

Guided Wave Radar Level Transmitter Operation Manual

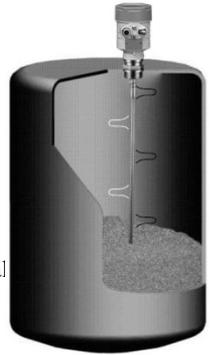
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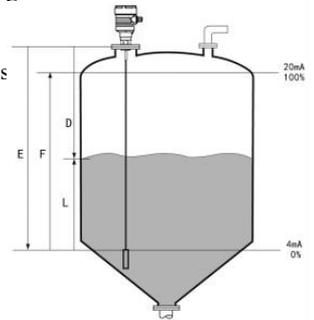
1. Principle of Measurement

Principle illustration:

The high frequency microwave pulse emitted by the guided wave radar propagates along the detection module (cable or rod). When it encounters the measured medium, due to the sudden change of the dielectric constant, it causes reflection, and part of the pulse energy is reflected back. The time interval between the transmitted and reflected pulses is proportional to the distance of the medium to be measured.



Guided wave radar is a measuring instrument based on the principle of time travel. Radar wave moves at the speed of light, and the running time can be converted into object position signal through electronic components. The probe sends out high frequency pulse and propagates along the cable or rod probe. When the pulse encounters the material surface, it is reflected back and received by the receiver in the meter, and converts the distance signal to the object position signal.



The reflected pulse signal is transmitted to the electronic circuit of the instrument along the cable or rod probe. The microprocessor processes the signal and identifies the echo generated by the microwave pulse on the material surface. Correct echo signal identification is completed by pulse software. The distance from the material surface D is proportional to the time travel T of the pulse: $D=C \times T/2$

Where C is the speed of light, since the distance of the empty tank E is known, the object location L is: $L=E-D$ Set by input of empty tank height E (= zero), full tank height F (= full range) and some application parameters that will automatically adapt the meter to the measuring environment corresponding to the 4-20mA output.

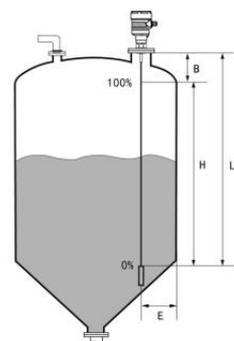
Range explanation:

H----measuring range

L----empty distance

B----near blanking

E----min distance to wall of tank



- The top near blanking is the minimum distance between the highest surface of material and measurement reference point.
- The bottom near blanking is a distance that cannot be accurately measured near the extreme bottom of the cable.
- Effective measurement distance is between the top near blanking and the bottom near blanking.

Note:

Reliable measurement of the tank level is ensured only when the material is between the top and the bottom near blanking.

2、 Install

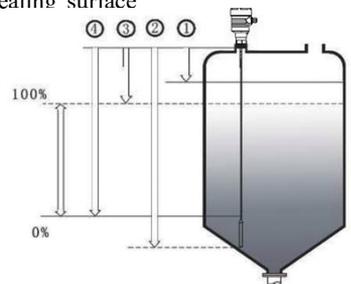
Ensure that the cable or rod shall not contact the internal obstacles within the whole range, so avoid the facilities in the tanks as much as possible during installation, like ladder, limit switches, heating equipment, brackets, etc. Also note that the cable or rod shall not intersect the feed stream.

Note when installing the instruments:

The maximum material level shall not enter the measurement near blanking; the instrument must be kept a certain distance from the tank wall. Making the cable or rod direction perpendicular to the surface of the measuring medium. Instruments installed in explosion-proof areas must comply with the national installation regulations for explosion-proof hazardous areas. The intrinsically safe shell adopts an aluminum shell. Intrinsically safe instruments can be installed in places where explosion-proof requirements are required, and the instruments must be connected to the ground.

The measurement reference surface is the threaded or flange sealing surface

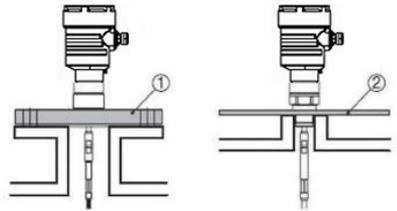
- 1、 Near blanking (minimum range).
- 2、 Measurement range (maximum range).
- 3、 Max adjustment (20mA corresponding point).
- 4、 Min adjustment (4mA corresponding point).



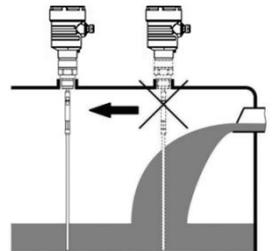
Note: When using guided wave radar level timing, make sure that the material

level cannot enter the blind zone.

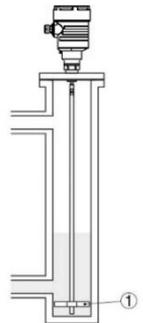
1. Plastic containers need to install metal flanges (size bigger than DN50) or metal sheets (diameter bigger than 200mm) at the process connection.



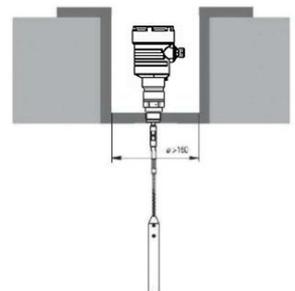
2. The installation position should avoid the incoming material flow and be at least 300 mm away from the side wall.



3. At the bottom part in by-pass pipe, we need add insulation holder to prevent the guided wave rod touch from wall of pipe.

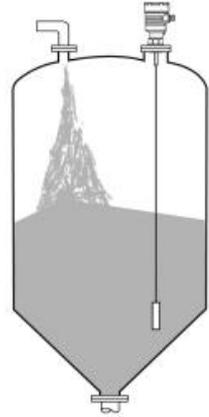


4. Thicker cement silos should be installed with a sinking type .

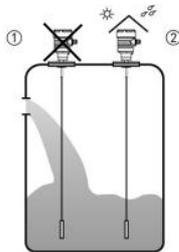


● **Installation position:**

1. Keep away from the outlet and inlet as far as possible.
2. Does not touch the metal tank wall and tank bottom in the entire range.
3. It is recommended to install at 1/4 or 1/6 of the diameter of the silo, and the minimum distance from the tank wall is 1/ 10 of the measurement range.
4. The minimum distance between the cable or rod probe and the tank wall is $\geq 300\text{mm}$.
5. The distance between the bottom of the probe and the bottom of the tank is $\geq 30\text{mm}$.
6. The minimum distance between the probe and the obstacle in the tank is $\geq 200\text{mm}$.
7. If the bottom of the container is cone-shaped, it can be installed in the center of the tank

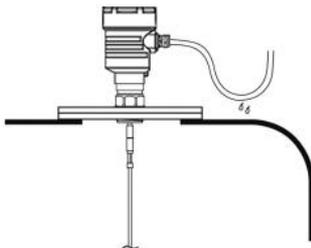


● **Installation correctness:**



1. Sensor rod or cable installation need to avoid the filling of material.
2. Add protection of sunshade and rainproof

● **Damp proof:**



Bend the cable down at the entrance as pic shows if the instrument installed outdoors or humid conditions,

3、 Wiring:

Power Supply

(4~ 20) mA/HART two-wire radar power supply and output current signal share a two-core shielded cable. The power supply voltage is recommended to use 24 VDC. For the intrinsically safe type, a safety barrier must be added between the power supply and the instrument. The instrument and the grounding terminal should be well grounded.

Usually, it can be connected to the grounding point of the tank. It should be connect to the neighboring ground in plastic tanks. 220VAC power supply should choose a double-chamber housing.

Cable Installation

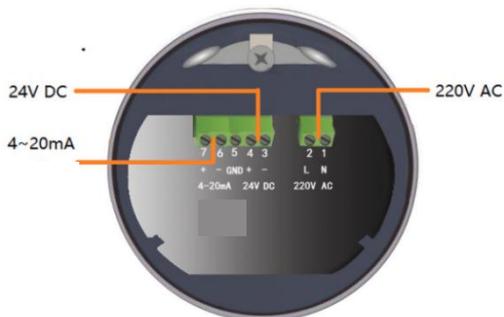
General connection (4~20) mA/HART(two cable) must be of shielded cable, generally two cores with an outer diameter of (6~ 10) mm, to ensure the cable entrance. The shielding and wiring of the shielding cables shall be well grounded. Inside the sensor, the shield must be directly connected to the internal ground terminals. The external earth terminals on the enclosure must connect to the earth. If there is ground current, the shield end of the shield cable away from the instrument side must be grounded through a ceramic capacitance (such as 1 nF 1500V) to inhibit the low frequency ground current and also prevent high frequency interference signals.

Mode of Connection

24VDC two-wire



220V AC Four-wire (Dual Chamber)



Explosion-proof Connection

The explosion-proof form of this product is intrinsically safe and (intrinsically safe + flameproof) composite type. Explosion-proof mark: Exia IICT6/ Exd (ia)ia IICT6. The pulse-type radar level instrument is using aluminum housing, and the electronic components are sealed with glue to ensure that the sparks generated when the circuit fails will not escape. The product is suitable for continuous level measurement of flammable gas media below Exia IICT6/ Exd (ia) ia IIC T6. The safety barrier must be used for power supply when using intrinsically safe instruments. Intrinsic safety parameters: U_i : 28VDC, I_i : 93mA, P_i : 0.65W, C_i : ∞ F, L_i : 0mH. All cables must be shielded cables, and the maximum length from the instrument to the safety barrier is 500m. Distributed capacitance \leq 0.1 μ F/Km, distributed inductance \leq 1mH/Km.

The instrument must be connected to the ground during installation. Do not use other related equipment that has not been tested for explosion protection.

4、 Instrument Debugging

Display/ Debug Module

The display module is a debugging tool, and the instrument is debugged through 4 buttons. The language of the menu can be changed. It is generally used for display after debugging, and the measured value can be read out very clearly through the LCD.

Key 『OK』

- Enter programming state ;
- Confirm programming item ;
- Confirm parameter modification

Key 『+』

- Modify parameter

Key 『▶』

- Select programming item;
- Select edit parameter bit;
- Parameter item content display

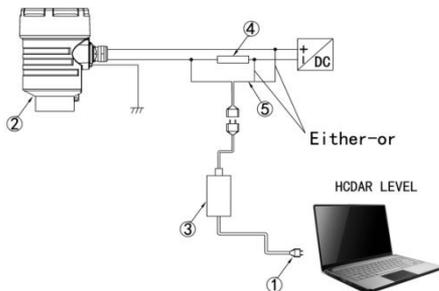
Key 『ESC』

- Exit programming state;
- Back to the previous menu
- Display the echo curve

PC Debugging

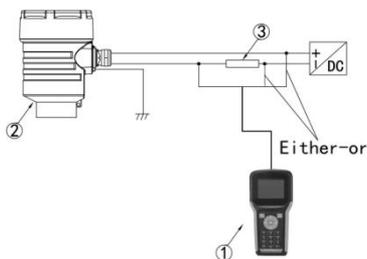
Connect computer via HART device

- 1、RS232 connector/USB connector
- 2、Radar level sensor
- 3、HART adapter
- 4、250Ω resistor
- 5、Transducer
- 6、

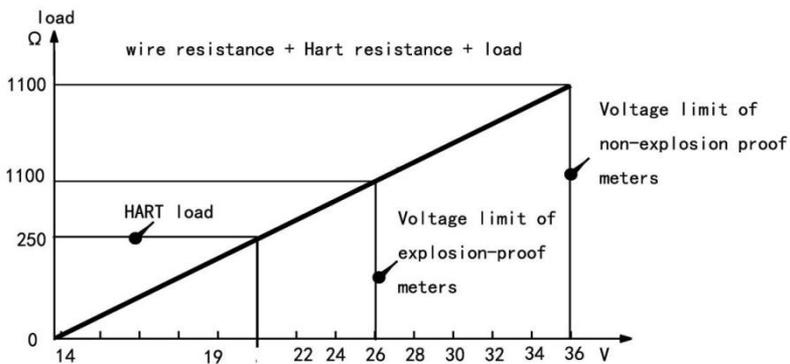


HART handheld programmer for debugging

- 1、HART handheld programmer
- 2、Radar level sensor
- 3、250Ω resistor



Two-wire load resistance relationship diagram



5. Local Operation

5.1 Keyboard description

System provides 5 modes of operation interfaces:

[**Run mode**]: Display system running status and current measurement result.

[**Echo mode**]: Display the real-time measured echo curve.

[**Setup Mode**]: Set various system parameters.

[**Input Mode**]: Input value of parameters, number or character.

The functions of the 4 keys are different under different modes.

5.2 Instructions for measurement interface

Keyboard	Function
ESC	-Switch to echo interface
+	-NULL
▶	-NULL
OK	-Switch to Setup Interface

(1) Real-time data: Real-Time measurement result, which is converted from the distance between sensor and surface of medium.

(2) Unit: It refers to the system measurement unit.

(3) Version no. : the model number of product.

(4) Error code: specified Appendix:Error code.

5.3 Instructions for echo interface

Keyboard	Function
ESC	-Switch to Measurement Interface
+	-NULL
▶	-NULL
OK	-NULL

5.4 Instructions for setup interface

■ Press [OK] to switch from the **Measurement Interface** to the **Setup Interface**.

Keyboard	Features
ESC	-Switch to Measurement Interface/Exit
+	-Move up

▶	-Move down
OK	-Enter

5.5 Basic menu introduction

[Basic] Menu contains the necessary functions for quick start of the level meter, as shown in the following table. After selected the basic, press OK to enter into:

Default position	Parent menu item	Sub menu item
	Min. adjustment	
	Max. adjustment	
	Medium	Liquid/ Solid/ Micro DK
	Damping	0-40s
	Signal threshold	
	Mapping curve	<u>Linear</u>/ Cone
	Scaled units	Height/ m
	Scaling	
	Sensor length	
	Near blanking	
	Sensor tag	

- (1) Min. Adjustment: Equal to cable length or pole length.
- (2) Max. Adjustment: general is 0.
- (3) Medium: choose liquid, solid or micro DK according the real situation.
- (4) Signal threshold: that means signal strength. When the signal is weak in echo curve, it is suggested to adjust lower signal threshold.
- (5) Mapping curve: general set Linear. The relationship between quantities in proportion and in a straight line. For example, error between the distance from product to the surface of the measured object. The error is the same at any position, rather than having a large error before and after, and a small error in the middle.
- (6) Scaled units: generally set height and m.
- (7) Scaling: Just use according to the factory settings.
- (8) Sensor length: the length of product you ordered.
- (9) Near blanking: It will ignore the echo wave which is within the Near blanking when signal algorithm processing, so could use this option to avoid the interference near the sensor.
- (10) Sensor tag: it displays in measurement interface.

5.6 Display menu introduction

Default position	Parent menu item	Sub menu item
	Display value	Shut off/ Distance/ <u>Height</u>/ Percent/ Map percent/ Scaled/ Current
	LCD contrast	

- (1) Display value: generally set height, you can also adjust according to your own needs.
- (2) LCD contrast: you can adjust according to your needs.

5.7 Diagnostics menu introduction

Default position	Parent menu Item	Sub menu item
	Peak values	Distance-min/ Distance-max
	Meas. status	Meas. reliability/ Sensor status
	Choose curve	Echo curve/ False echo curve/ Output trend
	Echo curve	
	Simulation	Percent/ <u>Current</u>/ Distance

- (1) Peak values: it includes distance-min and distance-max.
- (2) Meas. Status: it includes measure reliability and sensor status.
- (3) Choose curve: it includes echo curve, false echo curve and output trend.
- (4) Echo curve: At measurement interface, then press ESC. You can also enter it.
- (5) Simulation: generally choose current to simulate. Current simulation is used to check whether the 4-20mA output loop current is accurate and normal.

5.8 Service menu introduction

[Service] contains the options for inquiring the information about the device itself, as shown in the following table:

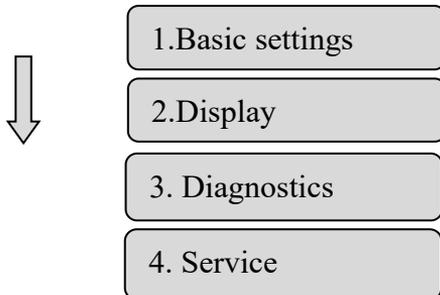
Default position	Parent menu Item	Sub menu item
	False echo memory	

	Current output	Output mode/ Failure mode/ Min current
	Reset	Basic settings/ Factory settings/ Peak values meas
	Units of measurement	m(d)/ ft(d)
	Language	中文/ English/ Italian/ French
	HART operation mode	Standard address 0
	Copy sensor data	
	PIN	
	Distance Adj.	

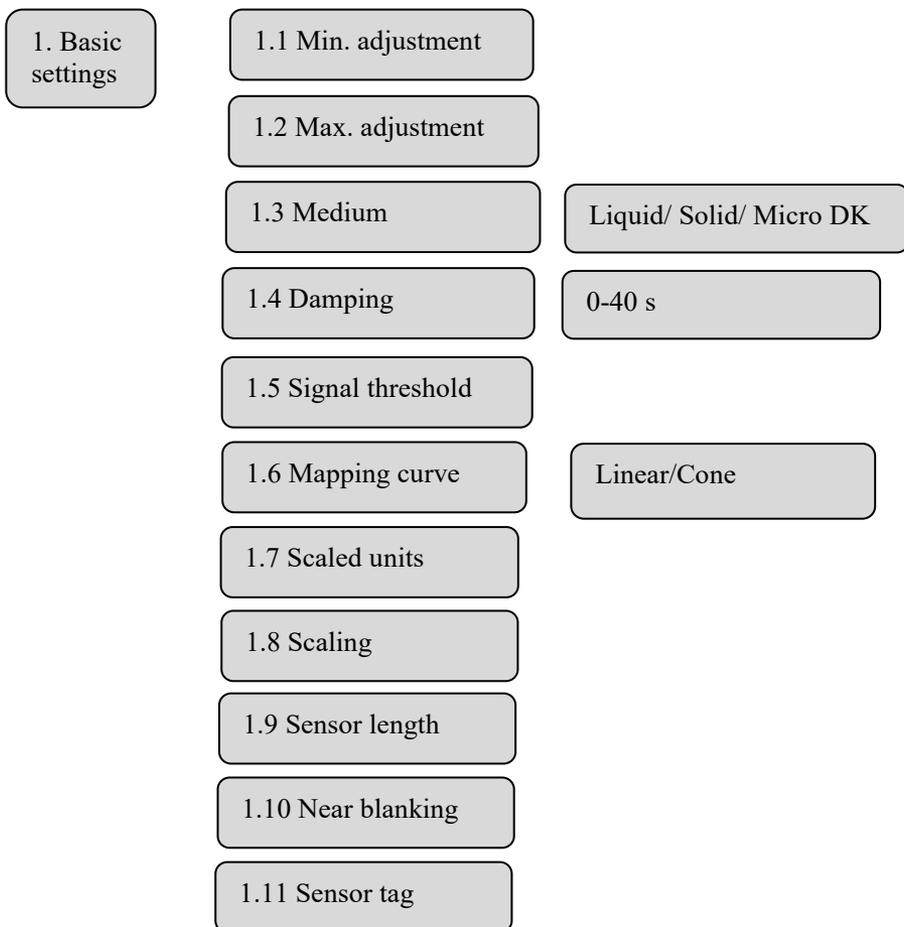
- (1) False echo memory: False echo curve could study the false echo waves including the known obstacles in container. And forming a screening curve for the background noise (threshold curve TVT).
- (2) Current output: it includes Output mode, Failure mode and Min current. Output mode includes 4-20mA and 20-4mA for your selection. Failure mode means that
- (3) when the product is in fault, the output current is the one you choose, such as no change, 20.5mA, 22mA or 4mA. Min current includes 3.9mA and 4mA.
- (4) Reset: It is used to restore the default factory settings of the level meter. The recovery time is about 15s to 20s. After that, LCD will jump to Measurement Interface automatically. It is recommended to used this option when the sensor can't works normally due to improper operations.
- (5) Units of measurement: you can choose m or ft according to your needs.
- (6) Language: it includes Chinese, English, Italian and French.
- (7) HART operation mode: the standard address is 0.
- (8) Copy sensor data: when use the debug app on PC, the set parameters can store in a file.
- (9) PIN: you can set it according to your needs. If you set it, you will input the PIN before change the parameters.
- (10) Distance Adj.:Used to correct the reference point of the sensor. If user wants to input negative value, just move the cursor to the high bit and press + button to input the negative sign and then move to right and input the data. Finally, press OK to confirm.

6. Menu tree

6.1 First-level menu tree view



6.2 Secondary menu tree- Basic settings



6.3 Secondary menu tree- Display

2. Display

2.1 Display value

Shut off/ Distance/ Height/
Percent/ Map percent/ Scaled/
Current

2.2 LCD Contrast

6.4 Secondary menu tree- Diagnostics

3. Diagnostics

3.1 Peak values

Distance-min/ Distance-max

3.2 Meas. status

Meas. Reliability/ Sensor status

3.3 Choose curve

Echo curve/ False echo curve/
Output trend

3.4 Echo curve

3.5 Simulation

Percent/ Current/ Distance

6.5 Secondary menu tree- Service

4. Service

4.1 False echo memory

Delete/ Update/ Create new

4.2 Current output

Output mode/ Failure
mode/ Min current

4.3 Reset

Basic settings/ Factory
settings/ Peak values meas

4.4 Units of measurement

m(d)/ ft(d)

4.5 Language

中文/ English/ Italian/ French

4.6 HART operations mode

Standard Address 0

4.7 Copy sensor data

4.8 PIN

4.9 Distance Adj.

XXX m

7. Appendix: Error code

Error Code	Error Description	Solution
Err11	Abnormal power supply	Use a multimeter to check if the voltage and current at both ends of the product exceed the normal range of use
Err12	Abnormal communication	Check if the wiring between the load resistance (250 ohms) and the product and the upper computer is correct
Err13	Abnormal communication of RS485 MODBUS	Firstly, check whether the positive and negative terminals of the RS485 communication cables are wired according to the instructions, and confirm whether the RS485 to RS232 communication conversion module is working properly. After the hardware connection is correct, confirm whether the RS485MODBUS command sent is correctly sent according to the instruction table.
Err14	No echo found within range	Check the echo curve to confirm if the echo exists. Next, confirm if the product is currently in the blind zone. Also, check if the range matches the actual situation. Finally, confirm if the installation position meets the requirements.
Err15	Device memory storage data read and write errors	Return to factory for repair
Err16	The temperature inside the device exceeds the allowable range	The actual temperature of the electronic has exceeded the range of -40 to 85°C. Please ensure that the product operates within normal temperature range
Err17	Device EEPROM data read and write errors	Return to factory for repair
Err18	System component parameter mismatch	Return to factory for repair

