OPTIWAVE 6400 C

Technical Datasheet

24 GHz Radar (FMCW) Level Transmitter for solids from granulates to rocks

- Market-entry transmitter
- Proven PP and PTFE Drop antenna insensitive to product build-up
- Built-in configurations for different surface profiles

HART COMMUNICATION PROTOCOL

KROHNE

1.1 The FMCW radar level transmitter for solids from granulates to rocks

This device is a non-contact radar level transmitter that uses FMCW technology. It measures distance, level and volume of powders, granulates, rocks, cereals and all other types of solids. It is ideal for measuring the level of solids from granulates to rocks.

① Drop antenna with small beam angle. Its ellipsoidal shape and smooth surface minimizes scaling.
② 2-wire 24 GHz FMCW radar level transmitter
③ Large, backlit LCD screen with 4-button keypad can be used with a bar magnet without opening the housing cover. The software has a quick setup assistant for easy commissioning. 12 languages are available.
④ Aluminium or stainless steel housing

- KROHNE is the pioneer of FMCW radar level measurement and has more than 28 years of experience with this technology
- The first non-contact 2-wire FMCW Radar 24-26 GHz designed for solids
- Extremely high dynamics with considerable signal-to-noise ratio for clear vision in dusty atmospheres
- One user interface for all applications
- Proven Drop antenna design made of solid PP or PTFE. Ellipsoidal shape minimizes scaling, making purging systems obsolete.
- Highly focused beam with small beam angle (4° for DN150 / 6¨ PTFE Drop antenna), no need for huge parabolic antennas which are difficult to install
- No need for antenna aiming kits. A slanted flange can be installed if necessary.
- Low-cost low-pressure disc flange

Industries

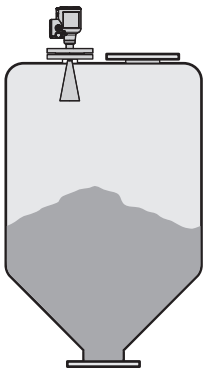
- Metals, Minerals & Mining
- Chemical market
- Power
- Agri-food
- Wastewater
- Pulp & Paper

Applications

- Finished and raw products (buffer silos, hoppers, stock piles, bulk storage containers, rock crushers, blast furnace, conveyor belts etc.)

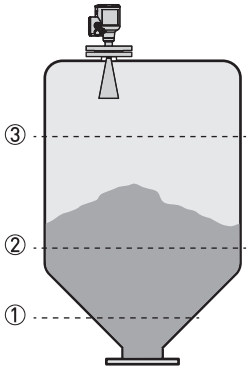
1.2 Applications

1. Level measurement of solids



The level transmitter can measure the level of a wide range of solid products on a large variety of installations within the stated pressure and temperature range. It does not require any calibration: it is only necessary to do a short configuration procedure.

2. Mass (volume) measurement



A strapping table function is available in the configuration menu for volume or mass measurement. Up to 50 mass (volume) values can be related to level values. For example:
Level ①= 2 m / Mass ①= e.g. 100 kg
Level ②= 10 m / Mass ②= e.g. 500 kg
Level ③= 20 m / Mass ③= e.g. 1000 kg

This data permits the device to calculate (by linear interpolation) volume or mass between strapping table entries.

PACTware™ software and a DTM (Device Type Manager) is supplied free of charge with the device. This software permits the user to easily configure the device with a computer. It has a conversion table function with a large number of tank shapes.

1.3 Product family

OPTIWAVE 1010 (6 GHz)
for liquids in bypass chambers

The OPTIWAVE 1010 is a non-contact FMCW radar welded to a bypass chamber with an optional IP68 level indicator (BM 26 Advanced). It continuously measures the distance and level of clean liquids.

It measures in bypass chambers up to 8 m / 26.2 ft high with a maximum accuracy of ±5 mm / ±0.2¨. It can measure in process conditions with temperatures up to +150°C / +302°F and pressures up to 40 barg / 580 psig.

OPTIWAVE 5200 C/F (10 GHz)
for liquids in storage and process applications

This 10 GHz 2-wire FMCW radar level transmitter measures distance, level, volume, mass and flow rate of liquids and pastes. It is ideal for corrosive products with its PP or PTFE antenna options. It features unique PP and PTFE antennas for aggressive products. The device is able to measure distances up 30 m / 98.4 ft in process conditions up to +250°C / +482°F and 40 barg / 580 psig.

The device agrees with SIL2 requirements for safety-related systems (as per IEC 61508). Output options include HART®, FOUNDATION™ fieldbus and PROFIBUS PA industrial communication protocols.

OPTIWAVE 5400 C (24 GHz)
for liquids in basic process applications

Designed for basic liquid applications, this market entry 24 GHz 2-wire FMCW radar transmitter provides accurate readings even in fast moving processes, in closed tanks or in the open air like rivers or dams. Its proven PP Drop antenna is insensitive to condensation.

The OPTIWAVE 5400 can measure in process conditions with temperatures up to +130°C / +266°F and pressures up to 16 barg / 232 psig. The antenna options permit to measure distances up to 100 m / 328 ft. The device can be installed in high nozzles (≤1 m / 3.28 ft) when it is fitted with antenna extensions.

OPTIWAVE 7400 C (24GHz)
for agitated and corrosive liquids

This 24 GHz FMCW radar level transmitter is designed for liquids in harsh environment like tanks with agitators containing corrosives or in non-Ex applications with extremely high process temperatures, like molten salt in solar plants (+700°C / +1292°F). For toxic and dangerous products, the use of a Metaglas® second sealing barrier is recommended.

The PTFE and PEEK Drop antennas have optional flange plate protection for corrosive media. Heating and cooling systems prevent from crystallization inside the Metallic Horn antennas. The device measures distances up to 100 m / 328 ft and can be installed in high nozzles (≤1 m / 3.28 ft) when fitted with antenna extensions. Standard process conditions up to +200°C / 392°F; 100 barg / 1450 psig (higher on request).

OPTIWAVE 7500 C (80 GHz)
for liquids in narrow tanks with internal obstructions

The small beam angle and negligible dead zone of this 80 GHz FMCW radar level transmitter makes it the premium choice for liquids in small and narrow tanks with internal obstructions like agitators or heating coils, as well as tanks with long nozzles. It can even measure through tank roofs made of non-conductive material (e.g. plastic, fiberglass or glass). The flush-mounted PEEK Lens antenna (no tank intrusion) is insensitive to deposit.

There is an extensive choice of process connections starting from ¾". Flanges have an optional PEEK plate protection for corrosive tank contents. The OPTIWAVE 7500 operates in process conditions with temperatures up to +150°C / +302°F and pressures up to 40 barg / 580 psig. It measures distances up to 100 m / 328 ft and a 112 mm / 4.4" extension is available for high nozzles.

OPTIWAVE 3500 C (80 GHz)
for liquids with hygienic requirements

This 80 GHz FMCW radar transmitter for hygienic liquid applications in the pharmaceutical, food and beverage industries is CIP-SIP suitable and offers a large choice of hygienic process connections: Tri-Clamp®, Tuchenhagen VARIVENT®, SMS, DIN 11851, DIN 11864-1 Form A, NEUMO BioControl®.

The small dead zone and beam angle of its flush-mounted Lens antenna enables precise measurement even in small and narrow tanks with agitators. The OPTIWAVE 3500 measures up to 50 m / 164 ft in process conditions up to +150°C / +302°F and 25 barg / 363 psig.

OPTIWAVE 6400 C (24 GHz)
for solids from granulates to rocks

By combining high signal dynamics and FMCW radar technology, this market-entry 24 GHz radar device measures accurately and reliably the level of solids like stone, plastic granulates or coffee beans. No need for expensive antenna aiming kits or purging systems; the proven Drop antenna design minimizes scaling and is not affected by the angle of repose.

It operates in process conditions with temperatures up to +130°C / +266°F and pressures up to 16 barg / 232 psig. The antenna options permit the device to measure distances up to 100 m / 328 ft.

OPTIWAVE 6500 C (80 GHz)
for powders and dusty atmosphere

Accurate continuous level measurement of fine powders has to deal with a series of issues like dust, low-reflective media, build-up and uneven surfaces. The specific algorithms and high signal dynamics of this 80 GHz FMCW radar transmitter are the key to provide reliable and accurate readings despite these difficult conditions. Thanks to the small beam angle of the flush-mounted Lens antenna, this powerful device handles high and narrow silos even in the presence of internal obstructions.

The OPTIWAVE 6500 operates in process conditions with temperatures up to +200°C / +392°F and pressures up to 40 barg / 580 psig. It offers an extensive choice of threaded (≥1½¨) and flanged (≥DN50 / 2¨) process connections. The antenna options permit the device to measure distances up to 100 m / 328 ft. A 112 mm / 4.4¨ extension is available for high nozzles.

1.4 Measuring principle

A radar signal is emitted via an antenna, reflected from the product surface and received after a time t. The radar principle used is FMCW (Frequency Modulated Continuous Wave).

The FMCW-radar transmits a high frequency signal whose frequency increases linearly during the measurement phase (called the frequency sweep). The signal is emitted, reflected on the measuring surface and received with a time delay, t. Delay time, t=2d/c, where d is the distance to the product surface and c is the speed of light in the gas above the product.

For further signal processing the difference Δf is calculated from the actual transmitted frequency and the received frequency. The difference is directly proportional to the distance. A large frequency difference corresponds to a large distance and vice versa. The frequency difference Δf is transformed via a Fast Fourier Transform (FFT) into a frequency spectrum and then the distance is calculated from the spectrum. The level results from the difference between the tank height and the measured distance.

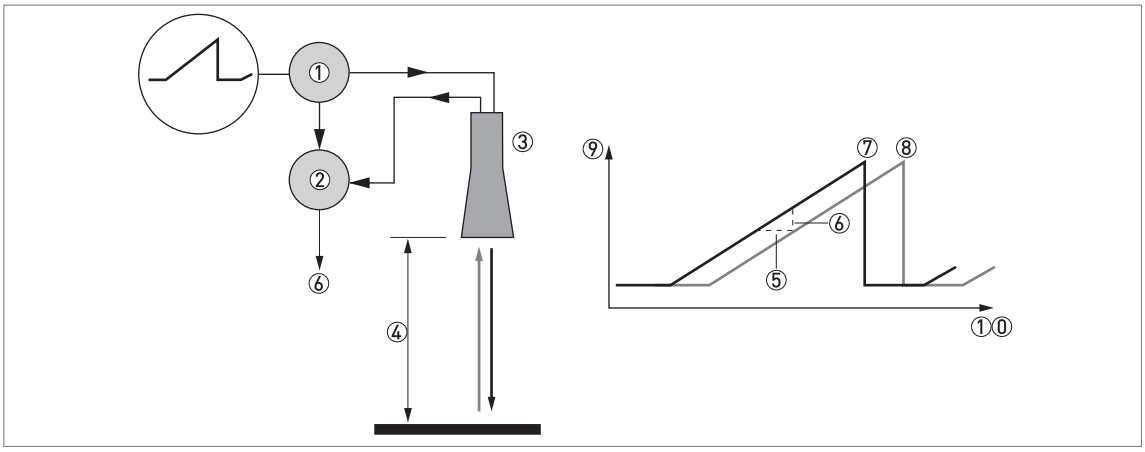


Figure 1-1: Measuring principle of FMCW radar

① Transmitter
② Mixer
③ Antenna
④ Distance to product surface, where change in frequency is proportional to distance
⑤ Differential time delay, Δt
⑥ Differential frequency, Δf
⑦ Frequency transmitted
⑧ Frequency received
⑨ Frequency
①⓪ Time

Measurement modes

"Direct" mode
The device uses the largest radar signal to monitor level.

"Direct Plus" mode
If it is possible there will be an interference signal in the measurement zone that is larger than the level signal, select "Direct Plus" mode. If you select "Direct Plus" mode, the device locks on the level signal and monitors changes in level. If the device then finds larger reflections in the silo, it will only monitor the largest signal in a small search zone around the first reflection found and ignore all other reflections. The interference signal must not be near to the level signal.

2.1 Technical data

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).*

Measuring system

Measuring principle	2-wire loop-powered level transmitter; FMCW radar
Frequency range	K-band (24...26 GHz)
Max. radiated power (EIRP)	< -41.3 dBm according to ETSI EN 307 372 (TLPR) and ETSI EN 302 729 (LPR)
Application range	Level measurement of powders and granulates
Primary measured value	Distance and reflection
Secondary measured value	Level, volume and mass

Design

Construction	The measurement system consists of a measuring sensor (antenna) and a signal converter
Options	Integrated LCD display (-20..+70°C / -4...+158°F); if the ambient temperature is not in these limits, then this condition can stop the display
	Straight antenna extensions (length 105 mm / 4.1¨) Max. extension length, Metallic Horn antenna: 1050 mm / 41.3¨ Max. extension length, Drop antenna: 525 mm / 20.7¨
	Antenna purging system for Metallic Horn antennas (supplied with a ¼ NPTF connection)
	2° slanted PP flange (for all antennas)
	Weather protection
Max. measuring range (antenna)	Metallic Horn, DN80 (3¨): 25 m / 82 ft
	Metallic Horn, DN100 (4¨): 40 m / 131.2 ft
	Metallic Horn, DN150 (6¨): 80 m / 262.5 ft
	Metallic Horn, DN200 (8¨): 100 m / 328 ft
	PP or PTFE Drop, DN80 (3¨): 25 m / 82 ft
	PP or PTFE Drop, DN100 (4¨): 40 m / 131.2 ft
	PP or PTFE Drop, DN150 (6¨): 100 m / 328.1 ft
	Refer also to "Measuring accuracy" on page 16
Min. tank height	1 m / 40¨
Recommended minimum blocking distance	Antenna extension length + antenna length + 0.3 m / 12¨

Beam angle (antenna)	Metallic Horn, DN 80 (3¨): 9°
	Metallic Horn, DN 100 (4¨): 8°
	Metallic Horn, DN150 / 6¨: 6°
	Metallic Horn, DN200 / 8¨: 5°
	PP Drop, DN80 / 3¨: 9°
	PP Drop, DN100 / 4¨: 7°
	PP Drop, DN150 / 6¨: 5°
	PTFE Drop, DN80 / 3¨: 8°
	PTFE Drop, DN100 / 4¨: 7°
	PTFE Drop, DN150 / 6¨: 4°
Display and user interface	
Display	Backlit LCD display
	128 × 64 pixels in 64-step greyscale with 4-button keypad
Interface languages	English, French, German, Italian, Spanish, Portuguese, Chinese (simplified), Japanese, Russian, Czech, Polish and Turkish

Measuring accuracy

Resolution	1 mm / 0.04¨
Repeatability	±1 mm / ±0.04¨
Accuracy	Standard: ±2 mm / ±0.8¨, when distance ≤ 10 m / 33 ft; ±0.02% of measured distance, when distance > 10 m / 33 ft. For more data, refer to *Measuring accuracy* on page 16.
Reference conditions acc. to EN 61298-1	
Temperature	+15...+25°C / +59...+77°F
Pressure	1013 mbara ±50 mbar / 14.69 psia ±0.73 psi
Relative air humidity	60% ±15%
Target	Metal plate in an anechoic chamber. The device has specified settings.

Operating conditions

Temperature	
Ambient temperature	-40…+80°C / -40…+176°F Ex: see supplementary operating instructions or approval certificates
Relative humidity	0...99%
Storage temperature	-40…+85°C / -40…+185°F
Process connection temperature (higher temperature on request)	**Metallic Horn antenna:** -50…+130°C / -58…+266°F (the process connection temperature must agree with the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex: see supplementary operating instructions or approval certificates
	Drop antenna (PTFE): -50…+130°C / -58…+266°F (the process connection temperature must agree with the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex: see supplementary operating instructions or approval certificates
	Drop antenna (PP): -40…+100°C / -40…+212°F (the process connection temperature must agree with the temperature limits of the gasket material. Refer to "Materials" in this table.) Ex: see supplementary operating instructions or approval certificates

Pressure	
Process pressure	-1…16 barg / -14.5…232 psig
	Subject to the process connection used and the process connection temperature. For more data, refer to *Guidelines for maximum operating pressure* on page 18.
Other conditions	
Dielectric constant (ε_r)	≥1.4
Ingress protection	IEC 60529: IP66 / IP68 (0.1 barg / 1.45 psig)
	NEMA 250: NEMA type 6 - 6P (housing) and type 6P (antenna)
Maximum rate of change	60 m/min / 196 ft/min

Installation conditions

Process connection size	The nominal diameter (DN) should be equal to or larger than the antenna diameter.
	If the nominal diameter (DN) is smaller than the antenna, either: – provide the means to adapt the device to a larger process connection on the tank (for example, a plate with a slot), or – use the same process connection, but remove the antenna from the device before installation and fit it from inside the tank.
Process connection position	Make sure that there are not any obstructions directly below the process connection for the device. For more data, refer to *Installation* on page 26.
Dimensions and weights	For dimensions and weights data, refer to *Dimensions and weights* on page 20.

Materials

Housing	Polyester-coated aluminium
	Option: Stainless steel (1.4404 / 316L) – non-Ex devices only. Ex approvals will be available in the second quarter of 2018.
Wetted parts, including antenna	Metallic Horn antenna: Stainless steel (1.4404 / 316L)
	Drop antenna: PTFE; PP
Process connection	Stainless steel (1.4404 / 316L)
Gaskets (and O-rings for the sealed antenna extension option)	**PTFE Drop antenna:** FKM/FPM (-40…+130°C / -40…+266°F); Kalrez® 6375 (-20…+130°C / -4…+266°F); EPDM (-50°C…+130°C / -58…+266°F) ①
	PP Drop antenna: FKM/FPM (-40…+100°C / -40…+212°F); Kalrez® 6375 (-20…+100°C / -4…+212°F); EPDM (-40°C…+100°C / -40…+212°F) ①
	Metallic Horn antenna: FKM/FPM (-40…+130°C / -40…+266°F); Kalrez® 6375 (-20…+130°C / -4…+266°F); EPDM (-50°C…+130°C / -58…+266°F)
Feedthrough	PEI (-50...+130°C / -58...+266°F) This is the maximum range. The feedthrough temperature limits must agree with the temperature limits of the gasket material and antenna type.
Cable gland	Standard: none
	Options: Plastic (Non-Ex: black, Ex i-approved: blue); nickel-plated brass; stainless steel; M12 (4-pin connector)
Weather protection (Option)	Stainless steel (1.4404 / 316L)

Process connections

Thread	G 1 A...1½ A (ISO 228); 1...1½ NPT (ASME B1.20.1)
Flange version	
EN 1092-1	Low-pressure flanges: DN80...200 in PN01; Standard flanges: DN80...200 in PN10, PN16 and PN40 (Type B1); others on request Optional flange facing for standard flanges: Type A
ASME B16.5	Low-pressure flanges: 3¨...8¨ in 150 lb (max. 15 psig); Standard flanges: 3¨...8¨ in 150 lb RF and 300 lb RF; others on request Optional flange facing for standard flanges: FF (Flat Face)
JIS B2220	80…200A in 10K RF; others on request
Other	Others on request

Electrical connections

Power supply	**Terminals output – Non-Ex / Ex i:** 12…30 VDC; min./max. value for an output of 21.5 mA at the terminals
	Terminals output – Ex d: 16…36 VDC; min./max. value for an output of 21.5 mA at the terminals
Maximum current	21.5 mA
Current output load	**Non-Ex / Ex i:** R_L [Ω] ≤ ((U_{ext} -12 V)/21.5 mA). For more data, refer to *Minimum power supply voltage* on page 17.
	Ex d: R_L [Ω] ≤ ((U_{ext} -16 V)/21.5 mA). For more data, refer to *Minimum power supply voltage* on page 17.
Cable entry	Standard: M20×1.5; Option: ½ NPT
Cable gland	Standard: none
	Options: M20×1.5 (cable diameter: 7…12 mm / 0.28…0.47¨); others are available on request
Cable entry capacity (terminal)	0.5…3.31 mm² (AWG 20...12)

Input and output

Current output	
Output signal	Standard: 4…20 mA
	Options: 3.8…20.5 mA acc. to NAMUR NE 43; 4…20 mA (reversed); 3.8…20.5 mA (reversed) acc. to NAMUR NE 43
Output type	Passive
Resolution	±5 µA
Temperature drift	Typically 50 ppm/K
Error signal	High: 21.5 mA; Low: 3.5 mA acc. to NAMUR NE 43
HART®	
Description	Digital signal transmitted with the current output signal (HART® protocol) ②
Version	7.4
Load	≥ 250 Ω
Digital temperature drift	Max. ±15 mm / 0.6¨ for the full temperature range
Multi-drop operation	Yes. Current output = 4 mA. Enter Program mode to change the polling address (1...63).
Available drivers	FC475, AMS, PDM, FDT/DTM

Approvals and certification

CE	The device meets the essential requirements of the EU Directives. The manufacturer certifies successful testing of the product by applying the CE marking.
	For more data about the EU Directives and European Standards related to this device, refer to the EU Declaration of Conformity. You can find this documentation on the DVD-ROM supplied with the device or it can be downloaded free of charge from the website.
Vibration resistance	EN 60068-2-6 and EN 60721-3-4 (1...9 Hz: 3 mm / 10...200 Hz:1g, 10g shock ½ sinus: 11 ms)
Explosion protection	
ATEX (EU Type Approval)	II 1/2 G Ex ia IIC T6...T* Ga/Gb; ③
	II 1/2 D Ex ia IIIC T85°C...T*°C Da/Db; ④
	II 1/2 G Ex db ia IIC T6...T* Ga/Gb; ③
	II 1/2 D Ex ia tb IIIC T85°C...T*°C Da/Db ④
ATEX (Type Approval)	II 3 G Ex nA IIC T6...T* Gc; ③
	II 3 G Ex ic IIC T6...T* Gc; ③
	II 3 D Ex ic IIIC T85°C...T*°C Dc ④
IECEx	Ex ia IIC T6...T* Ga/Gb; ③
	Ex ia IIIC T85°C...T*°C Da/Db; ④
	Ex db ia IIC T6...T* Ga/Gb; ③
	Ex ia tb IIIC T85°C...T*°C Da/Db; ④
	Ex ic IIC T6...T* Gc; ③
	Ex ic IIIC T85°C...T*°C Gc ④
cQPSus	**Division ratings**
	XP-IS, Class I, Div 1, GPS ABCD, T6...Tx – available in September 2017;
	DIP, Class II, III, Div 1, GPS EFG, T85°C...T*°C – available in September 2017; ④
	IS, Class I, Div 1, GPS ABCD, T6...Tx;
	IS, Class II, III, Div 1, GPS EFG, T85°C...T*°C; ④
	NI, Class I, Div 2, GPS ABCD, T6...Tx – available in September 2017;
	NI, Class II, III, Div 2, GPS EFG, T85°C...T*°C – available in September 2017 ④
	Zone ratings
	Class I, Zone 1, AEx db ia [ia Ga] IIC T6...T* Gb (US) – antenna suitable for Zone 0 – available in September 2017; Ex db ia [Ex ia Ga] IIC T6...T* Gb (Canada) – antenna suitable for Zone 0 – available in September 2017; ③
	Class I, Zone 0, AEx ia IIC T6...T* Ga (US); Ex ia IIC T6...T* Ga (Canada); ③
	Class I, Zone 2, AEx nA IIC T6...T* Gc (US); Ex nA IIC T6...T* Gc (Canada); ③
	Zone 20, AEx ia IIIC T85°C...T*°C Da (US); Ex ia IIIC T85°C...T*°C Da (Canada); ④
	Zone 21, AEx ia tb [ia Da] IIIC T85°C...T*°C Db (US) – antenna suitable for Zone 20 – available in September 2017 Ex ia tb [Ex ia Da] IIIC T85°C...T*°C Db (Canada) – antenna suitable for zone 20 – available in September 2017 ④

NEPSI (available in September 2017)	Ex ia IIC T*~T6 Ga/Gb; ③
	Ex d ia IIC T*~T6 Ga/Gb; ③
	Ex iaD 20/21 T85°C...T*°C IP6X; ④
	Ex iaD tD A20/A21 T85°C...T*°C IP6X ④
EAC-EX (available in November 2017)	Ga/Gb Ex ia IIC T6...T*; ③
	Ex ia IIIC T85°C...T*°C Da/Db; ④
	Ga/Gb Ex d ia IIC T6...T*; ③
	Ex ia tb IIIC T85°C...T*°C Da/Db; ④
Other standards and approvals	
Electromagnetic compatibility	**EU**: Electromagnetic Compatibility directive (EMC)
Radio approvals	**EU**: Radio Equipment directive (RED)
	FCC Rules: Part 15
	Industry Canada: RSS-211
Electrical safety	**EU**: Agrees with the safety part of the Low Voltage directive (LVD)
	USA and Canada: Agrees with NEC and CEC requirements for installation in ordinary locations
NAMUR	NAMUR NE 21 Electromagnetic Compatibility (EMC) of Industrial Process and Laboratory Control Equipment
	NAMUR NE 43 Standardization of the Signal Level for the Failure Information of Digital Transmitters
	NAMUR NE 53 Software and Hardware of Field Devices and Signal Processing Devices with Digital Electronics
	NAMUR NE 107 Self-Monitoring and Diagnosis of Field Devices
CRN	Option available in September 2017. This certification is applicable for all Canadian provinces and territories. For more data, refer to the website.
Construction code	Option: ASME B31.3

① Kalrez® is a registered trademark of DuPont Performance Elastomers L.L.C.

② HART® is a registered trademark of the HART Communication Foundation

③ T* = T5 or T4. For more data, refer to the related Ex approval certificate.

④ T*°C = 100°C or 130°C. For more data, refer to the related Ex approval certificate.

2.2 Measuring accuracy

Use these graphs to find the measuring accuracy for a given distance from the transmitter.

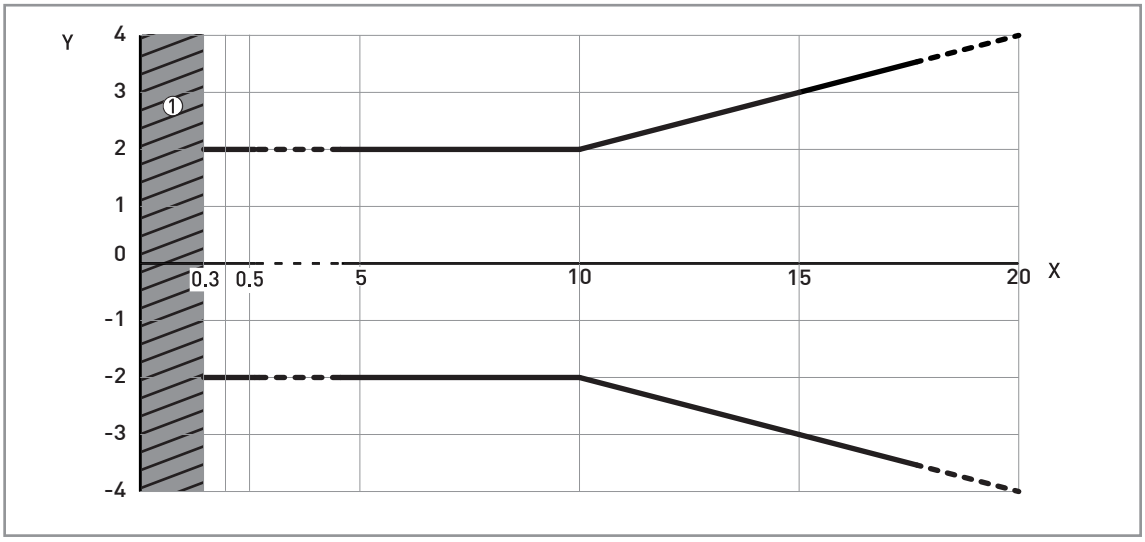


Figure 2-1: Measuring accuracy (graph of measuring accuracy in mm against measuring distance in m)

X: Measuring distance from the thread stop or flange facing of the process connection [m]
Y: Measuring accuracy [+yy mm / -yy mm]
① Minimum recommended blocking distance = antenna extension length + antenna length + 300 mm

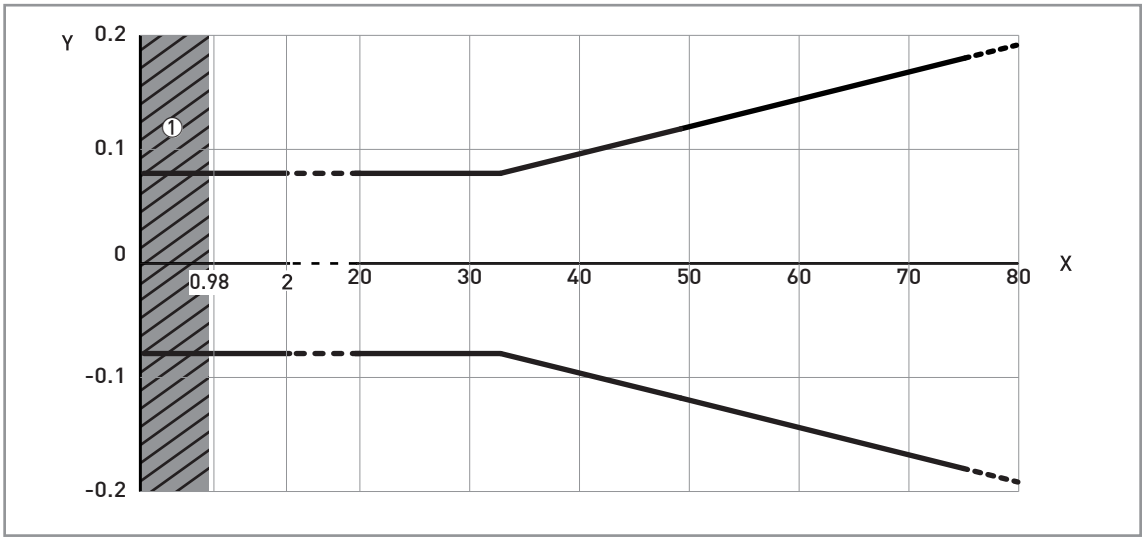


Figure 2-2: Measuring accuracy (graph of measuring accuracy in inches against measuring distance in ft)

X: Measuring distance from the thread stop or flange facing of the process connection [ft]
Y: Measuring accuracy [+yy inches / -yy inches]
① Minimum recommended blocking distance = antenna extension length + antenna length + 11.81¨

To calculate the accuracy at a given distance from the antenna, refer to Technical data on page 10 (measuring accuracy).

2.3 Minimum power supply voltage

Use these graphs to find the minimum power supply voltage for a given current output load.

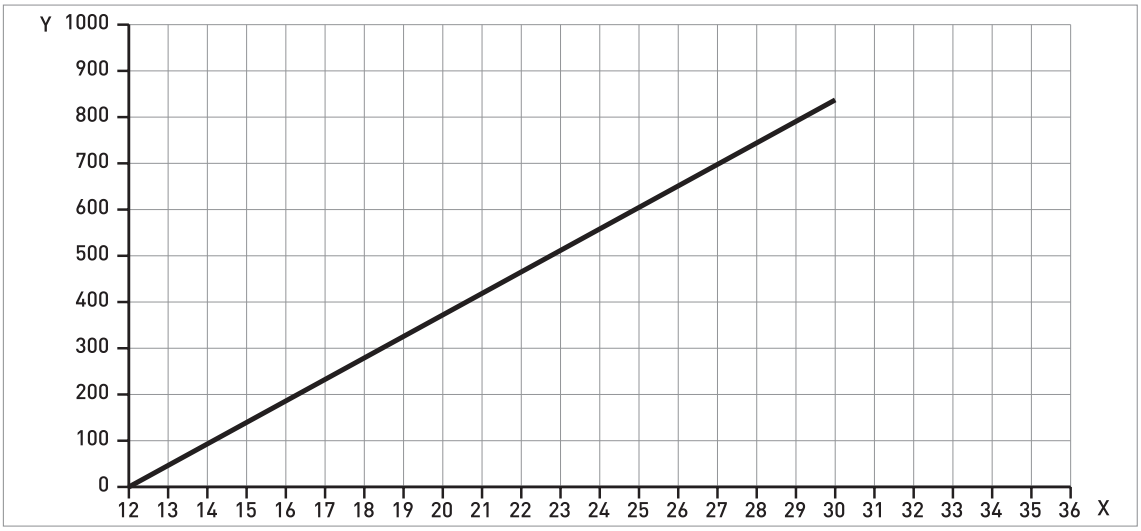


Figure 2-3: Minimum power supply voltage for an output of 21.5 mA at the terminal (Non-Ex and Hazardous Location approval (Ex i / IS))

X: Power supply U [VDC]
Y: Current output load R_L [Ω]

Hazardous Location (Ex d / XP/NI) approved devices

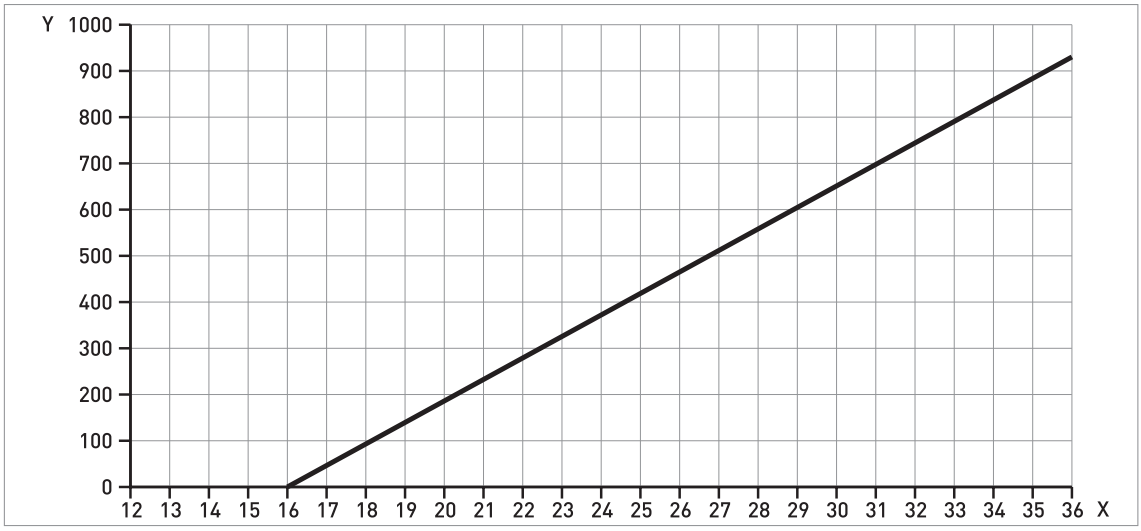


Figure 2-4: Minimum power supply voltage for an output of 21.5 mA at the terminal (Hazardous Location approval (Ex d / XP/NI))

X: Power supply U [VDC]
Y: Current output load R_L [Ω]

2.4 Guidelines for maximum operating pressure

Make sure that the devices are used within their operating limits.

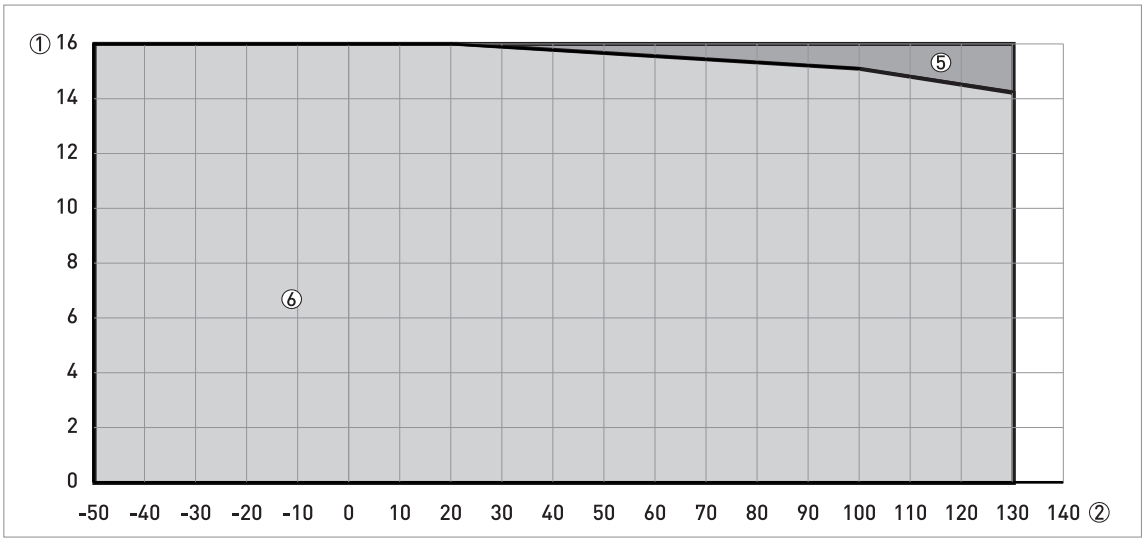


Figure 2-5: Pressure / temperature de-rating (EN 1092-1), flange and threaded connection, in °C and barg

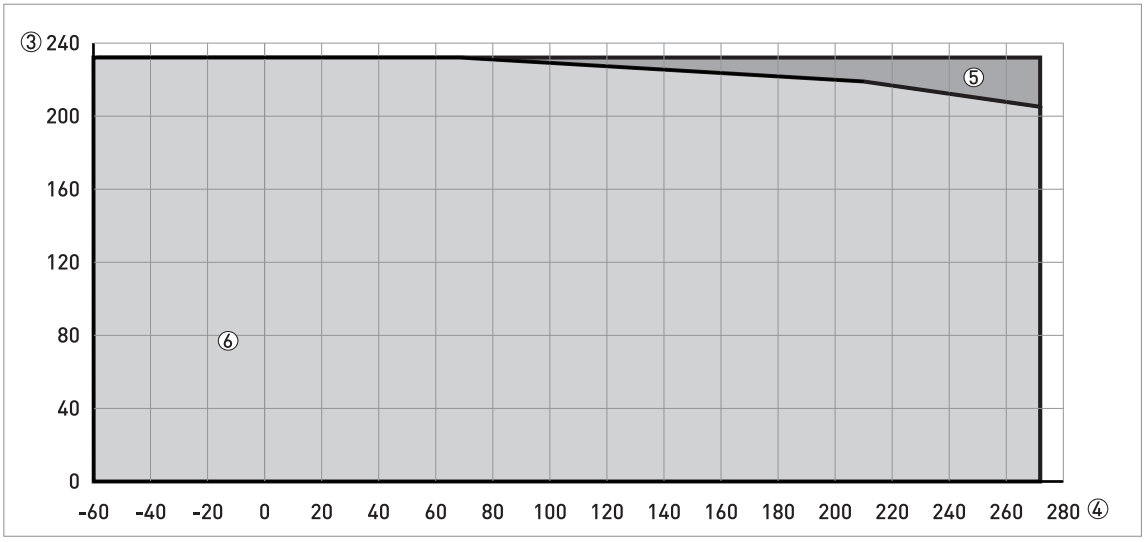


Figure 2-6: Pressure / temperature de-rating (EN 1092-1), flange and threaded connections, in °F and psig

① Process pressure, p [barg]
② Process connection temperature, T [°C]
③ Process pressure, p [psig]
④ Process connection temperature, T [°F]
⑤ Threaded connection, G (ISO 228-1)
⑥ Threaded connection, G (ISO 228-1). Flange connection, PN40.
⑦ Flange connection, PN16

CRN certification (available in September 2017)

There is a CRN certification option for devices with process connections that agree with ASME standards. This certification is necessary for all devices that are installed on a pressure vessel and used in Canada.

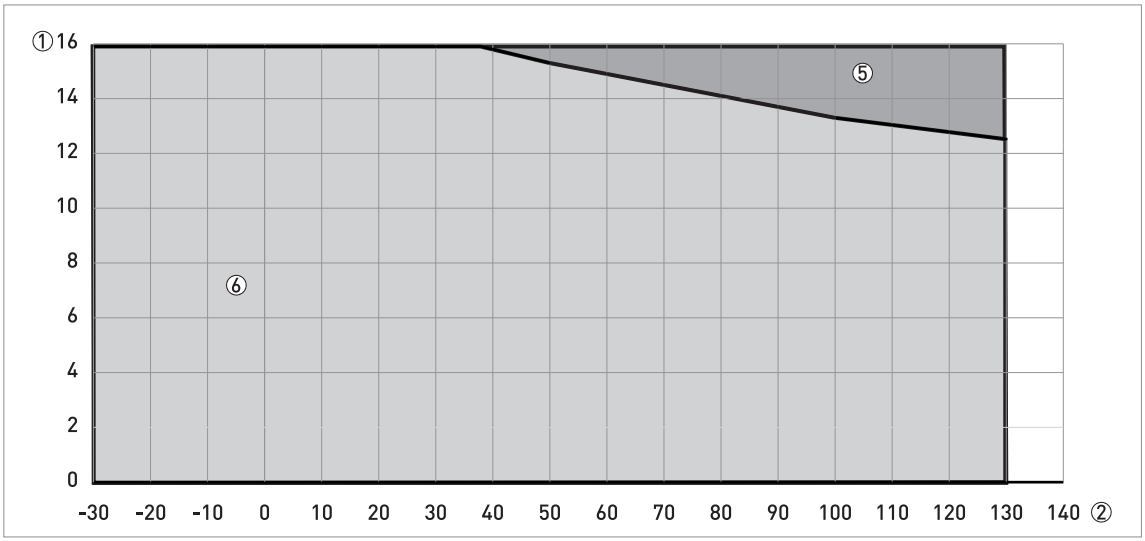


Figure 2-7: Pressure / temperature de-rating (ASME B16.5), flange and threaded connections, in °C and barg

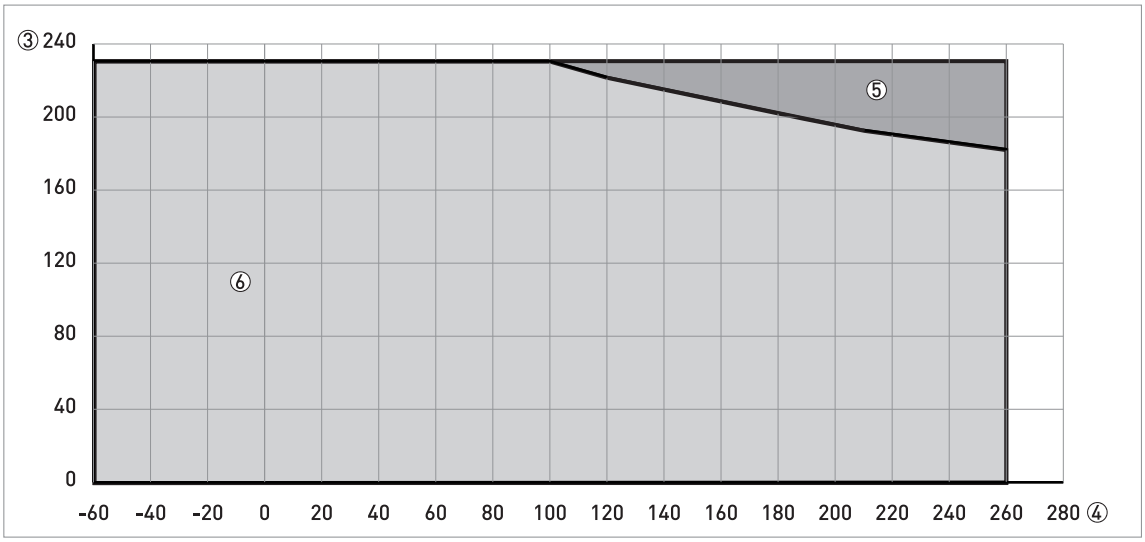


Figure 2-8: Pressure / temperature de-rating (ASME B16.5), flange and threaded connections, in °F and psig

① Process pressure, p [barg]
② Process connection temperature, T [°C]
③ Process pressure, p [psig]
④ Process connection temperature, T [°F]
⑤ Threaded connection, NPT (ASME B1.20.1). Flange connection, Class 300.
⑥ Flange connection, Class 150

2.5 Dimensions and weights

Metallic Horn antennas with threaded connections

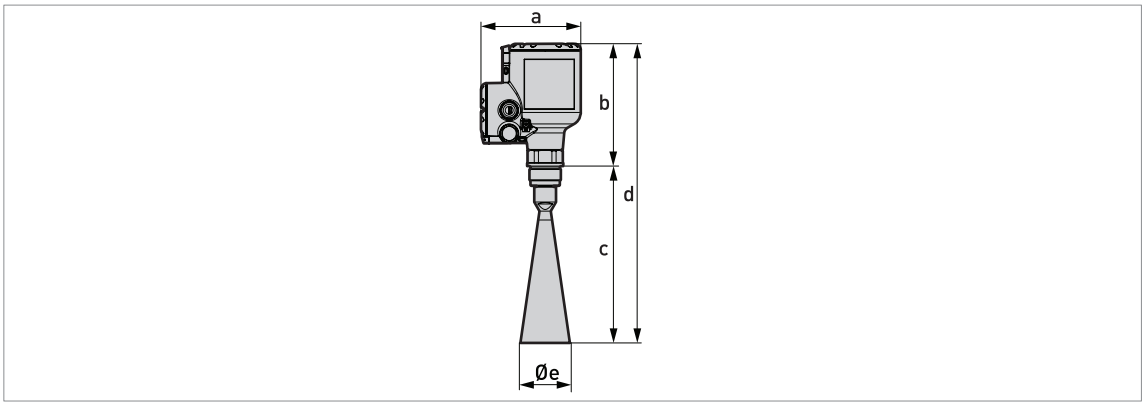


Figure 2-9: Metallic Horn antennas with G or NPT threaded connections

- *Cable glands are delivered on demand with non-Ex, Ex i- and Ex d-approved devices.*
- *The diameter of the outer sheath of the cable must be 7...12 mm or 0.28...0.47".*
- *Cable glands for cQPSus-approved devices must be supplied by the customer.*
- *A weather protection cover is available as an accessory with all devices.*

Metallic Horn antennas with threaded connections: Dimensions in mm

Horn antenna version	Dimensions [mm]				
	a	b	c	d	Øe
DN80/3"	151	185	267 ①	452 ①	75
DN100/4"	151	185	336 ①	521 ①	95
DN150/6"	151	185	491 ①	675 ①	140
DN200/8"	151	185	662 ①	847 ①	190

① This is the dimension without the antenna extension option. A maximum of 10 antenna extensions are available. Each antenna extension is 105 mm long.

Metallic Horn antennas with threaded connections: Dimensions in inches

Horn antenna version	Dimensions [inches]				
	a	b	c	d	Øe
DN80/3"	5.94	7.28	10.51 ①	17.80 ①	2.95
DN100/4"	5.94	7.28	13.23 ①	20.51 ①	3.74
DN150/6"	5.94	7.28	13.33 ①	26.57 ①	5.51
DN200/8"	5.94	7.28	26.06 ①	33.35 ①	7.48

① This is the dimension without the antenna extension option. A maximum of 10 antenna extensions are available. Each antenna extension is 4.1" long.

Metallic Horn antenna versions with flange connections

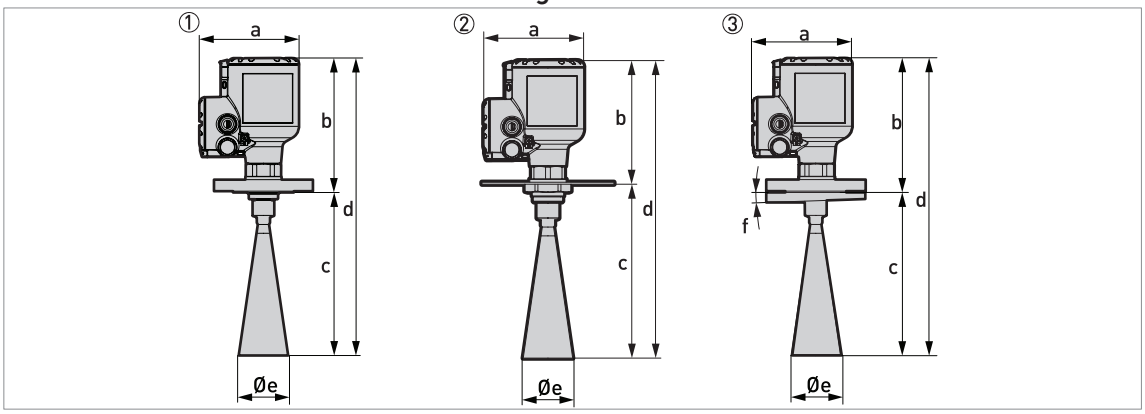


Figure 2-10: Metallic Horn antennas with flange connections

① Metallic Horn antenna with a flange connection
② Metallic Horn antenna with a low-pressure flange attached to a threaded connection
③ Metallic Horn antenna with a flange connection and the 2° slanted flange option

- *Cable glands are delivered on demand with non-Ex, Ex i- and Ex d-approved devices.*
- *The diameter of the outer sheath of the cable must be 7...12 mm or 0.28...0.47".*
- *Cable glands for cQPSus-approved devices must be supplied by the customer.*
- *A weather protection cover is available as an accessory with all devices.*

Metallic Horn antennas with flange connections: Dimensions in mm

Horn antenna version	Dimensions [mm]						[°]
	a	b	c	d	Øe	f	g
DN80/3"	151	215 ①	262 ②	452 ②	75	10 ③	2° ③
DN100/4"	151	215 ①	331 ②	521 ②	95	10 ③	2° ③
DN150/6"	151	215 ①	486 ②	675 ②	140	10 ③	2° ③
DN200/8"	151	215 ①	657 ②	847 ②	190	10 ③	2° ③

① Maximum dimension
② This is the maximum dimension without the antenna extension option. A maximum of 10 antenna extensions are available. Each antenna extension is 105 mm long.
③ If the device has the 2° slanted flange option.

Metallic Horn antennas with flange connections: Dimensions in inches

Horn antenna version	Dimensions [inches]						[°]
	a	b	c	d	Øe	f	g
DN80/3"	5.94	8.46 ①	10.31 ②	17.80 ②	2.95	0.39 ③	2° ③
DN100/4"	5.94	8.46 ①	13.03 ②	20.51 ②	3.74	0.39 ③	2° ③
DN150/6"	5.94	8.46 ①	19.13 ②	26.57 ②	5.51	0.39 ③	2° ③
DN200/8"	5.94	8.46 ①	25.87 ②	33.35 ②	7.48	0.39 ③	2° ③

① Maximum dimension
② This is the maximum dimension without the antenna extension option. A maximum of 10 antenna extensions are available. Each antenna extension is 4.1" long.
③ If the device has the 2° slanted flange option.

Drop antennas with threaded connections

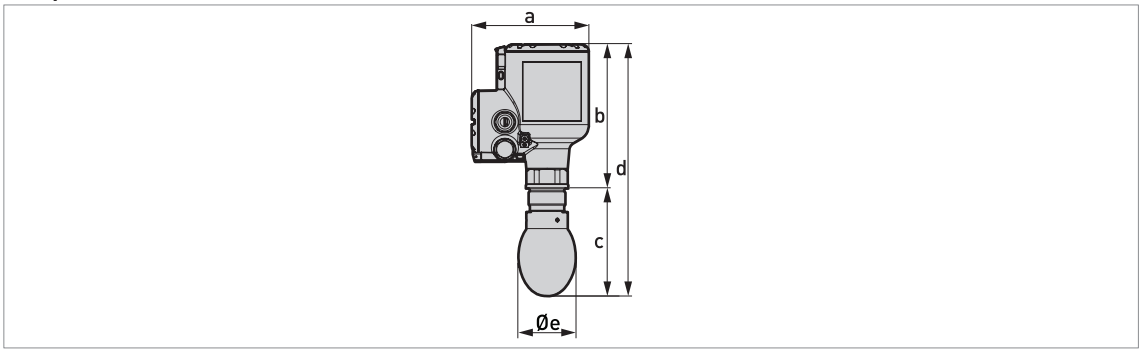


Figure 2-11: Drop antennas with threaded connections

- *Cable glands are delivered on demand with non-Ex, Ex i- and Ex d-approved devices.*
- *The diameter of the outer sheath of the cable must be 7...12 mm or 0.28...0.47".*
- *Cable glands for cQPSus-approved devices must be supplied by the customer.*
- *A weather protection cover is available as an accessory with all devices.*

Drop antennas with threaded connections: Dimensions in mm

Drop antenna version	Dimensions [mm]				
	a	b	c	d	Øe
DN80/3"	151	185	139 ①	323 ①	74
DN100/4"	151	185	162 ①	347 ①	94
DN150/6"	151	185	220 ①	405 ①	144

① This is the dimension without the antenna extension option. A maximum of 5 antenna extensions are available. Each antenna extension is 105 mm long.

Drop antennas with threaded connections: Dimensions in inches

Drop antenna version	Dimensions [inches]				
	a	b	c	d	Øe
DN80/3"	5.94	7.28	5.47 ①	12.72 ①	2.91
DN100/4"	5.94	7.28	6.38 ①	13.66 ①	3.70
DN150/6"	5.94	7.28	8.66 ①	15.94 ①	5.67

① This is the dimension without the antenna extension option. A maximum of 5 antenna extensions are available. Each antenna extension is 4.1" long.

Drop antennas with flanged connections

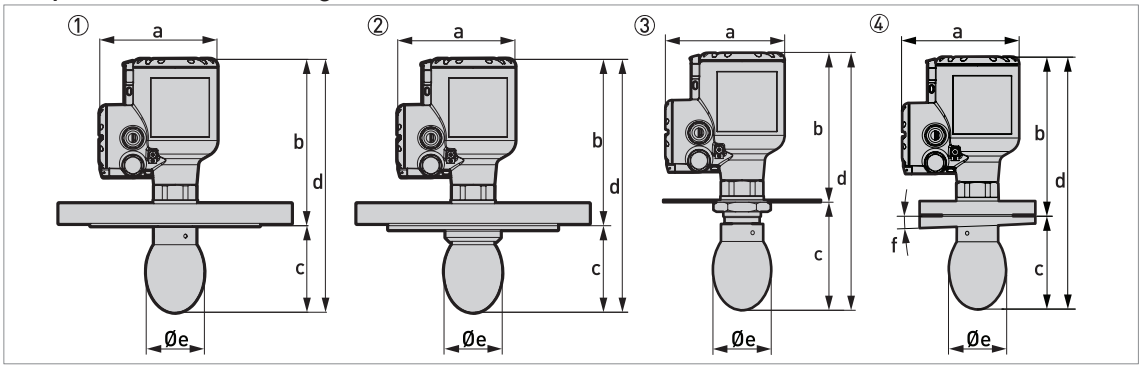


Figure 2-12: Drop antennas with flanged connections

① Drop antenna with a flange connection
② Drop antenna with a flange connection and a flange plate protection option
③ Drop antenna with a low-pressure flange connection
④ Drop antenna with a flange connection and a 2° slanted flange option

- *Cable glands are delivered on demand with non-Ex, Ex i- and Ex d-approved devices.*
- *The diameter of the outer sheath of the cable must be 7…12 mm or 0.28…0.47¨.*
- *Cable glands for cQPSus-approved devices must be supplied by the customer.*
- *A weather protection cover is available as an accessory with all devices.*

Drop antennas with flange connections: Dimensions in mm

Drop antenna version	Dimensions [mm]						[°]
	a	b	c	d	Øe	f	g
DN80/3¨	151	215 ①	134 ②	323 ②	74	③	④
DN100/4¨	151	215 ①	157 ②	347 ②	94	③	④
DN150/6¨	151	215 ①	215 ②	405 ②	144	③	④

① Maximum dimension
② This is the maximum dimension without the antenna extension option. A maximum of 5 antenna extensions are available. Each antenna extension is 105 mm long.
③ If the device has the PP flange protection option, then f = 20 mm. If the device has the 2° slanted flange option, then f = 10 mm.
④ If the device has the 2° slanted flange option, then g = 2°

Drop antennas with flange connections: Dimensions in inches

Drop antenna version	Dimensions [inches]						[°]
	a	b	c	d	Øe	f	g
DN80/3¨	5.94	8.46 ①	5.28 ②	12.72 ②	2.91	③	④
DN100/4¨	5.94	8.46 ①	6.18 ②	13.66 ②	3.70	③	④
DN150/6¨	5.94	8.46 ①	8.46 ⑤	15.94 ②	5.67	③	④

① Maximum dimension
② This is the maximum dimension without the antenna extension option. A maximum of 5 antenna extensions are available. Each antenna extension is 4.1¨ long.
③ If the device has the PP flange protection option, then f = 0.79¨. If the device has the 2° slanted flange option, then f = 0.39¨.
④ If the device has the 2° slanted flange option, then g = 2°
⑤ Maximum dimension without antenna extensions. A maximum of 5 antenna extensions are available. Each antenna extension is 4.1¨ long.

Purging option

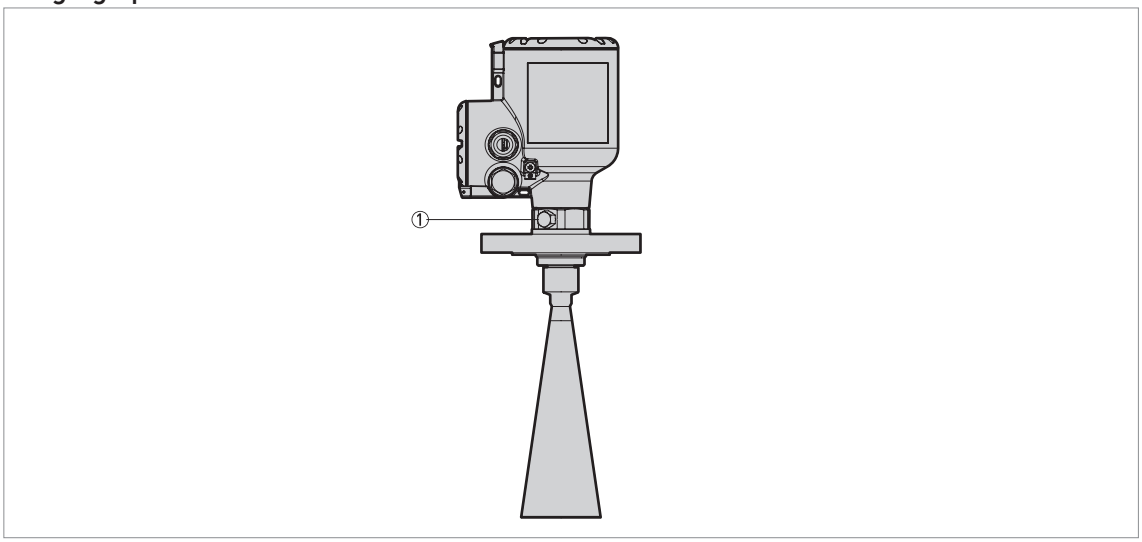


Figure 2-13: Purging options

① G ¼ threaded connection for purging system (the plug is supplied by the manufacturer)

Purging system

This option is available for all Metallic antennas. Flange connections must have a pressure rating of PN01, PN16 or PN40 (EN 1092-1), or Class 150 or 300 (ASME B16.5).

Weather protection option

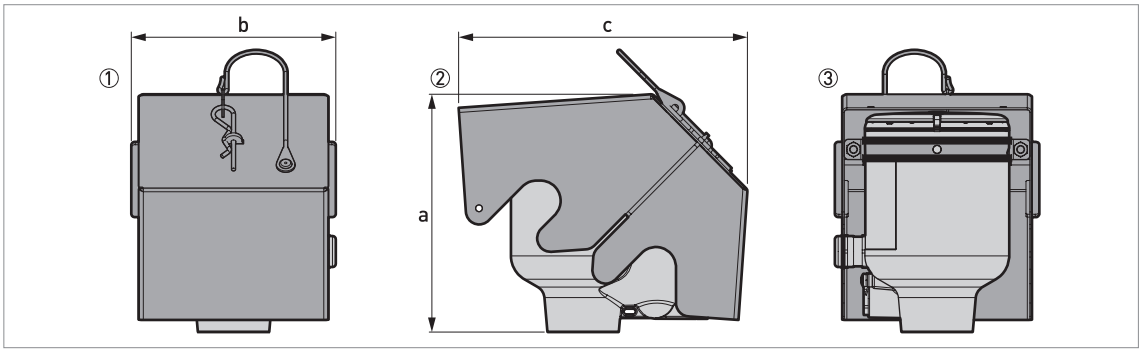


Figure 2-14: Weather protection option

① Front view (with weather protection closed)
② Left side (with weather protection closed)
③ Rear view (with weather protection closed)

Weather protection: Dimensions and weights

	Dimensions						Weights [kg]	
	a		b		c			
	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[kg]	[lb]
Weather protection	177	6.97	153	6.02	216	8.50	1.3	2.9

Converter weight

Type of housing	Weights	
	[kg]	[lb]
Compact aluminium housing	2.1	4.6
Compact stainless steel housing	4.5	9.9

Antenna option weights

Antenna options	Min./Max. weights	
	[kg]	[lb]
Standard options, without converter		
DN80 / 3¨ Metallic Horn antenna with process connection, standard length ①	2.5...58.9	5.5...129.6
DN100 / 4¨ Metallic Horn antenna with process connection, standard length ①	2.6...59	5.7...129.8
DN150 / 6¨ Metallic Horn antenna with process connection, standard length ①	3...59.4	6.6...130.7
DN200 / 8¨ Metallic Horn antenna with process connection, standard length ①	3.7...60	8.1...132
DN80 PP Drop antenna with process connection, standard length ①	2.7...59.1	5.9...130
DN100 PP Drop antenna with process connection, standard length ①	3.1...59.5	6.8...131.2
DN150 PP Drop antenna with process connection, standard length ①	4.5...60.9	9.9..134
DN80 PTFE Drop antenna with process connection, standard length ①	3.1...59.2	6.8...130.9
DN100 PTFE Drop antenna with process connection, standard length ①	3.8...60.2	8.4...132.7
DN150 PTFE Drop antenna with process connection, standard length ①	7.2...63.6	15.8..139.9
Antenna extension options		
Straight extension, length 105 mm ②	+0.92	+2.03
Straight extension, length 210 mm ②	+1.84	+4.06
Straight extension, length 315 mm ②	+2.76	+6.08
Straight extension, length 420 mm ②	+3.68	+8.11
Straight extension, length 525 mm ②	+4.60	+10.14
Straight extension, length 630 mm ③	+5.52	+12.17
Straight extension, length 735 mm ③	+6.44	+14.20
Straight extension, length 840 mm ③	+7.36	+16.23
Straight extension, length 945 mm ③	+8.28	+18.25
Straight extension, length 1050 mm ③	+9.20	+20.28
Other options		
Flange plate option, DN80 PP Drop antenna	+0.1	+0.22
Flange plate option, DN100 PP Drop antenna	+0.2	+0.44
Flange plate option, DN150 PP Drop antenna	+0.3	+0.66
Flange plate option, DN80 PTFE Drop antenna	+0.3	+0.66
Flange plate option, DN100 PTFE Dropantenna	+0.5	+1.10
Flange plate option, DN150 PTFE Drop antenna	+0.7	+1.54

① Standard length = without antenna extensions
② This option is for Metallic Horn and Drop antenna options
③ This option is for Metallic Horn antenna options

3.1 Intended use

Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

This radar level transmitter measures distance, level, mass, volume and reflectivity of granulates and powders.

It can be installed on silos, hoppers and bunkers.

3.2 Pre-installation requirements

Obey the precautions that follow to make sure that the device is correctly installed.

- Make sure that there is sufficient space on all sides.
- Protect the signal converter from direct sunlight. If necessary, install the weather protection accessory.
- Do not subject the signal converter to heavy vibrations. The devices are tested for vibration and agree with EN 50178 and IEC 60068-2-6.

3.3 Installation

3.3.1 Pressure and temperature ranges

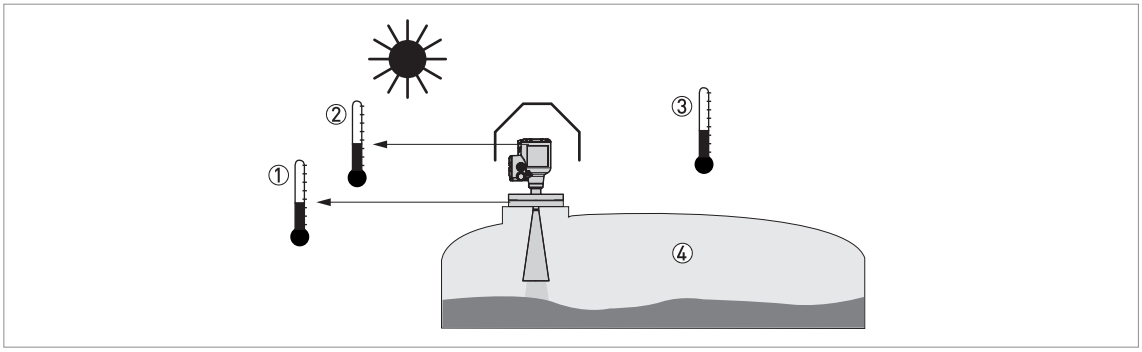


Figure 3-1: Pressure and temperature ranges

① Temperature at the process connection
Non-Ex devices: The temperature range depends on the type of antenna, process connection and the seal material. Refer to the table that follows.
Devices with Hazardous Location approvals: see supplementary instructions

② Ambient temperature for operation of the display
-20...+70°C / -4...+158°F
If the ambient temperature is not between these limits, then it is possible that the display screen will not operate temporarily. The device continues to measure level and send an output signal.

③ Ambient temperature
Non-Ex devices: -40...+80°C / -40...+176°F
Devices with Hazardous Location approvals: see supplementary instructions

④ Process pressure
Depends on the type of antenna and process connection. Refer to the table that follows.

The process connection temperature range must agree with the temperature limits of the gasket material. The operating pressure range is subject to the process connection used and the flange temperature.

Maximum process connection temperature and operating pressure

Antenna type	Maximum process connection temperature		Maximum operating pressure	
	[°C]	[°F]	[barg]	[psig]
PP Drop	+100	+212	16	232
PTFE Drop	+130	+266	16	232
Metallic Horn	+130 ①	+266 ②	16	232

① The maximum process connection temperature must agree with the temperature limits of the gasket material
② The maximum process connection temperature must agree with the temperature limits of the gasket material.

For more data on pressure ratings, refer to *Guidelines for maximum operating pressure* on page 18.

3.3.2 Recommended mounting position

Follow these recommendations to make sure that the device measures correctly. They have an effect on the performance of the device.

We recommend that you prepare the installation when the tank is empty.

Recommended nozzle position for solids

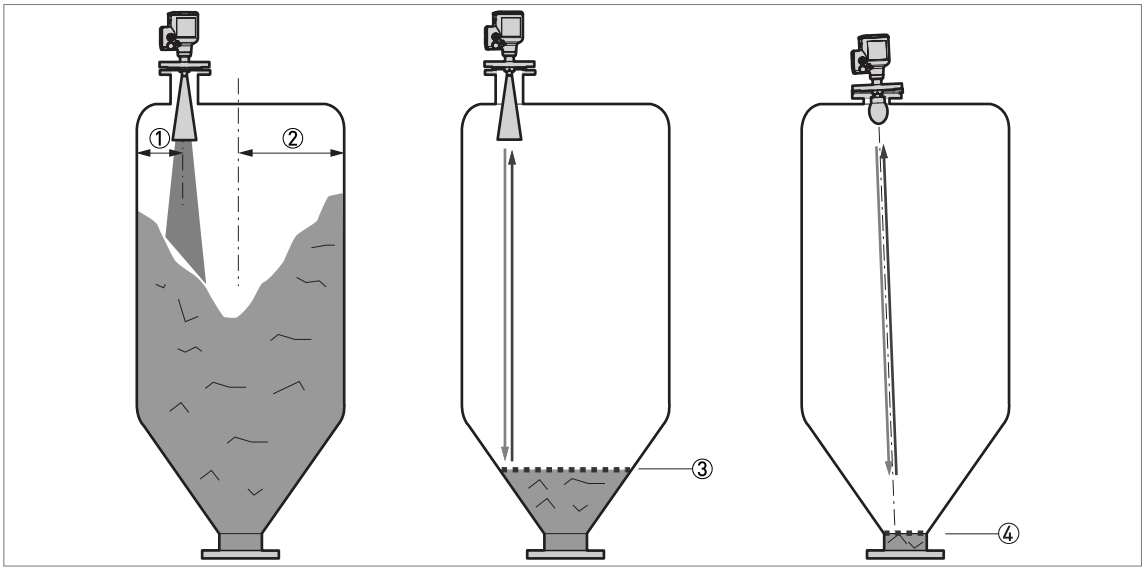


Figure 3-2: Recommended nozzle position for solids

① Position of the process fitting from the silo wall, r/2 (for DN80, DN100, DN150 or DN200 horn antennas, and DN80, DN100 or DN150 Drop antennas)
② Radius of the silo, r
③ The minimum measured level for a device without a 2° slanted PP flange option
④ The minimum measured level for a device with a 2° slanted PP flange option

If there is a nozzle on the tank before installation, the nozzle must be a minimum of 200 mm / 7.9" from the tank wall. The tank wall must be flat and there must not be obstacles adjacent to the nozzle or on the tank wall.

Number of devices that can be operated in a silo

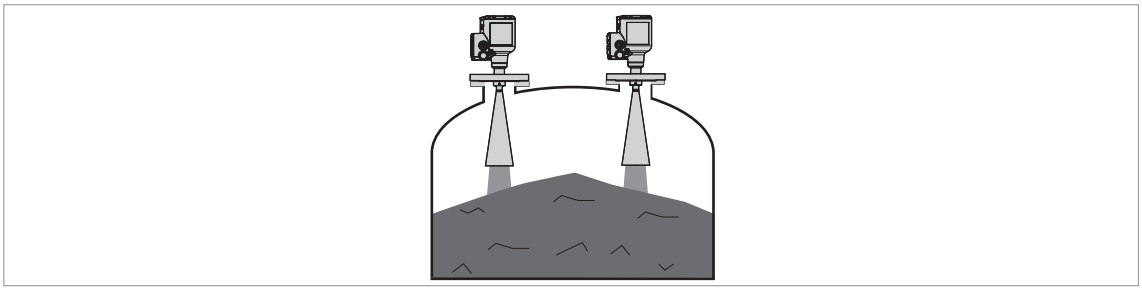


Figure 3-3: There is no maximum limit to the number of devices that can be operated in the same silo

There is no maximum limit to the number of devices that can be operated in the same silo. They can be installed adjacent to other radar level transmitters.

3.3.3 Mounting restrictions

LPR and TLPR devices

LPR (Level Probing Radar) *devices measure level in the open air or in a closed space (a metallic tank etc.).* ***TLPR (Tank Level Probing Radar)*** *devices measure level in a closed space only. You can use LPR devices for TLPR applications. For more data, refer to Order code on page 36*, antenna options.

Causes of interference signals

- Objects in the tank or silo.
- Sharp corners that are perpendicular to the path of the radar beam.
- Sudden changes in tank diameter in the path of the radar beam.

Do not install the device above objects in the silo (ladder, supports etc.) or pit. Objects in the silo or pit can cause interference signals. If there are interference signals, the device will not measure correctly.
If it is not possible to install the device on another part of the silo or pit, do an empty spectrum scan. For more data, refer to the handbook.

Equipment and obstacles: how to prevent measurement of interference signals

Do not put the device immediately above equipment and obstacles in a silo or pit. This can have an effect on the performance of the device.

If possible, do not install a nozzle on the silo centerline.

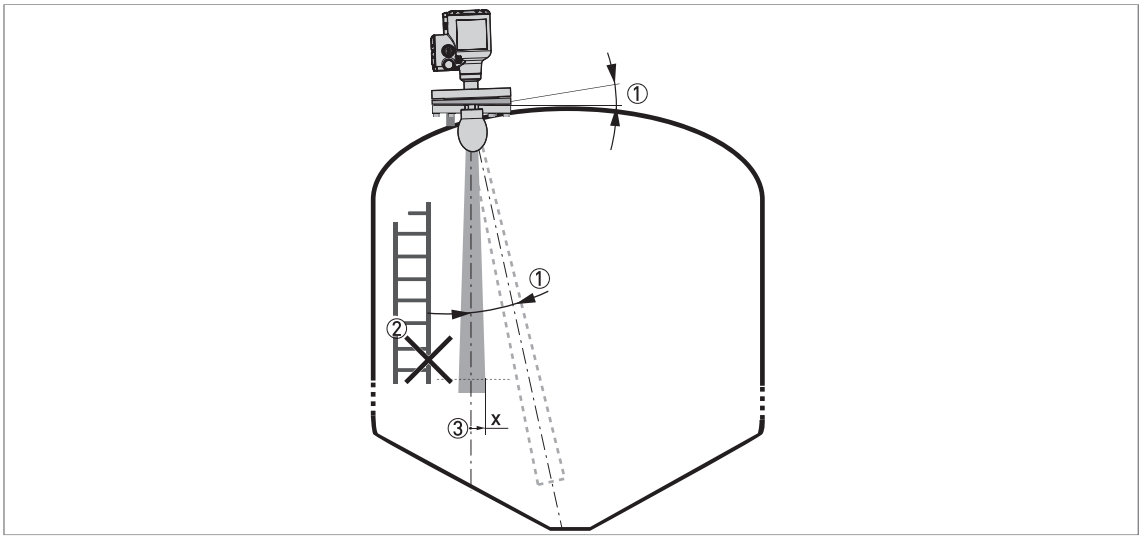


Figure 3-4: Equipment and obstacles: how to prevent measurement of interference signals

① Do not tilt the device more than 2°
② We recommend that you do an empty spectrum recording if there are too many obstacles in the radar beam (refer to the handbook).
③ Beam radius of the antenna: refer to the table below. The beam radius increases by increments of "x" mm for each metre of distance from the antenna.

Beam radius of the antenna

Antenna type	Beam angle	Beam radius, x	
		[mm/m]	[in/ft]
Metallic Horn, DN80 (3¨)	9°	79	0.9
Metallic Horn, DN100 (4¨)	8°	70	0.8
Metallic Horn, DN150 (6¨)	6°	53	0.6
Metallic Horn, DN200 (8¨)	5°	44	0.5
PTFE Drop, DN80 (3¨)	8°	70	0.8
PTFE Drop, DN100 (4¨)	7°	61	0.7
PTFE Drop, DN150 (6¨)	4°	35	0.4
PP Drop DN80 (3¨)	9°	79	0.9
PP Drop, DN100 (4¨)	7°	61	0.7
PP Drop, DN150 (6¨)	5°	44	0.5

Product inlets

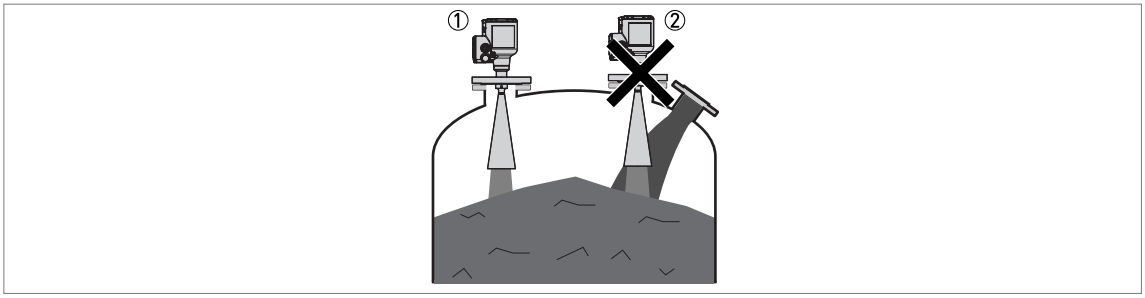


Figure 3-5: Product inlets

① The device is in the correct position.
② The device is too near to the product inlet.

Do not put the device near to the product inlet. If the product that enters the silo touches the antenna, the device will measure incorrectly. If the product fills the silo directly below the antenna, the device will also measure incorrectly.

For more data about the measuring range of each type of antenna, refer to Measuring accuracy on page 16.

3.3.4 Process connections

All the procedures that follow are applicable to Metallic Horn and Drop antennas.

Flange connections

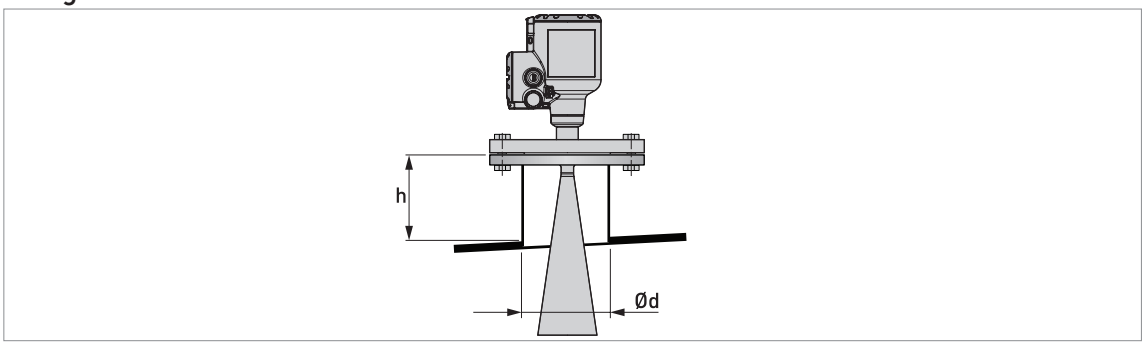


Figure 3-6: Flange connections

Ød = nozzle diameter
h = nozzle height

Recommended nozzle size for flange connections

The nozzle must be as short as possible. Refer to the table below for the maximum height of the nozzle:

Nozzle and antenna diameter, Ød		Maximum nozzle height, h			
		Metallic Horn antenna		Drop antenna	
[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
80	3	260 ①	10.24 ①	60	2.36
100	4	330 ①	12.99 ①	70	2.76
150	6	490 ①	19.29 ①	100	3.94
200	8	660 ①	25.98 ①	—	—

① If the device has antenna extensions, this option extends the maximum nozzle height. Add the length of the antenna extensions attached to the device to this value.

Threaded connections

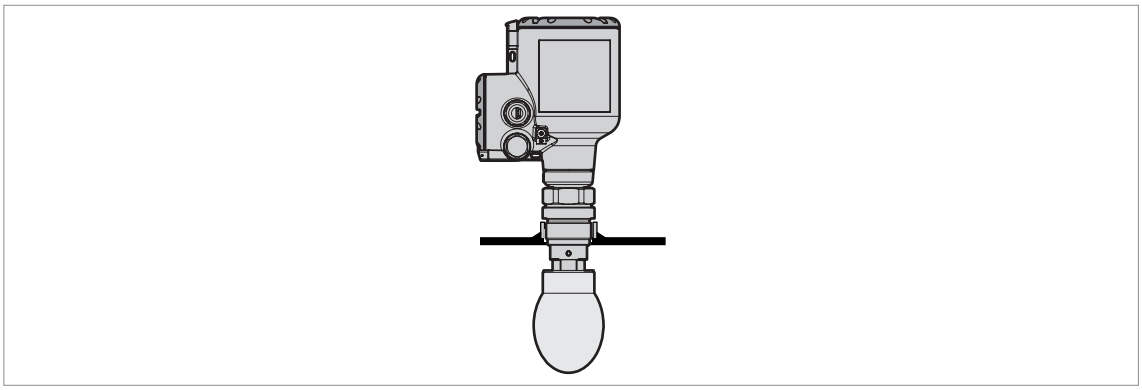


Figure 3-7: Threaded connections

Recommended socket size for threaded connections

The socket must be as short as possible. If the socket is in a recess, then use the maximum limits for nozzle dimensions (flange connections) in this section.

If the device has antenna extensions, this option extends the maximum socket height. Add the length of the antenna extensions attached to the device to this value.

4.1 Electrical installation: 2-wire, loop-powered

Terminals for electrical installation

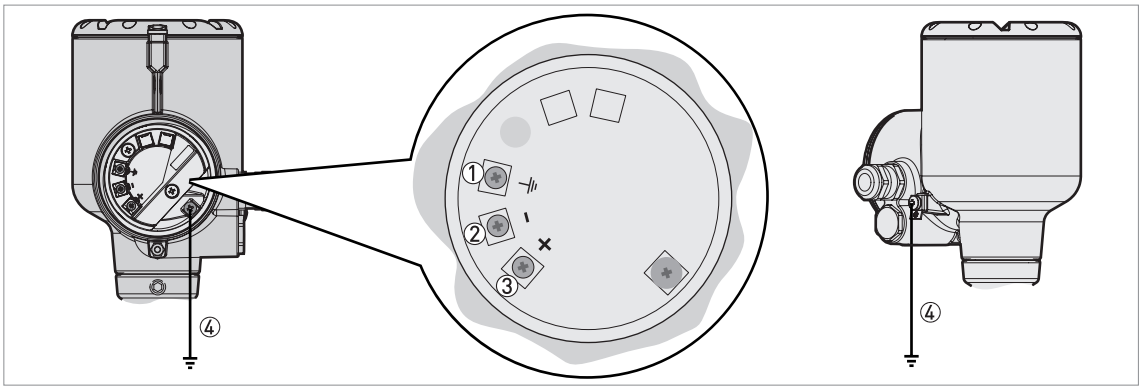


Figure 4-1: Terminals for electrical installation

① Grounding terminal in the housing (if the electrical cable is shielded)
② Current output -
③ Current output +
④ Location of the external grounding terminal (at the bottom of the converter)

Electrical power to the output terminal energizes the device. The output terminal is also used for HART® communication.

4.2 Non-Ex devices

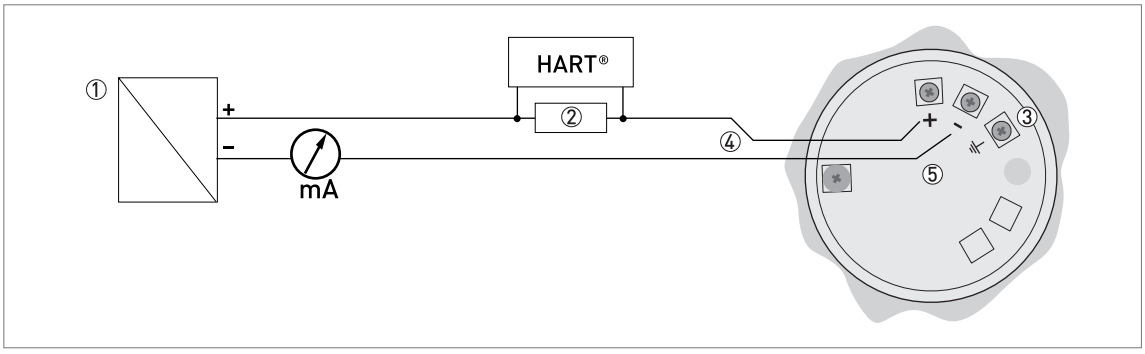


Figure 4-2: Electrical connections for non-Ex devices

① Power supply
② Resistor for HART® communication (typically 250 ohms)
③ Optional connection to the grounding terminal
④ Output: 12...30 VDC for an output of 21.5 mA at the terminal
⑤ Device

4.3 Devices for hazardous locations

For electrical data for device operation in hazardous locations, refer to the related certificates of compliance and supplementary instructions (ATEX, IECEx etc.). You can find this documentation on the DVD-ROM delivered with the device or it can be downloaded free of charge from the website (Download Center).

4.4 Networks

4.4.1 General information

The device uses the HART® communication protocol. This protocol agrees with the HART® Communication Foundation standard. The device can be connected point-to-point. It can also have a polling address of 1 to 63 in a multi-drop network.

The device output is factory-set to communicate point-to-point. To change the communication mode from **point-to-point** to **multi-drop**, refer to "Network configuration" in the handbook.

4.4.2 Point-to-point connection

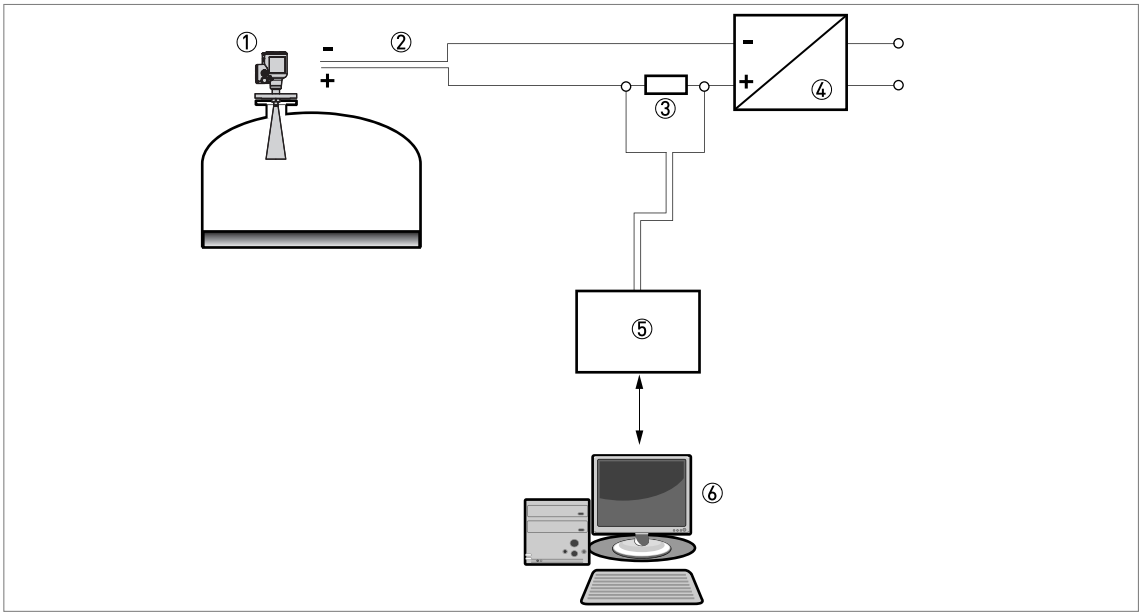


Figure 4-3: Point-to-point connection (non-Ex)

① Address of the device (0 for point-to-point connection)
② 4...20 mA + HART®
③ Resistor for HART® communication (typically 250 ohms)
④ Power supply
⑤ HART® converter
⑥ HART® communication software

4.4.3 Multi-drop networks

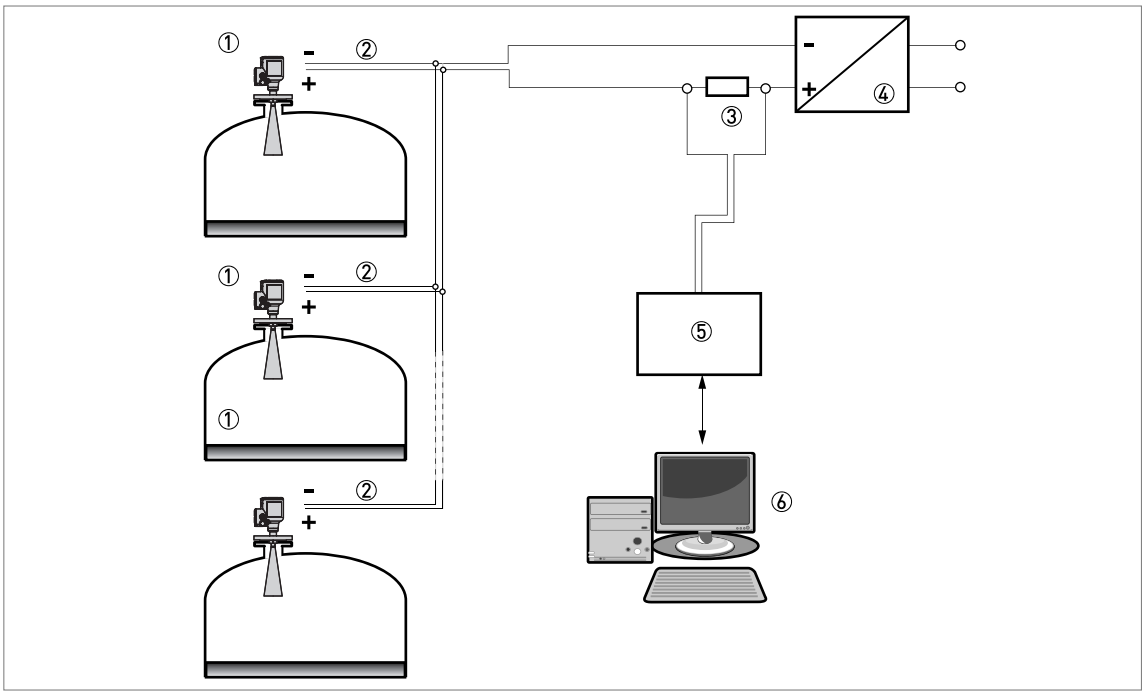


Figure 4-4: Multi-drop network (non-Ex)

① Address of the device (each device must have a different address in multidrop networks)
② 4 mA + HART®
③ Resistor for HART® communication (typically 250 ohms)
④ Power supply
⑤ HART® converter
⑥ HART® communication software

5.1 Order code

Make a selection from each column to get the full order code.

VFDC	4	0	**OPTIWAVE 6400 C 24 GHz Radar (FMCW) level transmitter for solids from granulates to rocks (up to 16 barg (232 psig) and 130°C (266°F))**					
			Regional directives					
			1	Europe				
			2	China				
			3	USA				
			4	Canada				
			5	Brazil				
			6	Australia				
			A	Russia				
			B	Kazakhstan				
			C	Belarus				
			W	Worldwide				
				Ex approvals				
				0	Without			
				1	ATEX II 1/2 G Ex ia IIC T6…T4 Ga/Gb + II 1/2 D Ex ia IIIC T85°C…T100°C or T85°C…T130°C Da/Db			
				2	ATEX II 1/2 GD Ex db ia IIC T6…T4 Ga/Gb + II 1/2 D Ex ia tb IIIC T85°C…T100°C or T85°C…T130°C Da/Db			
				3	ATEX II 3 G Ex ic IIC T6…T4 Gc + II 3 D Ex ic IIIC T85°C…T100°C or T85°C…T130°C Dc			
				4	ATEX II 3 G Ex nA T6…T4 Gc			
				5	NEPSI Ex ia IIC T6…T4 Ga/Gb + Ex iaD 20/21 T85°C…T100°C or T85°C…T130°C IP6X ①			
				6	NEPSI Ex d ia IIC T6…T4 Ga/Gb + Ex iaD tD A20/A21 T85°C…T100°C or T85°C…T130°C IP6X ①			
				A	cQPSus IS CL I/II/III DIV 1 GP A-G + CL I Z0 AEx ia/Ex ia IIC T6…T4 Ga + Z20 AEx ia/Ex ia IIIC T85°C…T100°C or T85°C…T130°C Da			
				B	cQPSus XP-IS/DIP CL I DIV 1 GP A-G + CL I Z1 AEx db ia/Ex db ia IIC T6…T4 Gb + Z21 AEx ia tb/Ex ia tb IIIC T85°C…T100°C or T85°C…T130°C Db ②			
				C	cQPSus NI CL I/II/III DIV 2 GP A-G + CL I Z2 AEx nA/Ex nA IIC T6…T4 Gc			
				K	IECEx Ex ia IIC T6…T4 Ga/Gb + Ex ia IIIC T85°C…T100°C or T85°C…T130°C Da/Db			
				L	IECEx Ex d ia IIC T6…T4 Ga/Gb + Ex ia tb IIIC T85°C…T100°C or T85°C…T130°C Da/Db			
				M	IECEx Ex ic IIC T6…T4 Gc + Ex ic IIIC T85°C…T100°C or T85°C…T130°C Dc			
				P	EAC Ex Ga/Gb Ex ia T6…T4 + Ex ia IIIC T85°C…T100°C or T85°C…T130°C Da/Db ③			
				R	EAC Ex Ga/Gb Ex d ia T6…T4 + Ex ia tb IIIC T85°C…T100°C or T85°C…T130°C Da/Db ③			
					0	**Construction**		
						0	Without	
						2	CRN / ASME B31.3 ①	
						4	ASME B31.3	
							Converter version (Housing material / IP class)	
							2	C / Compact version (aluminium housing – IP66/68 0.1 barg)
							3	C / Compact version (stainless steel housing – IP66/68 0.1 barg) ④
VFDC	4	0			0			**Order code (complete this code on the pages that follow)**

								Outputs						
								1	2-wire / 4...20mA passive HART®					
									Cable entry / cable gland					
									1	M20×1.5 / without				
									2	M20×1.5 / 1 × plastic + plug				
									3	M20×1.5 / 1 × nickel-plated brass + plug				
									4	M20×1.5 / 1 × stainless steel + plug				
									5	M20×1.5 / 1 × M12 (4-pin connector) + plug				
									6	M20×1.5 / 2 × plastic				
									7	M20×1.5 / 2 × nickel-plated brass				
									8	M20×1.5 / 2 × stainless steel				
									A	M20×1.5 / 2 × M12 (4-pin connector)				
									C	½ NPT / without				
									D	½ NPT / 1 × nickel-plated brass + plug				
									E	½ NPT / 1 × stainless steel + plug				
									F	½ NPT / 2 × nickel-plated brass				
									G	½ NPT / 2 × stainless steel				
										Display				
										0	Without (no display, cover without window)			
										4	Plug-in display (cover with window)			
											Display – Documentation language			
											1	English		
											2	German		
											3	French		
											4	Italian		
											5	Spanish		
											6	Portuguese		
											7	Japanese		
											8	Chinese (simplified)		
											A	Russian		
											B	Czech		
											C	Turkish		
											D	Polish		
												0	**Process conditions (Pressure, temperature, material and remarks) / Process seal**	
												0	Without	
												1	-1…16 barg (-14.5…232 psig) / -40°C...+130°C (-40°F…+266°F) / FKM/FPM ⑤	
												2	-1…16 barg (-14.5…232 psig) / -50°C...+130°C (-58°F…+266°F) / EPDM ⑤	
												3	-1…16 barg (-14.5…232 psig) / -20°C...+130°C (-4°F…+266°F) / Kalrez® 6375 ⑤	
VFDC	4	0			0			1						**Order code (complete this code on the pages that follow)**

														Antennas (antenna type, material, radio approval)					
														0	Without				
														4	Metallic Horn, DN80 (3¨) / 316L / LPR ⑥				
														5	Metallic Horn, DN100 (4¨) / 316L / LPR ⑥				
														6	Metallic Horn, DN150 (6¨) / 316L / LPR ⑥				
														7	Metallic Horn, DN200 (8¨) / 316L / LPR ⑥				
														A	Drop, DN80 (3¨) / PP / LPR ⑥				
														B	Drop, DN100 (4¨) / PP / LPR ⑥				
														C	Drop, DN150 (6¨) / PP / LPR ⑥				
														E	Drop, DN80 (3¨) / PTFE / LPR ⑥				
														F	Drop, DN100 (4¨) / PTFE / LPR ⑥				
														G	Drop, DN150 (6¨) / PTFE / LPR ⑥				
															Antenna extension / Flange plate protection				
															0	Without			
															Extension				
															1	105 mm (4¨) / 316L			
															2	210 mm (8¨) / 316L			
															3	315 mm (12¨) / 316L			
															4	420 mm (17¨) / 316L			
															5	525 mm (21¨) / 316L			
															6	630 mm (24¨) / 316L for Metallic Horn antennas			
															7	735 mm (29¨) / 316L for Metallic Horn antennas			
															8	840 mm (33¨) / 316L for Metallic Horn antennas			
															A	945 mm (37¨) / 316L for Metallic Horn antennas			
															B	1050 mm (41¨) / 316L for Metallic Horn antennas			
																Process connection: Size / Pressure class / Flange face finish			
																0	0	0	Without
																ISO 228 (threaded connection)			
																F	P	0	G 1 A
																G	P	0	G 1½ A
																ASME B1.20.1 (threaded connection)			
																F	A	0	1 NPT
																G	A	0	1½ NPT
																Low-pressure EN flange (screwed to G 1½A connection)			
																L	C	7	DN80 PN01
																M	C	7	DN100 PN01
																P	C	7	DN150 PN01
																R	C	7	DN200 PN01
VFDC	4	0			0			1				0							**Order code (complete this code on the pages that follow)**

															Low-pressure ASME flange (screwed to 1½ NPT connection)			
															L	1	B	3¨ 150 lb 15 psig max.
															M	1	B	4¨ 150 lb 15 psig max.
															P	1	B	6¨ 150 lb 15 psig max.
															R	1	B	8¨ 150 lb 15 psig max.
															EN 1092-1 flange			
															L	D	1	DN80 PN10 – Type B1
															L	E	1	DN80 PN16 – Type B1
															L	G	1	DN80 PN40 – Type B1
															M	D	1	DN100 PN10 – Type B1
															M	E	1	DN100 PN16 – Type B1
															M	G	1	DN100 PN40 – Type B1
															P	D	1	DN150 PN10 – Type B1
															P	E	1	DN150 PN16 – Type B1
															P	G	1	DN150 PN40 – Type B1
															R	D	1	DN200 PN10 – Type B1
															R	E	1	DN200 PN16 – Type B1
															ASME B16.5 flange			
															L	1	A	3¨ 150 lb RF
															L	2	A	3¨ 300 lb RF
															M	1	A	4¨ 150 lb RF
															M	2	A	4¨ 300 lb RF
															P	1	A	6¨ 150 lb RF
															P	2	A	6¨ 300 lb RF
															R	1	A	8¨ 150 lb RF
															JIS B2220 flange			
															L	U	P	80A JIS 10K RF
															M	U	P	100A JIS 10K RF
															P	U	P	150A JIS 10K RF
															R	U	P	200A JIS 10K RF
																		Alternative flange facing
																		EN 1092-1 flange
																	7	Type A (Flat Face)
																		ASME B16.5 flange
																	B	FF (Flat Face)
VFDC	4	0			0			1				0						**Order code (complete this code on the pages that follow)**

																		Calibration certificate			
																		0	Without: Accuracy ±2 mm (±0.08¨)		
																		1	Calibration certificate ±2 mm (±0.08¨) up to 10 m (32.81 ft), 2 points		
																		2	Calibration certificate ±2 mm (±0.08¨) up to 10 m (32.81 ft), 5 points		
																		3	Calibration certificate ±2 mm (±0.08¨) up to 10 m (32.81 ft), 5 points specified by the customer min. ≥ 400 mm (16¨)		
																			Options		
																			0	Without	
																			2	Purging system (for Metallic Horn antennas only)	
																				Accessories / Tag plate	
																				0	Without
																				1	Weather protection
																				2	Adaptor for OPTIWAVE 6300 C flange system
																				3	Stainless steel Tag plate (18 characters max.)
																				5	Weather protection + Adaptor for OPTIWAVE 6300 C flange system
																				6	Weather protection + Stainless steel Tag plate (18 characters max.)
																				7	Weather protection + Stainless steel Tag plate (18 characters) + Adaptor for OPTIWAVE 6300 C flange system
																				8	Stainless steel Tag plate (18 characters max.) + Adaptor for OPTIWAVE 6300 C flange system
																				A	Weather protection + 2° slanted flange ⑦
																				B	Weather protection + stainless steel tag plate (18 characters) + 2° slanted flange ⑦
																				C	Stainless steel tag plate (18 characters max.) + 2° slanted flange ⑦
VFDC	4	0			0			1				0									**Order code**

① Available in September 2017

② Available in September 2017. DIP = Dust Ignition Proof.

③ Available in November 2017

④ For non-Ex devices only. Ex approvals will be available in the second quarter of 2018.

⑤ For Metallic Horn and Drop antennas

⑥ LPR = You can install the antenna in a closed tank or outdoors, but the antenna must point down. Do not install LPR devices near sensitive installations (e.g. a radio astronomy station). TLPR = You must install the antenna in a closed tank.

⑦ If the device has a PP Drop antenna, the 2° slanted flange is made of PP. If antenna is made of other materials, the 2° slanted flange is made of PTFE.

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Head Office KROHNE Messtechnik GmbH
Ludwig-Krohne-Str. 5
47058 Duisburg (Germany)
Tel.: +49 203 301 0
Fax: +49 203 301 10389
info@krohne.com

The current list of all KROHNE contacts and addresses can be found at:
www.krohne.com

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