TECHNICAL GUIDANCE

Level Radar with 2-wire system

TLR3000

Microwave Level Meter

GENERAL

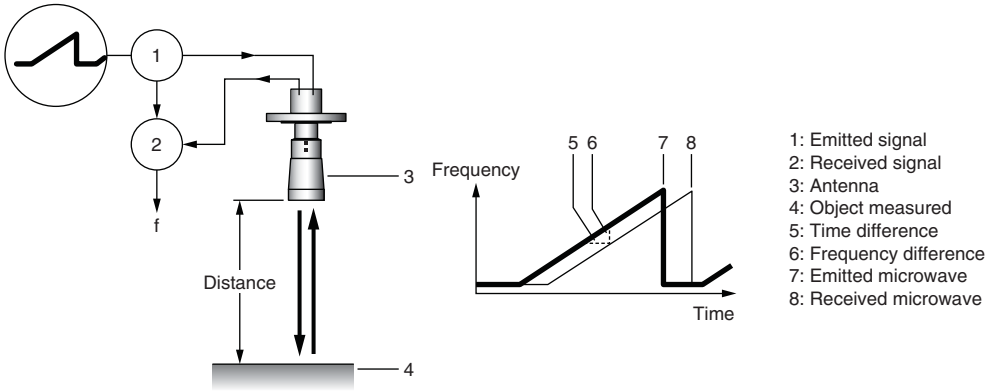
The **TLR3000** is a non-contact type continuous level meter using microwaves. It detects a level by measuring a reciprocating time of a microwave emitted from the level meter to reflect and return from an object measured.
As the electric wave velocity is very little affected by the temperature and pressure, high-accuracy level measurement is allowed regardless of changes to the measuring conditions in a vessel.
It provides level measurement independent of density change, temperature change or viscosity of the object measured, allowing a variety of applications, ranging from low temperature to high temperature, and from vacuum to high pressure.
Use of 2-wire transmission system has realized high-accuracy and low-cost performance.
Its large clear graphic display allows you to set the data easily.
Inheriting the features of the microwave level meters, it has further improved the ease of using.

FEATURES

- ❏ Non-contact type continuous level measurement.
- ❏ Reduced total cost by the 2-wire transmission system.
- ❏ Easy operation through the wide graphic display.
- ❏ Available for a variety of applications owing to improved dynamic range.
- ❏ Available for various objects measured such as liquids and slurry.
- ❏ Capable of displaying a level, ullage, volume and mass.
- ❏ Responds to a wide range of temperature and pressure.
- ❏ High-accuracy level measurement independent of temperature, pressure or density change
- ❏ The drop antenna prevents product build-up on the surface of antenna.
- ❏ The drop antenna with a corrosion-resistant flange plate withstands corrosive liquids.

OPERATION PRINCIPLE

A microwave, whose frequency has been linearly changed inside the main body, is continuously emitted from an antenna.
The emitted microwave reflects from the object measured and is received by the antenna.
By reciprocating over the distance to the object measured, the received microwave causes a frequency difference from the emitted microwave.
A reciprocating time is calculated from this frequency difference. As the microwave speed is constant, the distance to the object measured can be calculated.
The calculated distance is displayed (output) in terms of level, based on the preset tank data.



1: Emitted signal
2: Received signal
3: Antenna
4: Object measured
5: Time difference
6: Frequency difference
7: Emitted microwave
8: Received microwave

TOKYO KEISO CO.,LTD.

TG-EM140E-0 SEP. 2005K
TG-EM140E-2 SEP. 2010K

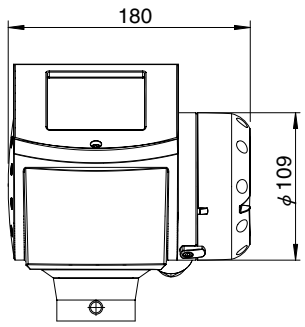
STANDARD SPECIFICATIONS

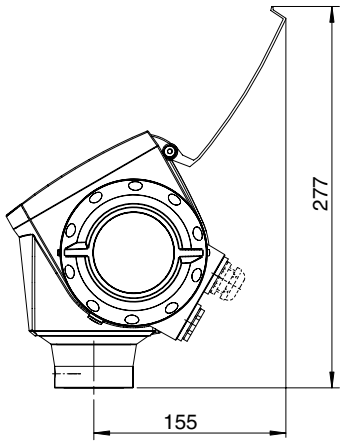
Objects	Item	Contents
Measuring object	Measurable materials	Liquids and Slurries
	Measuring method	Frequency Modulated Continuous Wave (FMCW)
	Measured variable	Level, distance, and volume
	Minimum tank height	0.5m
	Measuring range	Max. 40m (Depending on the measuring condition)
	Blocking distance	Antenna length + 0.2m
Output	Output	4 to 20mA DC (HART)
	Accuracy	±0.01mA (at 20°C)
	Resolution	±3μA
	Temperature drift	50ppm/K (Key value)
	Error signal	22mA DC, 3.6mA DC (Selected by parameter)
	Load resistance (Max.)	350ohms
Accuracy: Based on criteria condition	Liquid measurement	±3mm/R.D. (Less than 10m), ±0.03%/R.D. (10m or more)
Measuring conditions	Temperature of process connection	-40 to +200°C: Horn antenna (Standard type), (Explosionproof type: Refer to EXPLOSIONPROOF SPECIFICATIONS)
		-40 to +150°C: Drop antenna (PTFE) (Standard type) , (Explosionproof type: Refer to EXPLOSIONPROOF SPECIFICATIONS)
		-40 to +100°C: Horn antenna (PP) (Standard type), (Explosionproof type: Refer to EXPLOSIONPROOF SPECIFICATIONS)
	Thermal shock resistance	40°C/sec
	Operating pressure	0kPa (abs) to 4MPa: Horn antenna (subject to flange rating)
		0kPa (abs) to 1.6MPa: Drop antenna (subject to flange rating)
	Dielectric constant	1.5 or more (Depending on the measuring condition and antenna type)
Instrument specification	Ambient temperature	–40 to +80°C (General type), (Explosionproof type: Refer to EXPLOSIONPROOF SPECIFICATIONS)
	Storage temperature	–40 to +85°C
	Temperature at indication part	–20 to +60°C
	Protection class	IP67 (JIS C0920, equivalent to NEMA6)
Electrical connection	Type	2-wire loop powered system
	Power supply (Output 1)	Rated voltage: 24V DC
		Voltage range: 20 to 36V DC (Exd)*1 14 to 30V DC (Non-Ex, Exia)*1
	Cable entry	M20 (with waterproof gland), G1/2 female thread, 1/2 NPT female gland (Option: G1/2 waterproof cable gland)
	Terminal	0.5 to 1.5mm^2
Material	Housing	Aluminum alloy
	Process connection	Stainless steel (SS316L): Standard Hastelloy® C-22
	Parts in contact with process gas	Stainless steel (SS316L): Standard Hastelloy® C-22 PTFE, PP (Drop antenna)
	Seal	FKM (–40 to +200°C) Standard Kalrez® 6375 (–20 to +200°C)
	Sun shade	Stainless steel (SS304)
Display		9 lines 160 × 160 pixels in 8-step grey scale 4 buttons (Right shift key, Enter key, Up key and Down key) Language: English or Japanese
Mass		DN40 / 50 Horn antenna (Thread connection): Approx. 6kg
		DN40 / 50 Horn antenna (Flange connection): Approx. 8kg
		DN80 Horn antenna (Flange connection): Approx. 12kg
		DN100 Horn antenna (Flange connection): Approx. 13kg
		Drop antenna (Flange connection): Approx. 8.5kg
		Drop antenna, with flange plate (Flange connection): Approx. 8.6kg
Process connection	Thread	G1 1/2 Male thread
		1 1/2" NPT Male thread
	Flange	1 1/2", 2", 3", 4", 6", 8", ASME 150lbs, 300lbs
		40A, 50A, 80A, 100A JIS 10K

*1 Voltage range at TLR3000 terminals when output is 22mA.

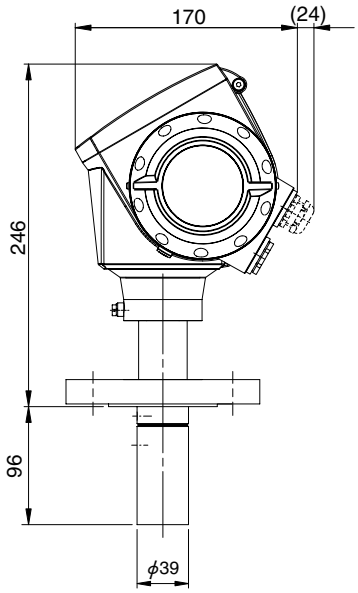
DIMENSIONS

Housing

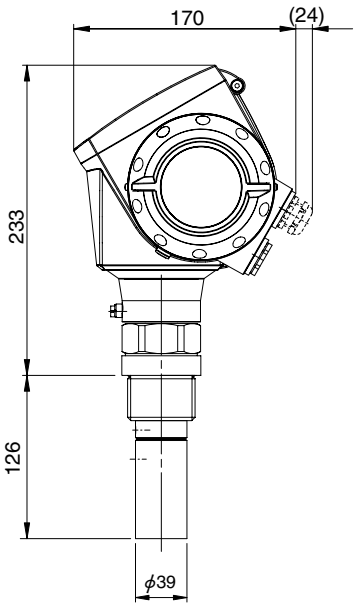




DN40 Horn antenna

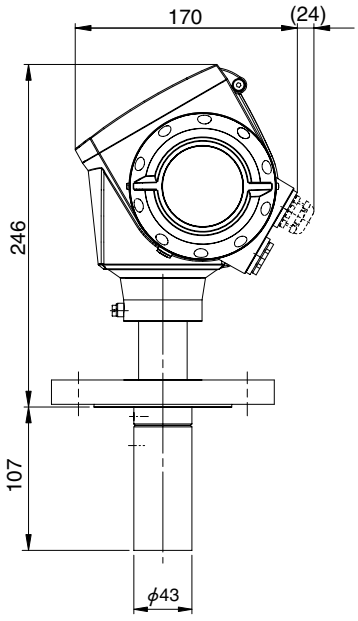


Flange connection

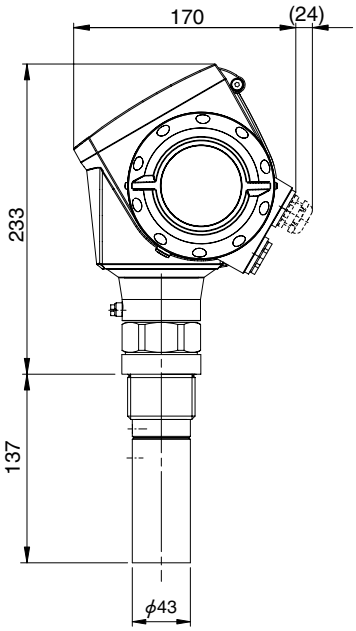


Thread connection

DN50 Horn antenna

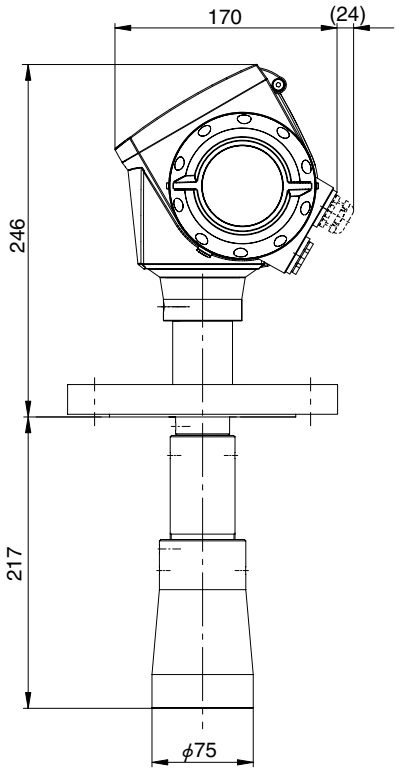


Flange connection

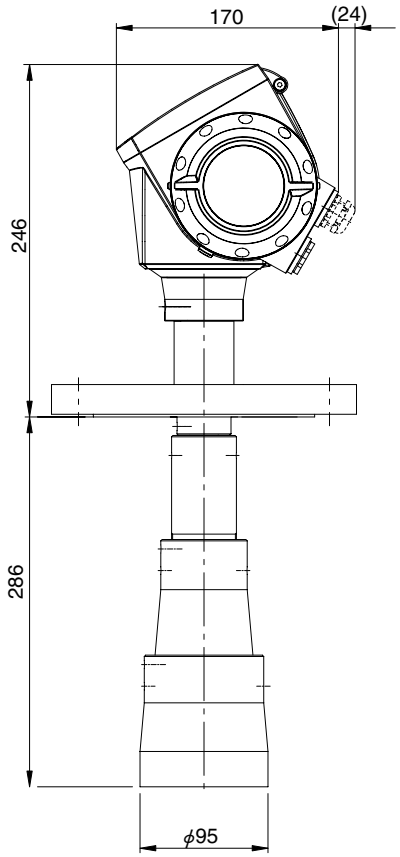


Thread connection

DN80, DN100 Horn antenna

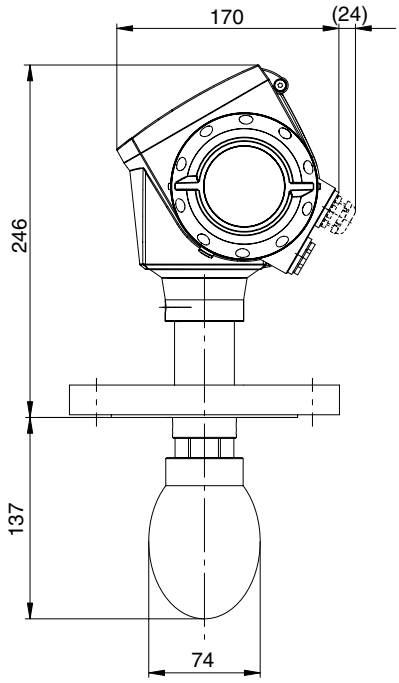


DN80 Horn antenna

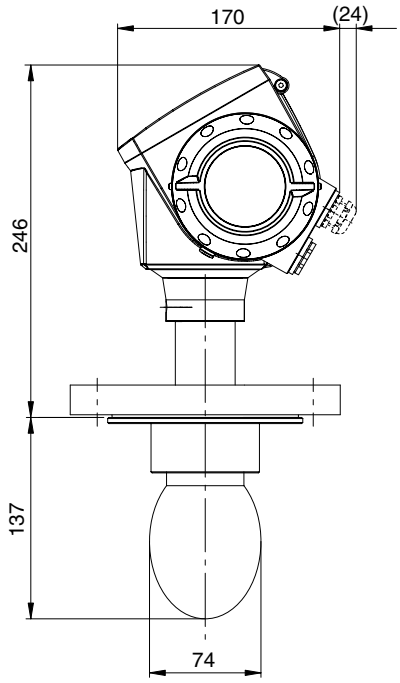


DN100 Horn antenna

DN80 Drop antenna



DN80 Drop antenna



DN80 Drop antenna with flange plate

EXPLOSIONPROOF SPECIFICATIONS

ATEX (ATEX Directives 94/9/EC)
Certificate number: KEMA 05ATEX1181 X

II 1G or II 1/2 G or II 2G
: EX ia IIC or Ex ia IIB or Ex ia IIA T6..T3
II 1D or II 1/2 D or II2D
: Ex ia D 20 or Ex iaD 20/21or Ex ia D 21 IP6X T65°C...90°C
or
II 1/2 G or II 2G
: EX d [ia] IIC or Ex d [ia] IIB or Ex d [ia] IIA T6...T3
II 1/2 D or II2D
: Ex tD[iaD] A21/20 or Ex tD[iaD]A21 IP6X T65°C...90°C

OPERATING CONDITIONS

- Ambient temperature, flange temperature

Equipment category	Ambient temperature	Flange temperature
II 1G	–20°C to +60°C	–20°C to +60°C
II 1/2 G	–40°C to +85°C	–20°C to +60°C
II 2 G	–40°C to +85°C	–40°C*1 to +200°C
II 1 D, II 1/2 D, II 2D	–40°C to +85°C	–40°C*1 to +200°C

*1 Flange temperature of the product in which EPDM gasket is used must be higher than -50°C.

- Housing surface temperature

Max. ambient temperature	Max. flange temperature	Surface temperature
60°C	60°C	62°C
75°C	75°C	77°C
85°C	85°C	87°C
63°C	150°C	83°C

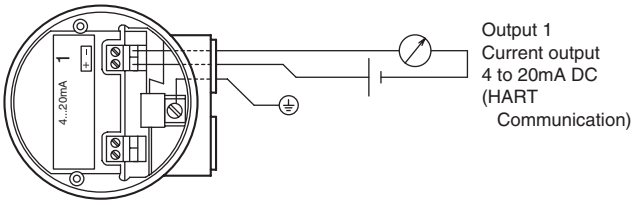
- Temperature class

Equipment category	Max. ambient temperature	Max. process temperature	Temperature class
II 1 G	60°C	60°C	T6
II 1/2 G	60°C	60°C	T6
	75°C	60°C	T5
	85°C	60°C	T4
II 2 G	60°C	60°C	T6
	51°C	85°C	
	75°C	75°C	T5
	66°C	100°C	
	85°C	85°C	T4
	80°C	100°C	
	76°C	110°C	
	68°C	135°C	
	63°C	150°C	T3
	54°C	180°C	
	47°C	200°C	

[Intrinsically safe circuit]
Observe followings when this instrument is used as intrinsically safe circuit.

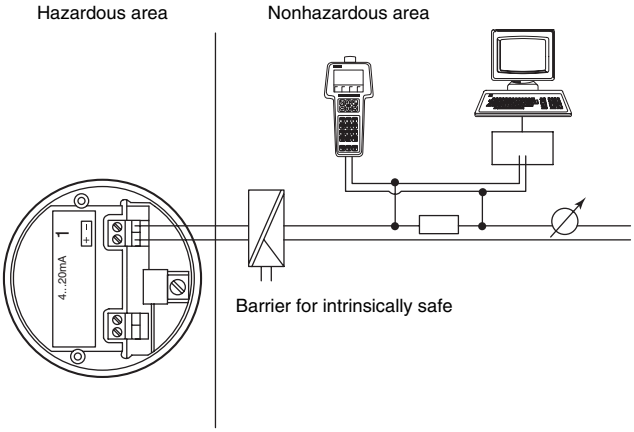
Max. voltage for intrinsically safe circuit (Ui) ≤30V
Max. Current for intrinsically safe circuit (Ii) ≤300mA
Max. Power consumption for intrinsically safe circuit (Pi) ≤1W
Capacitance inside intrinsically safe circuit (Ci) = 30nF
Inductance intrinsically safe circuit (Li) = 200µH

WIRING DIAGRAM



Output 1	Max. load resistance: 350Ω	
	External power supply	Exd: Max. DC36V
		Non-Ex, Exi: Max DC30V

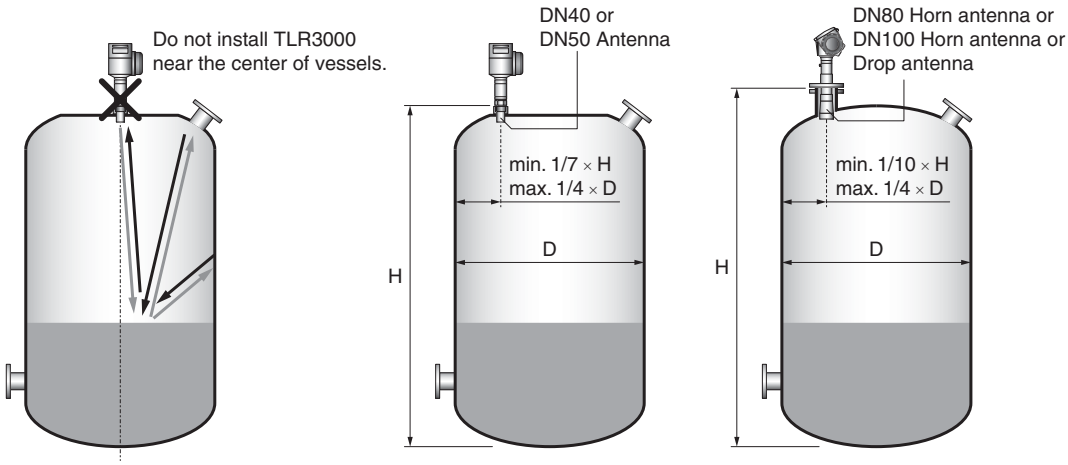
If Used in Intrinsically Safe



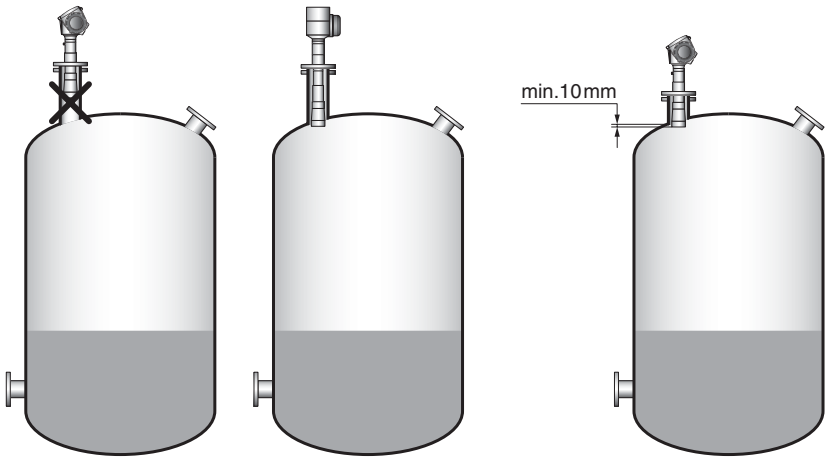
- When using TLR3000 at the hazardous area as intrinsically safe instrument, the intrinsically safety barrier shall be used.
- The items as mentioned in "EXPLOSIONFROOF SPECIFICATIONS" shall be observed when used as explosionproof instrument.
- Regarding the required supply power when using insulating barrier, the specification for barrier shall be confirmed.

NOTES FOR MOUNTING

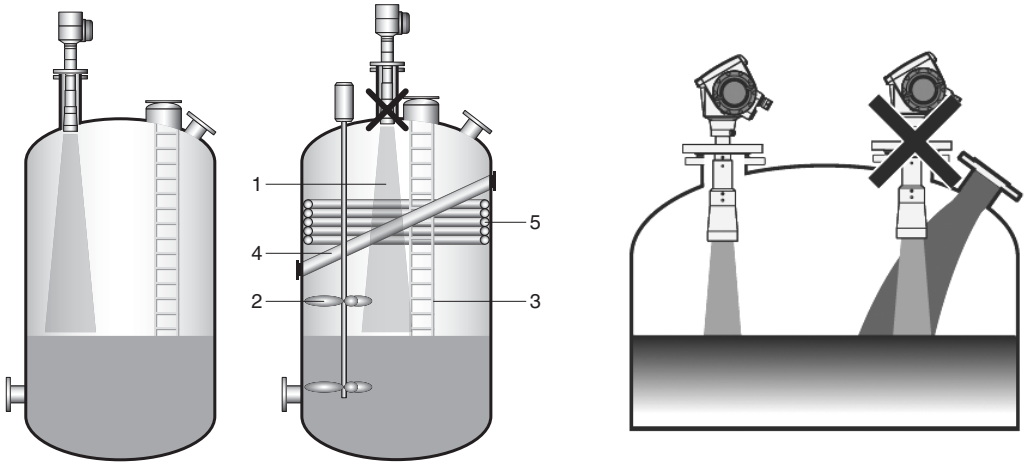
- Do not mount the TLR3000 close to the center of the tank because multiple reflections disable measurement. Mount it 1/4 or less of the tank diameter apart from the tank wall. When mounting to a non-circular vessel such as a concrete pit, install TLR3000 at the place whose distances to the two adjacent walls are not equal.
- Mount the TLR3000 to the position away from the tank wall by 1/7 or more (DN40 or DN50 Horn antennas) or 1/10 or more (DN80 Horn antenna or DN100 Horn antenna or DN80 Drop antenna) of the tank height.
  Regardless of the numerical values above, install the TLR3000 away from the tank wall at least by 150 mm or more. When installing close to the tank wall, ensure that the walls within the emission range of micro waves are flat and smooth without any unevenness.



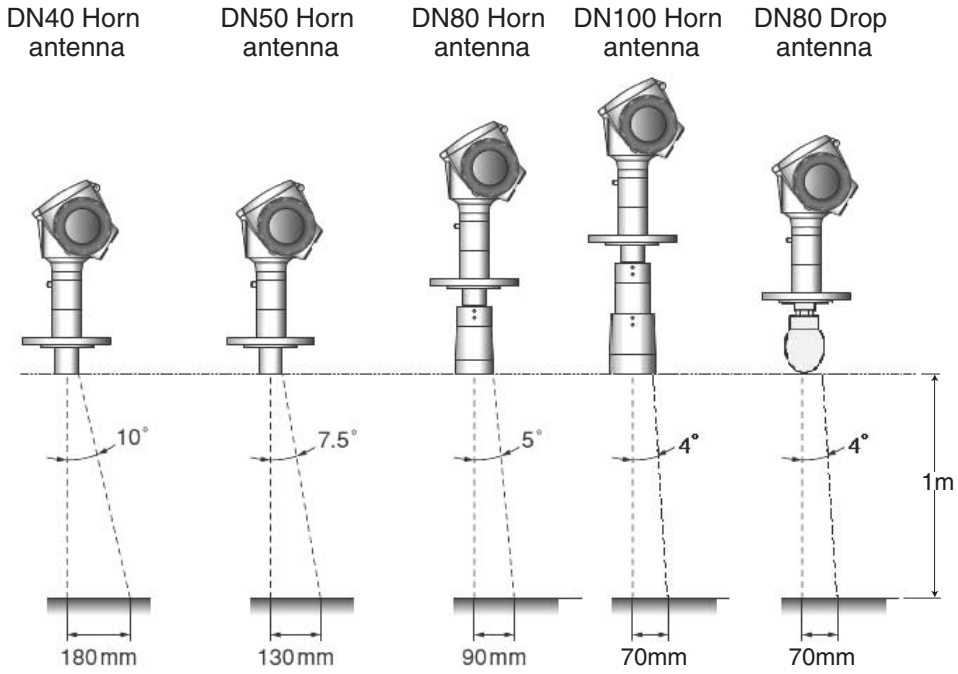
- The tip of the antenna should be extended into the vessel by 10 mm or more from the nozzle.



- Mount the TLR3000 to the position where no stream of product loading enters the emission range of microwaves. Ensure that there are no obstacles within the emission range of micro waves (1), such as a stirrer (2), ladder (3), reinforcement (4) and heating coil (5).

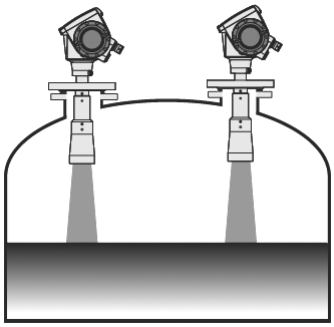


- Beam angle of micro waves for each type of antenna

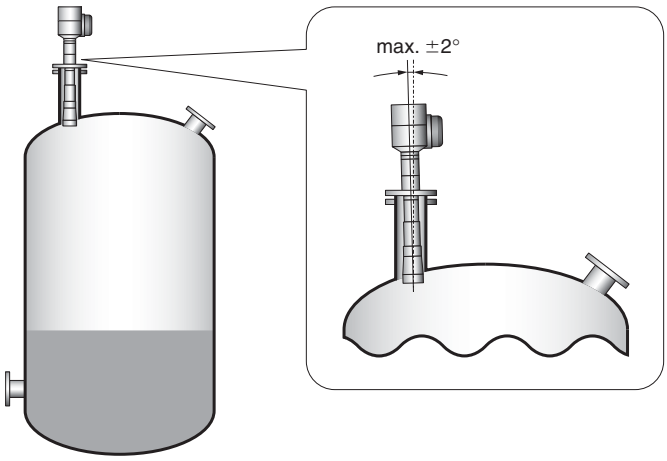


Beam angle of electric wave for each type of antenna

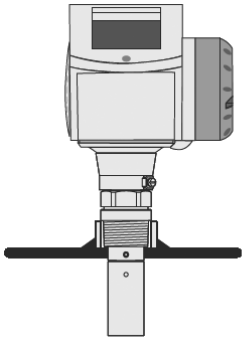
- When installing multiple TLR3000s for an identical vessel, space them out as far as possible.

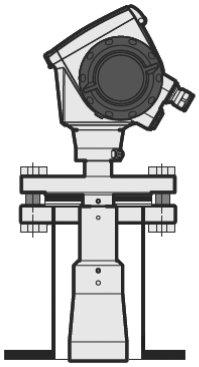


- The inclination of the mounting flange face should be within ±2 degrees.

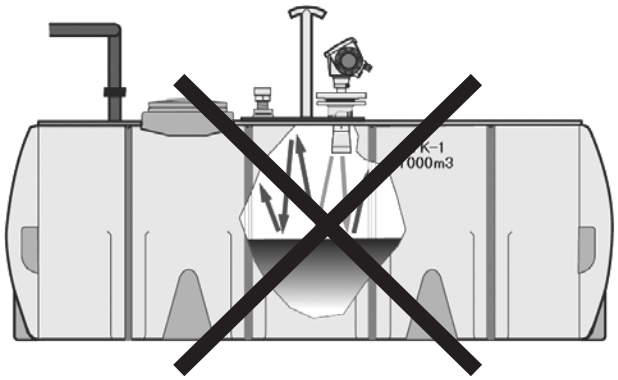


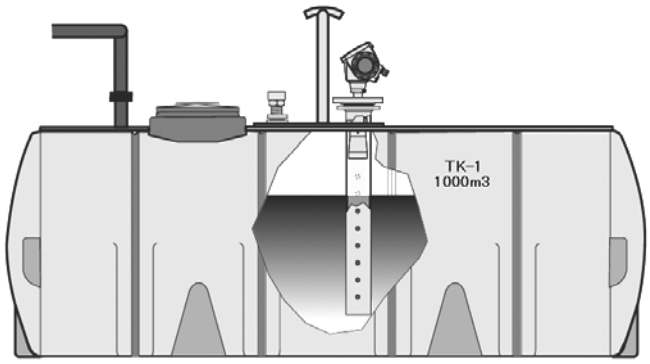
- When installing TLR3000 with a threaded connection, a half coupling welded on the roof is required for screwing. Do not screw in with an excessive force.
- Insert a gasket between the flanges of vessel and TLR3000 before fixing them with bolts and nuts. The drop antenna with flange plate needs no gasket. Fix it in the same manner. Loose installation may lead to the malfunction of the instrument because of the gas penetration into the internal body of the level meter.



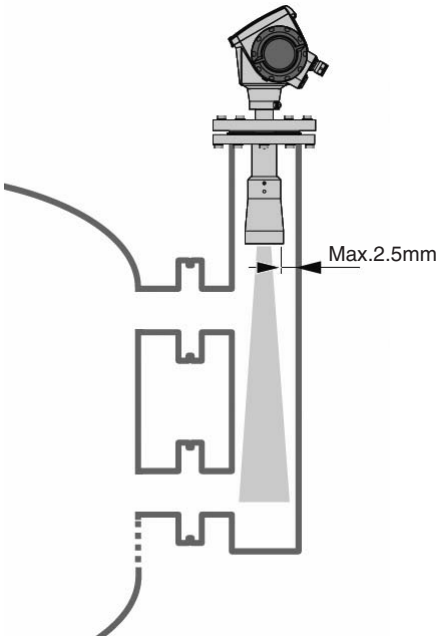


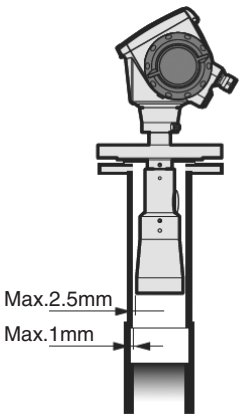
- To install TLR3000 on a cylindrical horizontal vessel, use either an internal pipe or external pipe for measuring inside pipe. If measuring inside pipe is not allowed, install TLR3000 at the distance of 1/3 of radius of the vessel apart from the center of the vessel.



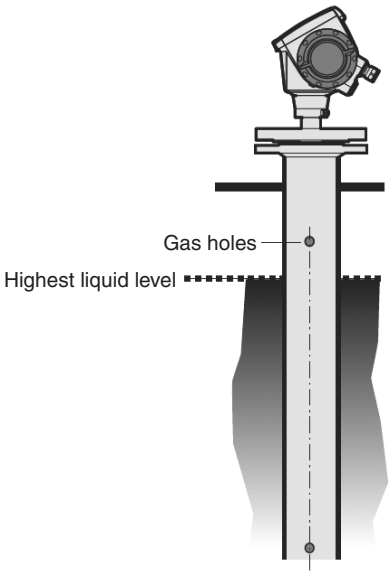


- When measuring inside the pipe, manufacture it with metal. Ensure that a difference between the inner diameter of the pipe and the outer diameter of the antenna is within 5 mm. The surface roughness of the pipe inner figure should be 0.1 mm or less. A fluctuation of the pipe inner diameter should be 1 mm or less.



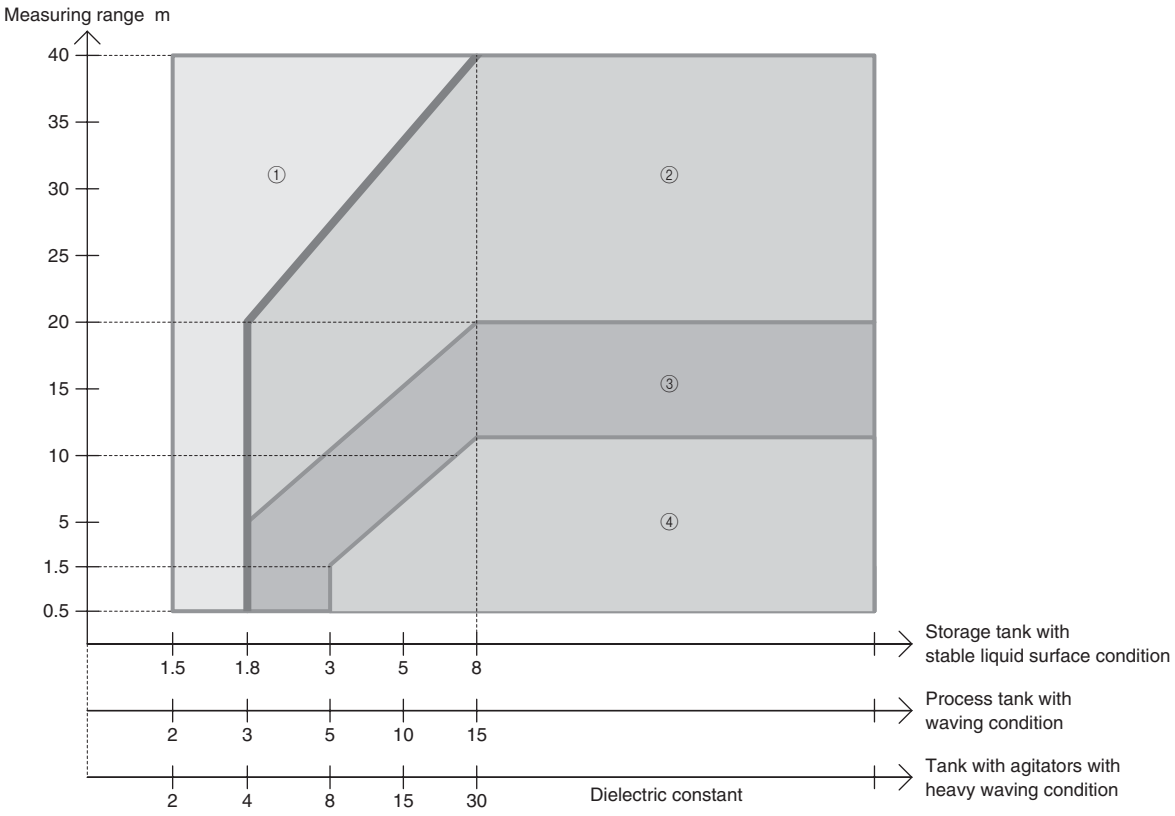


- Make holes on the inner pipe at higher than the highest liquid level for gas passage.
  The holes for liquid passage located at lower part and gas passage located upper part must not be clogged up.



- If the temperature of the housing rises due to the direct sunshine, install a sunshade to use within operating temperature range.
  Do not expose the LCD indicator to direct sunshine.
- Do not use the antenna extension for such applications as the intense dew condensation is expected.
- Do not install TLR3000 in the place subject to strong vibration.

ANTENNA SELECTION



① Measuring inside pipe with DN80 or DN100 Horn antenna
② Measuring with DN80 or DN100 Horn antenna, or DN80 Drop antenna
Measuring inside pipe with DN80 or DN100 Horn antenna
③ Measuring inside pipe with DN40 or DN50 or DN80 or DN100 Horn antenna
Measuring with DN80 or DN100 Horn antenna, or DN80 Drop antenna
④ Measuring inside pipe with DN40 or DN50 or DN80 or DN100 Horn antenna
Measuring with DN40 or DN50 or DN80 or DN100 Horn antenna, or DN80 Drop antenna

ANTENNAS AND THEIR APPLICATIONS

Type of antennas		DN40 Horn antenna	DN50 Horn antenna	DN80 Horn antenna	DN100 Horn antenna	DN80 Drop antenna
Process connection	G 1 1/2 male thread	○	○	×	×	×
	NPT1 1/2 male thread	○	○	×	×	×
	40A JIS flange	○	×	×	×	×
	50A JIS flange	○	○	×	×	×
	80A JIS flange	×	○	○	×	○
	100A JIS flange	×	×	○	○	○
	ASME 1 1/2" flange	○	×	×	×	×
	ASME 2" flange	○	○	×	×	×
	ASME 3" flange	×	○	○	×	○
	ASME 4" flange	×	×	○	○	○
	ASME 6" flange	×	×	○	○	×
	ASME 8" flange	×	×	×	○	×
Antenna materials	Stainless steel SS316L	○	○	○	○	○
	Hastelloy® C-22	○	○	○	○	×
	PP	×	×	×	×	○
	PTFE	×	×	×	×	○
Antenna specifications	Antenna extension	Max.1050mm	Max.1050mm	Max.1050mm	Max.1050mm	Max.525mm *1
	Flange plate of which wet parts is made of plastics	×	×	×	×	○
	Beam angle(one side against horizontal line)	10 degrees	7.5 degrees	5 degrees	4 degrees	4 degrees
	Beam range (one side against horizontal line)	180mm/m	132mm/m	90mm/m	70mm/m	70mm/m
Measuring conditions	External pipe mount	○	○	○	○	×
	Internal pipe mount	○	○	○	○	×
	Small tank	×	×	○	○	○
	Tank with agitator	△	△	△	○	○
	Cylindrical horizontal tank	○ *2 Measuring inside pipe	○ *2 Measuring inside pipe	○ *2 Measuring inside pipe	○ *2 Measuring inside pipe	×
	Long nozzle	○	○	○	○	△
	High temperature	○	○	○	○	×
	High pressure	○	○	○	○	×
Measuring objects	Low dielectric liquid	△	△	○	◎	◎
	High dielectric liquid	○	○	○	○	○
	Slurry	○	○	○	○	○
	Corrosive liquid	×	×	×	×	◎ *3
	Sticky liquid	×	×	△	△	◎
	Volatile liquid	×	×	×	×	◎
	Foaming liquid	○ Measuring inside pipe	○ Measuring inside pipe	○ Measuring inside pipe	○ Measuring inside pipe	×

*1 The antenna extension is not available for the model with flange plate type.
*2 The measuring is feasible with the internal or external pipe, i.e. chamber.
*3 with flange plate
Legends: ◎ : most suitable, ○ : suitable, △ : not suitable, × : can not be used

MODEL AND SPECIFICATION CODES

Model: TLR3000

Spec. code VF70	4												4 0 0 0 0 0 0		Description	Standard
Fixed code	4														Always 4	
Authorization		0													Standard (Non-Ex)	○
		2													ATEX Explosionproof version (Intrinsically safe)	
		3													ATEX Explosionproof version (Flameproof)	
Process connection and Antenna material			0												Stainless steel (SS316L)	○
			1												Hastelloy® C-22	
Antenna type				3											DN80 Horn antenna (Ø75mm)	○
				4											DN40 Horn antenna (Ø39mm)	
				5											DN50 Horn antenna (Ø43 mm)	
				F											DN100 Horn antenna (Ø95 mm)	
				P											DN80 PTFE Drop antenna (Ø75 mm)	
				S											DN80PP Drop antenna (Ø75 mm)	
Antenna extension and flange plate					0										Non	○
					1										105mm	
					2										210mm	
					3										315mm	
					4										420mm	
					5										525mm	
					6										630mm	
					7										735mm	
					8										840mm	
					A										945mm	
					B										1050mm	
					P										Flange plate (PP for drop antenna)	
					S										Flange plate (PTFE for drop antenna)	
Seal / temperature range						0									FKM / –40°C….+200°C *1	○
						1									Kalretz® 6375 / –15°C….+200°C *1	
Process connection: G male thread							0								Other than G thread	○
							3								G1 1/2 male thread	
Process connection: ASME flange or NPT male thread								0							Other than ASME flange or NPT thread	○
								3							1 1/2 NPT male thread	
								5							1" 1/2 150 lb RF ASME B16.5	
								6							1" 1/2 300 lb RF ASME B16.5	
								7							2" 150 lb RF ASME B16.5	
								8							2" 300 lb RF ASME B16.5	
								A							3" 150 lb RF ASME B16.5	
								B							3" 300 lb RF ASME B16.5	
								C							4" 150 lb RF ASME B16.5	
								D							4" 300 lb RF ASME B16.5	
								E							6" 150 lb RF ASME B16.5	
								F							8" 150 lb RF ASME B16.5	
Process connection: JIS flange									0						Other than JIS flange	
									5						40AJIS10K RF	
									6						50AJIS10K RF	
									7						80AJIS10K RF	○
									8						100AJIS10K RF	
Output										0					4 to 20mA × 1 output (HART)	○
Cable entry											0				M20 (With waterproof gland)	
											1				1/2NPT female thread	
											2				G1/2 female thread	○
											Y				G1/2 with flameproof packing adapter	
Housing option												0			Non	○
												2			Sunshade	
Display													0		Non	
													1		English	○
													7		Japanese	
Fixed code													4 0 0 0 0 0 0		Always 400000	
Special														(Blank)	Non	○
														/Z	with special request *2	

*1: The temperature limitation is applied for only general type, not for explosionproof type.
For the explosionproof type, see Explosionproof specifications.

*2: When special specification is required, add a word "/Z" at the end of code. (Ask factory in advance about the possibility of production.)

STANDARD ACCESSORIES

- Parameter sheet: 1
- Instruction manual: 1

OPTION

- G1/2 watertight gland for cable entry (Symbol: WG)
- Other standard data setting (with parameter sheet) (Symbol: DS)

ORDERING INSTRUCTIONS

1. Model and spec. code
   Example) Model : TLR3100
   Spec. code: VF704002000070201400000O
2. Option (if required)
   Specify by the symbol referring to "OPTION".
3. Special request (if required)
   Please state special requests clearly.
   Consult Tokyo Keiso or representative before ordering.

ORDERING INFORMATION

Measurement

Measuring range	The distance from the process connection to the minimum level ( ) m
	The distance from the process connection to the maximum level ( ) m

Product

Name	( )
Dielectric constant	εr ( )
Fluid	☐ Liquid ☐ Slurry
Corrosivity	☐ Non ☐ Medium ☐ Strong
Stickiness	☐ Non ☐ Medium ☐ Strong
Crystalline	☐ Non ☐ Medium ☐ Strong
Waving	☐ Non ☐ Medium ☐ Strong
Foam	☐ Non ☐ Medium ☐ Strong

Operating condition

Measuring condition	☐ Outdoor use ☐ Indoor use
Product temperature	( ) °C
Ambient temperature	( ) °C
Pressure	( )
Explosionproof	☐ Not required ☐ Required

Vessel

Shape	☐ Ground tank ☐ Underground tank ☐ Closed pit ☐ Others
Height	( ) m
Diameter or width	( ) m
Obstructive inner structures	☐ No ☐ Yes: ☐ Agitator (Shape:) ☐ Temp. sensor ☐ Level switch ☐ Reinforce or stay ☐ Ladder ☐ Others ( )
Material	☐ Metal ( ) Liner or coating: ☐ Yes ☐ No ☐ Non metal ( )

Installment condition

Position	Distance from Tank wall	( ) m
	Distance from liquid inlet nozzle	( ) m
	Distance from obstruction	( ) m
Mounting nozzle	Diameter	( ) mm
	Length	( ) mm

*Specification is subject to change without notice.

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