

Safety Instructions

Micropilot

FMR60B/62B/63B/67B

Ex ia IIC T6...T1 Ga/Gb

Ex db IIC T6...T1 Ga/Gb

Ex ta/tb IIIC Txxx °C Da/Db



Micropilot FMR60B/62B/63B/67B

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About this document



The document number of these Safety Instructions (XA) must match the information on the nameplate.

Associated documentation

All documentation is available on the Internet:

www.endress.com/Deviceviewer

(enter the serial number from the nameplate).

To commission the device, please observe the Operating Instructions pertaining to the device:

HART

- BA02247F (FMR60B)
- BA02248F (FMR62B)
- BA02249F (FMR63B)
- BA02251F (FMR67B)

PROFIBUS PA

- BA02261F (FMR60B)
- BA02262F (FMR62B)
- BA02263F (FMR63B)
- BA02265F (FMR67B)

PROFINET

- BA02266F (FMR60B)
- BA02267F (FMR62B)
- BA02268F (FMR63B)
- BA02270F (FMR67B)

Supplementary documentation

Special Documentation for cable gland M20 Ex d: SD02550F

Explosion protection brochure: CP00021Z

The explosion protection brochure is available on the Internet:

www.endress.com/Downloads

General notes: Combined approval

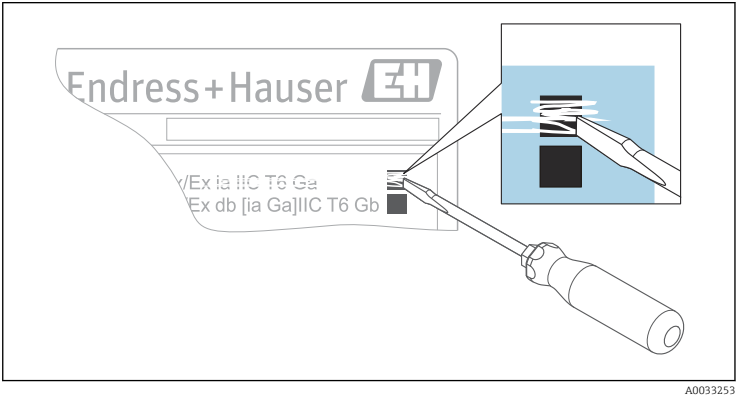
The device is suitable for installation with explosion protection "Intrinsic safety Ex ia" or "Flameproof enclosure Ex db" or "Equipment dust ignition protection by enclosure Ex t".

- Before initial commissioning, specify the type of protection.
- It is not permitted to change the type of protection after initial commissioning as this can jeopardize the explosion protection.

For aluminum enclosures:

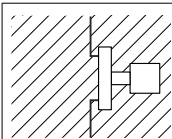
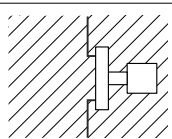
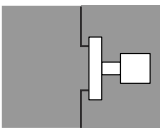
Void out the explosion protection that is not used on the nameplate.

For stainless steel enclosures:
Using a striking tool, mark the explosion protection used, or void out the explosion protection that is not used.



 1

 Depending on the type of protection used: Observe the safety instructions for installation with explosion protection "Intrinsic safety Ex ia", "Flameproof enclosure Ex db" or "Equipment dust ignition protection by enclosure Ex t".

		
Ex ia IIC	Ex db IIC	Ex ta/tb IIIC
Zone 0 or Zone 1	Zone 0 or Zone 1	Zone 20 or Zone 21
Zone 1	Zone 1	Zone 21

The device is designed for operation in explosive gas or explosive dust atmosphere as shown in the sketch above. In the event of potentially explosive gas-air and dust-air mixtures occurring simultaneously: Suitability requires further assessment.

Certificates and
declarations

Certificate of Conformity

Certificate number:
CML 23JPN2055X

Affixing the certificate number certifies conformity with the following standards (depending on the device version):

- JNIO SH-TR-46-1 : 2020
- JNIO SH-TR-46-2 : 2018
- JNIO SH-TR-46-6 : 2015
- IEC 60079-26 : 2021
- JNIO SH-TR-46-9 : 2018

Manufacturer address

Endress+Hauser SE+Co. KG
Hauptstraße 1
79689 Maulburg, Germany
Address of the manufacturing plant: See nameplate.

Extended order code

The extended order code is indicated on the nameplate, which is affixed to the device in such a way that it is clearly visible. Additional information about the nameplate is provided in the associated Operating Instructions.

Structure of the extended order code

FMR6xB – ***** + A*B*C*D*E*F*G*..
(Device (Basic (Optional
type) specifications) specifications)

* = Placeholder
At this position, an option (number or letter) selected from the specification is displayed instead of the placeholders.

Basic specifications

The features that are absolutely essential for the device (mandatory features) are specified in the basic specifications. The number of positions depends on the number of features available.
The selected option of a feature can consist of several positions.

Optional specifications

The optional specifications describe additional features for the device (optional features). The number of positions depends on the number of features available. The features have a 2-digit structure to aid identification (e.g. JA). The first digit (ID) stands for the feature group and consists of a number or a letter (e.g. J = Test, Certificate). The second digit constitutes the value that stands for the feature within the group (e.g. A = 3.1 material (wetted parts), inspection certificate).

More detailed information about the device is provided in the following tables. These tables describe the individual positions and IDs in the extended order code which are relevant to hazardous locations.

Extended order code: Micropilot

-  The following specifications reproduce an extract from the product structure and are used to assign:
- This documentation to the device (using the extended order code on the nameplate).
 - The device options cited in the document.

Device type
FMR60B, FMR62B, FMR63B, FMR67B

Basic specifications

Position 1, 2 (Approval)		
Selected option		Description
FMR6xB	JN	JPN Ex ia IIC T6...T1 Ga/Gb
		JPN Ex ia IIC T6...T1 Gb
		JPN Ex db IIC T6...T1 Ga/Gb
		JPN Ex db IIC T6...T1 Gb
		JPN Ex ta/tb IIIC Txxx°C Da/Db
		JPN Ex tb IIIC Txxx°C Db

Position 3, 4 (Output)		
Selected option		Description
FMR6xB	BA	2-wire, 4-20 mA HART
	BB	2-wire, 4-20 mA HART, switch output ¹⁾
	BC	2-wire, 4-20 mA HART + 4 to 20 mA analog ¹⁾
	DA	2-wire, PROFIBUS PA
	FA	PROFINET over Ethernet-APL, 10Mbit/s

1) Only in connection with Position 6 = J, K, M, N

Position 5 (Display, Operation)		
Selected option		Description
FMR6xB	N	Prepared for display FHX50B + Thread NPT1/2
	O	Prepared for display FHX50B + Thread M20

Position 6 (Housing, Material)		
Selected option		Description
FMR6xB	B	Single compartment; Alu, coated
	J	Dual compartment; Alu, coated
	K	Dual compartment; 316L
	M	Dual compartment L-shape; Alu, coated
	N	Dual compartment L-shape; 316L, coated

Position 7 (Electrical Connection)		
Selected option		Description
FMR6xB	F	Thread M20, IP66/68 NEMA Type 4X/6P
	G	Thread G1/2, IP66/68 NEMA Type 4X/6P
	H	Thread NPT1/2, IP66/68 NEMA Type 4X/6P

Position 8 (Application)		
Selected option		Description
FMR60B FMR62B FMR63B	B	Process temperature -20...+150°C
	D	Process temperature -20...+200°C
FMR60B FMR67B	F	Process temperature -40...+80°C
FMR60B	H	Process temperature -40...+130°C
FMR6xB	J	Process temperature -40...+150°C
	L	Process temperature -40...+200°C
FMR63B	Q	Process temperature -10...150°C
	S	Process temperature -10...200°C
FMR62B FMR67B	N	Process temperature -40...+280°C
	P	Process temperature -40...+450°C
FMR62B	R	Process temperature -60...+150°C
	T	Process temperature -196...+200°C
FMR62B FMR63B	V	Process temperature -20...+150°C, Steam application
	W	Process temperature -20...+200°C, Steam application

Position 9, 10 (Antenna)		
Selected option		Description
FMR60B FMR62B FMR67B	GA	Drip-off, PTFE 50mm/2"
FMR60B FMR63B	GE	Integrated, PEEK, 20mm/3/4"
FMR60B	GF	Integrated, PEEK, 40mm/1-1/2"
FMR62B FMR63B	GM	Cladded flush mount, PTFE, 50mm/2"
	GN	Cladded flush mount, PTFE, 80mm/3"
FMR67B	GP	Flush mount, PTFE, 80mm/3"
FMR63B	GQ	Cladded, flush mount, PEEK, 20mm/3/4"
	GR	Cladded, flush mount, PEEK, 40mm/1-1/2"
FMR62B FMR67B	GT	Horn, 316L, 65mm/2.6"

Position 11, 12 (Process Connection, Sealing Surface)		
Selected option		Description
FMR67B	JD	Alignment device, UNI flange

Position 16 (Seal)		
Selected option		Description
FMR62B FMR63B	B	PTFE cladded
FMR63B	C	PEEK cladded
FMR6xB	D	VKM Viton GLT
FMR60B FMR62B	J	HNBR
FMR60B FMR62B FMR63B	P	FFKM Kalrez
	G	EPDM
FMR62B FMR67B	U	Graphite

Position 17 (Air Purge Connection)		
Selected option		Description
FMR67B	1	G1/4
	2	NPT1/4
	3	Adapter G1/4
	4	Adapter NPT1/4

Optional specifications

ID Jx, Kx (Test, Certificate, Declaration)		
Selected option		Description
FMR62B FMR67B	JL	Ambient temp. transmitter -50°C/-58°F, sensor see specification

ID Nx, Ox (Accessory Mounted)		
Selected option		Description
FMR6xB	NA	Overvoltage protection ¹⁾

1) Only in connection with Position 6 = J, K, M, N

ID Px, Rx (Accessory Enclosed)		
Selected option		Description
FMR6xB	PA	Weather protection cover, 316L ¹⁾
	PB	Weather protection cover, plastic ²⁾

1) Only in connection with Position 6 = J, K, M, N

2) Only in connection with Ex ia IIC

Safety instructions:
General

- The device is intended to be used in explosive atmospheres as defined in the scope of IEC 60079-0 or equivalent national standards. If no potentially explosive atmospheres are present or if additional protective measures have been taken: The device may be operated according to the manufacturer's specifications.
- Devices suitable for zone separation (marked Ga/Gb or Da/Db) are always suitable for installation in the less critical zone (Gb or Db). Due to space limitations the corresponding marking maybe not indicated on the nameplate.
- Comply with the installation and safety instructions in the Operating Instructions.

- Staff must meet the following conditions for mounting, electrical installation, commissioning and maintenance of the device:
 - Be suitably qualified for their role and the tasks they perform
 - Be trained in explosion protection
 - Be familiar with national regulations
- Install the device according to the manufacturer's instructions and national regulations.
- Do not operate the device outside the specified electrical, thermal and mechanical parameters.
- Only use the device in media to which the wetted materials have sufficient durability.
- Avoid electrostatic charging:
 - Of plastic surfaces (e.g. enclosure, sensor element, special varnishing, attached additional plates, ...)
 - Of isolated capacities (e.g. isolated metallic plates)
- Alterations to the device can affect the explosion protection and must be carried out by staff authorized to perform such work by Endress+Hauser.

**Safety
instructions:
Specific
conditions of use**

- To avoid electrostatic charging: Do not rub surfaces with a dry cloth.
- In the event of additional or alternative special varnishing on the enclosure or other metal parts or for adhesive plates:
 - Observe the danger of electrostatic charging and discharge.
 - Do not install in the vicinity of processes (≤ 0.5 m) generating strong electrostatic charges.
- Avoid sparks caused by impact and friction.
- In the case of process connections made of polymeric material or with polymeric coatings, avoid electrostatic charging of the plastic surfaces.
- For light metal flanges or flange faces (e.g. titanium, zirconium), avoid sparks caused by impact and friction.
- Avoid electrostatic charging of the sensor (e.g. do not rub dry and install outside the filling flow).

Optional specification, ID Px, Rx = PA

Connect the weather protection cover to the local potential equalization.

Optional specification, ID Px, Rx = PB

The use of the plastic weather protection cover is only permitted for type of protection Ex ia IIC.

Device type FMR67B and Basic specification, Position 11, 12 = JD

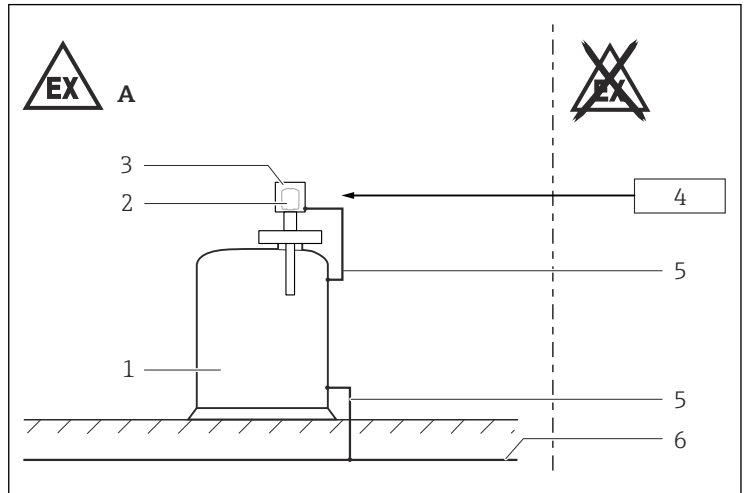
- In Zone 0, Zone 20, avoid sparks caused by impact and friction.
- Changing the position of the alignment device must be impossible:
 - After the alignment of the antenna via the pivot bracket
 - After tightening of the clamping flange
 - After setting the damping ring (torque 10 to 11 Nm)
- Degree of protection IP67 must be fulfilled.

Device type FMR67B and Basic specification, Position 17 = 1, 2, 3, 4

- In Zone 0, Zone 20, avoid sparks caused by impact and friction.
- After removing the air purge connection: Lock the opening with a suitable plug.
Torque: 6-7 Nm
- Degree of protection IP67 must be fulfilled.

Ex ia IIC T6...T1 Ga/Gb,
Ex ia IIC T6...T1 Gb

**Safety
instructions:
Installation**



A0025536

- A Zone 1
1 Tank; Zone 0, Zone 1
2 Electronic insert
3 Enclosure
4 Associated intrinsically safe power supply units
5 Potential equalization line
6 Local potential equalization

- After aligning (rotating) the enclosure, retighten the fixing screw.
- When the device is connected to certified intrinsically safe circuits of Category Ex ib for Equipment Groups IIC and IIB, the type of protection changes to Ex ib IIC and Ex ib IIB. Do not operate the sensor in Zone 0 if connecting to an intrinsically safe circuit of Category Ex ib.
- Continuous service temperature of the connecting cable: $\geq T_a + 20\text{ K}$.
- Observe the pertinent guidelines when interconnecting intrinsically safe circuits.
- Observe the maximum process conditions according to the manufacturer's Operating Instructions.
- Install the device to exclude any mechanical damage or friction during the application. Pay particular attention to flow conditions and tank fittings.

Basic specification, Position 5 = N, O

Observe the requirements according to IEC/EN 60079-14 for conduit systems and the wiring and installation instructions of the suitable Safety Instructions (XA). In addition, observe national regulations and standards for conduit systems.

Intrinsic safety

- The device is only suitable for connection to certified, intrinsically safe equipment with explosion protection Ex ia / Ex ib.
- The intrinsically safe input power circuit of the device is isolated from ground. The dielectric strength is at least $500 V_{\text{rms}}$.

Potential equalization

Integrate the device into the local potential equalization.

Safety**instructions:****Zone separation**

**Zone 0, Zone 1,
Zone 20, Zone 21**

Basic specification, Position 9, 10 = Gx

- The separating element is not directly in contact with the process (process-wetted).
- Material specification of the separating element:
 - Glass feedthrough: $\geq 3 \text{ mm}$
 - Stainless steel weld: $\geq 1 \text{ mm}$
- Flameproof joint in connection with stainless steel weld: $\geq 0.2 \text{ mm}$.

Basic specification, Position 9, 10 in connection with Position 16

The sealing is directly in contact with the process (process-wetted).

**Temperature
tables**

- The specified ambient and process temperature ranges exclusively refer to the explosion protection and must not be exceeded. Operationally permitted ambient temperature ranges can be restricted depending on the version: See Operating Instructions.
- Do not exceed the max. ambient temperature at the enclosure.

*Basic specification, Position 16 = J, P*

Lower limit of the ambient temperature for explosion protection changes to -20°C .

Optional specification, ID Jx, Kx = JL

Lower limit of the ambient temperature for explosion protection changes to -50°C .

Description notes



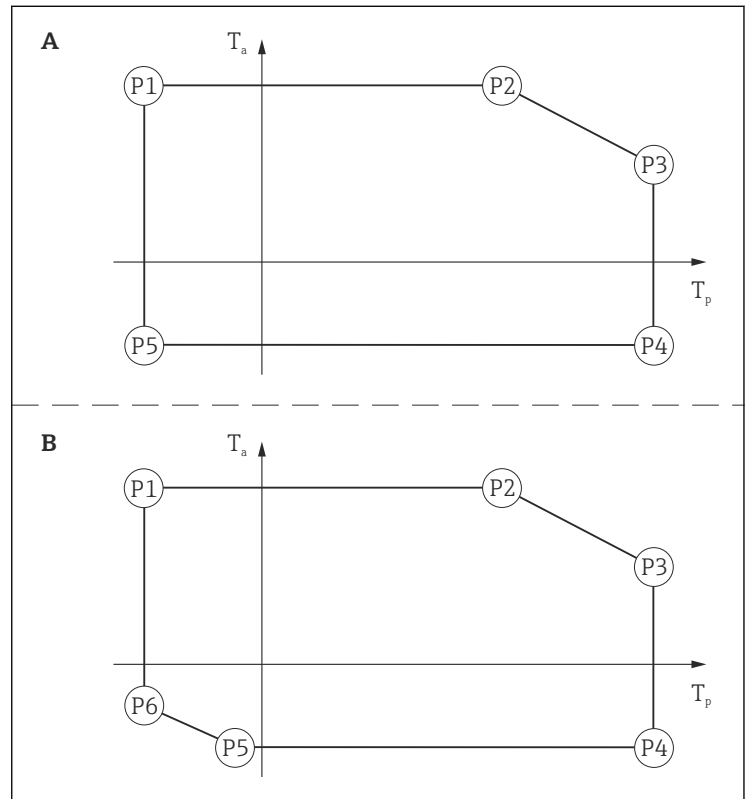
Unless otherwise indicated, the positions always refer to the basic specification.

1st column: Temperature classes T6 (85 °C) to T1 (450 °C)

Column P1 to P6: Position (temperature value) on the axes of the derating

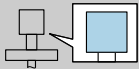
- T_a : Ambient temperature in °C
- T_p : Process temperature in °C

Example diagrams of possible deratings



A0022717

Basic specification, Position 3, 4 = BA, DA, FA (Channel 1)

	Position 6 (Housing, Material)
	B, J, K, M, N

FMR60B, FMR62B, FMR63B, FMR67B

Position 8 (Application)
B, F, H, J, Q, V

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GP, GQ, GR

 Depending on the enclosure, higher temperatures are possible:
up to 7 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-40 ^{1) 2)}	60	60	60	80	55	80	-40	-40 ^{1) 2)}	-40	-	-
T5	-40 ^{1) 2)}	65	65	65	95 ³⁾	59	95 ³⁾	-40	-40 ^{1) 2)}	-40	-	-
T4	-40 ^{1) 2)}	65	65	65	130 ³⁾	53	130 ³⁾	-40	-40 ^{1) 2)}	-40	-	-
T3...T1	-40 ^{1) 2)}	65	65	65	150 ^{3) 4)}	44	150 ^{3) 4)}	-40	-40 ^{1) 2)}	-40	-	-

- 1) Position 8 = Q: -10 °C
- 2) Position 8 = B, V: -20 °C
- 3) Position 8 = F: 80 °C
- 4) Position 8 = H: 130 °C

Position 8 (Application)
R

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GP, GQ, GR

 Depending on the enclosure, higher temperatures are possible:
up to 7 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-60	60	60	60	80	55	80	-40	-40	-40	-60	-44
T5	-60	65	65	65	95	59	95	-40	-40	-40	-60	-44
T4	-60	65	65	65	130	53	130	-40	-40	-40	-60	-44
T3...T1	-60	65	65	65	150	44	150	-40	-40	-40	-60	-44

Position 8 (Application)
D, L, S, T, W

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GP, GQ, GR

 Depending on the enclosure, higher temperatures are possible:
up to 9 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-196 ^{1) 2) 3)}	60	60	60	80	56	80	-40	-50 ^{1) 2) 3)}	-40	-196	3
T5	-196 ^{1) 2) 3)}	65	65	65	95	60	95	-40	-50 ^{1) 2) 3)}	-40	-196	3
T4	-196 ^{1) 2) 3)}	65	65	65	130	56	130	-40	-50 ^{1) 2) 3)}	-40	-196	3
T3	-196 ^{1) 2) 3)}	65	65	65	195	41	195	-40	-50 ^{1) 2) 3)}	-40	-196	3
T2...T1	-196 ^{1) 2) 3)}	65	65	65	200	39	200	-40	-50 ^{1) 2) 3)}	-40	-196	3

1) Position 8 = S: -10 °C; P6 not relevant
2) Position 8 = D, W: -20 °C; P6 not relevant
3) Position 8 = L: -40 °C; P6 not relevant

FMR62B, FMR67B

Position 8 (Application)
N, T

Position 9, 10 (Antenna)
GT

 Depending on the enclosure, higher temperatures are possible:
up to 2 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-196 ¹⁾	60	60	60	80	58	80	-40	-50 ¹⁾	-40	-196	-30
T5	-196 ¹⁾	65	65	65	95	63	95	-40	-50 ¹⁾	-40	-196	-30
T4	-196 ¹⁾	65	65	65	130	61	130	-40	-50 ¹⁾	-40	-196	-30
T3	-196 ¹⁾	65	65	65	195	57	195	-40	-50 ¹⁾	-40	-196	-30
T2...T1	-196 ¹⁾	65	65	65	280 ²⁾	52	280 ²⁾	-40	-50 ¹⁾	-40	-196	-30

1) Position 8 = N: -40 °C; P6 not relevant
2) Position 8 = T: 200 °C

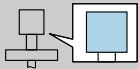
Position 8 (Application)
P

Position 9, 10 (Antenna)
GT

 Depending on the enclosure, higher temperatures are possible:
up to 6 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-40	60	60	60	80	58	80	-40	-40	-40	-	-
T5	-40	65	65	65	95	63	95	-40	-40	-40	-	-
T4	-40	65	65	65	130	61	130	-40	-40	-40	-	-
T3	-40	65	65	65	195	57	195	-40	-40	-40	-	-
T2	-40	65	65	65	290	51	290	-40	-40	-40	-	-
T1	-40	65	65	65	440	33	440	-40	-40	-40	-	-

Basic specification, Position 3, 4 = BB, BC (Channel 2)

	Position 6 (Housing, Material)
	J, K, M, N

FMR60B, FMR62B, FMR63B, FMR67B

Position 8 (Application)
B, F, H, J, Q, V

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GP, GQ, GR

 Depending on the enclosure, higher temperatures are possible:
up to 4 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-40 ^{1) 2)}	58	58	58	80	54	80	-40	-40 ^{1) 2)}	-40	-	-
T5	-40 ^{1) 2)}	63	63	63	95 ³⁾	57	95 ³⁾	-40	-40 ^{1) 2)}	-40	-	-
T4	-40 ^{1) 2)}	63	63	63	130 ³⁾	51	130 ³⁾	-40	-40 ^{1) 2)}	-40	-	-
T3...T1	-40 ^{1) 2)}	63	63	63	150 ^{3) 4)}	44	150 ^{3) 4)}	-40	-40 ^{1) 2)}	-40	-	-

- 1) Position 8 = Q: -10 °C
- 2) Position 8 = B, V: -20 °C
- 3) Position 8 = F: 80 °C
- 4) Position 8 = H: 130 °C

Position 8 (Application)
R

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GP, GQ, GR

 Depending on the enclosure, higher temperatures are possible:
up to 4 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-60	58	58	58	80	54	80	-40	-40	-40	-60	-28
T5	-60	63	63	63	95	57	95	-40	-40	-40	-60	-28
T4	-60	63	63	63	130	51	130	-40	-40	-40	-60	-28
T3...T1	-60	63	63	63	150	44	150	-40	-40	-40	-60	-28

Position 8 (Application)
D, L, S, T, W

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GP, GQ, GR

 Depending on the enclosure, higher temperatures are possible:
up to 10 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-196 ^{1) 2) 3)}	58	58	58	80	55	80	-40	-50 ^{1) 2) 3)}	-40	-196	17
T5	-196 ^{1) 2) 3)}	63	63	63	95	58	95	-40	-50 ^{1) 2) 3)}	-40	-196	17
T4	-196 ^{1) 2) 3)}	63	63	63	130	53	130	-40	-50 ^{1) 2) 3)}	-40	-196	17
T3	-196 ^{1) 2) 3)}	63	63	63	195	41	195	-40	-50 ^{1) 2) 3)}	-40	-196	17
T2...T1	-196 ^{1) 2) 3)}	63	63	63	200	39	200	-40	-50 ^{1) 2) 3)}	-40	-196	17

1) Position 8 = S: -10 °C; P6 not relevant
2) Position 8 = D, W: -20 °C; P6 not relevant
3) Position 8 = L: -40 °C; P6 not relevant

FMR62B, FMR67B

Position 8 (Application)
N, T

Position 9, 10 (Antenna)
GT

 Depending on the enclosure, higher temperatures are possible:
up to 3 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-196 ¹⁾	58	58	58	80	56	80	-40	-50 ¹⁾	-40	-196	-18
T5	-196 ¹⁾	63	63	63	95	61	95	-40	-50 ¹⁾	-40	-196	-18
T4	-196 ¹⁾	63	63	63	130	58	130	-40	-50 ¹⁾	-40	-196	-18
T3	-196 ¹⁾	63	63	63	195	55	195	-40	-50 ¹⁾	-40	-196	-18
T2...T1	-196 ¹⁾	63	63	63	280 ²⁾	49	280 ²⁾	-40	-50 ¹⁾	-40	-196	-18

1) Position 8 = N: -40 °C; P6 not relevant
2) Position 8 = T: 200 °C

Position 8 (Application)
P
Position 9, 10 (Antenna)
GT

 Depending on the enclosure, higher temperatures are possible:
up to 6 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-40	58	58	58	80	56	80	-40	-40	-40	-	-
T5	-40	63	63	63	95	61	95	-40	-40	-40	-	-
T4	-40	63	63	63	130	58	130	-40	-40	-40	-	-
T3	-40	63	63	63	195	55	195	-40	-40	-40	-	-
T2	-40	63	63	63	290	49	290	-40	-40	-40	-	-
T1	-40	63	63	63	440	39	440	-40	-40	-40	-	-

Connection data *Basic specification, Position 3, 4 = BA, BB, BC*

Power supply	
Channel 1 $U_i \leq 30\text{ V}_{DC}$ $I_i \leq 300\text{ mA}$ $P_i \leq 1\text{ W}$ $C_i \leq 10\text{ nF}$ $L_i = 0$	Channel 2 (only BB, BC) $U_i \leq 30\text{ V}_{DC}$ $I_i \leq 300\text{ mA}$ $P_i \leq 1\text{ W}$ $C_i \leq 10\text{ nF}$ $L_i = 0$

Basic specification, Position 3 = DA

Power supply	
FISCO $U_i \leq 17.5\text{ V}_{DC}$ $I_i \leq 380\text{ mA}$ $P_i \leq 5.32\text{ W}$ $C_i \leq 5\text{ nF}$ $L_i = 0$	Entity $U_i \leq 24\text{ V}_{DC}$ $I_i \leq 300\text{ mA}$ $P_i \leq 1.2\text{ W}$ $C_i \leq 5\text{ nF}$ $L_i = 0$

Basic specification, Position 3 = FA

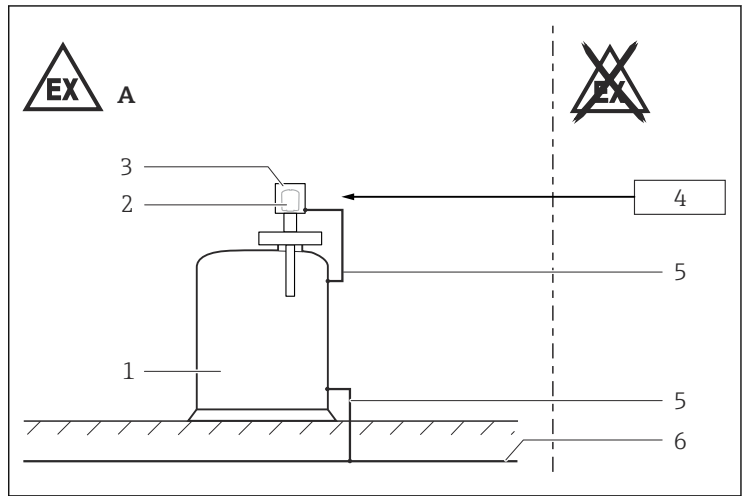
Power supply	
2-WISE	Entity
$U_i \leq 17.5\text{ V}_{DC}$	$U_i \leq 17.5\text{ V}_{DC}$
$I_i \leq 380\text{ mA}$	$I_i \leq 300\text{ mA}$
$P_i \leq 5.32\text{ W}$	$P_i \leq 1.2\text{ W}$
$C_i \leq 5\text{ nF}$	$C_i \leq 5\text{ nF}$
$L_i = 0$	$L_i = 0$

In connection with: *Basic specification, Position 5 = N, O*
Installation according to the specifications of FHX50B.

 Only the type of protection suitable for the device shall be connected!

Ex db IIC T6...T1 Ga/Gb,
Ex db IIC T6...T1 Gb

**Safety
instructions:
Installation**



A0025536

- A Zone 1
1 Tank; Zone 0, Zone 1
2 Electronic insert
3 Enclosure
4 Power supply
5 Potential equalization line
6 Local potential equalization

- After aligning (rotating) the enclosure, retighten the fixing screw.
- In potentially explosive atmospheres: Do not open the connection compartment cover and the electronics compartment cover when energized.
- Before operation:
 - Screw in the cover all the way.
 - Tighten the securing screw on the cover.
- Connect the device:
 - Using suitable cable and wire entries of protection type "Flameproof Enclosure (Ex db)".
 - Using piping systems of protection type "Flameproof Enclosure (Ex db)".
- When connecting through a conduit entry approved for this purpose, mount the associated sealing unit directly at the enclosure.

- Seal unused entry glands with approved sealing plugs that correspond to the type of protection. The plastic transport sealing plug does not meet this requirement and must therefore be replaced during installation.
- Only use certified cable entries or sealing plugs. The metal sealing plugs supplied meet this requirement.
- Only use genuine spare parts from Endress+Hauser which are specified for the device.

Basic specification, Position 5 = N, O

Observe the requirements according to IEC/EN 60079-14 for conduit systems and the wiring and installation instructions of the suitable Safety Instructions (XA). In addition, observe national regulations and standards for conduit systems.

Basic specification, Position 7 = G

Flameproof equipment with G threaded holes is not intended for new installations, but only for replacing equipment in existing installations. Use of this equipment shall comply with the local installation requirements.

Safety instructions: Ex d joints

- Flameproof joints are not intended to be repaired.
- If required or if in doubt: ask manufacturer for specifications.

Safety instructions: Zone separation Zone 0, Zone 1

Basic specification, Position 9, 10 = Gx

- The separating element is not directly in contact with the process (process-wetted).
- Material specification of the separating element:
 - Glass feedthrough: $\geq 3 \text{ mm}$
 - Stainless steel weld: $\geq 1 \text{ mm}$
- Flameproof joint in connection with stainless steel weld: $\geq 0.2 \text{ mm}$.

Basic specification, Position 9, 10 in connection with Position 16

The sealing is directly in contact with the process (process-wetted).

Temperature tables



- The specified ambient and process temperature ranges exclusively refer to the explosion protection and must not be exceeded. Operationally permitted ambient temperature ranges can be restricted depending on the version: See Operating Instructions.
- Do not exceed the max. ambient temperature at the enclosure.



Basic specification, Position 16 = J, P

Lower limit of the ambient temperature for explosion protection changes to -20°C .

Optional specification, ID Jx, Kx = JL

Lower limit of the ambient temperature for explosion protection changes to -50°C .

Description notes



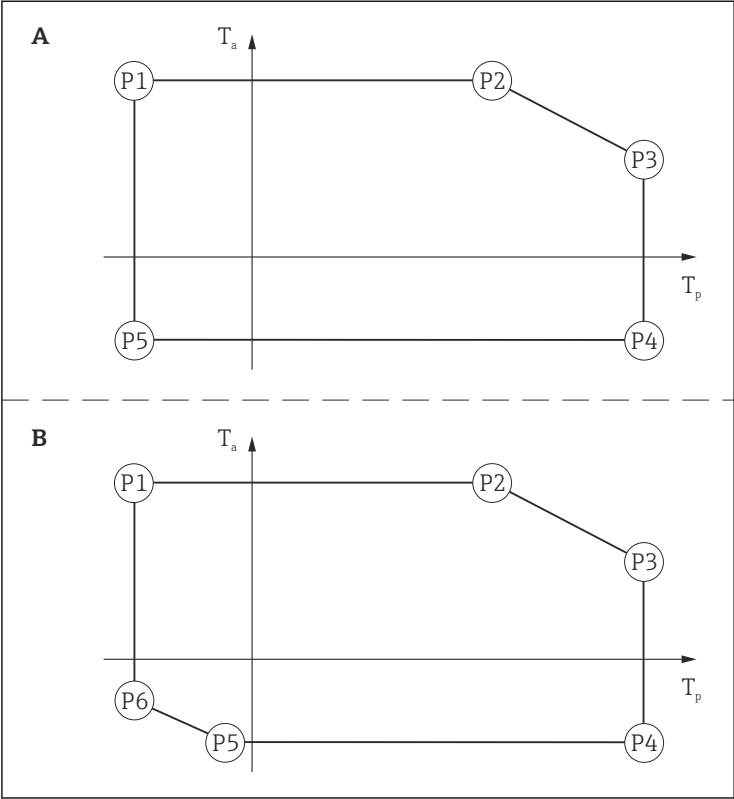
Unless otherwise indicated, the positions always refer to the basic specification.

1st column: Temperature classes T6 (85°C) to T1 (450°C)

Column P1 to P6: Position (temperature value) on the axes of the derating

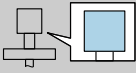
- T_a : Ambient temperature in $^{\circ}\text{C}$
- T_p : Process temperature in $^{\circ}\text{C}$

Example diagrams of possible deratings



A0022717

Basic specification, Position 3, 4 = BA, DA, FA (Channel 1)

	Position 6 (Housing, Material)
	B, J, K, M, N

FMR60B, FMR62B, FMR63B, FMR67B

Position 8 (Application)
B, F, H, J, Q, V

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GP, GQ, GR

 Depending on the enclosure, higher temperatures are possible:
up to 10 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-40 ^{1) 2)}	72	72	72	80	70	80	-40	-40 ^{1) 2)}	-40	-	-
T5	-40 ^{1) 2)}	77	77	77	95 ³⁾	73	95 ³⁾	-40	-40 ^{1) 2)}	-40	-	-
T4	-40 ^{1) 2)}	77	77	77	130 ³⁾	53	130 ³⁾	-40	-40 ^{1) 2)}	-40	-	-
T3...T1	-40 ^{1) 2)}	77	77	77	150 ^{3) 4)}	42	150 ^{3) 4)}	-40	-40 ^{1) 2)}	-40	-	-

- 1) Position 8 = Q: -10 °C
- 2) Position 8 = B, V: -20 °C
- 3) Position 8 = F: 80 °C
- 4) Position 8 = H: 130 °C

Position 8 (Application)
R

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GP, GQ, GR

 Depending on the enclosure, higher temperatures are possible:
up to 10 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-60	72	72	72	80	70	80	-40	-60	-40	-	-
T5	-60	77	77	77	95	73	95	-40	-60	-40	-	-
T4	-60	77	77	77	130	53	130	-40	-60	-40	-	-
T3...T1	-60	77	77	77	150	42	150	-40	-60	-40	-	-

Position 8 (Application)
D, L, S, T, W

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GP, GQ, GR

 Depending on the enclosure, higher temperatures are possible:
up to 9 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-196 ^{1) 2) 3)}	72	72	72	80	70	80	-40	-50 ^{1) 2) 3)}	-40	-196	-10
T5	-196 ^{1) 2) 3)}	77	77	77	95	74	95	-40	-50 ^{1) 2) 3)}	-40	-196	-10
T4	-196 ^{1) 2) 3)}	77	77	77	130	63	130	-40	-50 ^{1) 2) 3)}	-40	-196	-10
T3	-196 ^{1) 2) 3)}	77	77	77	195	39	195	-40	-50 ^{1) 2) 3)}	-40	-196	-10
T2...T1	-196 ^{1) 2) 3)}	77	77	77	200	37	200	-40	-50 ^{1) 2) 3)}	-40	-196	-10

1) Position 8 = S: -10 °C; P6 not relevant

2) Position 8 = D, W: -20 °C; P6 not relevant

3) Position 8 = L: -40 °C; P6 not relevant

FMR62B, FMR67B

Position 8 (Application)
N, T

Position 9, 10 (Antenna)
GT



Depending on the enclosure, higher temperatures are possible:
up to 4 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-196 ¹⁾	72	72	72	80	71	80	-40	-50 ¹⁾	-40	-196	-41
T5	-196 ¹⁾	77	77	77	95	75	95	-40	-50 ¹⁾	-40	-196	-41
T4	-196 ¹⁾	77	77	77	130	73	130	-40	-50 ¹⁾	-40	-196	-41
T3	-196 ¹⁾	77	77	77	195	65	195	-40	-50 ¹⁾	-40	-196	-41
T2...T1	-196 ¹⁾	77	77	77	280 ²⁾	54	280 ²⁾	-40	-50 ¹⁾	-40	-196	-41

1) Position 8 = N: -40 °C; P6 not relevant
2) Position 8 = T: 200 °C

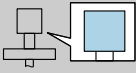
Position 8 (Application)
P

Position 9, 10 (Antenna)
GT

 Depending on the enclosure, higher temperatures are possible:
up to 7 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-40	72	72	72	80	71	80	-40	-40	-40	-	-
T5	-40	77	77	77	95	75	95	-40	-40	-40	-	-
T4	-40	77	77	77	130	73	130	-40	-40	-40	-	-
T3	-40	77	77	77	195	65	195	-40	-40	-40	-	-
T2	-40	77	77	77	290	52	290	-40	-40	-40	-	-
T1	-40	77	77	77	440	32	440	-40	-40	-40	-	-

Basic specification, Position 3, 4 = BB, BC (Channel 2)

	Position 6 (Housing, Material)
	J, K, M, N

FMR60B, FMR62B, FMR63B, FMR67B

Position 8 (Application)
B, F, H, J, Q, V

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GP, GQ, GR

 Depending on the enclosure, higher temperatures are possible:
up to 6 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-40 ^{1) 2)}	59	59	59	80	55	80	-40	-40 ^{1) 2)}	-40	-	-
T5	-40 ^{1) 2)}	64	64	64	95 ³⁾	59	95 ³⁾	-40	-40 ^{1) 2)}	-40	-	-
T4	-40 ^{1) 2)}	64	64	64	130 ³⁾	53	130 ³⁾	-40	-40 ^{1) 2)}	-40	-	-
T3...T1	-40 ^{1) 2)}	64	64	64	150 ^{3) 4)}	44	150 ^{3) 4)}	-40	-40 ^{1) 2)}	-40	-	-

- 1) Position 8 = Q: -10 °C
- 2) Position 8 = B, V: -20 °C
- 3) Position 8 = F: 80 °C
- 4) Position 8 = H: 130 °C

Position 8 (Application)
R

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GP, GQ, GR

 Depending on the enclosure, higher temperatures are possible:
up to 6 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-60	59	59	59	80	55	80	-40	-40	-40	-60	-28
T5	-60	64	64	64	95	59	95	-40	-40	-40	-60	-28
T4	-60	64	64	64	130	53	130	-40	-40	-40	-60	-28
T3...T1	-60	64	64	64	150	44	150	-40	-40	-40	-60	-28

Position 8 (Application)
D, L, S, T, W

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GP, GQ, GR

 Depending on the enclosure, higher temperatures are possible:
up to 10 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-196 ^{1) 2) 3)}	59	59	59	80	56	80	-40	-50 ^{1) 2) 3)}	-40	-196	17
T5	-196 ^{1) 2) 3)}	64	64	64	95	60	95	-40	-50 ^{1) 2) 3)}	-40	-196	17
T4	-196 ^{1) 2) 3)}	64	64	64	130	55	130	-40	-50 ^{1) 2) 3)}	-40	-196	17
T3	-196 ^{1) 2) 3)}	64	64	64	195	41	195	-40	-50 ^{1) 2) 3)}	-40	-196	17
T2...T1	-196 ^{1) 2) 3)}	64	64	64	200	39	200	-40	-50 ^{1) 2) 3)}	-40	-196	17

1) Position 8 = S: -10 °C; P6 not relevant

2) Position 8 = D, W: -20 °C; P6 not relevant

3) Position 8 = L: -40 °C; P6 not relevant

FMR62B, FMR67B

Position 8 (Application)
N, T

Position 9, 10 (Antenna)
GT



Depending on the enclosure, higher temperatures are possible:
up to 3 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-196 ¹⁾	59	59	59	80	58	80	-40	-50 ¹⁾	-40	-196	-18
T5	-196 ¹⁾	64	64	64	95	62	95	-40	-50 ¹⁾	-40	-196	-18
T4	-196 ¹⁾	64	64	64	130	60	130	-40	-50 ¹⁾	-40	-196	-18
T3	-196 ¹⁾	64	64	64	195	56	195	-40	-50 ¹⁾	-40	-196	-18
T2...T1	-196 ¹⁾	64	64	64	280 ²⁾	51	280 ²⁾	-40	-50 ¹⁾	-40	-196	-18

- 1) Position 8 = N: -40 °C; P6 not relevant
- 2) Position 8 = T: 200 °C

Position 8 (Application)
P

Position 9, 10 (Antenna)
GT

 Depending on the enclosure, higher temperatures are possible:
up to 6 K.

	P1		P2		P3		P4		P5		P6	
	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a	T _p	T _a
T6	-40	59	59	59	80	58	80	-40	-40	-40	-	-
T5	-40	64	64	64	95	62	95	-40	-40	-40	-	-
T4	-40	64	64	64	130	60	130	-40	-40	-40	-	-
T3	-40	64	64	64	195	56	195	-40	-40	-40	-	-
T2	-40	64	64	64	290	51	290	-40	-40	-40	-	-
T1	-40	64	64	64	440	33	440	-40	-40	-40	-	-

Connection data

Basic specification, Position 3 = BA, BB, BC

Power supply	
Channel 1 U ≤ 35 V _{DC}	Channel 2 (only BB, BC) U ≤ 35 V _{DC}

Basic specification, Position 3 = DA

Power supply
U ≤ 32 V _{DC}

Basic specification, Position 3 = FA

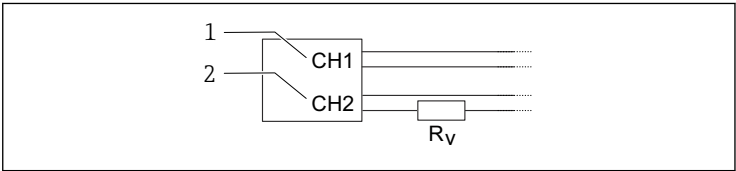
Power supply
U ≤ 15 V _{DC}

In connection with: *Basic specification, Position 5 = N, O*
Installation according to the specifications of FHX50B.

 Only the type of protection suitable for the device shall be connected!

Serial resistance (R_V)

Basic specification, Position 3, 4 = BB (only channel 2)



- 1 4 to 20 mA
- 2 Switch output

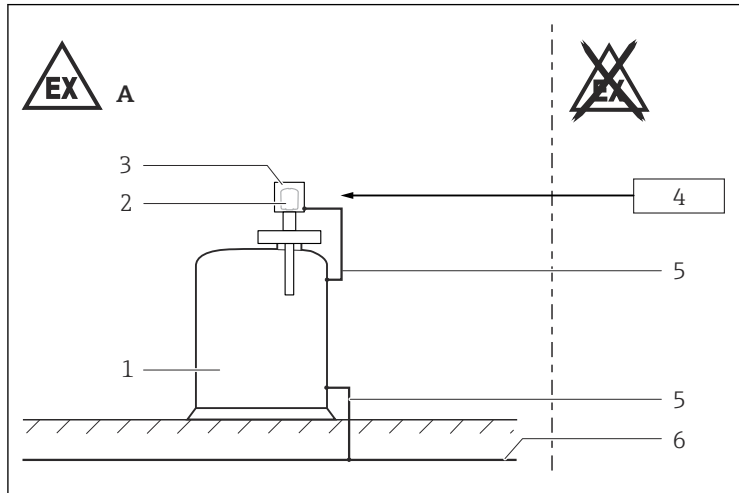
The power consumption have to be limited for certain applications.

- Recommended: Power consumption ≤ 1 W. This is obtained for a supply voltage up to 27 V_{DC}.
- For higher supply voltages (U_{max}): Insert a serial resistance (R_V) in order to limit the power consumption, see table below.

U _{max} [V]	R _V min
35	199 Ω
34	171 Ω
33	143 Ω
32	115 Ω
31	88 Ω
30	60 Ω
29	32 Ω
28	4 Ω
27	0 Ω

Ex ta/tb IIIC T_{xxx}°C Da/Db,
Ex tb IIIC T_{xxx}°C Db

Safety instructions: Installation



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- A Zone 21
1 Tank; Zone 20, Zone 21
2 Electronic insert
3 Enclosure
4 Power supply
5 Potential equalization line
6 Local potential equalization

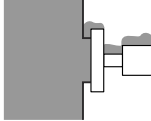
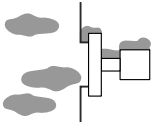
- After aligning (rotating) the enclosure, retighten the fixing screw.
- Do not open in a potentially explosive dust atmosphere.
- Seal the cable entry or piping tight (see protection type of enclosure in the "Temperature tables" chapter).
- Before operation:
 - Screw in the cover all the way.
 - Tighten the securing screw on the cover.

Basic specification, Position 5 = N, O

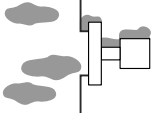
Observe the requirements according to IEC/EN 60079-14 for conduit systems and the wiring and installation instructions of the suitable Safety Instructions (XA). In addition, observe national regulations and standards for conduit systems.

Permitted ambient conditions

Ex ta/tb IIIC Txxx°C Da/Db

Process Zone 20		Enclosure Zone 21
Continuous dust submersion		Dust accumulation or temporary explosive dust atmosphere
Continuous explosive dust atmosphere and deposits		Dust accumulation or temporary explosive dust atmosphere

Ex tb IIIC Txxx°C Db

Process Zone 21		Enclosure Zone 21
Continuous dust deposits or temporary explosive dust atmosphere		Dust accumulation or temporary explosive dust atmosphere

Safety instructions:
Zone separation
Zone 20, Zone 21

Basic specification, Position 9, 10 = Gx

- The separating element is not directly in contact with the process (process-wetted).
- Material specification of the separating element:
 - Glass feedthrough: ≥ 3 mm
 - Stainless steel weld: ≥ 1 mm
- Flameproof joint in connection with stainless steel weld: ≥ 0.2 mm.

Basic specification, Position 9, 10 in connection with Position 16

The sealing is directly in contact with the process (process-wetted).

Temperature tables



- The specified surface temperature takes into account all direct heat influences from process heat and self-heating at the enclosure.
- The specified ambient and process temperature ranges exclusively refer to the explosion protection and must not be exceeded. Operationally permitted ambient temperature ranges can be restricted depending on the version: See Operating Instructions.
- Do not exceed the max. ambient temperature at the enclosure.



Basic specification, Position 16 = J, P

Lower limit of the ambient temperature for explosion protection changes to -20°C .

Optional specification, ID Jx, Kx = JL

Lower limit of the ambient temperature for explosion protection changes to -50°C .

Specific conditions of use:

- The surface temperature is
 - for equipment protection level (EPL) Da: $T_{200} \text{ xxx }^{\circ}\text{C}$ (with 200 mm dust deposit)
 - and equipment protection level (EPL) Db: $T_L \text{ xxx }^{\circ}\text{C}$ (with dust accumulation T_L)
- The surface temperature is
 - for equipment protection level (EPL) Db: $T_L \text{ xxx }^{\circ}\text{C}$ (with dust accumulation T_L)



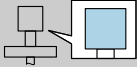
T_L marking:

The assigned surface temperature without dust layer is the same.

Description notes



Unless otherwise indicated, the positions always refer to the basic specification.

	Position 6 (Housing, Material)
	B, J, K, M, N

FMR60B, FMR62B, FMR63B, FMR67B

Ex ta/tb IIIC T₂₀₀ 150 °C Da/Db

Ex tb IIIC T_L 150 °C Db

Position 8 (Application)
B, F, H, J, Q, R, V

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GP, GQ, GR

Maximum surface temperature	Process temperature range	Ambient temperature range
T ₂₀₀ 80 °C	-40 °C ^{1) 2) 3)} ≤ T _p ≤ +80 °C	-40 °C ≤ T _a ≤ +65 °C
T ₂₀₀ 100 °C	-40 °C ^{1) 2) 3)} ≤ T _p ≤ +100 °C ⁴⁾	-40 °C ≤ T _a ≤ +60 °C
T ₂₀₀ 130 °C	-40 °C ^{1) 2) 3)} ≤ T _p ≤ +130 °C ⁴⁾	-40 °C ≤ T _a ≤ +55 °C
T ₂₀₀ 150 °C	-40 °C ^{1) 2) 3)} ≤ T _p ≤ +150 °C ^{4) 5)}	-40 °C ≤ T _a ≤ +50 °C

- 1) Position 8 = Q: -10 °C
- 2) Position 8 = B, V: -20 °C
- 3) Position 8 = R: -60 °C
- 4) Position 8 = F: 80 °C
- 5) Position 8 = H: 130 °C

Ex ta/tb IIIC T₂₀₀ 200°C Da/Db
Ex tb IIIC T_L 200°C Db

Position 8 (Application)
D, L, S, T, W

Position 9, 10 (Antenna)
GA, GE, GF, GM, GN, GQ, GR, GP

Maximum surface temperature	Process temperature range	Ambient temperature range
T ₂₀₀ 100 °C	-40 °C ^{1) 2) 3)} ≤ T _p ≤ +100 °C	-40 °C ≤ T _a ≤ +60 °C
T ₂₀₀ 150 °C	-40 °C ^{1) 2) 3)} ≤ T _p ≤ +150 °C	-40 °C ≤ T _a ≤ +55 °C
T ₂₀₀ 200 °C	-40 °C ^{1) 2) 3)} ≤ T _p ≤ +200 °C	-40 °C ≤ T _a ≤ +50 °C

- 1) Position 8 = S: -10 °C
- 2) Position 8 = D, W: -20 °C
- 3) Position 8 = T: -196 °C

FMR62B, FMR67B

Ex ta/tb IIIC T₂₀₀ 280 °C Da/Db

Ex tb IIIC T_L 280 °C Db

Position 8 (Application)
N, T

Position 9, 10 (Antenna)
GT

Maximum surface temperature	Process temperature range	Ambient temperature range
T ₂₀₀ 150 °C	-40 °C ¹⁾ ≤ T _p ≤ +150 °C	-40 °C ≤ T _a ≤ +65 °C
T ₂₀₀ 200 °C	-40 °C ¹⁾ ≤ T _p ≤ +200 °C	-40 °C ≤ T _a ≤ +60 °C
T ₂₀₀ 280 °C	-40 °C ¹⁾ ≤ T _p ≤ +280 °C	-40 °C ≤ T _a ≤ +55 °C

1) Position 8 = T: -196 °C

Ex ta/tb IIIC T₂₀₀ 450 °C Da/Db

Ex tb IIIC T_L 450 °C Db

Position 8 (Application)
P

Position 9, 10 (Antenna)
GT

Maximum surface temperature	Process temperature range	Ambient temperature range
T ₂₀₀ 150 °C	-40 °C ≤ T _p ≤ +150 °C	-40 °C ≤ T _a ≤ +65 °C
T ₂₀₀ 200 °C	-40 °C ≤ T _p ≤ +200 °C	-40 °C ≤ T _a ≤ +60 °C
T ₂₀₀ 450 °C	-40 °C ≤ T _p ≤ +450 °C	-40 °C ≤ T _a ≤ +45 °C

Connection data

Basic specification, Position 3 = BA, BB, BC

Power supply	
Channel 1	Channel 2 (only BB, BC)
U ≤ 35 V _{DC}	U ≤ 35 V _{DC}

Basic specification, Position 3 = DA

Power supply
$U \leq 32\text{ V}_{\text{DC}}$

Basic specification, Position 3 = FA

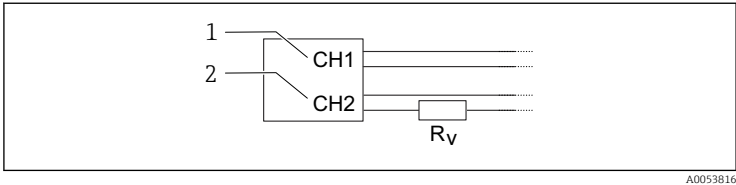
Power supply
$U \leq 15\text{ V}_{\text{DC}}$

In connection with: *Basic specification, Position 5 = N, O*
Installation according to the specifications of FHX50B.

 Only the type of protection suitable for the device shall be connected!

Serial resistance (R_V)

Basic specification, Position 3, 4 = BB (only channel 2)



A0053816

- 1 4 to 20 mA
- 2 Switch output

The power consumption have to be limited for certain applications.

- Recommended: Power consumption $\leq 1\text{ W}$. This is obtained for a supply voltage up to 27 V_{DC} .
- For higher supply voltages (U_{max}): Insert a serial resistance (R_V) in order to limit the power consumption, see table below.

U _{max} [V]	R _v min
35	199 Ω
34	171 Ω
33	143 Ω
32	115 Ω
31	88 Ω
30	60 Ω
29	32 Ω
28	4 Ω
27	0 Ω



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