

GENERAL

TGR3000 series is the 2-wire system Guided Radar Gauge which can continuously measure the level using micro-pulse. The micro-pulse emitted from the electronics is propagated along rod or cable probe. So the efficiency of micro-pulse propagation is high and dense. By the micro-pulse in low energy, sufficient reflection can be obtained from the products in a low dielectric constant, and it is possible to make measurement of level and interface of fluids in low dielectric constant, of organic solvents and oils, and solids. TGR-3000 detects a level by measuring the turnaround time for the micro pulse emitted from the instrument to reflect and return from an object along probe. As the electric wave velocity is little affected by the temperature and pressure, high-accuracy level measurement is allowed regardless of changes in measuring conditions. The local indication is large and easy to see at the site as graphic display is adopted.

FEATURES

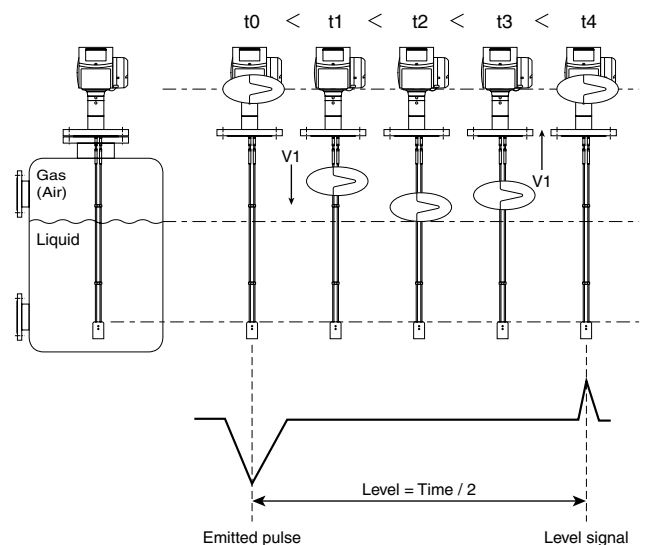
- Total cost can be reduced by the 2-wire system level meter.
- TDR system is available for various applications.
- Measurement in high accuracy is realized in spite of 2-wire loop powered system.
- Easy operation with wide graphic display
- Improvement in the dynamic range by modifying the specification of emitter.
- Measuring objects are level, interface, liquids and solids.
- Available for temperature and pressure in wide range.
 Measurement in high accuracy can be made without being influenced by the change in temperature, pressure and density.

OPERATION PRINCIPLE

TGR3000 is a unique instrument based on TDR (Time Domain Reflectometry) technology, by which the level can be continuously measured. The electric wave called a micro-pulse is intermittently emitted, and the emitted micro-pulse reflects on the surface. The level is detected by the turnaround time of reflection until it comes back to a emitting point.

The micro-pulse emitted from the electronics propagates to the surface of the measuring fluids at the fixed speed along with the rod or cable called a probe and reflects at the surface of liquids or solids where the dielectric constant changes. The level is measured by this turnaround time.

The velocity at which the micro-pulse spreads is mostly fixed by about 300,000 km/sec. and is not influenced by the change in temperature or pressure. Even when these measuring conditions are changed, there is no necessity for the compensation to be made. The error over the measured level is very small, and the measurement can be made without being influenced by the change in temperature, density, dielectric constant of the fluids to be measured, and dust, vapor, bubbles etc



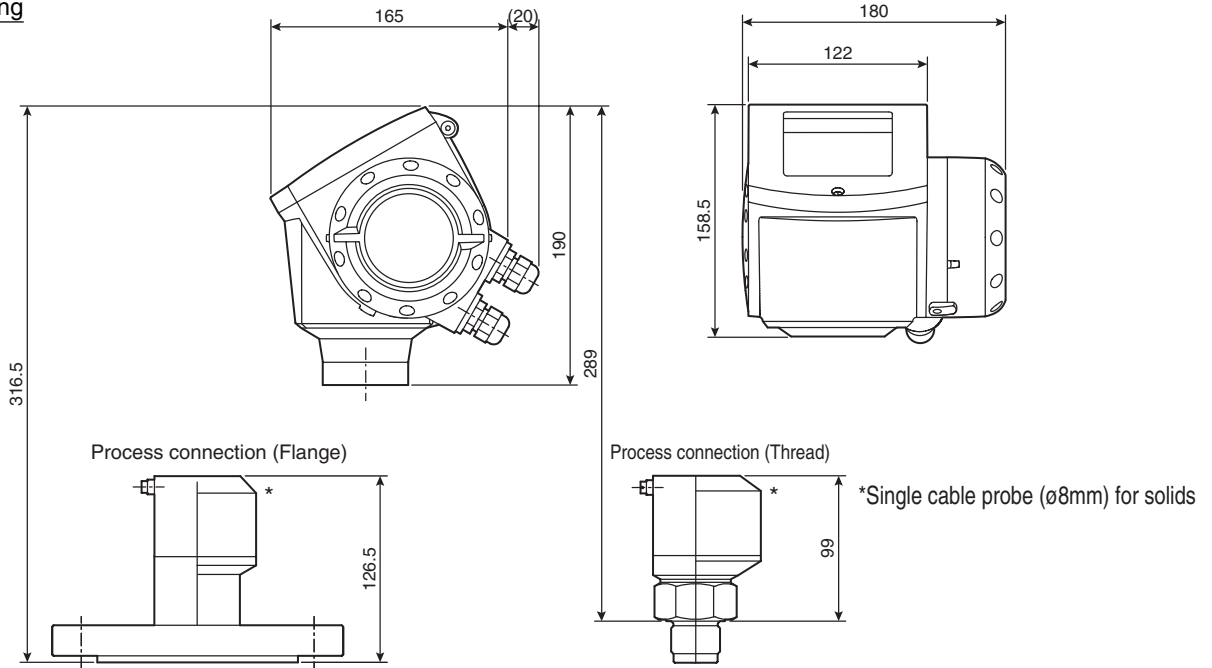
STANDARD SPECIFICATIONS

Objects	Item	Contents	
Measuring object	Measurable materials	Liquids, Slurries and/or solids (Less than 5mm of the grain diameter)	
	Measuring method	Time Domain Reflectometry (TDR)	
	Measured variable	Level, distance, volume and/or interface	
Probe type / Length (Max.)	TGR3101	Single rod probe (ϕ 8mm) / 3m	
	TGR3102	Twin rod probe (ϕ 8mm) / 3m	
	TGR3201	Single cable probe (ϕ 4mm: For liquid measurement) / 35m	
	TGR3201	Single cable probe (ϕ 8mm: For solid measurement) / 35m	
	TGR3202	Twin cable probe (ϕ 4mm) / 8m	
	TGR3301	Coaxial probe (ϕ 22mm) / 3m	
Output	Output 1	4 to 20mA DC (HART)	
	Output 2	4 to 20mA DC	
	Accuracy	± 0.01 mA (at 20°C)	
	Resolution	± 3 μ A	
	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	± 3 mm (Less than 10m), $\pm 0.03\%$ /R.D. (More than 10m)	
	Interface measurement	± 10 mm (If dielectric constant not changed.)	
Measuring conditions	Temperature of process connection	-40 to 200°C (Standard), (Explosionproof type: Refer to EXPLOSION PROOF SPECIFICATIONS)	
	Thermal shock resistance	100°C/min	
	Operating pressure	0kPa (abs) to 4MPa (Based on flange rate)	
	Dielectric constant	More than 1.4 (Coaxial probe)	
		More than 1.6 (Twin rod probe, Twin cable probe)	
		More than 1.8 (Single rod probe, Single cable probe)	
Interface measurement	ϵ_r of upper liquid is between 1.6 and 10 with upper liquid ϵ_r being less than lower liquid ϵ_r by more than 20.		
	Thickness of interface should be over 50mm and the interface should be formed definitely.		
Instrument specification	Protection class	IP66 (JIS0920, IEC 60529 Equivalent to Jet-proof)	
	Ambient temperature	-40 to +80°C (Standard), (Explosionproof type: Refer to EXPLOSION PROOF SPECIFICATIONS)	
	Storage temperature	-40 to +85°C	
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, Exi) *1	
	Power supply (Output 2)	Rated voltage: 24V DC	
		Voltage range: 10 to 30V DC (Non-Ex, Exd, Exi) *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	Aluminium	
	Process connection	Stainless steel (SS316L) as standard, Hastelloy® C-22	
	Probe	Single rod probe	Stainless steel (SS316L) as standard, Hastelloy® C-22
		Twin rod probe	Stainless steel (SS316L) as standard, Hastelloy® C-22
		Coaxial probe	Stainless steel (SS316L) as standard, Hastelloy® C-22
		Single cable probe(ϕ 4)	Stainless steel (SS316) as standard, Hastelloy® C-22
		Single cable probe(ϕ 8)	Stainless steel (SS316) as standard
		Twin cable probe	Stainless steel (SS316) as standard
Seal	FKM (-40 to 200°C) Standard Kalrez® 6375 (-20 to 200°C)		
Display		9 lines 160 x 160 pixels in 8-step grey scale with 4 buttons (Right shift key, Enter key, Up key and Down key)	
		Language: English or Japanese	
Weights	Housing	1" to 3" flange connection: 4 to 7kg	
		4" to 6" flange connection: 7 to 12kg	
		Thread connection: 3kg	
	Probe	Single cable probe (ϕ 4mm): 0.12kg/m	
		Single cable probe (ϕ 8mm): 0.41kg/m	
		Twin cable probe: 0.24kg/m	
		Single rod probe: 0.41kg/m	
	Twin rod probe: 0.82kg/m		
	Coaxial probe: 0.79kg/m		

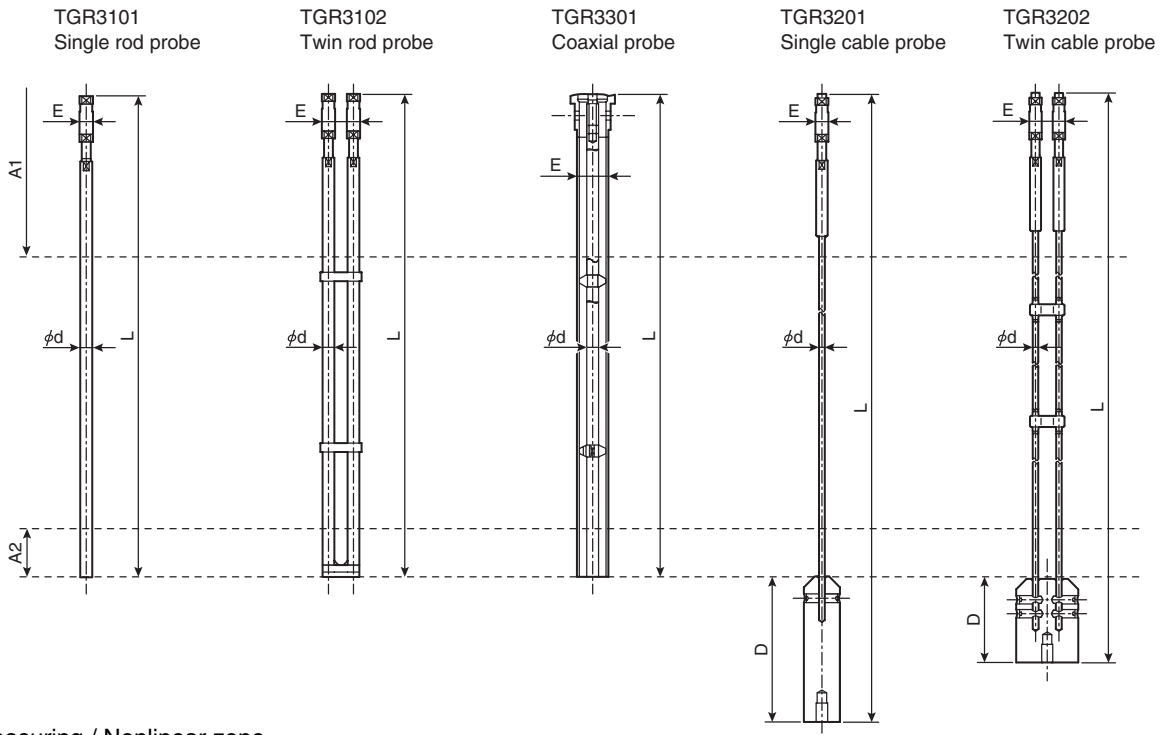
*1 Voltage at the terminals when output is 22mA.

DIMENSIONS

Housing



Probe



Non-measuring / Nonlinear zone

Specific dielectric const	Zone	Single rod	Twin rod	Coaxial single cable	Single cable	Twin cable
$\epsilon r \geq 40$	A1	200	150	50	200	150
	A2	10	10	10	10	10
$\epsilon r < 40$	A1	250	200	50	250	200
	A2	50	50	50	50	50
Probe diameter	ϕd	8	8	8	4, 8	4
Length of weight	D	—	—	—	100(*1: $\phi 20$)	60(*1: $\phi 38$)
					100(*1: $\phi 12$)	
					245(*1: $\phi 38$)	
Max. Probe width	E	9	25	22	9	25

A1: Top non-measurement zone (This range cannot be measured. The right value is not outputted although it is possible to convert this zone into the current output range.)

A2: Bottom nonlinear zone (Measurement is possible but out of guaranteed range in accuracy.)

ϕd : Probe diameter D: Non-measurable zone E: Max. Probe width (Except weight) L: Probe length *1: Dia. of weight

EXPLOSION PROOF SPECIFICATIONS

ATEX (ATEX Directives 94/9/EC)

- Certificate number: KEMA 05ATEX1182 X
- Certificates: II 1 G D or II 1/2 G D or II 2 G D
 EEx ia IIC T3...T6 T65°C...T107°C
 EEx d [ia] IIC T3...T6 T65°C...T107°C
- Ambient and process temperature ranges:

Guided Radar EEx ia

Equipment category	Ambient temperature range	Process temperature range
II 1 G	-20°C ... +60°C	-20°C ... +60°C
II 1/2 G	-40°C ... +85°C	-20°C ... +60°C
II 2 G	-40°C ... +85°C	-40°C ... +150°C
II 1 D, II 1/2 D, II 2 D	-40°C ... +85°C	-40°C ... +150°C

Guided Radar EEx d [ia]

Equipment category	Ambient temperature range	Process temperature range
II 1/2 G	-40°C ... +85°C	-20°C ... +60°C
II 2 G	-40°C ... +85°C	-40°C ... +150°C
II 1 D, II 1/2 D, II 2 D	-40°C ... +85°C	-40°C ... +150°C

- Temperature class:

Guided Radar EEx ia

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
	55°C	80°C	
	75°C	75°C	T5
	70°C	95°C	
	85°C	130°C	T4
	85°C	150°C	T3

Guided Radar EEx d [ia]

Equipment category	Max. ambient temperature	Max. process temperature	Temperature class
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
	55°C	80°C	
	75°C	75°C	T5
	70°C	95°C	
	85°C	130°C	T4
	85°C	150°C	T3

- The maximum surface temperature:

Max. ambient temperature	Max. process temperature	Surface temperature "T"
55°C	80°C	65°C
70°C	95°C	80°C
85°C	130°C	98°C
85°C	150°C	107°C

- Electrical data:

Guided Radar EEx ia

Supply and output circuit (terminals output 1, + and -)

in type of protection intrinsic safety EEx ia IIC, only for connection to a certified intrinsically circuit, with the following maximum values:

$$\begin{aligned} U_i &= 30V \\ I_i &= 300mA \\ P_i &= 1W \\ C_i &= 30nF \\ L_i &= 200\mu H \end{aligned}$$

Output circuit (terminals output 2, + and -)

in type of protection intrinsic safety EEx ia IIC, only for connection to a certified intrinsically circuit, with the following maximum values:

$$\begin{aligned} U_i &= 30V \\ I_i &= 300mA \\ P_i &= 1W \\ C_i &= 30nF \\ L_i &= 200\mu H \end{aligned}$$

Guided Radar EEx d [ia]

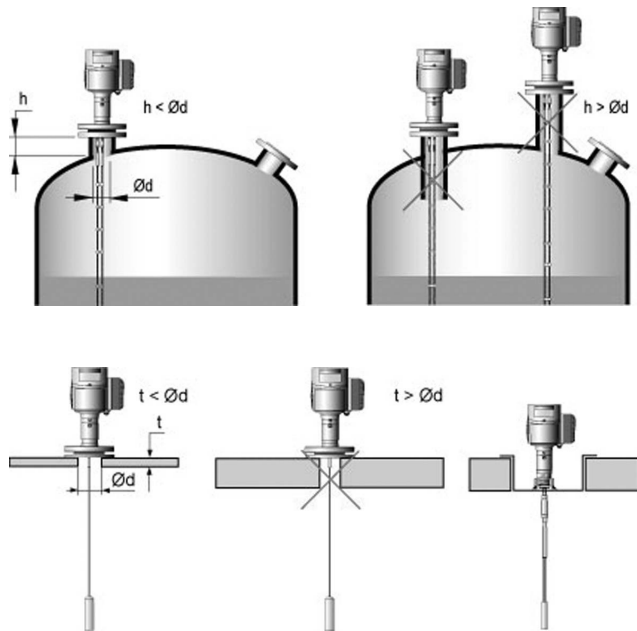
Power supply max. 36V DC
 Output 4-20mA
 intrinsically safe circuits $U_m = 253V$

PRECAUTIONS FOR INSTALLATION

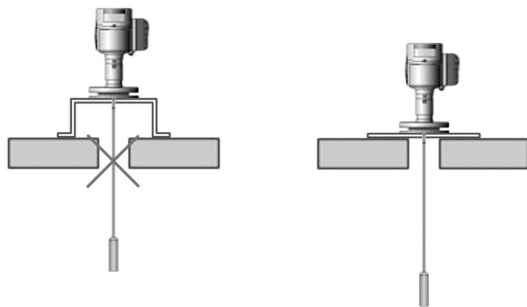
Following precautions must be paid when you plan to install TGR3000.

- Make installation nozzle length shorter than 100mm. The longer nozzle than 100mm must be shorter than the size of nozzle diameter. If this condition is not satisfied, the dead zone starts from the bottom end of the nozzle.
- Necessary measures should be taken for the services where sloshing is expected in the tank. Install the probe apart from agitator or fix the probe at its end to avoid entanglement. The supporting construction for probe fixing is deemed as the end of probe under which non-measurable zone starts.
- When measuring in the still pipe, the probe must be so aligned to be center of the pipe.
- The ambient temperature around housing should be between -40°C to 80°C. Install a sunshade where the housing is exposed to sun light if necessary.
- When installing two TGR3000 on the same tank, place them at least apart 1m.
- When measuring sticky liquids, avoid the accumulation of the remnants inside nozzle.
- When measuring powders, use the single cable probe with probe end unfixed, making it free.
- In order to prevent the cable from slackening when using the cable probe, set the weight afloat above tank base, or fix the weight, applying the tension.
- Consider the shape and location of the nozzle so that the probe may not touch the nozzle and tank wall.
- Install the single probe apart more than 300mm from the tank wall and the twin probes apart 100mm or more.
- Avoid the ingress of foreign materials and coagulation of liquids inside the coaxial probe.
- Fasten the probe at the end of it, if required, except coaxial probe.
- When fixing coaxial probe, do not exert excessive force on it to avoid bending.

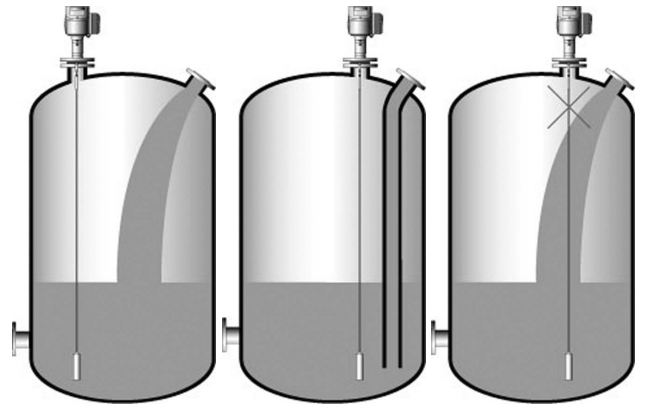
- Avoid using long and narrow nozzle. Regarding the diameter of nozzle, make it larger than the nozzle length, and do not make the projection of nozzle in a tank. When the installation of nozzle is made in a concrete tub, make the sum of the thickness of concrete and the length of nozzle not to be longer than the diameter of hole.



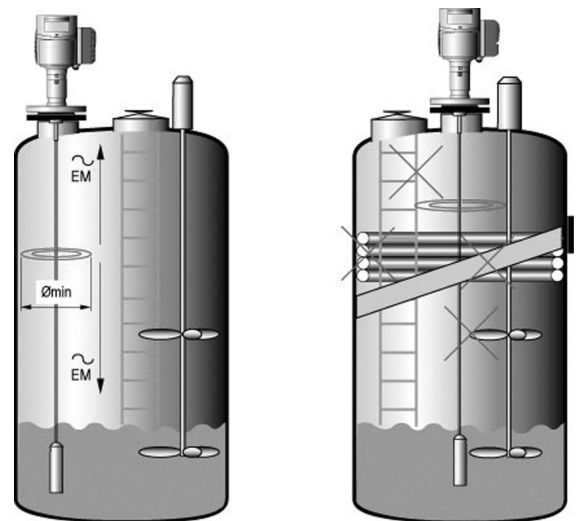
- When installing on the concrete or iron plate, do not install it on the raised pedestal like below.



- The installation is to be made in the location where the object to tank does not touch probe directly. Moreover, the main stream of flow should be separated from the probe by 300mm or more.

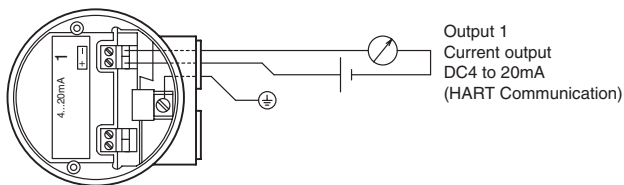


- When the obstructions such as a ladder, a heating coil etc. are in a tank, the installation of single rod and single cable probe is to be made, separated by 300mm or more from the obstruction, and twin rod and twin cable probe are to be installed, separated by 100mm or more.

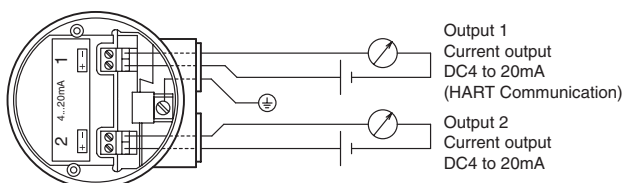


WIRING DIAGRAM

1 current output



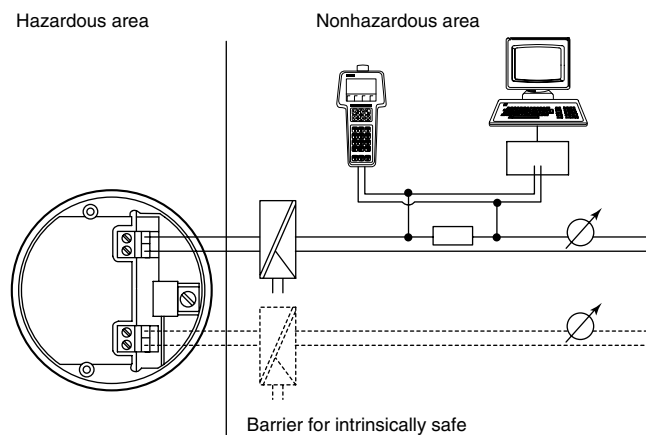
2 current outputs



Output 1	Max. load resistance: 350Ω	
	External power supply	Exd: Max. DC36V Non-Ex, Exi: Max DC30V
Output 2	Max. load resistance: 350Ω	
	External power supply	General purpose, Exd, Exi: Max. DC30V

- *Separate a signal cable from power cable to lay down.
- *Use a power source different from the one for power equipment.

IF USED IN INTRINSICALLY SAFE



- When using TGR3000 at the hazardous area as intrinsically safe instrument, the intrinsically safe barrier shall be used.
- The items as mentioned in "Precautions for installation" shall be observed when used as explosion proof instrument.
- Regarding the required supply power when using insulating barrier, the specification for barrier shall be confirmed.

PROBE MATERIAL / LENGTH / CONSTRUCTION

Model / Probe type		TGR3101	TGR3201		TGR3301	TGR3102	TGR3202
		Single rod	Single cable		Coaxial probe	Twin rod	Twin cable
Probe diameter		8mm	4mm	8mm	8mm	8mm	4mm
Probe length (Max.)		3m	35m	35m	3m	3m	8m
Dielectric constant		>1.8	>1.8	>1.8	>1.4	>1.6	>1.6
Process connection	G3/4, 3/4"NPT male thread	○	○		○		
	G1, 1"NPT male thread	○	○		○		
	G1 1/2, 1 1/2"NPT male thread	○	○	○	○	○	○
	Flange 40A JIS10K	○	○				
	Flange 50A JIS10K	○	○		○	○	○
	Flange 80A JIS10K	○	○		○	○	○
	Flange 100A JIS10K	○	○	○	○	○	○
	Flange 1 1/2" ANSI class150	○	○				
	Flange 2" ANSI class150	○	○		○	○	○
	Flange 3" ANSI class150	○	○		○	○	○
Flange 4" ANSI class 150	○	○	○	○	○	○	
Probe material	316SS		○	○			○
	316L SS	○			○	○	
	Hastelloy C-22	○	○		○	○	
Weight termination	w/o	○			○	○	
	φ 20 X 100mm		○				
	φ 38 X 60mm						○
	φ 38 X 245mm			○			
	φ 12 X 100mm			○			
Measuring object	Liquid of low dielectric constant				○	○	○
	Liquid of high dielectric constant	○	○		○	○	○
	Slurry	○	○				
	Crystallizing liquid	○	○				
	Foamy liquid	○	○		○		
	Solids			○			
Measuring condition	Interface				○	○	○
	Long nozzle				○	○	○
	Nozzle for small connection				○	○	○
	Measurement for small tank				○	○	○
	Without Non-measurable zone				○		
	Stilling wells	○	○		○	○	○
	Bypass chamber	○	○		○	○	○
	Tank with agitator		○*		○	○	○*
Tank with projection things				○	○	○	

*The end of the probe shall be fixed to the tank bottom.

MODEL AND SPECIFICATION CODES

Model : TGR3000

Spec.code	VF71	4																			4 0 0 0 0 0 0		Description	Standard	
Fixed code		4																					Always 4	○	
Authorization		0																					Standard (Non-Ex)	○	
		2																					ATEX II G/D 1, 1/2, 2 EEx ia IIC T6 ... T3		
		3																					ATEX II G/D 1/2, 2 EExd [ia] IIC T6 ... T3		
Process connection and Probe material		0																					Stainless steel (SS316L), Stainless steel (SS316): Cable probe	○	
		1																					Hastelloy® C-22 (Rod, Coaxial probe, Single cable probe)		
Probe type		0																					TGR3101 / Single rod Max. 3m	○	
		1																					TGR3102 / Twin rod Max. 3m		
		2																					TGR3301 / Coaxial probe Max. 3m		
		3																					TGR3201 / Single cable Max.35m, Diameter 4mm	○	
		4																					TGR3201 / Single cable Max.35m, Diameter 8mm (For solids)		
Probe termination		5																					TGR3202 / Twin cable Max. 8m		
		0																					Non (Rod probe and Coaxial probe types: Always Non)	○	
		1																					Weight φ 12mm, Length 100mm (Single cable diameter 8mm) for solid		
		2																					Weight φ 38mm, Length 245mm (Single cable diameter 8mm) for solid		
		3																					Weight φ 20mm, Length 100mm (Single cable diameter 4mm) for liquid	○	
		4																					Weight φ 38mm, Length 60mm (Single cable diameter 4mm) for liquid		
		A																					Turn buckle (For single cable)		
	B																					Cable clamp (For single cable)			
	E																					Open end (For single cable)			
Seal / Temperature range		0																					FKM -40°C to 200°C	○	
		1																					Kalrez® -20°C to 200°C		
Process connection: G thread		0																					Other than G thread	○	
		1																					G3/4 male thread		
		2																					G1 male thread		
		3																					G1 1/2 male thread		
Process connection: ANSI Flange or NPT male thread		0																					Other than ANSI flange or NPT thread	○	
		1																					3/4"NPT male thread		
		2																					1"NPT male thread		
		3																					1"1/2NPT male thread		
		4																					1" 150 lb RF ANSI B16.6		
		5																					1" 1/2 150 lb RF ANSI B16.5		
		6																					1" 1/2 300 lb RF ANSI B16.5		
		7																					2" 150 lb RF ANSI B16.5		
		8																					2" 300 lb RF ANSI B16.5		
		A																					3" 150 lb RF ANSI B16.5		
		B																					3" 300 lb RF ANSI B16.5		
		C																					4" 150 lb RF ANSI B16.5		
		D																					4" 300 lb RF ANSI B16.5		
		E																					6" 150 lb RF ANSI B16.5		
		F																					8" 150 lb RF ANSI 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																					DC4 to 20mA x 1 output (HART) Level output	○	
		1																					DC4 to 20mA x 1 output (HART) Interface output		
		2																					DC4 to 20mA x 2 outputs (HART) Level output		
		3																					DC4 to 20mA x 2 outputs (HART) Level and Interface output		
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 4000000	○
Probe length																							/	in cm (centimeter) unit *1	
Special																								Non	○
																							/Z	with special request *2	

*1: The minimum unit of probe length is to be 1cm, and put it down in 4 digits.
 For example: In case of 258 cm and 1258 cm, make them 0258 and 1258 respectively.
 The numerical value less than 1cm can not be designated.
 Contact factory beforehand if the length of a rod or a coaxial probe is more than 3m.

*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 : TGR3101
Spec. code: VF70400000060201400000
2. Probe length
Specify the length (cm).
3. Option (if required)
Specify by the symbol referring to "OPTION".
4. Special request (if required)
Please state special requests clearly.
Consult Tokyo Keiso or representative before ordering.

ORDERING INFORMATION

Measurement

Level Interface
Measuring range () m

Product

Name ()
Dielectric constant ϵ_r ()
Material Liquid Slurry Powder (Size: Less than 0.1mm) Pellet (Size: mm)
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 Open pit
Height ()
Diameter or width ()
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

Place Distance from Tank wall () m
 Distance from nozzle () m
 Distance from obstruction () m
Mounting nozzle Diameter () m
 Length () m

* Specification is subject to change without notice.

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