TECHNICAL GUIDANCE

2-Wire transmission type

TGR4000

Micro-pulse level meter

OUTLINE

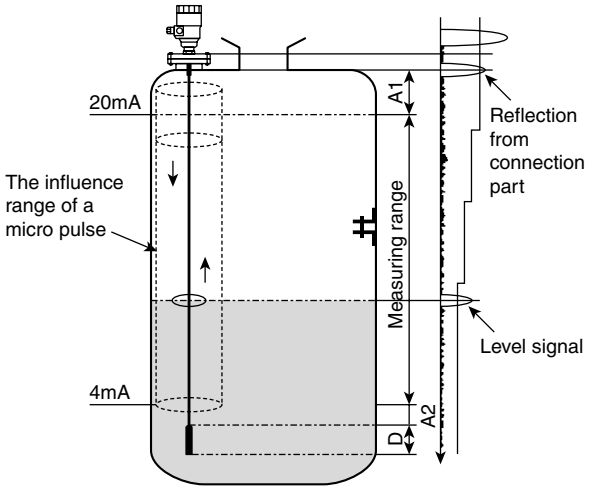
TGR4000 series is a unique 2-wire continuous level-measuring instrument using micro-pulse reflection.
A micro-pulse emitted from the electronics propagates along the probe and reflects on the surface of the product. The reflected pulse propagates back along the probe to the electronics. The level can be measured by computing the time interval between emission and receipt of the pulse.
Thanks to the probe, the efficiency of the micro-pulse propagation is high and dense. Thus only low energy is required even for the measurement of low dielectric constant product. Temperature, pressure and density change will not influence the measurement. High accuracy measurement and measurement in narrow spaces are also possible.
Thanks to the 2-wire loop powered system, reduction of cable cost and installation cost are available.

FEATURES

- ❏ Micro-pulse achieves high accuracy regardless of the temperature and pressure change, vapor and dust of the tank.
- ❏ Density or temperature change of measuring liquid will not affect the measuring accuracy.
- ❏ Non-moving parts guarantee maintenance-free operation.
- ❏ Thanks to the 2-wire loop powered system, reduction of cable and installation cost are possible.
- ❏ Thanks to the 2-wire loop powered system, revamp from other devices is also available easily.
- ❏ The device is delivered with factory setting, and therefore no need for field calibration.

OPERATION PRINCIPLE

TGR4000 is a unique continuous level-measuring instrument based on TDR (Time Domain Reflectometry) technology.
TDR is well known technology for the detection of the reflection point of micro-pulse based on propagation time from emission to receipt of reflection pulse. A micro-pulse emitted from the electronics propagates along the rod or cable probe and reflects on the surface, where the dielectric constant differs.
The surface of a liquid is the point where the dielectric constant suddenly changes. Since reflective strength is dependent on the dielectric constant of measuring liquid, strong reflection can be obtained from a liquid with a high dielectric constant.
TGR4000 measures the travel time of micro-pulse from emission to receipt of reflection pulse and computes the level. The time is proportional to the traveling distance of the pulse.
The propagation speed of the micro-pulse is almost constant in the gas phase. It will remain constant regardless of temperature or pressure change of the gas phase.
The measured level by TDR is therefore very accurate.
Neither change of the temperature in a tank, pressure, and a dielectric constant, nor the dust on the surface of liquid, vapor, a bubbles, etc. affect the measurement.

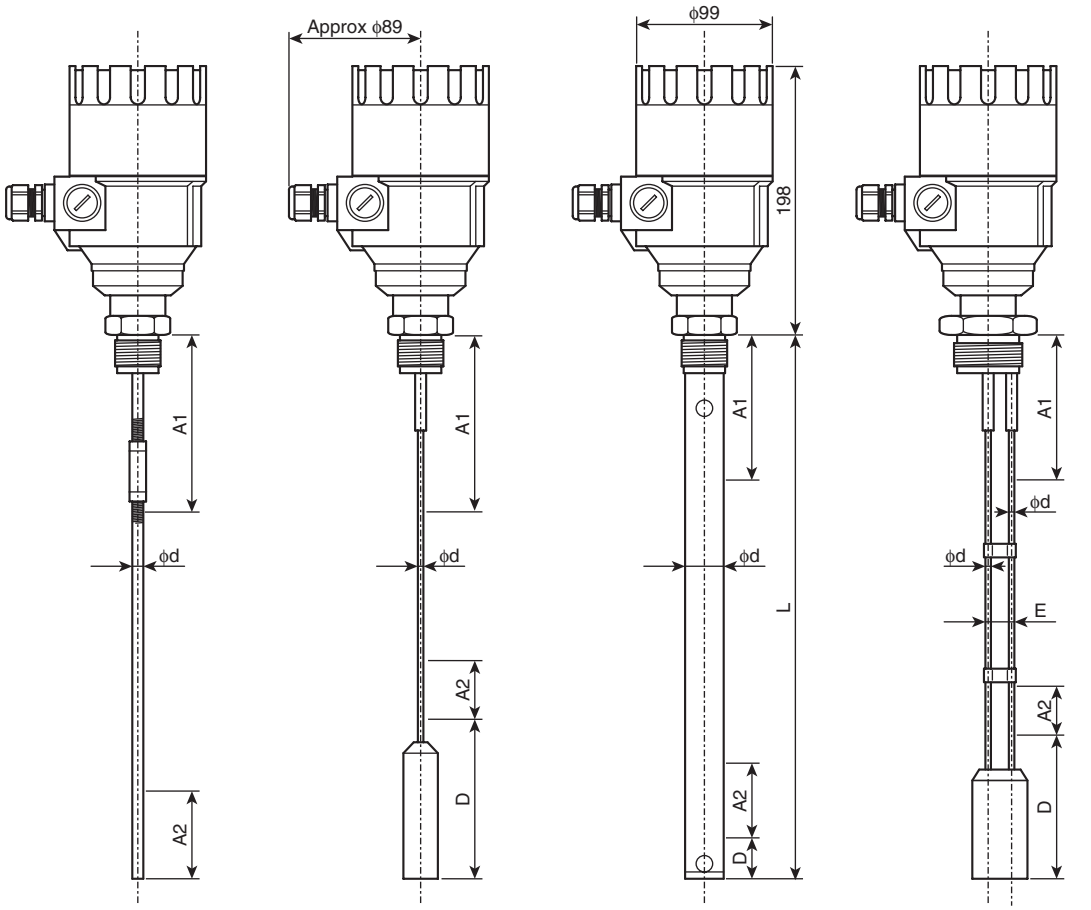


Refer to the technical data for A1, A2, and D.

STANDARD SPECIFICATIONS

Objects		Item	Contents
Measuring object	Measuring object	Measurable materials	Liquids
		Measuring method	Time Domain Reflectmetry (TDR)
		Output variables	Level, distance, or volume
Electric specification of housing	Output	Output	DC4 to 20mA (HART)
		Resolution	± 2μA
		Temperature drift	0.5μA/K (Key value)
		Output when error occurs	Selection of "Hold" or "DC22mA"
		Max. load resistance	750Ω
		Start-up drift	After turning on a power-supply, normal directions are carried out in about 30 seconds.
	Accuracy	20°C Based on a basal condition	Measurement distance < 15m: ± 15mm + 0.01% FS
			Measurement distance ≤ 15m: ± 0.1% of Reading + 0.01% FS
	Measurement condition	Product temperature	Single rod, Single cable: –30 to 200°C (However, care about process onnection temperature)
			Twin cable, Coaxial: –30 to 150°C (However, care about process connection temperature)
		Thermal shock resistance	100°C/min
		Maximum operating pressure	4MPa
	Specification of instrument	Protection class	IP65 (IEC 60529 / JIS C0920)
		Ambient temperature	–30 to 60°C (Standard type), –30 to 55°C (Explosion proof type)
		Temperature of process connection	–30 to 90°C (Standard type), –30 to 200°C (High temp. version), –30 to 150°C (Explosion proof type)
	Electric connection	Type	2-wire loop powered system
		Power supply	Rated voltage: DC24V
			Voltage range: DC18 to 35V (Standard type), DC18 to 28V (Explosion proof type)
		Cable	Max. 1.5mm^2, Finished outer diameter: 11mm or less
		Cable entry	M20 × 1.5 female screw, G1/2 female screw (with adapter), 1/2NPT female screw
	Material	Seal	FPM (Fluorine rubber)
		Housing	Aluminium alloy
	Weight	Aluminium housing	2kg (Screwing installation, without probe)
Probe specification	TGR4101	Probe type	Single rod
		Maximum length / Probe diameter	3m / ϕ8mm
		Material	Stainless steel (SS316)
		Dielectric constant	εr > 2.3
		Dead zone, Non linear range	0.4m (Upper part: A1), 0.1m (Lower part: A2): Refer to DIMENSIONS.
		Process connection	G1" Male screw, 1" NPT Male screw
		Weight	0.41kg/m
	TGR4201	Probe type	Single cable
		Maximum length / Probe diameter / weight	24m / ϕ4mm / ϕ25 × 100mm
		Material	Stainless steel (SS316), FEP coated probe
		Dielectric constant	εr > 2.3
		Dead zone, Non linear range	0.4m (Upper part: A1), 0.1m (Lower part: A2): Refer to DIMENSIONS.
		Process connection	G1" Male screw, 1" NPT Male screw
		Weight	0.12kg/m
	TGR4202	Probe type	Twin cable
		Maximum length / Probe diameter / weight	24m / ϕ4mm / ϕ40 × 80mm
		Material	Stainless steel (SS316), FEP (Spacer)
		Dielectric constant	εr > 1.8
		Dead zone, Non linear range	0.3m (Upper part: A1), 0.1m (Lower part: A2): Refer to DIMENSIONS.
		Process connection	G1-1/2" Male screw, 1-1/2" NPT Male screw
		Weight	0.24kg/m
	TGR4301	Probe type	Coaxial
		Maximum length / Probe diameter	3m / ϕ28mm
		Material	Stainless steel (SS316), PTFE (Spacer)
		Dielectric constant	εr > 1.5
		Dead zone, Non linear range	0.05m (Upper part: A1), 0.1m (Lower part: A2): Refer to DIMENSIONS.
		Process connection	G1" Male screw, 1" NPT Male screw,
		Weight	1.3kg/m

DIMENSIONS



TGR4101 (Single rod probe) | TGR4201 (Single cable probe) | TGR4301 (Coaxial probe) | TGR4202 (Twin cable probe)

Refer to the probe specification for weight sizes.
There is a dead zone and a nonlinear zone for each probe type. These areas are dielectric constant dependent. Refer to the table below for the selection of probe for the dead zone and non-linear zone.

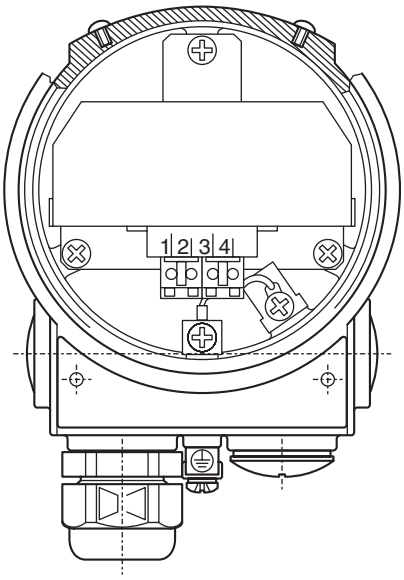
Non measurable / Non-linear zones

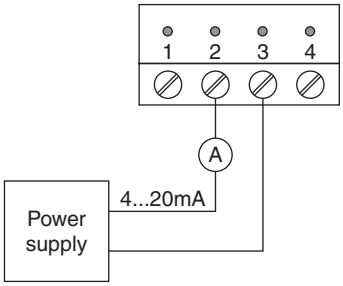
(mm)

Dielectric constant	Zone	Single rod	Single cable	Coaxial	Twin cable
εr ≥ 40	A1	300	300	50	150
	A2	100	100	100	100
εr < 40	A1	400	400	50	300
	A2	100	100	100	100
–	D	–	Weight length + 50	10	Weight length + 50
–	ϕd	8	4	28	4
–	E	–	–	–	17

A1: Top dead zone A2: Bottom non-linear zone (Measurement is possible but out of guaranteed range in accuracy.)
D: Non-measurable zone E: Probe distance L: Probe length (Including weight)

ELECTRICAL CONNECTION





Terminal No.	Polarity	Description
2	–	Current output (DC4 to 20mA) Load resistance (Max. 750Ω at DC24V)
3	+	External source (Standard type: Max. DC35V) (Exprosion proof type: Max. DC28V)
1	–	Check terminal * Do not connect external terminal.
4	+	

CAUTION FOR USING EXPLOSION PROOF TYPE

The TGR4000 has the intrinsically safe model also.
Observe the followings when the intrinsically safe model is used in the hazardous area.

Explosion proof specification

- ATEX
  II 1G EEX ia IIC T6...T3
  II 1G EEX ia IIB T6...T3
  (IIB is applied for the probe coated by FEP)

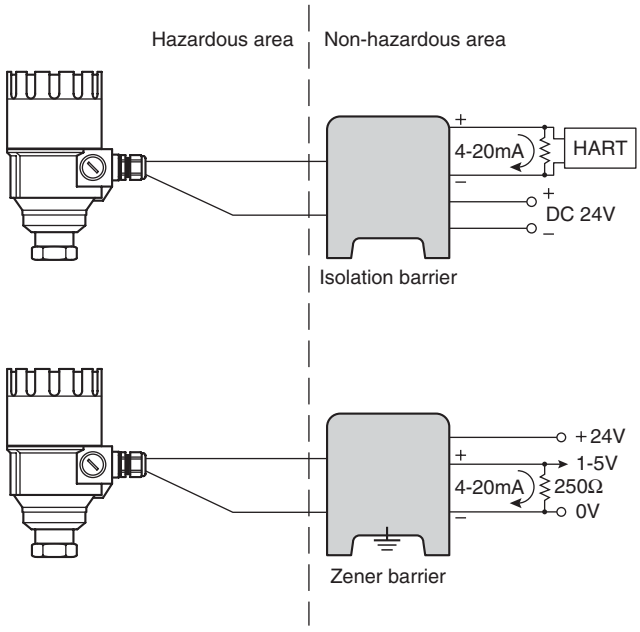
Temperature class	Product temperature	Amb. temperature
T6	≤ +85°C	≤ +55°C
T5	≤ +100°C	≤ +55°C
T4	≤ +135°C	≤ +55°C
T3	≤ +150°C	≤ +55°C

Minimum Amb. temperature	Minimum product temperature
–30°C	–30°C

[IS circuit rating]
Allowable supply voltage for IS circuit (Ui) = 30V
Allowable current for IS circuit (Ii) = 150mA
Allowable electric power for IS circuit (Pi) = 1W
Internal capacitance (Ci) = 10nF
Internal inductance (Li) = 10μH
* The product model in ATEX certification is “Micro TREK.”

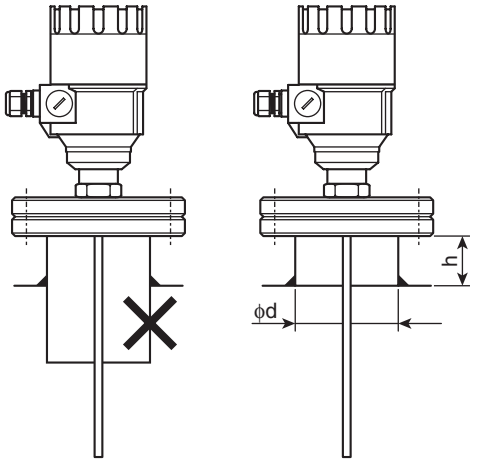
When using this model at the hazardous area as intrinsically safe circuit, the safety barrier shall be used in the non-hazardous area in 2 line loop.

Recommended isolation barrier:
The model KFD2-STC4-Ex1 installed on the DIN rail manufactured by P&F
Recommended zener barrier:
The model MTL7087P+ installed on the DIN rail of MTL7000 series manufactured by MTL instruments
* MTL7087P+ cannot perform HART communication from the non-hazardous area.

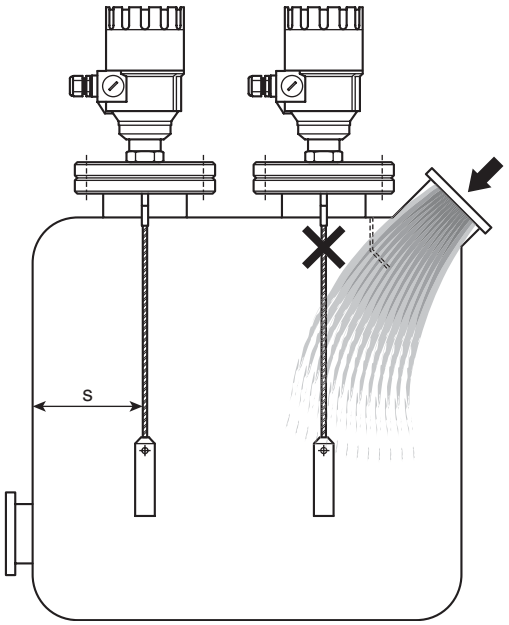


PRECAUTIONS FOR INSTALLATION

- The height of tank nozzle for mounting the instrument is preferably shorter than 100mm.
  When nozzle length is longer than 100mm, the diameter of the nozzle (ϕd) shall be more than the length (h) of the nozzle.
  The longer and narrow nozzle leads to a wide dead zone and erroneous level reading.
  Welding bead and ruggedness, on the inner surface and tip of the nozzle, shall be avoided. Do not extrude the nozzle inside tank.



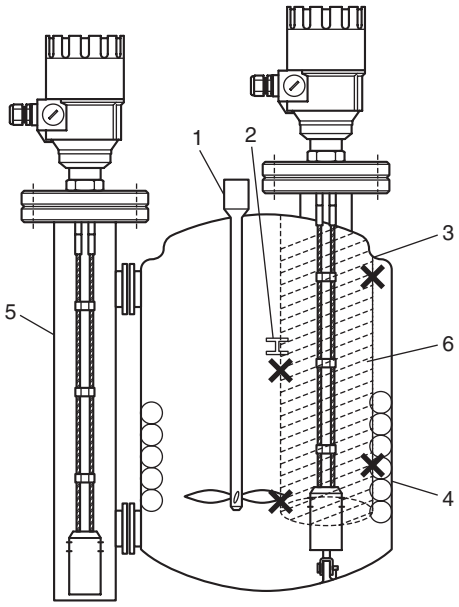
- Keep the probe at a distance from the liquid filling inlets and avoid direct contact with liquid flow.
  Mount the single rod or cable probe more than 300mm away from the wall or any projections of the vessels.
  Mount the twin cable probe more than 100mm away from the wall or any projections of the vessels. The coaxial probe is free from above restrictions.
  Avoid the physical contact of the probe with the mounting nozzle and tank wall.
  Install the cable probe at the place where it is not moved by the liquid flow or turbulence caused by such as agitator.
  Determine the probe-mounting location where any adhesive materials to tank wall will not touch the probe.



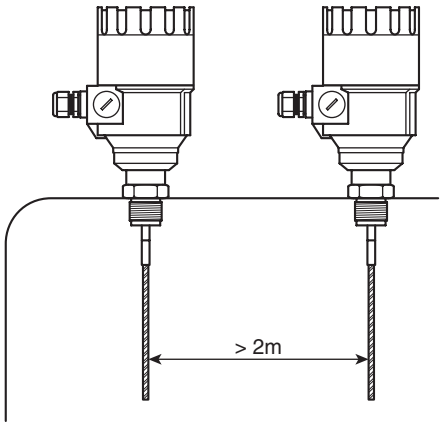
s ≥ 300mm: TGR4101, TGR4201
s ≥ 100mm: TGR4202

- Do not mount the probe close to the agitator blades. We recommend mounting the probe in a pipe when the tank is equipped with an agitator. Otherwise, fix the tip with a turnbuckle when the strong flow or turbulence may be caused by the agitator or the operation.

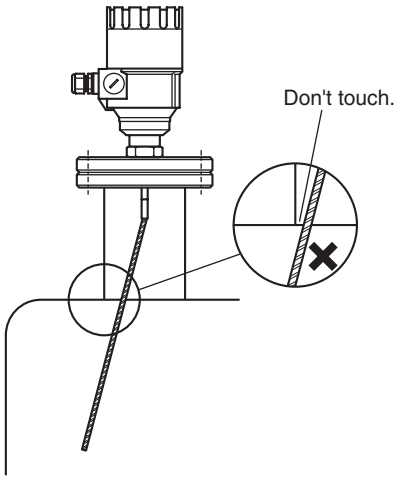
1. Agitator	2. Tank reinforcement etc.
3. Abrupt change of tank inside shape such as diameter	
4. Heating or cooling coil	5. External chamber
6. Micro pulse radiation range	



- When the two TGR4000 are installed in the same tank, keep a distance between them at least 2m to avoid the interference.
  Do not make a kink in the cable probe during the installation of it.



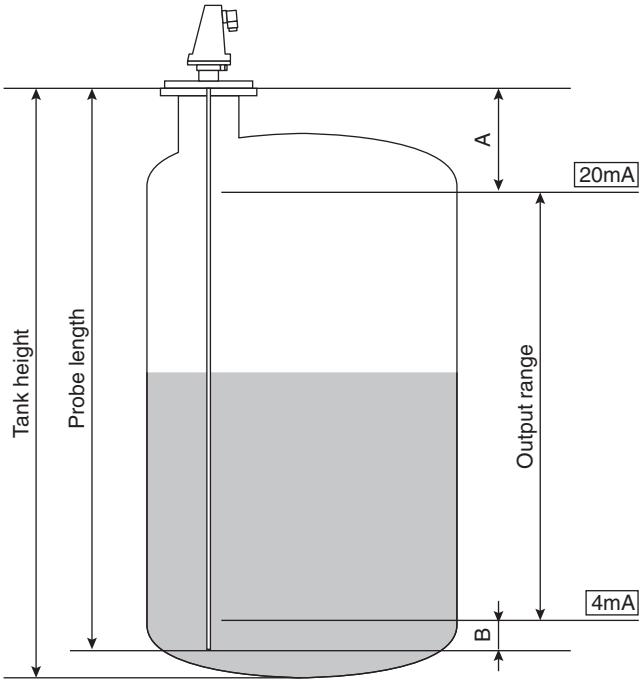
- Avoid the physical contact of the probe with the mounting nozzle. Otherwise, the measurement would not be performed.



- Do not introduce foreign materials or deposit adhesive substance inside the coaxial probe.
- Each probe has non-measurement zones both at upper and lower area, and non-linear zone also. The dead zone starts from the nozzle end when the probe is installed onto the nozzle. Please refer to DIMENSIONS.
- Install the sunshade for the probe head where it is exposed to the sun directly.
- TGR4000 is delivered with output range set at factory. It is not possible to change the setting with the device alone. Use a HART handheld communicator to change the setting.

STANDARD OUTPUT RANGE

TGR4000 is delivered with current output range (4-20mA) set as follows.
The probe length (means whole length including weight length) minus the lengths A and B is the standard setting value of output range (4 to 20mA).



STANDARD OUTPUT RANGE TABLE CLASSIFIED BY PROBE TYPE

(mm)

Range	TGR4101 / Single rod	TGR4201 / Single cable	TGR4301 / Coaxial	TGR4202 / Twin cable
A	400	400	50	300
B	100	200	100	200
Output range (4 to 20mA)	Probe length – 500	probe length – 600	probe length – 150	probe length – 500
	probe length – (A + B)			

A: Upper non-measurement zone B: Lower non-measurement zone

* Please consult us for the output range other than mentioned above table before ordering as an optional case.

MODEL AND SPECIFICATION CODES

Model: TGR4000

TGR				–	2	0	0	–		/					/			Description	Standard
Probe type	4101																	Single rod probe	○
	4201																	Single cable probe	○
	4202																	Twin cable probe	
	4301																	Coaxial probe	
Temperature at process connection		T																Standard (–30 to 90°C)	○
		H																High temperature version (–30 to 200°C) (ATEX Explosion proof type: –30 to 150°C)	
Probe / and Process connection			R															TGR4101 / Single rod probe, Connection: G1" Male, Max. 3m	○
			P															TGR4101 / Single rod probe, Connection: 1" NPT Male, Max. 3m	
			K															TGR4201 / Single cable probe, Connection: G1" Male, Max. 24m	○
			L															TGR4201 / Single cable probe, Connection: 1" NPT Male, Max. 24m	
			T															TGR4202 / Twin cable probe, Connection: G1-1/2" Male, Max. 24m	
			U															TGR4202 / Twin cable probe, Connection: 1-1/2" NPT Male, Max. 24m	
			A															TGR4301 / Coaxial probe, Connection: G1" Male, Max. 3m	
			B															TGR4301 / Coaxial probe, Connection: 1" NPT Male, Max. 3m	
			F															TGR4201 / Single cable probe (FEP coated), Connection: G1" Male, Max. 24m	
			G															TGR4201 / Single cable probe (FEP coated), Connection: 1" NPT Male, Max. 24m	
Housing				–	2													Aluminium alloy	○
(Fixed code)						0	0											always 00	
Output / Explosion proof								–	4									DC4 to 20mA (HART) Standard	○
								–	8Ex									DC4 to 20mA (HART) ATEX 1G EEx ia IIC or IIB (FEP coated probe)	
Probe length										/								Put it down in 4digits in cm (centimeter) unit (Example: 5m → 0500) *1	
Option for cable entry															/	0		None	○
															/	1		With M20 × G1/2 female adapter	
Special																	(Blank)	None	○
																	/Z	Involved *2	

*1 For example, the probe length of 153 cm is designated as 0153.

*2 Add [/Z] at the end of code for special requests not mentioned above table and describe your requirements.
You are kindly requested to consult Tokyo Keiso or representative for your requirements before ordering.

STANDARD ACCESSORIES

- Instruction manual : 1

OPTION

- Data setting other than standard output range not mentioned above (with parameter sheet) [Symbol : DS]

DATA SETTING METHODS AFTER DELIVERY

The TGR4000 is not possible to change the setting with the device alone.
The resetting of parameters is done by following two methods.

Method 1: Send it back to Tokyo Keiso and recalibration will be done by Tokyo Keiso as fare-paying services.

Method 2: Recalibrate it by customers using following equipment and software.

- Personal computers Windows 98 or Windows 2000, HART converter, communication software PC-Star2

or

- HART handheld-communicator

ORDERING INSTRUCTIONS

Specify the following when ordering :

1. Model and specification codes
   Example : Model : TGR4101
   Specification codes : TR-200-200-4/0153/0
2. Probe length
   Specify the length in centimeter (cm)
   (The length cannot be specified as small as 1mm unit.)
3. Option features (if required)
4. Special requests (if required)
   Please state special requests clearly.
   Consult Tokyo Keiso or representative for the availability before ordering.

HART communication tool (Option)

- HART converter
- PC-STAR2 software (CD-ROM disk × 1)

These devices are delivered as a separate packing from the Micro-pulse level meter.
Please specify the name of the device and quantity at ordering.

Barriers (Option)

- Recommended isolation barrier :
  Type : KFD2-STC4-Ex1 (DIN rail installation)
- Zener barrier : Type : MTL7087P+ (DIN rail installation)

When the TGR4000 is used at the hazardous area as intrinsically safe circuit, the safety barrier shall be installed at the non-hazardous area.

ORDERING INFORMATION

Measurement conditions

Measuring range : ( ) m

Measured fluid

Name	( )
Dielectric constant	εr ( )
Material	☐ Liquid ☐ Slurry
Corrosiveness	☐ No ☐ Medium ☐ Strong
Stickiness	☐ No ☐ Medium ☐ Strong
Crystallization	☐ No ☐ Medium ☐ Strong
Waving	☐ No ☐ Medium ☐ Strong
Foaming	☐ No ☐ Medium ☐ Strong
Liquid separation into layer	☐ No ☐ Yes

Vessel

Shape	☐ Closed tank ☐ Flat roof tank ☐ Cone roof tank ☐ Dome roof tank ☐ Cylindrical tank horizontal installation ☐ Open tank ☐ Closed pit ☐ Open pit
Height	( )
Diameter or width	( )
Obstructive inner structures	☐ Agitator ☐ No ☐ Yes (Shape :) ☐ Temperature sensors ☐ Level switches ☐ Reinforce or stay ☐ Ladder ☐ Others ( )
Material	☐ Metal ( ) ☐ Coating ☐ Yes ☐ No ☐ Resin ☐ Concrete ☐ Others
Temperature in the vessel	( ) °C
Pressure in the vessel	( )

Installation conditions

Place	Distance from Tank wall	( ) mm
	Distance from liquid filling inlet	( ) mm
	Distance from obstructions	( ) mm
Mounting nozzle	Diameter	( ) mm
	Nozzle length	( ) mm

Others

Measuring condition	☐ Outdoor use ☐ Indoor use
Ambient temperature	( ) °C
Explosion proof	☐ Not required ☐ Required (Intrinsically safety)

* Specification is subject to change without notice.

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