TECHNICAL GUIDANCE

Level Radar

TLR1000

Microwave level meter

GENERAL

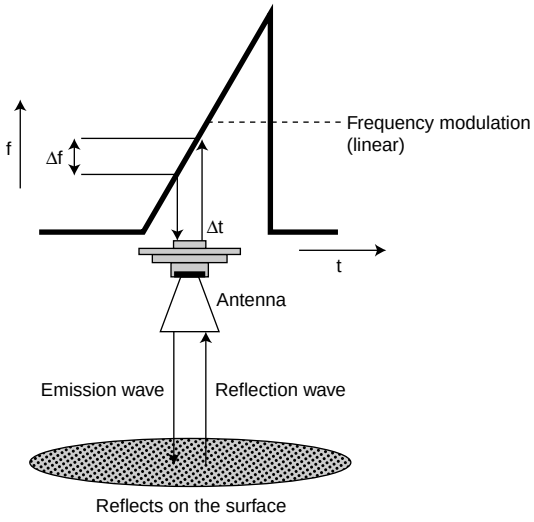
TLR1000 level radar is a non-contact level meter using FMCW radar, which results in higher reliability and higher performance than other radar technologies.
Thanks to such microwave technology,
TLR1000 provides non-contact level measurement independent of temperature and pressure. Vapor, gas, steam and dirt do not affect measurement performance nor do highly abrasive or highly viscous products.
A special sealing system guarantees that
TLR1000 can be used on products having a range of temperature and pressure change from vacuum to high pressure.
TLR1000 is a state of the art FMCW radar gauge applicable for use from simple storage to process tanks wherever higher performance is required.

FEATURES

- ❏ Non-contact, non- moving parts.
- ❏ Maintenance-free.
- ❏ Applicable for all kinds of liquids including highly viscous paste and slurry.
- ❏ A variety of antenna systems for a wide range of applications.
- ❏ Suitable for food industries with sanitary mounting.
- ❏ Measuring range up to 40 m.
- ❏ Accuracy ±10 mm (or ±0.3 % RDG)
- ❏ Pressure range –0.1 to 64 bar
- ❏ Flange temperature –40 to 250 °C

OPERATION PRINCIPLE

TLR1000 uses FMCW (Frequency Modulated Continuous Wave) radar technology.
TLR1000 emits microwave from the antenna, which is continuously linear modulated. The antenna receives the wave reflected back from the medium's surface while emission is still running.
The received wave differs in frequency from the emitted wave by the propagation time of microwave from emission to receipt. It causes beat signal.
After FFT (Fast Fourier Transform) and DSP (Digital Signal Processing), the beat signal gives a frequency spectrum and computes level output in accordance with registered tank data set in theTLR1000.



Δf : Frequency difference
Δt : Time delay

STANDARD SPECIFICATIONS

- Measurement technology : Continuous non-contact level, ullage measurement by microwave, volume calculation
- Measurement medium : Liquids, slurries, pastes
- Measurement principle : FMCW (Frequency Modulated Continuous Wave)
  Frequency ; 8.5 to 9.9 GHz (X band)
- Measurement conditions
  Dielectric constant : For horn antenna $\varepsilon \geq 1.5$
  * When $\varepsilon < 4$, measurement in a pipe is recommended depending on process condition
  For Wave Stick $\varepsilon \geq 2$
  * Also refer Antenna Selection
  * However, liquefied ammonia (L NH_3), liquefied hydrogen (L H_2), liquefied helium (L He) cannot be measured.
- Model and antenna : TLR1100 Horn antenna
  TLR1200 Wave Stick antenna
- Measuring range : Max. 40 m with Horn antenna
  Max. 20 m with Wave Stick antenna
  * Both depend on the measuring conditions
- Min. tank height : 0.5 m
- Blocking distance : 0.2 to 0.5 m
  * Depends on antenna type
- Accuracy (display) : ±10 mm or ± 0.3 % RDG whichever is greater
  * Under reference condition
- Response speed : Max. 10 m/min
- In/Output
  Type 1 (standard) :
  4 to 20 mA active/HART, Max. load 500 Ω
  * Output accuracy display accuracy + 0.05 % F.S.
  Status output ; Transistor contact
  * Max. 30 V AC/DC, max. 100 mA
  Control input ; 1 input, Output freeze when 5 to 28V DC supplied
  Type 2 :
  RS485 (Modbus protocol)
  4 to 20 mA active, Max. load 250 Ω
  * Output accuracy display accuracy + 0.05 % F.S.
  Others : Profibus PA or Field bus are available
- Display : Illuminated 2 lines 8 digits LCD
- Units : Length m, cm, mm, inch, feet, %
- Volume : m^3, L, USG, GBG, ft3, bbl
- Local operation : 4 magnetic and / or mechanical keys
- Power supply : 115 V (85 to 127 V) AC (standard)
  230 V (170 to 254 V) AC
  17 to 30V AC/DC
  * ( ) Voltage range
- Frequency : 45 to 66 Hz
- Power consumption : 12 VA for AC supply, 7.5 W for DC supply
- Cable entry : 2 × M25 × P1.5 gland (standard), 2 × G1/2
  2 × G3/4 Ex d gland *, 2 × NPT 1/2
  * For TIIS explosion proof
- Terminal : IEC type, cable diameter 0.5 to 2.5 mm^2
- Explosion proof
  ATEX PTB : EEx de IIC/IIB T6...T1
  Antenna Zone 0 (horn or wave stick)
  or Zone 1 (only for wave stick)
  Housing : Flameproof / Increased safety
  Terminal box : Flameproof or Increased safety
  TIIS (in preparation) : Ex de IIC T3, 4
  Housing : Flameproof / Increased safety
  Terminal box : Flameproof
- Ambient temperature : –20 to +55 °C (housing)
  –40 to +70 °C (function range)
- Flange temperature : Refer to table below

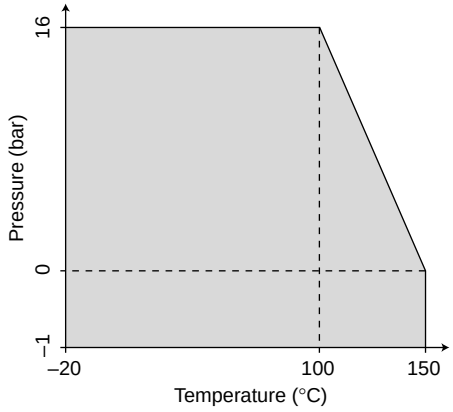
[Operation temperature]

Antenna type	Seal material	Min. temp.	Max. temp *1
Horn Antenna	Viton	–30°C	+130°C (+200°C)
	Parfluoro elastomer	–30°C	+130°C (+250°C)
	Kalrez 2035	–30°C	+130°C (+210°C)
PTFE Wave Stick	PTFE	–40°C	+130°C (+150°C)

*1 : ( ) for high temp. version

- Pressure
  Horn antenna and Wave stick for Zone 0: –1 to 64 bar
  * also refer to Flange rating
  Wave Stick for Zone 1: Depends on temperature

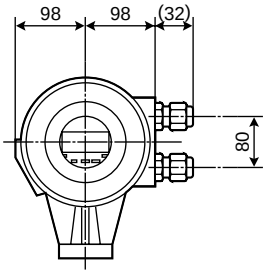
[Operation temperature/pressure]



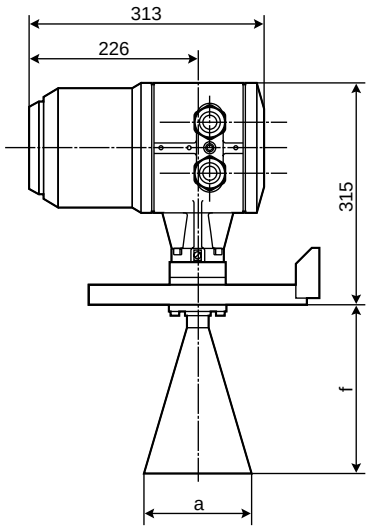
- Material
  Housing : Aluminum casting
  (Painting: Polyurethane paint, color Jade Green)
  Horn antenna, Flange, Antenna extension :
  316TiSS (standard), HastelloyC4 or B2, Titanium, Tantalum
  Wave Stick : PTFE
  Gasket
  For Horn antenna : Viton, Parfluoro elastomer, Karlez2035
  For Wave Stick : PTFE
- Process connection and size :
  80A/100A150A/200A JIS 10K / 20K flange,
  3“, 4”, 6“, 8” ANSI class 150/300 flange
  Sanitary connection Tri-clamp (ISO 2852) 2“, DIN11851 union thread
  * Refer to Antenna Selection for antenna type and possible connection
- Protection : IP67 of IEC529/JIS C0920
- EMC : EN50081-1, 50082-2 CE marking
- Weight
  TLR1100 : Horn antenna
  Approx. 23 kg for 316TiSS, 150A JIS 10 K flange
  TLR1200 : Wave stick
  Approx. 16kg for PTFE, 50A JIS 10K

DIMENSIONS

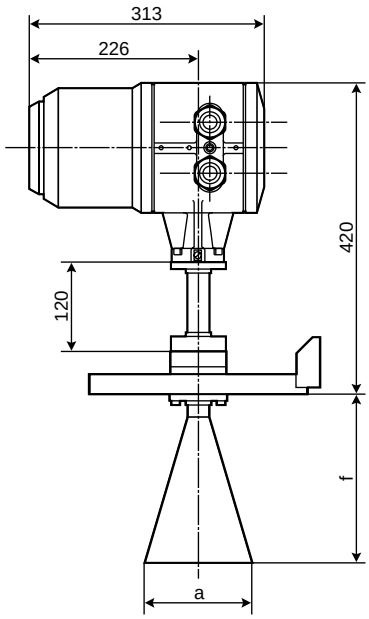
TLR1000 Horn Antenna



[Standard]



[High temperature version]

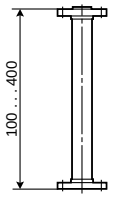


[Antenna dimensions]

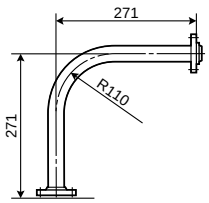
Antenna type	Flange type		Horn diameter	Horn height f (mm)		
	JIS	ANSI	øa (mm)	316TiSS	Hastelloy	Tantalum/Titanium
80mm	80A	3"	80	110	145	110
100mm	100A	4"	100	148	177	146
140mm	150A	6"	140	223	250	220
200mm	200A	8"	200	335	360	332

- **Antenna extension**

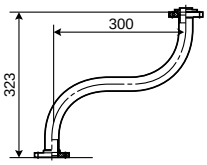
[Straight]



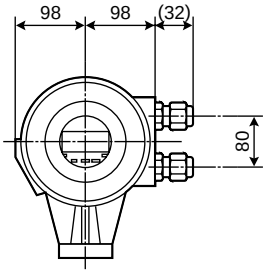
[Elbow]



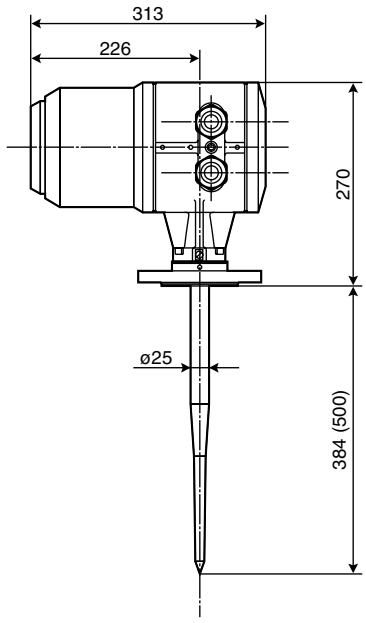
[S shape]



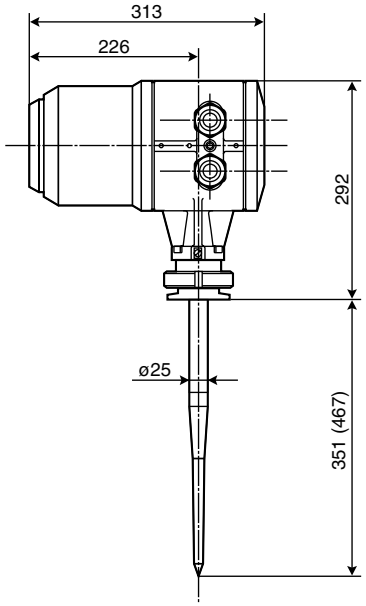
TLR1200 Wave Stick antenna



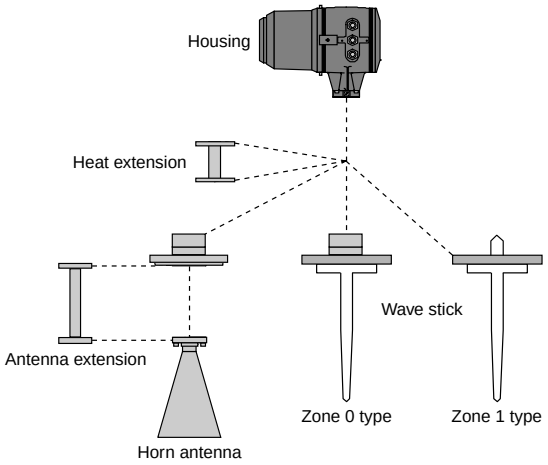
[Flange mounting]



[Sanitary]



ANTENNA SELECTION



Modular system:
TLR1000 Series is modulated from a housing (consisting of electronic compartment and terminal box), a process connection (flange, seal) and an antenna. This system enhances its flexibility to applications.
Please refer to the following explanations for selection of antenna

Horn antenna

- Material : 316Ti SS (standard); other materials such as Hastelloy C4/B2, Titanium, Tantalum or other special materials are also available
- Antenna size : 4 sizes, 80/100/140/200 mm opening diameter (note: 80, 100 mm antennas are only for measurement in a pipe)
- Process connection : 150A JIS 10K flange or 6" ANSI class 150 flange (standard with 140 mm antenna)
  Also 80A/100A/200A, JIS 20K, 3"/4"/8" ANSI class 150, class 300 flanges are available in accordance with antenna size (note: 80A/3", 100A/4" are only for pipe mounting)
- Measuring range : Max. 40 m (depending on the measuring condition)
- Blocking distance (dead zone) : Min. 200 mm from end of antenna for free space
  (Add 30 mm for Hastelloy antenna)
- Highest product level : The minimum distance from the antenna end to the highest product level (100 % of range) should be equal to or more than blocking distance.
  (For pipe mounting the minimum distance from the antenna end to the highest product level should be equal to or more than 300 mm.)
- Usage : 140, 200 mm antenna for free space mounting
  80, 100, 140 mm antenna for measurement in a pipe (The gap between inner diameter of the pipe and the antenna diameter should be less than 5 mm)
- Application : For low dielectric constant products ($\varepsilon_r \geq 1.5$), Long measuring range

Wave Stick antenna

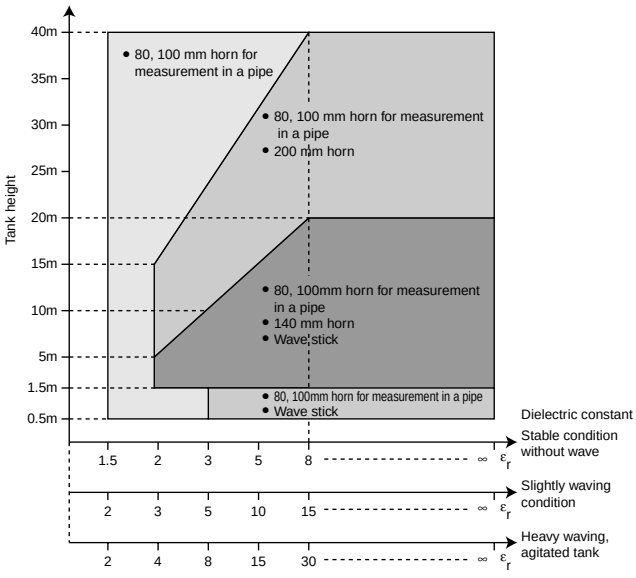
- Material : PTFE (combined with flange gasket)
- Process connection : 50A JIS10K flange (standard)
  80A/100A/150A, JIS 20K, 2"/3"/4"/6" ANSI class 150/300 flange
  Sanitary mounting Triclamp 2", Union nut (DIN11851) available
- Measuring range : Max. 20 m (according to measuring condition)
- Blocking distance (dead zone) : Min. 184 mm from flange for 384 mm antenna
  Min. 300 mm from flange for 500 mm antenna
- Highest product level : The highest product level can be equal to or less than 200 mm above the end of antenna. (The accuracy of the measurement above the end of the antenna is outside guaranteed accuracy)
- Application : For relatively high dielectric constant product ($\varepsilon_r \geq 2$)
  For small tanks, Highly corrosive products, Sanitary applications, chemical tanks, foodstuffs

[Antenna type and measuring range]

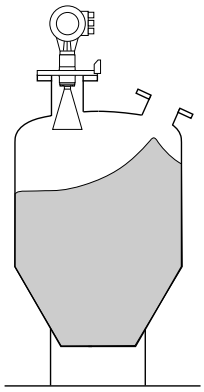
Antenna type	Size (mm)	Beam angle (°)	Expansion (mm/m)
Horn	80	Only for measurement in a pipe	
	100		
	140	8	140
	200	6	100
Wave Stick	384/500 (length)	9	160

* Beam angle: Half value angle where the wave strength becomes half

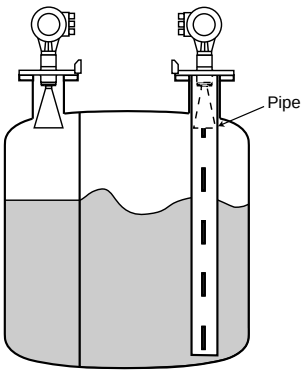
[Antenna type and measuring range]



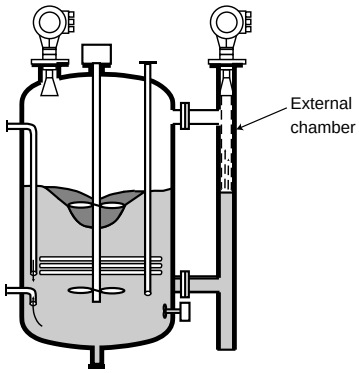
APPLICATION



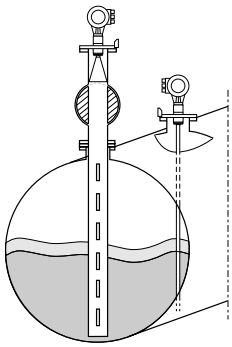
[Example 1]



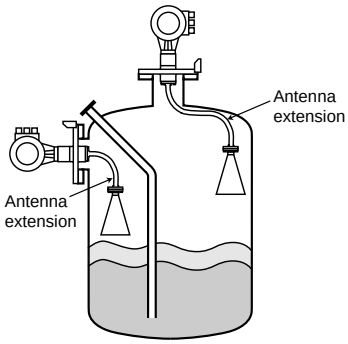
[Example 2]



[Example 3]



[Example 4]



[Example 5]

Mounting to a tank [Example 1]

Mount antenna to intrude the end of the antenna to the tank. Avoid mounting close to the center of the tank or inlet nozzle.

Application with strong turbulence [Example 2]

Use stilling well or separator when product is likely to be subject to strong turbulence.

Application of agitated tank [Example 3]

Avoid mounting the instrument close to agitator shaft where blades may often come within the microwave robe.
Mount the antenna to external chamber or pipe in the tank when the turbulence expected.

- Use antenna which matches to the inner diameter of the pipe
- The maximum allowable gap between inner diameter of the chamber or pipe and the antenna diameter is 5 mm
- The abrupt change of the inner diameter of the pipe should be less than 1 mm and maximum allowable surface roughness is 0.1 mm

Application in cylindrical tank [Example 4]

Mount onto pipe in case of cylindrical tank.

In use of antenna extension [Example 5]

Antenna extension (straight or bent) is available for proper mounting on vessels

- Without a mounting nozzle on top of the tank
- With mounting nozzle close to the center of the vessel
- Long and narrow mounting nozzle
- Mounting nozzle close to the inlet nozzle

NOTES FOR MOUNTING

- Do not mount close to the center of the vessel or center of a manhole. The multiple reflection may disable measurement.
- Mount the instrument within 1/6 of vessel diameter from the wall (close to the wall). When mounting onto particularly small vessels (1 to 1.5 m diameters), the mounting location should be within 1/8 of diameter from the vessel wall.
- In the case of 140 mm Horn antenna and Wave Stick antenna, it is recommended that the distance from vessel wall to the instrument should be more than 1/7 of the vessel height. It should be 1/10 of the vessel height in use of 200mm Horn antenna. (If there is no obstruction on the vessel wall, such as welding bead, more than 1 mm height, the distance can be reduced to 1/15 of the vessel height.)
- Mount the instrument where no possibility of obstruction in the microwave lobe.
- Installation notes are the same for the mounting onto square or rectangular vessels (e.g., pits). Do not install instrument where the distances to 2 neighboring walls are equal.
- When microwave beam is subject to dense product streaming and frequent loading, measurement may not be possible during such loading. Mount the instrument where no stream of product loading is expected.
- If mounting nozzle requires a valve, use ball valve type.
- Mount Horn antenna so that the end of the antenna intrudes into the vessel.
- The maximum length of the nozzle for Wave Stick (standard size) is 150 mm.
- Do not mount the instrument under direct sunlight. Keep the ambient condition as specified. Use sunshade, if necessary.

TYPE AND SPECIFICATION CODE

Type: TLR1100 (Horn antenna)

Spec. code	V 500	4						1			1			3		Description	Standard
(Fixed code)		4														Always 4	○
Antenna/Flange wetted surface material			1													316 Ti SS (DIN 1.4571)	○
			5													Hastelloy B2	
			6													Hastelloy C4	
			A													Tantalum	
			B													Titanium	
Process connection				A												3" ANSI class150 (for measurement in a pipe)	
				B												3" ANSI class300 (for measurement in a pipe)	
				C												4" ANSI class150 (for measurement in a pipe)	
				D												4" ANSI class300 (for measurement in a pipe)	
				E												6" ANSI class150	
				F												6" ANSI class300	
				G												8" ANSI class150	
				H												8" ANSI class300	
				M												80A JIS 10K (for measurement in a pipe)	
				N												80A JIS 20K (for measurement in a pipe)	
				P												100A JIS 10K (for measurement in a pipe)	
				R												100A JIS 20K (for measurement in a pipe)	
				S												150A JIS 10K	○
				T												150A JIS 20K	
				U												200A JIS 10K	
				V												200A JIS 16K	
Seal material/Temperature					1											Fuluoro rubber (Viton) up to 130°C	○
					2											Parfluoro elastomer (Kalrez 4079) up to 130°C	
					4											Kalrez 2035 up to 130°C	
					A											Fuluoro rubber (Viton) for high temp up to 200°C	
					B											Parfluoro elastomer (Kalrez 4079) for high temp up to 250°C	
					D											Kalrez 2035 for high temp up to 210°C	
Antenna type						1										80mm horn antenna (80A/3" flange for measurement in a pipe)	
						2										100mm horn antenna (100A/4" flange for measurement in a pipe)	
						3										140mm horn antenna (150A/6" flange)	○
						4										200mm horn antenna (200A/8" flange)	
Power supply							1									230 V AC	
							2									115 V AC	○
							3									24V DC/AC	
Output								1								Type 1: 4 to 20mA (Active)/HART	○
								3								Type 2: 4 to 20mA (Active)/RS485 (Modbus)	
								5								Profibus PA	
								B								Foundation Field bus	
Display									1							With display	○
Cable entry										1						M25 cable gland (G3/4 female adapter attached)	○
										A						1/2 NPT female	
										C						G1/2 female	
										Y						G3/4 Ex d cable gland for TIIS approval	
Explosion proof											1					ATEX (Ex e terminal box) Zone 0	○
											5					ATEX (Ex d terminal box) Zone 0	
											D					TIIS (Ex d terminal box: in preparation)	
(Fixed code)												1				Always 1	○
Antenna extension													0			Non	○
													1			100 mm	
													2			200 mm	
													3			300 mm	
													4			400mm	
													X			S shape	
													Z			90 degree bent	
Antenna option														0		Non	○
														1		Purge nozzle (only for 316Ti SS)	
														A		Heating/cooling system (316Ti SS, 140 mm horn only)	
(Fixed code)															3	Always 3	○
Special															Blank	Non	○
															/Z	with special request (*note)	

*Note : Use /Z for special request. Please consult Tokyo Keiso or representative for special request before order.

Type: TLR1200 (Wave stick antenna)

Spec. code	V 510	4							1		3		Description	Standard
(Fixed code)		4											always 4	○
Type			1										Standard type	○
			2										High temperature version	
Process connection				A									2" ANSI class150 flange	
				B									2" ANSI class300 flange	
				C									3" ANSI class150 flange	
				D									3" ANSI class300 flange	
				E									4" ANSI class150 flange	
				F									4" ANSI class300 flange	
				G									6" ANSI class150 flange	
				H									6" ANSI class300 flange	
				L									Triclamp 2"	
				R									Union nut ND 50 to DIN11851	
				Y									50A JIS 10K flange	○
				Z									80A JIS 10K flange	
Explosion proof					1								ATEX (Ex e terminal box) Zone 1	○
					2								ATEX (Ex e terminal box) Zone 0	
					6								ATEX (Ex d terminal box) Zone 0	
					D								TIIS (Ex d terminal box: in preparation)	
Antenna						1							Wave stick combined gasket PTFE 384mm	○
						2							Wave stick combined gasket PTFE 500mm	
Power supply							1						230 V AC	
							2						115 V AC	○
							3						24V DC/AC	
Output								1					4-20mA (Active)/HART	○
								3					4-20mA (active)/RS485 (Modbus)	
								5					Profibus PA	
								B					Foundation Field bus	
Display									1				With display	○
Cable entry										1			M25 cable gland (G3/4 female adapter attached)	○
										A			1/2 NPT female	
										C			G1/2 female	
										Y			G3/4 female Ex d gland for TIIS approval	
(Fixed code)											3		Always 3	○
Special												Blank	Non	○
												/Z	Specials (*Note)	

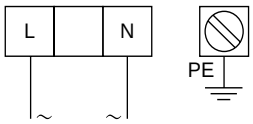
*Note : Use /Z for special request. Please consult Tokyo Keiso or representative for special request before order.

ELECTRICAL CONNECTION

This instrument is a 4-wire (minimum) instrument with galvanically isolated mains and output. Connect the instrument as per following figures.

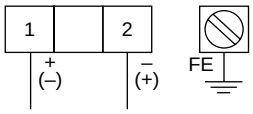
Connection of power supply

● **AC supply**



Type	Terminal	Polarity	Description
AC supply	L		115 or 230 V AC
	N		Supply range: 85 to 127V or170 to 254V
	PE		Ground

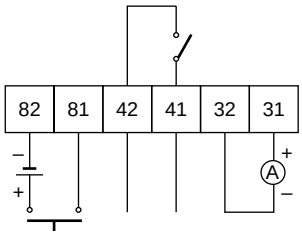
● **DC supply**



Type	Terminal	Polarity	Description
DC supply	1	Non	24V DC Supply range 17 to 30 V
	2		
	FE		Ground

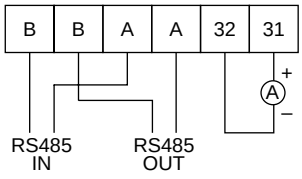
Connection of In/Output

● **Type 1 (standard)**



Type	Terminal	Polarity	Description
Current output	31	+	4 to 20 mA DC/HART
	32	–	Max. load: 500 Ω
Status output	41		Transistor output: for error status, high or low alarm
	42		Max. load: 100 mA, 30 V DC/AC Output can be programmable
Control input	81	+	Control input: 1 input Output freeze when
	82	–	5 to 28V DC supplied

● **Type 2**



Type	Terminal	Polarity	Description
Current output	31	+	4 to 20 mA DC
	32	–	Max load: 250 Ω
Digital output	A	OUT	Use twisted pair wire Cable length: Max 1200 m
	A	IN	
	B	OUT	
	B	IN	

ORDERING INFORMATION

Measuring condition

The distance from the mounting nozzle to the minimum level : ( ) m
Measuring range : ( ) m

Product

Name : ( )
Dielectric constant : ε_r ( )
Material : ☐Liquid ☐Slurry ☐Pellet
Corrosivity : ☐Non ☐Medium ☐Strong
Stickiness : ☐Non ☐Medium ☐Strong
Crystalline : ☐Non ☐Medium ☐Strong
Turbulence : ☐Non ☐Medium ☐Strong
Foam : ☐Non ☐Medium ☐Strong

Vessel

Condition : ☐Closed tank ☐Atmospheric ☐Pressurized ( ) bar
Shape : ☐Cylindrical ☐Horizontal ☐Other ( )
Roof type : ☐Flat ☐Conical ☐Dome ☐Other ( )
Mounting to : ☐Nozzle ☐Manhole ☐Other ( )
Vessel condition : Dust, mist ☐Non ☐Medium ☐Strong
Vessel height : ( )
Diameter or width : ( )
Obstructions : Agitator ☐No ☐Yes (Type:)
☐Temp sensor ☐Level switch ☐Reinforce or Stay ☐Ladder ☐Other ( )
Vessel material : ☐Metal ( ) Coated ☐Yes ☐No
☐Non metal ( ) ☐Other ( )
Temperature in the vessel : Operation ( ) , Design ( )
Pressure in the vessel : Operation ( ) , Design ( )

Mounting nozzle:

Height ( ) mm , Diameter ( ) mm
Distance from the vessel wall ( ) mm
Horizontal distance from the obstruction ( ) mm
Horizontal distance from the inlet ( ) mm

Others

Power supply : ☐AC ( ) V ☐DC ( ) V
Environment : ☐Outdoor use ☐Indoor use
Ambient temperature : ( ) °C
Explosion proof : ☐Required ☐Not required

STANDARD ACCESSORIES

- Cover opener: 1
- Magnet bar for data setting: 1
- Parameter sheet: 1
- Instruction manual: 1

OPTION

- 1/2 water tight gland for cable entry [Symbol : WG]

ORDERING INSTRUCTIONS

Specify the following when ordering :

1. Model and spec. code
   Example) Model : TLR1100
   Spec. code : V50041S13211111003
2. Option (if required)
3. Special request (if required)
   Please state special requests clearly.
   Consult Tokyo Keiso or representative before ordering.

* Specification subject to change without notice

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