TECHNICAL GUIDANCE

2-wire System Level Radar
TLR7500
80GHz
Microwave level meter

OUTLINE

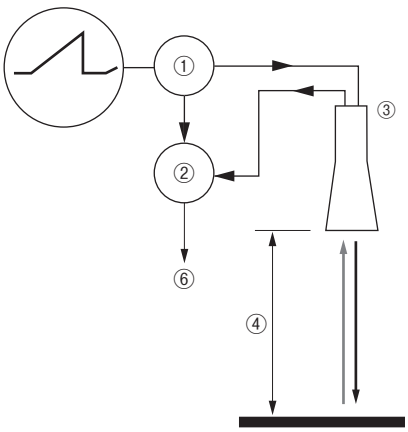
The **TLR7500** is a non-contact type continuous level meter using microwaves. This meter determines the level of a measured object by emitting microwaves and measuring the time taken for the microwaves to travel out, be reflected and return from the object.
Since the velocity of electromagnetic waves is hardly affected by temperature and pressure, meters of this type can accurately measure levels under any conditions. Measurements are also independent of the viscosity, or changes in the density and temperature of measured objects, allowing such meters to be used for a wide range of temperatures and pressures.
Using a newly developed lens antenna, the **TLR7500** can be mounted on small-diameter nozzles, and is ideal for level measurement of 80-GHz high directivity as well as ultra-small containers.
Inheriting the features of existing microwave level meters, the **TLR7500** is even easier to use.

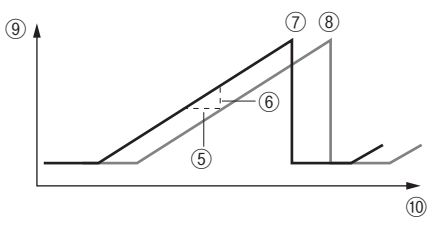
FEATURES

- ❑ Non-contact, continuous level measurement with high accuracy
- ❑ Measuring various objects such as liquids and slurries
- ❑ Displaying and outputting measurements of level, distance, volume, and mass
- ❑ High-accuracy level measurement independent of changes in temperature, pressure, or density
- ❑ Up to 4 MPa operating pressure range from vacuum
- ❑ Wide operating temperature range from –50°C to 150°C
- ❑ Minimum-size DN20 (¾") antenna mountable on small-diameter nozzles
- ❑ Easy mounting on top of tanks, no need to worry about leakage
- ❑ Suitable for various installation environments with high directivity
- ❑ Compact housing design for mounting in narrow spaces
- ❑ Can start measuring immediately after mounting with simple parameter setting
- ❑ Range setting by numerical values, no need to adjust the range for the fluctuation of actual liquid
- ❑ Easy to input parameters
- ❑ Maintenance-free with no moving parts

MEASUREMENT PRINCIPLE

Microwaves, whose frequency linearly changes in the main body, are continuously emitted from the antenna. The microwaves are reflected by the measured object and return to the antenna. Based on the frequency of the returned microwaves, the return time can be calculated. Since the propagation speed of microwaves is constant, the return time is used to calculate the distance to the measured object. The calculated distance can be displayed (output) as a level, based on the preset tank data.





① Emitted microwaves
② Received microwaves
③ Antenna
④ Distance
⑤ Time difference
⑥ Frequency difference
⑦ Emitted microwaves
⑧ Received microwaves
⑨ Frequency
⑩ Time

TOKYO KEISO CO., LTD.

TG-L2186-E00
1st edition Oct 2021 K

STANDARD SPECIFICATIONS

	Item	Description
Measurement	Object	Liquids, pastes, and slurries
	Method	Frequency modulated continuous wave (FMCW)
	Frequency	78 to 82 GHz (W band)
	Output	Level, distance, volume, and mass
	Range	Max. 50 m (depends on the dielectric constant of the measured objects and antenna type)
	Minimum output range	0.2 m
	Minimum dead zone	Antenna length + antenna extension length + 0.1 m (depends on the measuring conditions)
Output	Output	4 to 20 mA DC (HART)
	Accuracy	±0.01 mA (at 20ºC) (Output accuracy is added to the accuracy of the display value)
	Resolution	±5μA
	Temperature drift	50 ppm/K (typical)
	Error signal	21.5 mA DC, 3.5 mA DC (selectable by parameter)
	Load resistance (max.)	R [Ω] ≤ (Supply voltage – 12 V)/21.5 mA (Standard type/Ex i)
		R [Ω] ≤ (Supply voltage – 16 V)/21.5 mA (Ex d)
Accuracy		±3 mm R. D. (less than 10 m), ±0.03%/R. D. (10 m or more)
	Standard conditions	Temperature: 15ºC to 25ºC Pressure: 0.1 MPa ±5 kPa Humidity: 60% ±15% Target: Metal plate
	Resolution	1mm
	Repeatability	±1mm
Measuring conditions	Temperature of process connection	–50 to +150ºC The operating temperature range depends on the seal materials. Refer to ANTENNA SPECIFICATIONS.
	Operating pressure	0 kPa (abs) to 4.0 MPa
	Dielectric constant	1.4 or more: Direct mode (depends on the measuring conditions and antenna type) 1.1 or more: TBF mode *1
	Change rate (max.)	60 m/min (depends on the measuring conditions)
Instrument specifications	Ambient temperature	–40 to +80ºC (For explosionproof type, refer to EXPLOSIONPROOF SPECIFICATIONS)
	Relative humidity	0 to 99% (no condensation)
	Storage temperature	–40 to +85ºC
	Protection class	IP66/IP68 [IEC60529]
		NEMA250: NEMA type 6, 6P (housing), type 6P (antenna)
	Explosionproof	JPN Ex explosionproof Ex ia IIC T6...T3 Ga/Gb Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db Ex db ia IIC T6...T3 Ga/Gb Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db
		ATEX explosionproof II 1/2 G Ex ia IIC T6...T3 Ga/Gb II 1/2 D Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db II 1/2 G Ex db ia IIC T6...T3 Ga/Gb II 1/2 D Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db
		IECEx explosionproof Ex ia IIC T6...T3 Ga/Gb Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db Ex db ia IIC T6...T3 Ga/Gb EX ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db
Electrical connection	Type	2-wire loop-powered system
	Power supply	Rated voltage: 24 V DC
		Voltage range: 16 to 36 V DC (Ex d), 12 to 30 V DC (Standard type, Ex i) *2
	Cable entry	M20 × 1.5
	Terminal	0.5 to 2.5 mm^2
	Cable outer diameter	7 to 12 mm
Material	Housing	Aluminum (polyester coating)
	Process connection	Stainless steel (SS316L)
	Antenna	PEEK, stainless steel (SS316L)
	Seal	FKM / FPM, Kalrez® 6375, EPDM
	Weather protection (Accessory)	Stainless steel (SS316L)
Display	Display panel	LCD with backlight, 128 × 64 pixels in 64-step gray scale
		Language: English or Japanese
	Control unit	4 key buttons (Right, Enter, Up and Down)
	Operating ambient temperature	–20 to +70°C
Process connection	Thread	G¾", G1", G1-½", G3", ¾NPT, 1NPT, 1-½NPT, 3NPT male thread
	Flange	JIS 10K 50 to 200 A
		2" to 8" ASME 150 lbs, 300 lbs

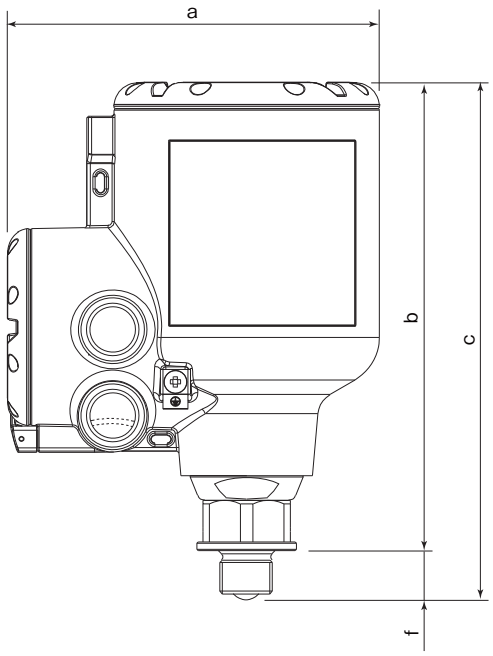
*1: The dielectric constant of measured objects may not be measured depending on the measuring conditions.
*2: Voltage supply required to output 21.5 mA

ANTENNA SPECIFICATIONS

	Description	
Antenna type	DN20 (¾") lens antenna	
	DN25 (1") lens antenna	
	DN40 (1½") lens antenna	
	DN70 (2¾") lens antenna	
Measuring range	Max. 5 m: DN20 (¾") lens antenna	
	Max. 10 m: DN25 (1") lens antenna	
	Max. 25 m: DN40 (1½") lens antenna	
	Max. 50 m: DN70 (2¾") lens antenna	
Beam angle	DN20 (¾") lens antenna: 15 degrees	
	DN25 (1") lens antenna: 10 degrees	
	DN40 (1½") lens antenna: 8 degrees	
	DN70 (2¾") lens antenna: 4 degrees	
Operating temperature	–40 to +150°C (Seal material: FKM/FPM) –20 to +150°C (Seal material: Kalrez® 6375) –50 to +150°C (Seal material: EPDM)	
Operating pressure	0 kPa (abs) to 4.0 MPa	
Process connection	DN20 (¾") lens antenna	G¾", ¾NPT male thread
	DN25 (1") lens antenna	G1", 1NPT male thread
	DN40 (1½") lens antenna	G1½", 1½NPT male thread JIS10K 50A, 80A, ASME 2", 3" 150 lbs, 300 lbs, flange
	DN70 (2¾") lens antenna	G3", 3NPT male thread JIS10K 80A, 100A, 150A, 200A, ASME 3", 4", 6", 8" 150 lbs, 300 lbs, flange

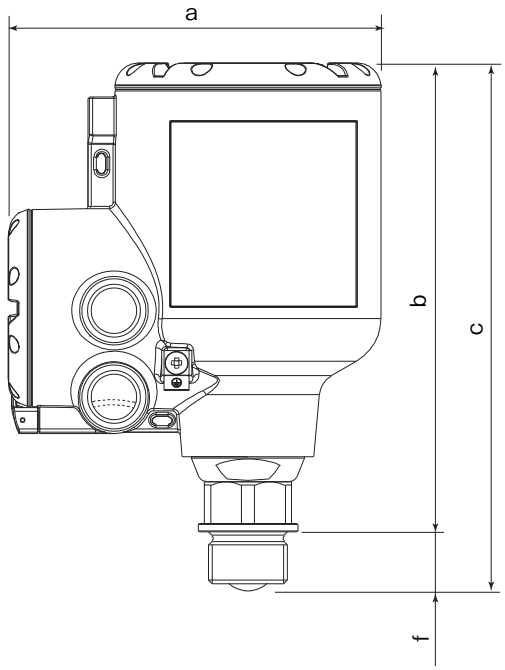
EXTERNAL DIMENSIONS

DN20 lens antenna



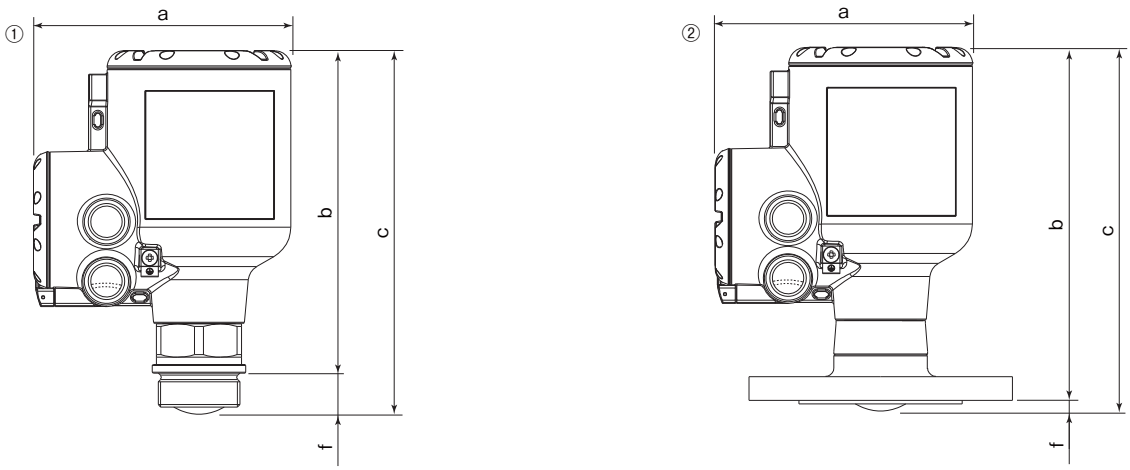
Process connection	Dimensions [mm]			
	a	b	c	f
¾" thread	151	190	213	23

DN25 lens antenna



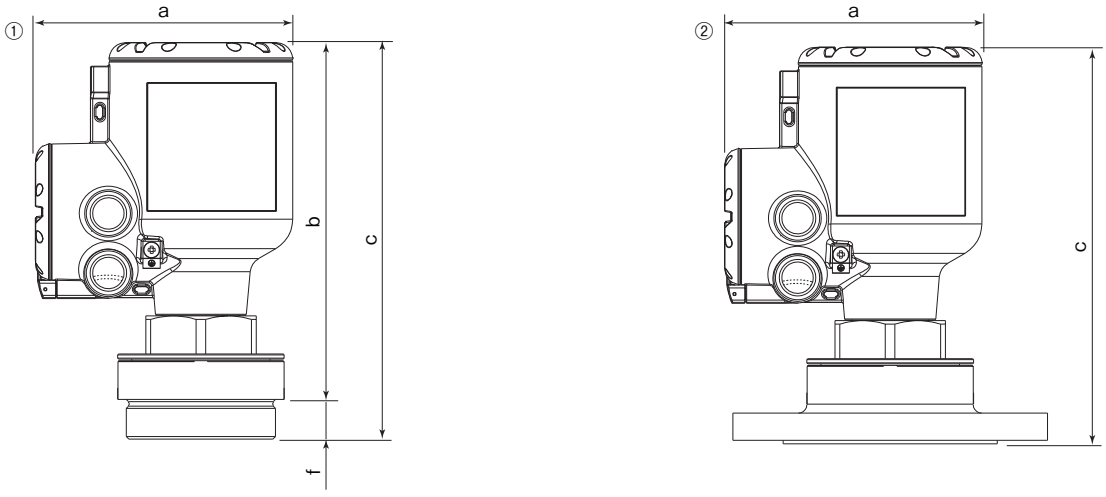
Process connection	Dimensions [mm]			
	a	b	c	f
1" thread	151	191	215	24

DN40 lens antenna



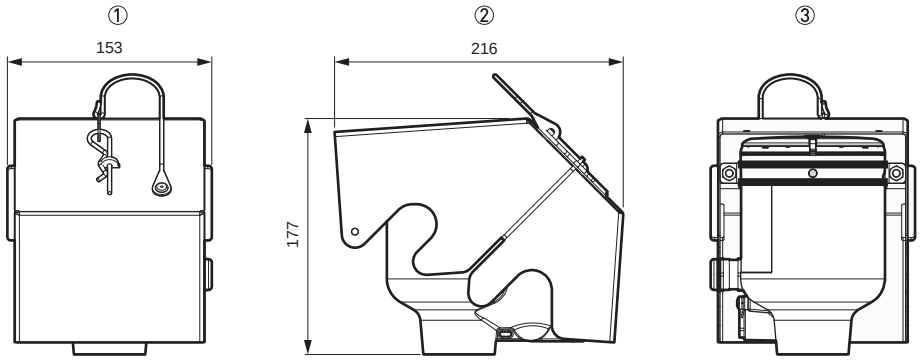
Process connection	Dimensions [mm]			
	a	b	c	f
① 1½" thread	151	190.5	215	24.5
② Flange	151	210.5	215	4.5

DN70 lens antenna



Process connection	Dimensions [mm]			
	a	b	c	f
① 3" thread	151	210	233	23
② Flange	151	—	233	—

Weather protection (Accessory)



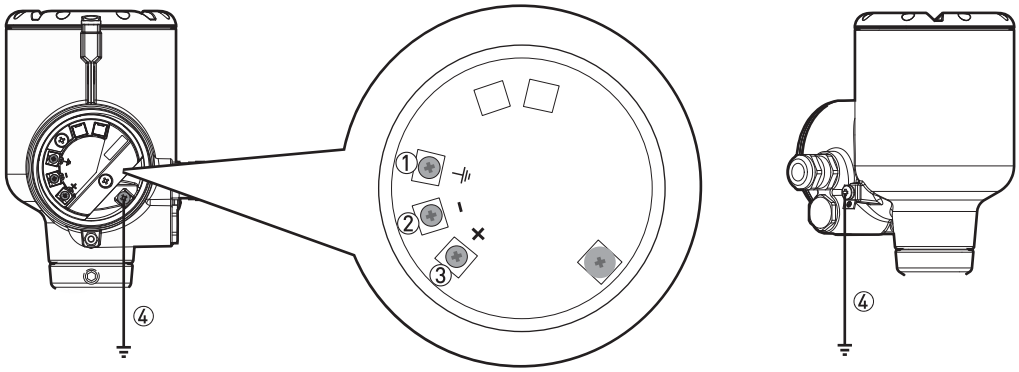
① Front
② Left side
③ Back

MASS

Part name		Specification	Mass [kg]
Housing		Aluminum	2.1
Antenna	DN40 lens antenna	1½" thread	2.6
		DN80 /3" flange	6.7
		DN80 /3" flange with antenna extension	7.8
	DN70 lens antenna	3" thread	4.3
		DN80 /3" flange	7.0
Accessory			
Weather protection		Stainless steel	1.3

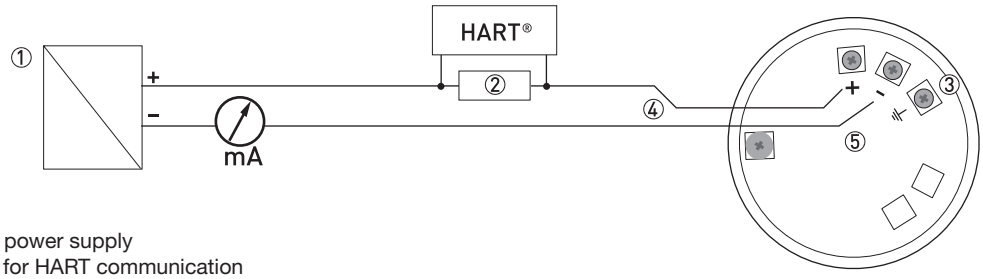
WIRING

Terminals



① Housing ground terminal (connected when the signal line is a shielded cable)
② Signal (power supply) cable (–)
③ Signal (power supply) cable (+)
④ Ground terminal (underneath the converter housing)

Wire connection



① 24 V DC power supply
② Resistor for HART communication
③ Housing ground terminal
④ Signal line
⑤ Housing wire connection board

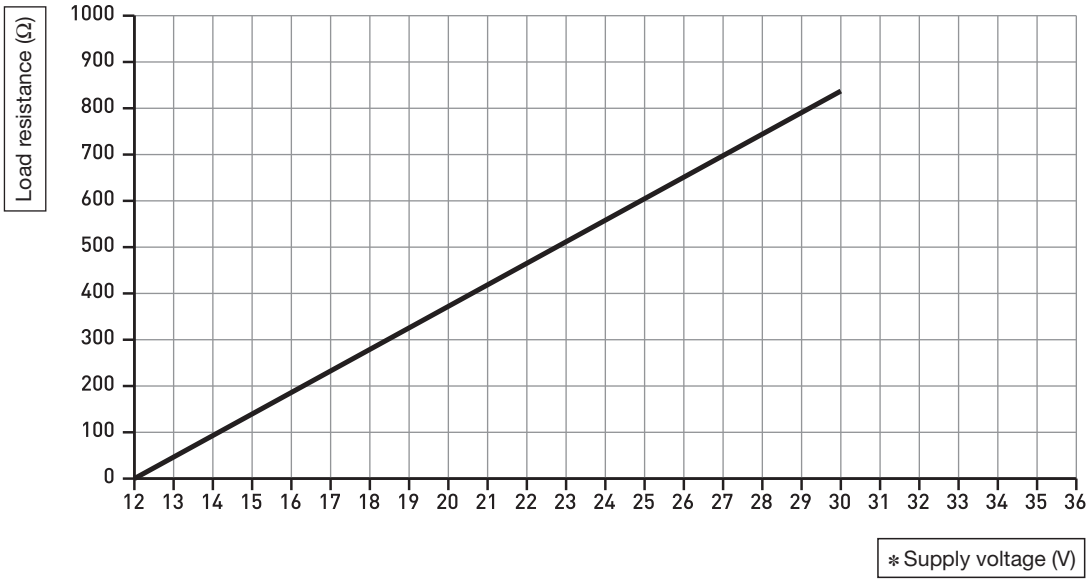
- Use stranded cable of 0.5 to 2.5 mm² cross section for a signal (power supply) line.
- Avoid laying a signal (power supply) line close to a power cable.
- Use a different power supply for the TLR7500 from those for other power instruments.
- It is recommended to use a shielded cable.
- A single-point ground with a shielded cable is recommended.

POWER SUPPLY

The graphs below show the minimum voltage required across a resistor in the loop.

Non-explosionproof products and intrinsically safe products

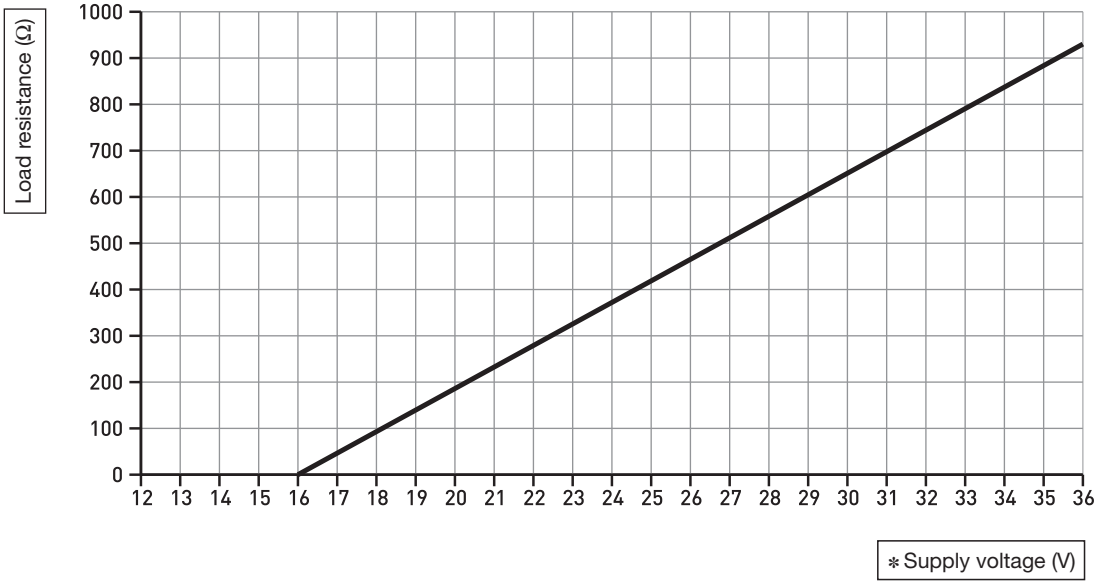
Supply voltage: 12 V to 30 V DC



∗ : The minimum voltage required to output 21.5 mA at the device terminal

Flameproof products

Supply voltage: 16 V to 36 V DC



∗ : The minimum voltage required to output 21.5 mA at the device terminal

EXPLOSIONPROOF SPECIFICATIONS

JPN Ex
Certificate number: CML 19JPN2030X

Ex ia IIC T6...T3 Ga/Gb
Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db
Ex db ia IIC T6...T3 Ga/Gb
Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db

Without distance piece

Temperature class	Max. surface temperature	Max. ambient temperature [°C]		Max. process temperature [°C]
		Aluminum housing	Stainless steel housing	
T6	T85°C	+60	+60	+60
		+48	+43	+85
T5	T100°C	+75	+75	+75
		+63	+58	+100
T4	T135°C	+64	+56	+115
		+55	+43	+135
T3	T150°C	+49	+33	+150

Temperature class	Max. surface temperature	Min. ambient temperature [°C]		Min. process temperature [°C]
		Aluminum housing	Stainless steel housing	
All *1	All *1	–40	–40	–40
		–35	–33	–50

*1: The minimum process temperature of seal material: –20°C for Kalrez 6375, and –40°C for FKM/FPM

With distance piece

Temperature class	Max. surface temperature	Max. ambient temperature [°C]		Max. process temperature [°C]
		Aluminum housing	Stainless steel housing	
T6	T85°C	+60	+60	+60
		+53	+51	+85
T5	T100°C	+75	+75	+75
		+68	+66	+100
T4	T135°C	+70	+68	+115
		+65	+61	+135
T3 *1	T200°C *1	+61	+56	+150
		+53	+46	+180
		+48	+40	+200

*1: The maximum process temperature of seal material: +150°C for EPDM

Temperature class	Max. surface temperature	Min. ambient temperature [°C]		Min. process temperature [°C]
		Aluminum housing	Stainless steel housing	
All *2	All *2	–40	–40	–40
		–37	–36	–50

*2: Minimum process temperature of seal material: –20°C for Kalrez 6375, and –40°C for FKM/FPM

When using the TLR7500 as an intrinsically safe device, circuit variables must not exceed the following values.
Ui=30 V dc, Ii=130 mA, Pi=1 W, Ci=10 nF, Li=0 μH

When using the TLR7500 as a flameproof device, the ratings below must be observed.
U=16 to 36 V DC, 4 to 20 mA (passive, HART)
Um=250 V AC 50/60Hz, 250 V DC

Note: The stainless steel housing is available only for intrinsically safe devices.

ATEX
Certification No. KIWA 19ATEX0015X

II 1/2 G Ex ia IIC T6...T3 Ga/Gb
II 1/2 D Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db
II 1/2 G Ex db ia IIC T6...T3 Ga/Gb
II 1/2 D Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db

Without distance piece

EPL Ga/Gb Temperature class	EPL Da/Db Max. surface temperature	Max. ambient temperature [°C]		Max. process temperature [°C]
		Aluminum housing	Stainless steel housing	
T6	T85°C	+60	+60	+60
		+48	+43	+85
T5	T100°C	+75	+75	+75
		+63	+58	+100
T4	T135°C	+64	+56	+115
		+55	+43	+135
T3	T150°C	+49	+33	+150

EPL Ga/Gb Temperature class	EPL Da/Db Max. surface temperature	Min. ambient temperature [°C]		Min. process temperature [°C]
		Aluminum housing	Stainless steel housing	
All *1	All *1	–40	–40	–40
		–35	–33	–50

*1: The minimum process temperature of seal material: –20°C for Kalrez 6375, and –40°C for FKM/FPM

With distance piece

EPL Ga/Gb Temperature class	EPL Da/Db Max. surface temperature	Max. ambient temperature [°C]		Max. process temperature [°C]
		Aluminum housing	Stainless steel housing	
T6	T85°C	+60	+60	+60
		+53	+51	+85
T5	T100°C	+75	+75	+75
		+68	+66	+100
T4	T135°C	+70	+68	+115
		+65	+61	+135
T3 *1	T200°C *1	+61	+56	+150
		+53	+46	+180
		+48	+40	+200

*1: The maximum process temperature of seal material: +150°C for EPDM

EPL Ga/Gb Temperature class	EPL Da/Db Max. surface temperature	Min. ambient temperature [°C]		Min. process temperature [°C]
		Aluminum housing	Stainless steel housing	
All *2	All *2	–40	–40	–40
		–37	–36	–50

*2: Minimum process temperature of seal material: –20°C for Kalrez 6375, and –40°C for FKM/FPM

When using the TLR7500 as an intrinsically safe device, circuit variables must not exceed the following values.
Ui=30 V dc, Ii=130 mA, Pi=1 W, Ci=10 nF, Li=0 μH

When using the TLR7500 as a flameproof device, the ratings below must be observed.
U_N=36 Vdc, I_N=22 mA, Um=250 V ac

Note: The stainless steel housing is available only for intrinsically safe devices.

IECEx
Certification No. IECEx KIWA 19.0009X

Ex ia IIC T6...T3 Ga/Gb
Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db
Ex db ia IIC T6...T3 Ga/Gb
Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db

Without distance piece

EPL Ga/Gb Temperature class	EPL Da/Db Max. surface temperature	Max. ambient temperature [°C]		Max. process temperature [°C]
		Aluminum housing	Stainless steel housing	
T6	T85°C	+60	+60	+60
		+48	+43	+85
T5	T100°C	+75	+75	+75
		+63	+58	+100
T4	T135°C	+64	+56	+115
		+55	+43	+135
T3	T150°C	+49	+33	+150

EPL Ga/Gb Temperature class	EPL Da/Db Max. surface temperature	Min. ambient temperature [°C]		Min. process temperature [°C]
		Aluminum housing	Stainless steel housing	
All *1	All *1	–40	–40	–40
		–35	–33	–50

*1: The minimum process temperature of seal material: –20°C for Kalrez 6375, and –40°C for FKM/FPM

With distance piece

EPL Ga/Gb Temperature class	EPL Da/Db Max. surface temperature	Max. ambient temperature [°C]		Max. process temperature [°C]
		Aluminum housing	Stainless steel housing	
T6	T85°C	+60	+60	+60
		+53	+51	+85
T5	T100°C	+75	+75	+75
		+68	+66	+100
T4	T135°C	+70	+68	+115
		+65	+61	+135
T3 *1	T200°C *1	+61	+56	+150
		+53	+46	+180
		+48	+40	+200

*1: The maximum process temperature of seal material: +150°C for EPDM or PTFE drop antenna

EPL Ga/Gb Temperature class	EPL Da/Db Max. surface temperature	Min. ambient temperature [°C]		Min. process temperature [°C]
		Aluminum housing	Stainless steel housing	
All *2	All *2	–40	–40	–40
		–37	–36	–50

*2: Minimum process temperature of seal material: –20°C for Kalrez 6375, and –40°C for FKM/FPM

When using the TLR7500 as an intrinsically safe device, circuit variables must not exceed the following values.
Ui=30 V dc, Ii=130 mA, Pi=1 W, Ci=10 nF, Li=0 μH

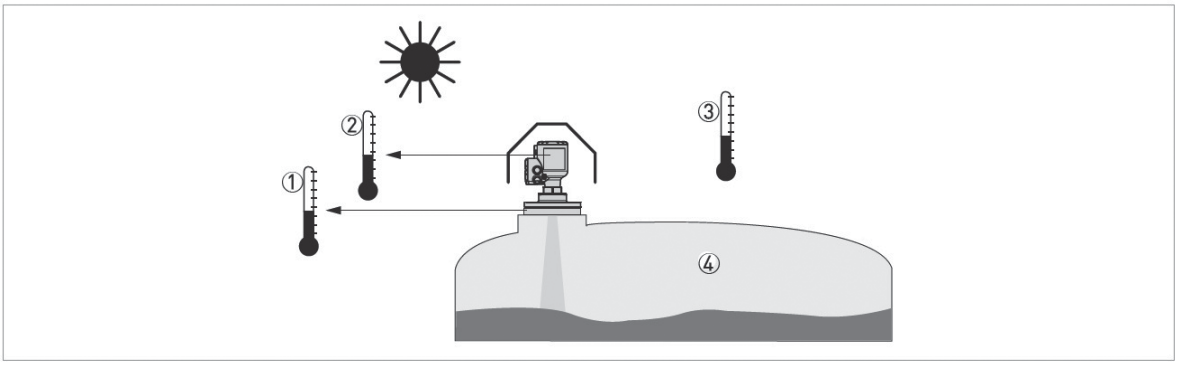
When using the TLR7500 as a flameproof device, the ratings below must be observed.
U_N=36 V dc, I_N=22 mA, Um=250 V ac

Note: The stainless steel housing is available only for intrinsically safe devices.

NOTES ON USE

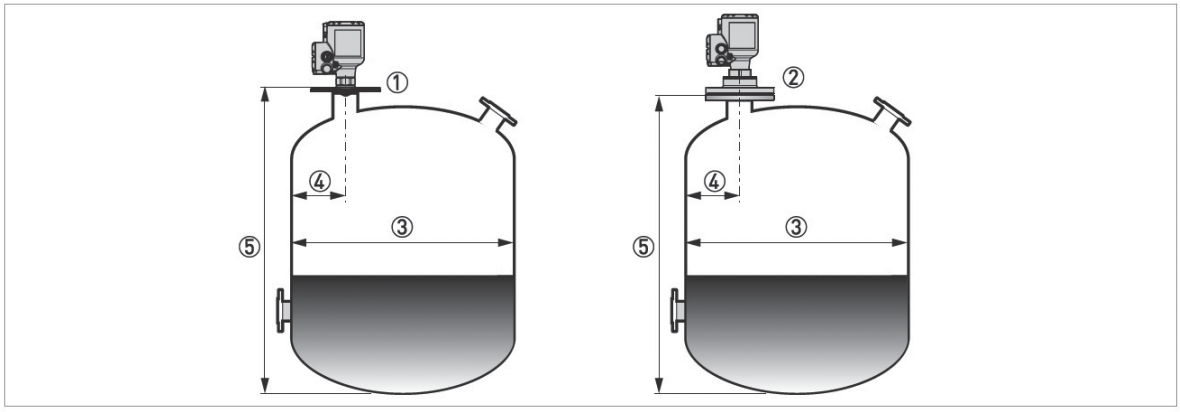
Mounting location

- Avoid direct sunshine. Use a sunshade or weather protection to keep the TLR7500 within the operating temperature range. In particular, do not expose the LCD indicator to direct sunshine. The ambient temperature must be between –40°C and +80°C.
- Do not mount the TLR7500 at a place subject to strong vibration.
- The TLR7500 has a dead zone near the sensor in which the TLR7500 cannot measure the level. This may cause difficulties. Consider the range (vertical length) of this zone when mounting the TLR7500.



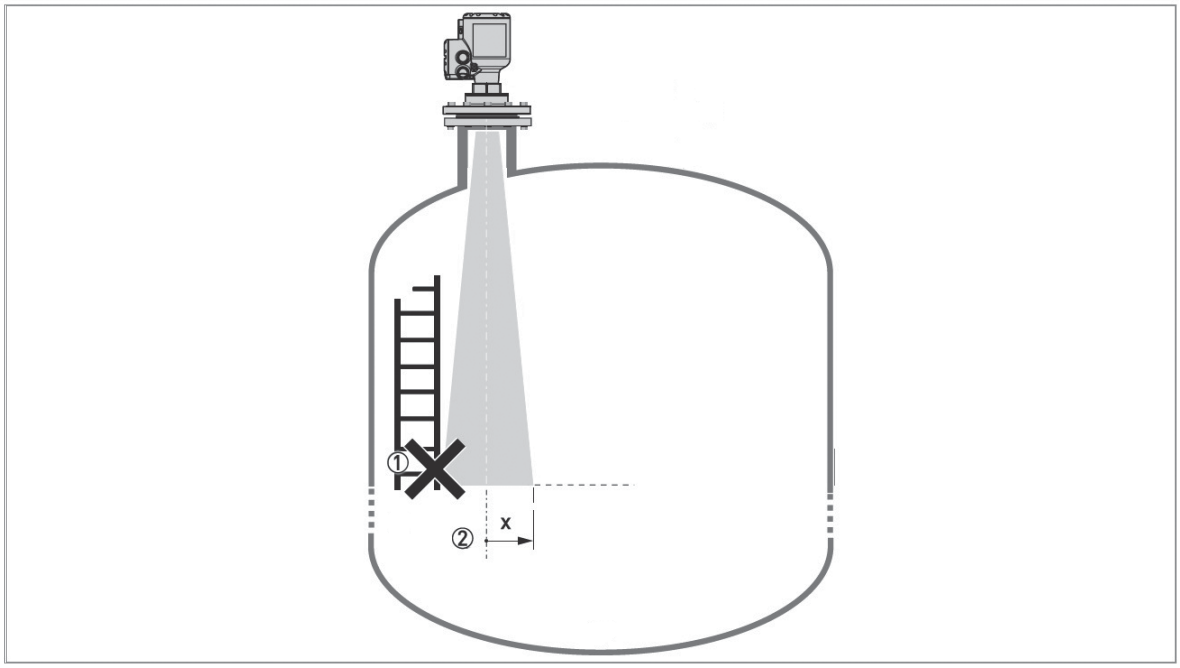
① The allowable temperature range of the process connection varies depending on the seal material.
② The temperature of the indicator must be between –20°C and +70°C.
③ The ambient temperature must be between –40°C and +80°C. Refer to EXPLOSIONPROOF SPECIFICATIONS for explosionproof types.
④ Use the TLR7500 within the specified pressure range.

- When the TLR7500 is mounted in the center of a circular tank with a diameter of 1 m or less, multiple reflections interfere with the measurement. Install it away from the center of the tank.
  When installing in the four corners of a non-cylindrical vessel such as a concrete pit, install it in a position where the distances to the two adjacent walls are not equal.
- Recommended mounting locations and distances from the vessel wall are shown below.
  In any case, the TLR7500 must be at least 200 mm off the tank wall.
- Ensure that walls within the emission range of microwaves are smooth.



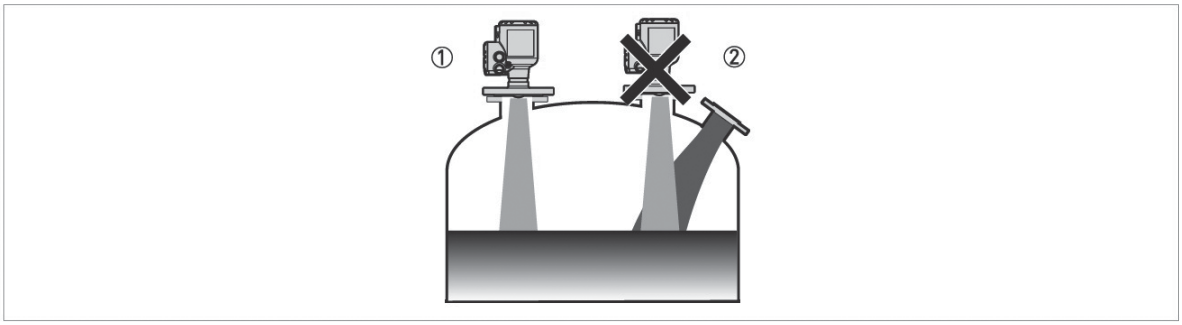
① Mounting location for DN20 and DN25 lens antennas
② Mounting location for DN40 and DN70 lens antennas
③ Inner diameter of the vessel
④ Recommended minimum distance between the mounting location and the vessel wall for each antenna type
  • DN20 and DN25 lens antennas: Vessel height × 1⁄5 (in the case of a 5 m high vessel: 5 m × 1⁄5 = 1 m)
  • DN40 lens antenna: Vessel height × 1⁄10 (in the case of a 5 m high vessel: 5 m × 1⁄10 = 0.5 m)
  • DN70 lens antenna: Vessel height × 1⁄20 (in the case of a 5 m high vessel: 5 m × 1⁄20 = 0.25 m)
  Recommended minimum distance between the mounting location and the vessel wall: diameter of the vessel × 1⁄3
⑤ Height of the vessel

● Ensure that there are no obstacles within the emission range of microwaves.
①Obstacles include agitators, ladders, reinforcements, and heating coils.
②The emission range of microwaves for measurement varies depending on the antenna type. Refer to the table below.



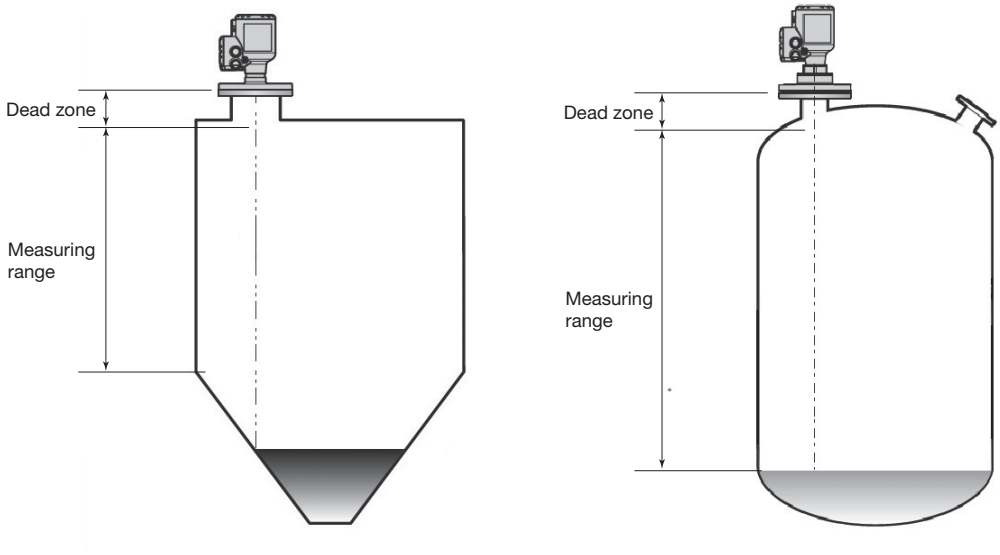
Antenna type	Beam angle	Beam range (x) mm/m
DN20 [¾"] lens horn antenna	15°	132
DN25 [1"] lens antenna	10°	87
DN40 [1½"] lens horn antenna	8°	70
DN70 [2¾"] lens horn antenna	4°	35

● Avoid a mounting position where any inflow of product enters the emission range of microwaves.
Take appropriate measures such as changing the mounting location or the product loading method.

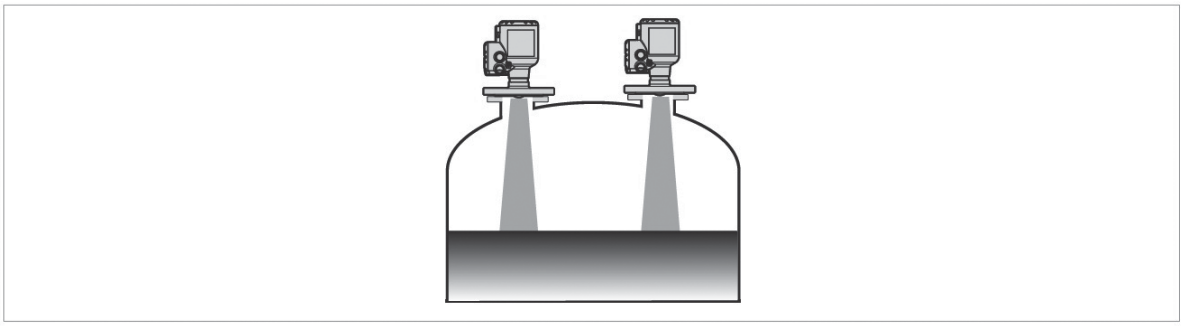


① Correct mounting position
② Inflow of product may disturb measurement.

● For tanks whose bottom is not flat but dish- or cone-shaped, the measuring range is from the lower end of the dead zone to the lower end of the cylindrical part of the tank. It is not possible to measure the level precisely below the cylindrical part.

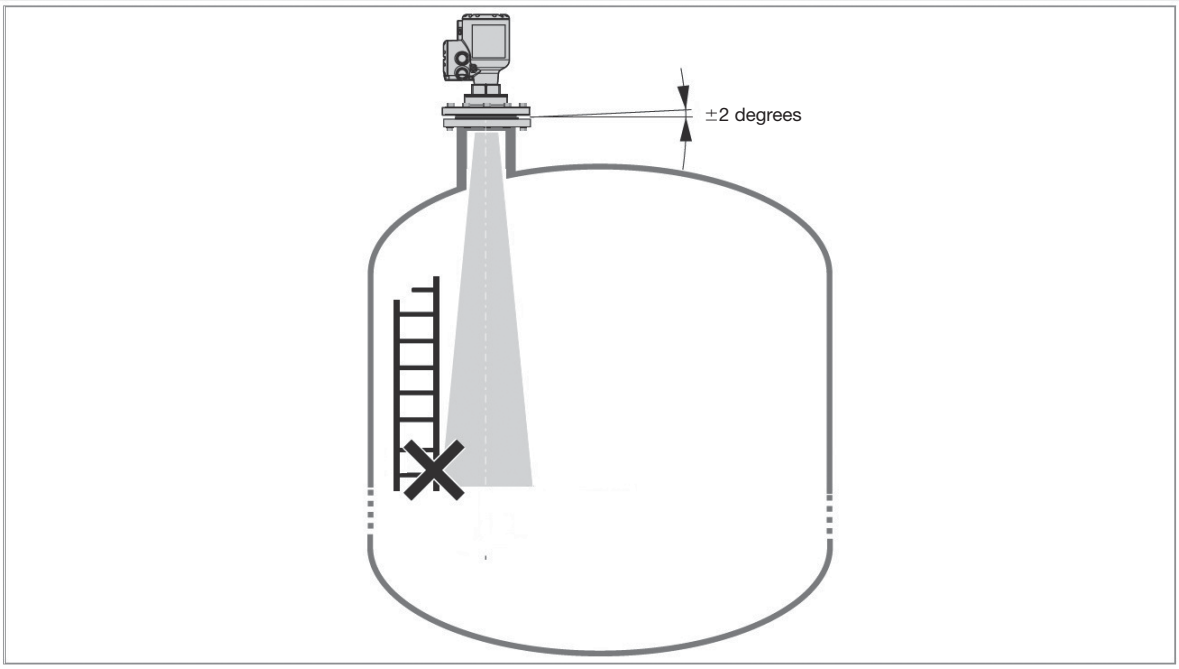


● Multiple TLR7500 units can be mounted on the same vessel. In this case, however, mount them as far as possible from each other.



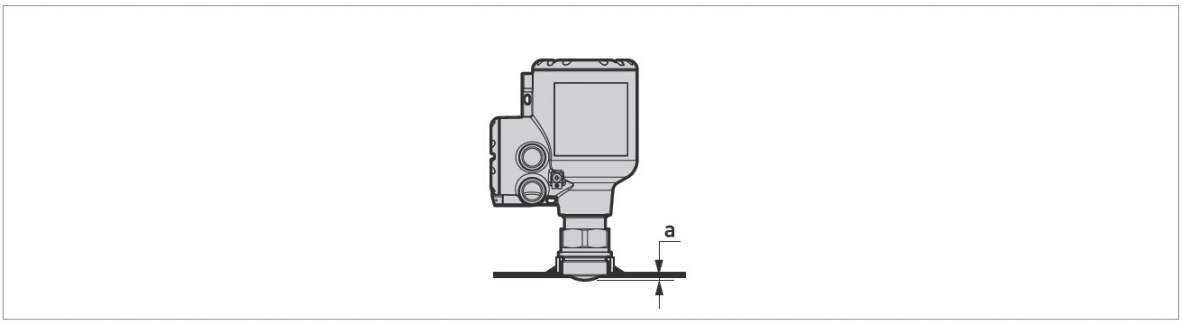
Mounting method

The mounting flange face should not be tilted more than ±2 degrees.



Thread mounting

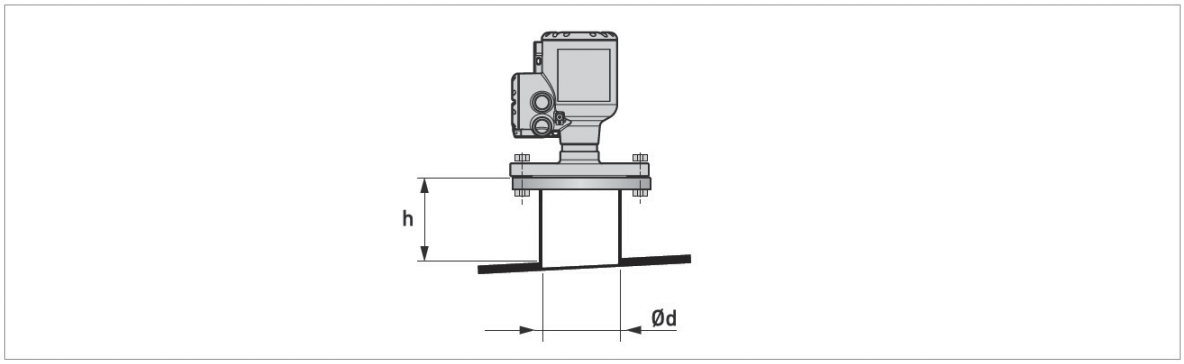
● Weld a half coupling on the vessel roof. Do not screw in the thread with an excessive torque.



Dimension a: 6mm for DN20, DN25, and DN40 lens antennas

Flange mounting

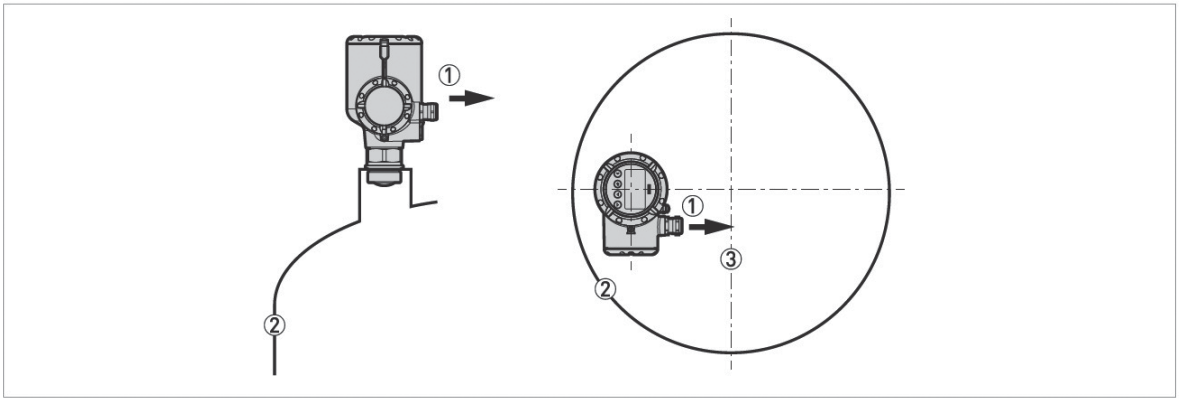
● Insert a gasket between the flanges of the vessel and the TLR7500 and fix them all with bolts and nuts.
● The nozzle length should be as short as possible and kept within the allowable range listed in the table below.
● Use an antenna extension when the antenna is shorter than the nozzle (DN40 lens antenna).



Nozzle diameter (ød)		Allowable max. nozzle length (h)			
		DN20	DN25	DN40	DN70
[mm]	[inch]	[mm]	[mm]	[mm]	[mm]
20	¾	50	—	—	—
25	1	50	50	—	—
40	1½	50	50	50∗	—
50	2	100	100	150∗	—
80	3	150	150	200∗	250
100	4	150	200	300∗	350
150	6	200	300	500∗	550
200	8	300	400	700∗	750

∗ : When an antenna extension is used, its length is added to the allowable maximum nozzle length.

Mounting direction



① Cable entry
② The nearest tank wall
③ Center of tank

• Ideally, the cable entry should be located toward the center of the tank.

ANTENNAS AND THEIR APPLICATIONS

Type of antenna		Lens antenna			
		DN20	DN25	DN40	DN70
Process connection	G1¾", ¾ NPT thread	○	×	×	×
	G1", 1 NPT thread	×	○	×	×
	G1½ ", 1½ NPT thread	×	×	○	×
	G3", 3 NPT thread	×	×	×	○
	50A JIS	×	×	○	×
	80A JIS	×	×	○	○
	100A JIS	×	×	×	○
	150A JIS	×	×	×	○
	200A JIS	×	×	×	○
	ASME 2"	×	×	○	×
	ASME 3"	×	×	○	○
	ASME 4"	×	×	×	○
	ASME 6"	×	×	×	○
	ASME 8"	×	×	×	○
Antenna material	PEEK	○	○	○	○
Antenna specifications	Measuring range	5 m	10 m	25 m	50 m
	Beam angle	15 degrees	10 degrees	8 degrees	4 degrees
	Beam range (one-side)	132 mm/m	87 mm/m	70 mm/m	35 mm/m
	Antenna extension	—	—	112 mm	—

○: Most suitable, ×: Not suitable, −: Cannot be used

MODEL AND SPECIFICATION CODES

Model: TLR7500

DN20 lens antenna

Spec.code	VFDF	4	4	W		0		2	1				0		1	0				0	0			Description	Std.
Fixed code	VFDF	4	4	W																					
Approval					0																			Standard (Non-ex)	○
					1																			ATEX: Intrinsically safe II 1/2 G Ex ia IIC T6...T3 Ga/Gb II 1/2 D Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					2																			ATEX: Flameproof II 1/2 G Ex db ia IIC T6...T3 Ga/Gb II 1/2 D Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					K																			IECEx: Intrinsically safe Ex ia IIC T6...T3 Ga/Gb Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					L																			IECEx: Flameproof Ex db ia IIC T6...T3 Ga/Gb Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					U																			JPN Ex: Intrinsically safe Ex ia IIC T6...T3 Ga/Gb Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					W																			JPN Ex: Flameproof Ex db ia IIC T6...T3 Ga/Gb Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
Fixed code						0																		Always 0	
Approval 2							0																	N/A	○
							3																	NACE design (MR0175/MR0103/ISO 15156)	
Housing type/material								2																Compact type housing (aluminum), IP66/IP68	○
Output									1															Two-wire system/4–20 mA passive (HART®)	
Cable entry/cable gland										1														M20 × 1.5 without cable gland (Flameproof models need a flameproof cable gland as an option.)	○
										2														M20 × 1.5 with a plastic cable gland	
										3														M20 × 1.5 with a metal cable gland	
										C														M20 × 1.5 with ½NPT female adapter	
Display											0													Without display unit	
											4													With a plug-in display unit	○
Display language												1												English	
												7												Japanese	○
Fixed code													0											Always 0	
Seal material/temperature range														1										FKM/FPM, 0KPa to 4MPa, –40 to 150°C	○
														2										EPDM, 0KPa to 4MPa, –50 to 150°C	
														3										Kalrez®6375, 0KPa to 4MPa, –20 to 150°C	
Antenna type															1									DN20 (¾") lens antenna/PEEK ¾" thread connection	○
Antenna extension																0								N/A	○
Process connection/type							ISO 228-1, thread										E	P	0					G ¾A	○
							ASME B1.20.1, thread										E	A	0					¾NPT	
Fixed code																				0	0			Always 00	
Accessories																						0		N/A	
																						1		Weatherproof protection ✻2	
Special qualification																							Blank	Yes	
																							/Z	N/A ✻1	

✻1: Special requirements not included in the above coding system should be designated by adding "/Z" at the end of the code. Consult us for the availability of such requirements before ordering.
✻2: Select awning when installing in a place exposed to direct sunshine or heavy wind and rain.

DN25 lens antenna

Spec.code	VFDF	4	4	W		0		2	1				0		2	0				0	0			Description	Std.
Fixed code	VFDF	4	4	W																					
Approval					0																			Standard (Non-ex)	○
					1																			ATEX: Intrinsically safe II 1/2 G Ex ia IIC T6...T3 Ga/Gb II 1/2 D Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					2																			ATEX: Flameproof II 1/2 G Ex db ia IIC T6...T3 Ga/Gb II 1/2 D Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					K																			IECEx: Intrinsically safe Ex ia IIC T6...T3 Ga/Gb Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					L																			IECEx: Flameproof Ex db ia IIC T6...T3 Ga/Gb Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					U																			JPN Ex: Intrinsically safe Ex ia IIC T6...T3 Ga/Gb Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					W																			JPN Ex: Flameproof Ex db ia IIC T6...T3 Ga/Gb Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
Fixed code						0																		Always 0	
Approval 2							0																	N/A	○
							3																	NACE design (MR0175/MR0103/ISO 15156)	
Housing type/material								2																Compact type housing (aluminum), IP66/IP68	○
Output									1															Two-wire system/4–20 mA passive (HART®)	
Cable entry/cable gland										1														M20 × 1.5 without cable gland (Flameproof models need a flameproof cable gland as an option.)	○
										2														M20 × 1.5 with a plastic cable gland	
										3														M20 × 1.5 with a metal cable gland	
										C														M20 × 1.5 with ½NPT female adapter	
Display											0													Without display unit	
											4													With a plug-in display unit	○
Display language												1												English	
												7												Japanese	○
Fixed code													0											Always 0	
Seal material/temperature range														1										FKM/FPM, 0KPa to 4MPa, –40 to 150°C	○
														2										EPDM, 0KPa to 4MPa, –50 to 150°C	
														3										Kalrez®6375, 0KPa to 4MPa, –20 to 150°C	
Antenna type															2									DN25 (1”) lens antenna/PEEK 1” thread connection	○
Antenna extension																0								N/A	
Process connection/type							ISO 228-1, thread										F	P	0					G 1 A	○
							ASME B1.20.1, thread										F	A	0					1 NPT	
Fixed code																				0	0			Always 00	
Accessories																						0		N/A	
																						1		Weatherproof protection ✻2	
Special qualification																							Blank	Yes	
																							/Z	N/A ✻1	

✻1: Special requirements not included in the above coding system should be designated by adding “/Z” at the end of the code. Consult us for the availability of such requirements before ordering.
✻2: Select awning when installing in a place exposed to direct sunshine or heavy wind and rain.

DN40 lens antenna

Spec.code	VFDF	4	4	W		0		2	1				0		3					0	0			Description	Std.
Fixed code	VFDF	4	4	W																					
Approval					0																			Standard (Non-ex)	○
					1																			ATEX: Intrinsically safe II 1/2 G Ex ia IIC T6...T3 Ga/Gb II 1/2 D Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					2																			ATEX: Flameproof II 1/2 G Ex db ia IIC T6...T3 Ga/Gb II 1/2 D Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					K																			IECEx: Intrinsically safe Ex ia IIC T6...T3 Ga/Gb Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					L																			IECEx: Flameproof Ex db ia IIC T6...T3 Ga/Gb Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					U																			JPN Ex: Intrinsically safe Ex ia IIC T6...T3 Ga/Gb Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					W																			JPN Ex: Flameproof Ex db ia IIC T6...T3 Ga/Gb Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
Fixed code						0																		Always 0	
Approval 2							0																	N/A	○
							3																	NACE design (MR0175/MR0103/ISO 15156)	
Housing type/material								2																Compact type housing (aluminum), IP66/IP68	○
Output									1															Two-wire system/4–20 mA passive (HART®)	
Cable entry/cable gland										1														M20 × 1.5 without cable gland (Flameproof models need a flameproof cable gland as an option.)	○
										2														M20 × 1.5 with a plastic cable gland	
										3														M20 × 1.5 with a metal cable gland	
										C														M20 × 1.5 with ½NPT female adapter	
Display											0													Without display unit	
											4													With a plug-in display unit	○
Display language												1												English	
												7												Japanese	○
Fixed code													0											Always 0	
Seal material/temperature range														1										FKM/FPM, 0KPa to 4MPa, –40 to 150°C	○
														2										EPDM, 0KPa to 4MPa, –50 to 150°C	
														3										Kalrez®6375, 0KPa to 4MPa, –20 to 150°C	
														4										PEEK (with flange plate), 0KPa to 4MPa, –50 to 150°C	
Antenna type															3									DN40 (1.5") lens antenna/PEEK 1.5" thread or flange connection	○
Antenna extension/flange plate																0								N/A	○
																1								Antenna extension (112 mm (4.4")/SS316L)	
																A								Flange plate	
Process connection/ Type/ Rating																	ISO 228-1, thread			G	P	0			G 1 ½A	
																	ASME B1.20.1, thread			G	A	0			1 ½NPT	
																	ASME B16.5 flange			H	1	A			2" 150 lb RF	
																				H	2	A			2" 300 lb RF	
																				L	1	A			3" 150 lb RF	
																				L	2	A			3" 300 lb RF	
																	JIS B2220 flsnge			H	U	P			50A JIS 10K RF	○
																				L	U	P			80A JIS 10K RF	
Fixed code																							0	0	Always 00	
Accessories																								0	N/A	○
																								1	Weatherproof protection ✻2	
Special qualification																								Blank	Yes	○
																								/Z	N/A ✻1	

✻1: Special requirements not included in the above coding system should be designated by adding "/Z" at the end of the code. Consult us for the availability of such requirements before ordering.
✻2: Select awning when installing in a place exposed to direct sunshine or heavy wind and rain.

DN70 lens antenna

Spec.code	VFDF	4	4	W		0		2	1				0		4					0	0			Description	Std.
Fixed code	VFDF	4	4	W																					
Approval					0																			Standard (Non-ex)	○
					1																			ATEX: Intrinsically safe II 1/2 G Ex ia IIC T6...T3 Ga/Gb II 1/2 D Ex ia IIIC T85°C…T150°C or T85°C...T200°C Da/Db	
					2																			ATEX: Flameproof II 1/2 G Ex db ia IIC T6...T3 Ga/Gb II 1/2 D Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					K																			IECEx: Intrinsically safe Ex ia IIC T6...T3 Ga/Gb Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					L																			IECEx: Flameproof Ex db ia IIC T6...T3 Ga/Gb Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					U																			JPN Ex: Intrinsically safe Ex ia IIC T6...T3 Ga/Gb Ex ia IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
					W																			JPN Ex: Flameproof Ex db ia IIC T6...T3 Ga/Gb Ex ia tb IIIC T85°C...T150°C or T85°C...T200°C Da/Db	
Fixed code						0																		Always 0	
Approval 2							0																	N/A	○
							3																	NACE design (MR0175/MR0103/ISO 15156)	
Housing type/material								2																Compact type housing (aluminum), IP66/IP68	○
Output									1															Two-wire system/4–20 mA passive (HART®)	
Cable entry/cable gland										1														M20 × 1.5 without cable gland (Flameproof models need a flameproof cable gland as an option.)	○
										2														M20 × 1.5 with a plastic cable gland	
										3														M20 × 1.5 with a metal cable gland	
										C														M20 × 1.5 with ½NPT female adapter	
Display											0													Without display unit	
											4													With a plug-in display unit	○
Display language												1												English	
												7												Japanese	○
Fixed code													0											Always 0	
Seal material/temperature range														1										FKM/FPM, 0KPa to 4MPa, –40 to 150°C	○
														2										EPDM, 0KPa to 4MPa, –50 to 150°C	
														3										Kalrez®6375, 0KPa to 4MPa, –20 to 150°C	
														4										PEEK (with flange plate), 0KPa to 4MPa, –50 to 150°C	
Antenna type															4									DN70 (2.75") lens antenna/PEEK 3" thread or flange connection	○
Antenna extension/flange plate																0								N/A	○
																A								Flange plate/PEEK	
Process connection/ Type/ Rating																	ISO 228-1, thread		L	P	0				G 3A	
																	ASME B1.20.1, thread		L	A	0				3 NPT	
																	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	
																			R	2	A				8" 300 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	
Fixed code																						0	0		Always 00	
Accessories																								0	N/A	○
																								1	Weatherproof protection ✻2	
Special qualification																								Blank	Yes	
																								/Z	N/A ✻1	○

✻1: Special requirements not included in the above coding system should be designated by adding "/Z" at the end of the code. Consult us for the availability of such requirements before ordering.
✻2: Select awning when installing in a place exposed to direct sunshine or heavy wind and rain.

STANDARD ACCESSORIES

- Parameter sheet : 1
- Instruction manual : 1
- Magnet for setting parameters : 1
- Tool for opening the converter cover : 1
- Tool for removing the display : 1

OPTIONS

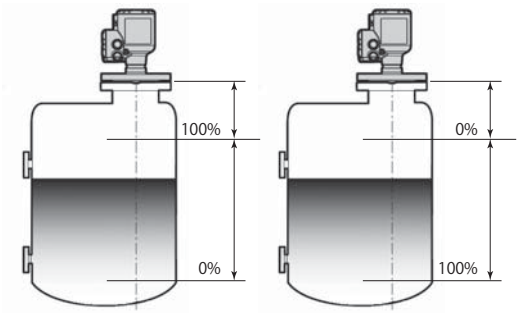
- M20 × G½ female adapter: [GA]
- Flameproof cable gland (G½): [DG]
  Note: Rated temperature –20°C to +60°C
- Individual data setting of output ranges: [DS]

ORDERING INFORMATION

Measuring conditions

Measuring method

☐ Level ☐ Distance



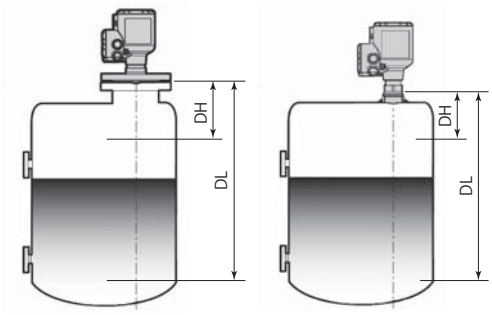
Measuring range

Distance from the process connection to the lowest level

( ) m

Distance from the process connection to the highest level

( ) m



☐ Flange ☐ Thread (screwed flange)

Measured object

Name	( )	
Dielectric constant (εr)	( )	
Fluid	☐ Liquid	☐ Slurry
Corrosivity	☐ No ☐ Medium	☐ Strong
Adhesiveness	☐ No ☐ Medium	☐ Strong
Crystallinity	☐ No ☐ Medium	☐ Strong
Waving	☐ No ☐ Medium	☐ Strong
Foaming	☐ No ☐ Medium	☐ Strong

Operation conditions

Measuring location	☐ Outdoor ☐ Indoor
Fluid temperature	( ) °C
Ambient temperature	( ) °C
Pressure	( ) MPa
Explosionproof	☐ Non-hazardous area
	☐ Hazardous area

Vessel conditions

Shape	☐ Ground tank ☐ Underground tank
	☐ Closed pit ☐ Others
Height	( )
Diameter or width	( )
Inner structure	☐ N/A
	☐ Yes: ☐ Agitator (shape:)
	☐ Thermometer ☐ Level switch
	☐ Reinforcement ☐ Ladder
	☐ Others
Material	☐ Metal ( )
	Coating: ☐ Yes ☐ N/A ☐ Others

Installation conditions

Location	Distance from tank wall	( ) m
	Distance from inlet	( ) m
	Distance from obstacle	( ) m
Mounting nozzle		
	Nozzle diameter	( ) mm
	Nozzle height	( ) mm

ORDERING INSTRUCTIONS

1. Model and specification code
   Example Model: TLR7500, standard, DN25 lens antenna, G1" thread connection, with weather protection
   Specification code: VFDF44W000211470120FP0001
2. Option (specified only when necessary)
   Refer to “OPTIONS” and specify any with respective codes.
3. Special requirements (specified only when necessary)
   If you have any special requirements, let us know separately from the model and specification code.
   Consult us for the availability of such requirements before ordering.
4. Intrinsically safe specification
   This model needs a barrier.
5. Flameproof specification
   This model needs a flameproof cable gland.

* Specification is subject to change without notice.

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