TECHNICAL GUIDANCE

2-wire System Level Radar

TLR7500

80GHz
Microwave level meter

OUTLINE

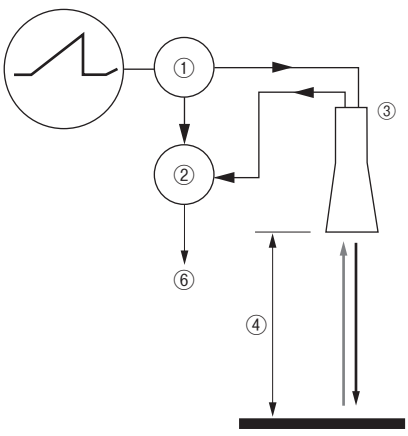
The **TLR7500** is a non-contact type continuous level meter using microwaves. This meter determines the level of a measured object by emitting microwaves and measuring the time taken for the microwaves to travel out, be reflected and return from the object.
Since the velocity of electromagnetic waves 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.

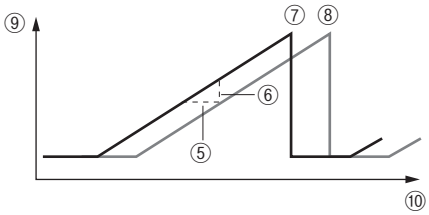
FEATURES

- ❑ 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 +200°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
- ❑ Can start measuring immediately after mounting with simple parameter setting
- ❑ Maintenance-free with no moving parts
- ❑ The reflected signal can be checked on the display unit, which is effective for solving problems.
- ❑ Various types of explosion-proofing available [Ex d, Ex i, Ex t]

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-E02
3rd edition Aug 2024 K
1st edition Oct 2021 K

STANDARD SPECIFICATIONS

	Item	Description
Measurement	Object	Liquids, pastes, and slurries
	Method	Frequency modulated continuous wave (FMCW)
	Frequency	80 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) *3, ±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 [-50 to +200ºC: with distance piece] The operating temperature range depends on the seal materials. Refer to ANTENNA SPECIFICATIONS.
	Operating pressure	0 kPa (abs) to 4.0 MPa, 0 kPa (abs) to 1.6 MPa [PTFE lens antenna]
	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
		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, PTFE, 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

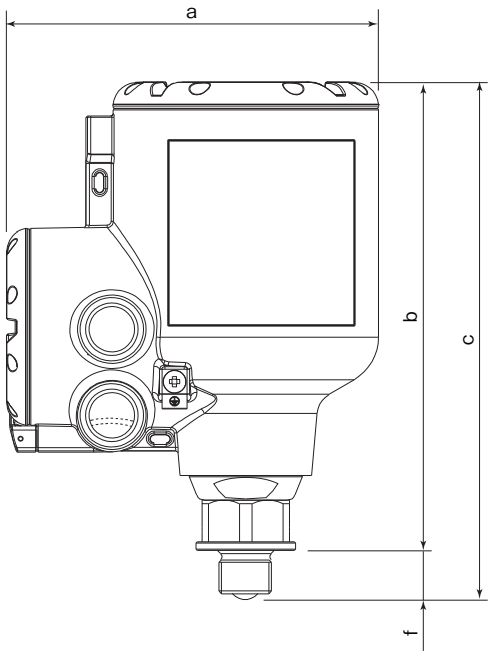
∗1: The dielectric constant of measured objects may not be measured depending on the measuring conditions.
∗2: Voltage supply required to output 21.5 mA
∗3: DN20, DN25, DN70 lens antenna: Excludes 100mm from antenna
DN40 lens antenna: Excludes 200mm from the antenna

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 +150ºC [-40 to +200ºC: with distance piece] (Seal material: FKM/FPM) –20 to +150ºC [-20 to +200ºC: with distance piece] (Seal material: Kalrez® 6375) –50 to +150ºC (Seal material: EPDM) –50 to +150ºC [With distance piece: max.+200°C]: With PEEK flange plate –50 to +150ºC: With PTFE flange plate	
Operating pressure	0 kPa (abs) to 4.0 MPa, 0 kPa (abs) to 1.6 MPa [PTFE lens antenna]	
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

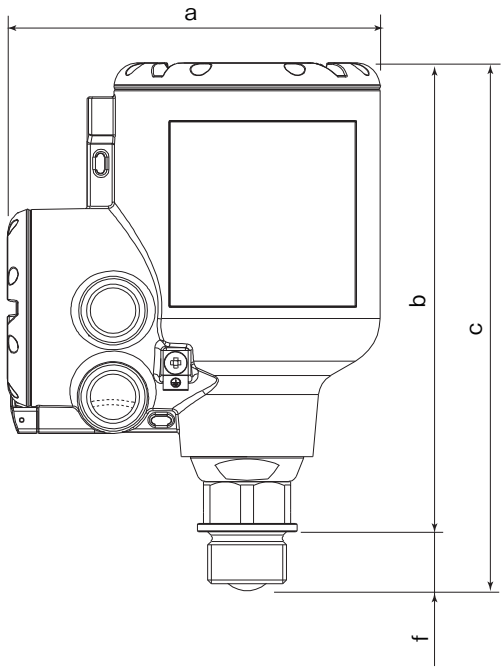
DN20 lens antenna



Process connection	Dimensions [mm]			
	a	b	c	f
¾" thread	151	190 *1	213 *1	23

*1 If the process temperature is more than +150°C, add 112 mm to this value

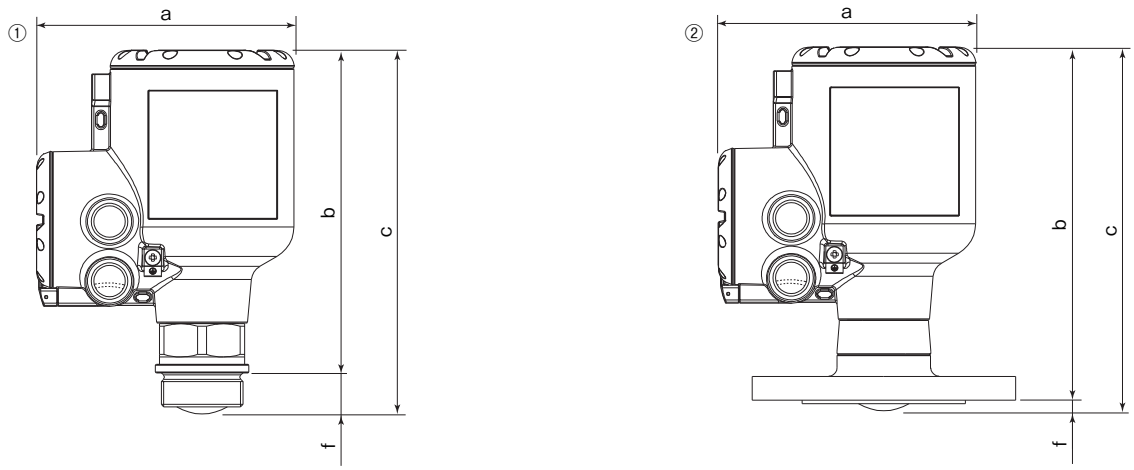
DN25 lens antenna



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

*1 If the process temperature is more than +150°C, add 112 mm to this value

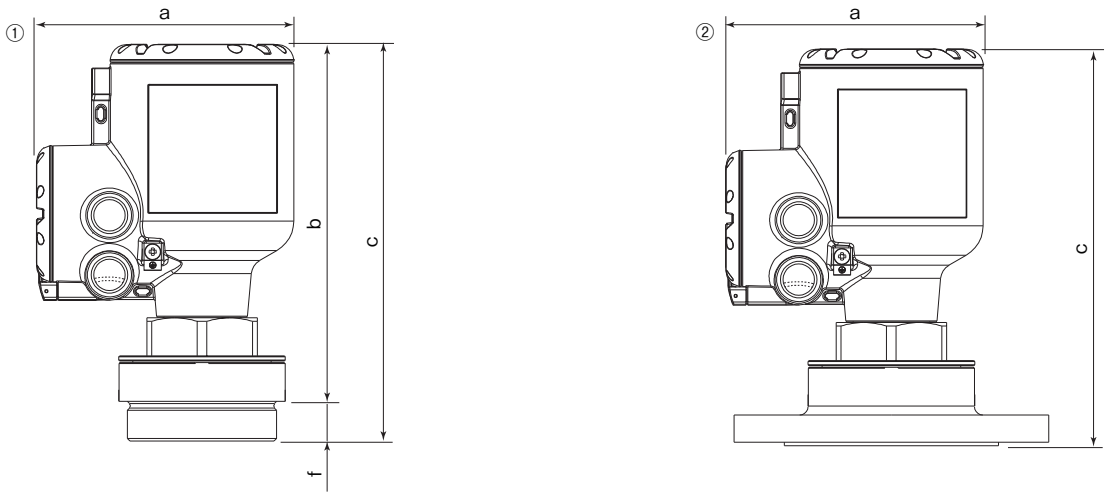
DN40 lens antenna



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

*1 If the device has the antenna extension option, add 112 mm to this value [PEEK antenna only]
*2 If the process temperature is more than +150°C, add 112 mm to this value [PEEK antenna only]

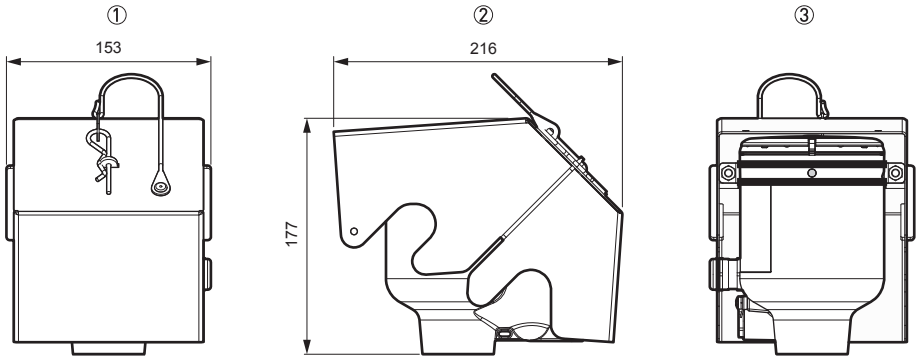
DN70 lens antenna



Process connection	Dimensions [mm]			
	a	b	c	f
① 3" thread	151	210 *1	233 (G3 male thread) *1 240 (3" NPT) *1	23 (G3 male thread) 30 (3" NPT)
② Flange	151	—	233 *1	—

*1 If the process temperature is more than +150°C, add 112 mm to this value

Weather protection (Accessory)



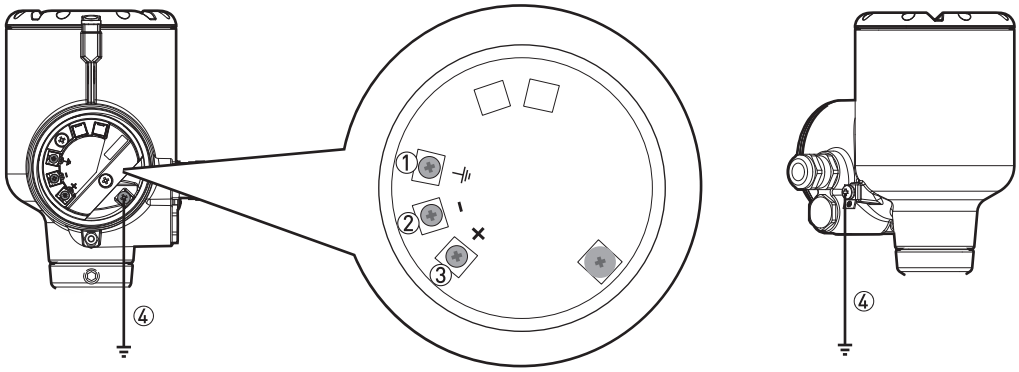
① Front
② Left side
③ Back

MASS

Part name		Specification	Mass [kg]
Housing		Aluminum	2.1
		Alminium, Distance piece	3.0
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

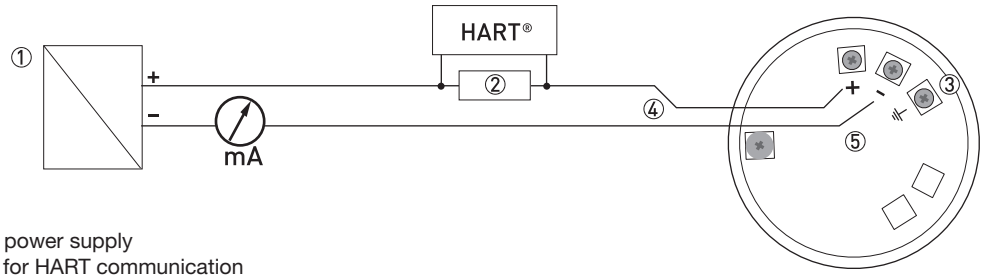
WIRING

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

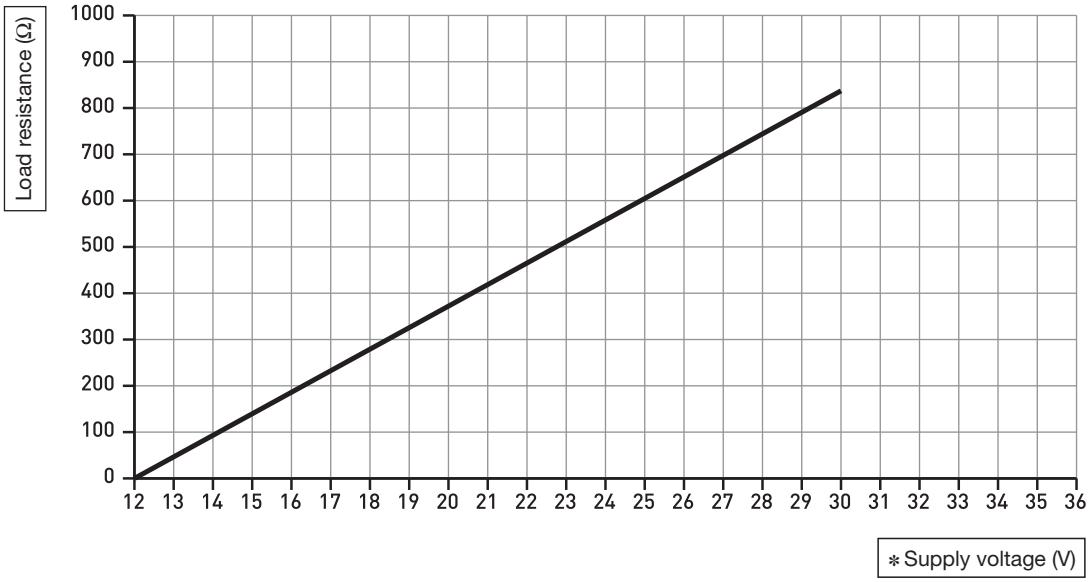
- Use stranded cable of 0.5 to 2.5 mm^2 cross section for a signal (power supply) line.
- Avoid laying a signal (power supply) line close to a power cable.
- Use a different power supply for the TLR7500 from those for other power instruments.
- It is recommended to use a shielded cable.
- A single-point 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

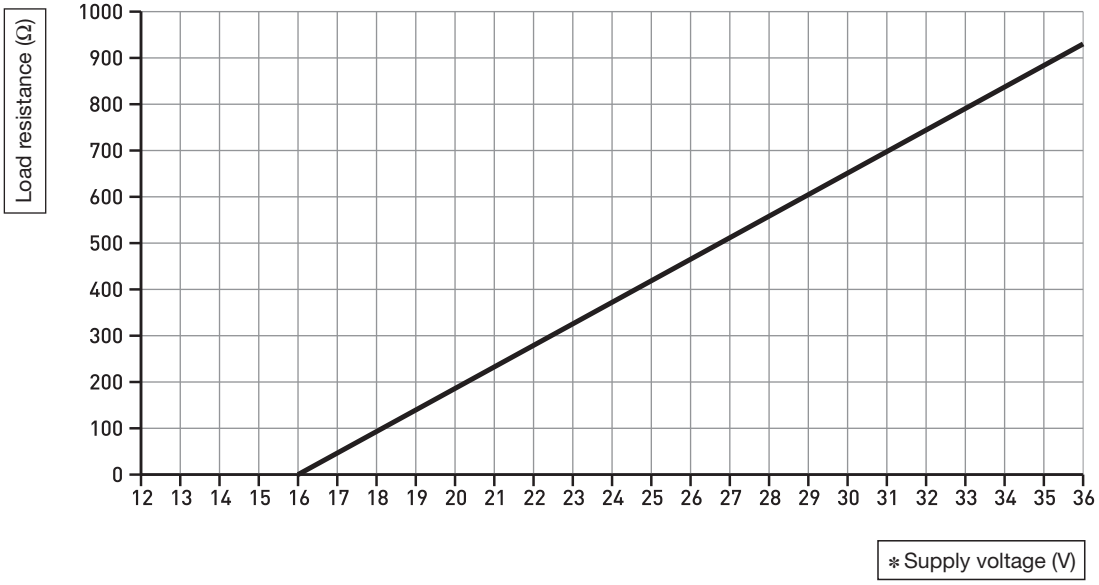
Supply voltage: 12 V to 30 V DC



∗ : 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 [+70] *2	+75 [+68] *2	+75
		+63	+58	+100
T4	T135°C	+64	+56 [+52] *2	+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
*2: Values in parentheses are for Ex db ia- or Ex ia tb- approved device.

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 [+70] *2	+75 [+69] *2	+75
		+68	+66 [+64] *2	+100
T4	T135°C	+70	+68 [+61] *2	+115
		+65	+61 [+58] *2	+135
T3 *1	T200°C *1	+61	+56 [+55] *2	+150
		+53	+46	+180
		+48	+40	+200

*1: The maximum process temperature of seal material: +150°C for EPDM
*2: Values in parentheses are for Ex db ia- or Ex ia tb- approved device.

Temperature class	Max. surface temperature	Min. ambient temperature [°C]		Min. process temperature [°C]
		Aluminum housing	Stainless steel housing	
All *3	All *3	–40	–40	–40
		–37	–36	–50

*3: 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

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 [+70] *2	+75 [+68] *2	+75
		+63	+58	+100
T4	T135°C	+64	+56 [+52] *2	+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
*2: Values in parentheses are for Ex db ia- or Ex ia tb- approved device.

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 [+70] *2	+75 [+69] *2	+75
		+68	+66 [+64] *2	+100
T4	T135°C	+70	+68 [+61] *2	+115
		+65	+61 [+58] *2	+135
T3 *1	T200°C *1	+61	+56 [+55] *2	+150
		+53	+46	+180
		+48	+40	+200

*1: The maximum process temperature of seal material: +150°C for EPDM or PTFE drop antenna
*2: Values in parentheses are for Ex db ia- or Ex ia tb- approved device.

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 *3	All *3	–40	–40	–40
		–37	–36	–50

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

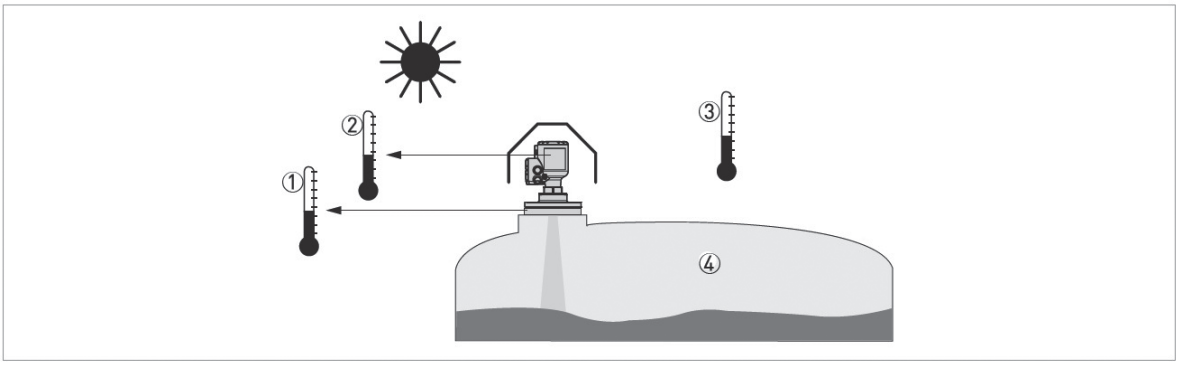
When using the TLR7500 as an intrinsically safe device, circuit variables must not exceed the following values.
Ui=30 V dc, Ii=130 mA, Pi=1 W, Ci=10 nF, Li=0 μH

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

NOTES ON USE

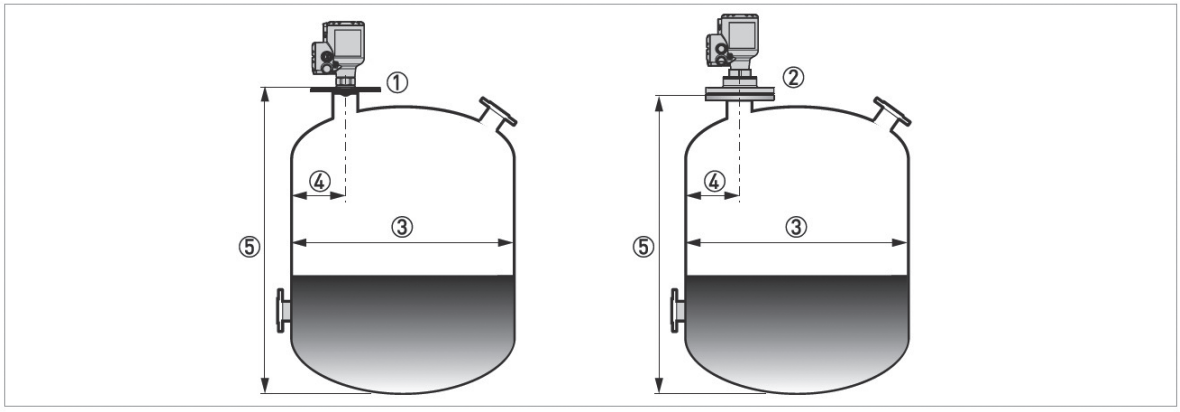
Mounting location

- 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.



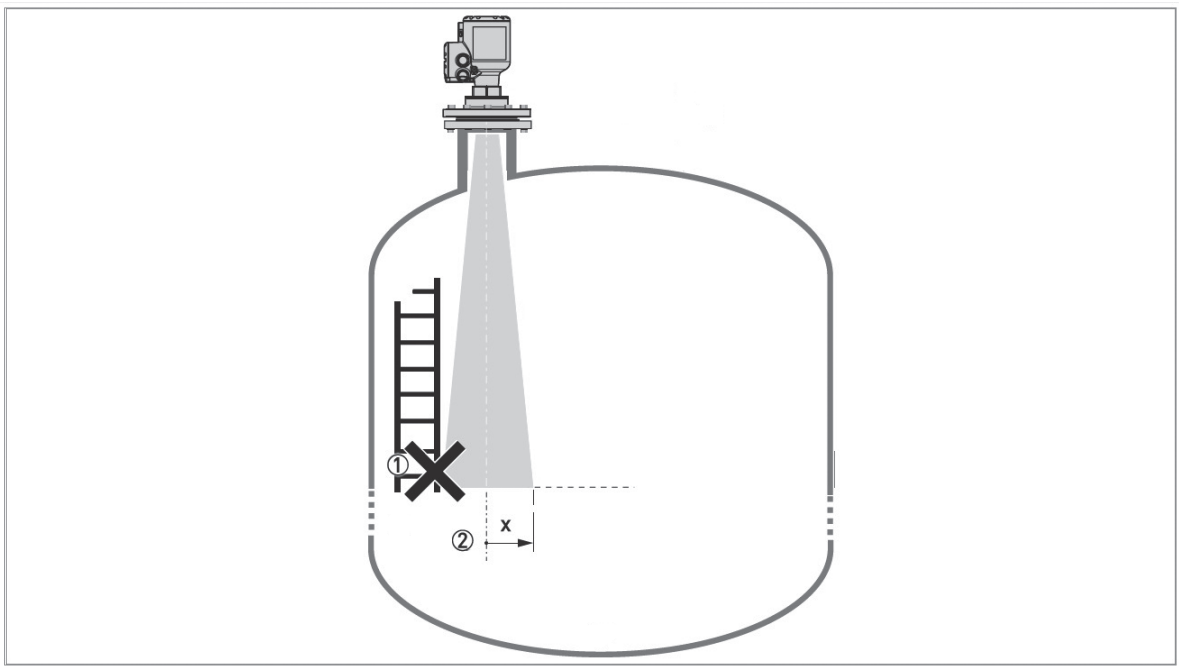
① The allowable temperature range of the process connection varies depending on the seal material.
② The temperature of the indicator must be between –20°C and +70°C.
③ The ambient temperature must be between –40°C and +80°C. Refer to EXPLOSIONPROOF SPECIFICATIONS for explosionproof types.
④ Use the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



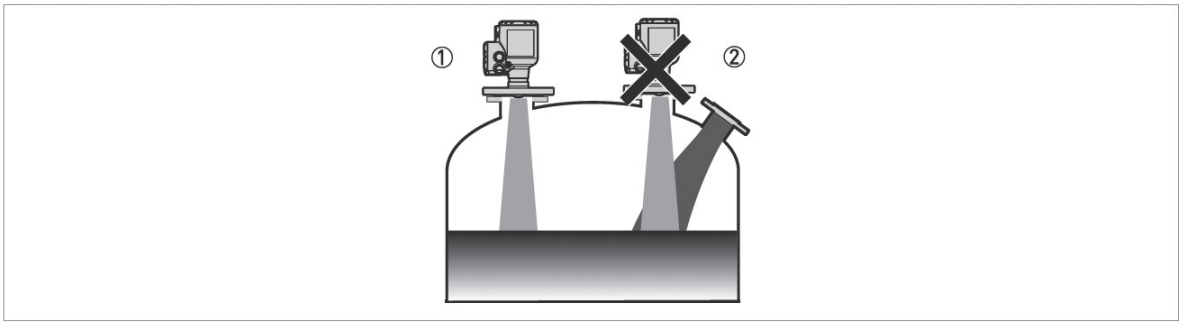
① Mounting location for DN20 and DN25 lens antennas
② Mounting location for DN40 and DN70 lens antennas
③ Inner diameter of the vessel
④ Recommended minimum distance between the mounting location and the vessel wall for each antenna type
  • DN20 and DN25 lens antennas: Vessel height × 1/5 (in the case 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.



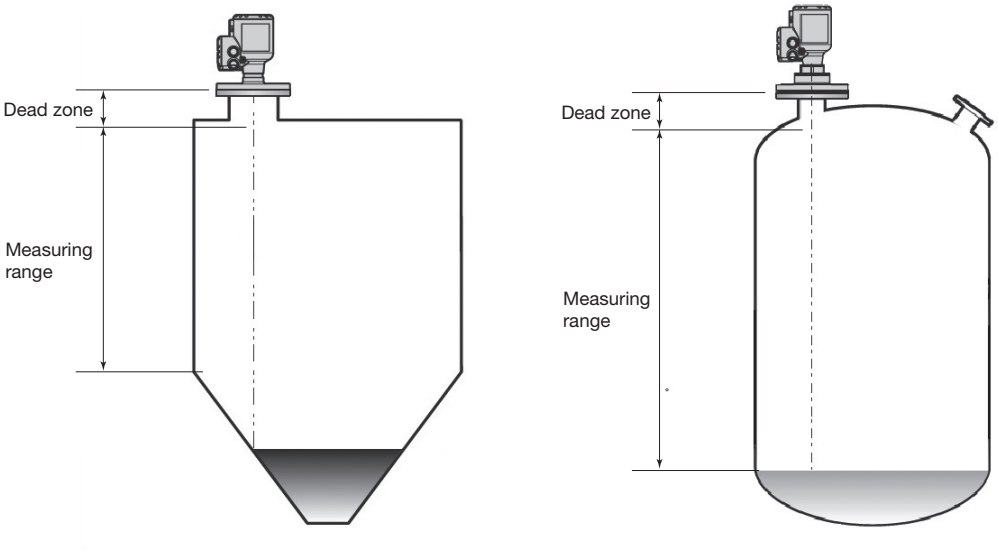
Antenna type	Beam angle	Beam range (x) mm/m
DN20 [¾"] lens antenna	15°	132
DN25 [1"] lens antenna	10°	87
DN40 [1½"] lens antenna	8°	70
DN70 [2¾"] lens antenna	4°	35

● 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.

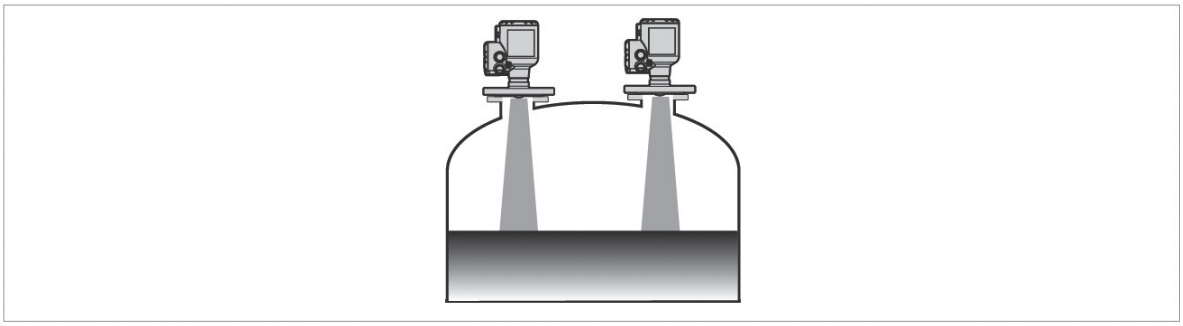


① Correct mounting position
② Inflow of product may disturb measurement.

● 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.

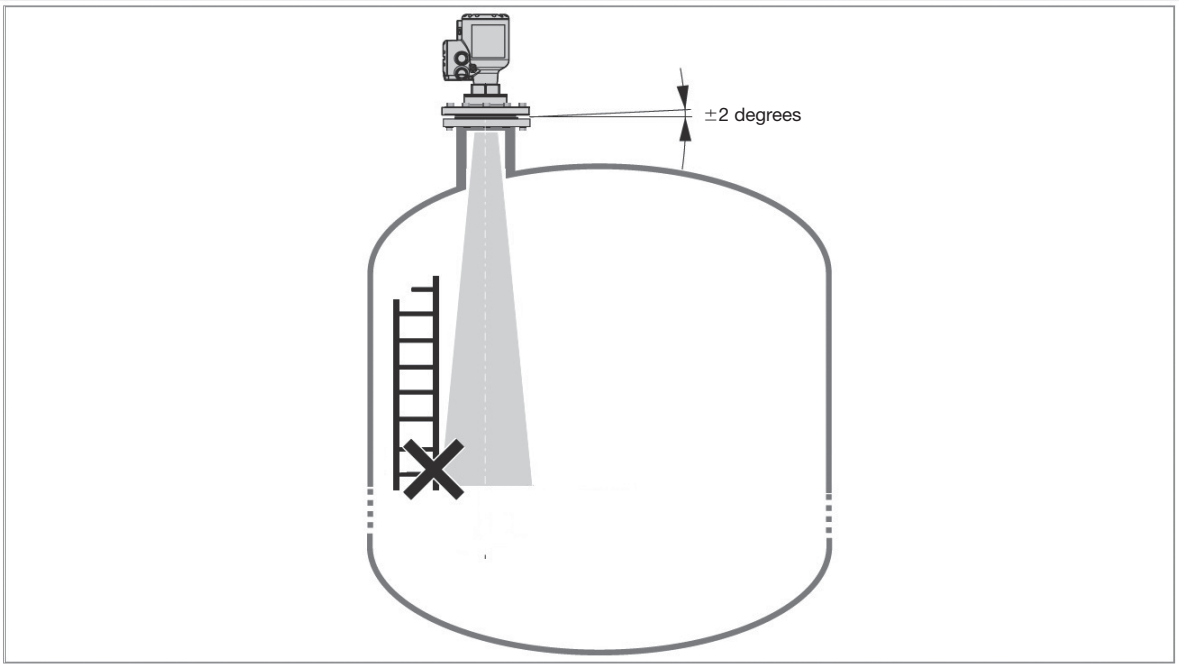


● Multiple TLR7500 units can be mounted on the same vessel. In this case, however, mount them as far as possible from each other.



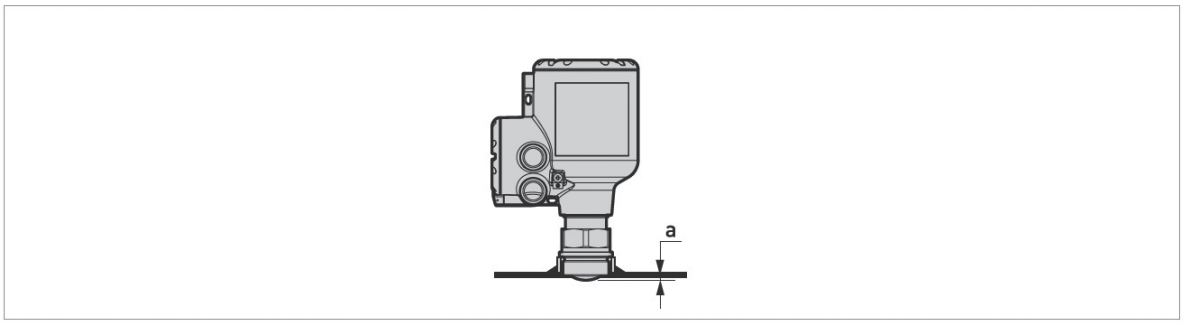
Mounting method

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



Thread mounting

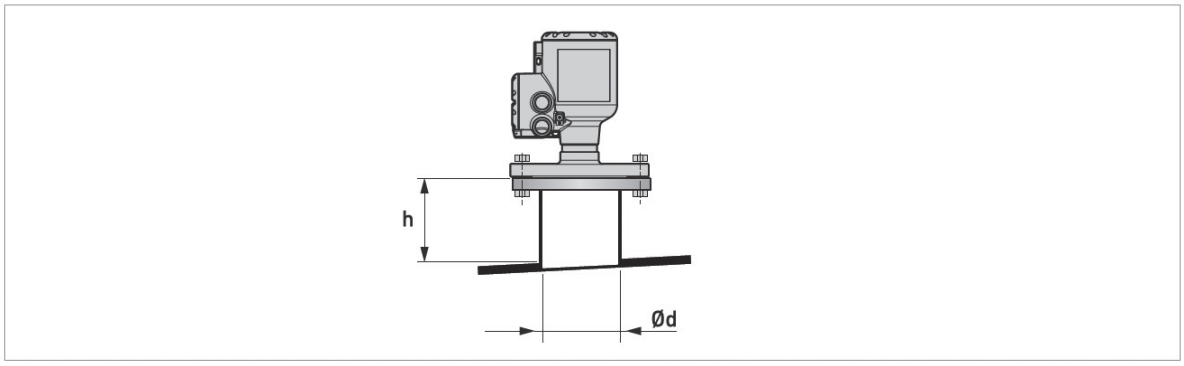
● Weld a half coupling on the vessel roof. Do not screw in the thread with an excessive torque.



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

Flange mounting

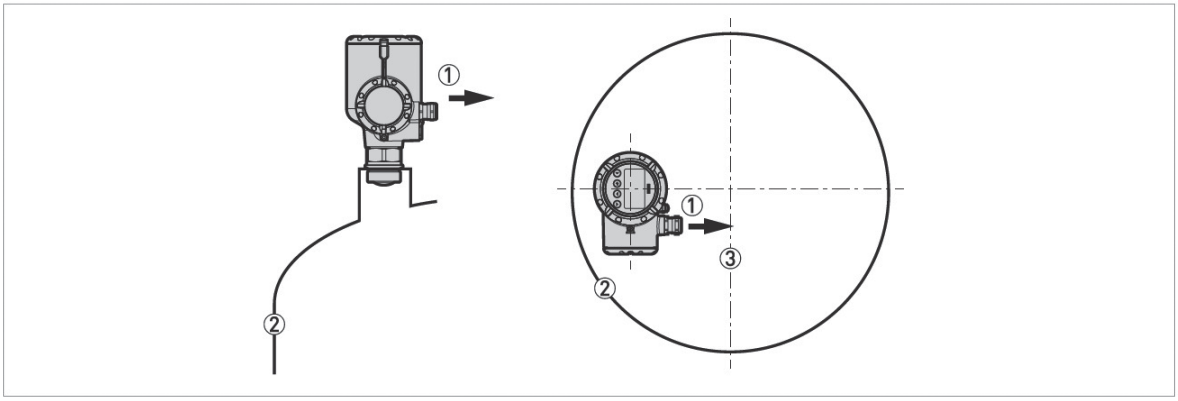
● Insert a gasket between the flanges of the vessel and the TLR7500 and fix them all with bolts and nuts.
● The nozzle length should be as short as possible and kept within the allowable range listed in the table below.
● Use an antenna extension when the antenna is shorter than the nozzle (DN40 lens antenna).
● If the flange size is smaller than 80A [3"] and the nozzle is short, use a stud bolt to connect the flange.
Hexagonal bolts may interfere with the converter housing and may not be usable.



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 (DN40 PEEK antenna).

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

PEEK antenna [Process connection temp. : max. 150°C (standard), max. 200°C (with distance piece)]

Type of antenna		Lens antenna			
		DN20	DN25	DN40	DN70
Process connection	G¾", 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 specifications	Measuring range	Max. 5m	Max. 10m	Max. 25m	Max. 50m
	Beam angle (both-angle)	15 degrees	10 degrees	8 degrees	4 degrees
	Beam range (one-angle)	132 mm/m	87 mm/m	70 mm/m	35 mm/m
	Antenna extension	–	–	○ *1	–
	PEEK flange plate	–	–	○ *1	○

○: Most suitable, –: Cannot be used

*1 : Combination of antenna extension and flange plate is not possible.

PTFE antenna [Process connection temp. : max. 150°C (standard)]

Type of antenna		Lens antenna
		DN40
Process connection	50A JIS	○
	80A JIS	○
	100A JIS	○
	ASME 2"	○
	ASME 3"	○
	ASME 4"	○
Antenna specifications	Measuring range	Max. 25m
	Beam angle (both-angle)	8 degrees
	Beam range (one-angle)	70 mm/m
	PTFE flange plate	Attached

○: Possible

MODEL AND SPECIFICATION CODES

Model: TLR7500

DN20 lens antenna

																							Description	Std.
Spec.code	VFDF	4	4	W		0		2	1				0		1	0				0	0			
Fixed code	VFDF	4	4	W																				○
Approval					0																		Standard (Non-Ex)	○
					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 (Cable entry : For G½ female thread, select M20 × G½ adapter as an option.) (For JPN Ex of flameproof / dust ingnition, select the Flameproof cable gland (G½) 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 / –40 to +150°C	○
														2									EPDM / –50 to +150°C	
														3									Kalrez® 6375 / –20 to +150°C	
														5									FKM/FPM / –40 to +200°C, with distance piece	
														6									Kalrez® 6375 / –20 to +200°C, with distance piece	
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 specification																						Blank	N/A	○
																						/Z	For special requirements ✻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)	○
					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 (Cable entry : For G½ female thread, select M20 × G½ adapter as an option.) (For JPN Ex of flameproof / dust ingnition, select the Flameproof cable gland (G½) 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 / –40 to +150°C	○
														2										EPDM / –50 to +150°C	
														3										Kalrez® 6375 / –20 to +150°C	
														5										FKM/FPM / –40 to +200°C, with distance piece	
														6										Kalrez® 6375 / –20 to +200°C, with distance piece	
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 specification																							Blank	N/A	○
																							/Z	For special requirements ✻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 (Antenna material: PEEK)

Spec.code	VFDF	4	4	W		0		2	1				0		3					0	0			Description	Std.
Fixed code		4	4	W																					○
Approval					0																			Standard（Non-Ex）	○
					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 (-JEx) : 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 (-JEx) : Flamproof 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, aluminium - IP66 / IP68	○
Output									1															Two-wire system / 4-20 mA passive HART®	○
Cable entry / cable gland										1														M20 × 1.5 / without cable gland (Cable entry : For G½ female thread, select M20 × G½ adapter as an option.) (For JPN Ex of flameproof / dust ingnition, select the Flameproof cable gland (G½) 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 ½ NPT 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 / tenperature range														1										FKM/FPM / −40 to +150°C	○
														2										EPDM / −50 to +150°C	
														3										Kalrez® 6375 / −20 to +150°C	
														4										PEEK (with flange plate) / −50 to +150°C	
														5										FKM/FPM / −40 to +200°C, with distance piece	
														6										Kalrez® 6375 / −20 to +200°C, with distance piece	
														7										PEEK (with flange plate) / −50 to +200°C, with distance piece	
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 / SS316L)	
																A								Flange plate (PEEK)	
Process connection	ISO 228-1, thread																G	P	0					G1-½A (Not selectable with flange plate)	
	ASME B1.20.1, thread																G	A	0					1-½"NPT (Not selectable with flange plate)	
	ASME B16.5 flange																H	1	A					2" 150lb RF	
																	H	2	A					2" 300lb RF (Not selectable with flange plate)	
																	L	1	A					3" 150lb RF (Not selectable with flange plate)	
																	L	2	A					3" 300lb RF (Not selectable with flange plate)	
	JIS B2220 flange																H	U	P					50A JIS10K RF	○
																	L	U	P					80A JIS10K RF (Not selectable with flange plate)	
Fixed code																				0	0			Always 00	○
Accessories																						0		N/A	○
																						1		Weatherproof protection ✻2	
Special specification																							Blank	N/A	○
																							/Z	For special requirements ✻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 (Antenna material: PTFE)

Spec.code	VFDF	4	4	W		0		2	1				0	A	A	C				0	0			Description	Std.
Fixed code		4	4	W																					○
Approval					0																			Standard (Non-Ex)	○
					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 (-JEx) : 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 (-JEx) : Flamproof 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、aluminium - IP66/IP68	○
Output									1															Two-wire system / 4-20 mA passive HART®	○
Cable entry / cable gland										1														M20 × 1.5 / without cable gland (Cable entry : For G½ female thread, select M20 × G½ adapter as an option.) (For JPN Ex of flameproof / dust ingnition, select the Flameproof cable gland (G½) 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 ½ NPT 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 / tenperature range														A										PTFE, 0 kPa to 1.6 MPa / –50 to +150°C	○
Antenna type															A									DN40 (1.5") lens antenna / PTFE, flange connection	○
Flange plate																C								Flange plate (PTFE)	○
Process connection					ASME B16.5 flange												H	1	A					2" 150lb RF	
																	L	1	A					3" 150lb RF	
																	M	1	A					4" 150lb RF	
					JIS B2220 flange												H	U	P					50A JIS10K RF	○
																	L	U	P					80A JIS10K RF	
																	M	U	P					100A JIS10K RF	
Fixed code																				0	0			Always 00	○
Accessories																						0		N/A	○
																						1		Weatherproof protection ✻2	
Special specification																							Blank	N/A	○
																							/Z	For special requirements ✻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	7		0		2	1				0		4					0	0			Description	Std.
Fixed code	VFDF	4	4	7																					○
Approval					0																			Standard (Non-Ex)	○
					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 (Cable entry : For G½ female thread, select M20 × G½ adapter as an option.) (For JPN Ex of flameproof / dust ingnition, select the Flameproof cable gland (G½) 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 ½ NPT 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 / –40 to +150°C	○
														2										EPDM / –50 to +150°C	
														3										Kalrez® 6375 / –20 to +150°C	
														4										PEEK (with flange plate) / –50 to +150°C	
														5										FKM/FPM / –40 to +200°C, with distance piece	
														6										Kalrez® 6375 / –20 to +200°C, with distance piece	
														7										PEEK (with flange plate) / –50 to +200°C, with distance piece	
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 (Not selectable with flange plate)	
							ASME B1.20.1, thread									L	A	0						3 NPT (Not selectable with flange plate)	
							ASME B16.5, flange									L	1	A						3" 150 lb RF	
																L	2	A						3" 300 lb RF (Not selectable with flange plate)	
																M	1	A						4" 150 lb RF (Not selectable with flange plate)	
																M	2	A						4" 300 lb RF (Not selectable with flange plate)	
																P	1	A						6" 150 lb RF (Not selectable with flange plate)	
																P	2	A						6" 300 lb RF (Not selectable with flange plate)	
																R	1	A						8" 150 lb RF (Not selectable with flange plate)	
																R	2	A						8" 300 lb RF (Not selectable with flange plate)	
							JIS B2220 flange									L	U	P						80A JIS 10K RF	○
																M	U	P						100A JIS 10K RF (Not selectable with flange plate)	
																P	U	P						150A JIS 10K RF (Not selectable with flange plate)	
																R	U	P						200A JIS 10K RF (Not selectable with flange plate)	
Fixed code																			0	0				Always 00	
Accessories																					0			N/A	○
																					1			Weatherproof protection ✻2	
Special specification																						Blank		N/A	○
																						/Z		For special requirements ✻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

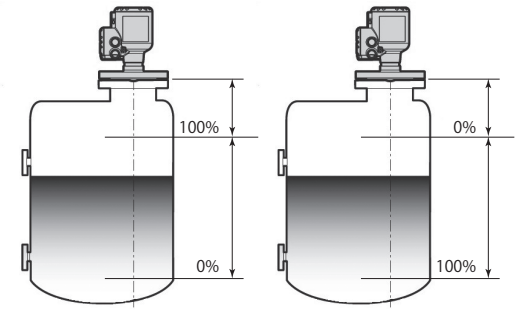
- M20 × G½ female adapter: [GA]
- Flameproof cable gland (G½): [DG]
  Note : Service temperature –40°C to +80°C
- Individual data setting of output ranges: [DS]

ORDERING INFORMATION

Measuring conditions

Measuring method

☐ Level ☐ Distance



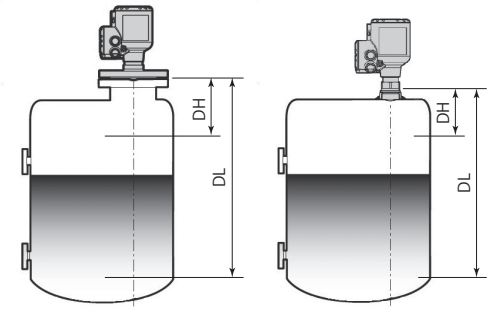
Measuring range

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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