GWLF guided wave radar level (interface) transmitter

General

GWLF guided wave radar level (interface) transmitter is designed and developed by Dandong Top Electronics Instrument Co., Ltd. GWLF can be used for measuring level or interface with 4-20mA standard current signal output. The measuring accuracy is not affected by change of specific gravity and dielectric constant of medium (in the setting range). It features itself easy operation and simple maintenance. It only needs to be entered figuration data into the instrument and it doesn't need to change the liquid level at field. So, GWLF is a new kind of level (interface) measuring instrument.

GWLF is designed for complicate and tough working conditions. Radar signals travel along guided wave rod(s) (or cable(s)), instead of propagating in air, so measuring accuracy output is stable. The measuring performance cannot be affected by condensate the on rod. The lowest dielectric constant of the medium can be 1.4 (Example: butane). Measurement cannot be affected by boiling, fluctuation, turbulence, even mixer in the medium. Measuring data have nothing to do with changes of working conditions (process temperature, process pressure, specific gravity of medium). GWLF can trace the liquid level quickly.

Application

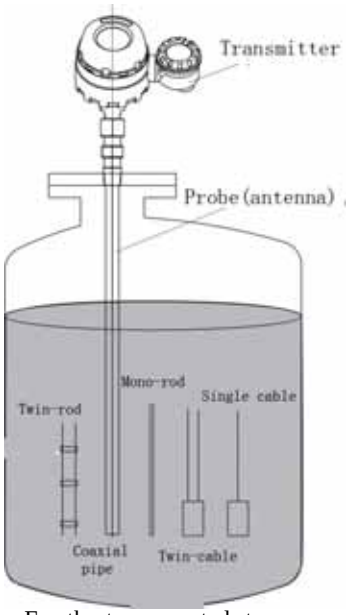
Medium: Any liquid, slurry or powder material with dielectric constant between1.4-100

Vessel: Almost all processing vessels, tanks and bypass containers within the allowed range of temperature and pressure for probe.

Conditions: GWLF can be workable under the different tough working conditions such as volatile liquids, liquids with foam, sticky liquids, liquids with fluctuation, bubbling or boiling liquids, frequently loading and unloading, variable dielectric constant or specific gravity, etc.

Performance

- Two-wire, DC 24V supply power, low power consumption, optional HART protocol.
- Performances cannot be affected with change of specific gravity, dielectric constant, and other change of working conditions.
- For twin-rod probes, measurement cannot be affected by a little quantity of medium stuck with probes. And the instrument can still keep high measuring accuracy.
- With universal coupling, orientation of transmitter can be adjusted to any required direction.
- Three keys for configuration, LCD for values indication.
- Housing with 45° structural angle is convenient for wiring and installation.
- The length of rigid probe is from 0.6 to 6.1m. The length of cable probe can be up to 21m.
- The connection between transmitting head and probe is interchangeable. Transmitter can be disassembled off simply by screwing off the nut between transmitter and probe.

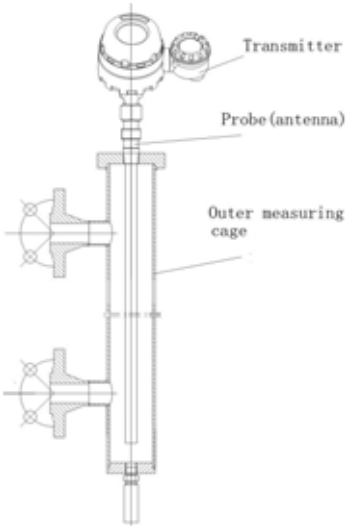


For the top mounted, types of transmitting head and probe, length of neck (stand-off pipe) should be provided

Add: No..10 Huanghai Street, Zhenxing District, Dandong City, Liaoning Province, P.R. China P.C.: 118000
Tel: +86-415-6227343 Fax: +86-415-6227341 Website: http://www.ddtop.com E-mail: davidsong@ddtop.com

Parameters of transmitter

Output signal: 4-20mA or 4-20mA with HART protocol, applicable within 3.8-20.5mA.
Resolution: Analog: 0.01mA, Display: 1mm
Accuracy: 5mm or 0.1% FS for coaxial probe
Measuring range: 0.3-6.0 m
Load resistance: Max.650 @ 24V DC
Damping: 0-32 seconds adjustable
Diagnosis alarm: 3.6mA, 22mA, Hold
User interface: 3 keys, LCD or HART communication
Ambient temperature: -40℃ to 60℃ (LCD operating temperature: -20℃ to 60℃)
Electric entry: M20×1.5 or Rc1/2 or NPT1/2 (female thread)
Ingress protection: IP66
Supply power: 11 to 26.4V DC
Housing material: Aluminium（Magnesium ＜ .25%)
Note：When both HART protocol and field indication are selected, 3.6mA self-check is not available.



For GWLF with measuring cage, please provide types of transmitter, probe and measuring cage.

Model selection table for Transmitter

Model	Code			Code Meaning
GWLF-				Guided wave radar level (interface) transmitter
	M			Electronic components: 4-20mA
	Z			Electronic components: 4-20mA with HART protocol
		I		Explosion-proof: Intrinsically safe
		A		Explosion-proof: Intrinsically safe + Explosion isolation
		P		Explosion-proof: Non Explosion-proof
			1	Electric entry: M20×1.5(female thread)
			2	Electric entry: NPT1/2 (female thread)
			3	Electric entry: Rc1/2 (female thread)
GWLF-	□	□	□	

Explosion-proof Approval

Explosion-proof	Intrinsically safe	Explosion isolation + Intrinsically safe
Mark	Exia II CT_2-T_6	Exd (ia) II CT_2-T_6
Certificate No.	GYB071234	GYB071242

Intrinsically safe parameters:

Vi: 28 Ii:93mA Pi:0.75W Ci:2nF Li:60μH

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Recommended Safety Barrier

Dandong Top Electronics Instrument Co.,Ltd	TP5041-Ex TP5045-Ex
Shanghai Automatic Instrument Institute	GS8041—Ex GS8037-Ex
TURCK Co.	MK33-11 Ex-Hli/24V DC
English MTL Co.	MTL3046B MTL5042
Deutsch P+F Co.	KFD2-STC3- Ex1

Parameter for Probes

Probe ype	GWPB-A Coaxial	GWPB-B Twin-rod	GWPB-C Mono- rod
Process temperature	-196℃ ≤ T < 450℃	-196℃ ≤ T < 300℃	-196℃ ≤ T < 300℃
Nominal Pressure	Less than 10.0MPA	Less than 10.0MPA	Less than 10.0MPA
Recommended Working Condition	Universal working condition, Clean liquid with low viscosity	Universal working condition with little medium-sticking	with partly medium-sticking and foam
Non-recommended Working condition	with medium-sticking and scaling	scaling on the isolator	Dielectric constant ＜10
Dielectric constant range	1.4 - 100	1.9 - 100	10 - 100
Max. viscosity	500CP	1500CP	8000CP
Max. pressure	6.3MPA	6.3MPA	6.3MPA
Max. temperature	300℃	300℃	300℃
Probe material (standard)	316L	316L	316L
Optional probe material	Hastelloy, Monel	Hastelloy, Monel	Hastelloy, Monel
Seal material	PTFE/PEEK/GLASS	PTFE/PEEK	PTFE/PEEK
Process connection (Recommended)	NPT3/4	NPT2	NPT2
Optional process connection	R3/4 or flange	R2 or flange	R2 or flange
Length of probe	0.6-6.1m	0.6-6.1m	0.6-6.1m
Non-linearity Zone upper	180mm	180mm	150-1000mm (Depend on length of probe)
Non-linearity Zone lower	120mm	120mm	50mm
Distance (from probe to wall)	No requirements	100mm	300mm
Min. neck diameter	Large than diameter of probe	Φ100mm	Φ150mm

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Liquid interface level measurement	×	√	√
Solid level measurement	×	×	√
medium with foam	Depend on kind of foam	√	√

①: If installation space is big enough, the dimension of non-linearity zone is selected as 1000mm.
If there is no enough installation space, non-linearity zone = 0.2 × measuring rang

Probe type	GWPB-D Twin - cable	GWPB-E Mono - cable	GWPB-F coaxial for interface
Process temperature	-196℃ ≤ T < 450℃	-196℃ ≤ T < 450℃	-196℃ ≤ T < 450℃
Nominal Pressure	Less than 10MPA	Less than 10MPA	Less than MPA
Recommended Working Condition	Universal working condition with partly medium-sticking	With medium-sticking and foam	Universal working condition, Clean liquid with low viscosity
Non-recommended Working condition	scaling on isolator	Dielectric constant ＜10	Medium-sticking and scaling
Dielectric constant range	1.9-100	10-100	Upper: 1.4-4 Lower:15-100
Max. viscosity	1500CP	8000CP	500CP
Max. pressure	6.3MPA	6.3MPA	6.3MPA
Max. temperature	300℃	300℃	300℃
Probe material (standard)	316L	316L	316L
Optional probe material	Hastelloy, Monel	Hastelloy, Monel	Hastelloy, Monel
Seal material	PTFE/PEEK	PTFE/PEEK	PTFE/PEEK
Process connection (Recommended)	NPT2	NPT2	NPT3/4
Optional process connection	R2 or flange	R2 or flange	R3/4or flange
Length of probe	0.6-6.1m (ε r＜10.0) 21m (ε r≥10.0)	0.6-21m	0.6-6.1m
Non-linearity Zone upper	180mm	150-1000mm (Depend on length of probe)	180mm
Non-linearity Zone lower	320mm	320mm	120mm
Distance (from probe to wall)	100mm	300mm	No requirements

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Min. neck diameter	Φ100mm	Φ150mm	Large than the diameter of probe
Liquid interface level measurement	√	√	√
Solid level measurement	×	√	×
medium with foam	√	√	Depend on kind of foam

Example for probe selection

Known conditions:

Medium: condensation water, Process pressure: 0.35MPA, Process temperature:120℃, Measuring range: 800mm, Mounting type: side-side mounted.

The first step: confirm the type of probe:

Firstly, consider twin-rod (cable) probe, secondly, coaxial probe (-A, -F), the last, mono- rod (cable).

For interface measurement, A type probe is not applicable.

1.Probe selection, according to viscosity of medium under working condition.

Operation viscosity＜500CP, Optional probe : Coaxial –A,-F

500CP≤Operation viscosity＜1500CP， Optional probe : twin- rod (cable) –B,-D

1500CP≤Operation viscosity＜8000CP， Optional probe: mono- rod (cable) –C,-E

current selected probe: Coaxial type (-A□□-□□-,-F□□-□□-)

2. Confirm if the selected probe is suitable for the application according to medium of dielectric constant. (Refer to Appendix---for dielectric constant of common medium)

1.4≤dielectric constant＜1.9, unsuitable probe: twin-rod (cable):-B,-D, mono- rod (cable):-C,-E

1.9 ≤dielectric constant＜10.0 , unsuitable probe: mono- rod (cable):-C,-E

dielectric constant≥10.0, all kinds of probes are available.

The dielectric constant of condensation water is 81, coaxial probe is available

(-A□□-□□-,-F□□-□□-)

Due to liquid level measurement, current option：-A□□-□□-

The second step: Select pressure grade according to process temperature and operating pressure. (Refer to process temperature and pressure curve)

Current selection: -A0□-□□-

The third step: Confirm temperature range of probe according to process temperature

Current selection: -A0F-□□-

The fourth step: Select material of probe according to causticity of medium

Current selection: -A0F-S□-

The fifth step: Confirm process connection to probe:

When adopting top mounting, the process connection of probe means the connection between probe and tank. For side-side mounting, the process connection of probe means the connection between probe and measuring cage, both thread and flange connection are selectable.

For coaxial probe (-A,-F), any connection in the model selection table can be selected. For other probe type (-B,-C,-D,-E), due to limit from tank structure, R3/4 or NPT3/4 is not applicable.

Current selection: -A0F-SE-

The sixth step: Confirm length of probe

Min. length of probe= measuring range + upper non-linearity zone or length of neck (select bigger value) + lower non-linearity zone.

When measuring water, the data of non-linearity zone for -A type probe: the upper non-linearity zone is 180mm, the lower non-linearity zone is 120mm.

Min. length of probe=800+180+120=1100mm

Finally confirmed length of probe: 1.1mm

Finally confirmed model of probe : GWPB-A0F-SE-1.1 (800mm)

Guided wave radar probe, coaxial probe, nominal pressure 2.0MPA, 100℃≤process temperature≤200℃, probe material:316L, process connection NPT3/4, the length of probe: 1.1m.

Model Selection Table for Probe

Type	Mode	Code meaning
GWPB-		Guided wave radar level (interface) transmitter
	A	Coaxial probe
	B	Twin-rod probe
	C	Mono- rod probe
	D	Twin-cable probe
	E	Mono- cable probe
	F	Coaxial interface probe
	0	PN2.0MPa (class 150)
	1	PN2.5MPa
	2	PN4.0MPa
	3	PN6.3MPa (class 300)
	4	PN10.0 MPa (class 600)
	L	-196℃≤process temperature＜ -40℃
	D	-40℃≤process temperature＜100℃
	F	100℃≤process temperature≤ 200℃
	G	200℃≤process temperature ＜ 300℃
	O	300℃≤Process temperature ≤ 450℃
	-	
	S	Probe material：316
	L	Probe material: 316L
	M	Probe material: Monel
	H	Probe material: Hastelloy

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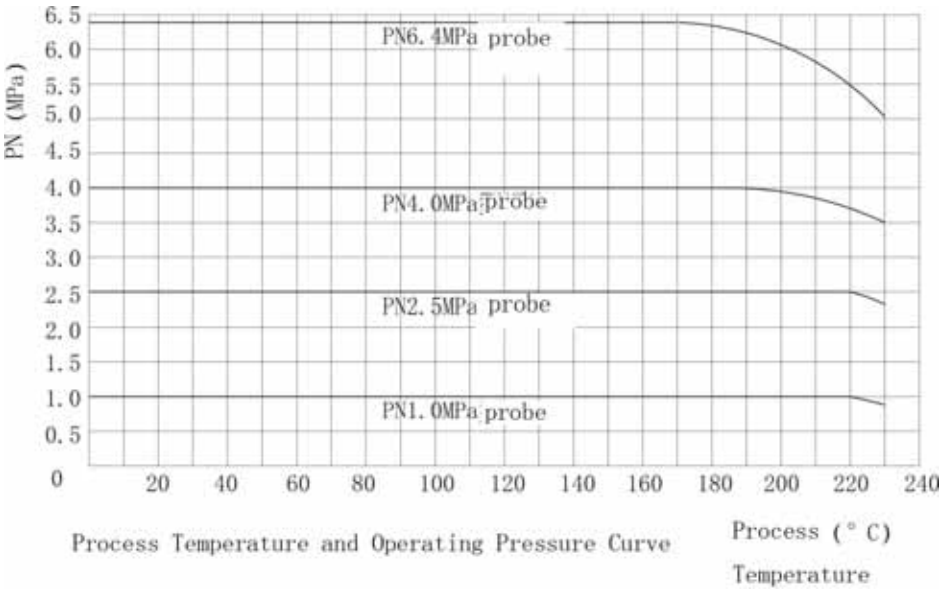
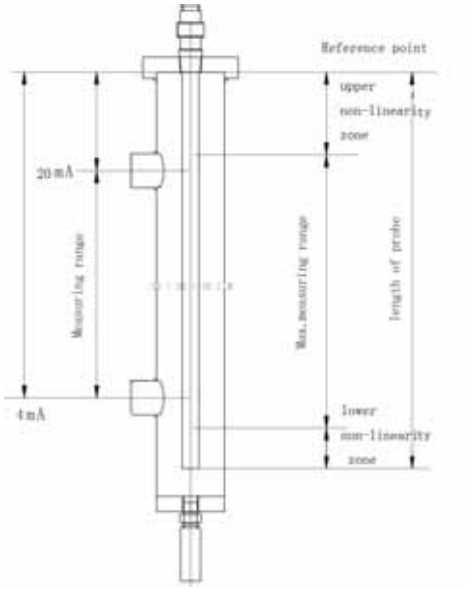
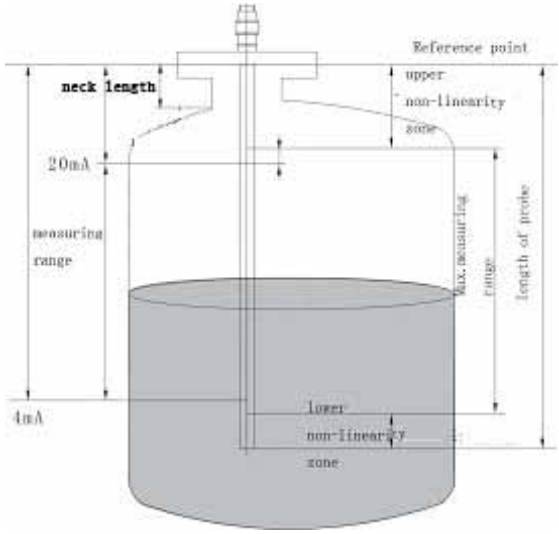
					A			Coated probe: PTFE (only for type C)
					D			Process connection: R3/4 (Only for coaxial probe)
					E			Process connection: NPT3/4 (Only for coaxial probe)
					F			Process connection: R2
					G			Process connection: NPT2
					N			Process connection: Flange
					X			Process connection: others
						-		
								Length of probe (m) / measuring range (m)
GWPB-	□	□	□	-	□	□	-	

Process Temperature and Operating Pressure Curve







Non-linearity zone and measurement range setting for probe

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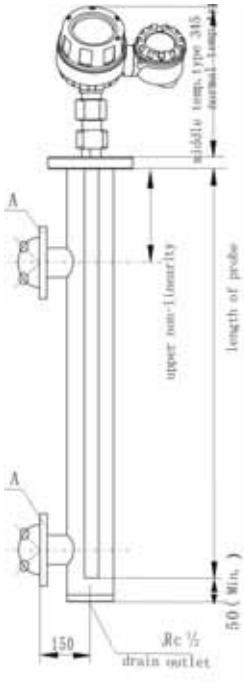
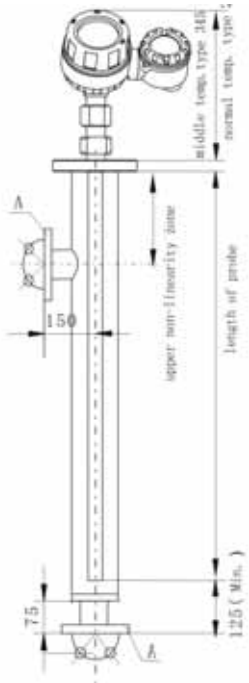
Model Selection Table for Measuring Cage

It is strongly suggested using guided wave radar level transmitter with measuring cage

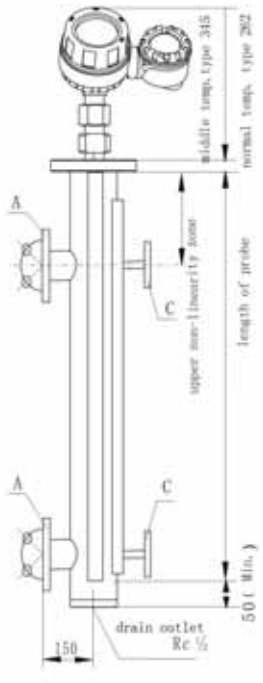
Type			Code meaning
GWLT-			measuring cage used for guided wave radar level (interface) transmitter
	C		Side-side mounted
	D		Bottom-side mounted
	R		Side-side mounted with heating (heating connection flange:DN15, recommended standard: JB/82.1-94)
	S		Bottom-side mounted with heating (heating connection flange:DN15, recommended standard: JB/T82.1-94)
		0	Process connection: DN40 flange PN1.0MPa (flat)
		1	Process connection: DN40 flange PN2.5MPA (flat)
		2	Process connection: DN40 flange PN4.0MPA (raised face)
		3	Process connection: DN40 flange PN6.3MPA (raised face)
		9	Process connection: others (Please offer the standard of flange, nominal diameter, nominal pressure, pressure grade, sealing face type or code)
GWLT-	☐	☐	



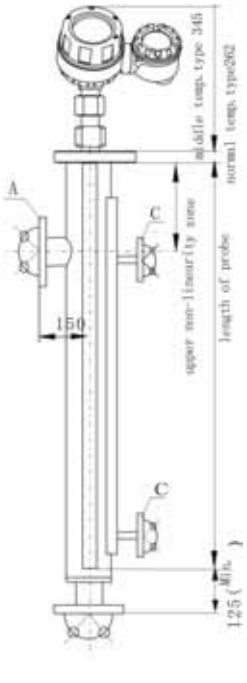
C. side-side mounted



D. bottom- side mounted



R. side-side mounted with heating



S. bottom-side mounted with heating

In the above pictures: A: Process flange connection; C: Heating flange connection; unit: mm

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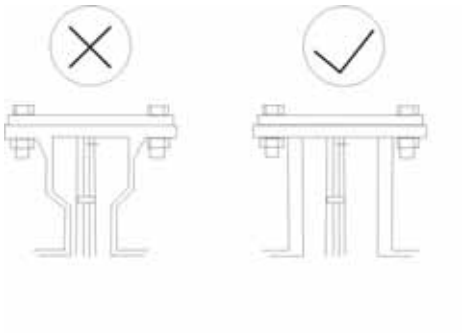
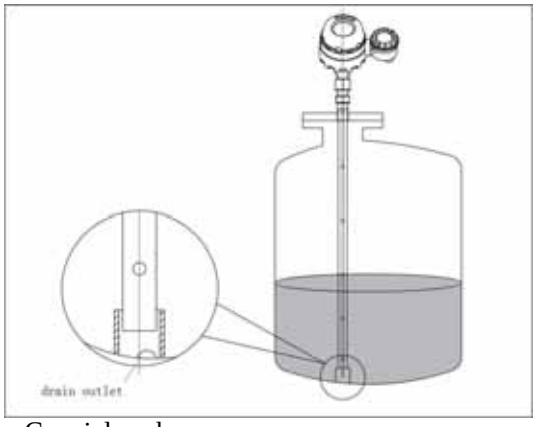
Hints for Installation

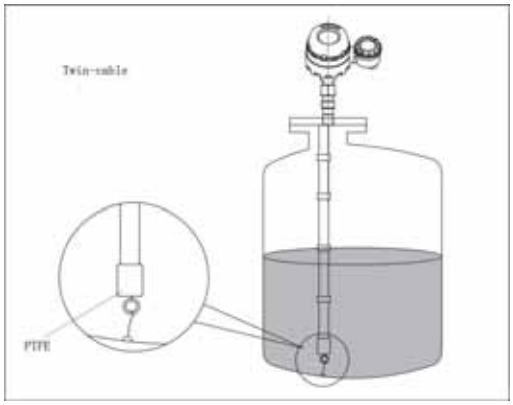


Wrong neck type Correct neck type



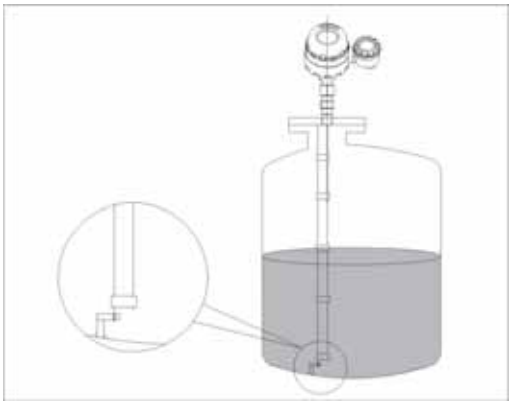
Coaxial probe

Weld a short section of pipe prepared by user on the bottom of vessel to keep coaxial probe from wavering. The inner diameter should be little bigger than the diameter of probe. The recommended diameter is Φ24mm.



Twin-cable/mono-cable probe with weight and ring

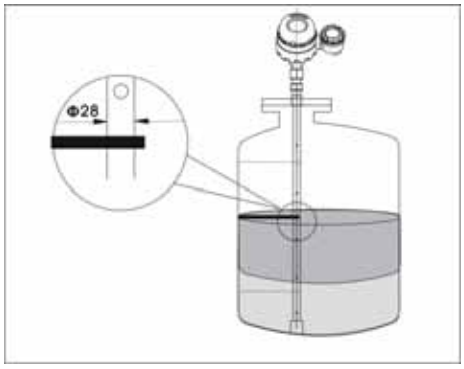
Connect a ring to the weight through female thread M8 x 14 at the bottom of it, and then connect this ring to a suitable fixed point.



Twin-rod probe

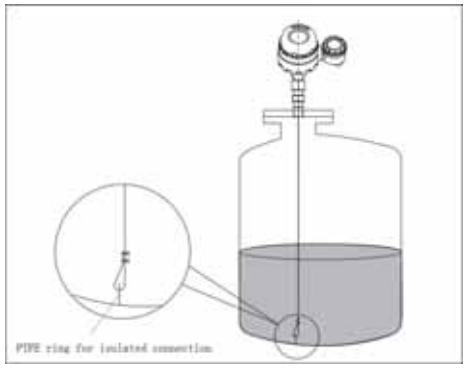
Keep twin-rod probe from wavering by connecting a fixed bracket prepared by user at bottom of tank to its end. Bracket can't touch the axial rod (short rod).

The inner diameter of the hole at the bracket should be little bigger than the diameter of rod. The recommended diameter is Φ14mm.



Coaxial probe fixed on wall of tank

Keep coaxial probe from wavering by a fixed bracket prepared by user on the wall of a tank. Make sure that probe can move freely up and down, which can never be locked when in thermal expansion. The inner diameter of a hole in the bracket should be little bigger than the diameter of rod. The recommended diameter is Φ24mm.



Mono- cable probe

The cable of probe can be restricted by itself. Let the cable go through a hole fixed at an appropriate point, for example, a welded ring at the bottom of a tank, and fold the end back to the cable and make the cable straightened, then use two clips to fix the end with the cable.

The folded length of the cable should be added to the dead zone. The position of the top clip determines the start point of the dead zone.

Installation:

1. Tools and equipment for installation:

a. A spanner or adjustable spanner with open-end size 38mm;
b. A 0.6kg-m torque wrench;
c. A spanner or adjustable spanner with open-end size 47mm;
d. A flat-head screw driver;
e. A digital multimeter;
f. An electrician knife and 2.5mm hexagon spanner;
g. 24 V DC power supply

2. Fast installing steps:

a. Check and ensure that probe serial number must match with that of transmitter which the probe will be connected;
b. Put the probe into the container carefully, adjust the thread or flange's installing position;
c. Tighten the hexagon nuts or flange bolts for probe connection. Note: don't take the protection cap off before install the probe.

d. Take off the protection cap of the probe and keep it in a certain place for use of maintenance in the future. Be sure to keep the thread of the transmitting head dry and clean. If there is a need, clean it with cotton dipped with alcohol. Note: Never use the PTFE film as the sealing between the transmitting head and the probe. The only selection is to use "O" type sealing ring.

e. Put the transmitting head onto the probe along it's axial direction, and then tighten the connection with hands.

f. Tighten the thread connection.

3. Wiring

a. Unscrew the cover of the wiring box to the transmitting head;

b. Connect a self-tighten nut into the electric entry of the housing, then put the 18～22AWG armored twin-core stranded wires cable through the nut into the wiring house, and then tighten the nut;

c. Ground the armored cover cable of the power supply;

d. Connect the positive power supply wire onto "＋" terminal (the left terminal), connect the negative power supply wire onto "－" terminal (the right terminal). For the explosion isolation environment, the electric entry and wiring should be performed according to Standard GB3836.2 <Electric Equipment in Explosive Gas Environment, Part Two: Explosion Isolation Type "d">

e. Screw the cover of the wiring box to the transmitting head again and tighten it.

Fast Configuration

After the configuration at the workshop, the instrument may need to be set at field (Since the probe is not connected with the transmitting head, without considering the problem information)

a. Electrify the transmitter, the LCD shows respectively "liquid level", "percentage %", "current" every five minutes;

b. Unscrew the cover of the electronic chamber to the transmitter;

c. Press the keys (↑ ↓) shows a state to another state;

d. Press the enter key (↙), there appears little letters "FIX" at the left upper corner on LCD;

e. Press the keys (↑ ↓) to increase or decrease the indicating values or do selection;

f. Press the enter key (↙) to confirm a value;

g. The last value should be input 10 seconds before switching off the power supply;

h. The followings are the least configuration input:

No.	LCD Indication	Meaning	Answer
2	Type	Probe type?	
3	Mount	Mounting type, thread or flange mounting?	
4	Pb-Ln	Length of the ordered probe	
5	Dielc	Dielectric Constant	
6	Ofst	Input desired offset of the liquid level	
7	St-4.	Set the zero point 4mA (0%)	
8	St-20	Set the full scale 20mA (100%)	

Data modification

In normal operation, the instrument is in a indication mode (there is no 【FIX】 at left upper corner on the LCD screen). It will be in the data modification mode when modifying data (or selection) (there appears 【FIX】 at the left upper corner on the LCD screen). If you want to mXodify the probe length, press the key " ↑ " (" ↓ ") shift into "【PASS】", press key " ↑ " (key " ↓ "), set the pass word as "85", and then press key "—┐". Press key " ↑ " (key " ↓ ") to shift into "【PB--LN】", press key "—┐", and then the instrument enters the modification mode from the indication mode, at the time, you can modify the data. Press key " ↑ " (key " ↓ ") to modify data. Whey you confirm that the existing data is what you want to have, press key "—┐", now, the instrument enters the indication mode again. Press key " ↑ " (key " ↓ ") to show other data or measuring values.

Keys

Unscrewing the glass cover of the transmitting head, you can see there are three keys at the lower middle position of the top face to a plastic box. If you face the LCD, the keys are key" ↑ ", key " ↓ " and key "—┐" from left to right. You can review or modify data by pressing the keys. After 5 minutes without pressing any key, the indication of the transmitter will return back to the default state.

Table 1. Key function

Key	Functions in indication state	Functions in modification state
Key ↑	From a indication state to another indication	Increase or decrease values, or shift a selection to another. When adjusting values, press a key for longer time to increase or decrease value rapidly.
Key ↓		
Key —┐	Enter a modification mode	Accept the shown value or selection and enter a indication mode
When there is 【FIX】at the left upper corner on the LCD screen, the transmitter is in a modification mode, without 【FIX】,the transmitter is in a indication mode.		

Indications

In the below table 2, there lists data based on liquid level measurement (i.e. change of liquid level causes change of current in a circuit). The first column shows sequence number. The second column shows transmitter indication. Arrow " ↑ " means a scrolling menu, the indications show in the order at the table. The third column depicts transmitter's response or the operation that the operator takes when calibrating the transmitter. The fourth column shows further supplement explanation.

Table 2 Screen indication and explanation

No.	Indication	Response	Description
1	X.XXXm X.XXmA X.X%	Transmitter indicating	The circuit current is controlled by liquid level. The transmitter indicates by default the followings: liquid level (unit: m), circuit current (unit: mA), Current percentage (marked in %). The indication shows circularly and restores every five seconds.
2	X.XXXm	Transmitter indicating	Transmitter indicates liquid level (m)
3	X.XXmA	Transmitter indicating	Transmitter indicates circuit current (mA)
4	X.X%	Transmitter indicating	Transmitter indicates the current caused by the change of liquid level (the value is equal to the current circuit current value minus 4mA) takes the percentage of the whole current width (if the value is 20mA, minus 4mA, the balance is 16mA)
5	XXXX PASS		The engineer's pass word is 85. When modifying CAL-K, CAL-B, the password is 385.
6	MODEL	Probe's model	Coaxial (A), Twin-rod (B), Single rod (C), twin-cable (D), Single cable (E)
7	MOUNT	Probe mounting type	Flange, NPT thread connection, Standard pipe thread connection.
8	----m UNITS	Transmitter indicating	Liquid level unit (m)
9	X.XXm PB--LN	Input exact probe length	Maximum length is up to 30m
10	xx-xx DIELC	Select medium dielectric constant ranges	Options: --1.9 (less than 1.9) only available for coaxial probe 1.9 – 4, 4 – 10 10 - - (large than 10)
11	X.X DAMP	Input the needed damping constant	Increase damping coefficient (0.1-32.0 seconds) to ease output change influenced by noise or liquid turbulence. Note: the unit is "second".
12	X.XXXm OFST	Input needed liquid level offset	Liquid level offset means the distance (-9.998 to 9.999m) from the end of probe to the needed zero liquid level point (Set 4mA to correspond with the zero point).

No.	Indication	Response	Description
13	X.XXXm ST--4	Input PV value corresponding current 4mA	Set the zero point of measuring range
14	X.XXXm ST--20	Input PV value corresponding current 20mA	Set the top point of measuring range
15	X.XXXm TR--LV	Input a value to adjust liquid level reading	-0.998m≤TR--LV≤0.999m (Adjusting the system error)
16	XXXX FAULT	Select a circuit current value when transmitter has a trouble.	Options: 3.6mA, 22mA, HOLD
17	THRSH	Echo threshold	No need to change the inner setting
18	XXX GAIN	Transmitter indicating	No need to change the inner setting
19	XX SWEEP	Transmitter indicating	No need to change the inner setting
20	XXX DELAY	Transmitter indicating	No need to change the inner setting
21	XXX CAL-K	Calibrating data	Manufacture data
22	XXX CAL-B	Calibrating data	Manufacture data
23	RE-CV	Restore data	
24	XXXX STATE		Diagnoses message
25	DDTOP	Transmitter indicating	Manufacture and version message
26	XXX F-TCK	Diagnoses indications	No need for change
27	XXX L-TCK	Diagnoses indications	No need for change

Troubleshooting

Phenomenon	Problem	Solution
Liquid level, output% and circuit current are not accurate.	There are problems on basic configuration.	Reset the probe length and offset 1. Ensure the liquid level is accurate 2. Reset the circuit current value
Liquid level reading keeps no change whatever the actual liquid level is high or low.	The set data cannot match probe length or tank height accurate.	Ensure probe length, adjust offset value and make a sure the instrument can reach the known accuracy.
Liquid level, output% and circuit current fluctuate	There is turbulence	Increase damping coefficient till the reading is stable.
Liquid level, output% and circuit current value are all lower than the accurate values	1. There is a medium with lower dielectric constant covering the another medium with higher dielectric constant. For example, oil floats on the surface of water. 2. Packing material, blocks or inner structure obstruct the probe. 3. There are sticky and thick material or water based foam.	1. Select constant threshold selection. 2. The imprecise is caused by some influence to the pulse propagation.
Liquid level reading on LCD screen stops at full scale point, while the circuit current stops at 20.5mA	The software believes the liquid level is overfilled (the liquid level approaches the highest point of the probe)	Check actual liquid level. If the liquid level is not full, decrease voltage. When the voltage increase, the liquid level will lower than the highest point of the probe.
No liquid level signal	1. The selected dielectric constant is not appropriate. 2. Liquid level is at transition zone. 3. Analogue circuit board or 32 pins connector doesn't work normally.	1. Check medium dielectric constant or configuration dielectric constant. 2. Transition zone value has not input when configuration. 3. Replace the circuit board.
Unsuitable calculating data	1. Data input in software is not equal to the value measured by the circuit board. 2. There may be medium bridging on the probe. 3. The selected dielectric constant is not right.	1. Configuration: Input right probe length 2. Clear off the medium remaining on probe. 3. Select appropriate dielectric constant range.

Appendix

Dielectric constants for common mediums

Group	Medium	Temperature (℃)	Dielectric constant
1.0…1.4	Steam		1.007
	Most gases		＜1.01
1.4…1.9	Butane	-1	1.4
	Liquefied air	--	1.5
	Propane	0	1.6
	Carbon dioxide (Liquid)		1.6
	Methane		1.7
	Coal oil (kerosene)	21	1.8
	Liquefied petroleum gas	--	1.6-1.9
1.9…4.0	Propylene	20	1.9
	Gasoline	21	2.0
	Freon	--	2.0
	Ethylene	17	2.0
	Crude oil	20	2.1
	Transformer oil	20	2.2
	Carbon tetrachloride	20	2.2
	Benzene	20	2.3
	Styrene	25	2.4
	Bitumen	24	2.6
	Edible oil	--	Around 3.3
	Coal tar		2.0-3.0
	olefin		1.9-2.5
	Most hydrocarbon		1.9-4
4.0…10.0	Amylamine	22	4.6
	Chloroform	20	4.8
	Chlorobenzene	38	4.7
	Aniline	20	7.3
10.0…100.0	Water	0	88
	Water	20	81
	Water	100	55.3
	Water	199	34.5
	Concentrated sulfuric acid	20	84
	Concentrated sulfuric acid	25	100
	Hydrofluoric acid	0	83.6
	Alcohol	25	24.3
	Most acid	Molten state	＞10
	Most alkali	Molten state	＞10
	Most inorganic salt	Molten state	＞10
	Water contained liquid		＞10

Add: No..10 Huanghai Street, Zhenxing District, Dandong City, Liaoning Province, P.R. China P.C.: 118000
Tel: +86-415-6227343 Fax: +86-415-6227341 Website: http://www.ddtop.com E-mail: davidsong@ddtop.com