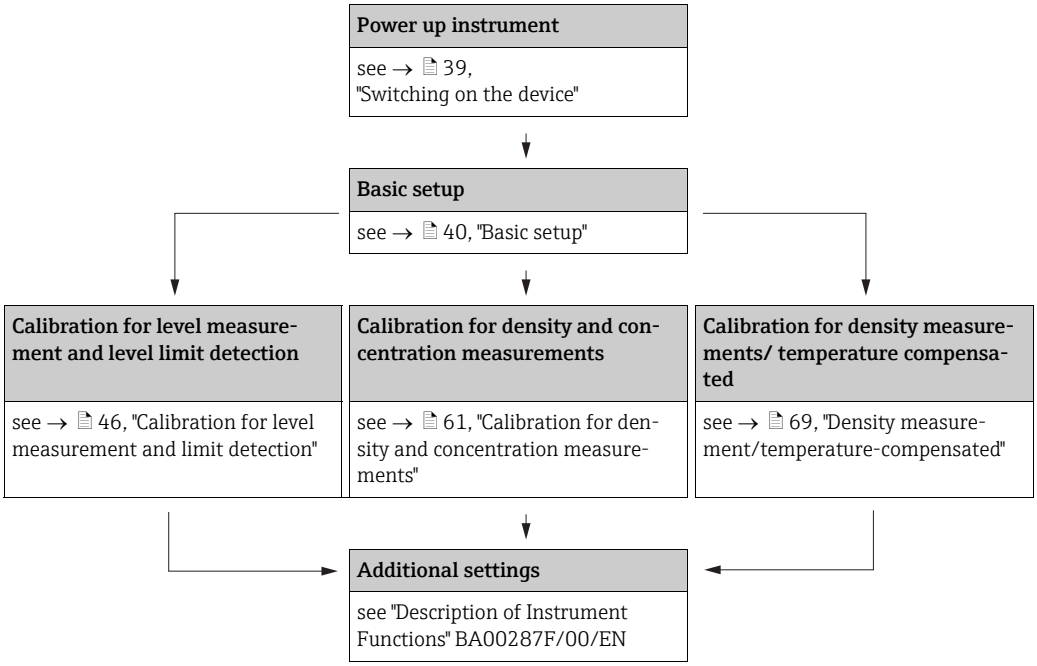
NOTICE
The default values of each parameter are shown in bold in the menu overview in the appendix.

6 Commissioning

NOTICE

This chapter describes the commissioning of the Gammapilot M using the operating module VU331 (which is located in the remote display and operating unit FHX40). Commissioning using the "FieldCare" or the "Field Xpert SFX100" is similar. For further instructions to the operating program "FieldCare" see BA00027S/04/EN or the BA00060S/04/EN supplied together with the Field Xpert SFX100.

6.1 Calibration: overview



A detailed description of the functions used can be found in the following sections:
→ 40, "Basic setup"
→ 46, "Calibration for level measurement and limit detection"
→ 61, "Calibration for density and concentration measurements"
→ 69, "Density measurement/temperature-compensated"

6.2 Switching on the device

NOTICE

Error messages A165 "electronics defect" and A635 "present date not defined"

The Gammapilot M contains 2 real-time clocks for the decay compensation, which are permanently compared to each other for safety reasons. In order to bridge voltage interruptions, the clocks are buffered with a capacitor. To ensure that the clocks work correctly and retain the date in the event of a voltage interruption, this capacitor must have a minimum charge. If the A165 "Electronics defect" or A635 "Present date not defined" error message appears **after switching on** the Gammapilot M, then the capacitor may possibly not yet be charged sufficiently. In this case, the Gammapilot M must be operated at the operating voltage for at least 20 to 30 minutes, in order to charge the capacitor. After this, the date must be entered correctly. If the error message still persists subsequent to this, it can be deleted by switching the Gammapilot M off and on.

After switching on the supply voltage, the instrument is first initialized. Due to internal memory tests, this takes approx. 2 minutes.

On-site display	Meaning
FMG60 V01.03.06 HART	Then, the following appear for approximately five seconds: ▪ Device type ▪ Software version ▪ Type of the communication signal
	On first power up you are requested to select the language for the display texts.
Language 092 ✔ Englisch Français Español	Select the language with the + and − keys. Confirm your choice by pressing E twice.
	After that the measured value display appears. Now you can perform the basic setup and the calibration. Press E to switch to the group selection.
Group selection ✔ Basic setup Calibration Safety settings	Press E again to enter the first function of the "basic setup" function group.

6.3 Basic setup

6.3.1 "Present date" (*01)

On-site display	
Present date	*01
17.11.04	10:30
dd.mm.yy	hh:mm

Meaning

Date and time of the basic setup are specified in this function. Each of these values must be confirmed by "E" after it has been entered.

6.3.2 "Beam type" (*02)

On-site display	
Beam type	*02
✔ Standard/cont.	
Modulated	

Meaning

This function is used to specify whether the radiation source used emits radiation continuously or whether it is modulated (for grammagraphy suppression).

- Standard/continuous (permanent, continuous radiation)
- Modulated (modulated radiation source)

6.3.3 "Isotope" (*03)

On-site display	
Isotope	*03
✔ 137 Cs	
60 Co	
no compens.	

Meaning

This function is used to specify which isotope is used for the measurement. The Gammapilot M needs this information for the decay compensation.

6.3.4 "Operating mode" (*04)

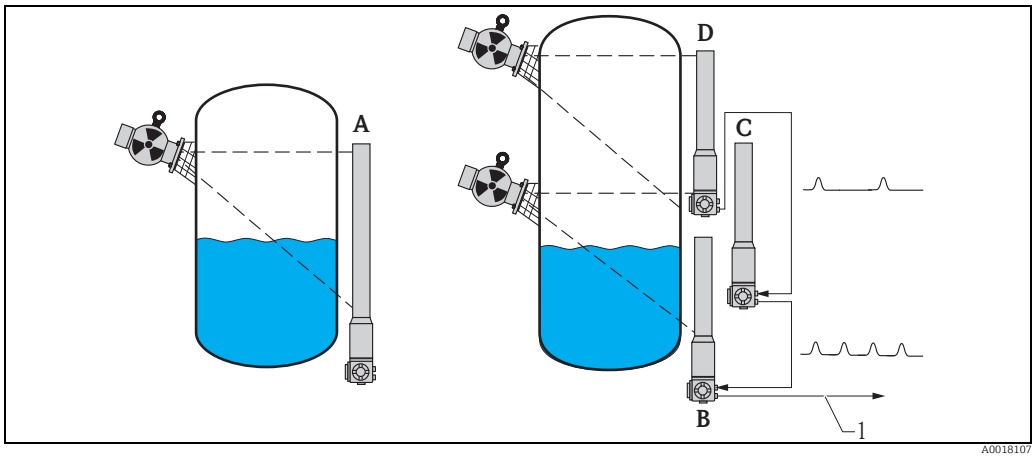
On-site display	
Operating mode	*04
✔ Stand alone	
Master	
Slave	

Meaning

This function is used to specify in which operating mode the Gammapilot M will be used.

NOTICE

The selection can be performed only once and the function is automatically locked after that. It can only be unlocked again by a reset of the Gammapilot M ("Reset" (*A3) function).



A One Gammapilot M is sufficient for measuring ranges up to 2 m (6.6 ft); For larger measuring ranges as many Gammapilot M as required can be connected (cascading mode). By Software settings they are defined as
B Master
C Slave(s) or
D End-Slave
1 4 to 20 mA HART; PROFIBUS PA; FOUNDATION Fieldbus

Options/display:

- **Stand alone**: This option is selected if the Gammapilot M is used as a single instrument.
- **Master**: This option is selected if the Gammapilot is located at the beginning of a cascading chain. It receives pulses from a connected slave, adds its own pulses and calculates the measuring value from this total.
- **Slave**: This option is selected if the Gammapilot M is located in the middle of a cascading chain. It receives the pulses from an additional connected slave or end-slave, adds its own pulses and transmits this total to the next device (master or slave). After selecting this option, the basic setup is finished. When cascading several transmitters the further calibration is performed on the master only.
- **End slave**: This option is selected if the Gammapilot M is located at the end of a cascading chain. It does not receive pulses from another device but transmits its own pulses to the next device (master or slave). After selecting this option, the basic setup is finished. When cascading several transmitters the further calibration is performed on the master only.
- **Not defined**: Is displayed if no operating mode has been selected yet. In order to continue the basic setup, a selection is necessary.

NOTICE

If a "Slave" or an "End-slave" are connected to the "FieldCare", the pulse rate of this device is displayed in the header instead of the measured value.

6.3.5 "Measuring mode" (*05)

On-site display	
Meas. mode	*05
✔ Level	
Limit	
Density	

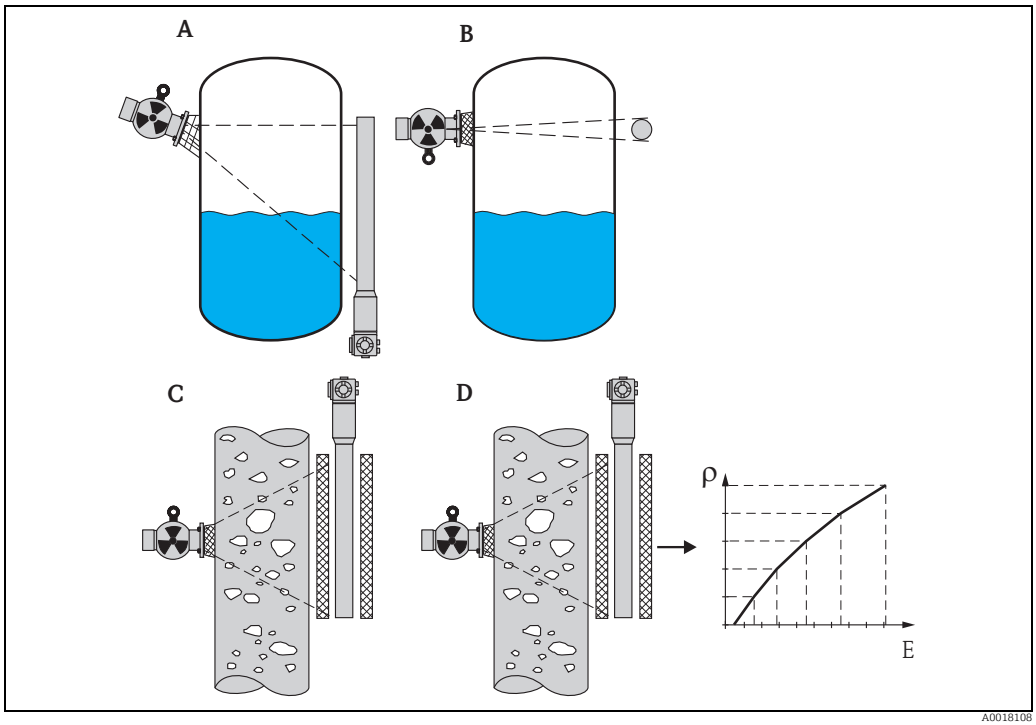
Meaning

This function is used to select the desired measuring mode.

Further options:
- Level measurement (continuous)
- Level limit detection
- Density measurement (with temperature compensation if required)
- Concentration measurement (density measurement followed by linearization)

NOTICE

The selection can be performed only once and the function is automatically locked after that. It can only be unlocked again by a reset of the Gammapilot M ("Reset" (*A3) function).



A Level measurement (continuous)
B Level limit detection
C Density measurement (with temperature compensation if required)
D Concentration measurement (density measurement followed by linearization)
ρ Density
E Concentration

6.3.6 "Density unit" (*06)

On-site display	
Density unit	*06
✔ g/cm3	
g/l	
lb/gal	

Meaning

This function is needed for density and concentration measurements only. It is used to select the density unit.

Further options:
- g/cm^3
- g/l
- lb/gal; [1g/cm^3 = 8,345 lb/gal]
- lb/ft^3; [1g/cm^3 = 62,428 lb/ft^3]
- 1°Brix = [270 (1 - 1/x)]
- °Baumé; [1°Baumé = 144.3 (1 - 1/x)]
- °API; [1°API = 131.5 (1.076/x - 1)]
- °Twaddell; [1°Twaddell = 200 (x-1)]

"x" refers to the density in g/cm^3. The formula indicates how many degrees this density corresponds to.

6.3.7 "Min. density" (*07)

On-site display	
Min. density	*07
0,9500 g/cm^3	

Meaning

This function is needed for density and concentration measurements only. It is used to specify the lower limit of the density range.
The output current for this density is 4 mA.

6.3.8 "Max. density" (*08)

On-site display	
Max. density	*08
1,2500 g/cm^3	

Meaning

This function is needed for density and concentration measurements only. It is used to specify the upper limit of the density range.
The output current for this density is 20 mA.

6.3.9 "Pipe diameter unit" (*09)

On-site display	
Pipe diam. unit	*09
✔ mm	
inch	

Meaning

This function is needed for density and concentration measurements only. It is used to select the unit for the pipe diameter.

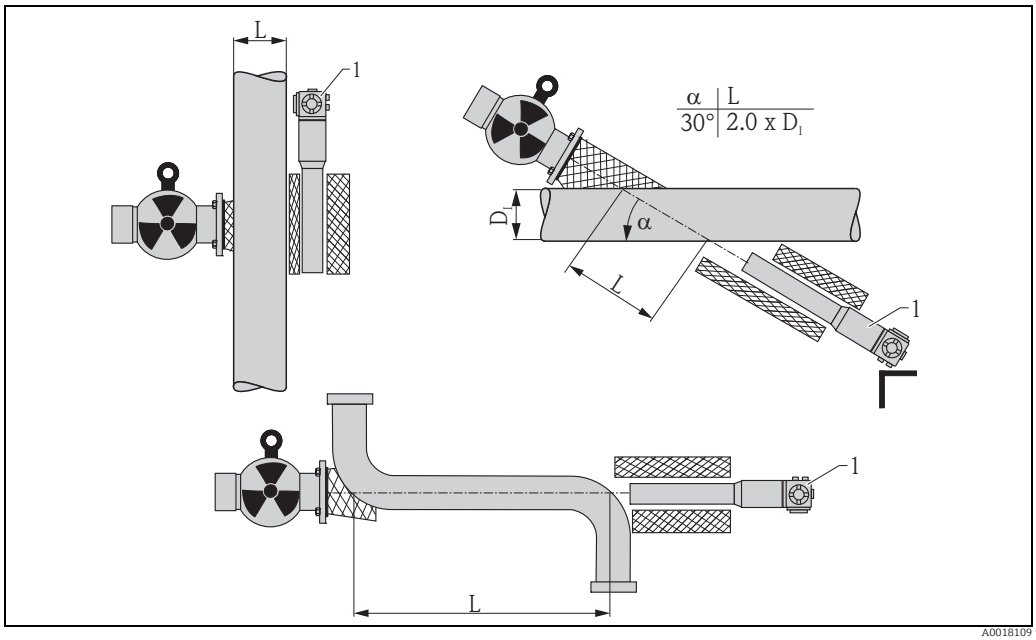
1 inch = 25,4 mm

6.3.10 "Pipe diameter" (*0A)

On-site display	
Pipe diam.	*0A
200 mm	

Meaning

This function is needed for density and concentration measurements only. It is used to specify the irradiated measuring path L. With standard installation, this value is identical to the inner pipe diameter D_I. For other installations (in order to enlarge the irradiated measuring path) it may be larger (see figure). The pipe walls are **not** to be considered a part of the measuring path.



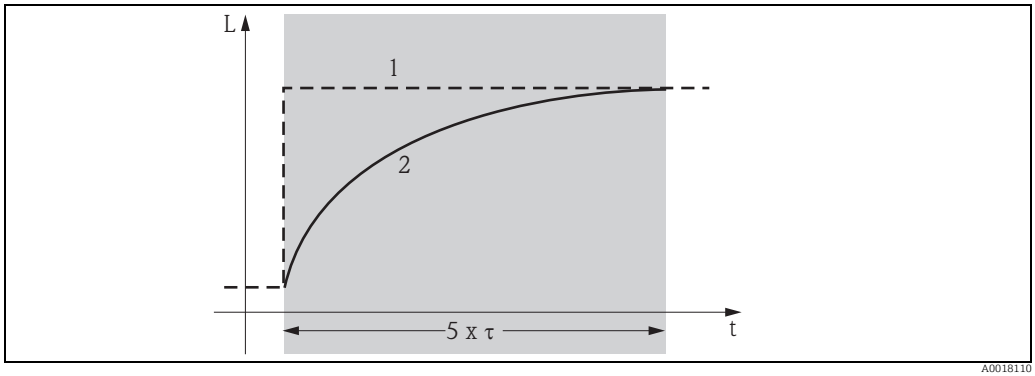
*Always specify the complete irradiated measuring path L in the "pipe diameter" (*0A) function. Depending on the installation, this value may be larger than the actual pipe diameter.*

6.3.11 "Output damping" (*0B)

On-site display	
Output damping	*0B
60 s	

Meaning

This function is used to specify the output damping τ (in seconds) by which changes of the measured value are attenuated.
After a surge in the level or density it takes 5 x τ until the new measured value is reached.



1 Level change (or density change)
2 Measured value

Range of values
1 to 999 s

Default
The default depends on the selected **"measuring mode" (*05)**:
- Level: 6 s
- Limit: 6 s
- Density: 60 s
- Concentration: 60 s

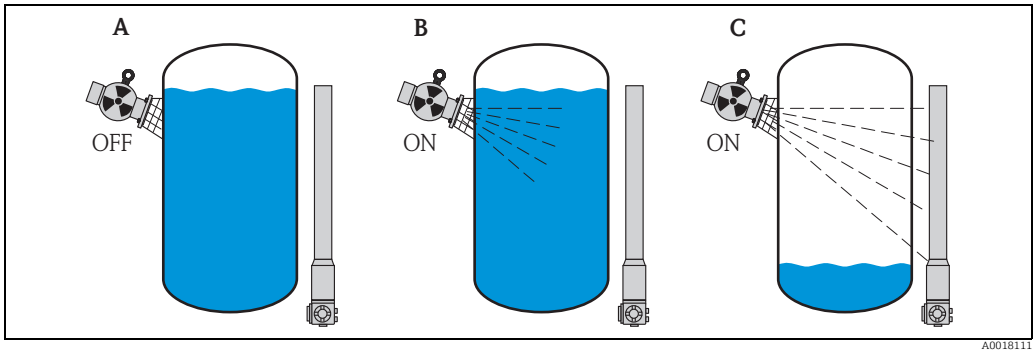
Selecting the output damping
The best value of the output damping depends on the process conditions. By enlarging the output damping, the measured value becomes considerably steadier but also slower.
In order to dampen the influence of strongly fluctuating surfaces or stirrers, it is advisable to enlarge the output damping. On the other hand, if rapid changes of the measured value have to be detected accurately, the output damping may not be selected to large.

6.4 Calibration for level measurement and limit detection

6.4.1 Basic principles

The calibration points for the measurement are entered in the **"calibration" (*1)** function group. Each calibration point consists of a level and the associated pulse rate.

Calibration points for level measurement



A Background calibration
B Full calibration
C Empty calibration

Background calibration

Refers to the following situation:
- The radiation is switched off.
- Within the measuring range, the vessel is filled as far as possible (ideally: 100%).

The background calibration is necessary, in order to register the natural background radiation at the mounting position of the Gammapilot M. The pulse rate of this background radiation is automatically subtracted from any other measured pulse rate. That means: only the part of the pulse rate which originates from the applied radiation source is taken into account and is displayed.
As opposed to the radiation of the applied source, the background radiation remains nearly constant during the complete measurement. Therefore, it is not submitted to the automatic decay compensation of the Gammapilot M.

Full calibration

Refers to the following situation:
- The radiation is switched on.
- Within the measuring range, the vessel is filled as far as possible (ideally: 100%, minimum 60%).

If the vessel cannot be filled to at least 60% during the calibration, the full calibration can alternatively performed with the radiation being switched off, which is a way of simulating a filling of 100%. In this case, the full calibration is identical to the background calibration. As the pulse rate of the background radiation is automatically subtracted, the displayed pulse rate is about 0 cps.

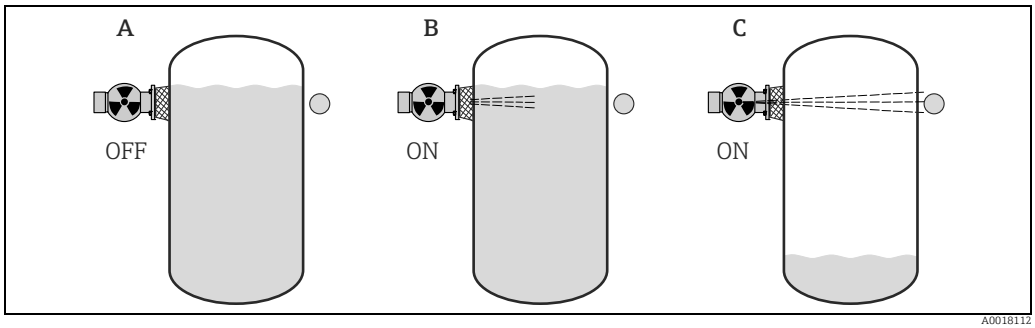
NOTICE

This type of simulated calibration is not possible with self-radiating media. In this case it is always necessary to perform the background and full calibration with the vessel filled to 100%.

Empty calibration

Refers to the following situation:
- The radiation is switched on.
- Within the measuring range, the vessel is emptied as far as possible (ideally: 0%, maximum 40%).

Calibration points for limit detection



A Background calibration
B Covered calibration
C Free calibration

Background calibration

Refers to the following situation:
- The radiation is switched off.
- If possible, the radiation path is completely covered.

The background calibration is necessary, in order to register the natural background radiation at the mounting position of the Gammapilot M. The pulse rate of this background radiation is automatically subtracted from any other measured pulse rate. That means: only the part of the pulse rate which originates from the applied radiation source is taken into account and is displayed.
As opposed to the radiation of the applied source, the background radiation remains nearly constant during the complete measurement. Therefore, it is not submitted to the automatic decay compensation of the Gammapilot M.

Covered calibration

Refers to the following situation:
- The radiation is switched on.
- If possible, the radiation path is completely covered.

If the radiation path cannot be completely covered during the calibration, the covered calibration can alternatively be performed with the radiation being switched off, which is a way of simulating complete covering. In this case, the covered calibration is identical to the background calibration. As the pulse rate of the background radiation is automatically subtracted, the displayed pulse rate is about 0 c/s.

NOTICE

This type of simulated calibration is not possible with self-radiating media. In this case it is always necessary to perform the background calibration and the covered calibration with the radiation path completely covered.

Free calibration

Refers to the following situation:
- The radiation is switched on.
- The radiation path is completely free.

Methods for entering the calibration points

Automatic calibration

For an automatic calibration, the vessel is filled to the required value. For the background calibration the radiation remains switched off, for the other calibration points the radiation is switched on.
The Gammapilot M automatically records the pulse rate. The associated level is entered by the user.

Manual calibration

If during the commissioning of the Gammapilot M one or more calibration points cannot be realized (e.g. because the vessel cannot be sufficiently filled or emptied), the calibration point must be entered manually.
That is, not only the level but also the associated pulse rate must be entered by the user.
For details concerning the calculation of the count rate please refer to your Endress+Hauser sales organization.

NOTICE

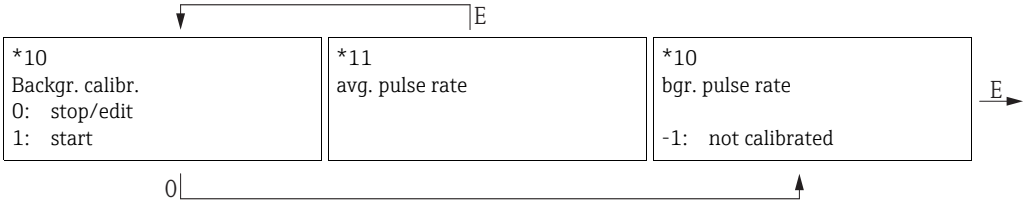
Calibration date and calibration

- When calibrating manually, the calibration date is not set automatically. Instead, it must be entered manually into the **"calibration date" (*C7)** function.
- A manually entered calibration point should be replaced by an automatic calibration as soon as the associated level occurs during the operation of the plant. This recalibration is advisable because calibration points entered automatically result in more precise measurement results than calculated ones.

6.4.2 Background calibration

Excerpt from the operating menu

The following excerpt from the operating menu shows how the background calibration is entered. The individual functions are explained in the sections below.



"Background calibration" (*10)

On-site display	
Backgr. cal.	*10
stop/edit	
start	

Meaning

This function is used to start the background calibration.

Options:

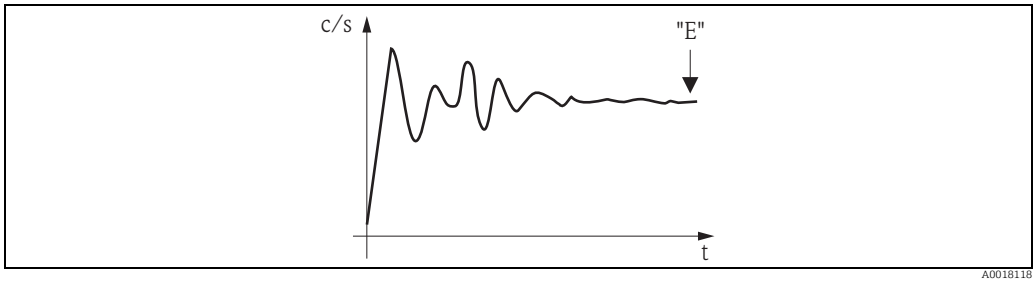
- **stop/edit**
  This option must be selected if
  – No background calibration is to be performed but the pulse rate of an existing background calibration is to be displayed instead.
  – A manual background calibration is to be performed.
  After selecting this option, the Gammapilot M changes to the **"bgr. pulse rate" (*12)** function, where the existing pulse rate is displayed and can be changed if required.
- **start**
  This option is used to start an automatic background calibration. The Gammapilot M changes to the **"avg. pulse rate" (*11)** function.

"Avg. pulse rate" (*11)

On-site display	
Avg. pulse rate	*11
186 cps	

Meaning

The average pulse rate is displayed in this function (after selection of "start" in the previous function). Initially, this value fluctuates (because of the decay statistics), but due to the integration it reaches an average value in the course of time. The longer the averaging is performed the lower are the remaining fluctuations.



A0018118

If the value is sufficiently stable, the function can be left by pressing "E".
Thereafter, the Gammapilot M changes to the **"backgr. calib." (*10)** function. Select **"stop/edit"** to stop the averaging procedure. The value is then automatically transmitted to the **"bgr. pulse rate" (*12)** function.

NOTICE

Bgr. Pulse rate

- The maximum integration time is 1000 s. After this time, the value is automatically transmitted to the **"bgr. pulse rate" (*1B)** function.
- The integration is **not** terminated by pressing "E" in the **"avg. pulse rate" (*11)** function. It is continued until the selection of **"stop/edit"** in the **"backgr. calib." (*10)** function. This may result in a slight deviation between the last displayed average pulse rate and the final **"bgr. pulse rate" (*12)**.

"Background pulse rate" (*12)

On-site display	
Backgr. pulse rate	*12
186 cps	

Meaning

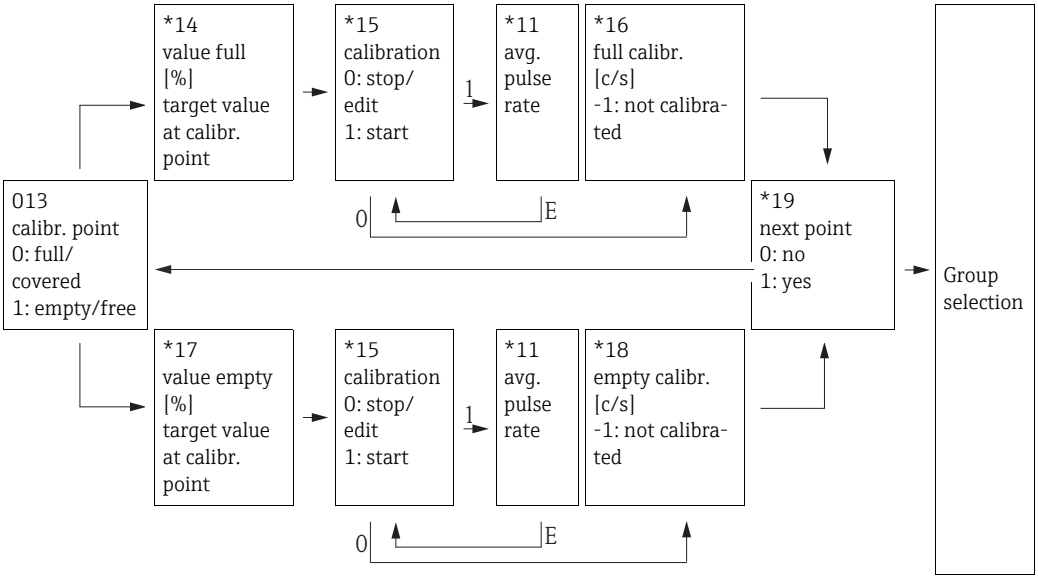
The pulse rate of the background calibration is displayed in this function. By pressing "E" the displayed value can be confirmed and the background calibration completed. **"-1"** indicates, that no background calibration is present yet. In this case there are two options:

- Either return to the **"background calibration" (*10)** function and restart the background calibration
- Or enter a known or calculated pulse rate (manual calibration). Thereafter, the Gammapilot M changes to the **"calibr. point" (*13)** or **(*1A)** function.

6.4.3 Full and empty calibration or covered and free calibration

Excerpt from the operating menu

The following excerpt from the operating menu shows how the full and empty calibration (for level measurements) or the covered and free calibration (for level limit detection) are entered. The individual functions are explained in the sections below.
The functions are only accessible after the background calibration has been performed.



NOTICE

The "value full" (*14) and "value empty" (*17) functions only appear if the "level" option was selected in the "measurement method" function (*05).

"Calibration point" (*13)

On-site display	
Calibr. point	*13
✔ full/covered	
empty/free	

Meaning

This function is used to select which calibration point ("full/covered" or "empty/free") will be entered.

"Value full" (*14) / "Value empty" (*17)

On-site display	
value full	*14
100%	

Meaning

These functions are needed for level measurements only. They are used to specify the level at which the full or empty calibration are performed.

value empty	*17
0%	

Range of values

	optimum value	minimum value	maximum value
Value full (*14)	100%	60%	100%
Value empty (*17)	0%	0%	40%

"Calibration" (*15)

On-site display	
calibration	*15
stop/edit	
start	

Meaning

This function is used to start the automatic entering of the selected calibration point.

Options:

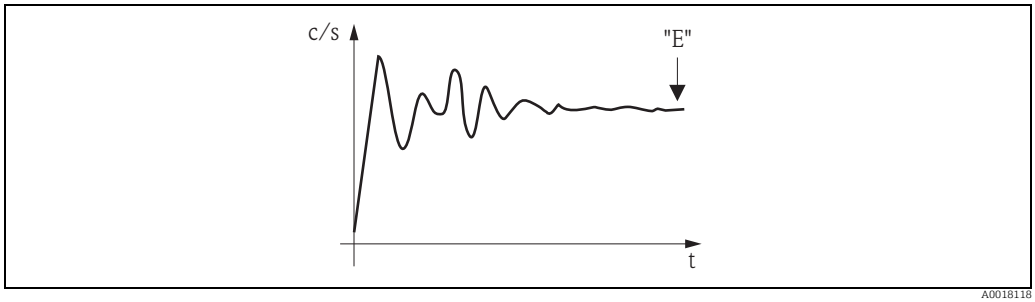
- **stop/edit**
  This option must be selected if
  - the calibration point is not to be entered (e.g. because it has already been entered). The pulse rate of the calibration point is then displayed in the following function, **"full calibr." (*16)** or **"empty calibr." (*18)**. If required, this value can be changed.
  - the calibration point is to be entered manually. This can be done in the following function, **"full calibr." (*16)** or **"empty calibr." (*18)**.
- **start**
  This option is used to start the automatic entering of the calibration point. The Gammapilot M then changes to the **"avg. pulse rate" (*11)** function.

"Avg. pulse rate" (*11)

On-site display	
avg. pulse rate	*11
2548 cps	

Meaning

The average pulse rate is displayed in this function (after selection of "start" in the previous function). Initially, this value fluctuates (because of the decay statistics), but due to the integration it reaches an average value in the course of time. The longer the averaging is performed the lower are the remaining fluctuations.



Initially, the pulse rate strongly fluctuates. In the course of time an average value is reached.

If the value is sufficiently stable, the function can be left by pressing "E".
Thereafter, the Gammapilot M changes to the **"calibration" (*15)** function. Select **"stop/edit"** to stop the averaging procedure. The value is then automatically transmitted to the **"full calibr." (*16)** or **"empty calibr." (*18)** function respectively.

NOTICE

Avg. Pulse rate

- The maximum integration time is 1000 s. The value is then transmitted automatically to the **"full calibr." (*16)** or **"empty calibr." (*18)** function.
- The integration is **not** terminated by pressing "E" in the **"avg. pulse rate" (*11)** function. It is continued until the selection of **"stop/edit"** in the **"calibration" (*15)** function. This may result in a slight deviation between the last displayed average pulse rate and the final **"full calibr." (*16)** or **"empty calibr. (*18)**.

"Full calibration" (*16) / "Empty calibration" (*18)

On-site display	
full calibr.	*16
33 cps	

empty calibr.	*18
2548 cps	

Meaning

The pulse rate of the respective calibration points is displayed in these functions. The displayed value must be confirmed by pressing "E". **"-1"** indicates, that no background calibration is present yet. In this case there are two options:

- either return to the "calibration" (*15) function and restart the calibration
- or enter a knwon or calculated pulse rate (manual calibration)

"Next point" (*19)

On-site display	
next point	*19
✔ no	
yes	

Meaning

This function is used to specify, if a further calibration point is to be entered or not.

Options:

- **no**
  This option must be selected after both calibration points have been entered. After this selection the Gammapilot M returns to the group selection and the calibration is completed.
- **yes**
  This option must be selected, if only one calibration point has been entered yet. After this selection the Gammapilot M returns to the **"calibr. point" (*13)** function and the next point can be entered.

6.4.4 Additional settings

After the calibration has been finished, the Gammapilot M outputs the measuring value via the current output and via the HART signal. The complete measuring range (0 to 100%) is mapped to the range (4 to 20 mA) of the output current.
Many additional functions are available for optimizing the measuring point. They can be configured as required. A detailed description of all instrument functions is given in Operating Instructions BA00287F/00/EN, "Gammapilot M - Description of Device Functions". This document can be found on the supplied CD-ROM.

6.4.5 Configuration of the contactor for level limit detection

For safety-related applications, the threshold values in the Safety Manual SD00230F/00/EN and SD00324F/00/EN must be observed.

The calculation of the switching signal from the continuous signal is not performed within the Gammapilot M but in the connected evaluation unit or process transmitter. For further information refer to the Operating Instructions of the respective instrument.
If using the Endress+Hauser process transmitter RTA421 or RMA42 the following settings are recommended:

For maximum fail-safe mode

- Switch threshold (SETP) = 75%
- Hysteresis (HYST) = 50%

6.5 Function group "Safety settings" (*2)

On-site display	
group selection	*2Þ
✔ safety settings	
temp. compensation	
linearization	

6.5.1 "Output on alarm" (*20)

On-site display	
outp. on alarm	*20
MIN -10% 3.6 mA	
MAX 110% 22 mA	
Hold	

Meaning

This function determines what value the output of the Gammapilot M assumes in the event of an alarm condition.

(*20)	Output on alarm	
	4 to 20 mA with HART	PROFIBUS PA FOUNDATION Fieldbus
MIN	3.6 mA	-99999
MAX	22 mA	+99999
Hold	The last measured value is held	
User-specific (can only be selected for HART devices)	As defined in "Output on alarm" (*21)	Not possible

6.5.2 "Output on alarm" (*21)

On-site display	
outp. on alarm	*21
22.00 mA	

Meaning

This function is used to specify what user-specific value the current output should assume in the event of an alarm condition. The value is entered in mA. This function is only available for HART devices.
It is only active if the **"user-specific"** option has been selected in the **"output on alarm" (*20)** function.
Range of values: 3.6 to 22 mA

6.6 SIL locking (for level limit detection 200/400 mm PVT scintillator)

SIL locking ("Security locking" (022) function) is in the "**Safety settings function group**" **(S2)**. It can only be accessed in the "**stand alone**" operating mode in conjunction with the "**level limit**" measurement method (see also "Requirements for locking").
As soon as SIL locking or unlocking is started, communication via the display or via FieldCare is significantly slower. This is due to internal readback and parameter validation. However, this only applies during the locking or unlocking phase and does not affect the measurement itself.
In the event of locking, all the parameters are locked apart from the manufacturer reset code. The parameters can only be viewed. Only the manufacturer reset code can be modified. Locking starts by entering a four-digit password (1000 to 9999). Then there follows a sequence of prompts for the most important parameters which all have to be confirmed. The locking is concluded by confirming the password. The device is locked as soon as the password is confirmed. The password is no longer visible. If a parameter or the password is displayed incorrectly and thus the password or a parameter is not confirmed, the locking procedure is aborted. The FMG60 is then in an unlocked state, as it was before the locking procedure began.

Prerequisites for locking

The following parameters must be configured for locking to be possible:

1. Operating mode = stand alone
2. Measurement mode = limit
3. Communication = HART Ex i or HART Ex e/d
4. Type of scintillator = PVT
5. Detector length = 200 or 400
6. SW version = 01.02.00 or 01.02.02
7. Radiation source = Cs or Co

Check whether the calibration values of the readback path are in the valid range.

6.6.1 List of the parameters to be confirmed

The following parameters can be modified by the user and thus they have to be confirmed. The detector length must be confirmed since it cannot be defined with regard to the safety function in the final check and is only in the service segment following any repair work.

1. Date
2. Beam type (standard or modulated[6)])
3. Source type (Cs or Co)
4. Output damping
5. Calibration date
6. Background pulse rate cps
7. Free calibration cps
8. Covered calibration cps
9. Gammagraphy hold time (can only be configured for standard beam type) or 10 for modulated source
10. Output current ≤ 3.0 mA
11. Detector length

6) Modulated just for max. level limit detection.

6.6.2 Function "security locking" (*22) (SIL unlocking)

The FMG60 can be unlocked in SIL2/3 mode by entering the password. If the password is entered correctly, the FMG60 is unlocked. If an incorrect password is entered, the FGM60 goes back to the group selection. The device cannot be unlocked by switching the power ON and then OFF.

On-site display	
security locking	*22
✔ unlocked	
locked	
device locked	

Further options:
- unlocked
- locked
- device locked
- device unlocked

6.6.3 Forgotten your password?

The password cannot be viewed when the device is locked. For this reason, the password can only be deleted by a manufacturer reset. At the same time, all the parameters are set to default values and the calibration data are deleted. The device then has an error current.

6.6.4 Function "password" (*23) (security password)

The password is always a four-digit number in the range from 1000 to 9999. Other values are not valid. After locking, 0000 is displayed. The password itself is not.

On-site display	
password	*23
_ _ _ _	

6.6.5 Function "confirm Iout" (*24) (output current during locking)

The output current is shifted to <3.6, typically 2.4 mA, by means of the 2nd switch-off path by selecting "Device locked" so the user can clearly see that the FMG60 has actually been locked.
The user must explicitly confirm this current value. The FMG60 is only set to the "device locked" state and the current output is only released again once the system has successfully run through the entire locking sequence. If the FMG60 is switched off and then on again during the locking process, the FMG60 resumes normal, unlocked operation. If a parameter is not confirmed, the FMG60 remains in the "device locked" state. The device can be switched to "unlocked" during the locking process; it then operates in the normal measuring mode. The "device locked" state can also be disabled by means of a total reset (7864) which also deletes all the calibration parameters, however. The correct locking state can be determined using the "partial stroke test".

On-site display	
confirm Iout	*24
✔ not valid	
valid	

6.6.6 Function "confirm sequence" (*25) (display check)

To verify that numbers are shown properly on the display, the sequence of numbers > 0123456789 .- < is the first element to be confirmed on the display. The user must confirm the numbers are displayed correctly. If an error occurs in how the numbers are displayed, the user must abort the locking action.

On-site display	
confirm sequence	*24
>0123456789 .-<	
✔ not valid	
valid	

6.6.7 Function "confirm backgr." (*26)

On-site display	
confirm backgr.	*26
_ _ _ _ _ _ _	
✔ not valid	
valid	

Meaning

Select "valid" if the data displayed (see _ _ _ _ _ _) match the data you entered. Select "not valid" if you want to abort SIL locking.

6.6.8 Function "confirm cal." (*27)

On-site display	
confirm cal.	*27
✔ not valid	

Meaning

Select "valid" if the data displayed (see _ _ _ _ _ _) match the data you entered. Select "not valid" if you want to abort SIL locking.

Further options:
- Not valid
- Valid

6.6.9 Function "confirm source" (*28)

On-site display	
confirm source	*28
✔ not valid	

Meaning

Select "valid" if the data displayed (see _ _ _ _ _ _) match the data you entered. Select "not valid" if you want to abort SIL locking.

Further options:
- Not valid
- Valid

6.6.10 Function "confirm time" (*29) (output damping)

On-site display	
confirm time	*29
✔ not valid	

Meaning

Select "valid" if the data displayed (see _ _ _ _ _ _) match the data you entered. Select "not valid" if you want to abort SIL locking.

Further options:
- Not valid
- Valid

6.6.11 Function "confirm date" (*2A)

On-site display	
confirm date	*2A
✔ not valid	

Meaning

Select "valid" if the data displayed (see _ _ _ _ _ _) match the data you entered. Select "not valid" if you want to abort SIL locking.

Further options:
- Not valid
- Valid

6.6.12 Function "confirm length" (*2B)

On-site display	
confirm length	*2B
✔ not valid	
valid	

Meaning

Select "valid" if the data displayed (see _ _ _ _ _ _) match the data you entered. Select "not valid" if you want to abort SIL locking.

6.6.13 Function "confirm password" (*2C)

On-site display	
confirm password	*2C
✔ not valid	
valid	

Meaning

Select "valid" if the data displayed (see _ _ _ _ _ _) match the data you entered. Select "not valid" if you want to abort SIL locking.

6.6.14 Function "password" (*2D) (unlock password)

The password is always a four-digit number in the range from 1000 to 9999. Other values are not valid. To unlock the device, enter the the four-digit number password.

On-site display	
password	*2D

6.7 Calibration for density and concentration measurements

6.7.1 Basic principles

The calibration points for the measurement are entered in the **"calibration" (*1)** function group. Each calibration point consists of a density value and the associated pulse rate.

Calibration points for density and concentration measurements

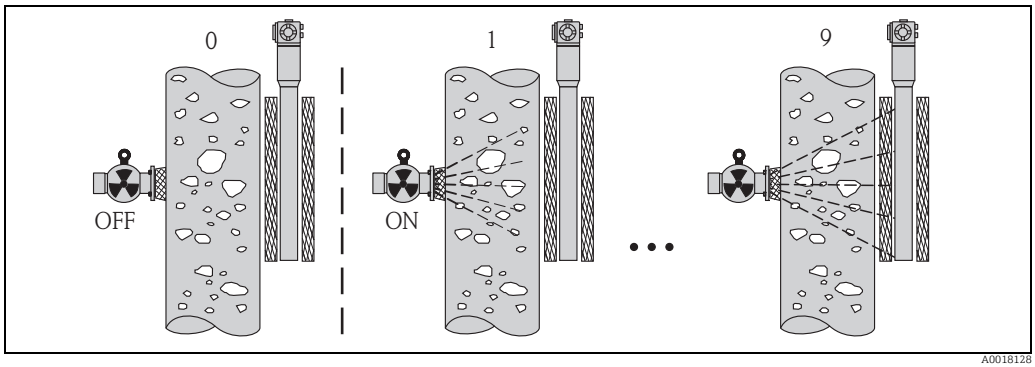
Function of the calibration points

For density and concentration measurements the Gammapilot M needs (apart from the length of the irradiated measuring path) the following two parameters:
- The absorption coefficient μ of the material measured
- The reference pulse rate I_0[7)].

It calculates these parameters automatically from the following calibration points:
- Background calibration (calibration with the radiation switched off)
- Up to nine calibration points for samples of various known densities.

NOTICE

With self-radiating media it is always necessary to perform the background calibration with a filled pipe. A simulated calibration with an empty pipe is not possible in this case.



0 Background calibration
1-9 Calibration points for various densities

Two-point calibration

The recommended comparisen procedure for high exactness standards about the whole measuring range is the two-point calibration. First the background calibration occurs. The two calibration points will be adapt. They should lie differ considerably. After input of both calibration points, the Gammapilot M calculates the parameters I_0 und μ.

One-point calibration

If a two-point calibration is not possible, a one-point calibration can be carried out.
That means, that apart from the background calibration only one further calibration point is used. This calibration point should be located as near as possible to the operating point. Densities in the proximity of this operating point are measured fairly precisely, whereas the precision may decrease with increasing distance to the operating point.
In one-point calibration, the Gammapilot M only calculates the reference pulse rate I_0.
For the absorption coefficient it uses the standard value μ = 7.7 mm^2/g in this instance.

7) I_0 is the pulse rate for the tube being empty. The value is significantly higher than any real pulse rate occurring during the measurement.

Multiple-point calibration

The multiple-point calibration is recommended particularly for measurements in a large density area or for especially exact measurements. Up to 9 calibration points can be used about the whole measuring range. The calibration points should be located as far from each other as possible and should be uniformly distributed over the measuring range. After the calibration points have been entered, the Gammapilot M automatically calculates the parameters I_0 and μ. Multiple-point calibration is especially advisable for measurement in a wide range of densities or for especially precise measurements.

Recalibration

The Gammapilot M provides a further calibration point ("10") for recalibration. This point can be entered, if the measuring conditions have changed, e.g. by deposit in the measuring tube. After entering of the recalibration point, I_0 is recalculated according to the current measuring conditions. The absorption coefficient μ is kept unchanged from the original calibration.

Methods for entering the calibration points

Automatic calibration

For an automatic calibration, the desired calibration point is realized at the measuring tube, i.e. the measuring tube is filled with a medium of the desired density. For the background calibration the radiation remains switched off, for the other calibration points the radiation is switched on. The Gammapilot M automatically records the pulse rate. The associated density is determined in the laboratory and entered by the user.

Manual calibration

In order to achieve a high measuring accuracy, it is advisable to determine the pulse rates for a couple of samples of the same density and to calculate the average density and average pulse rate for these samples. These values can then be entered manually into the Gammapilot M.
If possible, this procedure should be repeated at a further density. The both density values should be as far from each other as possible.

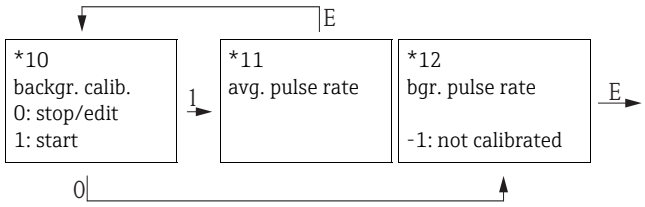
NOTICE

When calibrating manually, the calibration date is not set automatically. Instead, it must be entered manually into the "calibration date" (*C7) function.

6.7.2 Background calibration

Excerpt from the operating menu

The following excerpt from the operating menu shows how the background calibration is entered. The individual functions are explained in the sections below.



"Background calibration" (*10)

On-site display		Meaning
backgr. cal.	*10	This function is used to start the background calibration.
stop/edit		
start		

Options:

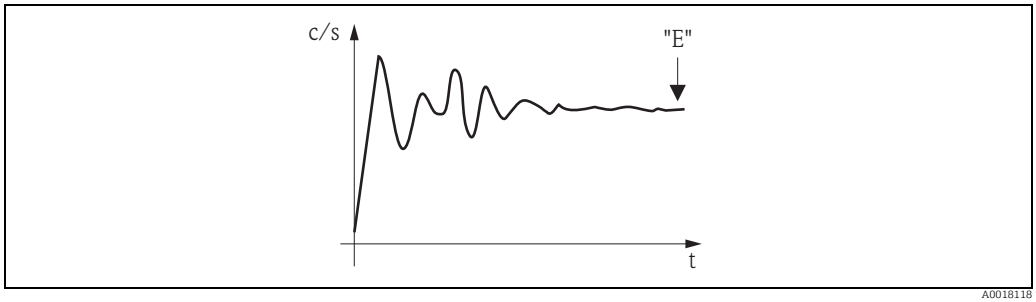
- **stop/edit**
  This option must be selected if
  – no background calibration is to be performed but the pulse rate of an existing background calibration is to be displayed instead.
  – a manual background calibration is to be performed.
  After selecting this option, the Gammapilot M changes to the **"bgr. pulse rate" (*12)** function, where the existing pulse rate is displayed and can be changed if required.
- **start**
  This option is used to start an automatic background calibration. The Gammapilot M changes to the **"avg. pulse rate" (*11)** function.

"Avg. pulse rate" (*11)

On-site display	
avg. pulse rate	*11
186 cps	

Meaning

The average pulse rate is displayed in this function (after selection of "start" in the previous function).
Initially, this value fluctuates (because of the decay statistics), but due to the integration it reaches an average value in the course of time. The longer the averaging is performed the lower are the remaining fluctuations.



A0018118

If the value is sufficiently stable, the function can be left by pressing "E".
Thereafter, the Gammapilot M changes to the **"backgr. calib." (*10)** function. Select **"stop/edit"** to stop the averaging procedure. The value is then automatically transmitted to the **"bgr. pulse rate" (*12)** function.

NOTICE

Bgr. Pulse rate

- The maximum integration time is 1000 s. After this time, the value is automatically transmitted to the **"bgr. pulse rate" (*1B)** function.
- The integration is **not** terminated by pressing "E" in the **"avg. pulse rate" (*11)** function. It is continued until the selection of **"stop/edit"** in the **"backgr. calib." (*10)** function. This may result in a slight deviation between the last displayed average pulse rate and the final **"bgr. pulse rate" (*12)**.

"Background pulse rate" (*12)

On-site display	
backgr. pul. rate	*12
186 cps	

Meaning

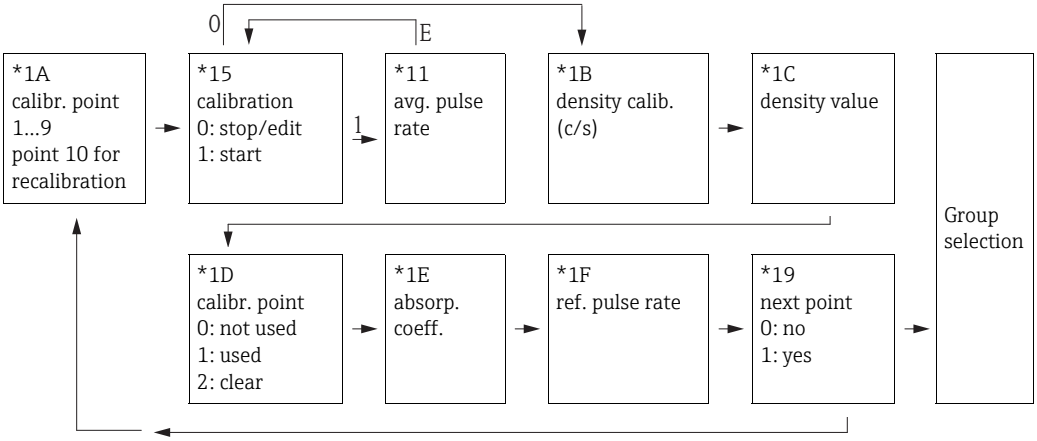
The pulse rate of the background calibration is displayed in this function. By pressing "E" the displayed value can be confirmed and the background calibration completed. "-1" indicates, that no background calibration is present yet. In this case there are two options:

- either return to the **"background calibration" (*10)** function and restart the background calibration
- or enter a known or calculated pulse rate (manual calibration). Thereafter, the Gammapilot M changes to the **"calibr. point" (*13)** or **(*1A)** function.

6.7.3 Calibration points

Excerpt from the operating menu

The following excerpt from the operating menu shows, how the density calibration points are entered. The individual functions are explained in the sections below.
The functions are only accessible after the background calibration has been performed.



"Calibration point" (*1A)

On-site display	
calibr. point	*1A
✔ 1	
2	
3	

Meaning

This function is used to select, which calibration point will be entered.

Further options:

- "1" to "9" : Calibration points for various densities
- "10": recalibration point
  After entering of the recalibration point, I_0 is recalculated according to the current measuring conditions. The absorption coefficient μ is kept unchanged from the original calibration. The calibration point "10" can be entered if the measuring conditions have changed, e.g. due to buildup in the measuring tube.

"Calibration" (*15)

On-site display	
calibration	*15
stop/edit	
start	

Meaning

This function is used to start the automatic entering of the selected calibration point.

Options:

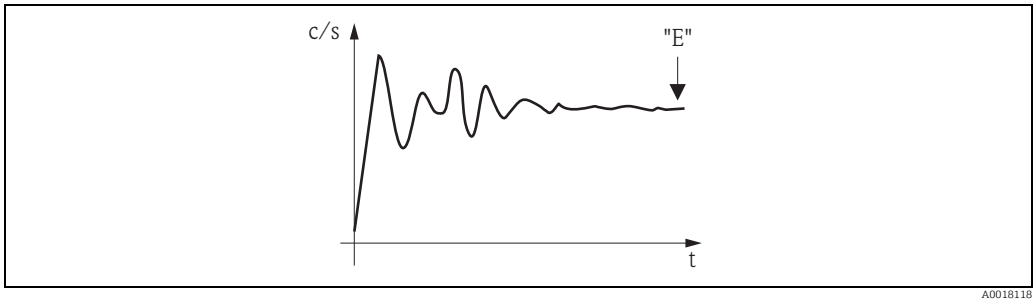
- **stop/edit**
  This option must be selected if
  - the calibration point is not to be entered (e.g. because it has already been entered). The pulse rate of the calibration point is then displayed in the following function **"density calib." (*1B)**. If required, this value can be changed.
  - the calibration is to be entered manually. For this purpose, the Gammapilot M changes to the **"density calib." (*1B) function**.
- **start**
  This option is used to start the automatic entering of the calibration point. The Gammapilot M then changes to the **"avg. pulse rate" (*11)** function.

"Avg. pulse rate" (*11)

On-site display	
avg. pulse rate	*11
1983 cps	

Meaning

The average pulse rate is displayed in this function (after selection of "start" in the previous function). Initially, this value fluctuates (because of the decay statistics), but in the course of time it reaches an average value. The longer the averaging is performed the lower are the remaining flucuations.



A0018118

If the value is sufficiently stable, the function can be left by pressing "E".
Thereafter, the Gammapilot M changes to the **"calibration" (*15)** function. Select **"stop/edit"** to stop the averaging procedure. The value is then automatically transmitted to the **"density calibr." (*1B)** function.

NOTICE

Density calibration

- ▶ The maximum integration time is 1000 s. After this time, the value is automatically transmitted to the **"density calibration" (*1B)** function.
- ▶ During the integration a sample of the measured material must be taken. Its density must be determined in the laboratory).
- ▶ The integration is **not** terminated by pressing "E" in the **"avg. pulse rate" (*11)** function. It is continued until the selection of **"stop/edit"** in the **"calibration" (*15)** function. This may result in a slight deviation between the last displayed average pulse rate and the final **"density calibration" (*1B)**.

"Density calibration" (*1B)

On-site display	
density calibr.	*1B
1983 cps	

Meaning

The pulse rate of the respective calibration point is displayed in this function. The display value must be confirmed by pressing "E". **"-1"** indicates, that no pulse rate is present yet. In this case there are two options:
- either return to the "calibration" (*15) function and restart the calibration
- or enter a known or calculated pulse rate (manual calibration)

"Density value" (*1C)

On-site display	
density value	*1C
0.9963 g/cm3	

Meaning

This function is used to enter the density of the calibration point. The value must be determined from the sample in a laboratory measurement.

NOTICE

When entering the value, temperature influences have to be taken into account. The density entered must refer to the temperature at which the pulse rate has been determined. If the density and the pulse rate have been determined at different temperatures, the density value must be corrected accordingly.

"Calibration point" (*1D)

On-site display	
calibr. point	*1D
not used	
✔ used	
clear	

Meaning

This function is used to specify, if the current calibration piont is to be used.

Options:
- **not used**
  The calibration point is **not** used. However, it can be reactivated at a later point of time.
- **used**
  The calibration point is used.
- **clear**
  The calibration point is deleted. It cannot be reactivated at a later point of time.

"Absorption coefficient" (*1E)

On-site display	
absorp. coeff.	*1E
7.70 mm2/g	

Meaning

This function displays the absorption coefficient which results from the currently active calibration points. The displayed value should be used for plausibility checking.

NOTICE

If only one calibration point is currently active, the absorption coefficient is not calculated. The last valid value is used instead. At the first commissioning or after a reset, the default value, μ = 7.70 mm^2/g, is used. The value can be changed by the user.

"Reference pulse rate" (*1F)

On-site display	
ref. pulse rate	*1F
31687 cps	

Meaning

This function displays the reference pulse rate I_0, which results from the currently active calibration points. The value cannot be edited.

NOTICE

I_0 is the pulse rate for the tube being empty (theoretical reference value). Generally, the value is significantly higher than any real pulse rate occurring during the measurement.

"Next point" (*19)

On-site display	
next point	*19
✔ no	
yes	

Meaning

This function is used to specify, if a further calibration point is to be entered or not.

Options:

- **no**
  This option must be selected if no further calibration point is to be entered or changed. After this selection the Gammapilot M returns to the group selection and the calibration is completed.
- **yes**
  This option must be selected, if a further calibration point is to be entered or changed. The Gammapilot M returns to the **"calibr. point" (*1A)** function and the next point can be entered or changed.

6.7.4 Linearization (for concentration measurements)

If the concentration is to be measured in a unit other than the **"density unit" (*06)**, a linearization must be performed after the calibration. This can be done in the **"Linearization" (*4)** function group. The functions of this group and the linearization procedure are described in Operating Instructions BA00287F/00/EN, "Gammapilot M - Description of Device Functions". This document can be found on the supplied CD-ROM.

6.7.5 Additional settings

After the calibration has been finished, the Gammapilot M outputs the measuring value via the current output and via the HART signal. The complete measuring range [min. density (*07) to max. density (*08)] is mapped to the current range 4 to 20 mA.
Many additional functions are available for optimizing the measuring point. They can be configured as required. A detailed description of all instrument functions is given in Operating Instructions BA00287F/00/EN, "Gammapilot M - Description of Device Functions". This document can be found on the supplied CD-ROM.

6.8 Density measurement/temperature-compensated

Perform density measurement as described in the section "Calibration for density and concentration measurements" and then perform temperature calibration (see "Temperature compensation" section in BA00287F/00/EN "Gammapilot M - Description of Device Functions").

6.9 Gammagraphy detection

See "Gammagraphy" section in BA00287F/00/EN "Gammapilot M - Description of Device Functions".

7 Maintenance and repairs

7.1 Exterior cleaning

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

7.2 Repair

The Endress+Hauser repair concept assumes that repairs to the Gammapilot M are performed by the Endress+Hauser Service in Endress+Hauser workshops.
For more information contact the Service Department at Endress+Hauser.

7.3 Repairs to Ex- or SIL-approved devices

When carrying out repairs to Ex- or SIL-approved devices, please note the following:
- Repairs to Ex- or SIL-approved devices may only be carried out by Endress+Hauser Service in Endress+Hauser workshops.
- Comply with the prevailing standards, national Ex-area regulations, safety instructions (XA) and certificates.
- Only use original spare parts from Endress+Hauser.
- A certified device may only be converted into a different certified device version by Endress+Hauser Service in Endress+Hauser workshops.
- Document all repair work and conversions.

7.4 Replacement

⚠ CAUTION
An uploading/download procedure is not permitted for safety-related use of the device.

After a complete device or electronic module has been replaced, the parameters can be downloaded into the device again via the communication interface. As a prerequisite, the data have to have been uploaded to the PC beforehand using the "FieldCare".

Level measurement and level limit detection
Measurement can be continued without a new setup. However, the calibration values should be checked as soon as possible, since the mounting position may have slightly changed.

Density and concentration measurement
After the replacement a new setup and calibration must be performed.

7.5 Return

7.5.1 Returning devices

The measuring device must be returned if repairs of a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at www.services.endress.com/return-material

7.6 Disposal

When disposing, separate and recycle the device components based on the materials.

7.7 Contact addresses of Endress+Hauser

Contact addresses can be found on our homepage: www.endress.com/worldwide.
If you have any questions, please contact your Endress+Hauser subsidiary.

8 Accessories

8.1 Commubox FXA195 HART

For intrinsically safe HART communication with FieldCare via the USB port.
For details, see TI00404F/00/EN.

8.2 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 computer or laptop.
For details, see TI00405C/07/EN.

For Gammapilot M, you also need the "ToF adapter FXA291" accessory.

8.3 ToF adapter FXA291

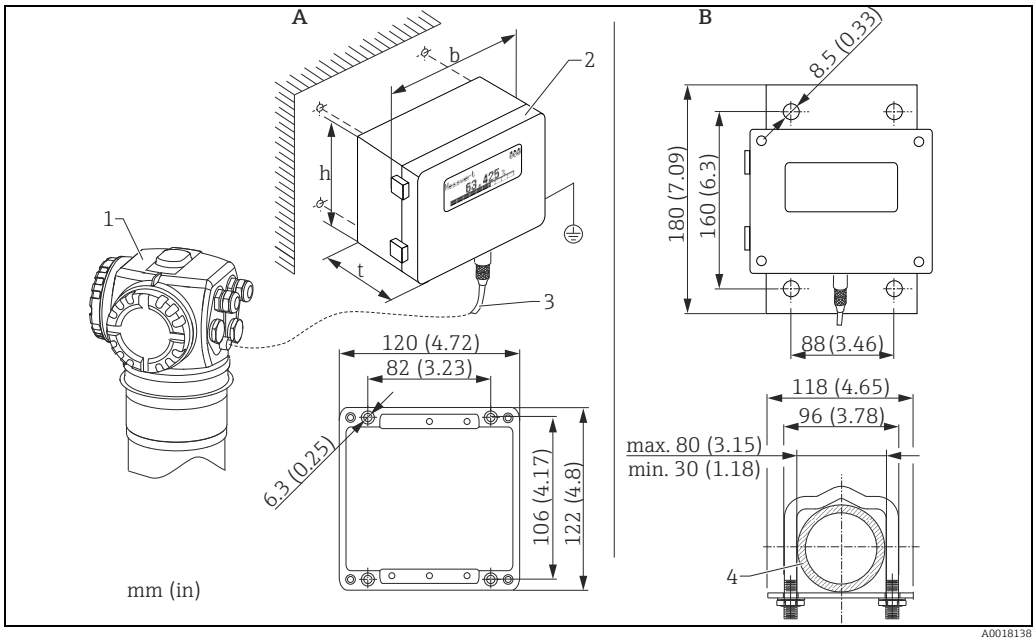
The ToF adapter FXA291 connects the Commubox FXA291 with the Gammapilot M by means of the USB port of a computer or laptop. For details, see KA00271F/00/A2.

8.4 Field Xpert SFX100

Compact, flexible and robus industry handheld terminal for remote parametrization and measured value inspection via the HART current output or FOUNDATION Fieldbus.
For details refer to Operating Instructions BA00060S/04/EN.

8.5 Remote display FHX40

8.5.1 Dimensions



A Wall-mounting (without mounting bracket)
B Pipe-mounting (mounting bracket and plate supplied optionally)
1 Gammapilot M
2 Separat housing FHX40
3 Cable
4 Pipe

8.5.2 Ordering information

010	Approval
A	Non-hazardous area
2	ATEX II 2G Ex ia IIC T6
3	ATEX II 2D Ex ia IIIC T80°C
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, zone 0
U	CSA IS Cl.I Div.1 Gr.A-D, zone 0
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/65ft (> HART)
5	20m/65ft (> PROFIBUS PA/FOUNDATION Fieldbus)
9	Special version, TSP-no. to be spec.

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

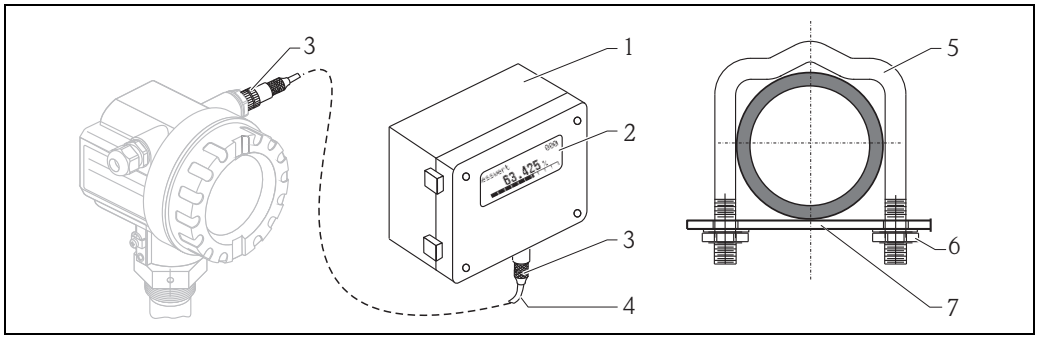
995	Marking
1	Tagging (TAG), see additional spec.

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

8.5.3 Technical data (cable and housing)

Max. cable length	20 m (66 ft) (fixed length including the cast-on 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); IP68 (cable) acc. to IEC 60529
Materials	Housing: AlSi12; cable glands: nickle plated brass
Dimensions [mm (in)	122x150x80 (4.72x5.91x3.15) / HxWxD

8.5.4 Materials

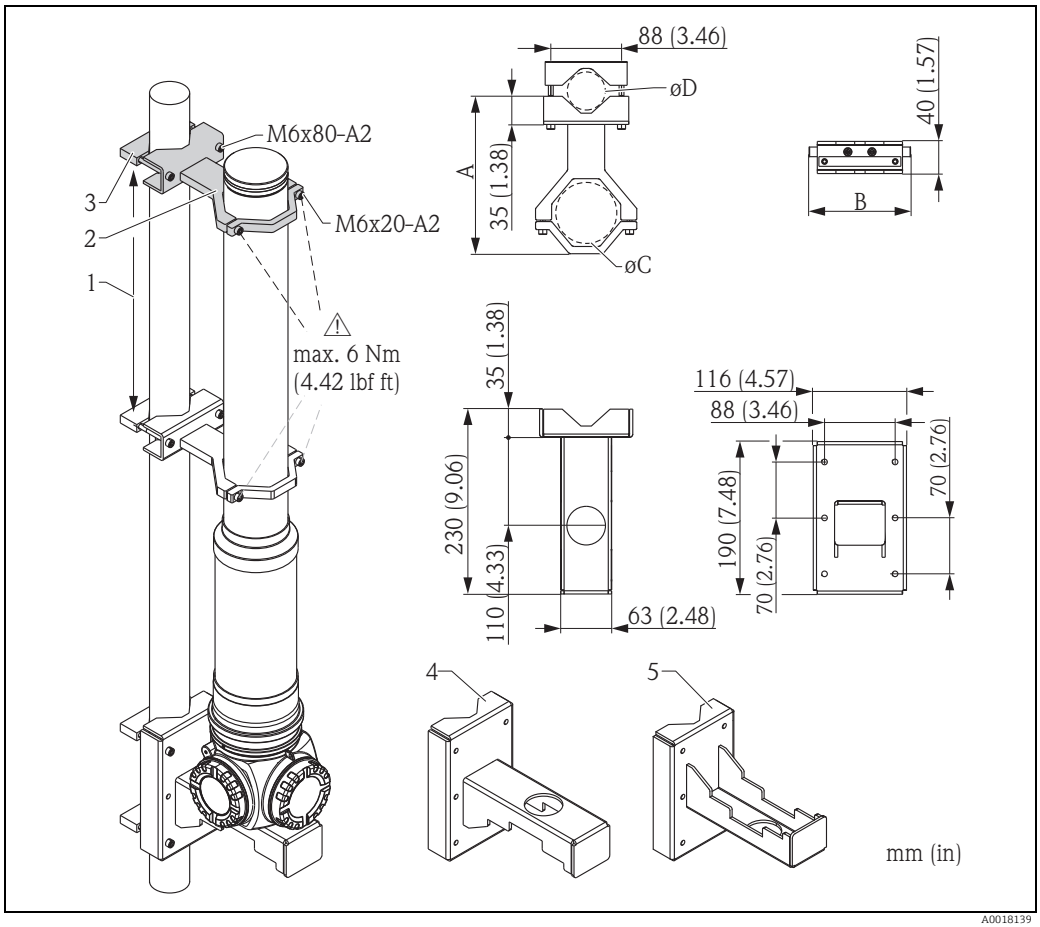


L00-FMxxxxxx-00-00-06-de-003

Position	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 (1.4310) or V2A Screw: V4A, Nut: V4A

8.6 Mounting device FHG60 (for level measurement and level limit measurement)

8.6.1 Dimensions



1 Spacing as large as possible
2 Retainers (number and size depending on selected application [8]; Allen screws to ISO 4762 are supplied)
3 Mounting clamps (number depending on selected application [8])
4 with preferred mounting method "housing head down" - bracket (for "level" application only [8])
5 with alternative mounting method "housing head up" - bracket (for "level" application only [8])

Size of the retainers (depending on the selected application):

Mounting position at the FMG60	A [mm (in)]	B [mm (in)]	øC [mm (in)]	øD [mm (in)]	Mounting
Scintillator pipe dimensions	196 (7.72)	126 (4.96)	80 (3.15)	40 to 65 (1.57 to 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

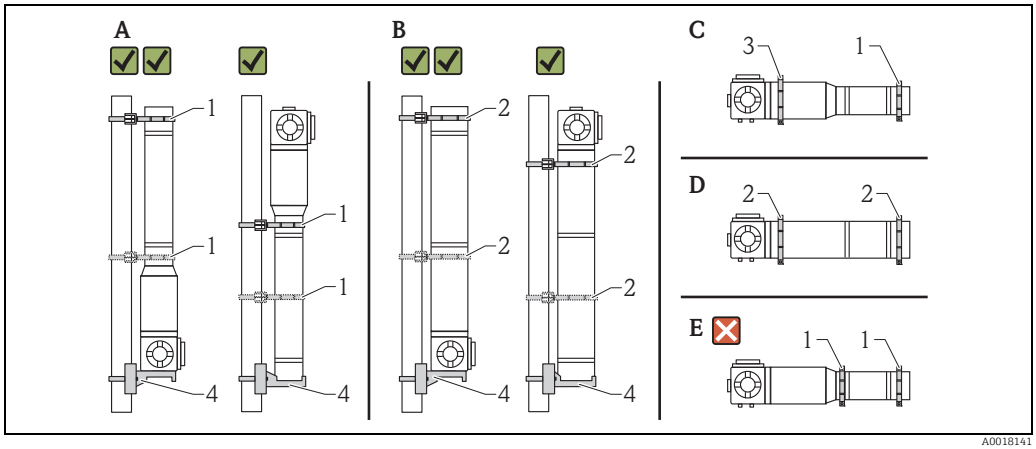
Max. torque for the screws of the retainers: 6 Nm (4.42 lbf ft).

8) See "Use" and "Ordering information for complete mounting set".

8.6.2 Application hints

✓ Allowed

✓✓ Preferred



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

⚠ CAUTION

Consider while mounting the device

- ▶ The mounting device must be fitted in a way such that it can withstand the weight of the Gammapilot M under all operating conditions to be expected.
- ▶ For a measuring length of 1600 mm (63 in) or more, two retainers (vertical) or three retainers (horizontal) must be used.
- ▶ For vertical mounting usage of the bracket or a support unit fitted by the customer is mandatory. Otherwise a sufficient stability and support of the Gammapilot M is not ensured.
- ▶ For stability reasons the mounting version with the compartment housing pointing upwards should only be used in exceptional cases (e.g. lack of space).
- ▶ To prevent damage of the detector tube, the maximum torque of the retainer screws is 6 Nm (4.42 lbf ft).

8.6.3 Ordering information

Detailed ordering information is available as follows:

- In the Product Configurator on the Endress+Hauser website: www.endress.com → Select country → Instruments → Select device → Accessories for FMG60
- From your Endress+Hauser sales center: www.endress.com/worldwide

Product Configurator - the tool for individual product configuration

- Configuration data updated on a daily basis
- Depending on the device: Direct input of data specific to measuring point, such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic generation of order code with breakdown in PDF or Excel output format
- Possibility to order directly from the Endress+Hauser online shop

8.7 Clamping device for density measurement FHG61

For details, see SD01221F/00/EN.

8.8 Measurement section for density measurement FHG62

For drawings and description, see SD00540F/00/EN.

9 Troubleshooting

9.1 System error messages

9.1.1 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

9.1.2 Last error

The last error is displayed in the **"diagnostics" (*A)** function group in the **"previous error" (*A1)** function. The displayed item can be deleted in the **"delete last error" function (*A2)**.

9.1.3 Types of error

Type of error	Symbol	Meaning
Alarm (A)	 continuous	The output signal assumes a value which can be set using the **"output on alarm" (*10)** function: ▪ MAX: 110 %, 22 mA ▪ MIN: -10 %, 3.8 mA ▪ Hold: last value is on hold ▪ User-specific value An error message is displayed.
Warning (W)	 flashing	The device continues measurement. An error message is displayed (alternating with the measured value).

9.1.4 Error codes

Code	Description	Remedy
A102	checksum error	Call Endress+Hauser Service
W103	initializing	Wait for completion of the initializing procedure
A106	downloading	Wait for completion of the download
A110	checksum error	Call Endress+Hauser Service
A111	electronics defect	Switch instrument off/on; If error still is present: call Endress+Hauser service or exchange transmitter
A113	electronics defect	Switch instrument off/on; If error still is present: call Endress+Hauser service or exchange transmitter
A114	electronics defect	Switch instrument off/on; If error still is present: call Endress+Hauser service or exchange transmitter
A116	download error	Repeat download
A121	electronics defect	Switch instrument off/on; If error still is present: call Endress+Hauser service or exchange transmitter
W153	initializing	Wait for completion of the initializing procedure
A160	checksum error	Call Endress+Hauser Service
A165	electronics defect	▪ Switch instrument off/on; If error still is present: call Endress+Hauser service or exchange transmitter ▪ See Note "**Error messages A165 "electronics defect" and A635 "present date not defined"** on → 39.
A291	slave error	Check basic setup and connection of the slave transmitter
A503	wrong sensor type	Call Endress+Hauser Service
W513	calibration integration running	Wait, until a stable pulse rate has been reached; then, terminate integration (by pressing "E" in the **"average pulse rate" (*11)** function)
W514	PT-100 calibration	Wait for the calibration to complete. if error still persists: call Endress+Hauser Service
A531	sensor electronics defect	Switch instrument off/on; If error still is present: call Endress+Hauser service or exchange transmitter
A532	sensor voltage error	Call Endress+Hauser Service
A533	wrong sensor software version	Call Endress+Hauser Service
A535	sensor regulation error	Call Endress+Hauser Service
W536	high voltage near limit	Call Endress+Hauser Service
A538	sensor communication error	Call Endress+Hauser Service
A602	linearization table not plausible	Check monotony of the linearization table; if necessary, adjust table (**"linearization" (*4)** function group)
A612	linearization table not defined	Enter or complete linearization table (**"linearization" (*4)** function group) The linearization table must contain the end points 0% = 1000 cps (standardized) and 100% = 0 cps (standardized). When entering via FieldCare: Select the right type of table (lin. tab. "level" or "concentration")
W621	simulation on	Switch off linearization (**"output" (*6)** function group **"simulation" (*65)** function)
W640	SIL lock device	SIL_locking not completed

Code	Description	Remedy
W642	I_back calibration running	Calibration of the current readback path active
A631	background not calibrated	Perform background calibration (**"calibration" (*1)** function group)
A632	full/covered not calibrated	Perform full/covered calibration (**"calibration" (*1)** function group)
A633	empty/free not calibrated	Perform empty/free calibration (**"calibration" (*1)** function group)
A634	density not calibrated	▪ Check: Has at least one calibration point been entered and activated? If not: Enter and activate calibration point(s). (**"calibration" (*1)** function group) ▪ Check: Is the "reference pulse rate" (*1F) larger than 2^{32}? If yes: re-perform density calibration (**"calibration" (*1)**) function group
A635	present date not defined	▪ Enter present date (**"basic setup" (*0)** function group **"today's date" (*01)** function) ▪ See Note "**Error messages A165 "electronics defect" and A635 "present date not defined"** on → 39.
A636	calibration date not plausible	Check calibration date and enter it again (**"system parameters" (*C)** function group **"calibration date" (*C7)** function)
A637	operating mode not defined	Enter operating mode ("basic setup" (*0) function group **"operating mode" (*04)** function)
A638	measurement mode not defined	Enter measurement mode ("basic setup" (*0) function group **"measurement mode" (*05)** function)
A639	temperature compensation not complete	Enter at least two "temperature - density" value pairs (**"temperature compensation" (*3)** function group)
W662	high sensor temperature (warning)	Install water cooling jacket or thermal shielding
A663	sensor temperature too high (alarm)	Install water cooling jacket or thermal shielding
A664	temperature measurement error	Check correct functioning and connection of the PT-100 sensor
W681	current out of range (3.8 to 20.5 mA)	Check calibration and linearization
A692	gammagraphy detected (alarm)	▪ Check, if interference radiation is present or the **"hold time" (*54)** is too short. ▪ If no interference radiation is present: decrease gammagraphy sensitivity (**"gammagraphy" (*5)** function group **"sensitivity" (*52)** function)
W693	gammagraphy detected (warning)	Wait for end of the gammagraphy measurement
W695	measurement counter overflow	The local dose rate is too high (where applicable, reduce with blind flange).

9.2 Possible calibration errors

Error	Possible cause and remedy
Pulse rate too low at empty vessel	▪ Radiation source switched off → Switch on source at the source container ▪ Incorrect alignment of radiation beam → Realign beam ▪ 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 source accordingly, if required ▪ Pressure in the vessel has not been considered in the activity calculation → Recalculate activity and change source accordingly, if required ▪ No radiation source in the source container → Load source capsule in the container ▪ Source too weak → Use source with higher activity
Pulse rate to high at empty vessel	▪ Activity too high → Attenuate radiation, e.g. by mounting a steel plate in front of the source container; or exchange source ▪ External radiation source (e.g. by gammagraphy) → Shield off if possible; repeat calibration without external radiation source
Pulse rate too high at full vessel	▪ External radiation source (e.g. by gammagraphy) → Shield off if possible; repeat calibration without external radiation source

9.3 Software history

Date	Software version	Software modifications	Documentation
Since 09.2004	01.01.02	Original software.	BA236F/00/en/08.04 52023878 BA287F/00/en/08.04 52023818
Since 11.2005	01.01.04	Bug fix. Concentration mode corrected. Density measurement recalibration corrected.	
Since 08.2006	01.01.06	Bug fix. Corrections for high and low pulse rate.	
Since 04.2007	01.02.00 01.02.02	Software extended to include "SIL locking" function.	BA236F/00/en/03.07 71041168 BA287F/00/en/04.07 71041170
			BA236F/00/en/06.07 71041168 BA287F/00/en/06.07 71041170
Since 08.2008	01.03.00	Automatic restart after error A165 caused by empty pipe at density measurements (pulse rate > 160000 c/s) **NOTICE** **For instruments with SIL or WHG approvals, software version 01.02.02 remains valid.**	BA236F/00/en/09.08 71082936 BA287F/00/en/06.07 71041170
Since 02.2009	01.03.02	New filtering function for Gamma Modulator FHG65 implemented	BA236F/00/en/03.09 71091966 BA287F/00/en/06.07 71041170
Since 10.2010	01.03.06	Improved EMC stability for extreme interferences.	BA236F/00/en/10.09 71104595 BA287F/00/en/06.07 71041170

10 Technical Data

10.1 Additional technical data

For the technical data, please refer to the Technical Information TI00363F/00/EN.

10.2 Documentation

This supplementary documentation can be found on our product pages at www.endress.com.
- Technical Information (TI00363F/00/EN)
- Operating Instructions "Description of Device Functions" (BA00287F/00/EN)
- Safety Manual "Functional Safety Manual":
  - For max. point level detection (SD00230F/00/EN)
  - For min. point level detection (SD00324F/00/EN)

10.2.1 Clamping device for level and point level detection FHG60

For details, see SD01202F/00/EN.

10.2.2 Clamping device for density measurement FHG61

For details, see SD01221F/00/EN.

10.2.3 Measurement section for density measurement FHG62

For drawings and description, see SD00540F/00/EN.

10.2.4 Certificates and approvals

Safety Manual (SIL 2/3)

SIL 2/3 in accordance with IEC 61508 see
- SD00230F/00/EN "Functional Safety Manual" (for max. point level detection)
- SD00324F/00/EN "Functional Safety Manual" (for min. point level detection)

Ex approval

The available certificates are listed in the ordering information.
Observe the related safety instructions (XA) and Control Drawings (ZD).

Certificates

Allocation to the option, 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	Approval number
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 GYJ101145

Approval Feature 010	Type of protection	Power supply wiring/ Output wiring Option 030	Output (Communication) Option 040	Approval number
C	Ex de [ia] IIC T6	C	1	XA00536F
		C	2, 3	XA00537F
		B	1	XA00536F
		B	2, 3	XA00537F
D	Ex d [ia] IIC T6	D	1	XA00536F
		D	2, 3	XA00537F
		E	1	XA00536F
		E	2, 3	XA00537F

Approval number: IECEx BKI 05.0001

Approval Feature 010	Type of protection	Power supply wiring/ Output wiring Option 030	Output (Communication) Option 040	Approval number
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
		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	Approval number
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
		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	Approval number
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	Approval number
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 (NaJ-Scintillator)

Approval Feature 010	Type of protection	Power supply wiring/ Output wiring Option 030	Output (Communication) Option 040	Approval number
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	Approval number
K	TIIS Ex d [ia] IIC T6	D	1	BA00236F

CE mark

The measuring system meets the legal requirements of the EC-guidelines. Endress+Hauser confirms the device passing the required tests by attaching the CE-mark.

GOST

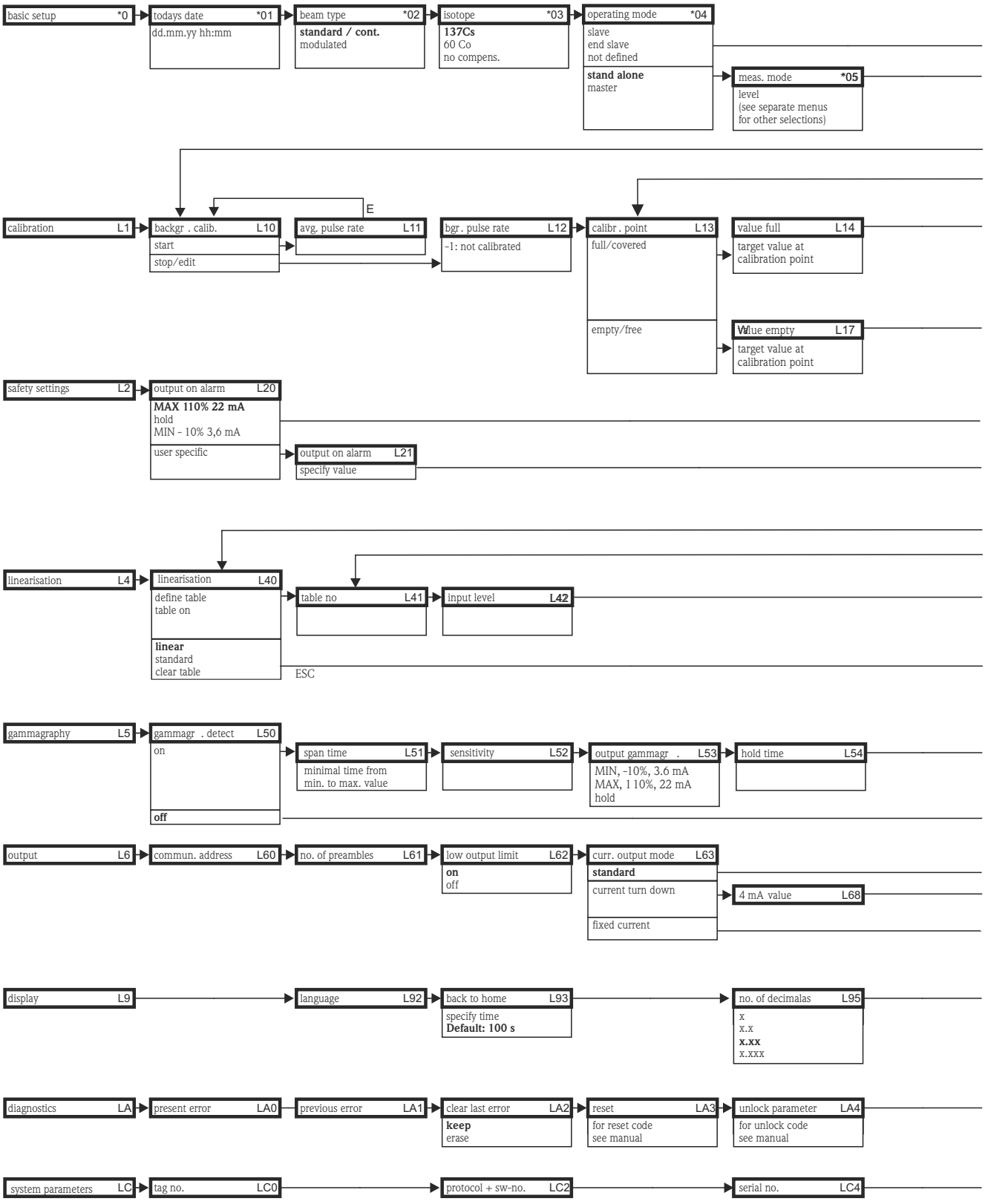
Approval for GOST available.

Overfill protection

WHG for level limit detection.

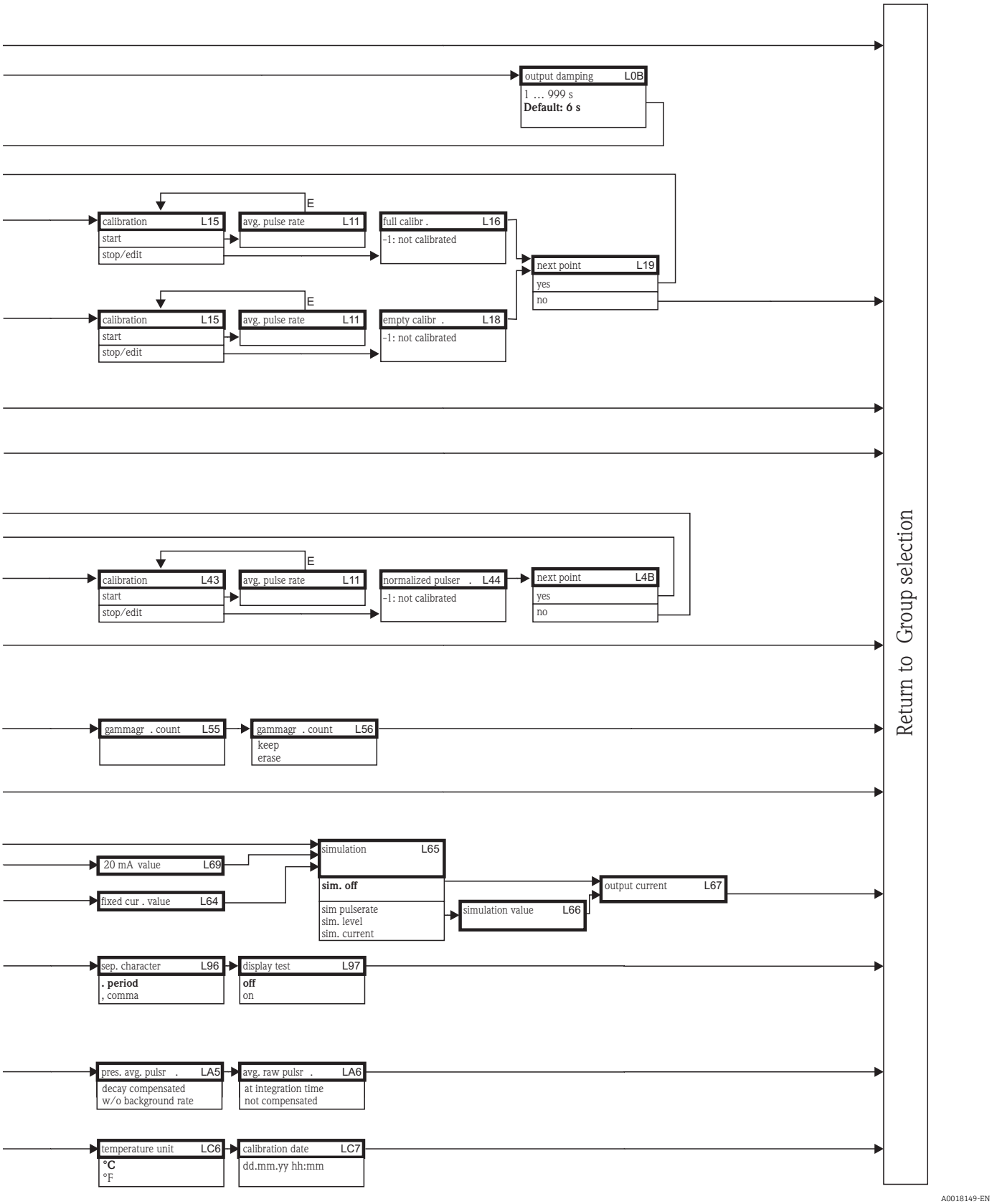
11 Appendix

11.1 Operating menu for level measurements

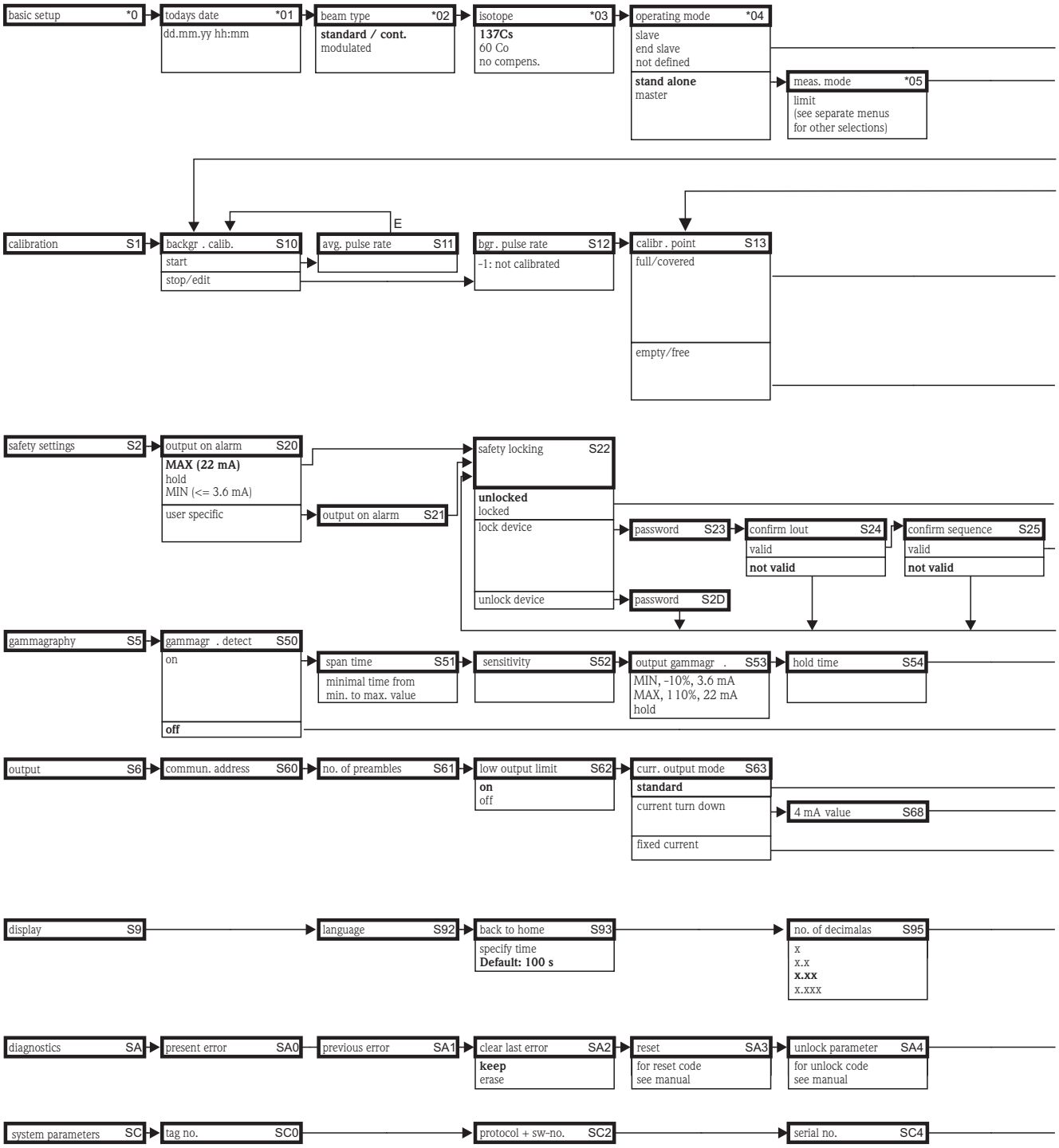


Note! The Default values of the parameters are typed in bold.

A0018143-EN

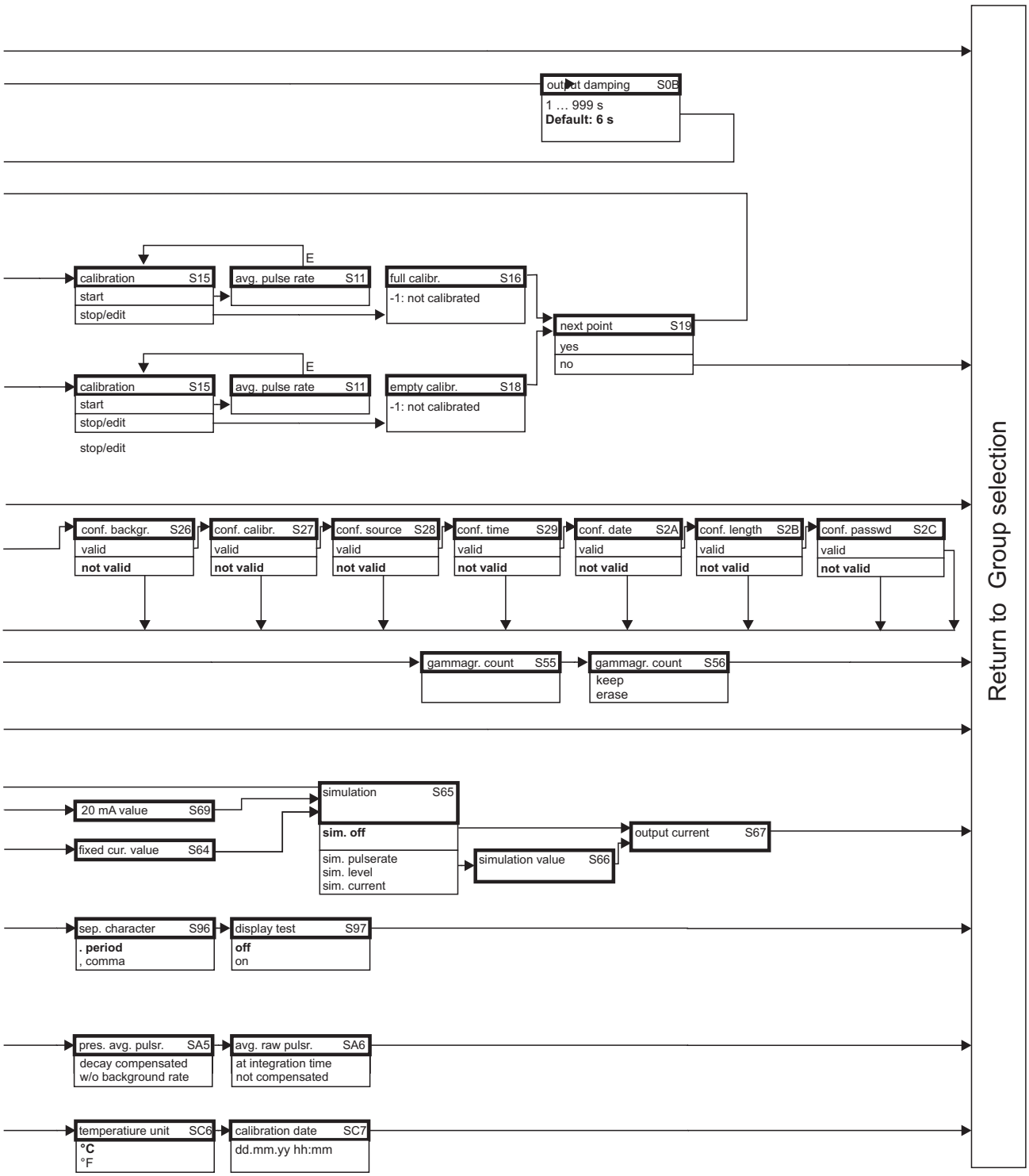

output damping L0B
1 … 999 s
Default: 6 s
E
calibration L15
start
stop/edit
avg. pulse rate L11
full calibr . L16
-1: not calibrated
next point L19
yes
no
E
calibration L15
start
stop/edit
avg. pulse rate L11
empty calibr . L18
-1: not calibrated
E
calibration L43
start
stop/edit
avg. pulse rate L11
normalized pulser . L44
-1: not calibrated
next point L4B
yes
no
gammagr . count L55
gammagr . count L56
keep
erase
20 mA value L69
fixed cur . value L64
simulation L65
sim. off
sim pulserate
sim. level
sim. current
simulation value L66
output current L67
sep. character L96
. period
, comma
display test L97
off
on
pres. avg. pulsr . LA5
decay compensated
w/o background rate
avg. raw pulsr . LA6
at integration time
not compensated
temperature unit LC6
°C
°F
calibration date LC7
dd.mm.yy hh:mm
Return to Group selection
A0018149-EN

11.2 Operating menu for level limit detection



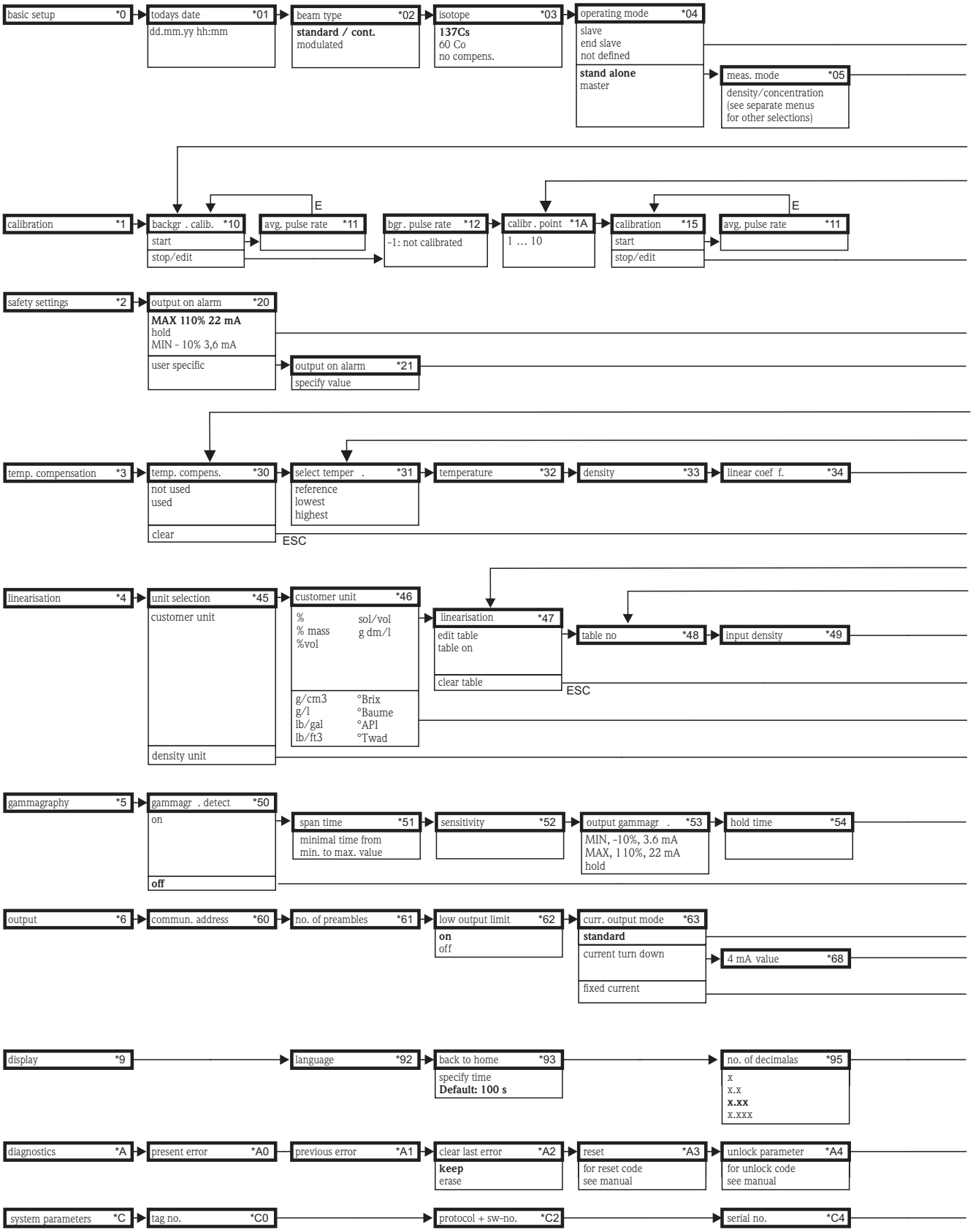
Note! The Default values of the parameters are typed in bold.

A0018150-EN


output damping S0B
1 … 999 s
Default: 6 s
E
calibration S15
start
stop/edit
avg. pulse rate S11
full calibr. S16
-1: not calibrated
next point S19
yes
no
E
calibration S15
start
stop/edit
avg. pulse rate S11
empty calibr. S18
-1: not calibrated
stop/edit
conf. backgr. S26
valid
not valid
conf. calibr. S27
valid
not valid
conf. source S28
valid
not valid
conf. time S29
valid
not valid
conf. date S2A
valid
not valid
conf. length S2B
valid
not valid
conf. passwd S2C
valid
not valid
gammagr. count S55
gammagr. count S56
keep
erase
simulation S65
sim. off
sim. pulserate
sim. level
sim. current
20 mA value S69
fixed cur. value S64
simulation value S66
output current S67
sep. character S96
. period
, comma
display test S97
off
on
pres. avg. pulsr. SA5
decay compensated
w/o background rate
avg. raw pulsr. SA6
at integration time
not compensated
temperatiure unit SC6
°C
°F
calibration date SC7
dd.mm.yy hh:mm
Return to Group selection

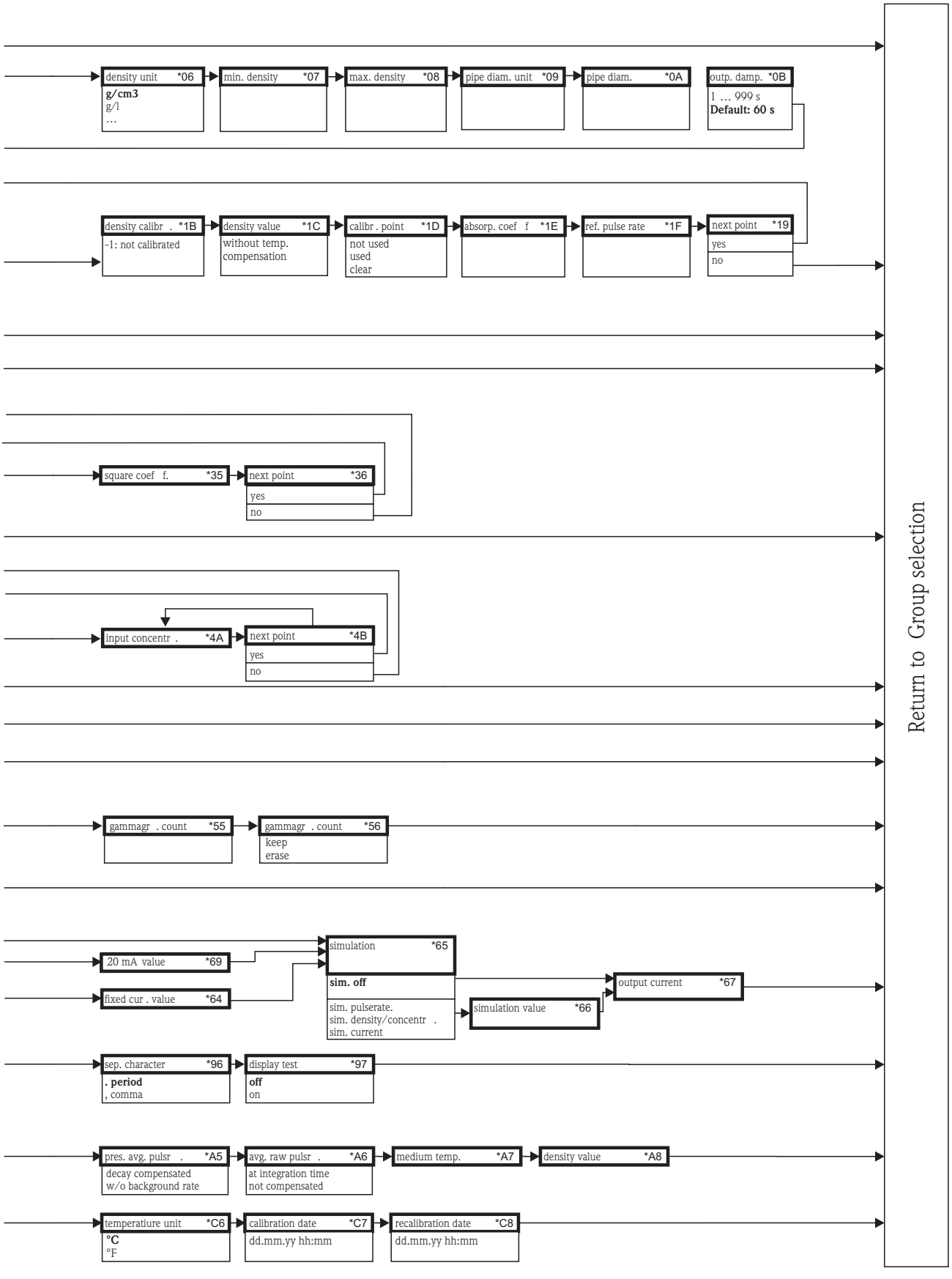
A0018151-EN

11.3 Operating menu for density and concentration measurements



Note! The Default values of the parameters are typed in bold.

A0018152-EN


density unit *06
g/cm3
g/l
...
min. density *07
max. density *08
pipe diam. unit *09
pipe diam. *0A
outp. damp. *0B
1 ... 999 s
Default: 60 s
density calibr . *1B
-1: not calibrated
density value *1C
without temp. compensation
calibr . point *1D
not used
used
clear
absorp. coef f *1E
ref. pulse rate *1F
next point *19
yes
no
square coef f. *35
next point *36
yes
no
input concentr . *4A
next point *4B
yes
no
gammagr . count *55
gammagr . count *56
keep
erase
20 mA value *69
fixed cur . value *64
simulation *65
sim. off
sim. pulserate.
sim. density/concentr .
sim. current
simulation value *66
output current *67
sep. character *96
. period
, comma
display test *97
off
on
pres. avg. pulsr . *A5
decay compensated
w/o background rate
avg. raw pulsr . *A6
at integration time
not compensated
medium temp. *A7
density value *A8
temperatiure unit *C6
°C
°F
calibration date *C7
dd.mm.yy hh:mm
recalibration date *C8
dd.mm.yy hh:mm
Return to Group selection

A0018153-EN

Index

Symbols

Numerics

A

B

C

D

E

F

H

I

K

L

www.addresses.endress.com

Endress+Hauser

People for Process Automation