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Technical Information

Gamma Modulator FHG65
Synchronizer FHG66

Radiometric Measurement
Effective Suppression of Background Radiation and Extraneous Radiation at the Gammapilot FMG60

Application

- **Gamma Modulator FHG65**
  Improving the measurement results of radioactive measurement through the effective suppression of background radiation and extraneous radiation (e.g. from nondestructive material testing) at the Gammapilot FMG60
- **Synchronizer FHG66**
  Synchronization of an unlimited number of Gamma Modulators FHG65

Your benefits

- Unhindered measurement with Gammapilot M FMG60 in the event of
  – Interference radiation from nondestructive material testing up to 50 µSv/h
  – Fluctuating background radiation
- Easy integration into existing systems
- No maintenance required
- Easy installation in conjunction with FQG61/62 (QG020/100) source containers

TI423F/00/en/03.10
71112578

Endress+Hauser
People for Process Automation

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Function and system design

System Design

A measuring point with the Gamma Modulator FHG65 consists of the following components:

- Gamma Modulator FHG65
- Gammapilot M FMG60
- Radiation Source Container FQG61 (QG020) or FQG62 (QG100)
- Radiation source ^{137}Cs or ^{60}Co
- if multiple Gamma Modulators are used: Synchronizer FHG66

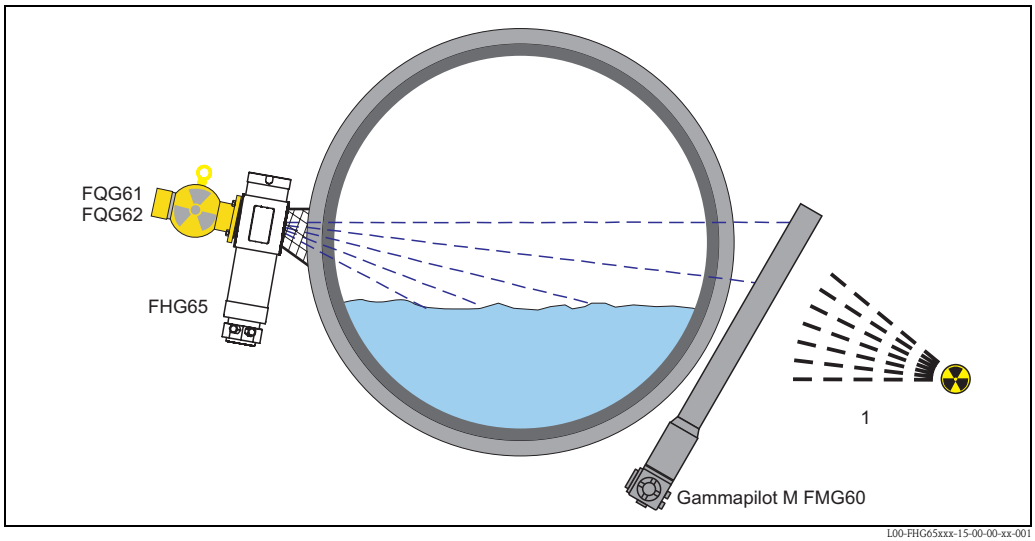
System requirements at Gammapilot M FMG60

In order to be able to evaluate the signal created by the Gamma Modulator FHG65, the Gammapilot M FMG60 must be equipped with at least one of the following software versions:

- HART electronics
  - for SIL devices of short level limit detectors (200 mm or 400 mm): SW 01.02.02 or higher
  - for all other device types: SW 01.03.02 or higher
- PROFIBUS PA electronics
  - SW 01.03.02 or higher
- FOUNDATION Fieldbus electronics
  - SW 01.03.02 or higher

Gamma Modulator FHG65

In a radiometric measuring point with Gammapilot FMG60, the Gamma Modulator FHG65 is mounted in front of the radiation exit channel of the source container. It contains a shaft slotted along the longitudinal axis. This shaft rotates continuously and alternately screens off the gamma beam at a frequency of 1 Hz or allows it through.
Due to this frequency, the useful beam differs from fluctuating ambient interference radiation and from interference radiation occurring sporadically (e.g. from nondestructive material testing). Using a frequency filter, the Gammapilot M FMG60 can thus separate the useful signal from interference radiation. In this way, it is possible to continue measuring even if interference radiation occurs, which, in turn, increases the measuring certainty and system availability.

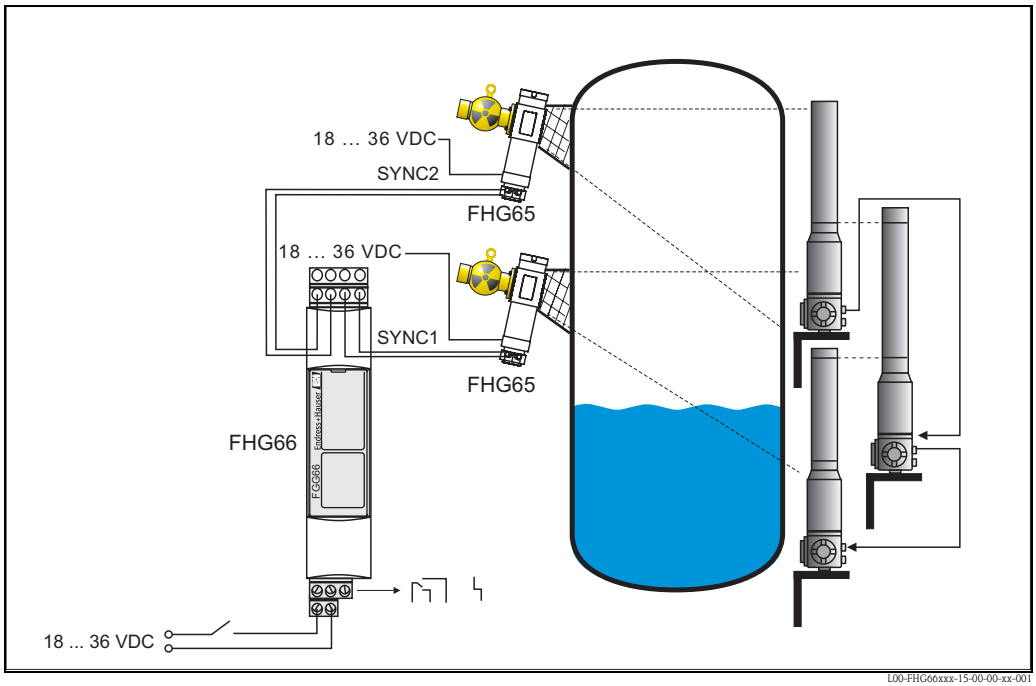


1: *Interference radiation*

Note!
The Gamma Modulator FHG65 and the Gammapilot M FMG60 are not interconnected electrically. When commissioning the Gammapilot FMG60, the **"beam type" (*02)** parameter must be set to "modulated".

Synchronizer FHG66

In a measuring point with multiple radiation sources, a Gamma Modulator FHG65 has to be mounted on every source container. The Synchronizer FHG66 synchronizes the individual modulators to common mode. A Synchronizer FHG66 can synchronize up to three Gamma Modulators FHG65.
(For more than 3 modulators refer to → 🖹 5)

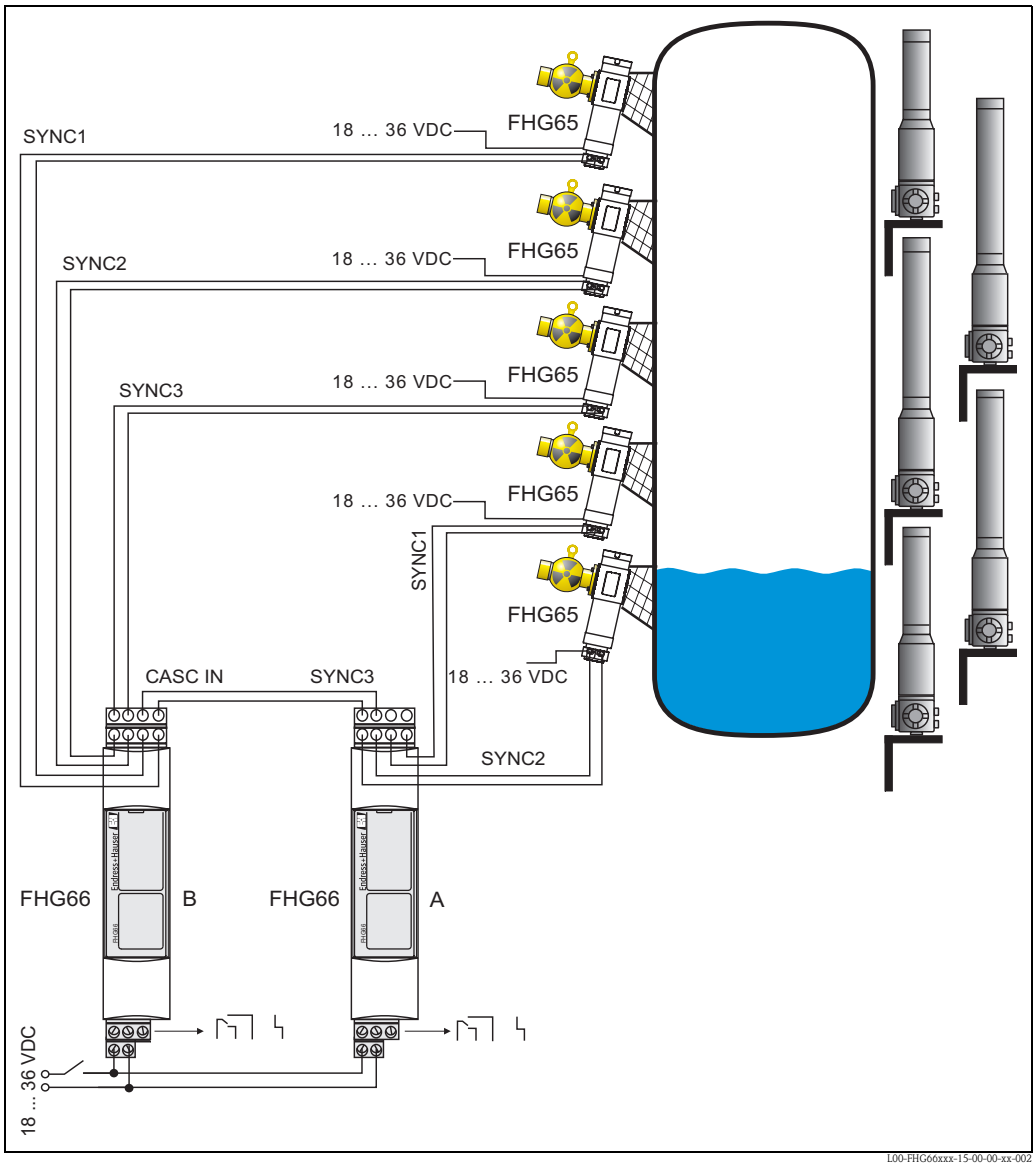


Synchronization of up to three source containers

Note!
It is recommended to install the switch for the supply voltage in the proximity of the instrument and to mark it as a disconnector for the instrument.

Cascading multiple Synchronizers FHG66

If more than three radiation sources are used, the synchronization chain must be extended by cascading, where another Synchronizer (B) is connected to one of the outputs of the Synchronizer (A) instead of a modulator. All connected Gamma Modulators then operate in common mode.
By interconnecting this cascading function, any number of modulators can be synchronized with one another.



A: primary Synchronizer; B: cascaded Synchronizer

Gamma Modulator FHG65: technical data

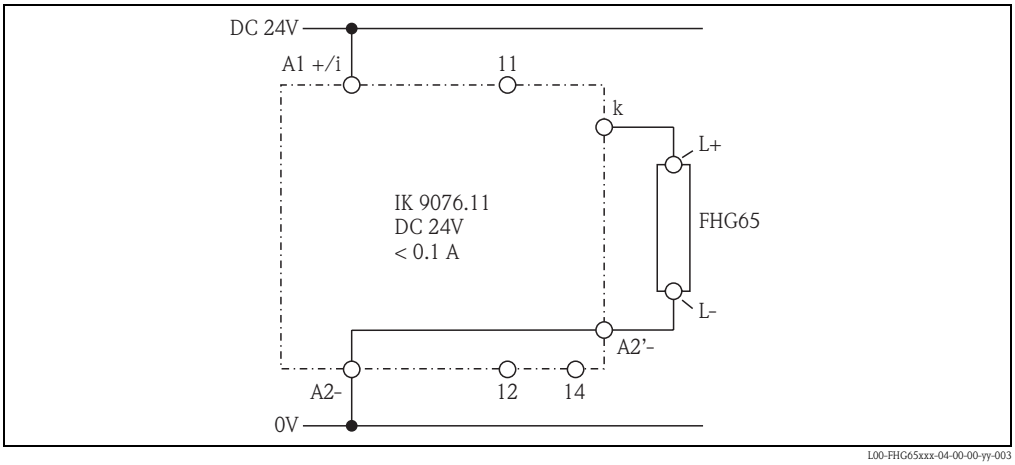
Power supply

Supply voltage	18 to 36 VDC
Power consumption	3.2 W
Overvoltage category	II
Protection class	1
Potential equalization	Present

Alarm output

The Gamma Modulator FHG65 does not have an alarm output of its own. Errors are indicated in the following way:

- if a Synchronizer FHG66 is connected:
  The error is reported via the synchronization terminals to the Synchronizer FHG66. The alarm relay of the FHG66 indicates the error.
- if no Synchronizer FHG66 is connected:
  In the case of an error, the FHG65 switches its motor off. This reduces the current consumption to less than 30 mA, which can be detected and indicated by an external current monitoring device (e.g. Dold IK9076.11, DC24V, < 0.1 A).



Environment

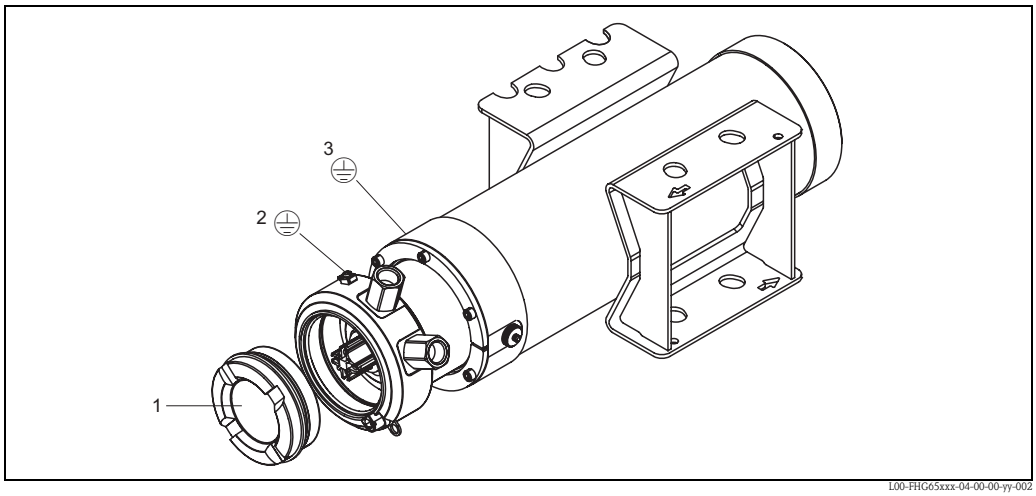
Ambient temperature range	■ without water cooling: -40 °C to +60 °C (-40 °F to 140 °F) ■ with water cooling: – at the water cooling jacket: 0°C to 120 °C (32 °F to 248 °F) – at the terminal housing: max. 75 °C (167 °F)
Storage temperature	-40 °C to 75 °C (-40 °F to 167 °F)
Housing degree of protection	IP65/67; NEMA 4/6
Climate class	DIN EN 60068-2-38 examination Z/AD
Vibration resistance	DIN EN 60068-2-64 test Fh; 10 to 2000 Hz, 1 $(m/s^2)^2/Hz$
Shock resistance	DIN EN 60068-2-27; test Ea; 30 g, 18 ms, 3 shocks/direction/axis
Electromagnetic compatibility	Interference emission to EN 61326, Appendix A (Industrial) and NAMUR Recommendation NE21

Interference suppression max. 10 μS/h per 1000 mm measuring length

Measuring range [mm]	Maximum interference suppression [μSv/h]
200	50
800	12.5
2000	5
10000 (cascading)	1

Gamma Modulator FHG65: electrical connection

Connection compartment



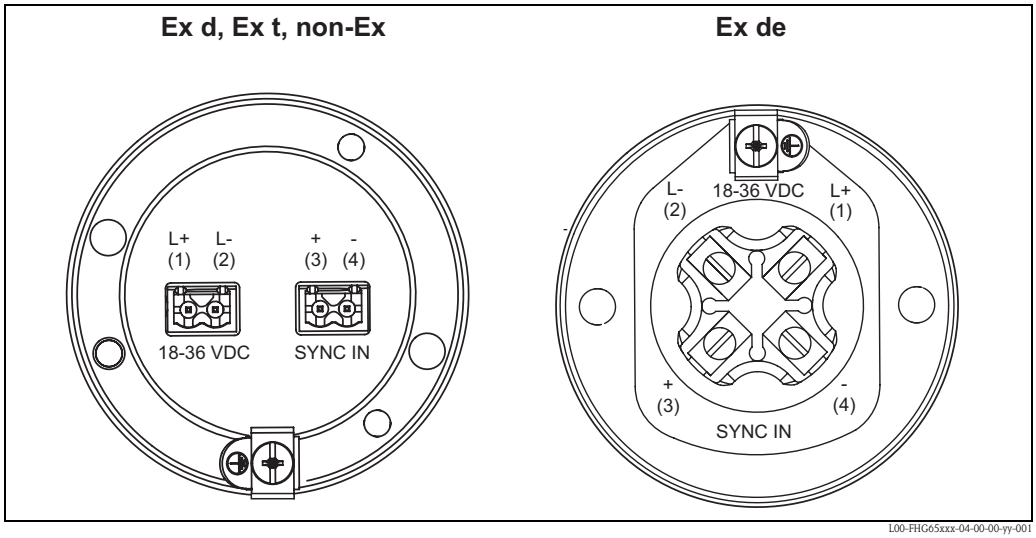
1*: Cover of the connection compartment;* **2***: ground terminal of the modulator;* **3***: ground terminal of the water cooling jacket*

Cable entries

2 cable entries (for supply voltage and synchronization connection)

Versions:
- M20 gland
- M20 thread
- G ½ thread
- NPT ½ thread

Terminal assignment



Terminal	Name	Meaning
1	L+	Supply voltage; 18 to 36 VDC
2	L-	
3	SYNC +	Synchronization connection (to connect the Synchronizer FHG66) 12 VDC, 5 mA
4	SYNC -	

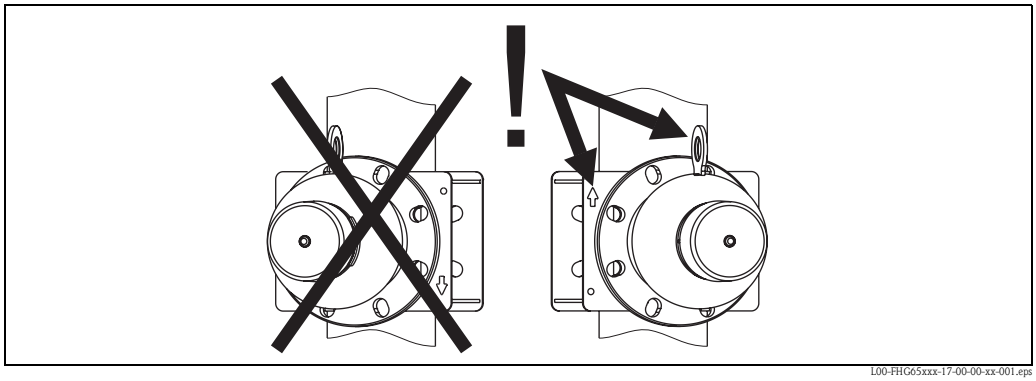
- Install a circuit breaker in the supply line.
- Use wires of ≥ 0.5 mm^2 cross section.

Gamma Modulator FHG65: installation

General installation conditions

- The Gamma Modulator FHG65 is mounted directly on the mounting flange of the FQG61,(QG020) or FQG62 (QG100) source container.[1)]

Caution!
It is absolutely essential to ensure the device is oriented correctly when mounting since the radiation exit channel is not located in the middle of the source container. The arrow on the mounting plate of the Gamma Modulator must point in the direction of the transporting lug of the source container. Measurement is not possible otherwise.



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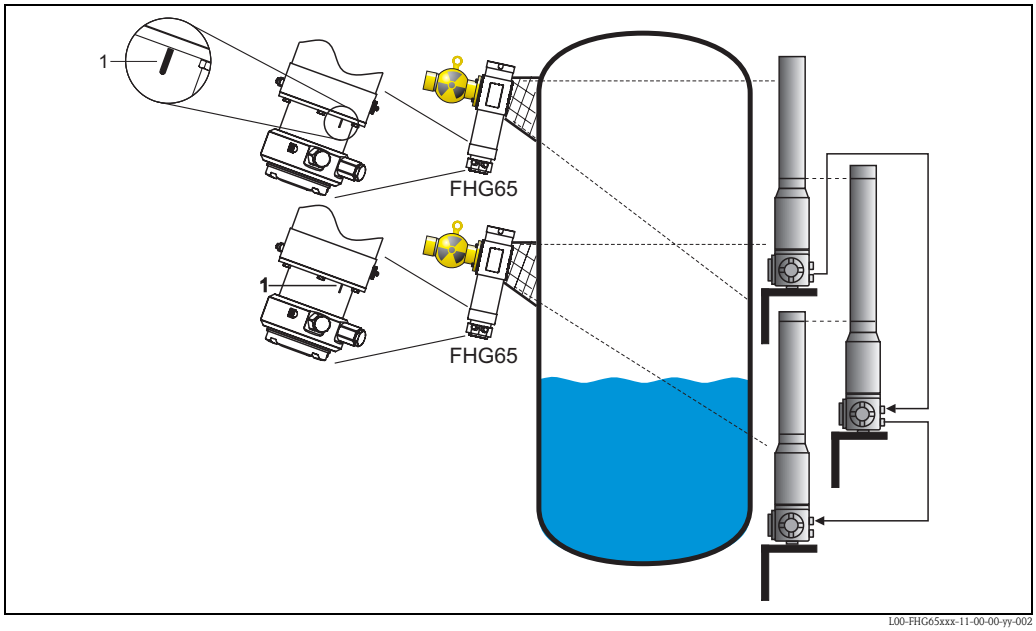
- The source container together with the Gamma Modulator must be mounted as close as possible to the tank or measuring tube.
- The unit must be mounted on a low-vibration construction.
- Use at least 4 threaded bolts (M16);
  Torque:
  – Steel: 210 Nm
  – Stainless Steel: 144 Nm
- When mounting, attention must be paid to the total weight consisting of the source container and Gamma Modulator FHG65. Ensure sufficient stability is guaranteed. Where necessary, an additional support must be provided.
- After mounting, the local dose rate in the vicinity of the source container and the Gamma Modulator must be measured. Any control zones must be cordoned off (see Technical Information TI264F).

1) For applications with the QG2000 source container: please contact your local Endress+Hauser sales office.

Mounting multiple Gamma Modulators FHG65

If multiple Gamma Modulators FHG65 are used in a measuring point, they have to run synchronically. The Synchronizer FHG66 is used for this purpose.

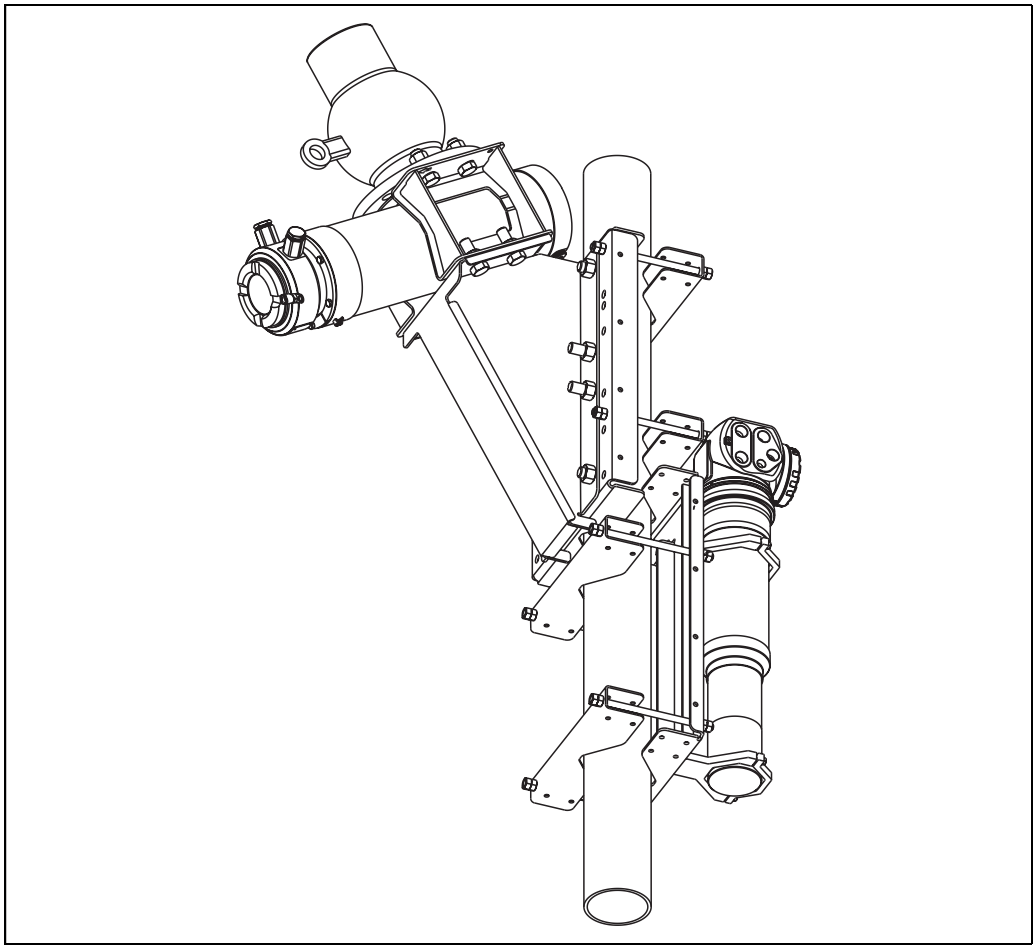
Note!
The synchronization requires that all the Gamma Modulators FHG65 be aligned the same. A mark is provided at the top of the Gamma Modulator FHG65 to align the units. This mark must be aligned in the same way relative to the source container on all the participating Gamma Modulators FHG65.



1: *Marking for aligning multiple Gamma Modulators*
This mark must be aligned in the same way relative to the source container on all the Gamma Modulators in a measuring point.

Mounting at diagonally irradiated pipes

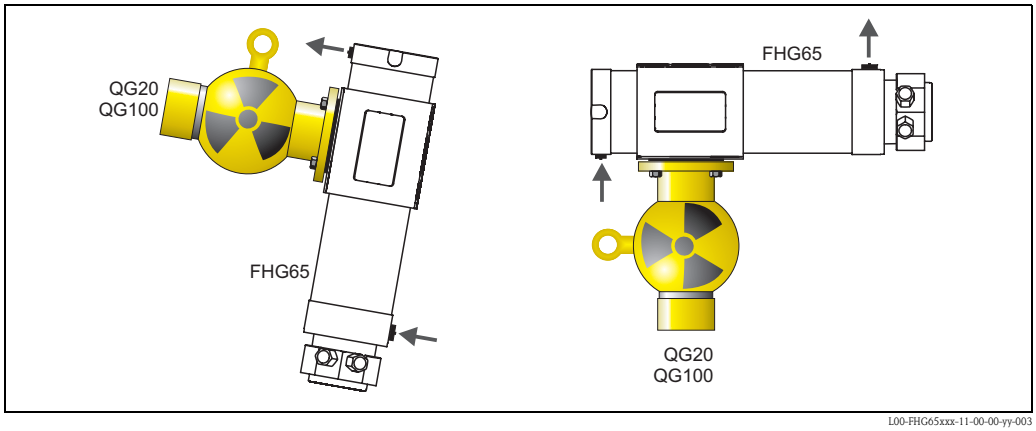
With diagonally irradiated pipes the clamping device FHG61 must be used for mounting. For details see Mounting Instructions KA261F.



Water cooling

The following applies to the FMG60 Gamma Modulator with water cooling:

- Material: 316L and 304
- Water connection: 2 x G 1/4"A, DIN ISO 228
- Return temperature: max. 40 °C (104 °F); temperature monitoring recommended
- Water pressure: 4 to 6 bar
- Water flow rate: min. 60 l/h



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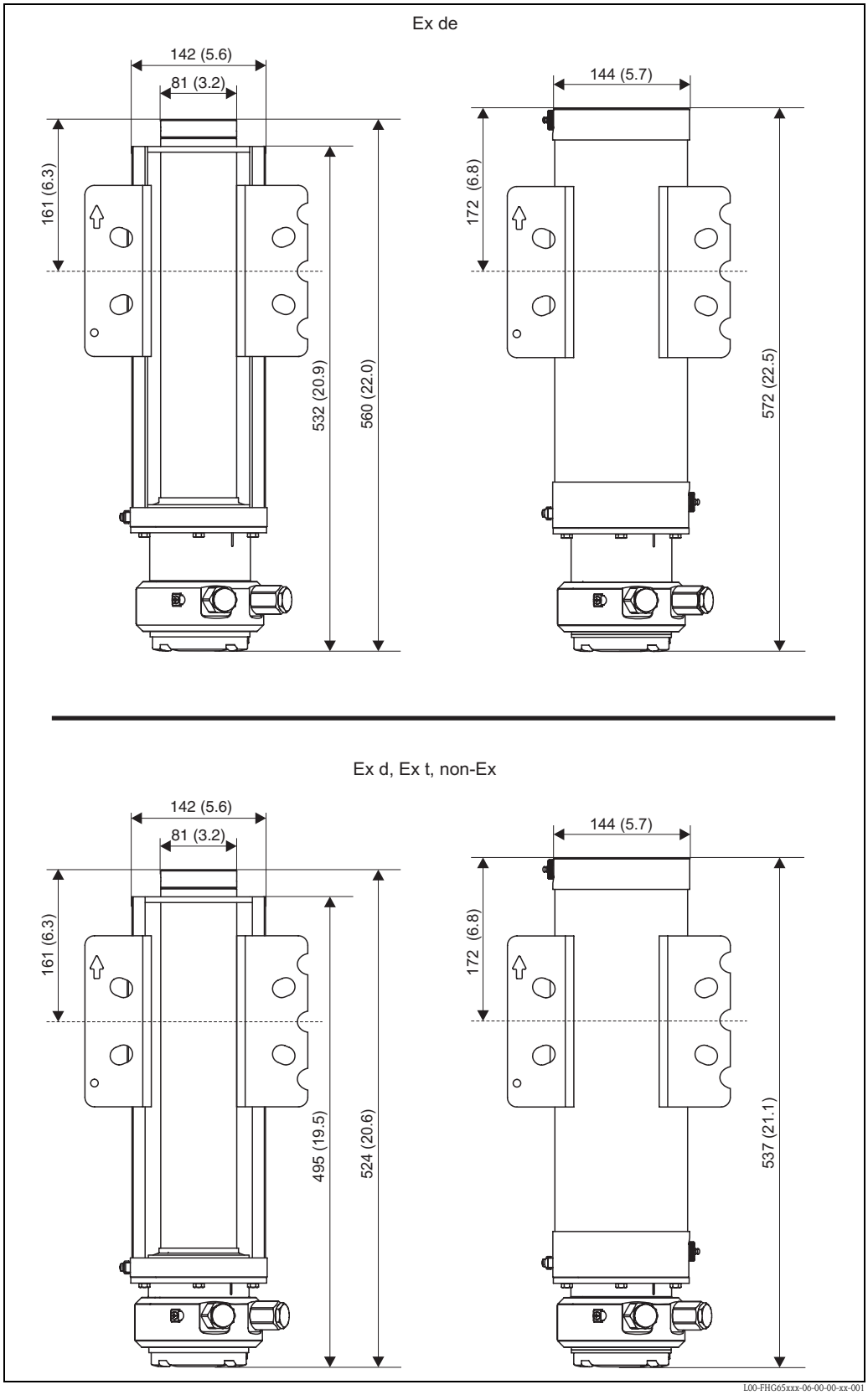
Caution!
The water must always be let in from the bottom to ensure that the water jacket is completely filled.

Gamma Modulator FHG65: mechanical construction

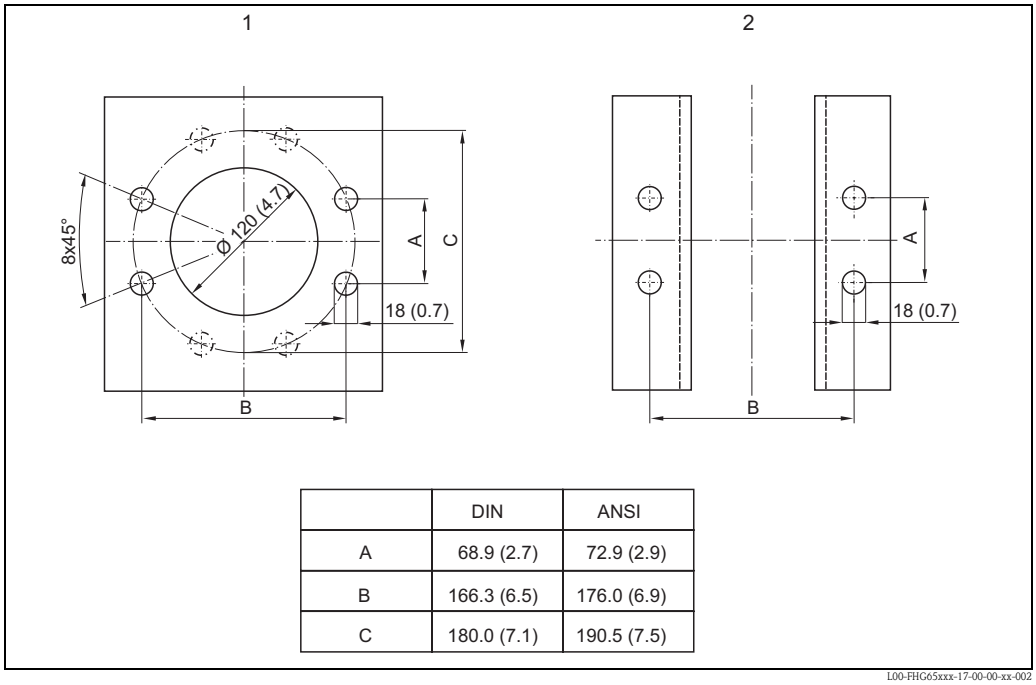
Dimensions

Gamma Modulator



Left: *without water jacket;* **right:** *with water jacket*

Examples of mounting brackets (supplied by customer)



	DIN	ANSI
A	68.9 (2.7)	72.9 (2.9)
B	166.3 (6.5)	176.0 (6.9)
C	180.0 (7.1)	190.5 (7.5)

1: Mounting plate (Bolt circle according to DN 100 PN 16 or ANSI 4" 150 psi)
2: L profile

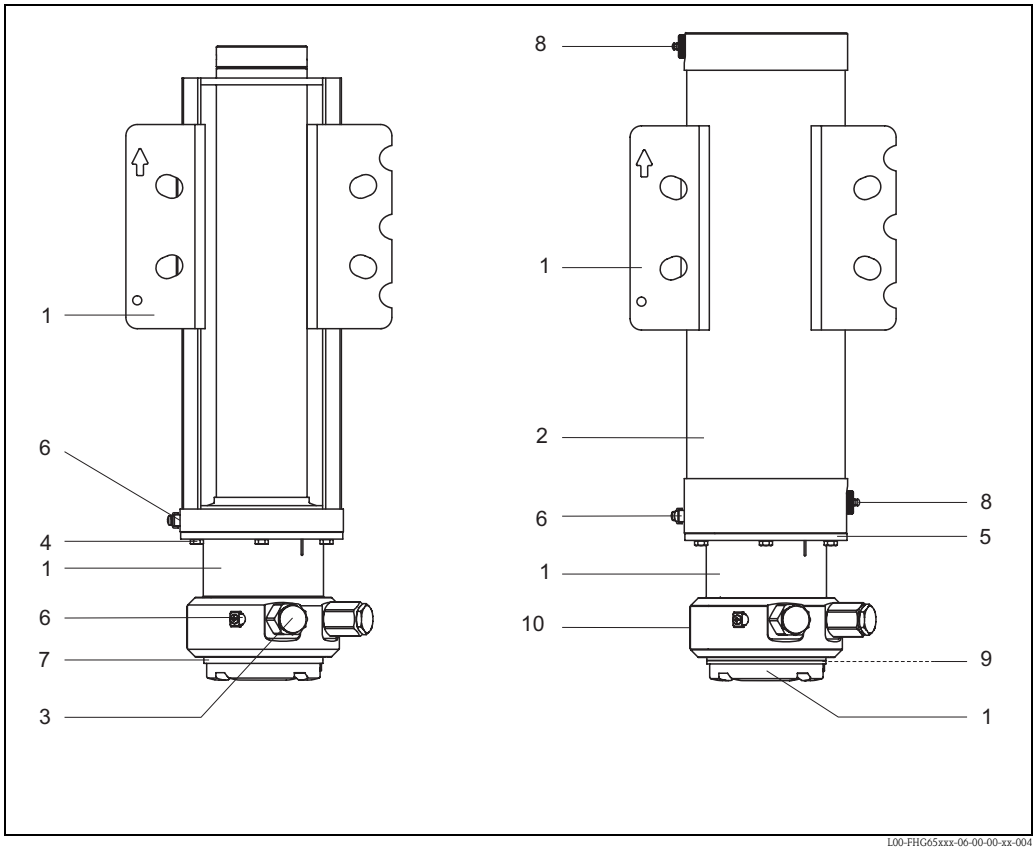
Weight

- Without water cooling jacket: max. 18 kg (40 lbs)
- With water cooling jacket (empty): max. 21 kg (46 lbs)
- With water cooling jacket (full): max. 25 kg (55 lbs)

Durability of the bearings

36 years at maximum load in continuous operation.

Material



Number	Part	Material
1	Housing	304 (1.4301)
2	Water cooling jacket	316L (1.4404)
3	Cable entry	see table below
4	Screws	A2-70
5	O-ring	FKM 70
6	Ground terminal	316Ti (1.4571); 304 (1.4301); A2 ; A4
7	O-ring	FKM 70
8	Cooling water connection	PA66
9	Safety pin for the lid	304 (1.4301); 1.4581 ; A2
10	Nameplate and grooved pins	304 (1.4301); A2

Material of cable entry and seal

Feature 040: "Cable entry, power supply"	316L (1.4435)	12L13 (1.0718)	304 (1.4301)	MS	EPDM70+PTFE
A: M20 gland	✓	✓		✓	✓
B: M20 thread	✓	✓			✓
C: G 1/2 thread	✓	✓	✓		✓
D: NPT 1/2 thread		✓	✓		✓

Gamma Modulator FHG65: ordering information

Gamma Modulator FHG65 product structure

010	Approval	
	A	Non-hazardous area
	1	ATEX II 2G Ex de IIC T6/T5
	3	ATEX II 2G Ex d IIC T6/T5
	5	ATEX II 2D Ex t IIIC T90°C/T105°C IP65
	G	IECEx Ex de IIC T6/T5 Gb
	H	IECEx Ex d IIC T6/T5 Gb
	N	CSA General Purpose
	P	CSA Cl.I Gr.A-D/Cl.II Gr.E-G/Cl.III, Cl. I Zone 1
	S	FM Cl.I Gr.A-D/Cl.II Gr.E-G/Cl.III, Cl. 1 Zone 1
	K	TIIS Ex d IIC T6
	C	NEPSI Ex de IIC T5/T6
	D	NEPSI Ex d IIC T5/T6

020		Power supply
	1	18-36 VDC

030			Housing
		A	304

040				Cable entry, power supply
			A	M20 gland
			B	M20 thread
			C	G ½ thread
			D	NPT ½ thread

050					Securing unit
				1	Level, limit detection, density
				2	Level, limit detection, density + water jacket

FHG65-						Product designation

Synchronizer FHG66: technical data

Input

Cascading input

- For connection of an additional Synchronizer FHG66
- Galvanically isolated from power supply and output
- Connecting cable: twin-core; shielding not required (apart from in the event of strong electromagnetic interference)
- Cable requirements:
  - Max. capacitance: 120 nF
  - Max. resistance 1000 Ω
  - Max. inductance: 0.65 mH
  - Cable: not shielded/not twisted
- Signal transmission: closed current loop with 0 to 5 mA, max. 12 V

Output

Alarm relay

Type	Floating changeover contact
Switching delay	0 to 3 s
Switching capacity	■ U~ maximum 250V ■ I~ maximum 2 A ■ P~ maximum 500 VA at cosφ ≥0.7 ■ U- maximum 40 V ■ I- maximum 2 A ■ P- maximum 80 W
Operating life	Min. 10^5 switching cycles with maximum contact load
Function indicator	Light emitting diodes for operation, faults and error assignment; device detects and reports errors in the configuration and in the connected devices
Overvoltage category	II
Protection class	2 (double/reinforced insulation)

Signal on alarm

- Fault indicated by red LED
- Fault assigned by yellow LEDs
- Alarm relay deenergized

Power supply

Supply voltage	18 to 36 VDC (power supply with safe isolation required)
Power consumption	≤ 1 W
Overvoltage category	II
Protection class	2
Contamination level	2

Environment

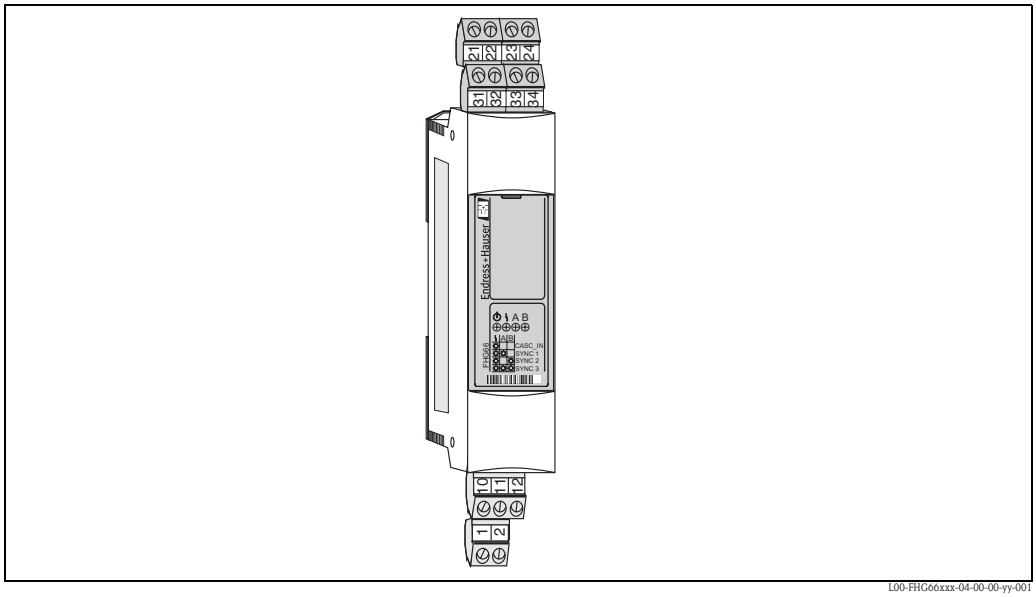
Ambient temperature range	■ Mounted individually: -20 °C to +60 °C ■ Mounted in a row without lateral spacing: -20 °C to +50 °C ■ When installed in protective housing: -20 °C to +40 °C
Storage temperature	-20 °C to +85 °C (preferably at 20 °C)
Climate and mechanical application class	■ 3C3 in accordance with DIN EN 60721-3-3 ■ 3M2 in accordance with DIN EN 60721-3-3
Degree of protection	IP20
Electromagnetic compatibility	■ Interference emission to EN61326, class B equipment ■ Interference immunity to EN61326, Appendix A (Industrial) and NAMUR Recommendation NE 21

Synchronizer FHG66: electrical connection

Terminals

Pluggable screw terminals
Wire cross-section:
- 1.0 ... 2.5 mm^2 for supply voltage and relay
- 0.5 ... 2.5 mm^2 for signal line

Caution!
The terminals may only be repalced by identical types.



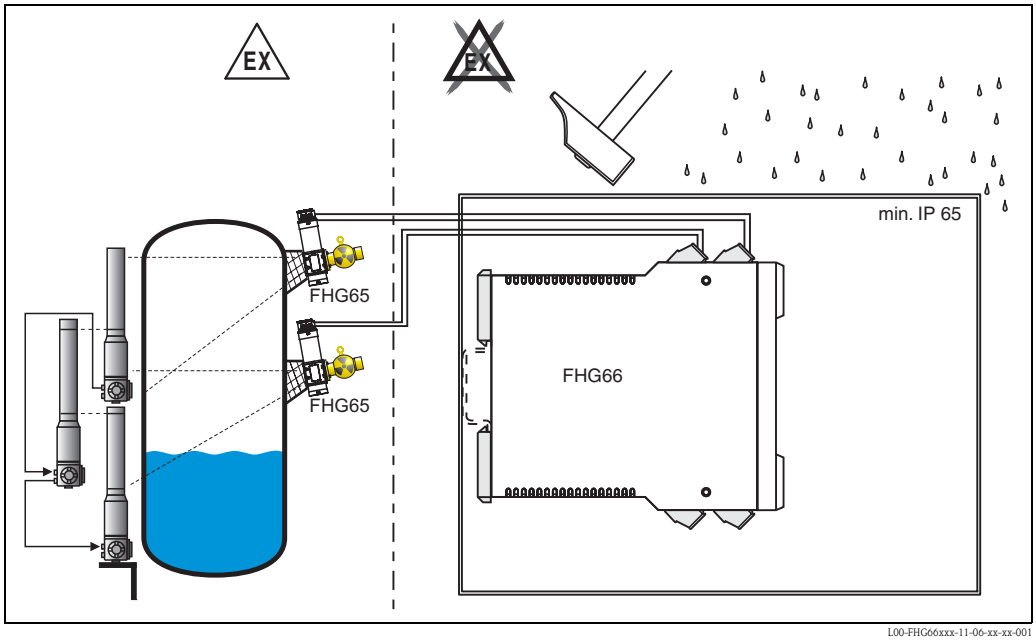
Terminal assignment

Terminal	Meaning	Remarks
Power supply		
1	L+	18 to 36 VDC power supply with safe isolation required
2	L-	
Alarm relay		
10	Changeover	
11	NC contact	Is connected to contact 10 if an error is present
12	NO contact	Is connected to contact 10 during error-free operation
Synchronization outputs		
33/34	Synchronization output 1	Synchronization signal: 12 V/5 mA
31/32	Synchronization output 2	The following can be connected: ■ A Gamma Modulator FHG65 or ■ An additional Synchronizer FHG66 (for cascading) Polarity is random.
21/22	Synchronization output 3	
Cascading input		
23/24	Cascading input	For connecting an additional, upstream Synchronizer FHG66. All the Gamma Modulators connected to the Synchronizers then run in common mode. Cascading signal: 12 V/5 mA

Synchronizer FHG66: installation

Mounting location

The Synchronizer FHG66 must be housed in a cabinet outside the hazardous area and protected against mechanical influences. If mounting outdoors, a protective housing (min. IP65) must be used.



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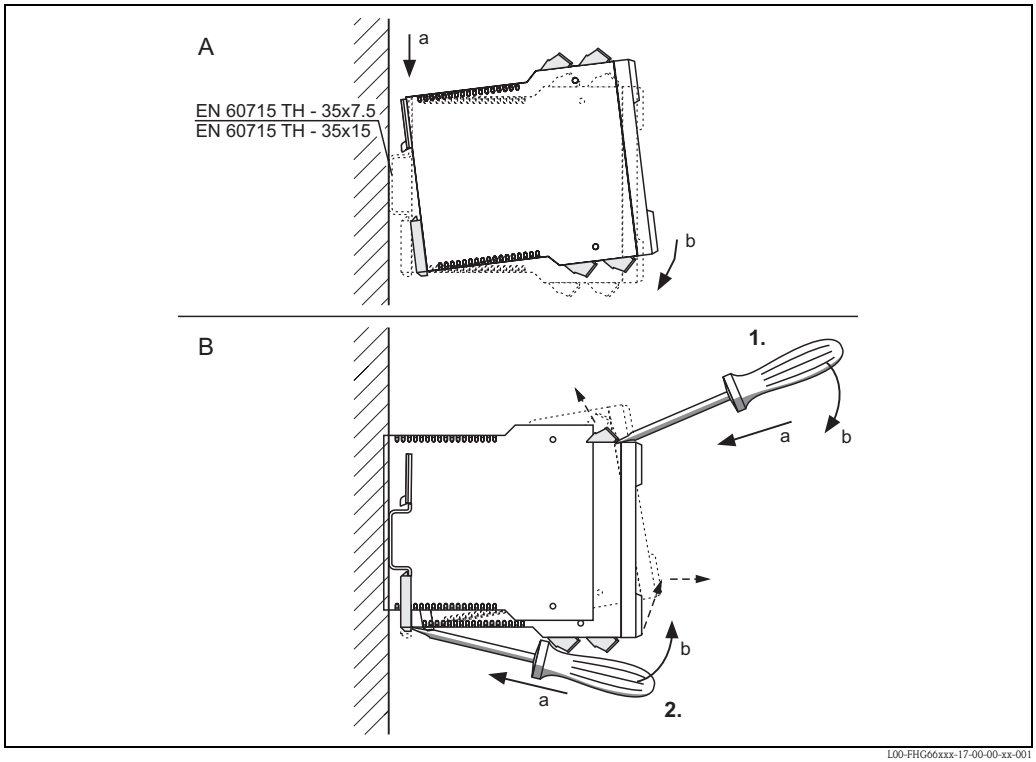
Installation instructions



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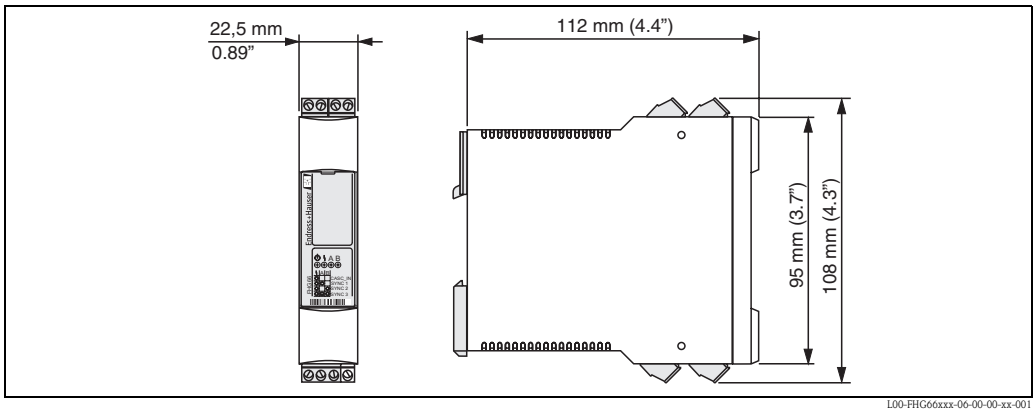
A: Mounting on top-hat rail
B: Disassembly (1: remove terminal blocks; 2: remove device)

Caution!
The ventilation slots of the housing must not be blocked.

Synchronizer FHG66: mechanical construction

Dimensions



Weight

Approx. 150 g

Material

Housing

- Polycarbonate
- Color: light-gray, RAL 7035

Front cover

- Polyamide PA6
- Color: film, blue NCS1040-B206

Fixing slide (to secure to top-hat rail)

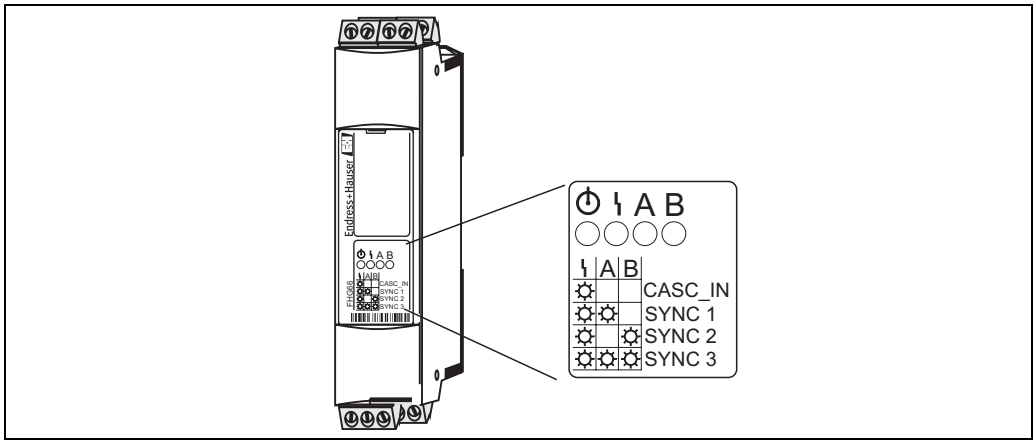
- Polyamide PA6
- Color: light-gray, RAL 7035

Synchronizer FHG66: human interface

Display elements

LEDs

Visible when the front panel is closed



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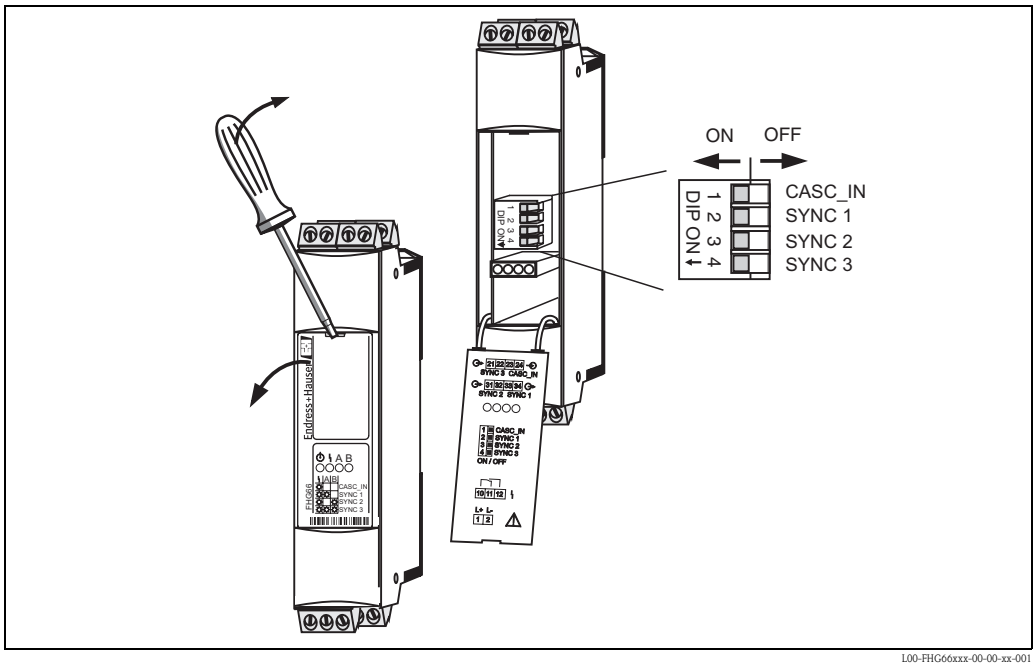
LED	Color	Meaning
⏻	Green	**Operational** Is lit as soon as the supply voltage is switched on.
↯	Red	**Error** Is lit if an error is present at one of the synchronization outputs or the cascading input.
A,B	Yellow	**Error identifier** Indicates the synchronization output where the error is present: ▪ **A:** Error at SYNC 1 ▪ **B:** Error at SYNC 2 ▪ **A and B:** Error at SYNC 3 ▪ **A and B off, but red LED lit**: Error at the cascading input (CASC_IN)

Operating elements

DIP switches

Behind the swing-back front panel



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The DIP switches are used to switch the synchronization outputs and the cascading input on and off in accordance with the diagram above.

DIP switches	Input/output
1	Cascading input (terminals 23/24)
2	Synchronization output 1 (terminals 33/34)
3	Synchronization output 2 (terminals 31/32)
4	Synchronization output 3 (terminals 21/22)

Synchronisator FHG66: Ordering information

Order code

71060806

Certificates and approvals

CE mark	The measuring system meets the legal requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
Explosion protection	**Gamma Modulator FHG65** According to product structure (→ 🖹 15)
Other approvals	**Synchronizer FHG66** CSA GP
Overspill protection	■ May be applied in max-level applications in connection with the Gammapilot M FMG60 (200/400 mm) in SIL 2/3 according to IEC61508. ■ not tested for overspill protection according to WHG
Other standards and guidelines	**IEC 60529** Degrees of protection by housing (IP code) **IEC 61326** Electromagnetic compatibility (EMC requirements) **IEC 61010** Protection measures for electrical equipment for measurement, control, regulation and laboratory procedures. **NAMUR** Association for Standards for Control and Regulation in the Chemical Industry

Documentation

Gamma Modulator FHG65 Synchronizer FHG66	**BA373F** Operating Instructions for Gamma Modulator FHG65 and Synchronizer FHG66
FQG61/FQG62 source containers	**TI435F** Technical Information for source containers FQG61 and FQG62 (in phase out)
QG020/QG100 source containers	**TI264F** Technical Information for source containers QG020 and QG100 (in phase out)
Gamma emitter FSG60/ FSG61	**TI439F** Technical Information for gamma emitters FSG60/FSG61
Gamma emitter	**TI213F** Technical Information for gamma emitters (in phase out)
Gammapilot M FMG60	**TI363F** Technical Information for FMG60 Gammapilot M **BA236F** Operating Instructions for FMG60 Gammapilot M, HART **BA329F** Operating Instructions for FMG60 Gammapilot M, PROFIBUS PA **BA330F** Operating Instructions for FMG60 Gammapilot M, Foundation Fieldbus **BA287F** Description of Device Functions for FMG60 Gammapilot M

Deutschland

Endress+Hauser
Messtechnik
GmbH+Co. KG
Colmarer Straße 6
79576 Weil am Rhein

Fax 0800 EHFAXEN
Fax 0800 343 29 36
www.de.endress.com

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Österreich

Endress+Hauser
Ges.m.b.H.
Lehnergasse 4
1230 Wien
Tel. +43 1 880 56 0
Fax +43 1 880 56 335
info@at.endress.com
www.at.endress.com

Schweiz

Endress+Hauser
Metso AG
Kägenstrasse 2
4153 Reinach
Tel. +41 61 715 75 75
Fax +41 61 715 27 75
info@ch.endress.com
www.ch.endress.com

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