

OUTLINE

TGR4500 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.
- ❑ Easy change of the basic settings and confirmation of the identifying value, with the display unit
- ❑ 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

TGR4500 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.

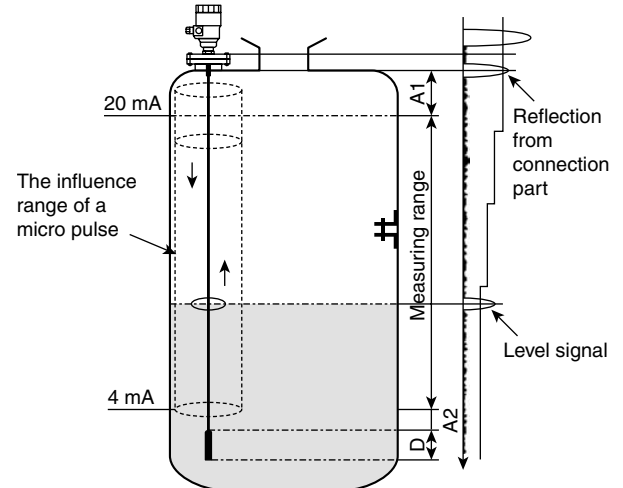
The surface of a liquid is the point where the dielectric constant suddenly changes. Since reflective strength is dependent on the dielectric constant of measuring liquid, strong reflection can be obtained from a liquid with a high dielectric constant.

TGR4500 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.

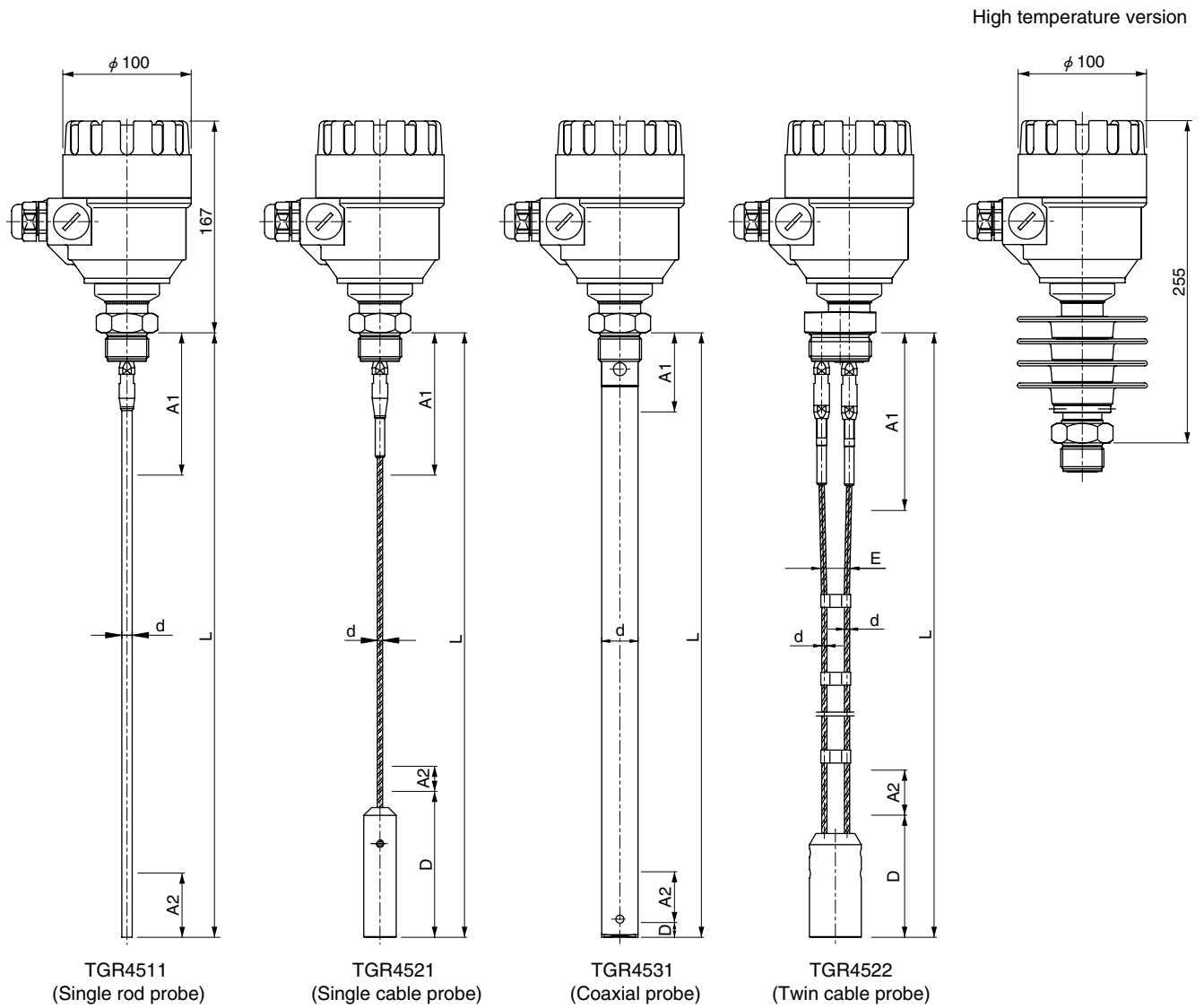


Refer to the technical data for A1, A2, and D.

STANDARD SPECIFICATION

Objects	Item	Contents	
Measuring object	Measurable materials	Liquids	
	Measuring method	Time Domain Reflectometry (TDR)	
	Output variables	Level, distance, or volume	
Electric specification of housing	Output	Output	DC4 to 20 mA (HART)
		Resolution	$\pm 2 \mu\text{A}$
		Temperature drift	0.5 $\mu\text{A/K}$ (Key value)
		Output when error occurs	Selection of "Hold" or "DC22 mA"
		Max. load resistance	750 Ω
		Start-up drift	After turning on a power-supply, normal directions are carried out in about 50 seconds.
	Accuracy	20°C	Measurement distance < 15 m: $\pm 15 \text{ mm} + 0.01\% \text{ FS}$
		Based on a basal condition	Measurement distance $\geq 15 \text{ m}$: $\pm 0.1\%$ of Reading + 0.01% FS
	Display unit	Display	LCD dot-matrix Display item: Level, Ullage (Distance), Volume, Ullage Volume,
		Controlling button	4 push button
	Measurement condition	Product temperature	Single rod, Single cable: -30 to 200°C (However, care about process connection temperature) Twin cable, Coaxial: -30 to 150°C (However, care about process connection temperature)
		Thermal shock resistance	100°C/min
Maximum operating pressure		4 MPa	
Specification of instrument	Protection class	IP65 (IEC 60529 / JIS C0920)	
	Ambient temperature	-20 to 60°C (Standard type), -30 to 60°C (With out display unit)	
	Temperature of process connection	-30 to 90°C (Standard type), -30 to 200°C (High temp. version)	
Electric connection	Type	2-wire loop powered system	
	Power supply	Rated voltage: DC 24 V Voltage range: DC 18 to 35 V (Standard type), DC 18 to 28 V (Explosion proof type)	
	Cable	Max. 1.5 mm ² , Finished outer diameter: 11 mm or less	
	Cable entry	M20 \times 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	1.5 kg (Screwing installation, without probe)	
Probe specification	TGR4511	Probe type	Single rod
		Maximum length / Probe diameter	3 m / $\varnothing 8 \text{ mm}$
		Material	Stainless steel (SS316)
		Dielectric constant	$\epsilon_r > 2.3$
		Dead zone, Non linear range	0.4 m (Upper part: A1), 0.1 m (Lower part: A2) : Refer to DIMENSIONS.
		Process connection	G1" Male screw, 1" NPT Male screw
	Weight	0.41 kg/m	
	TGR4521	Probe type	Single cable
		Maximum length / Probe diameter (weight)	24 m / $\varnothing 4 \text{ mm}$ / ($\varnothing 25 \text{ mm} \times 100 \text{ mm}$)
		Material	Stainless steel (SS316), FEP coated probe
		Dielectric constant	$\epsilon_r > 2.3$
		Dead zone, Non linear range	0.4 m (Upper part: A1), 0.1 m (Lower part: A2) : Refer to DIMENSIONS.
		Process connection	G1" Male screw, 1" NPT Male screw
	Weight	0.12 kg/m	
	TGR4522	Probe type	Twin cable
		Maximum length / Probe diameter (weight)	24 m / $\varnothing 4 \text{ mm}$ ($\varnothing 40 \text{ mm} \times 80 \text{ mm}$)
		Material	Stainless steel (SS316), FEP (Spacer)
		Dielectric constant	$\epsilon_r > 1.8$
		Dead zone, Non linear range	0.3 m (Upper part: A1), 0.1 m (Lower part: A2) : Refer to DIMENSIONS.
		Process connection	G1-1/2" Male screw, 1-1/2" NPT Male screw
	Weight	0.24 kg/m	
TGR4531	Probe type	Coaxial	
	Maximum length / Probe diameter	3 m / $\varnothing 28 \text{ mm}$	
	Material	Stainless steel (SS316), PTFE (Spacer)	
	Dielectric constant	$\epsilon_r > 1.5$	
	Dead zone, Non linear range	0.05 m (Upper part: A1), 0.1 m (Lower part: A2) : Refer to DIMENSIONS.	
	Process connection	G1" Male screw, 1" NPT Male screw	
Weight	1.3 kg/m		

DIMENSIONS



Refer to the probe specification for weight sizes.

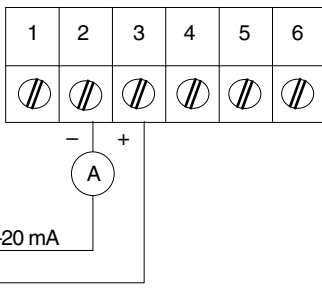
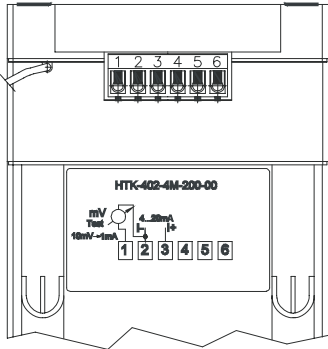
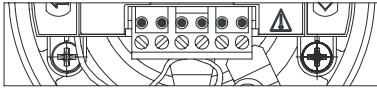
There is a dead zone and a non-linear zone for each probe type. These areas are dielectric constant dependent. Refer to the table below for the selection of probe for the dead zone and non-linear zone.

Non measurable / Non-linear zones

(mm)					
Dielectric constant	Zone	Single rod	Single cable	Coaxial	Twin cable
$\epsilon r > 40$	A1	300	300	50	150
	A2	100	100	100	100
$\epsilon r \leq 40$	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)

ELECTRIAL CONNECTION



Terminal No.	Polarity	Description
2	-	Current out put (DC 4 to 20 mA) Load resistance (M.750 Ω at DC 24 V) External source (Standard type: Max. DC 35 V) (Explosion proof type: Max. DC 28 V)
3	+	
1		Check terminal * Do not connect external cable
4		Not use
5		
6		

Note: Connect wires while the indicating part is being pulled up.

CAUTION FOR USING EXPLOSION PROOF TYPE

The TGR4500 has the intrinsically safe model also. Observe the following when the intrinsically safe model is using in the hazardous area

Explosion proof specification

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

Temperature class	Product temperature	Ambient temperature
T6	≦ + 85°C	≦60°C
T5	≦ + 100°C	≦60°C
T4	≦ + 135°C	≦60°C
T3	≦ + 200°C	≦60°C

Minimum ambient temperature	Minimum product temperature
-30°C	-50°C

[IS circuit rating]

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

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

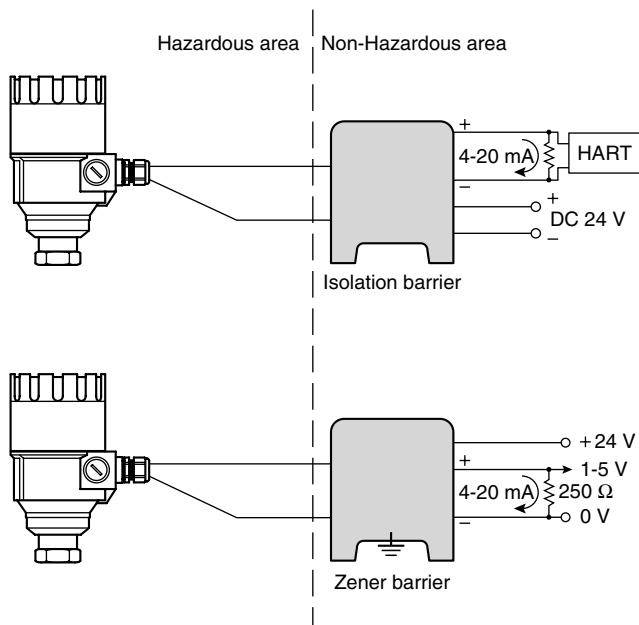
Recommended isolation barrier;

The model KFD2-STC4-Ex1 installed on DIN rail.
manufactured by PEPPERL + FUCHS

Recommended zener barrier;

The model MTL7087P+ installed on the DIN rail
MTL7000 series manufactured by MTL instruments.

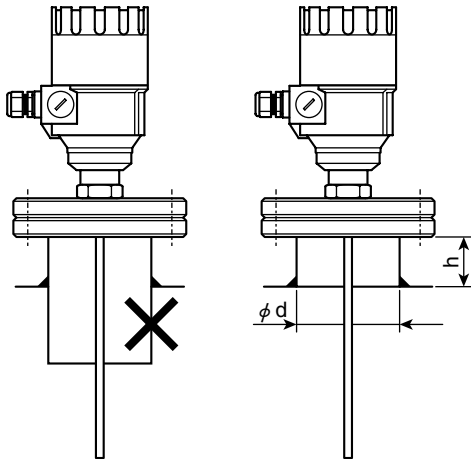
* MTL 7087P+ cannot perform HART communication from the non-hazardous area.



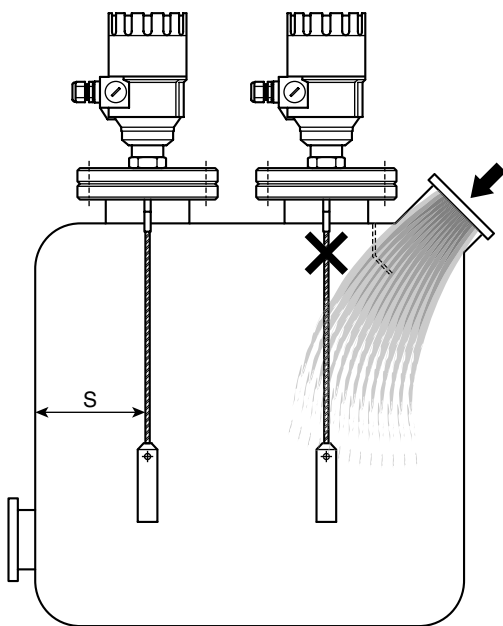
- The power supply requirements are subject to the specifications of isolation barriers when they are used.

PRECAUTIONS FOR INSTALLATION

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



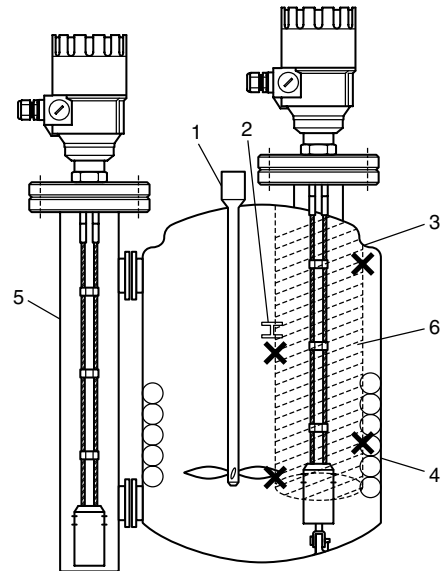
- Keep the probe at a distance from the liquid filling inside and avoid direct contact with liquid flow.
Mount the single rod or cable probe more than 300 mm away from the wall or any projections of the vessel.
Mount the twin cable probe more than 100 mm away from the wall or any projections of the vessel.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



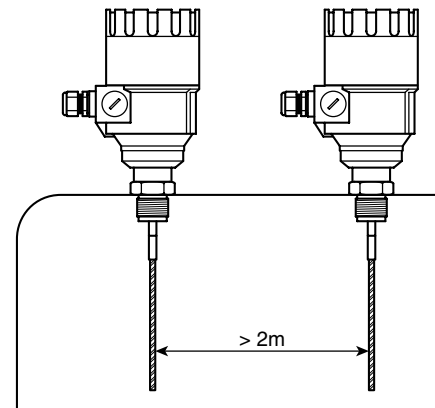
$S \geq 300\text{mm}$: TGR4511, TGR4521
 $S \geq 100\text{mm}$: TGR4522

- Do not mount the probe close to the agitator blades. We recommend mounting the probe in a pipe when the tank 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.

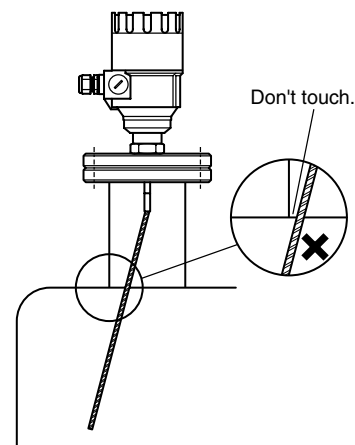
- | | |
|--|-------------------------------|
| 1. Agitator | 2. Tank reinforcement etc. |
| 3. Abrupt change of the tank inside shape such as diameter | 5. External chamber |
| 4. Heating or cooling coil | 6. Micropulse radiation range |



- When the two TGR4500 are installed in the same tank, keep a distance between them at least 2 m to avoid the interference.
Do not make a kink in the cable probe during the installation of it.



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

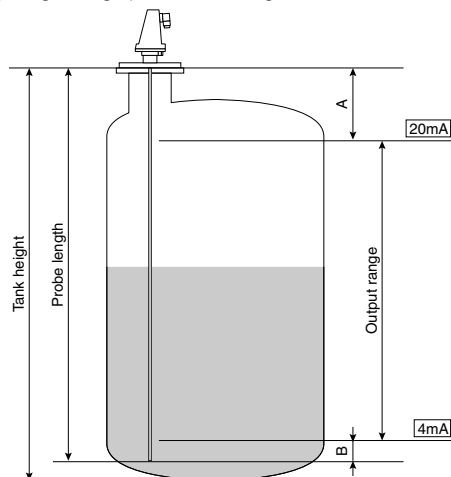


- Do not introduce foreign materials or deposit adhesive substance inside the coaxial probe.
- Each probe has non-measurement zones both at upper and lower area, and non linear zone also. The dead zone starts from the nozzle end when the probe install onto the long nozzle. Please refer to DIMENSIONS.
- Install the sunshade for the probe head where it is exposed to the sun directly.

STANDARD OUTPUT RANGE

TGR4500 is delivered with current output range (4 to 20 mA) set as follows.

The probe length (means whole length including weight length) minus the length A and B is the standard setting value of output range (4 to 20 mA)



STANDARD OUTPUT RANGE TABLE CLASSIFIED BY PROBE TYPE

(mm)				
Range	TGR4511/ Single Rod	TGR4521/ Single cable	TGR4531/ Coaxial	TGR4522/ Twin cable
A	400	400	50	300
B	100	200	100	200
Output range (4 to 20 mA)	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.

PROBE TYPE AND APPLICATION

Probe Type		Single rod	Single cable	Coaxial	Twin cable
Probe length (MAX)		3 m	24 m	3 m	24 m
Dielectric constant		>2.3	>2.3	>1.5	>1.8
Measuring object	Low dielectric liquid			○	○
	High dielectric liquid	○	○		
	Slurry	○	○		
	Crystallize liquid	○	○		
	Foaming liquid			○	
Measuring condition	Long nozzle			○	○
	Small diameter nozzle			○	○
	Small vessel			○	○
	Short Non measuring zone			○	
	Chamber or by pass chamber measuring	○	○		
	With agitator vessel		○ (Fix the Probe end)	○	○ (Fix the Probe end)
	With obstacles vessel			○	○

ORDERING INFORMATIONMeasurement conditions

Measuring range : () m

Measured fluid

Name ()
 Dielectric constant ϵ_r ()
 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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