OPTIWAVE 15XX Technical Datasheet

80 GHz radar level and flow transmitters

- For simple liquid and bulk solid applications
- Bluetooth® / Easy commissioning via Smartphone / Tablets or PC
- Flush-mounted PVDF Lens antenna

HART COMMUNICATION PROTOCOL

KROHNE

1.1 OPTIWAVE 15XX series - multipurpose 80 GHz level transmitter

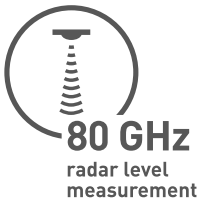
1.1.1 Overview

The OPTIWAVE 15XX series is a range of four reasonably priced non-contact level transmitters that use FMCW radar technology. The device housing and antenna are made of PVDF, which is compatible with almost all common products.

They can operate at temperatures from -25 to +80°C / -13 to +176°F and pressures from -1 to 5 bar / -14.5 to 75.2 psi.

Operating in a frequency range around 80 GHz and with a frequency sweep of 4 GHz, these devices can measure with a high signal resolution. They comply with NAMUR Recommendation NE 107 for status and error handling and enhanced diagnostic functions are available using either the OPTICHECK Level Mobile app or a DTM for PACTware that are both supplied free of charge.

① **1520 / 1540:** Flush-mounted DN40 Lens antenna with a small beam angle
② PVDF, IP68-rated housing (tested at 4 bar for 48 hours)
③ Shielded cable supplied as standard
④ Integrated Bluetooth® communication module
⑤ **1530 / 1560:** PVDF, standard housing (tested at 1 bar for 24 hours)
⑥ **1530 / 1560:** Flush-mounted DN70 Lens antenna with a small beam angle



80 GHz radar level measurement

The 80 GHz technology used in the OPTIWAVE series is the most recent and versatile radar technology for level measurement of liquids and solids.
Over an identical distance, it presents a highly focused beam with a smaller diameter compared to lower frequency radars, ideal for dusty atmospheres or low reflective media. The small dead zone and narrow beam angle allow for use in both small and tall vessels.

Tank Bottom Management (TBM)

TBM (Tank Bottom Management) for the OPTIWAVE radar level transmitters ensures reliable measurement even in empty tanks.
Based on many years of experience and know-how with radar level measurement, KROHNE developed dedicated algorithms to filter and compensate for irregular radar wave reflections that occur in the tank bottom. This only happens when the tank is empty. TBM allows for quick and easy commissioning of tanks regardless of their size, material or geometry.

OPTICHECK technology built-in

State-of-the-art measuring devices combine robust measuring principles and powerful electronics to produce a wide range of readings and device-specific data. OPTICHECK technology built-in leverages the features of the devices to translate their available comprehensive measuring system data into sophisticated diagnostics information for plant personnel. It goes beyond extensive device diagnostics, self-tests and on-site verification.
With measurement principle-specific application diagnostics, this technology also allows in-depth insights into the process and thus opens up far-reaching possibilities for device monitoring, condition-based maintenance and optimisation of measurement technology and systems.

General highlights

- PVDF housing is compatible with most measured products
- Small dead zone and beam angle (1520 / 1540: 8° and 1530 / 1560: 4°)
- 80 GHz FMCW radar - high signal dynamics ensure accurate, reliable measurements
- Extensive choice of accessories: brackets, low-pressure flange, orientation kit, purging system and weather protection cover
- User interface options include:
  - **1540 / 1560:** Display screen module
  - **Mobile device:** OPTICHECK Level Mobile app
  - **PC:** HART DTM and Bluetooth® DTM
- Easy step-by-step device configuration
- 3-year warranty

1.1.2 OPTIWAVE 1520

Radar level transmitter for basic applications with liquids and granulates

The OPTIWAVE 1520 is a 2-wire 80 GHz radar level transmitter for basic applications with liquids and solids. Its PVDF Lens antenna and compact housing make it particularly suitable for use in confined spaces as well as harsh process and environmental conditions such as outdoor applications, where a high degree of robustness is required.

Highlights

- Cost-effective non-contact level measurement in tanks (up to 5 bar / 72.5 psi), water basins, pumping stations etc.
- Compact and robust 80 GHz radar with flush-mounted PVDF Lens antenna, waterproof (IP68)
- Measuring range: 0...10 m / 0...32.8 ft

Industries

- Water and wastewater
- Chemical market
- Metals, Minerals & Mining
- Food & beverage

Applications

- General
  - Basic applications with open or pressurised tanks and moderate accuracy requirements
  - Level monitoring in harsh outdoor environments
  - Level measurement in granular silos
- Water and wastewater
  - Level measurement of sewage, sewage sludge, treated water etc.
  - Level monitoring in pumping stations, sewage screw lifting stations, rain water basins, etc.
  - Level measurement of sand, gravel or waste from coarse and fine screens (rags, debris, etc.)

1.1.3 OPTIWAVE 1530

Radar level transmitter for basic applications with minerals and other solids

The OPTIWAVE 1530 is a 2-wire 80 GHz radar (FMCW) level transmitter for cost-effective, non-contact level measurement of solids. It is also designed for measuring agitated and poorly reflecting liquids. Its flush-mounted DN70 / 3¨ Lens antenna has a beam angle of just 4°. As a result, the level radar provides reliable level measurement, particularly in extremely narrow tanks or containers, without causing interfering reflections.

Highlights

- Cost-effective non-contact level measurement of storage silos, stockpiles, crushers, conveyor belts, narrow tanks, poorly reflecting or agitated liquids
- Compact and robust 80 GHz radar with flush-mounted concave PVDF Lens antenna and fully potted electronics for use in dusty and vibrating environments
- Measuring range: 0...15 m / 0...49.2 ft

Industries

- Metals, Minerals & Mining
- Food & beverage

Applications

- General
  - Basic applications with solids from rocks to powders
  - Applications with poorly reflecting liquids featuring a low dielectric constant (εr value)
  - Level monitoring in harsh outdoor environments with vibration and/or heavy dust build-up
  - For use in extremely confined spaces, e.g. narrow silos, tanks, etc.
  - Low temperature and pressure applications
- Minerals and mining
  - Level measurement of solids in pits and quarries
  - Various stone sizes, e.g. rocks, ore, gravel, sand, granulates, waste/debris, powders, etc.
  - Monitoring and control of crushers, conveyor belts, stockpiles, small bunkers, narrow silos
  - Level monitoring of liquids and pastes (e.g. sumps, tailings damps, etc.)
  - Small and narrow tanks with foamy and highly agitated products
- Food and beverage
  - Stock inventory in silos up to 15 m / 49.2 ft
  - Various products, e.g. grain, seeds, animal feed
  - Level monitoring of poorly reflecting low-dielectric constant media in small and narrow tanks, e.g. edible oil
- Water and wastewater
  - Tanks with foaming and highly agitated liquids
  - Narrow pumping station with internals
  - Level measurement of lime, sand, waste, etc.

1.1.4 OPTIWAVE 1540

Radar level transmitter for basic applications with liquid chemicals and open channel flow

The OPTIWAVE 1540 is a 2-wire 80 GHz radar (FMCW) level transmitter for liquid chemicals, water or wastewater applications with high accuracy requirements as well as solids. Its front-flush Lens antenna and compact PVDF housing is resistant to many chemical products allowing for reliable level measurement in open tanks, pressurised tanks at moderate pressure conditions of up to 5 bar / 72.5 psi as well as granular silos. As the FMCW radar is also able to measure through the roof of closed tanks and containers made of non-conductive materials, the OPTIWAVE 1540 is also the perfect fit for cost-effective level measurement of liquids in moveable plastic containers such as IBC – without the need for direct installation in the tank and regular dismounting.

Highlights

- Cost-effective non-contact level measurement in IBCs, chemical tanks (up to 5 bar / 72.5 psi), water / wastewater applications with high accuracy requirements
- Compact and robust 80 GHz radar with flush-mounted PVDF Lens antenna, waterproof (IP68); for use as level and flow transmitter
- Measuring range: 0...15 m / 0...49.2 ft

Industries

- Chemical market
- Water and wastewater

Applications

- General

  - Cost-effective level measurement of liquids in open or pressurised tanks up to 5 bar / 72.5 psi

  - Level monitoring in applications with high accuracy requirements and distances up to 15 m / 49.2 ft

  - Level measurement in granular silos

- Chemical industry

  - Applications with liquid chemicals in storage and buffer tanks, containers etc.

  - Level measurement of chemicals and other liquids in moveable plastic tanks (e.g. IBC)

- Water and wastewater

  - Liquid level measurement during extraction, transport, storage and distribution of water from springs, rivers, lakes or the sea

  - Open channel flow measurement

  - Monitoring of Combined Sewer Overflows (CSO)

  - Floodwater alarm

  - Level measurement of sand, gravel or waste from coarse and fine screens (rags, debris etc.)

1.1.5 OPTIWAVE 1560

Radar level transmitter for basic applications with liquids in narrow tanks with internal obstructions

The OPTIWAVE 1560 is a 2-wire 80 GHz radar (FMCW) level transmitter for liquid and solid applications with low pressure and temperature ranges of up to 5 bar / 72.5 psi and a maximum measuring distance of 30 m / 98.4 ft. It is the best-in class radar when cost-effective level measurement with high accuracy is required. Featuring a flush-mounted Lens antenna with a small beam angle of only 4° makes the radar particularly effective in very confined installation spaces such as extremely narrow vessels or openings. The high dynamic range of its measurement signal allows the instrument to accurately measure extremely agitated product surfaces and under other difficult conditions. The concave design of the Lens antenna means that it is self-draining in the event of condensation, ensuring stable radar signal strength at all times.

Highlights

- Cost-effective non-contact level measurement with longer range and high accuracy
- Compact and robust 80 GHz radar with flush-mounted concave PVDF Lens antenna, not affected by condensation
- Measuring range: 0...30 m / 0...98.4 ft

Industries

- Chemical market
- Food & beverage (solids)

Applications

- Cost-effective radar level measurement for extended distances of up to 30 m / 98.4 ft
- All applications with compact radars requiring measuring distances >15 m / >49.2 ft
- Low-pressure / low-temperature applications with high accuracy requirements
- Level measurement in extremely narrow tanks and silos or vessels with confined spaces (nozzles, holes, containers)
- Level measurement of foamy or very agitated liquids, e.g. in dams, rivers, tanks with agitators or vessels with fast moving liquids etc.
- Poorly reflecting liquids with measuring distance >8 m / >26.2 ft
- Applications with large tanks requiring correction of volume measurements

1.2 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.

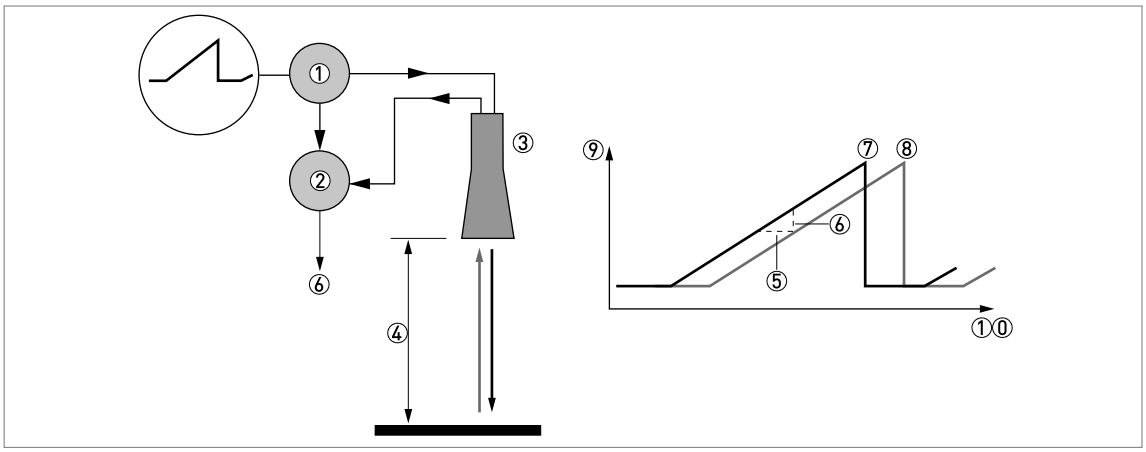


Figure 1-1: Measuring principle of FMCW radar

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

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 (Download Center).*

	1520	1530	1540	1560

Measuring system

Measuring principle	2-wire loop-powered level and flow transmitter; FMCW radar			
Frequency range	W-band (77...81 GHz)			
Max. radiated power (EIRP)	< +34 dBm according to ETSI EN 302 729, 47 CFR Part 15 (FCC) and RSS-211 (ISED)			
Application range	Level measurement of liquids, pastes, slurries and granulates			
Primary measured value	Distance			
Secondary measured value	Level, volume and flow rate			

Design

Construction	The measurement system consists of a measuring sensor (antenna) and a signal converter			
Antenna size	DN40 / 1½"	DN70 / 3"	DN40 / 1½"	DN70 / 3"
Options	Electrical cable supplied with the IP68 housing option, length Standard: 5 m / 16.4 ft Optional: 10 m / 32.8 ft, 25 m / 82.0 ft, other length (on request)			
	—		Integrated LCD display (-20...+70°C / -4...+158°F) ①	
Accessories	316L low-pressure flange disc for NPT (ASME B1.20.1) threaded connection			
	316L low-pressure flange disc for G (ISO 228-1) threaded connection			
	Cable clamp - for a device suspended from a ceiling or an overhang			
	Purging system adaptor with G 1/4 inlet ②			
	Weather protection cover			
	Stainless-steel long bracket (adjustable transmitter position)			
	Stainless-steel short bracket			
	Orientation system (max. tilt 30°) with 316L low-pressure flange disc (atmospheric pressure)			
	Stainless-steel tag plate (18 characters max.)			
Max. measuring range	10 m / 32.8 ft	15 m / 49.2 ft	15 m / 49.2 ft	30 m / 98.4 ft
Min. tank height	0.2 m / 8"			
Recommended minimum blocking distance	0.1 m / 4"			
Beam angle	8°	4°	8°	4°

	1520	1530	1540	1560
Display and user interface				
Display	—		Backlit LCD display. 160 × 128 pixels in 8-step greyscale with 4-button keypad.	
Remote operation	OPTICHECK Level Mobile app - wireless Bluetooth®			
	PACTware™ with the OPTIWAVE 15XX Device Type Manager (DTM) - wireless Bluetooth®			
	PACTware™ with the OPTIWAVE 15XX Device Type Manager (DTM) - HART			
	AMS Trex™ from Emerson Process - HART DD			
	PDM from Siemens - HART DD			
Interface languages	—		**LCD display**: English, French, German, Spanish, Portuguese, Italian, Russian, Czech, Polish, Turkish and Chinese (simplified)	
	DTM (HART), DTM (Bluetooth) and Mobile App: English, French, German and Chinese (simplified)			
	DD (HART): English			

Measuring accuracy

Resolution	1 mm / 0.04¨		
Repeatability	±1 mm / ±0.04¨		
Accuracy, liquids when distance ≤ 10 m / 33 ft	±5 mm / ±0.19¨, when distance > 0.2 m / 0.65 ft		±2 mm / ±0.08¨, when distance > 0.4 m / 1.31 ft
Accuracy, liquids when distance > 10 m / 33 ft	—	±0.05% of measured distance ③	±0.02% of measured distance ③
Accuracy, bulk solids	Variable. This value depends on the product measured and the application.		
Temperature drift (analogue)	Typically 50 ppm/K		
Temperature drift (digital)	< 3 mm/10 K ④		
Reference conditions according 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		

Operating conditions

Temperature	
Ambient temperature	-25...+80°C / -13...+176°F (max. +70°C / +158°F with the standard housing option)
Relative humidity	RH4% to RH99%
Storage temperature	-40...+80°C / -40...+176°F (max. +70°C / +158°F with the standard housing option)
Process connection temperature	-25...+80°C / -13...+176°F
Pressure	
Process pressure	-1...5 bar / -14.5...72.5 psi
Other conditions	
Dielectric constant (ε_r)	≥ 2

	1520	1530	1540	1560
Ingress protection	**Standard housing** IP66/IP67/IP68. IP68 test conditions: 48 hours at a pressure of 1 bar / 14.5 psi. ⑤			
	IP68 housing IP66/IP67/IP68. IP68 test conditions: 48 hours at a pressure of 4 bar / 58 psi.			
ESD protection	±8 kV according to DNVGL-CG-0339			
UV resistance	UL 746C - rating f1 (applicable to outdoor operation); ISO 4892-2 - method B; UL 1581 Sec.1200 (electrical cable)			
Flammability rating	**Standard housing**: UL 94 V-0 (housing); UL 94 V-2 (cover)			
	IP68 housing: UL 94 V-0 (housing); UL 2556 VW-1 (electrical cable and wires)			
Measuring cycle time	≥ 250 ms. If more power is available, then the measuring cycle time decreases.			
Step response time	≤ 3 s ⑥			
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.
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 27.
Dimensions and weights	For dimensions and weights data, refer to *Dimensions and weights* on page 18.

Materials

Main components	
Housing	PVDF
Wetted parts, including antenna	PVDF
Process connection	PVDF
Gasket	FKM/FPM (-15...+80°C / -5...+176°F) - only for devices with a G (ISO 228-1) threaded connection
Cable gland	Plastic (black) – for the standard housing option
Outer sheath, electrical cable	Polyurethane (PUR)
Housing entry seal, electrical cable	EPDM – for the IP68 housing option ⑦
Accessories	
Weather protection cover	ASA
Long bracket	Stainless steel (316Ti) with PVC-U nut
Short bracket	Stainless steel (316Ti) with PVC-U nut
Cable clamp	Galvanised carbon steel (clamping jaws: fibreglass-reinforced PA)

Process connections

Thread	G 1 1/2 A (ISO 228); 1 1/2 NPT (ASME B1.20.1)	G 3 A (ISO 228); 3 NPT (ASME B1.20.1)	G 1 1/2 A (ISO 228); 1 1/2 NPT (ASME B1.20.1)	G 3 A (ISO 228); 3 NPT (ASME B1.20.1)
Low-pressure flange	DN80...200 in PN2.5 (EN) / NPS 3...8 in Class 150 (ASME) – device accessories			

Electrical connections

Power supply	12...35 V DC (with display screen module: 14...35 V DC); min./max. value for an output of 22 mA at the terminal
Maximum current	22 mA

	1520	1530	1540	1560
Current output load	R_L [Ω] ≤ ((U_{ext} -12 V)/22 mA). For more data, refer to *Minimum power supply voltage* on page 15.			
IEC 61010-1 electrical data	Overvoltage category III / Maximum altitude: 5000 m above mean sea level / Pollution degree 4 / Outdoor use			
Standard housing				
Cable entry	M20×1.5 or 1/2 NPT			
Cable gland	none or M20×1.5 ⑧			
Cable entry capacity (terminal)	0.2...2.5 mm² (AWG 24...12)			
Electrical cable outer diameter	6...12 mm / 0.24...0.47¨			
IP68 housing				
Cable entry	N/A – integrated electrical cable			
Cable gland	N/A – integrated electrical cable			
Electrical cable diameter	6.4 mm ±0.2 mm / 0.25¨ ±0.008¨			

Input and output

Current output	
Output signal	Standard: 4...20 mA
	Options: 3.8...20.5 mA according to NAMUR NE 43; 4...20 mA (reversed); 3.8...20.5 mA (reversed) according to NAMUR NE 43
Output type	Passive
Resolution	±1 µA
Error signal	High: 22 mA; Low: 3.6 mA according to NAMUR NE 43
HART®	
Description	Digital signal transmitted with the current output signal (HART® protocol)
Version	7.7
Load	≥ 250 Ω
Multi-drop operation	Yes. Current output = 4 mA. Enter program mode to change the polling address (1...63).
Device drivers	Available for AMS Trex™, PDM, FDT/DTM
HART® registered	Yes
Bluetooth® interface	
Description	The interface offers wireless connectivity to the device via Bluetooth® Low Energy 5.2
Frequency range	R-band (2400...2483.5 MHz)
Max. emitted power	+6.5 dBm
Apps	OPTICHECK Level Mobile app – available for Google Android™ and Apple® iOS
	OPTIWAVE 15xx DTM – available for PACTware™ on Microsoft Windows
	Supported mobile devices must have at least the following features: - Bluetooth® Low Energy 4.0 interface or higher For the minimal supported versions of Google Android™ or Apple® iOS refer to the latest version of the OPTICHECK Level Mobile app available in "Google Play™ store" or "Apple® App Store®".
Effective range	50 m / 164 ft at the maximum power setting (in reference conditions)
Signal encryption	Proprietary PACE protocol based on ECDH

	1520	1530	1540	1560
Functionality	Display status, measurement & diagnostic data			
	Device parametrization and guided configuration wizards			
	Advanced diagnostic methods			

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 European Standards related to this device, refer to the EU Declaration of Conformity. You can download this document free of charge from the website (Download Center).
Vibration resistance	IEC 60721-3-4 4M7 (5...8.72Hz: ±10mm / 8.72...200Hz: 3g) IEC 61298-3 (10...58Hz: ±0.15mm / 58...1000Hz: 2g)
Shock resistance	IEC 60068-2-27 (class 4M7: 25g shock ½ sinus: 6ms)
Conformity to sanitary regulations (wetted parts)	**EU**: Regulation (EC) No 1935/2004, Commission Regulation (EC) No 2023/2006, Commission Regulation (EU) No 10/2011
	USA: FDA 21 CFR 177.2510
	China: GB 4806.7 and GB 9865
	France: ACS (drinking water)
Type approvals - ships and other offshore units	
DNV-GL - pending	Location Classes - temperature: D, humidity: B, vibration: A, EMC: B, and enclosure: C
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
	ANATEL (Brazil): Category II (Resolution 715)
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

Table 2-1: Technical data

① If the ambient temperature is not in these limits, then this condition can stop the display
② This option can also be attached to the orientation system
③ For more data, refer to the "Measuring accuracy" section
④ If the device operates in a hot and humid area, then there can be a small, permanent measurement offset (max. 5 mm / 0.20¨). If it is necessary to correct this measurement offset, then tell the supplier.
⑤ If the device has an IP68 cable gland that agrees with the specified test conditions
⑥ Time to change to 90% of the final value when there is a sudden change of level (1 m / 3.28 ft) and the time constant is set to 0.
⑦ EPDM is not compatible with mineral oils
⑧ Make sure that the cable gland has the appropriate IP rating for the location of the device.

2.2 Minimum power supply voltage

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

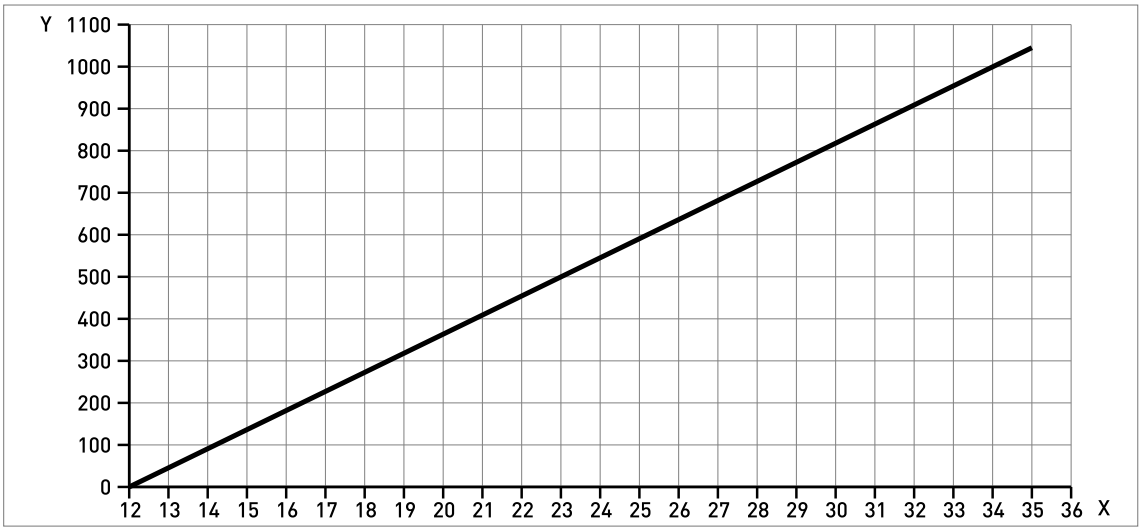


Figure 2-1: Minimum power supply voltage for an output of 22 mA at the terminals

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

2.3 Measuring accuracy

Use these graphs to find the measuring accuracy for a given distance from the transmitter. For a distance more than 10 m / 32.8 ft, refer to *Technical data* on page 10 (measuring accuracy).

OPTIWAVE 1520 and OPTIWAVE 1530

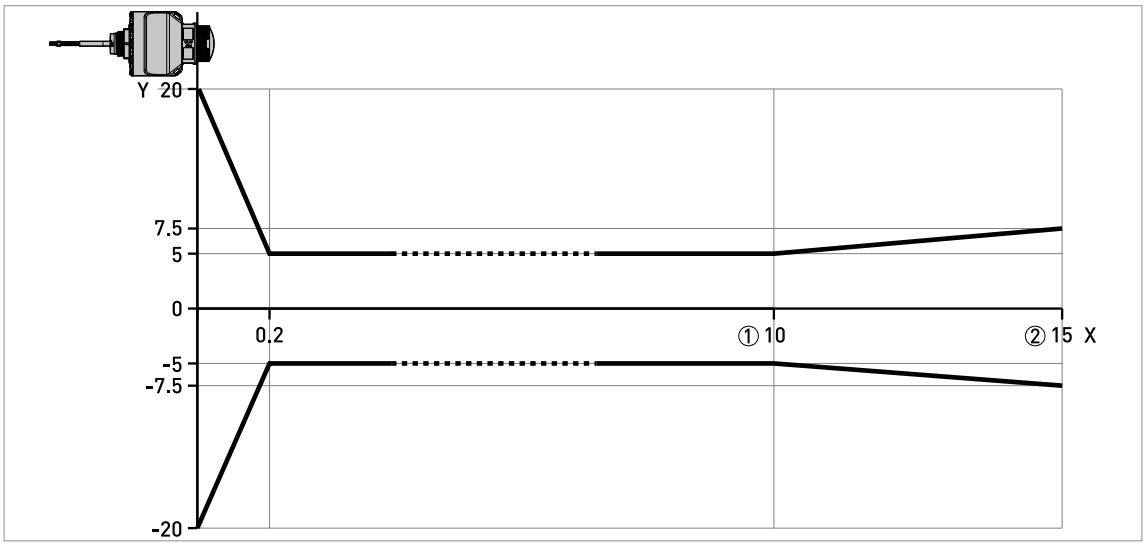


Figure 2-2: Graph of accuracy in mm against measuring distance in m

X: Measuring distance from the bearing surface of the threaded connection [m]
Y: Accuracy [+yy mm / -yy mm]
① OPTIWAVE 1520: maximum measuring distance
② OPTIWAVE 1530: maximum measuring distance

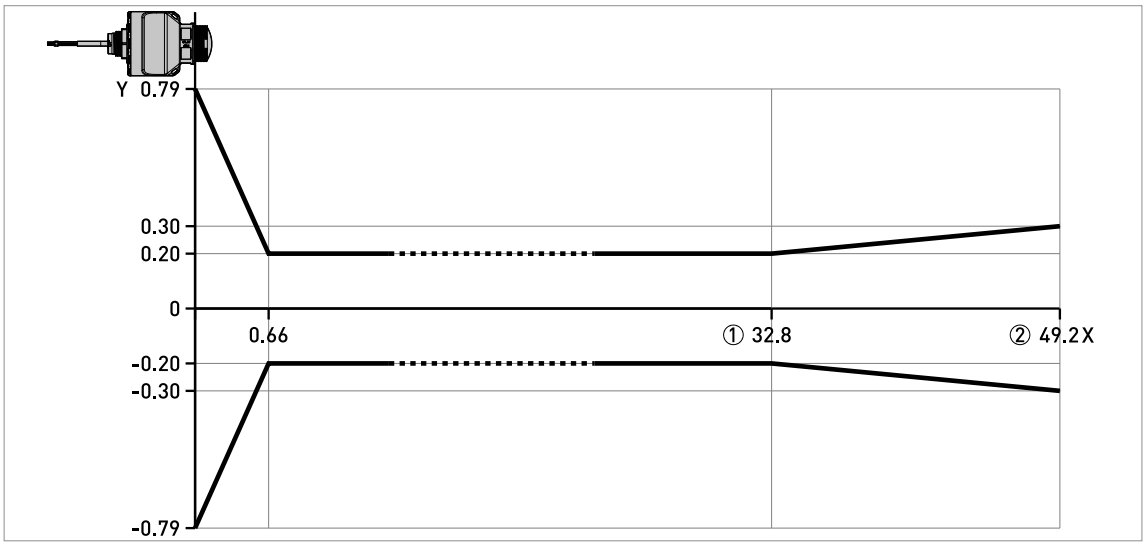


Figure 2-3: Graph of accuracy in inches against measuring distance in ft

X: Measuring distance from the bearing surface of the threaded connection [ft]
Y: Accuracy [+yy inch / -yy inch]
① OPTIWAVE 1520: maximum measuring distance
② OPTIWAVE 1530: maximum measuring distance

OPTIWAVE 1540 and OPTIWAVE 1560

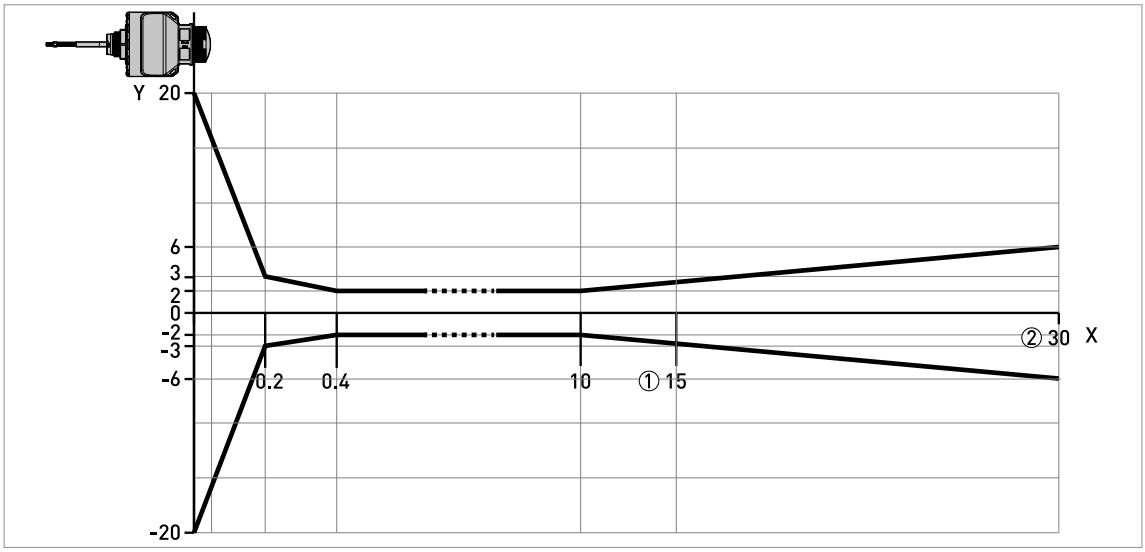


Figure 2-4: Graph of accuracy in mm against measuring distance in m

X: Measuring distance from the bearing surface of the threaded connection [m]
Y: Accuracy [+yy mm / -yy mm]
① OPTIWAVE 1540: maximum measuring distance
② OPTIWAVE 1560: maximum measuring distance

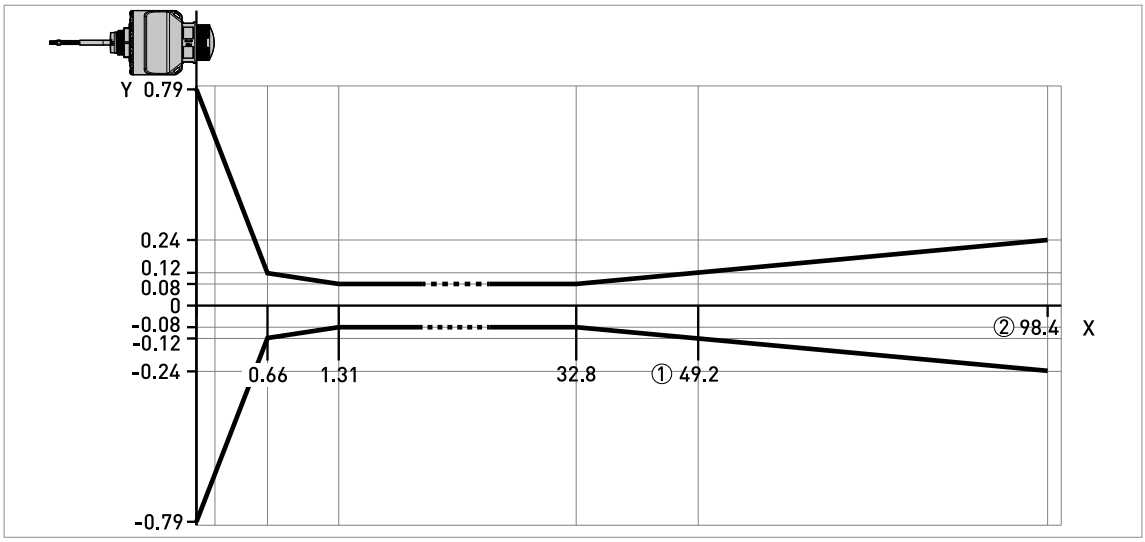


Figure 2-5: Graph of accuracy in inches against measuring distance in ft

X: Measuring distance from the bearing surface of the threaded connection [ft]
Y: Accuracy [+yy inch / -yy inch]
① OPTIWAVE 1540: maximum measuring distance
② OPTIWAVE 1560: maximum measuring distance

2.4 Dimensions and weights

2.4.1 OPTIWAVE 1520 or 1540

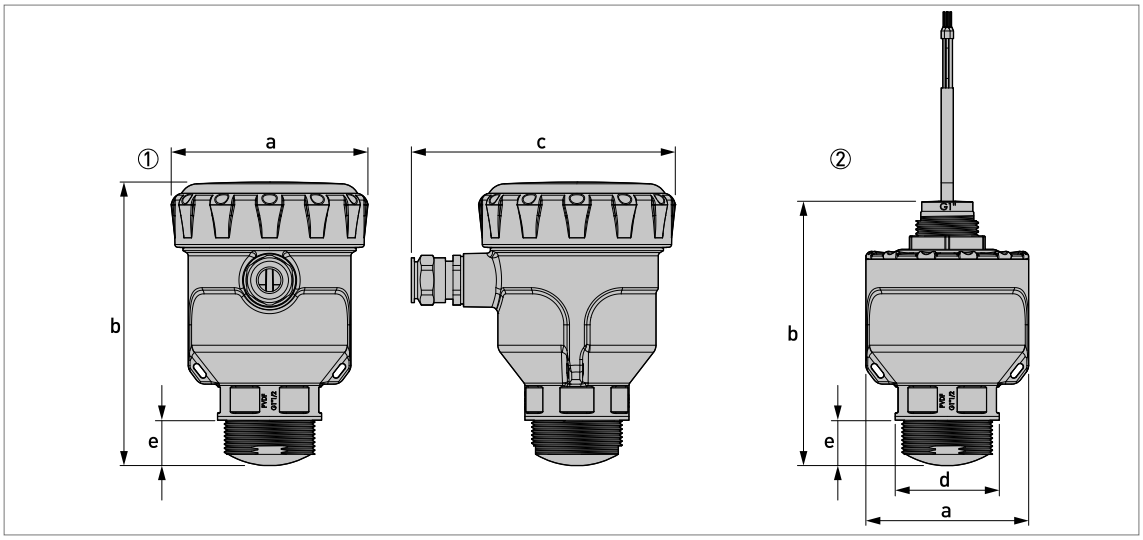


Figure 2-6: OPTIWAVE 1520 or 1540 with DN40 / 1½¨ Lens antenna

① Standard version with cable gland
② IP68-certified version with an integrated electrical cable

- *A weather protection cover is available as an accessory with all devices.*

Housing	Dimensions [mm]				
	a	b	c	d	e
Standard	104	194.4	139.5	—	20
IP68	86	139	—	55	20

Table 2-2: Dimensions in mm

Housing	Dimensions [inch]				
	a	b	c	d	e
Standard	4.09	7.65	5.49	—	0.79
IP68	3.39	5.47	—	2.17	0.79

Table 2-3: Dimensions in inch

2.4.2 OPTIWAVE 1530 or 1560

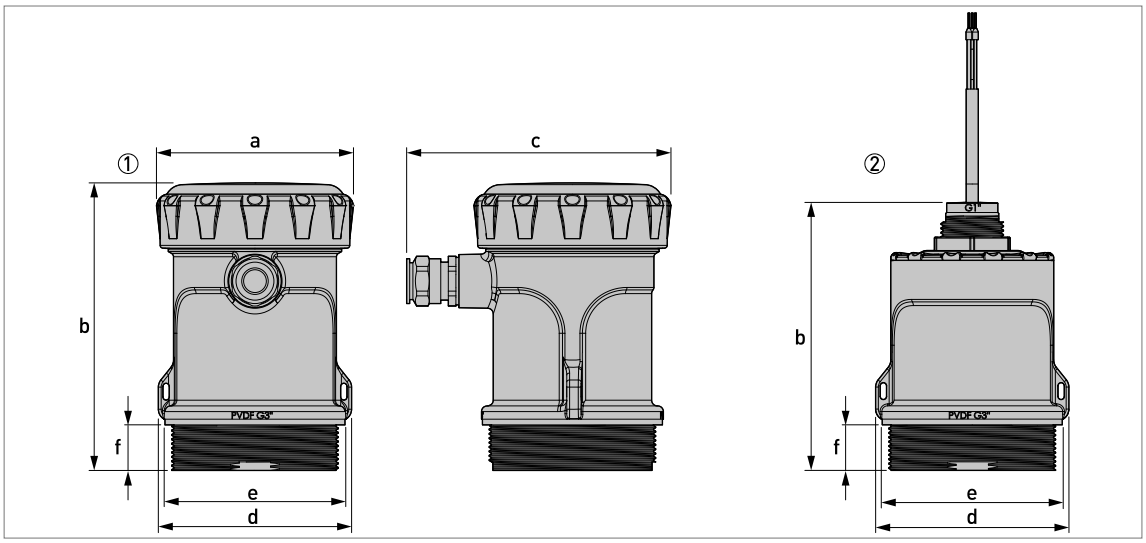


Figure 2-7: OPTIWAVE 1530 or 1560 with DN70 / 3¨ Lens antenna

① Standard version with cable gland
② IP68-certified version with an integrated electrical cable

- *A weather protection cover is available as an accessory with all devices.*

Housing	Dimensions [mm]					
	a	b	c	d	e	f
Standard	104	151.5	139.5	102	96	27
IP68	—	141	—	102	96	27

Table 2-4: Dimensions in mm

Housing	Dimensions [inch]					
	a	b	c	d	e	f
Standard	4.09	5.96	5.49	4.02	3.78	1.06
IP68	—	5.55	—	4.02	3.78	1.06

Table 2-5: Dimensions in inch

2.4.3 Cable clamp (accessory)

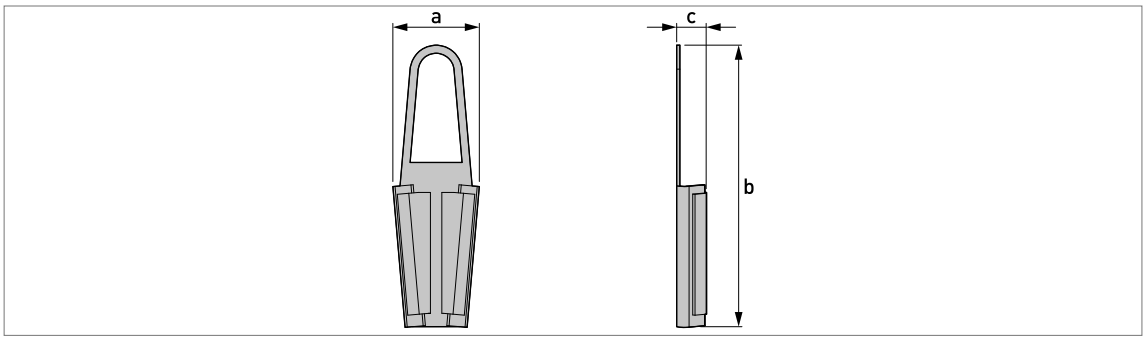


Figure 2-8: Cable clamp (accessory)

Dimensions					
a		b		c	
[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
54	2.13	174	6.85	18.4	0.72

Table 2-6: Dimensions in mm and inch

2.4.4 Long bracket (accessory)

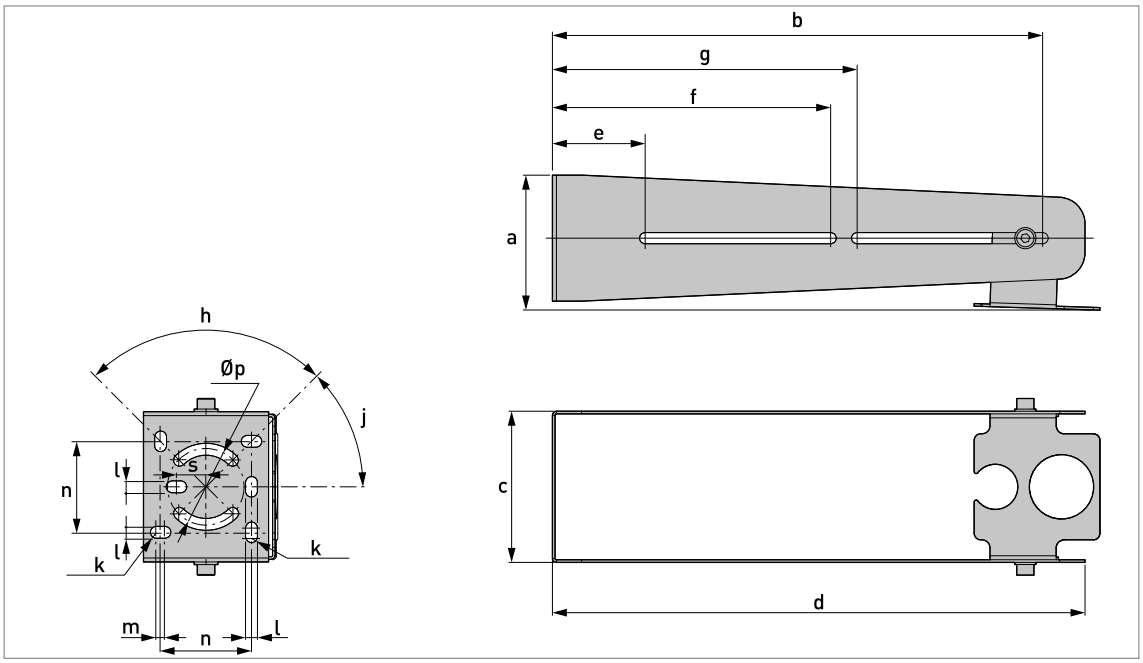


Figure 2-9: Long bracket (accessory)

Dimensions [mm]														
a	b	c	d	e	f	g	h	j	k	l	m	n	Øp	s
102	370	114	402	70	210	230	90°	45°	R4.5	9	6.5	69	57	22.5

Table 2-7: Dimensions in mm

Dimensions [inch]														
a	b	c	d	e	f	g	h	j	k	l	m	n	Øp	s
4.02	14.57	4.49	15.83	2.76	8.27	9.06	90°	45°	R0.18	0.35	0.26	2.72	2.24	0.89

Table 2-8: Dimensions in inch

2.4.5 Short bracket (accessory)

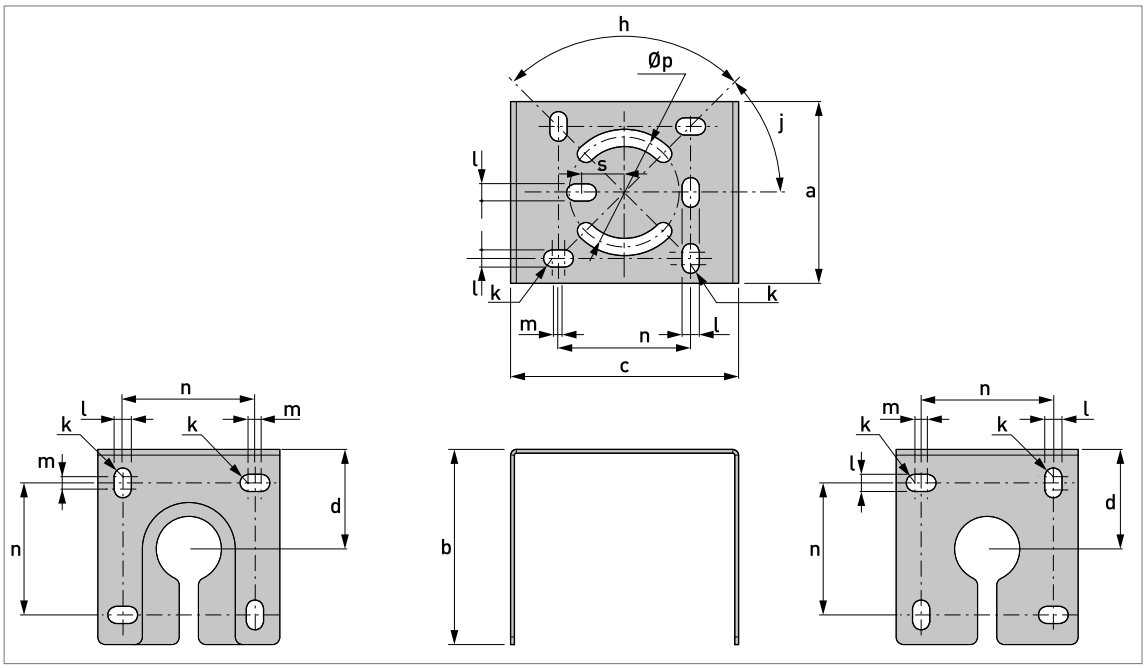


Figure 2-10: Short bracket (accessory)

Dimensions [mm]											
a	b	c	d	h	j	k	l	m	n	Øp	s
95	102	119	52	90°	45°	R4.5	9	6.5	69	57	22.5

Table 2-9: Dimensions in mm

Dimensions [inch]											
a	b	c	d	h	j	k	l	m	n	Øp	s
3.74	4.02	4.69	2.05	90°	45°	R0.18	0.35	0.26	2.72	2.24	0.89

Table 2-10: Dimensions in inch

2.4.6 Purging system (accessory)

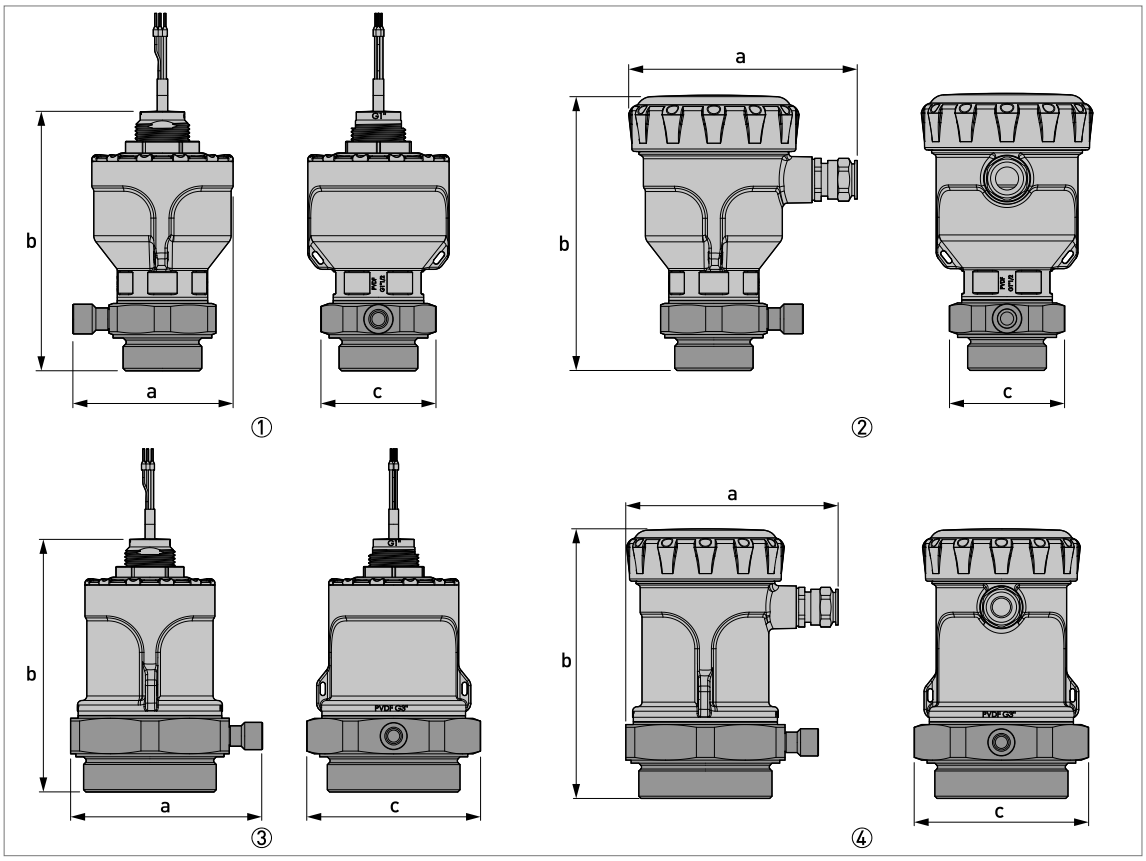


Figure 2-11: Purging system (accessory)

① Standard housing with DN40 Lens antenna
② IP68 housing with DN40 Lens antenna
③ Standard housing with DN70 Lens antenna
④ IP68 housing with DN70 Lens antenna

Antenna size	Dimensions					
	a		b		c	
	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
Standard housing, DN40	140	5.51	167.4	6.59	70	2.76
IP68 housing, DN40	97.5	3.84	158	6.22	70	2.76
Standard housing, DN70	140	5.51	178.1	7.01	115	4.53
IP68 housing, DN70	126.5	4.98	167.4	6.59	115	4.53

Table 2-11: Dimensions in mm and inch

2.4.7 Orientation system (accessory)

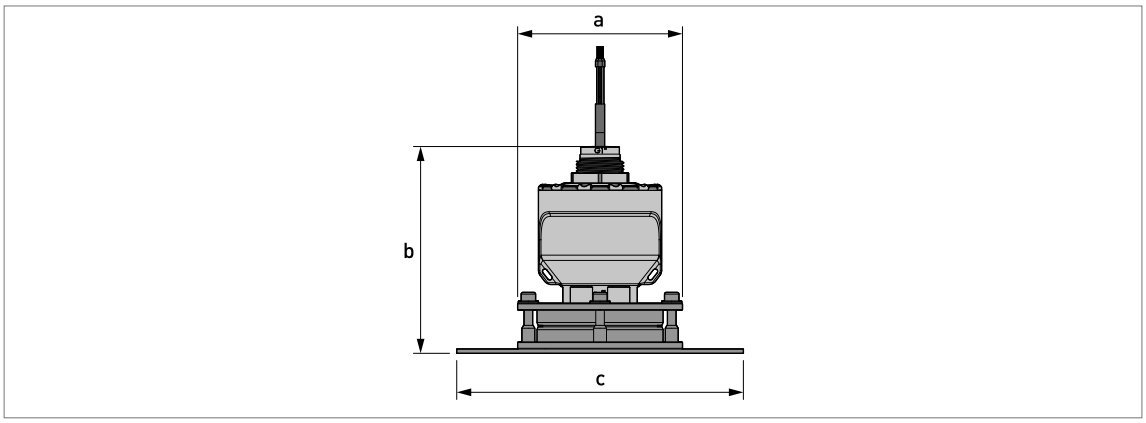


Figure 2-12: Orientation system (accessory)

Dimensions					
Øa		b		Øc	
[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
115	4.53	144	5.67	①	①

Table 2-12: Dimensions in mm and inch

① DN80 PN01 = 200 mm / 7.87¨. DN100 PN01 = 235 mm / 9.25¨. DN125 PN01 = 270 mm / 10.63¨. DN150 PN01 = 300 mm / 11.81¨. DN200 PN01 = 345 mm / 13.58¨. NPS 3 Class 150 = 200 mm / 7.87¨. NPS 4 Class 150 = 235 mm / 9.25¨. NPS 5 Class 150 = 270 mm / 10.63¨. NPS 6 Class 150 = 300 mm / 11.81¨. NPS 8 Class 150 = 345 mm / 13.58¨.

2.4.8 Weather protection cover (accessory)

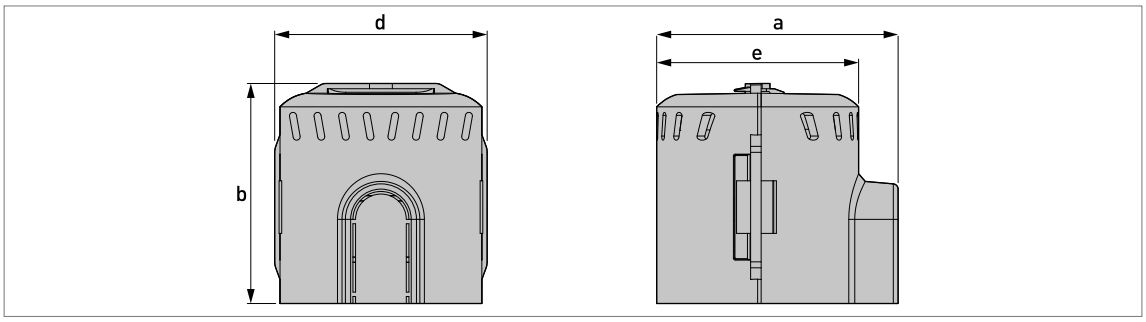


Figure 2-13: Weather protection cover (accessory)

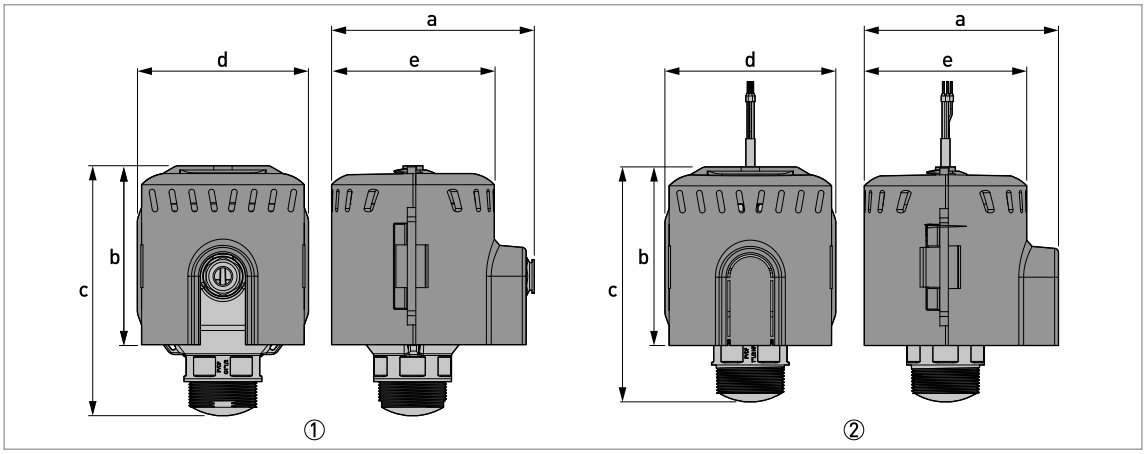


Figure 2-14: Weather protection cover attached to the OPTIWAVE 1520 / 1540

① Standard housing
② IP68 housing

Device	Housing	Dimensions									
		a		b		c		d		e	
		[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
Weather protection cover	—	137.5	5.41	125.5	4.94	—	—	121	4.76	115	4.53
OPTIWAVE 1520 / 1540 with weather protection cover	Standard	143.2	5.64	125.5	4.94	175.3	6.90	121	4.76	115	4.53
	IP68	137.5	5.41	125.5	4.94	165.1	6.50	121	4.76	115	4.53

Table 2-13: Dimensions in mm and inch

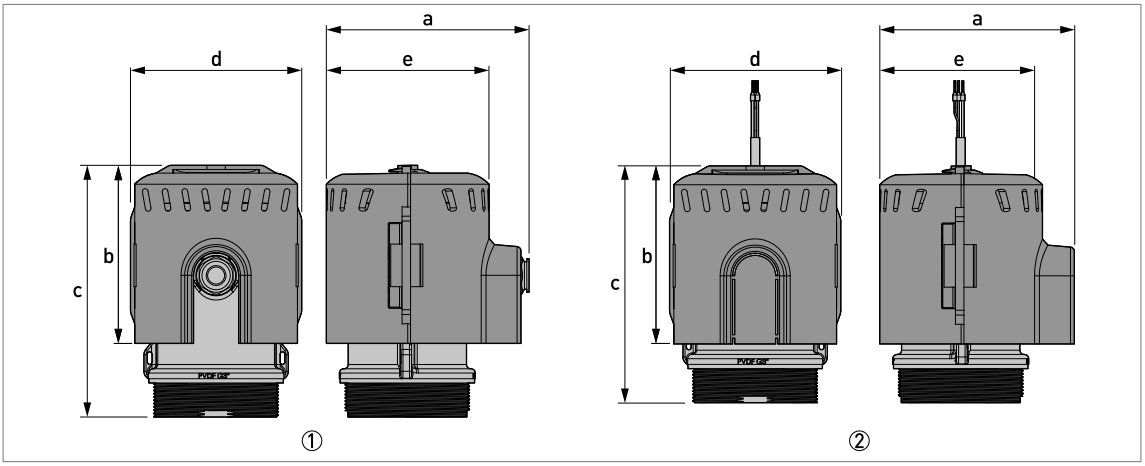


Figure 2-15: Weather protection cover attached to the OPTIWAVE 1530 / 1560

① Standard housing
② IP68 housing

Housing	Dimensions									
	a		b		c		d		e	
	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
Standard	143.2	5.64	125.5	4.94	177.4	6.98	121	4.76	115	4.53
IP68	137.5	5.41	125.5	4.94	166.9	6.57	121	4.76	115	4.53

Table 2-14: Dimensions in mm and inch

2.4.9 Weights

Type of housing	Weights	
	[kg]	[lb]
Device with standard housing, no display and DN40 antenna	0.568	1.25
Device with standard housing, display and DN40 antenna	0.610	1.34
Device with standard housing, no display and DN70 antenna	0.780	1.72
Device with standard housing, display and DN70 antenna	0.822	1.81
Device with IP68-certified housing and DN40 antenna	0.700	1.54
Device with IP68-certified housing and DN70 antenna	0.898	1.98
Accessory		
Cable clamp	0.155	0.34
Weather protection cover	0.22	0.49
Long bracket	1.30	2.87
Short bracket	0.363	0.80
Nut (PVC-U) for the bracket accessories	0.043	0.09

Table 2-15: Weights in kg and lb

3.1 Intended use

This radar level transmitter measures distance, level, volume and reflectivity of liquids, pastes, slurries and granulates.

It can be installed on tanks, reactors, open channels, open water, silos, hoppers and bunkers.

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.

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.
- Heat sources (sunlight, adjacent system components etc.) can increase the internal temperature of the device and cause damage. Make sure that the sensor temperature shown on the LCD display is not more than +70°C / +158°F. The maximum permitted surface temperature is +80°C / +176°F (max. +70°C / +158°F with the standard housing option). If it is necessary to decrease the temperature, install the weather protection cover.

- Protect the device from abrasive materials (e.g. sand, salt etc.) and corrosion. If necessary, install the weather protection cover.
- Make sure that objects (for example, loose rubble in quarries) do not hit the device.
- The devices are tested for their resistance to vibrations. For more data, refer to *Technical data* on page 10.
- The device housing and all wetted parts are made of PVDF. Make sure that the ambient conditions and the measured product are compatible with PVDF.

3.3 Installation

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

3.3.1 Pressure and temperature ranges

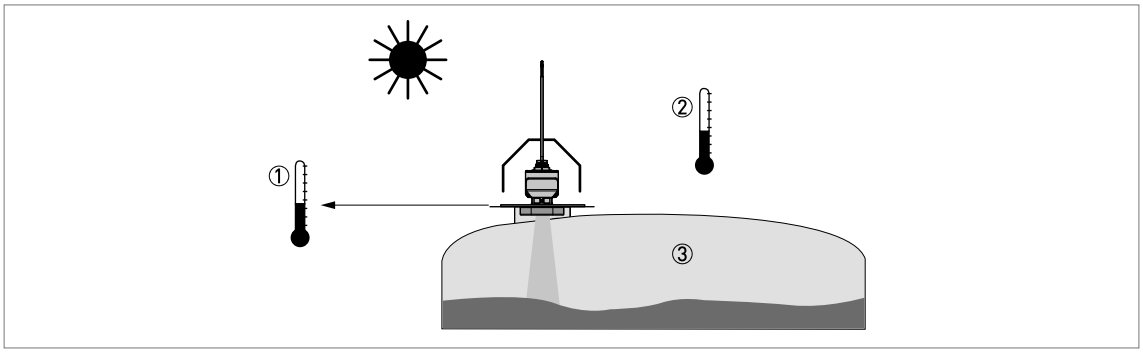


Figure 3-1: Pressure and temperature ranges

① Temperature at the process connection
-25...+80°C / -13...+176°F
Devices with Hazardous Location approvals: see supplementary instructions
② Ambient temperature
Standard housing: -25...+70°C / -13...+158°F
IP68 housing: -25...+80°C / -13...+176°F
Devices with Hazardous Location approvals: see supplementary instructions
③ Process pressure
-1...5 bar / -14.5...72.5 psi

Devices with a G (ISO 228-1) threaded connection are supplied with an FKM/FPM gasket. The process connection temperature range must agree with the temperature limits of the gasket material (FKM/FPM: -15...+80°C / -5...+176°F).

3.3.2 Types of installation

Accessories are available for installation of the device on a nozzle, wall, tube or other support.

Use brackets that are supplied by the manufacturer to prevent measurement errors.

Socket

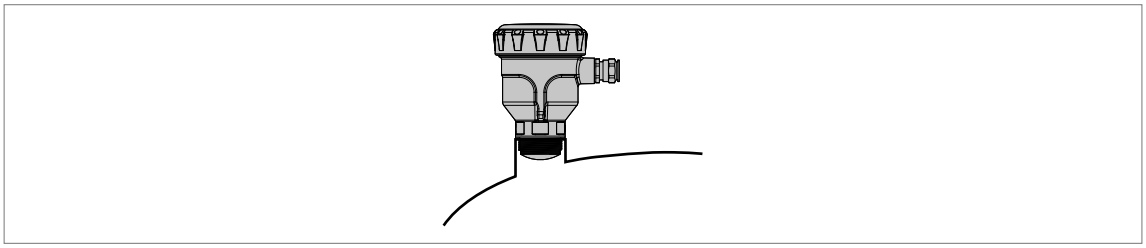


Figure 3-2: Threaded socket (NPT or G)

Low-pressure flange installed on a nozzle

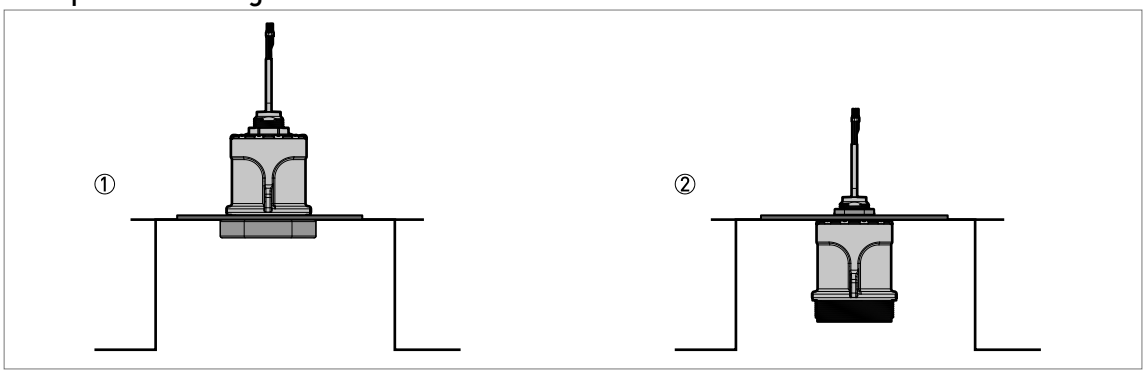


Figure 3-3: Installation of a device with a low-pressure flange (accessory)

① Device installed on the top of a low-pressure flange
② Device installed on the bottom of a low-pressure flange

Select a low-pressure flange that is compatible with the threaded connection on the device and is the correct size for the flange on the nozzle.

Orientation system installed on a nozzle

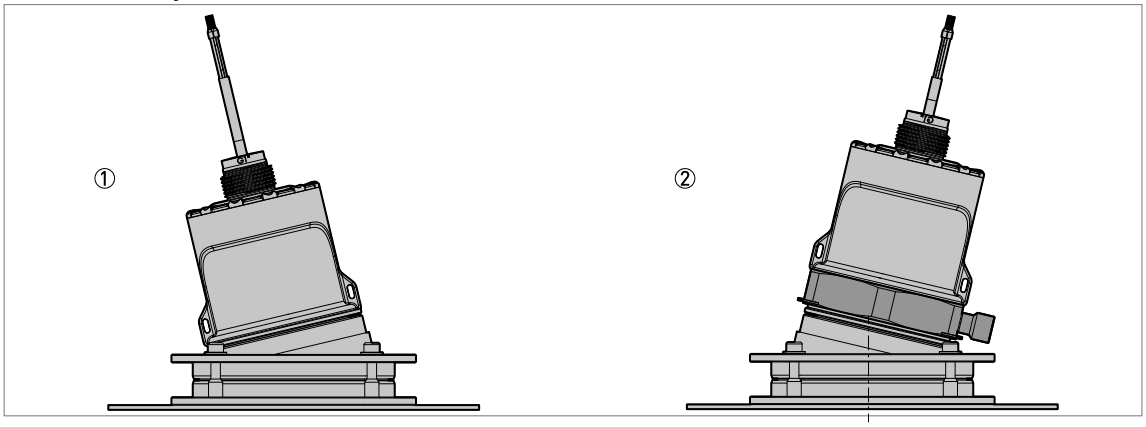


Figure 3-4: Installation of a device with an orientation system (max. tilt 30°)

① Device with the orientation system for level measurement of piles or silo contents
② Device with the orientation system and the purging system option

The orientation system has a low-pressure flange. Select an orientation system accessory that is compatible with the threaded connection on the device and is the correct size for the flange on the nozzle. For dimensional data, refer to *Dimensions and weights* on page 18. For part references, refer to the handbook (appendix).

Installation on a wall, ceiling or tube

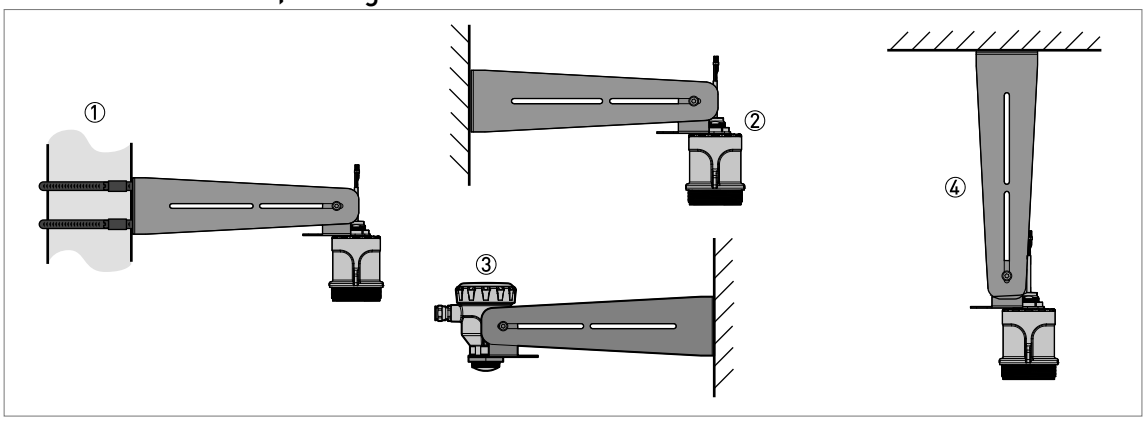


Figure 3-5: Installation on a wall, ceiling or tube with a long bracket

① Long bracket attached to a tube with a U-bolt or a metal collar (not supplied)
② Wall installation: top of the device attached to the long bracket
③ Wall installation: bottom of the device attached to the long bracket
④ Long bracket attached to the ceiling

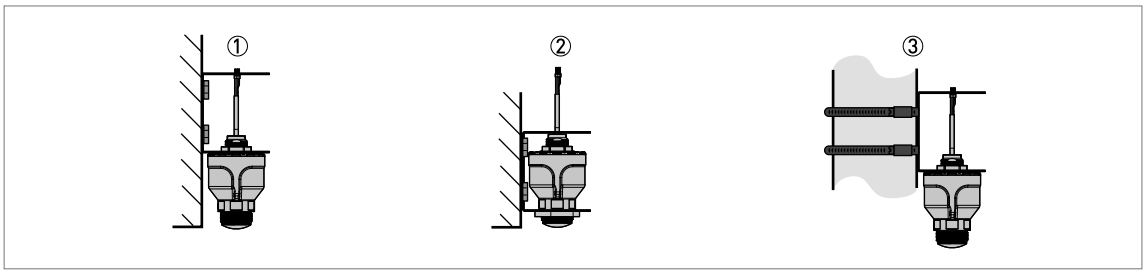


Figure 3-6: Installation on a wall or tube with a short bracket

① Wall installation: top of the device attached to the short bracket
② Wall installation: bottom of the device attached to the short bracket
③ Short bracket attached to a tube with a U-bolt or a metal collar (not supplied)

For part references, refer to the handbook (appendix).

Installation on a hook

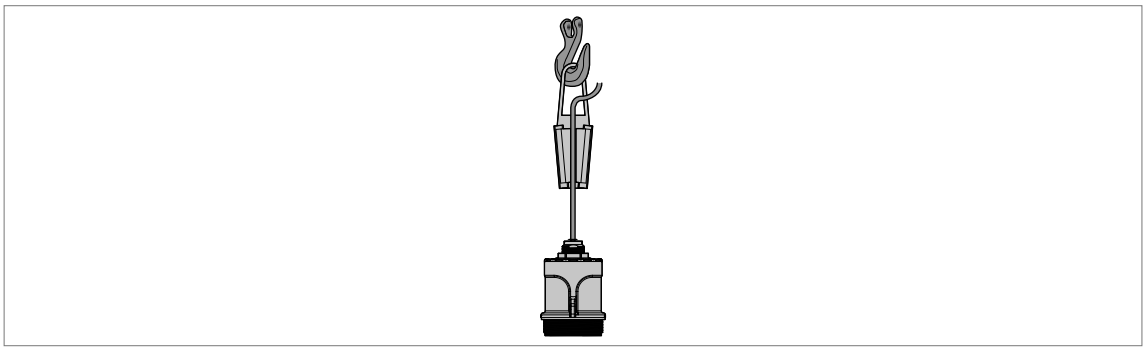


Figure 3-7: Installation on a hook with an electrical cable clamp (IP68 housing option only)

For part references, refer to the handbook (appendix).

Use good engineering practice to keep the mechanical loads on the electrical cable and device to a minimum.

3.3.3 Positioning the device

If there is a nozzle on the tank before installation, we recommend that the nozzle is a minimum of 200 mm / 7.9¨ from the tank wall.

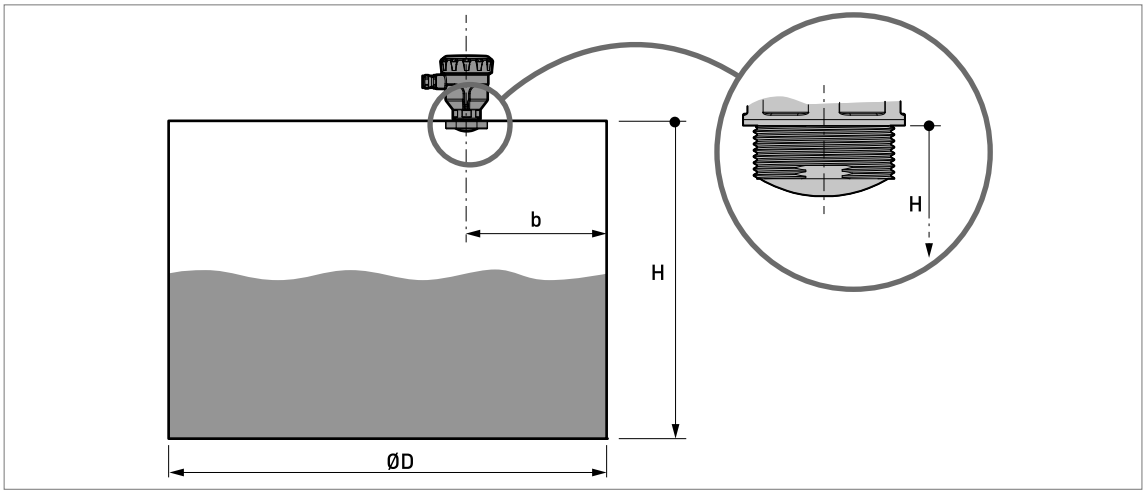


Figure 3-8: Position of the nozzle or socket on a tank

H = tank height
ØD = tank diameter
b = distance of the device from the tank wall. Refer to the table that follows.

Antenna size	Beam angle	Recommended minimum distance from the tank wall, b
DN40	8°	1/10 x tank height
DN70	4°	1/20 x tank height

Table 3-1: Distance of the nozzle or socket from the tank wall

3.3.4 Equipment and obstacles

The tank wall must be flat and there must not be obstacles adjacent to the nozzle or on the tank wall.

Objects in the tank or pit can cause interference signals. Do not install the device above objects in the tank (ladder, supports etc.) or pit.

If it is not possible to install the device on another part of the tank, do an empty spectrum scan to detect sources of radar signal interference and put these parasitic signals through a filter.
For more data, refer to the handbook.

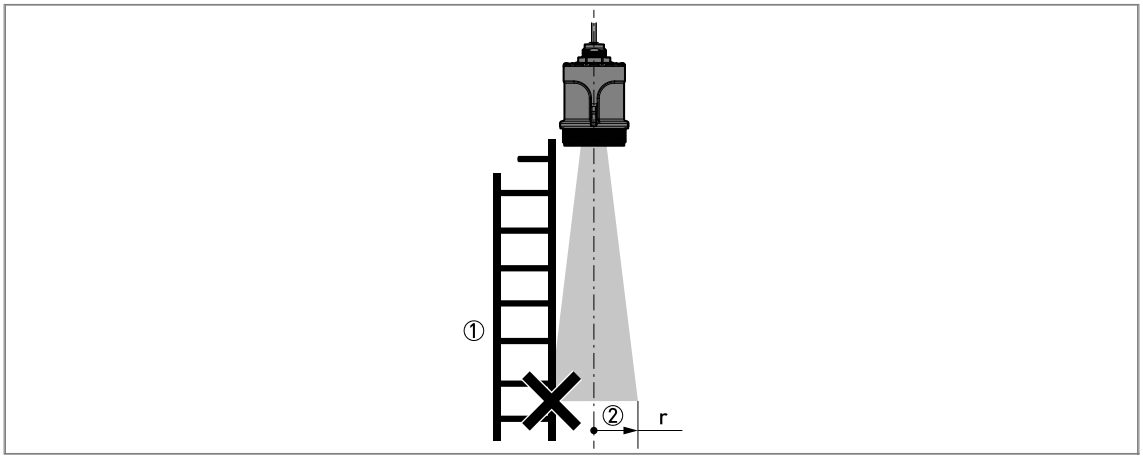


Figure 3-9: Equipment and obstacles: how to prevent measurement of interference signals

① Obstacle. Move the device away from the obstacle. If it is not possible to move the device, do an empty spectrum scan (refer to the handbook).
② Beam radius, r, of the antenna: refer to the table that follows

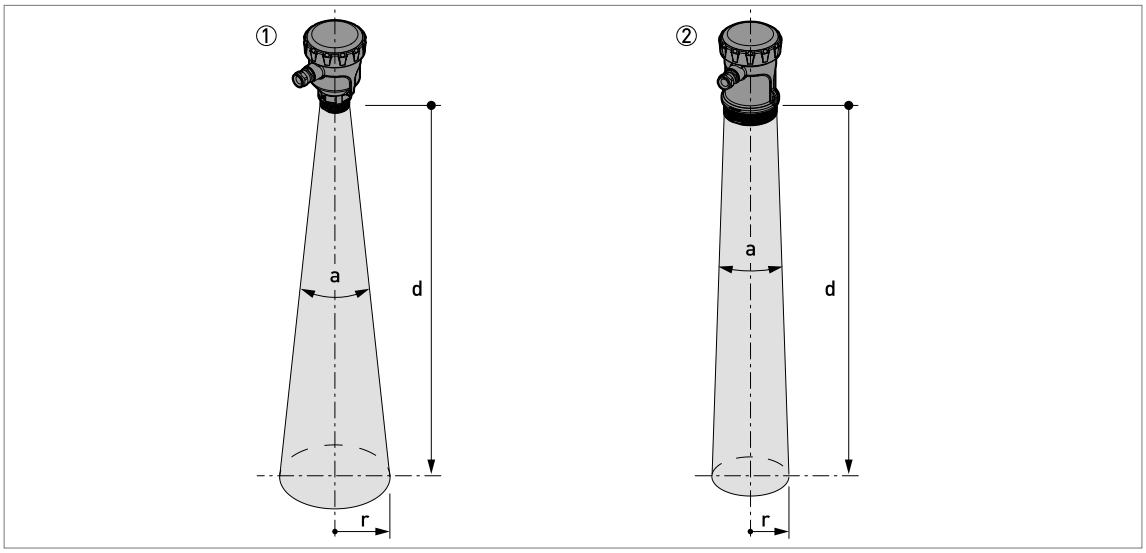


Figure 3-10: Beam angle

① Lens antenna, DN40 / 1½"
② Lens antenna, DN70 / 3"

Antenna type	Beam angle, a	Distance below the antenna, d	Beam radius, r	Distance below the antenna, d	Beam radius, r
		[m]	[mm]	[ft]	[inch]
Lens, DN40 / 1½"	8°	1	70	1	0.8
		2	140	2	1.6
		10	700	10	8
Lens, DN70 / 3"	4°	1	35	1	0.4
		2	70	2	0.8
		10	350	10	4

Table 3-2: Beam radius in mm and inch

The beam radius given in the table is the minimum free space from the centre of the beam for the device to operate correctly in a tank with obstacles. We recommend a safety factor of 3 (free space = beam radius x 3) to keep parasite signals to a minimum.

3.3.5 Product inlets on tanks and silos

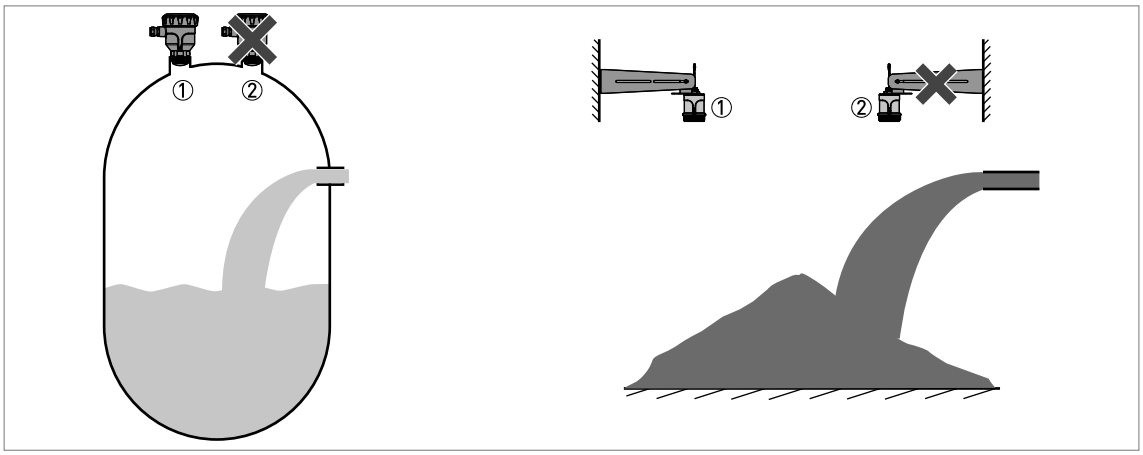


Figure 3-11: Do not put the device near to a loading inlet

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

If the inlet is too near to the device and it is not possible to move it, add an extension to the inlet pipe to prevent interference signals.

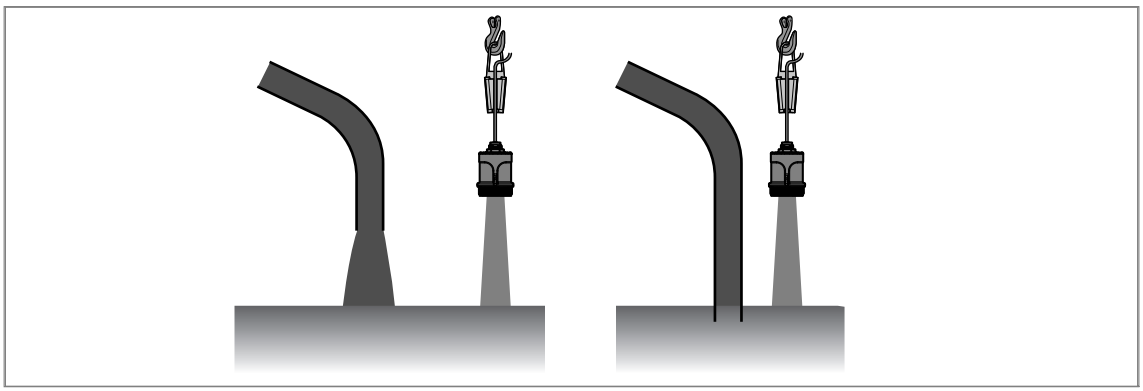


Figure 3-12: Add an extension to the inlet pipe to prevent interference signals

3.3.6 Tanks, hoppers and silos with dish-shaped or conical bottoms

If the device measures vertically, then dish-shaped or conical bottoms can prevent the device from measuring to the bottom of the tank.

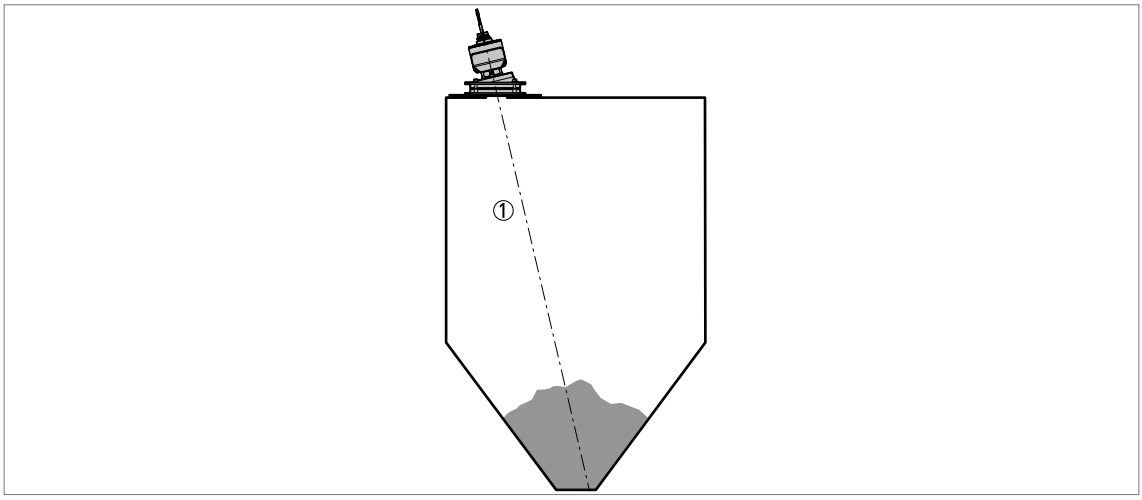


Figure 3-13: Tanks with dish-shaped or conical bottoms

① Axis of the radar beam

You can measure to the bottom of a tank or silo if you follow these instructions:

- Select an application in the quick setup menu of the DTM software or mobile app (refer to the list that follows).
- Use the orientation system accessory that permits you to tilt the device a maximum of 30° from the vertical axis.

Applicable applications are:

- **Solids:** narrow silo, bunker, large silo, and stockpile

3.3.7 Containers made of non-conductive materials

We recommend that you do not hang and use this device above a plastic tank that has a layer of dust, condensation or a standing body of liquid on it. Dust and liquid can have an effect on the device performance.

If the device cannot go in the tank and the tank is made of a non-conductive material (plastic etc.), you can attach a support to the top of the tank without a hole in the tank roof.

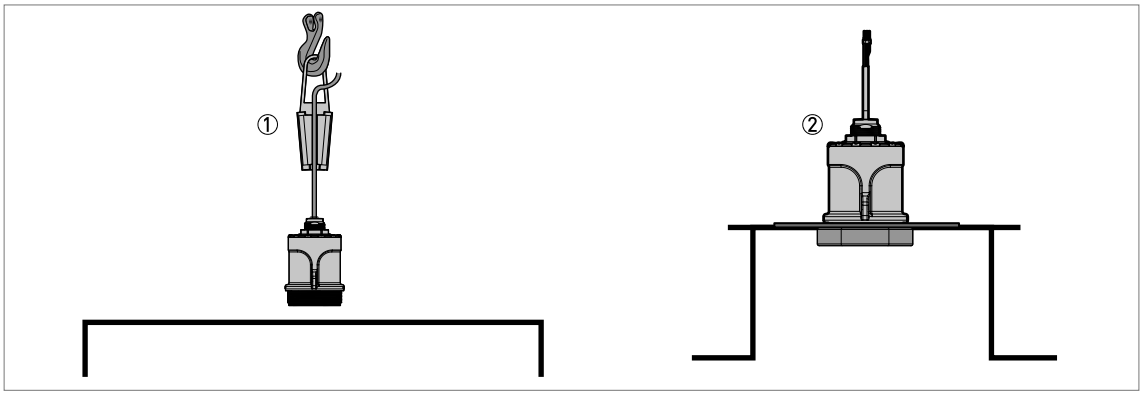


Figure 3-14: Containers made of a non-conductive material

① Device hung above a plastic tank
② Device attached to a plastic tank with a low-pressure flange

4.1 General notes

This chapter includes electrical connection data about devices with the 4...20 mA output and HART® communication options. These are 2-wire, loop-powered devices.

4.2 Electrical connection for current output

4.2.1 How to wire the device

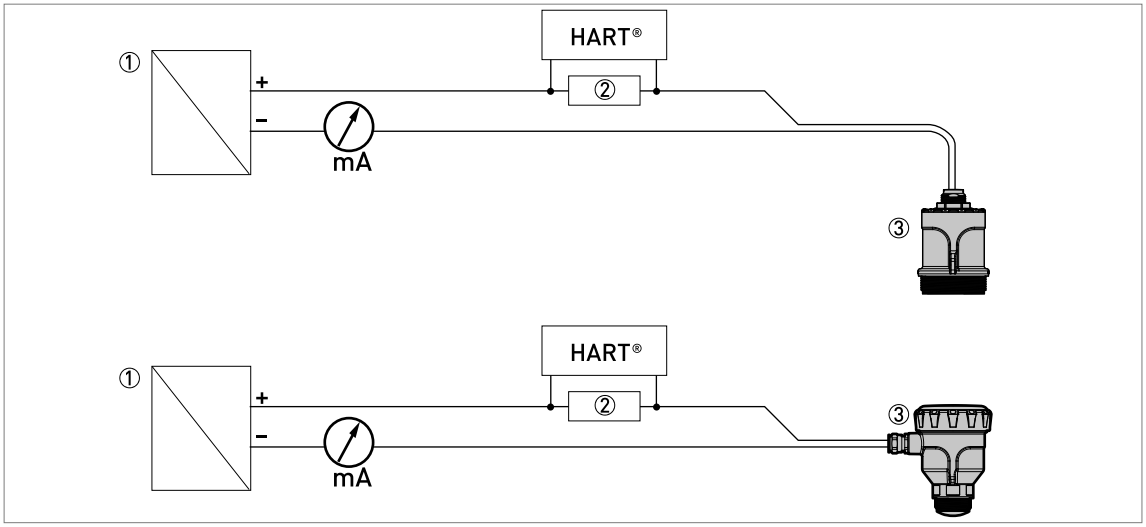


Figure 4-1: Electrical connections for non-Ex devices

① Power supply
② Resistor for HART® communication (typically 250 ohms)
③ Device

- *Make sure that there is an external switch or circuit breaker adjacent to the device. It must disconnect the positive and negative lines in the DC circuit.*
- *You must have access to the external switch or circuit breaker, and it must be identified as the electrical safety equipment for this device.*
- *The output of the power supply must be LPS-rated (limited power source) for a SELV (separated extra-low voltage) system.*
- *Use a Class 2 (UL 1310) power supply for electrical installations in the USA and Canada.*

4.2.2 Standard device with cable gland

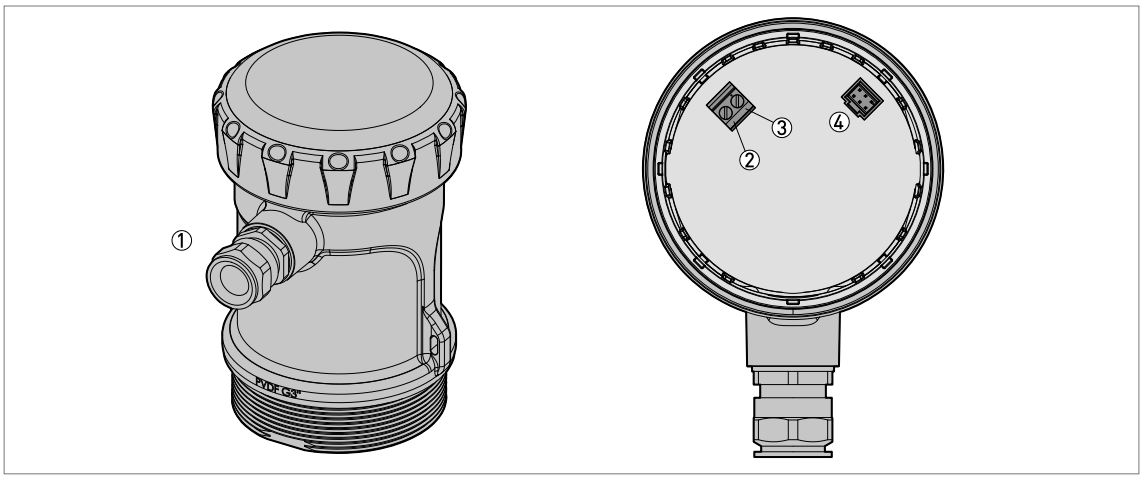


Figure 4-2: Terminals for electrical installation: standard cable gland

① Device with a standard cable gland
② Current output terminal
③ Current output terminal
④ Connection port for the LCD display screen

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

Make sure that the electrical cable is safely attached near to the device to prevent damage from vibrations.

4.2.3 IP68 device

The electrical cable is supplied with the device and cannot be replaced.

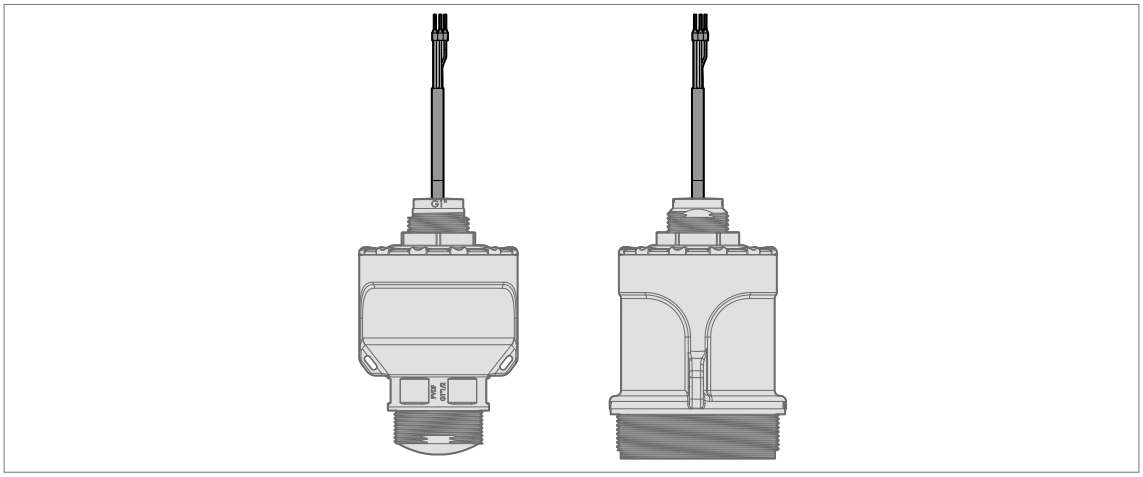


Figure 4-3: IP68 options

Install protection for the electrical cable, if the device is in a location where there is a risk of damage from wildlife (rats etc.).

4.3 Networks

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.

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- Flow metering, monitoring, wireless and remote metering solutions
- Engineering, commissioning, calibration, maintenance and training services

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