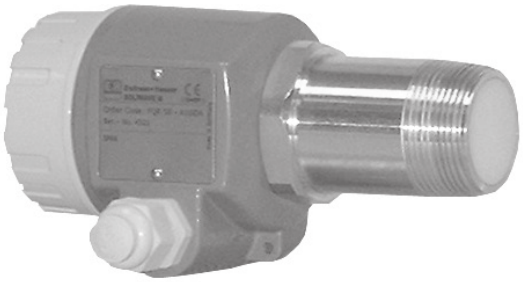
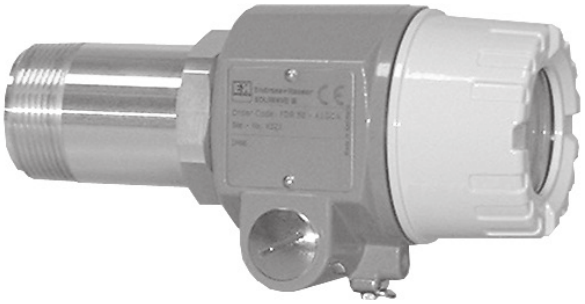
Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Soliwave FQR50/FDR50

Microwave Barrier





Application

The Soliwave microwave barrier uses a contact-free procedure for detection. It can be installed in containers, conduits, shafts or on free fall shafts. It is possible to take a measurement through non-metallic container materials from the outside.

Suitable as level limit switch for controlling and counting all types of bulk solids or piece goods (such as bags or boxes).

Typical bulk solids include:
- Wood chips, wood dust or flour
- Plaster, cement, ash
- Paper or cardboard shred
- Gravel, sand
- Dried powders in general

Your benefits
- Flush-mounted installation, non-contact installation possible
- Easy installation using R 1½ or 1½ NPT thread or suitable installation brackets
- Mechanical robustness
  - No wear
  - Long service life
  - Maintenance-free
- Indication of the signal strength on the receiver
- Adjustable sensitivity
- Conforms to ATEX and IECEx

TI00378F/97/EN/15.16
71336996

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People for Process Automation

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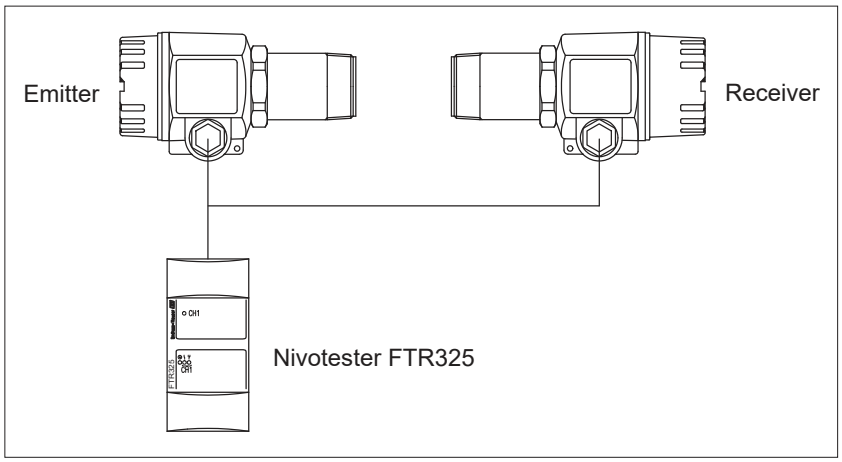
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Function and system design

Measuring principle

The FQR50 emitter puts out the microwave signal via an integrated horn antenna. The FDR50 receiver directly opposite detects this signal and forwards a switching signal to the FTR325 evaluator. Alarm and control devices may be connected to these relay outputs.

The range of the path is influenced by the different types of materials. The absorption of the microwaves here depends on the electric characteristics of the attenuating material. Materials with the capacity to conduct electricity, for example metals, reflect the waves and other materials with lower conductivity only weaken them or are even penetrated. The attenuation of the microwaves is reduced as the dielectric constant of the material to be emitted through becomes lower.



Measuring system

The complete measuring system for limit detection consists of:
- an emitter FQR50,
- a receiver FDR50 and
- an evaluator Nivotester FTR325

Optical or acoustic signallers, contactors, relays, solenoids etc. may be connected to the Nivotester.

Equipment combinations

The emitter and receiver unit FQR50/FDR50-C* (ATEX II 1/2G Ex ia IIC T4 Ga/Gb and ATEX II 1/2D Ex ia IIIC T98°C Da/Db resp.) may only be combined with the Nivotester FTR325-B* (ATEX II (1)G [Ex ia Ga] IIC and ATEX II (1)D [Ex ia Da] IIIC resp.).

The emitter and receiver unit FQR50/FDR50-D* (IECEx Ex ia IIC T4 Ga/Gb and IECEx Ex ia IIIC T98°C Da/Db resp.) may only be combined with the Nivotester FTR325-D* (IECEx [Ex ia Ga] IIC and IECEx [Ex ia Da] IIIC resp.).

Note:
The devices FQR50/FDR50-A* (non hazardous area) and FQR50/FDR50-B* (ATEX II 1/2D) of the microwave barrier Soliwave are no longer available, they have been replaced by the Soliwave FQR56/FDR56-AA* (non hazardous area) and FQR56/FDR56-BA* (ATEX II 1/2D). Please refer to the Technical Information TI00443F for details about the new microwave barrier Soliwave.

The following equipment combinations are impossible:
- FQR50/FDR50-C* (ATEX II 1/2G Ex ia IIC T4 and ATEX II 1/2D Ex iaD 20/21 IP66 T98°C resp.) with Nivotester FTR325-A* (non hazardous area)
- FQR50/FDR50-C* (ATEX II 1/2G Ex ia IIC T4 and ATEX II 1/2D Ex iaD 20/21 IP66 T98°C resp.) with Nivotester FTR325-D* (IECEx [Zone 0] [Ex ia] IIC and IECEx [Ex iaD] resp.)
- FQR50/FDR50-D* (IECEx Zone 0/1 Ex ia IIC T4 and IECEx Ex iaD 20/21 IP66 T98°C resp.) with Nivotester FTR325-A* (non hazardous area)
- FQR50/FDR50-D* (IECEx Zone 0/1 Ex ia IIC T4 and IECEx Ex iaD 20/21 IP66 T98°C resp.) with Nivotester FTR325-B* (ATEX II (1)G [Ex ia] IIC and ATEX II (1)D [Ex iaD] resp.)

Characteristics quantities

Measured variable

Absorption of the electromagnetic waves produced by the FQR50 emitter.

Measuring range (range of detection)

When there is an unrestricted path between the emitter and the receiver the maximum range, depending on the version (see ordering information), is 20 m.

The range is also dependent on the container walls to be penetrated.

Operating frequency

24.125 GHz

Transmitter power

The maximum power produced by the FQR50 emitter is 100 mW e.i.r.p.
(equivalent isotrope radiation performance).

- Power density directly in front of the emitter: 1 mW / cm^2
- Power density at a distance of 1 m: 0.3 µW / cm^2

Note:
The power density is significantly below the recommended limit values of the ICNIRP guidelines "*Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)*" and is thus harmless for humans!

Output signal

Switching signal for the Nivotester FTR325

Switching frequency FDR50

max. 2 Hz

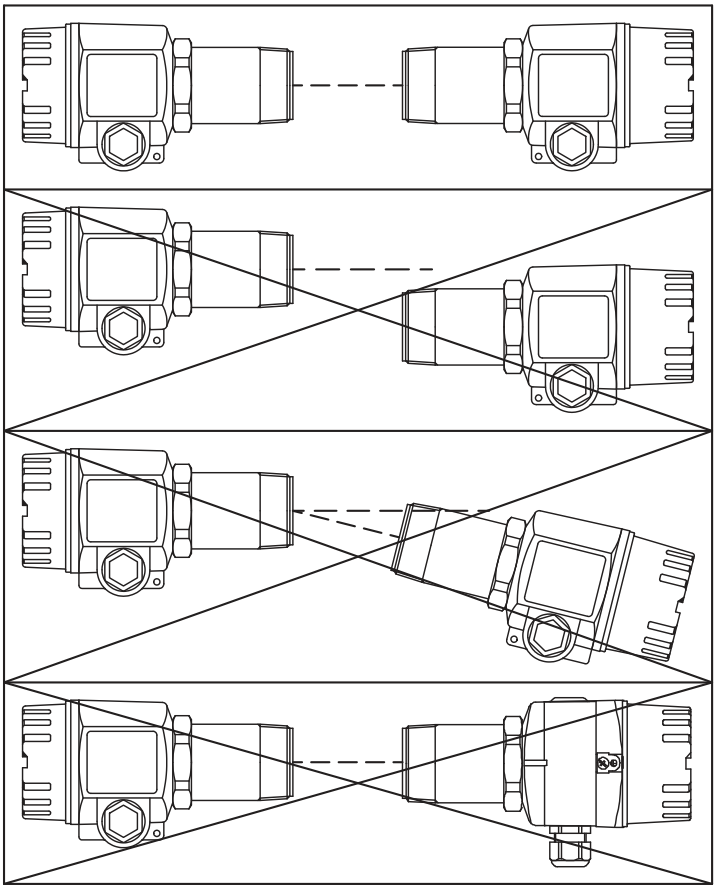
Operating conditions

Installation instructions

Both the FQR50 emitter and the FDR50 receiver are equipped with a standard thread (R 1½ in compliance with EN10226 and 1½" NPT in complience with ANSI/ASME B1.20.1) as a process connector. This makes a simple installation in the existing container sleeves or fittings possible.

Note:
- The fronts of the emitter and the receiver should face each other and be concentric.
- Since the microwaves are polarised the FQR50 emitter and the FDR50 receiver may not be rotated around their longitudinal axis, unless they are rotated exactly 180°.
- Disturbing reflections at metal parts are to be avoided.
- An improvement in the signal quality can be achieved by an adjustable mounting of emitter and receiver of ± 10 mm along their longitudinal axis (see "Installation").

Instructions for orientation

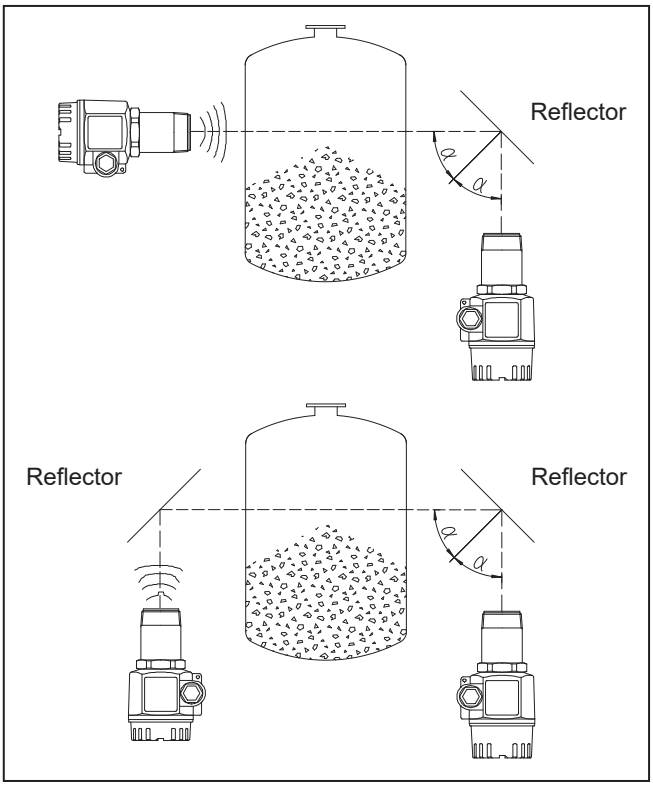


Minimum distance from emitter to receiver

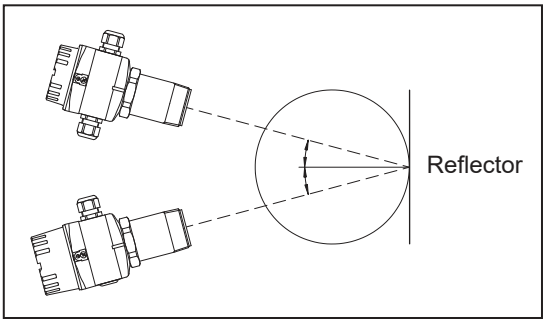
A minimum distance of 30 mm should be maintained between the emitter and the receiver.

Operating with reflectors

If, for construction reasons, a direct confrontation of the FQR50 emitter and the FDR50 receiver is not possible, the microwave beam can be redirected via a flat metal mirror (reflectors). By using reflectors the range of the microwave barrier is reduced by approximately 10% per reflector.

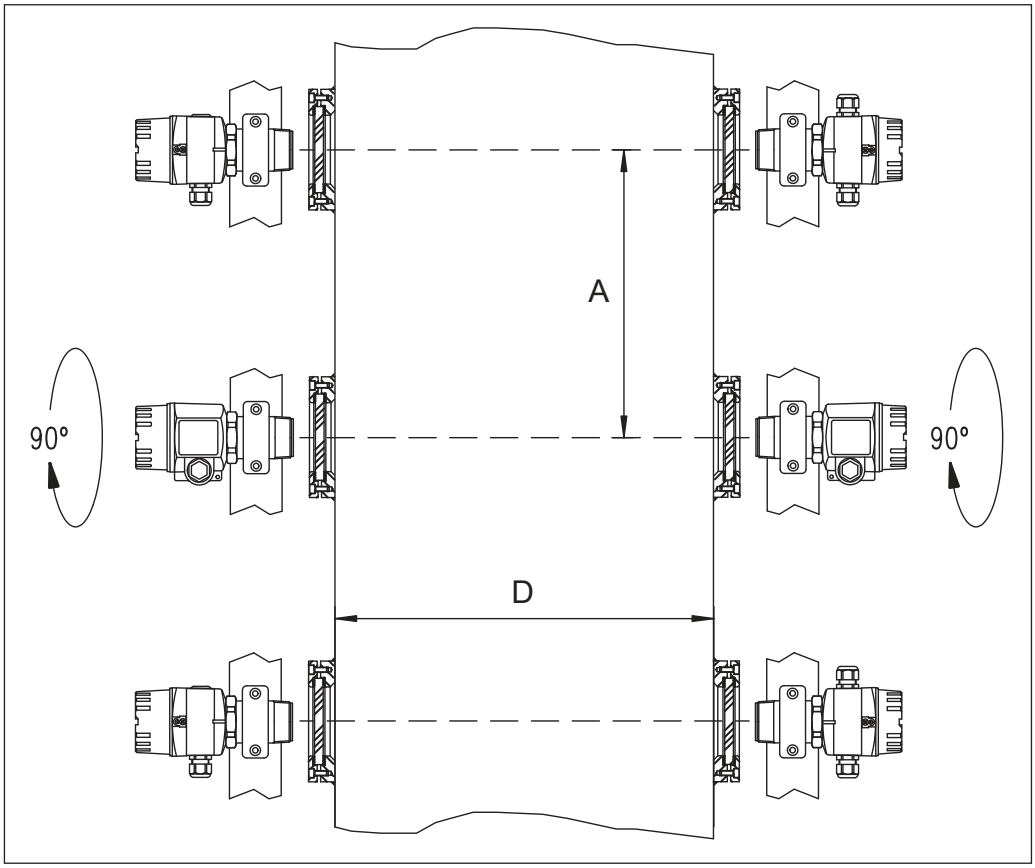


Please make sure that FQR50 emitter and FDR50 receiver are placed at symmetrical angles toward the reflector (entry angle = exit angle), since otherwise the receiver will get no evaluable signal.



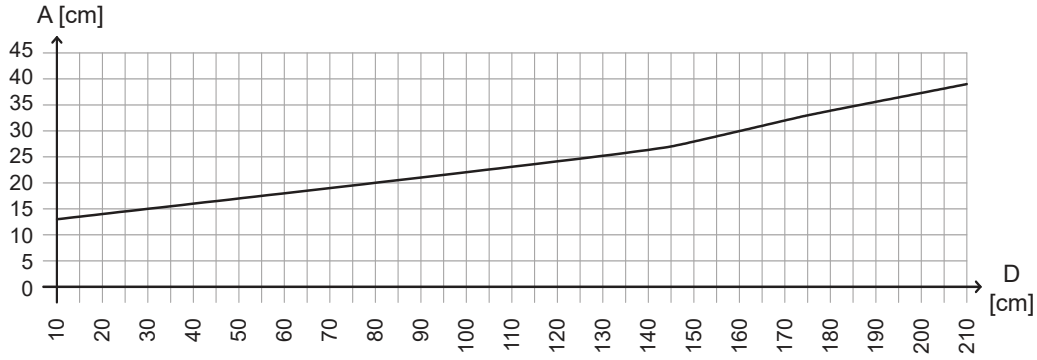
Parallel operation

It may be necessary to utilize several microwave barriers (each consisting of a FQR50 emitter, a FDR50 receiver and a FTR325 Nivotester) in one place (for example for detecting several limit states in a pipeline, see figure). To prevent interferences between the microwave paths, various modulation frequencies can be adjusted on the FQR50 emitter (as of production date July 2008).



Dependency of detection distance to the distance of the microwave barriers

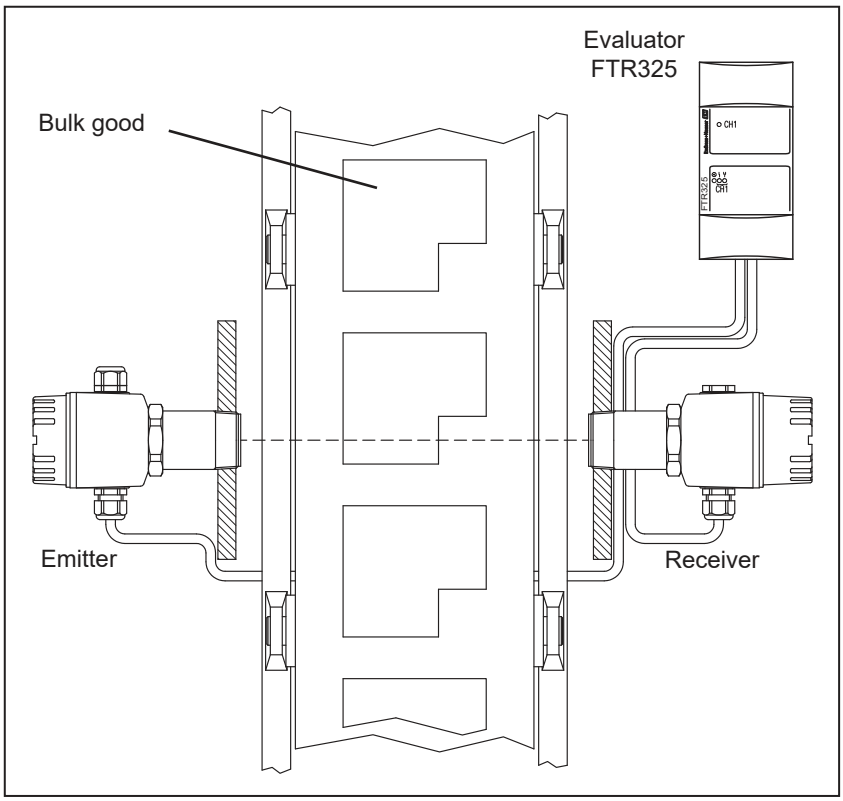
The following relation between detection distance **D** and minimum distance between microwave barriers **A** applies to parallel operation of several barriers using emitters with selectable modulation frequency as shown in the figure.



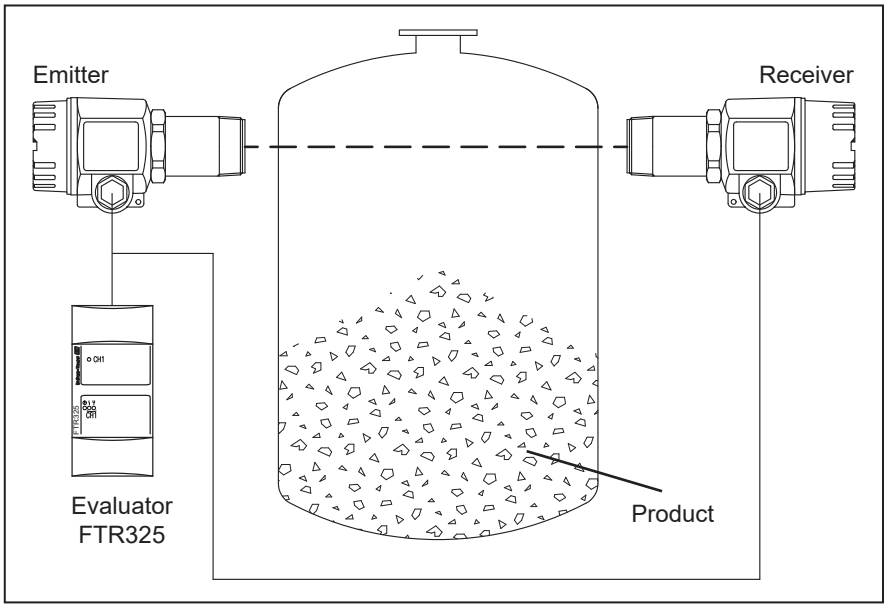
Note:
The values given in the diagramm relate to optimum installation conditions and may vary depending on the actual installation situation. The spacing of the microwave barriers may have to be adjusted with installations in sealed metal containers, funnels, or similar, due to occuring reflections for example.

Installation examples

Example 1: Bulk counting

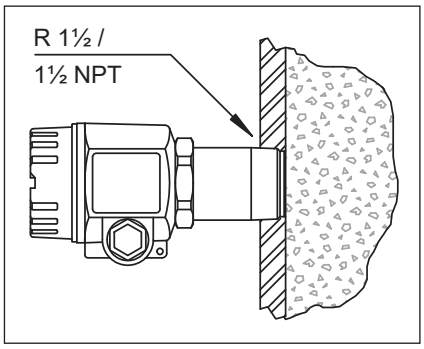


Example 2: Limit detection of bulk solids

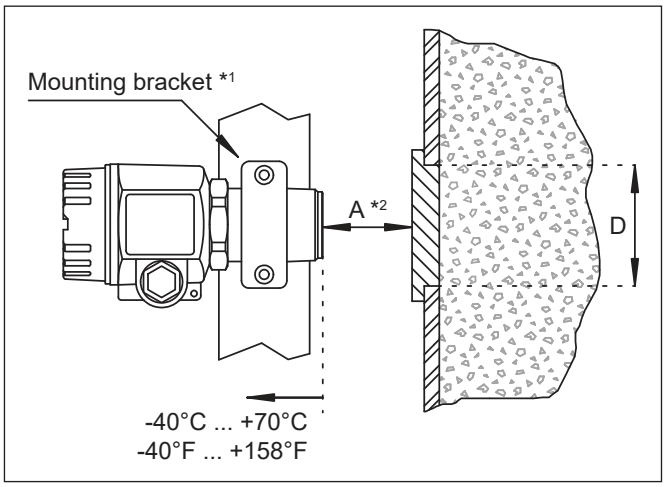


Installation

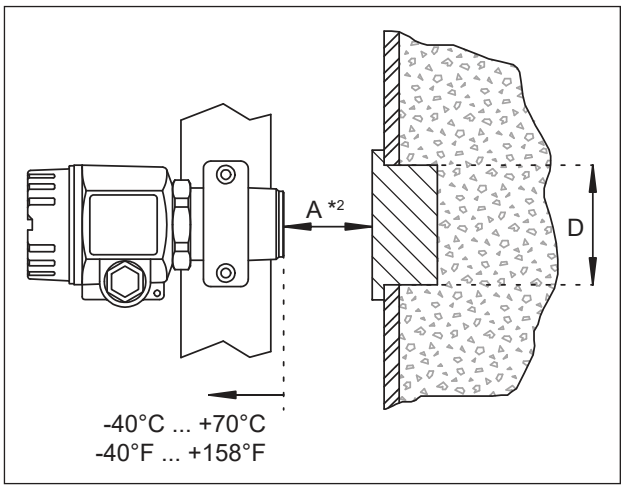
Direct installation with threaded connection



Bracket installation in front of microwave-permeable window



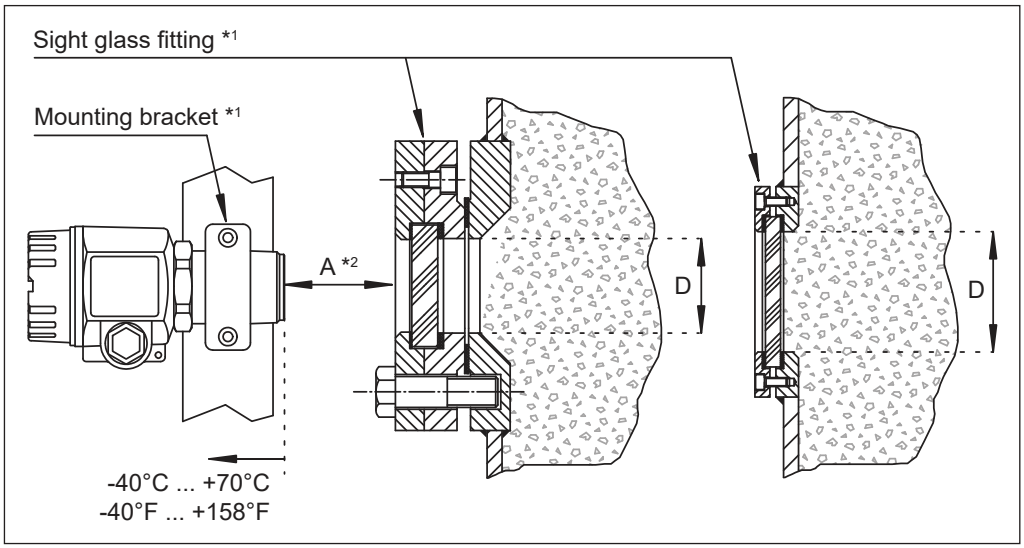
Bracket installation in front of microwave-permeable window with danger of condensation on the container's inner wall



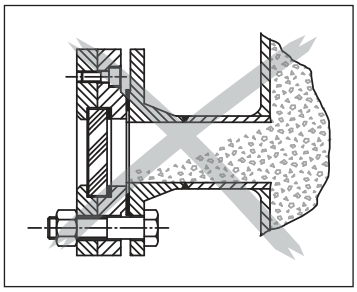
*1 Suitable mounting brackets are available as accessories (types and dimensions see "Accessories").

*2 The distance **A** depends on the open entry area **D** and the temperature at this area. To prevent possible signal attenuation, we recommend keeping the distance as short as possible (for example max. 40 mm at DN50).

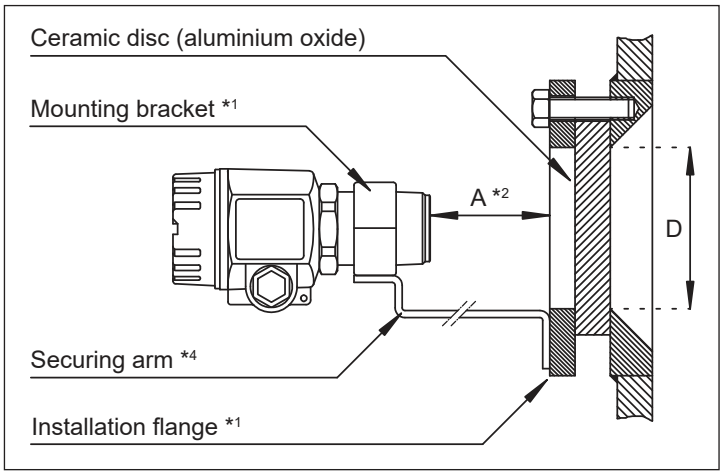
Bracket installation in front of microwave-permeable sight glass fitting



Installation position to avoid with sight glass fittings *3

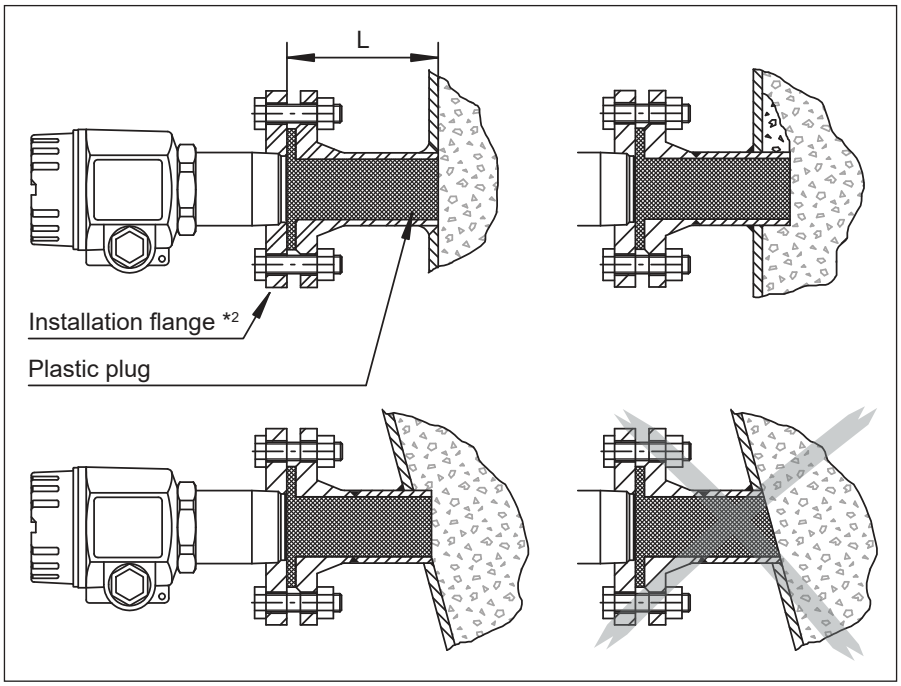


Installation with securing arm on container *4



*1 Suitable sight glass fittings, mounting brackets and installation flanges are available as accessories (types and dimensions see "Accessories").
*2 The distance **A** depends on the open entry area **D** and the temperature at this area. To prevent possible signal attenuation, we recommend keeping the distance as short as possible (for example max. 40 mm at DN50).
*3 Contamination (material accumulation) in the nozzle that is open to the process should always be avoid.
*4 Various installation adapters (for example for angle installation) are available as special equipment packages.

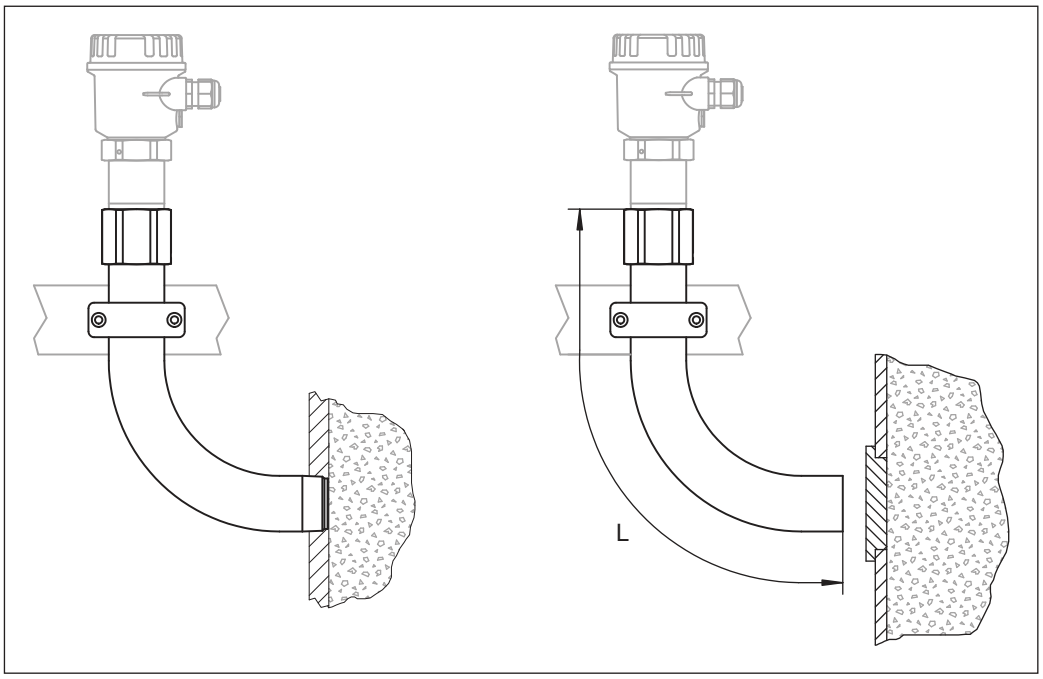
Flange mounting using screw-in flange and plastic plug *1



*1 An appropriate venting element should be installed to prevent condensation between the FQR50/FDR50 and the plastic plug. Suitable installation flanges with integrated venting element are available on request.
*2 Suitable installation flanges are available as accessories (types and dimensions see "Accessories").

Note:
- The maximum length **L** depends on the relative permittivity (DK value) and the water absorption of the plastic material. Observe the manufacturer's specifications.
- We recommend PTFE as the material, as this allows the length at the emitter and receiver to be up to 300 mm.
- For optimal orientation, the emitter and receiver should be able to be moved by ± 10 mm along their longitudinal axis.

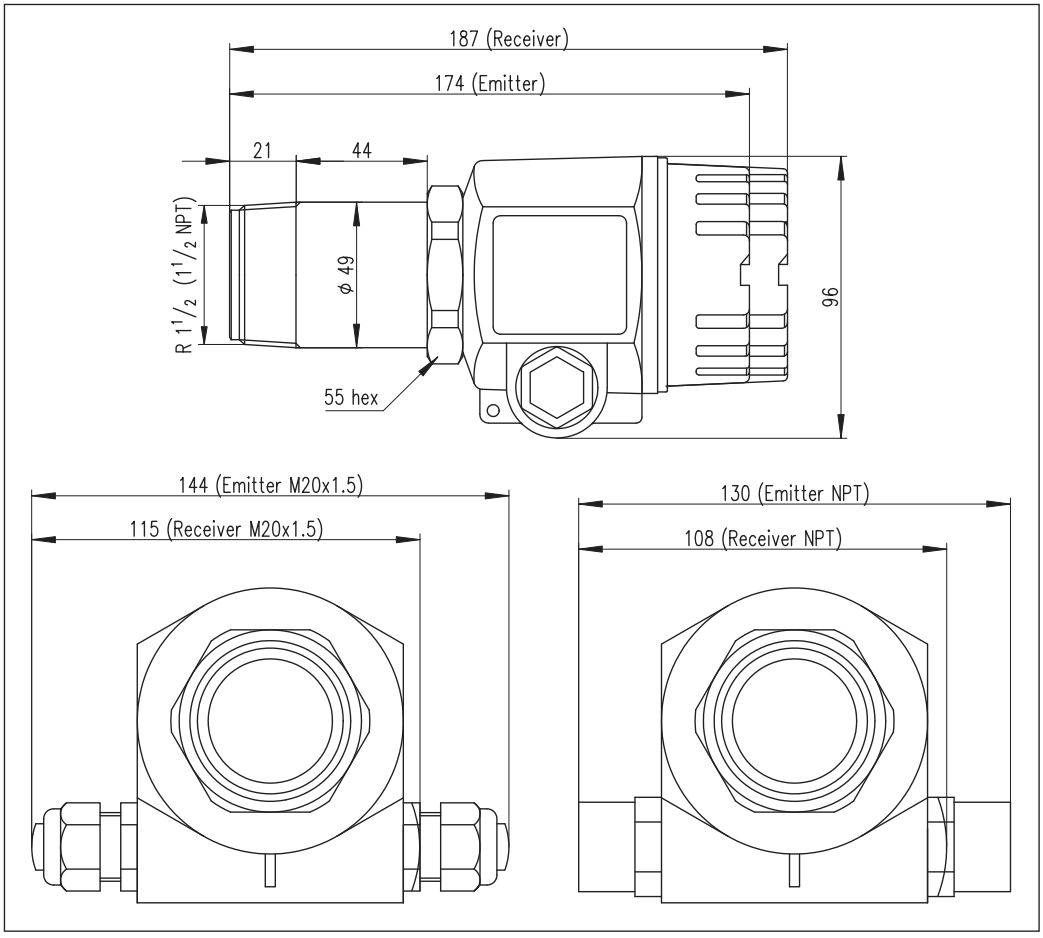
Installation with pipe as wave guide



Note:
- This type of mounting is recommended if conditions at the process or in the area surrounding the process are unfavorable (such as high temperatures or heavy contamination) or if the building's situation does not permit direct installation.
- The pipe can be made of any desired metallic material, and the length **L** is unimportant due to the wave-guide effect.
- Edges inside the pipe (for example at transitions) can cause signal attenuation and thus should be avoided wherever possible.

Mechanical construction

Design, dimensions F18-housing (aluminium)



Weight

- 1.0 kg

Material

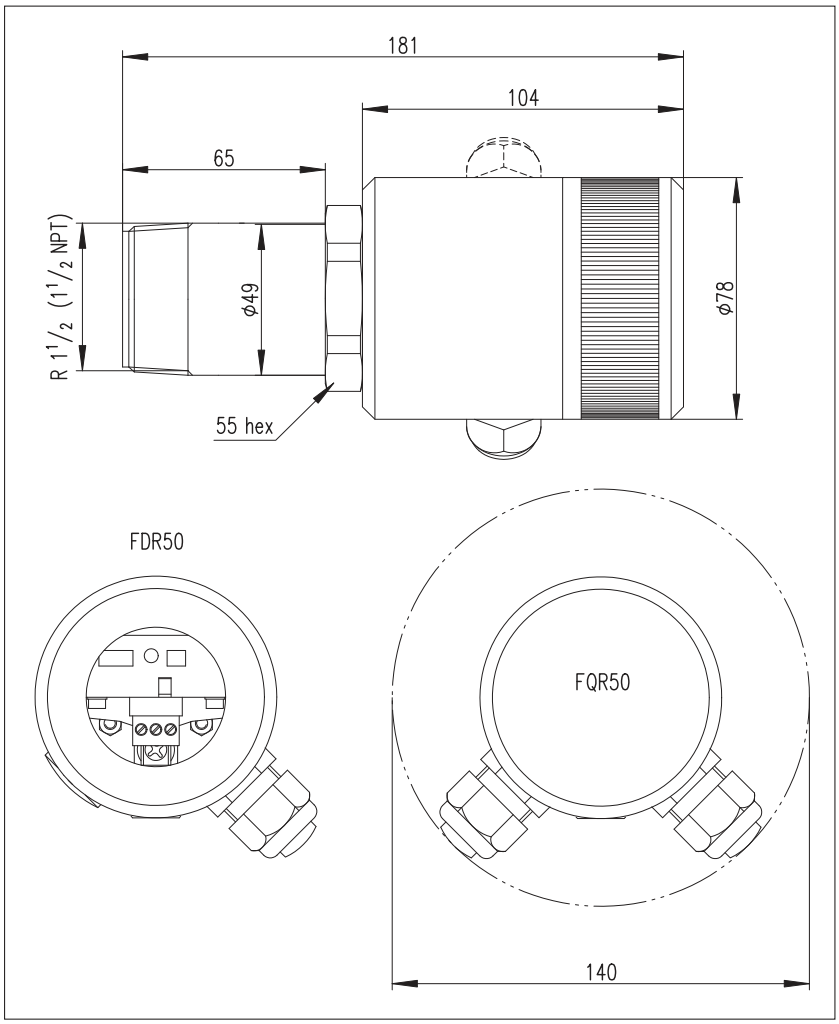
- Housing: Aluminium
- Process connection (fluid-wetted parts):
  - Stainless steel 316Ti/1.4571
  - Sensor diaphragm: PTFE
- Cable glands: PA

Process connection

- Thread R 1½ (EN 10226) or
- 1½ NPT (ANSI/ASME B1.20.1)

Design, dimensions (stainless steel housing)





Weight

- 2.1 kg

Material

- Housing: Stainless steel 316TI/1.4571
- Process connection (fluid-wetted parts):
  - Stainless steel 316Ti/1.4571
  - Sensor diaphragm: PTFE
- Cable glands: PA

Process connection

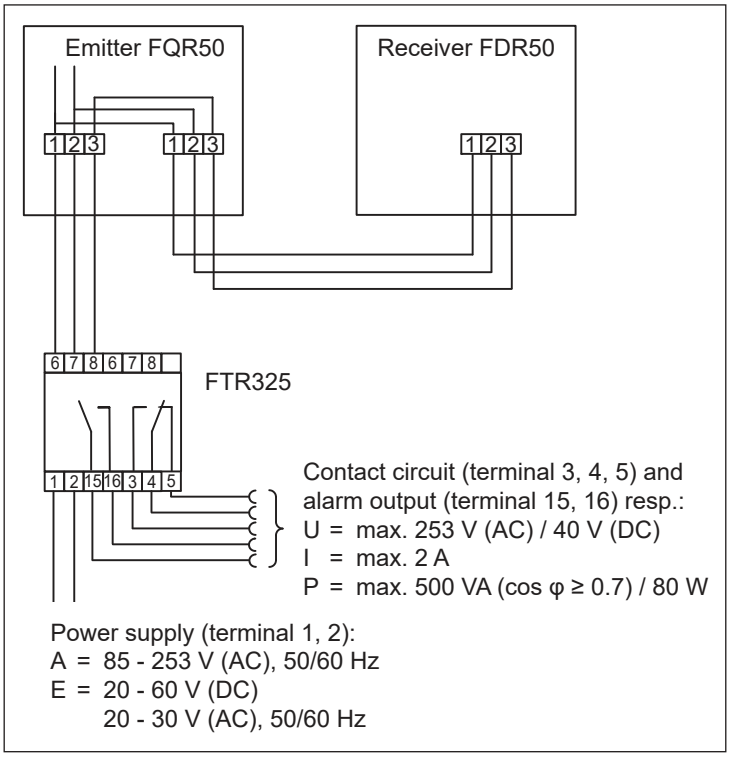
- Thread R 1½ (EN 10226) or
- 1½ NPT (ANSI/ASME B1.20.1)

Power supply

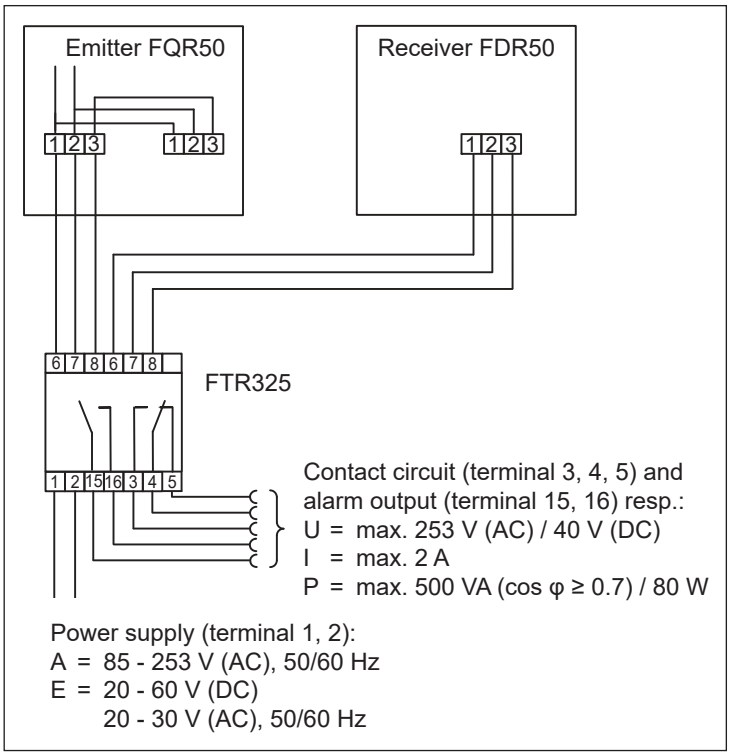
Electrical connection

A suitable wire (see "Wire specification") is used to connect the emitter and receiver of the Soliwave microwave barrier with the Nivotester FTR325. The following wiring variants are permitted:

Ring wiring



Star wiring



Supply voltage

Provided by the switching amplifier FTR325

Note:
For details please refer to the Technical Information of the Nivotester FTR325 (TI00377F).

Cable entry

- M20 x 1.5 or
- ½ NPT

Cable gland

- M20 x 1.5:
  - Degree of protection IP66
  - Scope of supply: 2

Wire specification

- Usual commercial installation wire
- Conductor cross-section: max. 1.5 mm
- Resistance: 15 Ω/km ≤ R' ≤ 150 Ω/km
- Inductance: 0.4 mH/km ≤ L' ≤ 1 mH/km
- Capacitance: 45 nF/km ≤ C' ≤ 200 nF/km
- Length of spurs max. 1000 m (IIC) and 5000 m (IIB) respectively

Example cable length
Copper cable, specific resistance $\rho = 0.0172\ \Omega mm^2/m$, cross section $0.75 mm^2$

It applies: $R\ [\Omega] = (\rho\ [\Omega mm^2/m] * l\ [m]) / A\ [mm^2]$

The maximum cable length is 1090 m.

Output

Output signal

- Switching signal for the Nivotester FTR325
- Switching frequency: max. 4 Hz

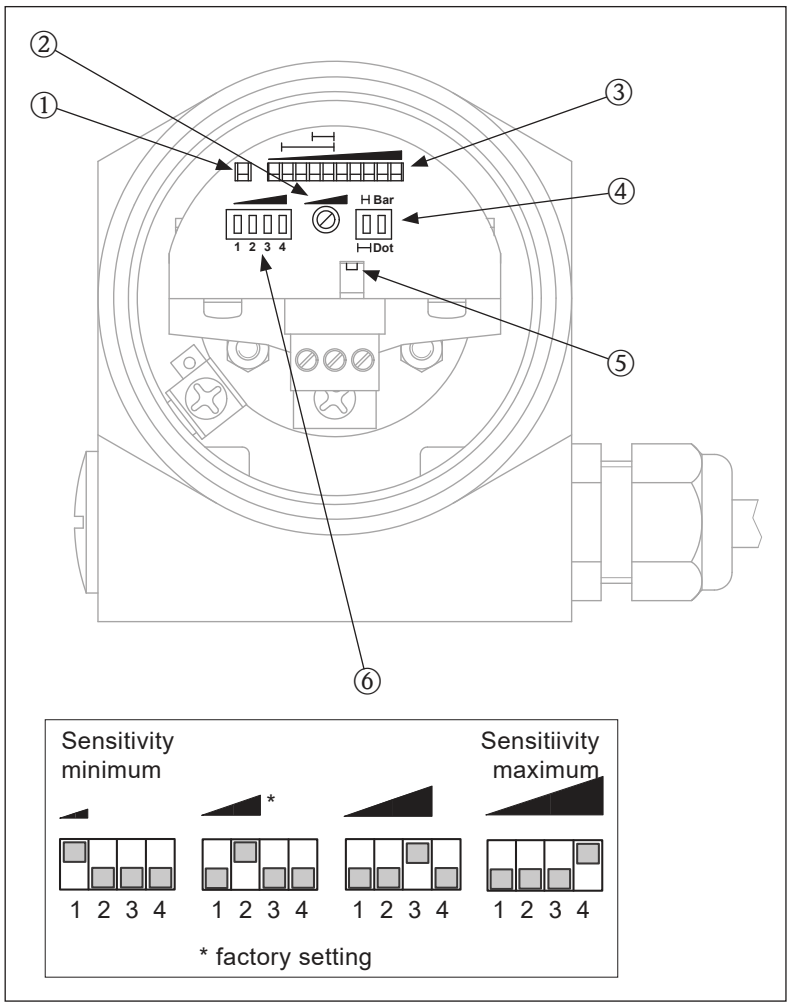
Note:
For details please refer to the Technical Information of the Nivotester FTR325 (TI00377F).

Settings

By using frequencies in the 24 GHz range it is possible to detect products having low attenuation even with low amounts of bulk product between the emitter and the receiver. The calibration options of the units offer the necessary flexibility to be able to adjust the barrier to individual situations easily.

- Rough/fine calibration (⑥, ②)
- Hysteresis ④ selected in 2 stages
- LED field strength is displayed as an adjustment and positioning aid
- LED for the switching output ① and for operation status ⑤ (supply voltage is present)

Operating the receiver



The microwave barrier Soliwave is calibrated using 4 DIP switches for rough calibration ⑥ and a potentiometer for fine calibration ② on the attenuation necessary for unambiguous product recognition. When there is sufficient attenuation or when the microwaves are interrupted by the product, the receiver reacts with an output (LED ①) on the through connection to the external evaluator FTR325. Field status and operation status are indicated on the spot either by a bar graph or by a dot display ③ (switchable by ④).

- High sensitivity can be set for the detection of materials with a very high dielectric constant or of metals because then the beam is attenuated strongly enough or covered.
- The sensitivity has to be adjusted precisely for the detection of materials with a low dielectric constant.

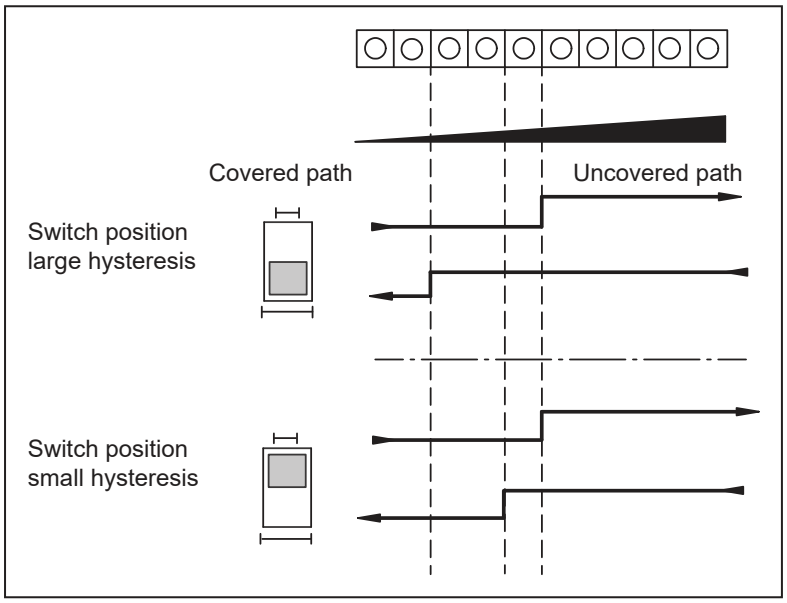
Calibration with covered path (switching point reached)

- The sensitivity of the microwave receiver FDR50 is to be adjusted in such a way that none, as a maximum however the first two LEDs in the LED line light up. If this should not be the case, the sensitivity is to be reduced appropriately.
- With the path uncovered, LED 6 must light up in the LED line as a minimum.

Calibration with free path (switching point not reached)

- The sensitivity of the receiver FDR50 must be adjusted in such a way that as a maximum LED 10 just starts to light up, but at least LED 6 in the LED line must light up.
- With the path covered, only LED 3 must light up in the LED line at the most.
- After a few filling procedures, the sensitivity should be readjusted, if necessary, with the path covered.

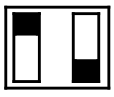
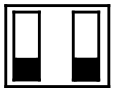
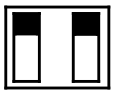
Configuration of the hysteresis

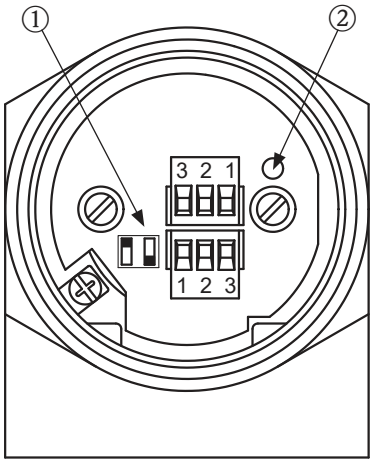


Calibration in applications with very low attenuation

Example: Paper shred
Setting up with covered path
- Reduce hysteresis: Adjust switch
- Adjust sensitivity: Change the rough and fine calibration so that the LEDs 1 to 3 in the LED line light up.

Display and operating elements (emitter)

Switch setting S1	Modulation frequency
	1 (factory setting)
	2
	3



The emitter FQR50 has a green LED ①, that signals the operating status (supply voltage present).

Configuring an operating frequency

To prevent intermodulation interference from microwave barriers located close to each other, slightly different operating frequencies for parallel operation (see "Operating conditions") can be configured with the rotary coding switch ②. Regard the following advice for parallel use of several microwave barriers:
- Use the differnt modulation frequencies in sequence, e.g. 1, 2, 3, 1, ...
- Regard the minimum distance **A** depending on the detection distance **D**.
- Rotate every other microwave barrier by 90° to eliminate interferences (pertains to emitter *and* receiver).

Ordering information

Ordering information Receiver FDR50 / Emitter FQR50

10						Approval:
					C	ATEX II 1/2G Ex ia IIC T4 Ga/Gb
						ATEX II 1/2D Ex ia IIIC T98°C Da/Db
					D	IECEx Ex ia IIC T4 Ga/Gb
						IECEx Ex ia IIIC T98°C Da/Db
					Y	Special version, to be specified

20							Distance emitter/receiver:
						1	Measuring range *[1] maximum 8 m
						2	Measuring range *[1] maximum 20 m
						9	Special version, to be specified

30								Process connection and material:
							R	Thread R 1½ EN10226, stainless steel 316Ti
							S	Thread 1½ NPT ANSI/ASME, stainless steel 316Ti
							Y	Special version, to be specified

40									Housing and cable entry:
								D	Aluminium F18-housing IP66, M20x1.5
								F	Aluminium F18-housing IP66, ½ NPT
								G	Stainless steel 316Ti, IP66, M20x1.5
								H	Stainless steel 316Ti, IP66, ½ NPT
								Y	Special version, to be specified

50										Optional features:
									A	Basic equipment
									Y	Special version, to be specified

FDR50/FDR50 - [ ][ ][ ][ ][ ]

*[1] Please select the same version for emitter FQR50 and receiver FDR50

Comments regarding the product structure

Only the following device combinations are possible:
- **FQR50/FDR50-C* with FTR325-B***
- **FQR50/FDR50-D* with FTR325-D***

Safety instructions

General safety instructions for electrical equipment for hazardous areas

- Install it according to manufacturer's specifications and the standards and regulations applicable in your area.
- Installation, electrical connection, commissioning, operation and, if necessary, maintenance may be carried out only by trained specialists authorized to do so by the facility's owner-operator.
- Do not operate the devices of the microwave barrier outside of the electrical, thermal or mechanical characteristic quantities.
- For additional safety instructions, refer to the following documents:
  - XA00219F (FQR50-C****/FDR50-C****)
  - XA00484F (FQR50-D****/FDR50-D****)

Environment

Ambient temperature

- -40°C to +70°C

Storage temperature

- -40°C to +80°C

Degree of protection

- With closed housing: IP 66
- With open housing: IP 20

Electromagnetic compatibility (EMC)

- Interference Emission to EN 61326, Electrical Equipment Class B
- Interference Immunity to EN 61326, Appendix A (Industrial)

Process conditions

Process temperature

- -40°C to +70°C (without optional adapter for temperature reduction)
- -40°C to +450°C (with optional adapter for temperature reduction, see "Accessories")

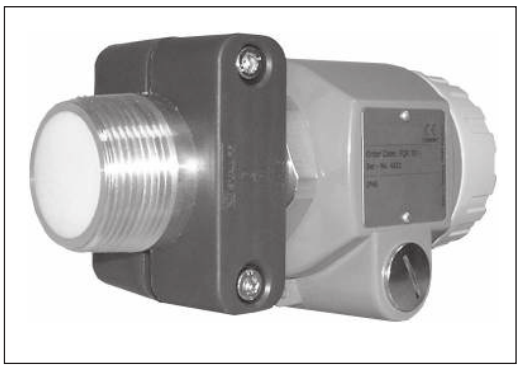
Process pressure

- 80 to 480 kPa absolute (0.8 to 5.8 bar absolute)
  (Applies only when FQR50 emitter or FDR50 receiver is installed directly in the process.)
- 80 to 510 kPa absolute (0.8 to 5.1 bar absolute)
  (Applies only when using the optional adapter for temperature reduction.)

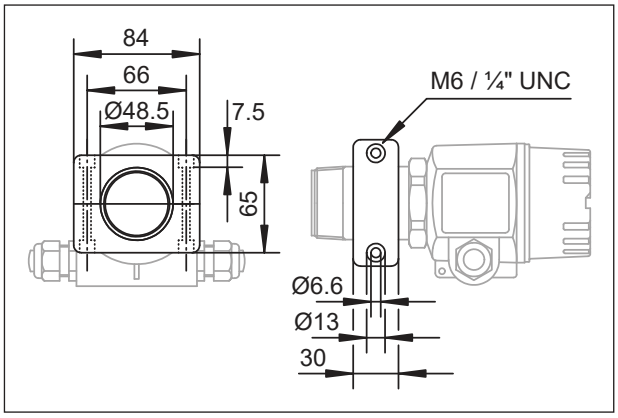
Accessories

Mounting bracket

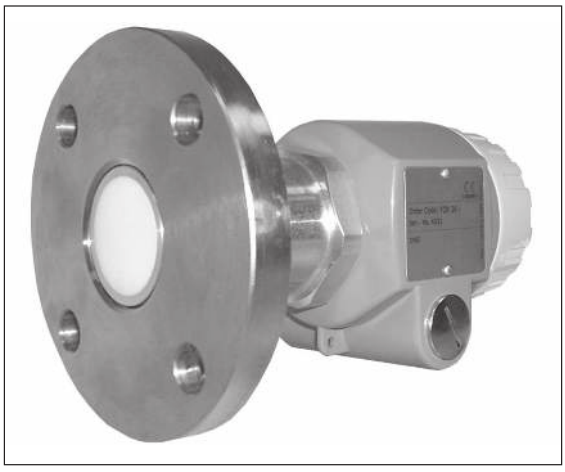
The FQR50 emitter and FDR50 receiver can be easily installed on existing frames using a mounting bracket.



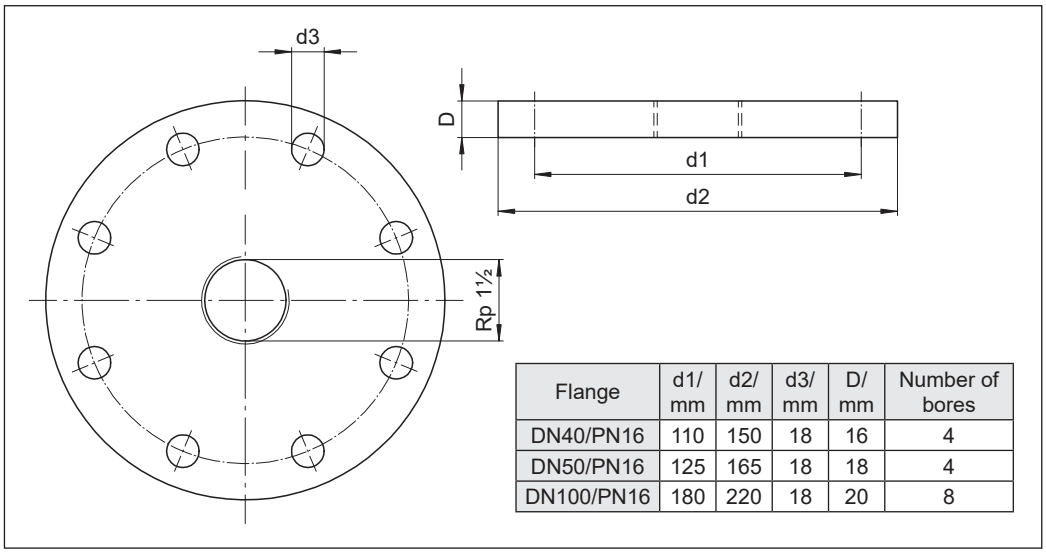
Mounting bracket for frame mounting
- Aluminum material: Part number 52017501
- Plastic material: Part number 52017502



Installation flanges, material: 316Ti (stainless steel)



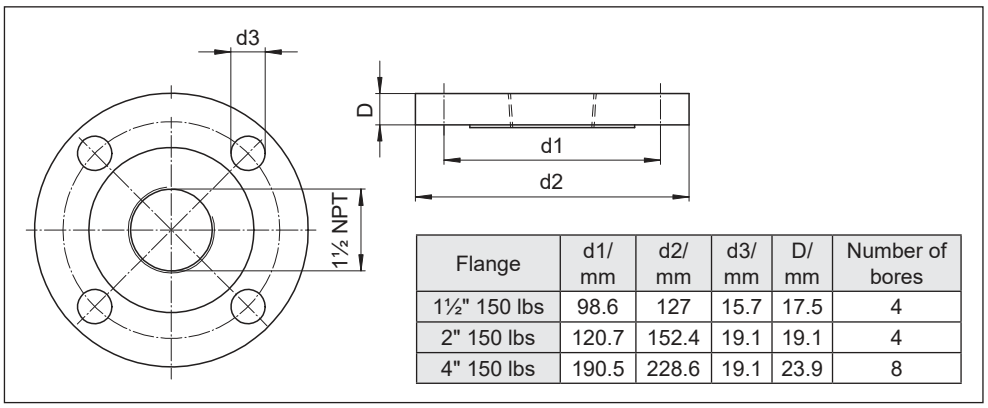
Connection dimensions to DIN EN 1092-1, with Rp 1½ internal thread:
- DN40 PN16 Part number 71006348
  with inspection certificate to EN 10204-3.1 Part number 71108383
- DN50 PN16 Part number 71006350
  with inspection certificate to EN 10204-3.1 Part number 71108388
- DN100 PN16 Part number 71006352
  with inspection certificate to EN 10204-3.1 Part number 71108390



Flange	d1/ mm	d2/ mm	d3/ mm	D/ mm	Number of bores
DN40/PN16	110	150	18	16	4
DN50/PN16	125	165	18	18	4
DN100/PN16	180	220	18	20	8

Connection dimensions to ANSI/ASME B16.5, with 1½ NPT internal thread:

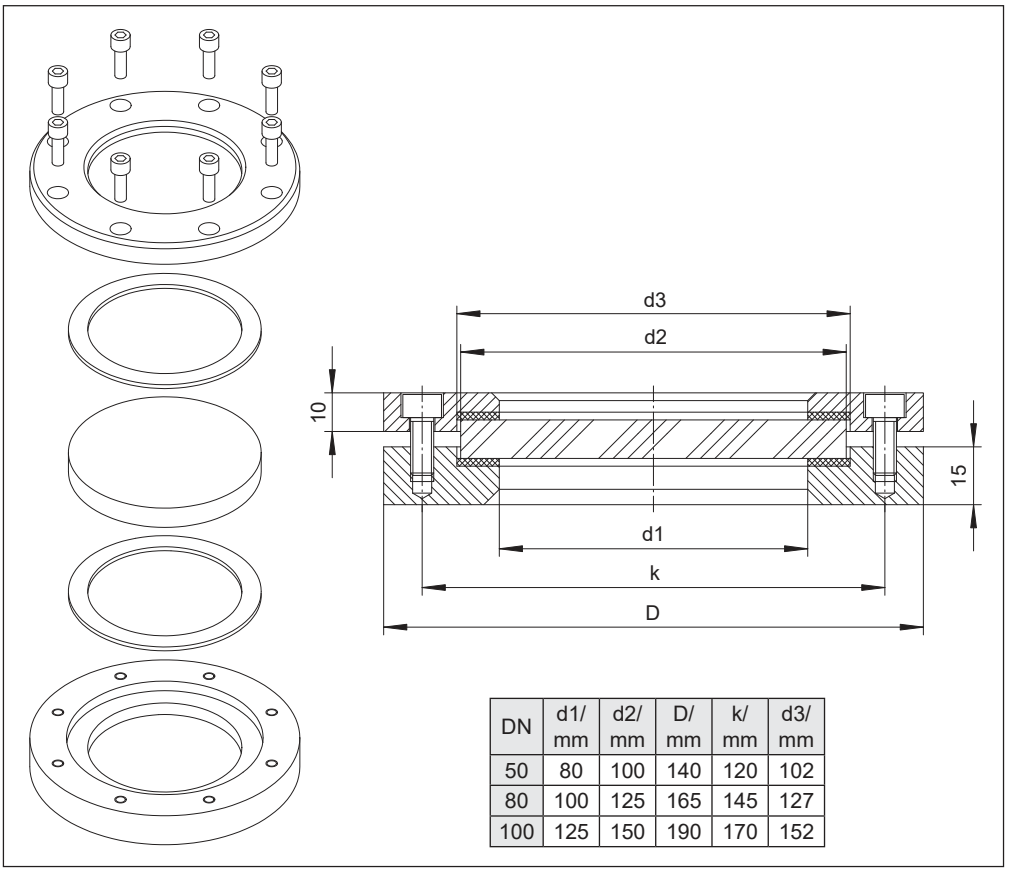
- 1½" 150 lbs — Part number 71006349
  with inspection certificate to EN 10204-3.1 — Part number 71108387
- 2" 150 lbs — Part number 71006351
  with inspection certificate to EN 10204-3.1 — Part number 71108389
- 4" 150 lbs — Part number 71006353
  with inspection certificate to EN 10204-3.1 — Part number 71108391



Flange	d1/ mm	d2/ mm	d3/ mm	D/ mm	Number of bores
1½" 150 lbs	98.6	127	15.7	17.5	4
2" 150 lbs	120.7	152.4	19.1	19.1	4
4" 150 lbs	190.5	228.6	19.1	23.9	8

Sight glass fitting

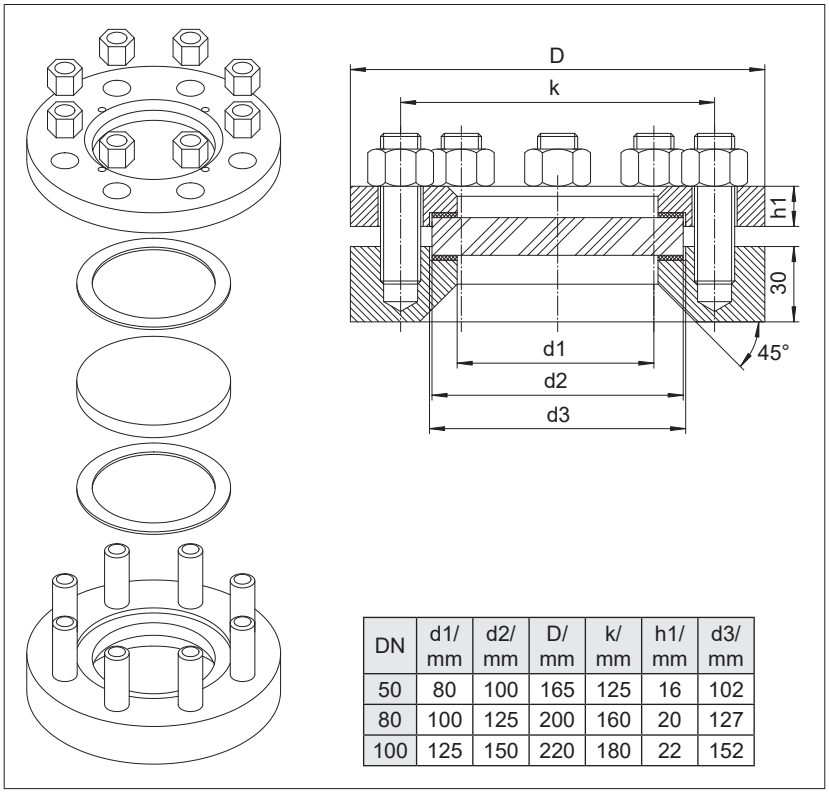
Weld-in fitting for unpressurized containers, materials: stainless steel 316Ti and silicone, Tmax = 200°C, borosilicate glass, screw-on installation



DN	d1/ mm	d2/ mm	D/ mm	k/ mm	d3/ mm
50	80	100	140	120	102
80	100	125	165	145	127
100	125	150	190	170	152

- DN 50, part number 71026443
- DN 80, part number 71026444
- DN 100, part number 71026445

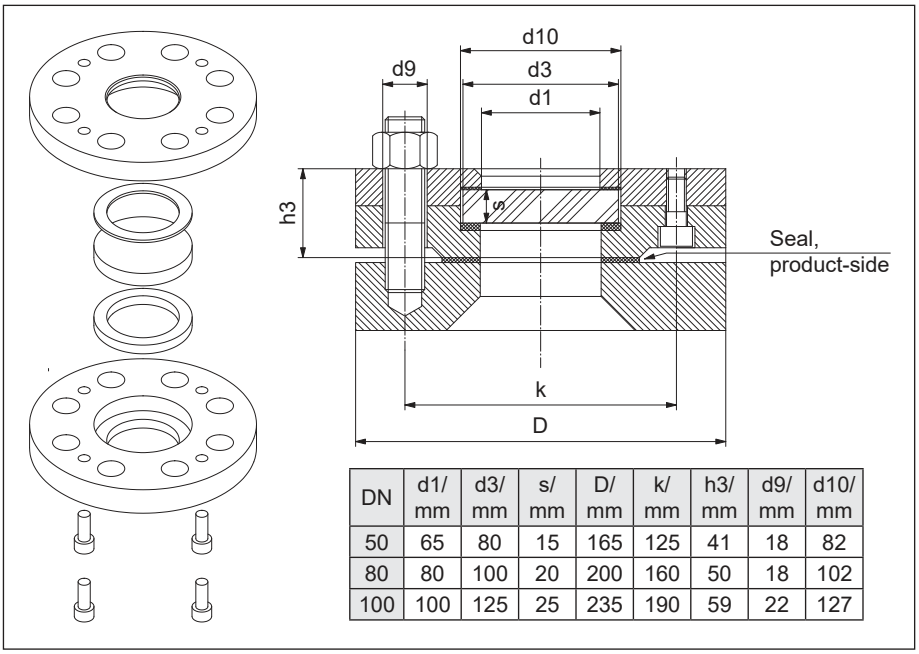
Weld-in fitting to DIN 28120, materials: stainless steel 316Ti/321 and silicone, Pmax = 1 MPa (10 bar), Tmax = 200°C, borosilicate glass, screw-on installation



DN	d1/ mm	d2/ mm	D/ mm	k/ mm	h1/ mm	d3/ mm
50	80	100	165	125	16	102
80	100	125	200	160	20	127
100	125	150	220	180	22	152

- DN 50, part number 71026446
- DN 80, part number 71026447
- DN 100, part number 71026448

Flange fitting to DIN 28121 for screwing onto existing counter or pad flange, materials: stainless steel 316Ti, PTFE and C4400, Pmax = 2.5 MPa (25 bar), Tmax = 200°C, borosilicate glass

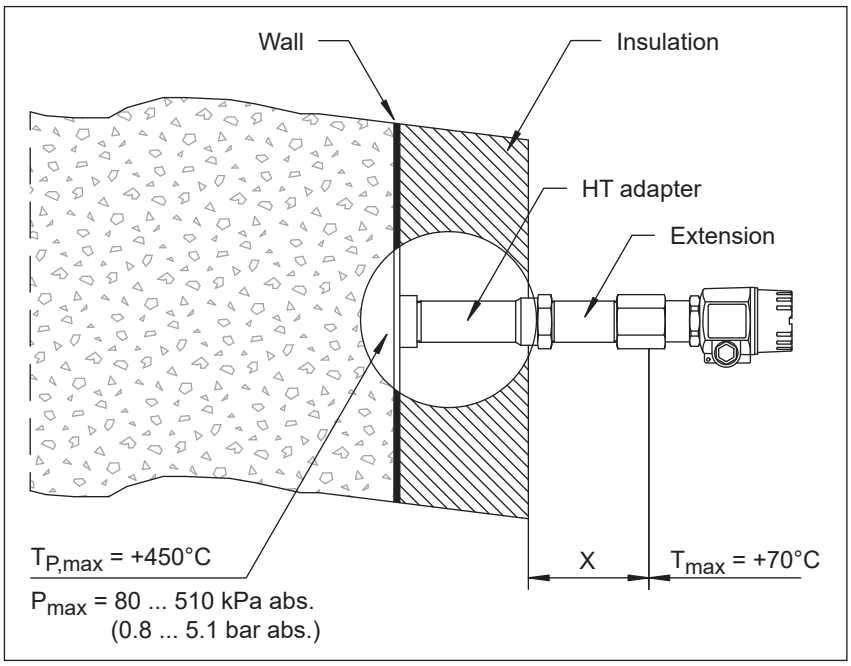


DN	d1/ mm	d3/ mm	s/ mm	D/ mm	k/ mm	h3/ mm	d9/ mm	d10/ mm
50	65	80	15	165	125	41	18	82
80	80	100	20	200	160	50	18	102
100	100	125	25	235	190	59	22	127

- DN 50, part number 71026449
- DN 80, part number 71026450
- DN 100, part number 71026451

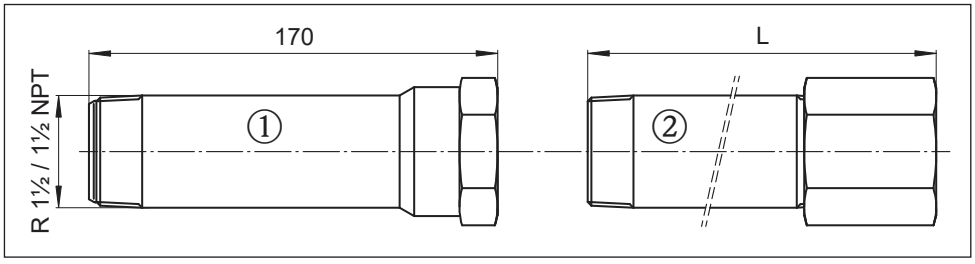
High-temperature application

For applications with process temperatures up to +450°C, the temperature reduction to max. +70°C takes place on the microwave barrier with a corresponding high-temperature adapter (with extension where necessary). The length of the adapter is based on the insulation thickness to be penetrated (if present) and the ambient conditions at the measuring point.



Note:
- To maintain the maximum temperature of +70°C at the FQR50/FDR50, we recommend a minimum difference (**X**) of 200 mm between the process or the insulation and the devices.
- The individual extensions can also be combined in any way desired.
- Each high-temperature adapter results in a reduction of the range.

High-temperature adapter and extension



HT adapter ① with flush-mounted ceramic disk:
- Thread R 1½ or Rp 1½, 55mm hex, 316Ti/1.4571
  Part number 71113441
- Thread 1½ NPT, 55mm hex, 316Ti/1.4571
  Part number 71113449

Extension for HT adapter ②:
- Thread R 1½ or Rp 1½, 55mm hex, 316Ti/1.4571
  L = 225 mm Part number 71113450
  L = 325 mm Part number 71113451
  L = 525 mm Part number 71113452
- Thread 1½ NPT, 55mm hex, 316Ti/1.4571
  L = 225 mm Part number 71113453
  L = 325 mm Part number 71113454
  L = 525 mm Part number 71113455

Certificates and approvals

CE mark

The Soliwave microwave barrier is in conformity with the statutory requirements of the EU Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

Radio approval

Directive 2014/53/EU (RED) according to EN 300440-2
FCC [**FCC ID UAS-FQR50**]

Ex approval

See "Ordering information"

Other standards and guidelines

- EN 60529
  Degrees of protection through housing (IP code)
- EN 61010-1
  Safety requirements for electrical equipment for measurement, control and laboratory use
- EN 61326-X
  EMC product family standard for electrical equipment for measurement, control and laboratory use

Supplementary Documentation

Operating Instructions (KA)

Soliwave FQR50/FDR50
KA00206F

Nivotester FTR325
KA00205F

Technical Information

Nivotester FTR325
TI00377F

Safety instructions

Soliwave FQR50/FDR50-C* with the Nivotester FTR325-B*
XA00219F

Soliwave FQR50/FDR50-D* with the Nivotester FTR325-D*
XA00484F

Subject to modifications and amendments

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