TECHNICAL GUIDANCE

2-Wire Level Radar

TLR2000

Microwave level meter

GENERAL

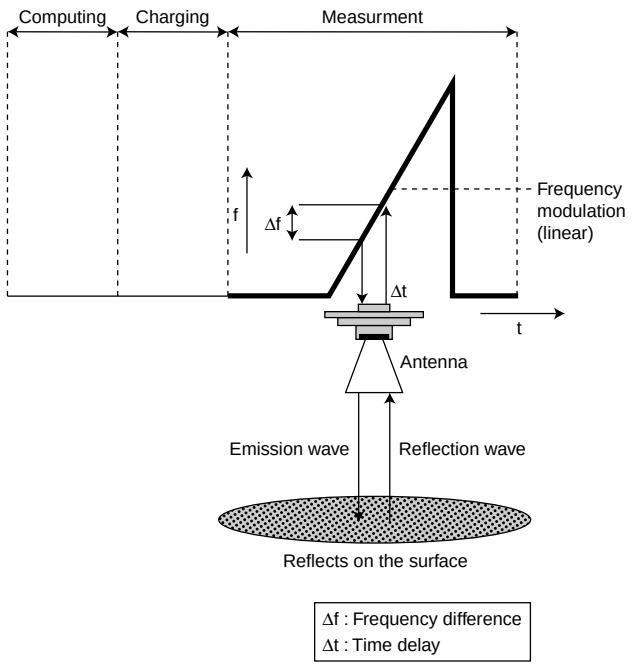
TLR2000 level radar is a unique 2 wires loop powered FMCW radar gauge, which achieves low cost and high performance level measurement.
Thanks to such microwave technology, TLR2000 provides contact less, temperature and pressure independent level measurement. Vapor, gas, steam and dusty condition do not affect the measurement performance nor highly abrasive or viscous products.
The TLR2000 provides non-contact level measurement for wide variety of application.
TLR2000 realized 2 wires loop powered transmission for FMCW that requires high energy. TLR2000 is a state of the art instrument aimed at easiest handling.

FEATURES

- ❏ Non contact, no moving part. Maintenance-free.
- ❏ The first 2 wire loop powered FMCW radar.
- ❏ Reduces total installation cost including cabling.
- ❏ Applicable for all kinds of liquids including highly viscous paste and slurry.
- ❏ Selected antenna system for wide range of application.
- ❏ Suitable for food industries with sanitary mounting.
- ❏ Measuring range up to 20m, Accuracy ±10mm (or ±0.2% RDG).

OPERATION PRINCIPLE

TLR2000 uses low power intermittent FMCW (Frequency Modulated Continuos Wave) radar, which realized 2 wire loop powered system. TLR2000 emits microwave packet from the antenna, which is linear modulated, every measuring interval. 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 emission and receipt of the microwave, TLR2000 turns off the microwave circuit. The level output is calculated in accordance with tank data set to the TLR2000 after computing of the beat signal and frequency spectrum by FFT (Fast Fourier Transform) and DSP (Digital Signal Processing).
TLR2000 accumulates energy necessary for the emission of microwave after computing.



Δf : Frequency difference
Δt : Time delay

STANDARD SPECIFICATIONS

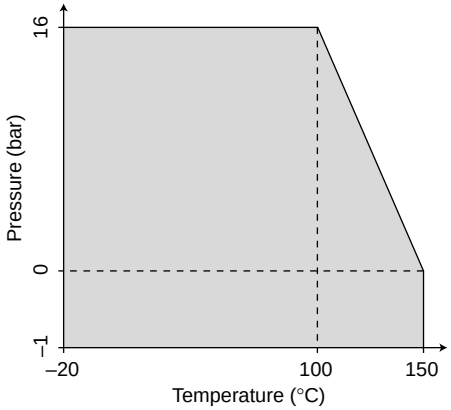
- Measurement : Continuous non-contact level, ullage measurement, volume calculation
- Measurement medium : Liquids, slurries, pastes
- Measurement principle : Intermittent FMCW (Frequency Modulated Continuous Wave)
  Frequency ; 8.5 to 9.9 GHz (X band)
- Measurement conditions
  Dielectric constant : For horn antenna $\varepsilon \geq 1.5$
  * When $\varepsilon < 3$, measurement in a pipe is recommended depending on process condition
  For Wave Stick $\varepsilon \geq 4$
  * 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 : TLR2100 Horn antenna
  TLR2200 Wave Stick antenna
- Measuring range : Max. 20 m
  * Depending on the measuring condition
  * Min. tank height ; 0.5 m
- Blocking distance : 0.2 to 0.5 m
  * Depends on antenna type
- Accuracy (display) : ±10 mm or ± 0.2 % RDG whichever is greater
  * Under reference condition
- Response speed : Max. 10 m/min
- Output : 4 to 20 mA passive, HART loop powered
  * Output accuracy add 0.1% F.S. to display accuracy
- Display : Illuminated 3 lines LCD
- Units : Length ; m, cm, mm, inch, feet, %
  Volume ; m^3, L, USG, GBG, ft^3, bbl
- Local operation : 4 keys
- Power supply : 17 to 30V DC
  * Consider the connected load
  * EEx ia power source required in case of explosion proof application
- Cable entry : 1-G1/2 (standard), 1-M20 × P1.5, 1-NPT 1/2
- Terminal : Cable diameter 0.5 to 1.5 mm
- Explosion proof : EEx ia IIC/IIB T6...T1 (ATEX)
  Ex ia IIC T4 (TIIS, in preparation)
- 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
Horn antenna	Viton	–30°C	+130°C
	Parfluoro elastomer	–30°C	+130°C
	Kalrez 2035	–30°C	+130°C
PTFE Wave Stick	PTFE	–40°C	+130°C
PP Wave Stick	Viton	–20°C	+100°C

- Pressure
  Horn antenna : –1 to 64 bar
  * Also refer to the flange rating
  Wave Stick with flange plate
  : Dependent on temperature
  Wave Stick (w/o flange plate)
  : –1 to 2 bar

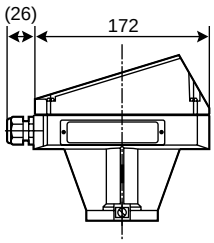
[Operation temperature/pressure]



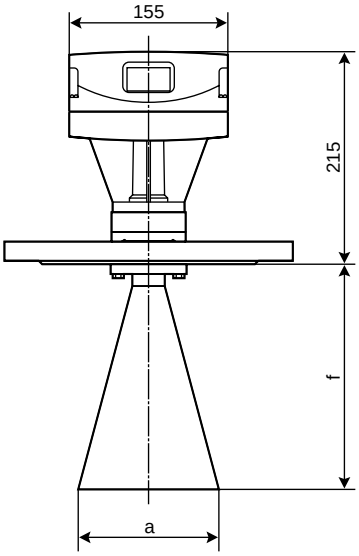
- Material
  Housing : Aluminum casting
  (Painting: Polyurethane paint, color Jade Green)
  Horn antenna, flange or thread
  : 316TiSS
  Wave Stick : PTFE or PP
  Gasket
  For Horn antenna : Viton, Parfluoro elastomer, Karlez2035
  For Wave Stick : PTFE, Viton (wave stick made of PP)
- Process connection and size : 50A/80A/100A/150A/200A JIS 10K /20K flange,
  2”, 3”, 4”, 6”, 8” ANSI class 150/300 flange
  Sanitary connection 2” Tri-clamp (ISO 2852), DIN11851 union thread
  G/R 1 1/2“ , 1 1/2” NPT thread
  * Refer Antenna Selection for antenna type and possible connection
- Protection : IP67 of IEC529/JIS C0920
- EMC : EN50081-1, 50082-2 CE marking
- Weight
  TLR2100 : Horn antenna
  Approx. 16 kg for 316TiSS, 150A JIS 10K flange
  TLR2200 : Wave stick antenna
  Approx. 9 kg for PTFE, 50A JIS 10K

DIMENSIONS

TLR2100 Horn Antenna



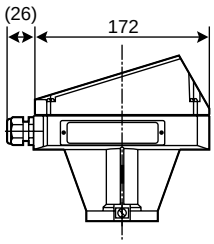
[Standard]



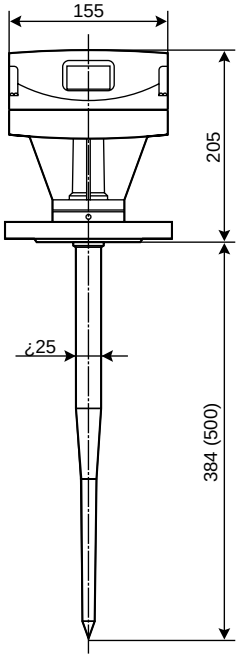
[Antenna dimensions]

Antenna type	Flange type		Horn diameter	Horn height
	JIS	ANSI	øa (mm)	f (mm)
80mm	80A	3"	80	110
100mm	100A	4"	100	148
140mm	150A	6"	140	223
200mm	200A	8"	200	335

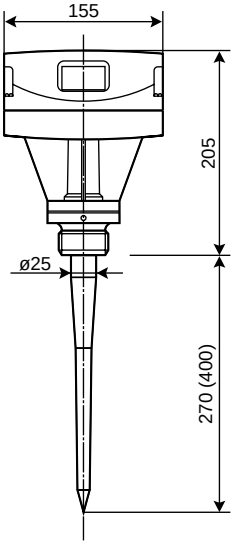
TLR2200 Wave Stick Antenna



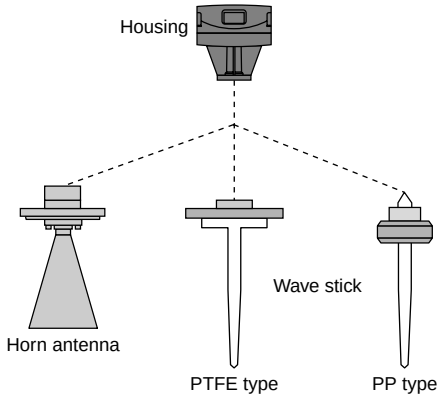
[Flange mounting]
(only for PTFE wave stick)



[G1 1/2 male thread]
(only for PP wave stick)



ANTENNA SELECTION



Modular system:
TLR2000 Series is modulated from a housing (consisting of electronic compartment with terminal), 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
- 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)
  80A/100A/200A, JIS 10/20K, 3"/4"/8" ANSI class 150, class 300 flanges are available in accordance with antenna seize
  (note: 80 mm/3" and 100 mm/4" are only for pipe mounting)
- Measuring range : Max. 20 m (depending on the measuring condition)
- Blocking distance (dead zone) : Min. 200 mm from end of antenna for free space
  Min. 300 mm from end of antenna for measurement in a pipe
- 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 level should be equal to or more than 500 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 (more than 10 m), measurement in a pipe

Wave Stick antenna

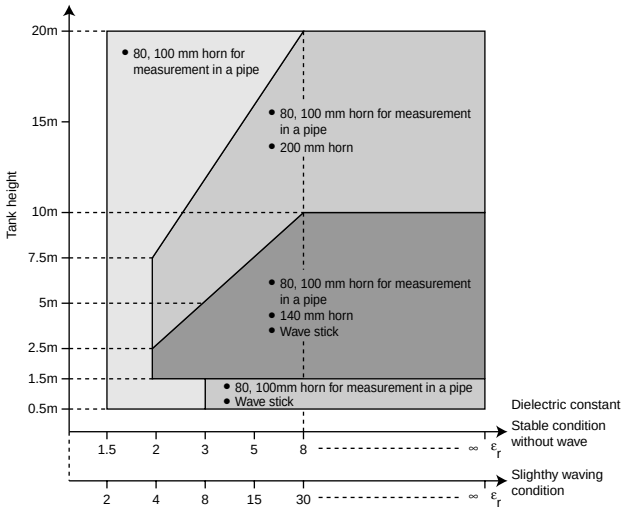
- Material : PTFE (combined with flange gasket),
  PP (polypropylene)
- Process connection : PTFE Wave Stick;
  50A JIS10K flange (standard)
  50A/80A JIS 10K, 2"/3"/4"
  ANSI class150/300 flange
  Sanitary mounting 2" Triclamp, union nut to (DIN11851) available
  PP Wave Stick;
  G1 1/2 thread (standard), R1 1/2, 1 1/2 NPT
- Measuring range : Max. 20 m (depending on measuring condition and dielectric constant of liquid)
- Highest product level : The highest 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 out of specified accuracy.)
- Application : For relatively high dielectric constant product ($\varepsilon_r \geq 4$), suitable for short measuring range (less than 10 m)
  For smaller tank, Highly corrosive liquid, Sanitary application, chemical tanks, food stuff
  Low cost (PP type)

[Antenna type and beam angle]

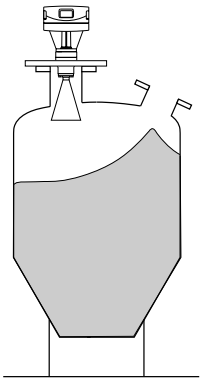
Antenna type	Size (mm)	Beam angle (°)	Expansion (mm/m)
Horn	80	Only for measurement in a pipe mounting	
	100		
	140	8	140
	200	6	100
Wave Stick (PTFE/ PP)	25	9	160

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

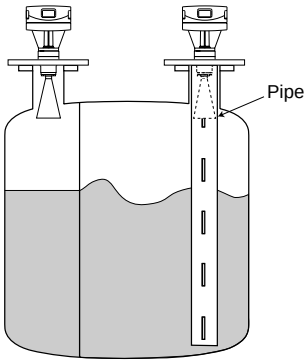
[Antenna type and measuring range]



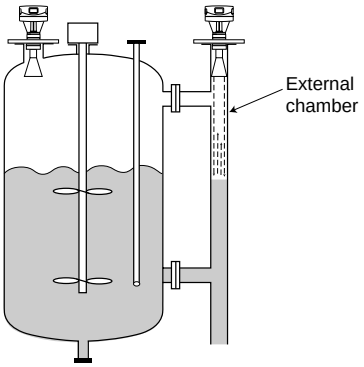
APPLICATION



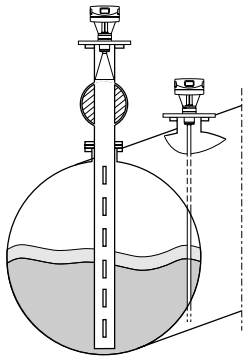
[Example 1]



[Example 2]



[Example 3]



[Example 4]

Mounting to a tank [Example 1]

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

Application with turbulence [Example 2]

Use stilling well or separator when product is likely to be subject to turbulence. TLR2000 is applicable for calm condition.

Application of agitated tank [Example 3]

TLR2000 can be used for a tank where the agitation is gentle and the surface condition is calm.
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 is expected.

- Use antenna which is matches to the inner diameter of the pipe
- The maximum allowable gap between inner diameter of the chamber 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]

Use pipe when installing into cylindrical tank

NOTES FOR MOUNTING

- Mount the instrument where no fear of obstruction in the microwave robe.
- For 140 mm horn antenna and wave stick antenna, it is recommended to mount the antenna more than 1/7 of the vessel height away from the vessel wall, It is 1/10 of the vessel height for 200 mm horn. (if there is no obstruction on the vessel wall, the distance can be reduced to 1/15 of the vessel wall. Ensure that there is no obstruction on the vessel wall or obvious projection such as welding bead more than 1 mm height.)
- When the incoming substances are frequent and dense in the microwave robe, the measurement may not be possible during filling.
- Mount the instrument where no stream of incoming substance is expected.
- Use ball valve when installing the valve to the mounting nozzle.
- 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.
- The same installation notes should be taken into account for the mounting of square or rectangular vessel, such as pit. In addition. Avoid installing the instrument where the distances to the 2 neighboring walls are equal.
- Do not mount the instrument under direct sun. Keep the ambient condition as specified. Use sunshade if necessary.

TYPE AND SPECIFICATION CODE

Type: TLR2100 (Horn antenna)

Spec. code	VG50	4	1				4	2	1			1	0	0	3		Description	Standard
(Fixed code)		4															Always 4	○
Antenna/Flange material			1														316 Ti SS (DIN 1.4571)	○
Process connection				A													3" ANSI class 150 for measurement in a pipe	
				B													3" ANSI class 300 for measurement in a pipe	
				C													4" ANSI class 150 for measurement in a pipe	
				D													4" ANSI class 300 for measurement in a pipe	
				E													6" ANSI class 150	
				F													6" ANSI class 300	
				G													8" ANSI class 150	
				H													8" ANSI class 300	
				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	
Antenna type						1											80mm horn antenna (80A/3" flange for meas. in a pipe)	
						2											100mm horn antenna (100A/4" flange for meas. in a pipe)	
						3											140mm horn antenna (150A/6" flange)	○
						4											200mm horn antenna (200A/8" flange)	
Power supply							4										24 VDC, loop powered	○
Output								2									4 to 20 mA (passive)/HART, applicable for Ex ia	○
Display									1								With display	○
Cable entry										2							M20 cable gland	
										B							1/2 NPT female thread	
										D							G1/2 female thread	○
Explosion proof											0						Standard (non Ex)	○
											1						ATEX	
											D						TIIS (in preparation)	
(Fixed code)												1	0	0	3		Always 1003	○
																Blank	Non	○
																/Z	with special request (note*)	

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

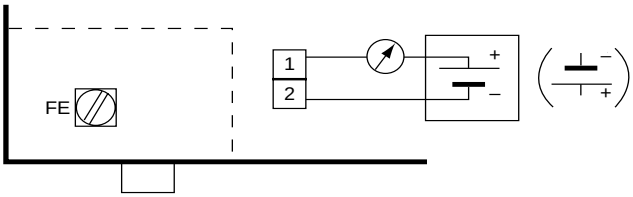
Type: TLR2200 (Wave stick antenna)

Spec. code	VG51	4	1				4	2	1			3		Description	Standard
(Fixed code)		4												Always 4	○
Type			1											Standard type wave stick	○
Process connection				8										G1 1/2 male bthread (only for PP wave stick)	○
				A										2" ANSI class150 flange (only for PTFE wave stick)	
				B										2" ANSI class300 flange (only for PTFE wave stick)	
				C										3" ANSI class150 flange (only for PTFE wave stick)	
				D										3" ANSI class300 flange (only for PTFE wave stick)	
				E										4" ANSI class150 flange (only for PTFE wave stick)	
				F										4" ANSI class300 flange (only for PTFE wave stick)	
				L										2" Triclamp (only for PTFE wave stick)	
				R										Union nut ND 50 to DIN11851 (only for PTFE wave stick)	
				Y										50A JIS 10K flange (only for PTFE wave stick)	○
				Z										80A JIS 10K flange (only for PTFE wave stick)	
Explosion proof					0									Standard (non Ex)	○
					1									ATEX	
					D									TIIS (in preparation)	
Antenna						1								Wave stick PTFE 384mm (with flange plate)	○
						2								Wave stick PTFE 500mm (with flange plate)	
						M								Wave stick PP 270mm/Viton seal (w/o flange plate)	○
						N								Wave stick PP 400mm/Viton seal (w/o flange plate)	
Power supply							4							24 VDC, loop powered	○
Output								2						4 to 20 mA (passive)/HART, applicable for Ex ia	○
Display									1					With display	○
Cable entry										2				M20 cable gland	
										B				1/2 NPT female thread	
										D				G1/2 female thread	○
(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.

ELECTRICAL CONNECTION

This instrument is 2 wire loop powered instrument.
Required voltage is 17 to 30 V DC, output is 4 to 20 mA.
Connect the instrument as per Figure below



Terminal	Polarity	Description
1	Non	Current output (DC4 to 20 mA)
2		Max. load (for DC24V, 500 Ω*)
		* Dependent on supply voltage
FE		Ground

Note : Consider the voltage drop by connecting loads and cable resistance. Use sufficient power source, which could keep minimum required supply voltage.
EEx ia source or barrier is required for hazardous area installation.

- Intrinsic safety circuit rating :
  - No-load voltage: 30 V
  - Short-circuit current: 100 mA
  - Output power: 1 W
  - Inner self-capacitance: 11 nF
  - Inner self-inductance: 20 mH
- Explosion proof :
  - ATEX PTB: EEx ia IIC T6...T1
  - TIIS approved: Ex ia IIC T4 (under preparation)

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
Waving : ☐Non ☐Medium
Foam : ☐Non ☐Medium

Vessel

Condition : ☐Closed tank ☐Atmospheric ☐Pressurized ( ) bar
Shape : ☐Cylindrical ☐Horizontal ☐Other ( )
Roof type : ☐Flat ☐Conical ☐Dome ☐Other ( )
Mounting to : ☐Nozzle ☐Manhole ☐pipe chamber ☐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 : DC ( ) V
Environment : ☐Outdoor use ☐Indoor use
Ambient temperature : ( ) °C
Explosion proof : ☐Required ☐Not required

STANDARD ACCESSORIES

- Parameter sheet: 1
- Instruction manual: 1

OPTION

- G1/2 water tight gland for cable entry [Symbol : WG]

ORDERING INSTRUCTIONS

Specify the following when ordering :

1. Model and spec. code
   Example) Model : TLR2100
   Spec. code : VG5041S13421D01003
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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