For details, please refer to page 15

PDG70-U

86GSuper High Frequency Radar Level Meter

Working principle

The frequency modulated continuous wave (FMCW) radar level meter antenna emits a frequency modulated continuous wave signal (76-86GHz), which propagates at the speed of light in space. When it encounters the surface of the measured medium, some of its energy is reflected back and received by the same antenna. The echo signal received by the antenna is mixed with the transmission signal, and the frequency of the output intermediate frequency signal after mixing is proportional to the distance, thus calculating the distance between the antenna and the surface of the measured medium.

Product description

The measurement range is large, up to 100m / 328 ft0 GHz to determine the small beam Angle, the process connection can be threaded or flanged connection, support a variety of materials; PEEK lens antenna is not sensitive to sediment. Communication protocols support FF/PROFIBUS/RS485, etc.

Non-contact radar level measurement using the latest technology. It can measure distance, level and volume of liquid and slurry. The empty spectrum function of the tank is used to filter out the interference in the tank.

Functional characteristics

High signal strength
Measurement grade accuracy
Small blind area
Small beam Angle
Strong anti-interference
Support remote upgrade

Product application

Oil and gas
Chemical market
Environmental protection
electricity

Product features

This instrument uses FMCW technology for non-contact radar level measurement. It can measure distance, level and volume of liquid and slurry. The empty spectrum function of the tank is used to filter the interference in the tank.

① 86GHz FMCW radar level meter

② Aluminum shell or stainless steel shell

③ A large backlit LCD screen with 4 buttons can be set by a magnetic bar without opening the cover. The software comes with a quick setup assistant to make debugging more convenient. 12 languages are optional.

④ PEEK lens antenna structure

characteristics

Peek lens antenna measures the distance from 0.3m to 100m/ 328.1ft

· Small dead zone and beam angle (the transmitting angle of DN70/2¾" lens antenna is only 4°, and that ofDN40/ 1 ½" lens antenna is only 8°)

. Antenna extension tube up to 112 mm/4.4 "for longer waves.

· Various process connection sizes: (thread ≥¾"and flange ≥DN50/2", and PEEK flange protection disc suitable for corrosive media

· Process conditions can reach-200 C/+392 F and 40 barg/580 psig.

One user interface for all applications

The empty spectrum function of the tank is used to eliminate the interference in the tank.

Follow the diagnostic function of NAMUR NE107.

Comply with NAMUR directives NE 21, NE 43 and NE 53.

Can measure rapidly changing process flow (≤ 60m/min/≤ 196.85ft/min); The quick response version can reach 0.2s

Flanged antenna purging system without antenna extension tube.

Ensure the clear detection ability with large dynamic and high signal-to-noise ratio in the floating dust space.

High-resolution 4 GHz scanning

Low-cost low-pressure flange

The blind area is less than 5 cm;

The characteristics of high precision and small blind area determine that radar is suitable for measuring small storage tanks, such as medicine, petrochemical, food, chemical and other industries.

Small beam angle

The beam angle can reach 3.

The extremely narrow beam angle makes the radar energy more focused; It can be applied to long and narrow installation space without false echo interference; Even if there are obstacles in the tank, such as stirring, heating coil, etc., the extremely narrow beam angle can be successfully avoided to achieve accurate measurement; Even if the range is as high as 100m, the signal will not be attenuated too much.

Strong anti-interference

The higher signal-to-noise ratio makes radar measurement almost unaffected by the fluctuation of material level;

The antenna is made of PTFE, which can effectively prevent corrosion and hanging;

More penetrating, when there are dust, steam condensation, attachments, etc. in the measuring tank/bin, radar waves can penetrate and reach the surface of the material level directly.

Support remote debugging and upgrading

Support remote debugging and remote upgrading. Based on the unique software algorithm, radar level meter is debugged or upgraded according to the field measurement conditions, so as to meet the requirements of field application, reduce waiting time and improve work efficiency.

Super High Frequency Radar Level Meter

model	PDG70-U
	
frequency band	W-band（76~86GHz）
measure a distance	100 m
precision	Standard: ±2mm；；Optional: 1 mm
dielectric coefficient	≥1.4；TBF≥1.1
O-ring	FKM/FPM/EPDM/Kalrez6375/PEEK/PTFE
Antenna form	Planar lens (PEEK)/ hemispherical (PTFE) antenna
Chinese menu operation	be
shell	Cast aluminum, optional 316L.
the protection grades	IP66/IP68，NEMA 4X/6P
output	4~20mA+HART7/FF/PROFIBUS/MODBUS
be explosion-proof	ATEX/IECEx/NEPSI Ex ia IIC T6 Ga/Gb + Ex
	iaD 20/21 T6；Ex d ia IIC T6 Ga/Gb + Ex
	iaD 20/21 tD A21 IP6X T6
SIL	SIL2
Optional accessories	Keywords PACTWARE and bluetooth wireless debugging, purging system, flange protection disk,
	Universal joint or 45 directional bracket, in line with NAMUR's instrument self-diagnosis work.
	Yes, quick response version 0.2s, maximum 5-point calibration certificate, recognized by NACE.
	Certificate, static pressure test report, tank side table, climate protection cover, signal lightning arrester

Comparison between 26GHz radar level meter and 80GHz radar level meter

contrast	26GHz radar	86GHz radar
transmitting frequency	26GHz	76-86GHz
Maximum range	70m	120m
Beam angle	10°	3°
Minimum blind area	30cm	5cm
Maximum accuracy	1cm	1mm
Measurable medium	Dielectric constant > 3	Dielectric constant > 1.5
applicability	Simple liquid level and material level	Simple liquid level, dust, steam, Attachment, slender mounting tube, stirring, foamEqual complex working condition

26GHz radar

86GHz radar

Housing

A non-contact radar level meter with frequency modulated continuous wave and pulse

“Direct” mode

If the dielectric constant of the liquid is very high（εr ≥1.4），The liquid level signal is reflected from the surface of the liquid。

“Automatic tank bottom tracking” mode

If the dielectric constant of the liquid is low (for long-distance measurementsεr 1.4...1.5），You must use the "Automatic Tank Bottom Tracking" mode for accurate liquid level measurement. The "Automatic Tank Bottom Tracking" mode is an automatic function that allows the instrument to automatically choose between "Direct" mode and "Tank Bottom Tracking" mode. If the instrument detects a large amount of radar reflection above the "Tank Bottom Area" (20% below the tank height), the instrument will use "Direct" mode. If the instrument detects a large amount of radar reflection in the "Tank Bottom Area", the instrument will use "Tank Bottom Tracking" Mode. This mode can only be used in flat bottomed tanks or guided wave tubes with reference plates at the bottom.

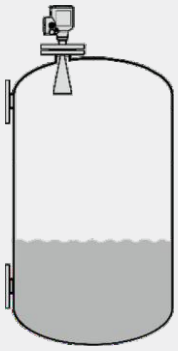
“Full range tank bottom tracking”

Mode TBF=Tank Bottom Tracking. If the dielectric constant of the liquid is very low（εr <1.4），You must use the "Full Range Tank Bottom Tracking" mode for accurate liquid level measurement. The instrument uses radar reflection from the bottom of the tank (signal passing through the liquid). This mode can only be used in flat bottomed tanks or guided wave tubes with reference plates at the bottom.

Application

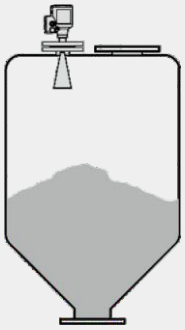
Level measurement

Within the specified pressure and temperature range, the Level sensor can measure a wide range of liquid levels under various installation conditions. It does not require any verification: only a brief configuration step is required.



level gauging

Within the specified pressure and temperature range, the Level sensor can measure a wide range of liquid levels under various installation conditions. It does not require any verification: only a brief configuration step is required.



Volume (mass) measurement

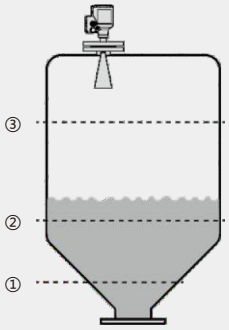
The instrument configuration menu has a tank capacity meter function for volume or mass measurement. You can associate up to 50 volume (mass) data with liquid level data. For example:

Level ①=2m/Volume ①=e.g. 0.7m^3

Level ②=10m/Volume ②=e.g. 5m^3

Level ③=20m/Volume ③=e.g. 17m^3

Through these data, the actual volume or mass can be calculated based on the tank volume table (linear internal difference method).



Measurement Principle of FM Continuous Wave Radar Level Meter

The antenna emits radar waves, which are reflected by the surface of the medium in the t-zone for a period of time before being received by the antenna. The radar measurement principle is FMCW (Frequency Modulated Continuous Wave).The FMCW radar emits signals in the high-frequency band, and the frequency of the radar wave increases linearly within its measurement related area (called sweep frequency). The emission of signals corresponds to a time difference between reflection and reception from the surface of the medium Δ T. Time difference, Δ T=2d/c, where d represents the distance between the radar and the surface of the medium, and c represents the speed of travel of the radar wave above the surface of the medium, that is, the speed of light.By comparing the difference between the actual transmission frequency and the received frequency Δ f. Perform signal processing. The frequency difference is proportional to the distance. The larger the frequency difference, the greater the distance, and vice versa. After Fast Fourier Transform (FFT), the frequency difference Δ F is converted into a frequency spectrum and the distance is calculated based on this. The level result is obtained from the difference in tank height and measurement distance.

① Transmitters
② Mixer
③ Antenna
④ Frequency variation and medium The distance between surfaces is proportional
⑤ Time difference, Δ T
⑥ Frequency difference, Δ F
⑦ Frequency of transmission
⑧ Received frequency
⑨ Frequency s
⑩ Time

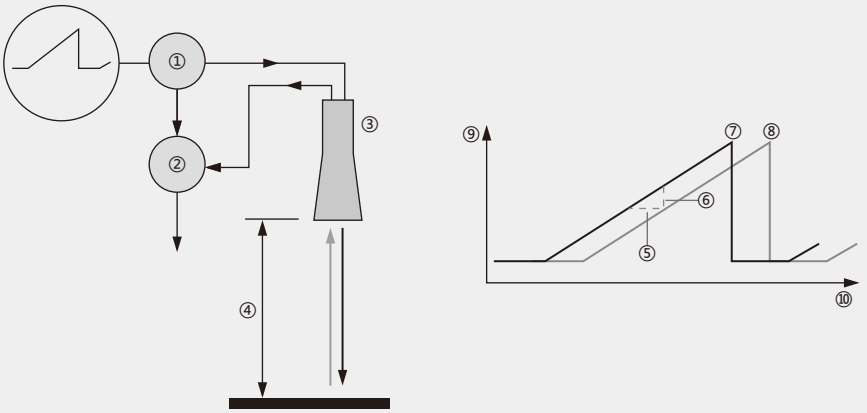


Figure 1-1: FMCW radar

Electrical installation: two wire and four wire systems

A non-contact radar level meter with frequency modulated continuous wave and pulse

Two wire non explosion-proof Non-Ex

① Power supply② HART ® Communication resistor, 250 Ω③ 14... 30 VDC for minimum/maximum port voltage at 22mA output④ 10... 30 VDC for minimum/maximum port voltage at 22mA output (requires additional power supply)

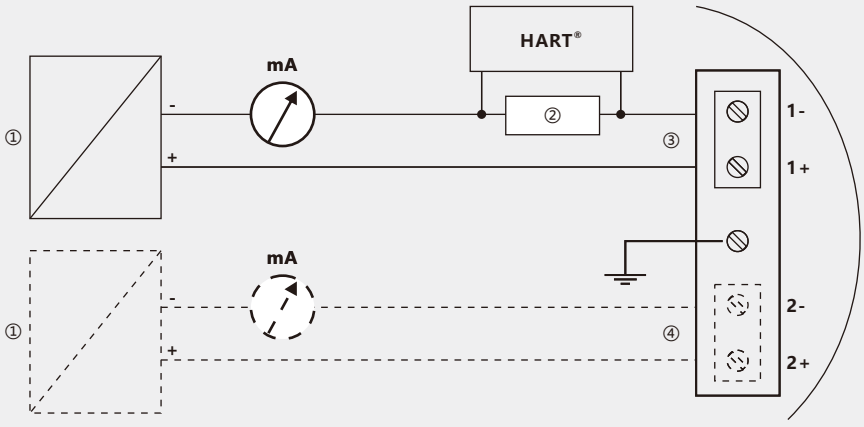


Figure 5-1: Non Explosion Proof HART ® Wiring diagram

Two wire non explosion-proof Non-Ex

① Intrinsic safety power supply
② Non explosion proof zone
③ Explosion proof zone
④ HART ® Communication resistor, 250 Ω
⑤ 14... 30 VDC, minimum/high port voltage for 22mA output
⑥ 10... 30 VDC, minimum/high port voltage for 22mA output (requires additional power supply)

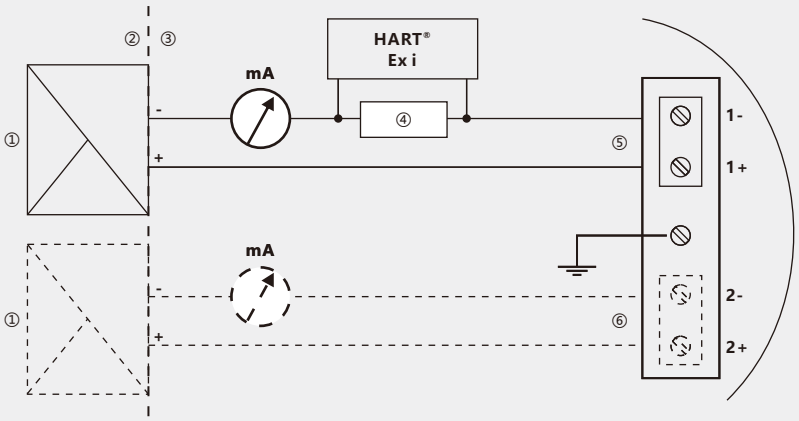


Figure 5-2: HART in Exi Loop ® Wiring diagram

Two wire explosion-proof explosion-proof type Exd

① power supply
② Resistance for HART communication, 250Ω
③ Non-explosion-proof area
④ Explosion-proof area
⑤ IUI≤5V
⑥ 20...36 VDC, which is used for the lowest/highest port voltage at 22mA output.
⑦ 10...30 VDC, which is used for the lowest/highest port voltage when 22mA is output (external power supply is required).

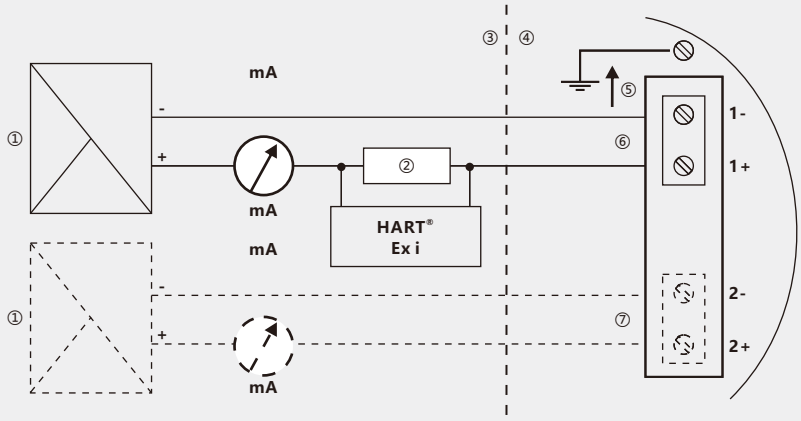


Figure 5-3: HART® wiring diagram in Exd loop

Four-wire non-explosion-proof and flame-proof type Non-Ex / Exd

① power supply
② 10...30 VDC, which is used for the lowest/highest port voltage when 22mA is output (external power supply is required).

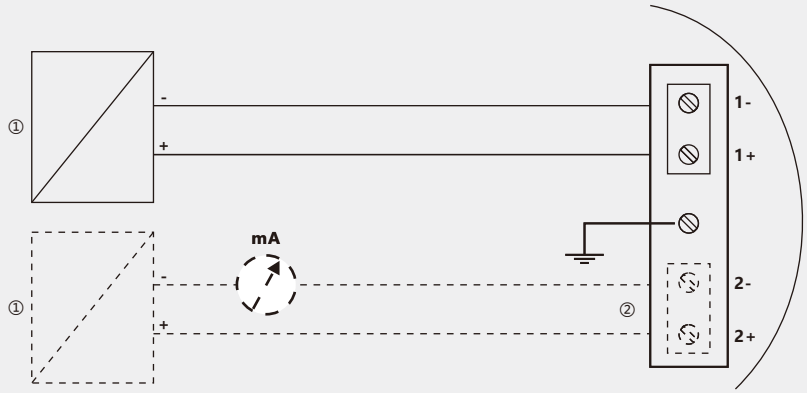


Figure 5-4: Wiring Diagram in Non-explosion-proof and Flameproof Circuit

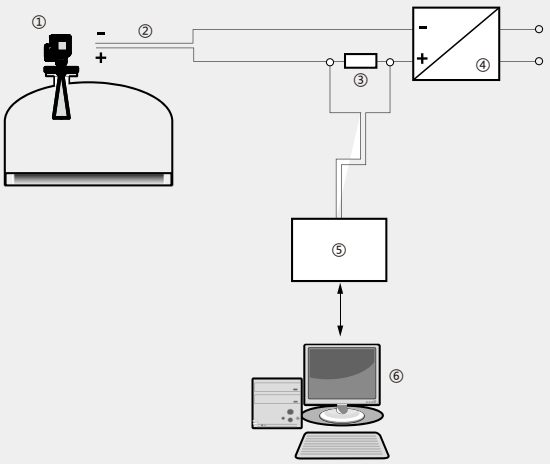
Network

Basic information

If the instrument adopts HART® communication protocol. This protocol conforms to the standards of HART® Communication Foundation. Point-to-point connection can be adopted. You can also have 1 to 63 addresses in a multipoint network. The instrument factory is set to point-to-point communication mode. If the communication mode needs to be changed from point-to-point to multipoint, please refer to the manual "Network Settings".

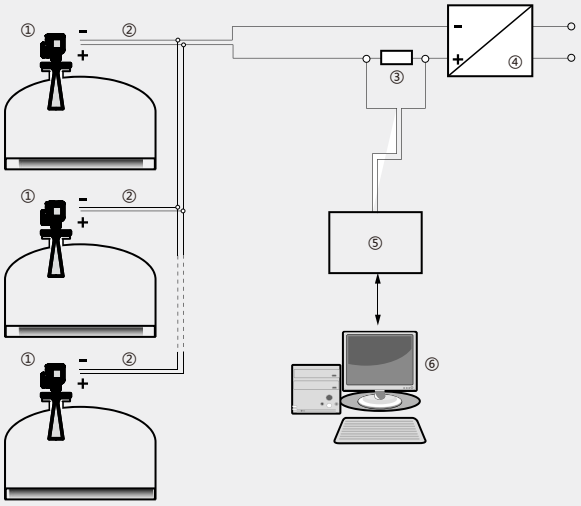
point-to-point connection

① Instrument address (0 is used for point-to-point connection)
② 4...20mA + HART®
③ Resistors for HART communication (usually 250 Ω)
④ Power supply
⑤ HART® converter
⑥ HART® communication software



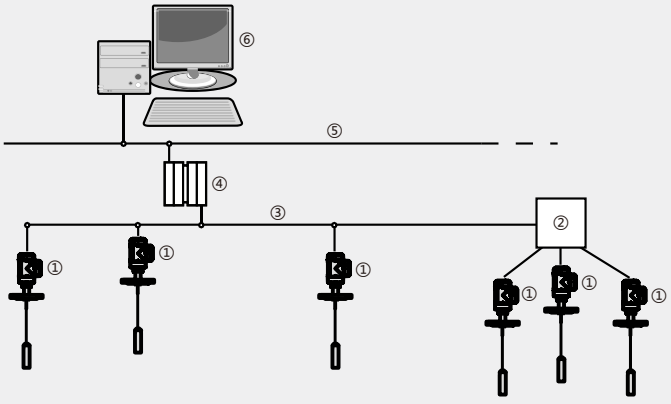
Multipoint network

(1) instrument address (each instrument must have a different address.
In a multipoint network)
② 4...20mA+HART®
③ Resistors for HART communication (usually 250 Ω)
④ Power supply
⑤ HART® converter
⑥ HART® communication software



Fieldbus network

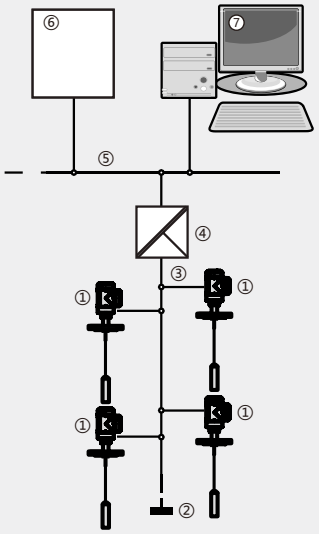
① Field instrument
② Junction box
③ H1 network
④ H1/HSE converter
⑤ High-speed Ethernet (HSE)
⑥ workstation



Network

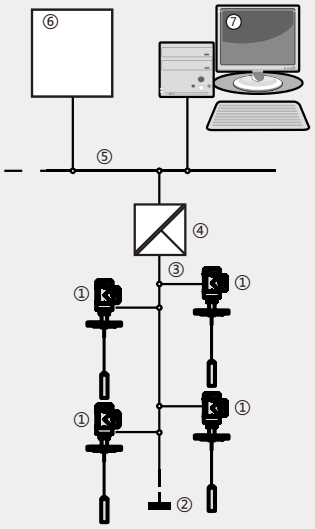
PROFIBUS PA/DP Network

① Field instrument
② Bus terminal
③ PROFIBUS PA bus segmentation
④ sectional coupler (PA/DP link)
⑤ PROFIBUS DP bus
⑥ Control system (PLC/Class 1 host)
⑦ Workstation or operation station (control tool/Class 2 host)



MODBUS RS-485 Network

① Field instrument
② Bus terminal
③ MODBUS bus segmentation
④ Segmented coupler (RS-485 link)
⑤ MODBUS
⑥ Control system (PLC/Class 1 host)
⑦ Workstation or operation station (control tool/Class 2 host)



Use

It is entirely the responsibility of the user of the instrument to use the measuring equipment correctly and reasonably and choose the appropriate material to make it resistant to the corrosion of the measuring medium.
The manufacturer shall not be liable for any damage caused by improper use or beyond the specified scope of use.
Ludwig radar level meter measures distance, level, mass, volume and reflectivity of liquid, paste and slurry.
It has the protection function of WHG anti-overflow tank and can be installed on tank, reaction kettle and open channel.

fix

Requirements before installation

To ensure the correct installation of the instrument, please follow the following precautions.

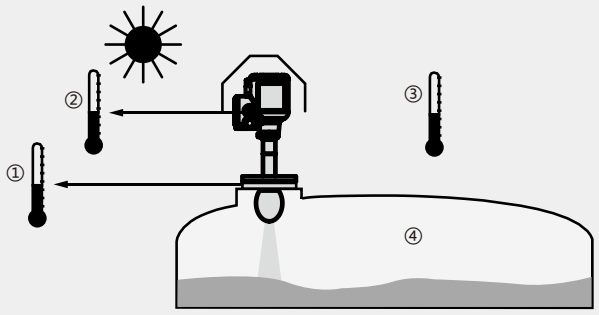
· Make sure there is enough space around.

· Protect the signal converter from direct sunlight. If there is direct sunlight, a protective cover should be installed.

· Do not subject the signal converter to violent vibration. The instrument was tested for vibration according to EN 50178 and IEC 60068-2-6 standards.

Non-contact radar level meter with FM continuous wave and pulse
Pressure and temperature range:

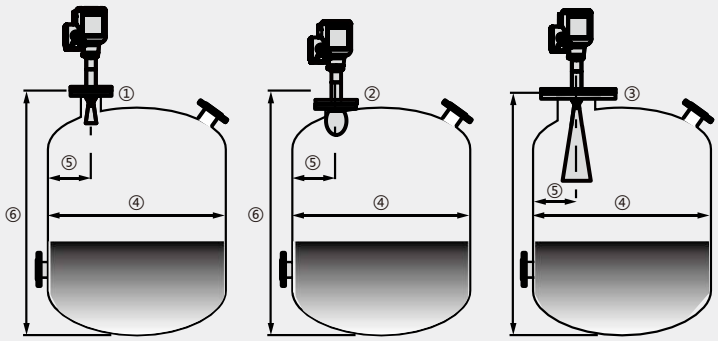
① **Process connection temperature**
Non-explosion-proof equipment: the temperature range depends on the type of antenna, process connection and sealing material. Refer to the following table.
Instruments with explosion-proof certification: See supplementary instructions.
(2) **the ambient temperature of the display screen.**
-20...+70℃/ -4...+158℉
If the ambient temperature is not within this range, the display may temporarily fail to work. The instrument will continue to measure the level and transmit the output signal.
③ **Ambient temperature**
Non-explosion-proof instrument: -40...+80℃/-40...+176℉
Instruments with explosion-proof certification: See supplementary instructions.
④ **Process pressure**
The temperature range of process connection must follow the temperature limit of sealing material. The operating pressure range is limited by the process connection and flange temperature used.



Recommended installation location

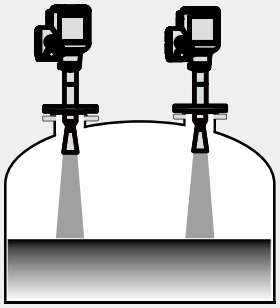
Please follow these suggestions to ensure the correct measurement of the instrument. This will affect the performance of the instrument.
We recommend that you prepare for installation when the tank is empty.
Recommended installation position of short neck for liquid, paste and slurry

① Short neck or mounting hole for DN40 or DN50 metal horn antenna.
② Short neck or mounting hole for DN80 or DN100 metal horn antenna and DN80 water drop antenna.
③ Used for short neck or installation of DN150 or DN200 metal horn antenna and DN100 or DN150 water-drop antenna.
④ Diameter of the tank
⑤ Minimum distance between short neck or installation hole and tank wall (depending on antenna type and size):
-DN40 or DN50 metal bell mouth: 1/5× tank height
-DN80 or DN100 metal bell mouth: 1/10× tank height.
-DN80 water drop type: 1/10× tank height
-DN150 or DN200 metal bell mouth: 1/20× tank height.
-DN100 or DN150 drop type: 1/20× tank height.
-Antenna of other specifications: 1/20× tank height
Maximum distance between short neck or installation hole and tank wall (depending on antenna type and size):
-Metal horn or water drop type: 1/3× tank diameter
⑥ Tank height
If there is a short neck on the tank before installation, it must be at least 200mm/ 7.9 "from the tank wall. The tank wall must be smooth and there must be no obstacles between the short neck or the tank wall.



Number of instruments running in a tank.

There is no limit to the number of instruments installed in the same tank. It can be installed beside other radar level meter.



Installation restriction

Level detection radar and tank level detection radar

The level detection radar measures the level in the open air or closed environment (metal cans, etc.). The tank level detection radar only measures the level in the closed environment. You can use the level detection radar to measure the application.

Generate signal interference

· Objects in tanks or pits.

· A sharp angle perpendicular to the radar wave path.

· Sudden change of tank diameter in radar wave path.

Instruments are not allowed to be installed above objects (mixers, etc.) in tanks or pits. Objects in the tank or pit will generate interference signals.

If there is interference signal, the instrument will not be able to measure accurately.

If the instrument can't be installed on the other side of the tank or the pit, conduct a space spectrum scan.

Equipment and Obstacles: How to Avoid Signal Interference

Avoid installing instruments directly above equipment and obstacles in tanks and pits. This will affect the performance of the instrument.

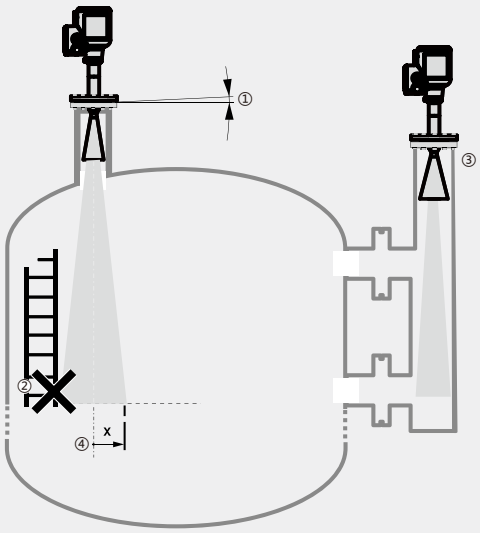
If possible, do not install the short neck at the center line of the tank.

① The inclination angle of the instrument shall not exceed 2.

② If there are many obstacles in the radar beam range, we recommend that you make a space spectrum record.

③ If there are many obstacles in the tank, you can install the instrument on the riser.

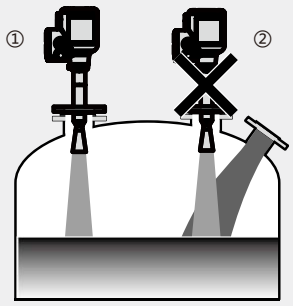
④ Antenna beam radius: refer to the table below. The beam radius increases by "x"mm with the increase of antenna distance per meter.



Medium inlet

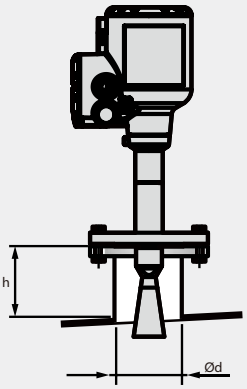
① The installation position of the instrument is correct.
② The instrument is too close to the inlet.

Do not place the instrument near the feed inlet. If the medium impacts the antenna when the tank is fed, it will cause erroneous measurement. If the medium is under the antenna when the tank is fed, it will also cause wrong measurement.



flanged connection

Ød = Short neck diameter
h = Short neck height



Recommended short neck size for flange connection
The short neck must be as short as possible. Refer to the figure below for the maximum height of short neck:

Short neck and antenna diameter, Ød		Maximum height of short neck, h			
		Metal horn antenna		Droplet antenna	
[mm]	[inch]	[mm]	[inch]	[inch]	[inch]
40	1½	140①	5.51①	-	-
50	2	150①	5.91①	-	-
80	3	260①	10.24①	2.36①	2.36①
100	4	330①	12.99①	2.76①	2.76①
150	6	490①	19.29①	3.94①	3.94①
200	8	660①	25.98①	-	-

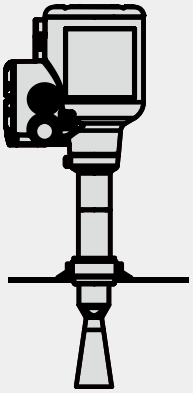
① If the instrument has an antenna extension tube, this option can extend the maximum height of the short neck. Increase the length of the antenna extension tube connected to the instrument on this value.

Threaded connection

Recommended sizes of threaded sockets
The socket must be as short as possible. If the socket is in a recess, use the maximum short neck size (flange connection) here.

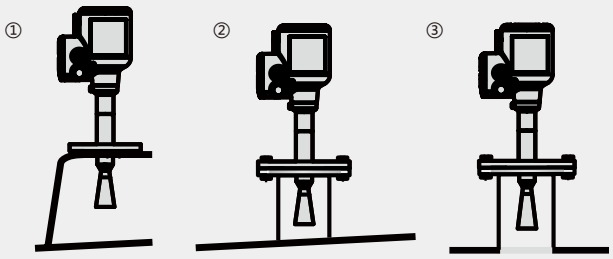
If the instrument has an antenna extension tube, this option can extend the maximum height of the socket. Increase the length of the antenna extension tube connected to the instrument on this value.

Radar instrument for level detection: suggestions for installation in pits and non-conductive tanks



The instrument is installed on the tank made of non-conductive material.

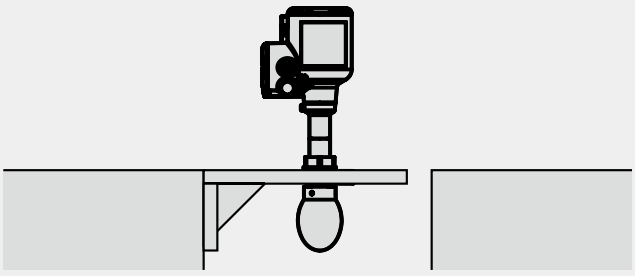
① The radar equipment for level detection is installed on the basic support (indoor installation).
② The level detection radar equipment is on the sealed support.
③ The radar equipment for level detection is on the tank made of conductive material, but it is equipped with a non-conductive sealed "window".
If the instrument cannot enter the tank and the tank is made of non-conductive material (plastic, etc.), you can install a bracket on the tank top without opening. We suggest that you install the antenna as close to the top of the tank as possible.
If the tank is outdoors, we suggest that you seal the support. If raindrops fall between the tank top and the instrument, it will affect the performance of the instrument.
If the instrument is used in a dusty environment, we suggest that you seal the bracket. If dust is between the tank top and the instrument, it will affect the performance of the instrument.



Open pit

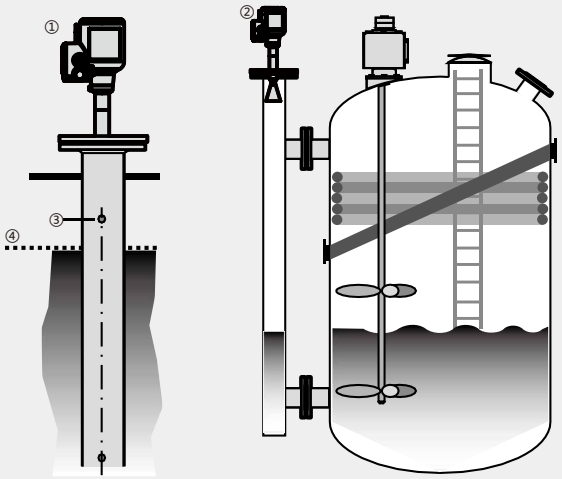
If the instrument must measure the material level in the pit, you can install a bracket beside or above the pit.

Riser (waveguide and bypass pipe)
This guide is only for meters with metal horn antenna option.
Install on the riser in the following cases:
· There is highly conductive foam in the tank.
· Liquid level fluctuates or is stirred violently.
· There are too many other interferences in the tank.
· The instrument is used to measure the liquid in the floating roof tank (petrochemical).
· The instrument is installed in a horizontal horizontal tank.



Suggestions on installation of riser (waveguide and bypass pipe)

① waveguide solution
② Bypass pipe solution
③ Air circulation hole
④ Liquid level

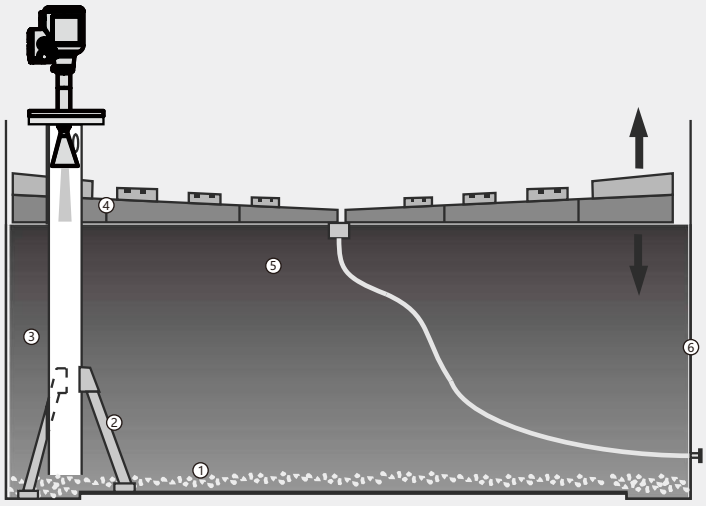


· Risers must conduct electricity.
· The internal diameter of the riser must not be greater than the antenna diameter by 5mm/ 0.2 "(for liquids with high dielectric constant).
· The riser must be straight. The diameter change of inner diameter shall not exceed 1mm/ 0.04 ".
· Risers must be vertical.
· Recommended surface finish: <±0.1mm/ 0.004" 。
· Ensure that there is no accumulation at the bottom of the riser.
· Make sure there is liquid in the riser.

·You must drill an air circulation hole.
Installed in a tank containing liquid and foam.
· Drill an air circulation hole (maxØ10 mm/0.4 ") above the maximum level of the waveguide.
· Remove the burr on the hole.
Installed in a tank containing liquid without foam.
· Drill an air circulation hole (maxØ10 mm/0.4 ") above the maximum level of the waveguide.
· Drill one or more liquid circulation holes in the waveguide (if the tank contains more than one liquid).
· These holes enable liquid to flow freely in the waveguide and tank.
· Remove the burr on the hole.

Waveguide: floating roof
If the instrument must be installed on a floating roof tank, install it in a metal waveguide.

① Sediment
② Fixed support
③ Waveguide tube
④ Floating roof
⑤ Medium
⑥ Tank body



Waveguide tube: horizontal horizontal tank

In the following cases, we suggest that you install the instrument in the waveguide:

It is a horizontal tank.

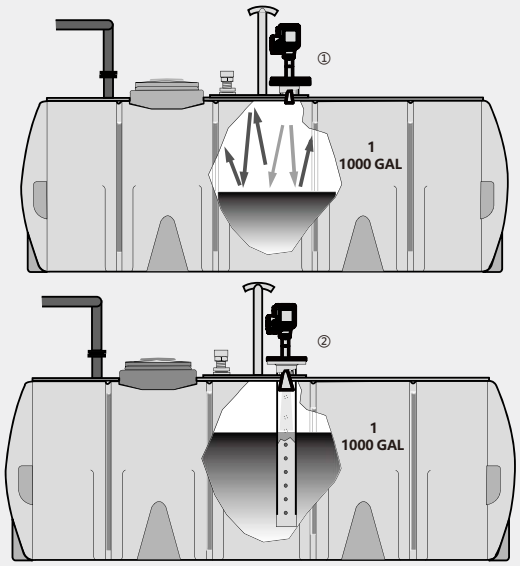
It's a metal can

The medium to be measured has a high dielectric constant and is at the center line of the tank;

① The instrument is not installed in the waveguide. There will be multiple reflections. Please refer to the following warnings.

② The instrument is installed in the waveguide and the measurement is accurate.

If the instrument is installed in a horizontal horizontal tank with high dielectric constant liquid and no waveguide, do not place it at the center line of the tank. This will produce multiple reflections and the meter will be inaccurate. Use instrument software to keep the effect of multiple reflections to a minimum.



by-pass pipe

Installed next to a tank containing liquid and foam.

The process connection at the top of the bypass pipe must be above the maximum liquid level.

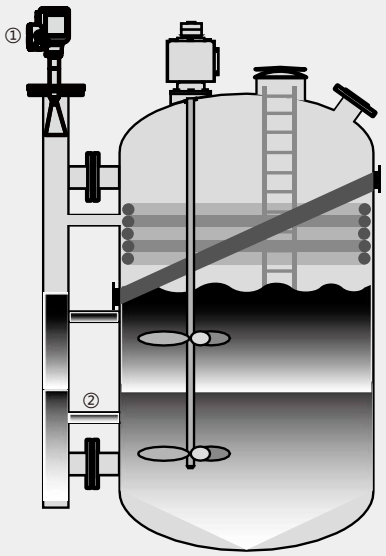
The process connection at the bottom of the bypass pipe must be below the minimum liquid level.

Installed beside a tank containing multiple liquids.

The process connection at the top of the bypass pipe must be above the maximum liquid level.

The process connection at the bottom of the bypass pipe must be below the minimum liquid level.

Additional process connections are also required for the free circulation of liquid along the bypass pipe.



PDG70-U-Selection composition

Selection examples PDG70-U

B	C	E	H	N	S	N	G	Y	A	H	L	C
1	2	3	4	5	6	7	8	9	10	11	12	13

1.Connection	A	Four wire system
	B	Two wire system
2.Antenna Types	C	Droplet type
	D	Flat flange type
3.material quality	E	316L
	F	304SS
	T( )	Other material types
4.Process temperature	H	-40℃-85℃
	I	-40℃-200℃
	J	-40℃-500℃
	K	-40℃-1000℃
5.Process pressure	N	2MPa
	O	3MPa
	T( )	Other pressures
6.Flange connection specifications(Thread item is not selected)	S	DN50
	U	DN65
	V	DN80
	W	DN100
	X	DN125
	Y	DN150
	Z	DN200
	T( )	Other flange types
6.1.Thread specification (Flange item is not selected)	A	G1½
	B	G3½
	T( )	Other specifications
7.Range and material type	S	0-10m
	V	0-30m
	N	0-70m
	U	0-120m
8.Output	G	4~20mA
	H	4-20mA+HART
	I	4-20mA+Modbus
	J	4-20mA+RS485
	T( )	Other output methods
9.Shell/protection level	X	Aluminum/IP67
	Y	304/IP67
	Z	316L/IP67
	T( )	Other materials

PDG70-U-Selection composition

Selection examples PDG70-U

B	C	E	H	N	S	N	G	Y	A	H	L	C
1	2	3	4	5	6	7	8	9	10	11	12	13

10.Electrical interface	A	M20x1.5	
	B	1/2NPT	
	T()	Other electrical interfaces	
11.Field display/ programming	G	Belt	
	H	Without	
12.Power source	L	24V DC	
	W	220V AC	
13.authentication	A	CE	
	B	SIL	
	C	Intrinsic safety type	
	D	Explosion proof type	
	E	Nothing	
	T( )	Other certifications	

Instructions:

The PDG70-U ultra-high frequency radar is wired in a two wire system, with a water droplet antenna type made of 316L material, a process temperature of -40 ℃ -85 ℃, a process pressure of 2MPa, a process connection specification of DN50 (6,6.1), a measurement range of 0-70m, an output of 4-20mA, a shell material of 304 stainless steel, a protection level of IP67, an electrical interface of M20 * 1.5, without on-site display, and a power supply of 24V DC, which is intrinsically safe and explosion-proof.

Product Certification

Compliance and approval; Ludwig flow meters meet key standards and certifications for process measurement technology; To ensure the highest reliability in such settings;

Ludwig China Representative Office
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