

FULLKON

INSTRUCTION MANUAL

Preface

Thank you for purchasing the Radar Level Transmitter. Please read this manual carefully before operating and using it correctly to avoid unnecessary losses caused by false operation.

Note

- Modification of this manual's contents will not be notified as a result of some factors, such as function upgrading.
- We try our best to guarantee that the manual content is accurate, if you find something wrong or incorrect, please contact us.
- This product is forbidden to use in explosion-proof occasions.

Version

U-FK-WSR450-EN4

Safety Precautions

In order to use this product safely, be sure to follow the safety precautions described.

About this manual

- Please submit this manual to the operator for reading.
- Please read the operation manual carefully before applying the instrument. On the precondition of full understanding.
- This manual only describes the functions of the product. The company does not guarantee that the product will be suitable for a particular use by the user.

Precautions for protection, safety and modification of this product

- To ensure safe use of this product and the systems it controls, Please read carefully the operation manual and understand the correct application methods before putting into operation, to avoid unnecessary losses due to operation mistakes. If the instrument is operated in other ways not described in the manual, the protections that the instrument give may be destroyed, and the failures and accidents incurred due to violation of precautions shall not be borne by our company.
- When installing lightning protection devices for this product and its control system, or designing and installing separate safety protection circuits for this product and its control system, it needs to be implemented by other devices.
- If you need to replace parts of the product, please use the model specifications specified by the company.
- This product is not intended for use in systems that are directly related to personal safety. Such as nuclear power equipment, equipment using radioactivity, railway systems, aviation equipment, marine equipment, aviation equipment and medical equipment. If applied, it is the responsibility of the user to use additional equipment or systems to ensure personal safety.

-
- Do not modify this product.
 - The following safety signs are used in this manual:



Hazard, if not taken with appropriate precautions, will result in serious personal injury, product damage or major property damage.



Warning: Pay special attention to the important information linked to product or particular part in the operation manual.



- Confirm if the supply voltage is in consistent with the rated voltage before operation.
- Don't use the instrument in a flammable and combustible or steam area.
- To prevent from electric shock, operation mistake, a good grounding protection must be made.
- Thunder prevention engineering facilities must be well managed: the shared grounding network shall be grounded at is-electric level, shielded, wires shall be located rationally, SPD surge protector shall be applied properly.
- Some inner parts may carry high voltage. Do not open the square panel in the front except our company personnel or maintenance personnel acknowledged by our company, to avoid electric shock.
- Cut off electric powers before making any checks, to avoid electric shock.
- Check the condition of the terminal screws regularly. If it is loose, please tighten it before use.
- It is not allowed to disassemble, process, modify or repair the product without authorization, otherwise it may cause abnormal operation, electric shock or fire accident.
- Wipe the product with a dry cotton cloth. Do not use alcohol, benzine or other organic solvents. Prevent all kinds of liquid from splashing on the product. If the product falls into the water, please cut off the power

immediately, otherwise there will be leakage, electric shock or even a fire accident.

- Please check the grounding protection status regularly. Do not operate if you think that the protection measures such as grounding protection and fuses are not perfect.
- Ventilation holes on the product housing must be kept clear to avoid malfunctions due to high temperatures, abnormal operation, shortened life and fire.
- Please strictly follow the instructions in this manual, otherwise the product's protective device may be damaged.



- Don't use the instrument if it is found damaged or deformed at opening of package.
- Prevent dust, wire end, iron fines or other objects from entering the instrument during installation, otherwise, it will cause abnormal movement or failure.
- During operation, to modify configuration, signal output, startup, stop, operation safety shall be fully considered. Operation mistakes may lead to failure and even destruction of the instrument and controlled equipment.
- Each part of the instrument has a certain lifetime, which must be maintained and repaired on a regular basis for long-time use.
- The product shall be scrapped as industrial wastes, to prevent environment pollution.
- When not using this product, be sure to turn off the power switch.
- If you find smoke from the product, smell odor, abnormal noise, etc., please turn off the power switch immediately and contact the company in time.

Disclaimer

- The company does not make any guarantees for the terms outside the scope of this product warranty.
- This company is not responsible for damage to the instrument or loss of parts or unpredictable damage caused directly or indirectly by improper operation of the user.

No.	Name	Quantity	Note
1	82G Radar Level Transmitter	1	
2	Manual	1	
3	Certificate	1	

After opening the box, please confirm the package contents before starting the operation. If you find that the model and quantity are incorrect or there is physical damage in appearance, please contact us.

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Chapter 1 Production Introduction

1.1. Introduction

The series is FMCW radar operating at 76-81 GHz, which has a maximum measuring range of 120m and nearly zero blind zone. It supports 4-wire and 2-wire applications. Higher operating frequency and shorter wavelength make it ideal for solid applications, including those with extreme dust and high temperature. Built-in rich algorithm ensure stable output even in the application with fast agitator.

1.2. The main benefits

- Based on the self-developed CMOS millimeter wave RF chip, a more compact RF architecture, a higher signal-to-noise ratio, and nearly zero blind zone are realized.
- 5GHz working bandwidth means higher measurement resolution and accuracy.
- 3 ° antenna beam angle, so the interference in the environment has less impact on the instrument, and the installation is more convenient.
- Shorter wavelength yields good reflection properties on sloped solids, so aiming towards material angle of repose is usually not necessary.
- Remote debugging and remote upgrading is supported to reduce the cost of field personnel.

1.3. Communication and Programming

Supports 485 modbus protocol (4-wire), TTL serial-port (2-wire) protocol, and hart (2-wire) protocol. It is very easy to install and configure by debug software on PC. Or you can modify the built-in parameters either locally via the push buttons. Or you can use cell phone to control via Bluetooth.

Chapter 2 Technical Parameters

Table 1 Technical Parameters

Measured variable	Level / Distance
Frequency	76GHz ~ 81GHz, 5GHz FMCW bandwidth
Measuring range	0.08m~10m / 0.08m~20m / 0.08m~30m / 0.3 m ~ 60m
Accuracy	Liquid measurement: $\pm 2\text{mm}$ Solid measurement: $\pm 5\text{mm}$
Resolution	Display resolution: 1 mm Distance resolution ^[1] : 3cm
Beam angle	3° / 8°
Minimum measured dielectric constant	≥ 2
Power	(15~28)VDC or 220VAC
Power consumption	$\leq 2\text{W}$
Communication	MODBUS HART/Series
Signal output	(4 ~ 20)mA or RS-485
Fault output	3.8mA, 4mA, 20mA, 21mA, hold
Field operation / programming	128 × 64 dot matrix display / 4 buttons PC software Bluetooth
Humidity	$\leq 95\%\text{RH}$
Enclosure	Aluminum alloy, stainless steel
Antenna type	Lens antenna/anti-corrosive antenna / flange isolated by quartz
Process temperature	T0: -40~80℃; T1: -40~150℃;
Process pressure	(-0.1~2) MPa
Product Size	Ø100*270mm
Cable entry	M20*1.5
Recommended cables	AWG18 or 0.75mm ²
Protection class	IP67
Installation method	Thread or flange
Weight	2.480Kg / 2.995Kg

[1] Note:

Range resolution describes a radar's ability to distinguish between two closely spaced objects.

If the distance between the two objects is smaller than the range resolution of the level radar, the radar will not be able to tell them apart and will instead detect only a single distance value. This detected value does not represent the true distance of either object, but rather a combined result derived from both reflected signals.

For this radar, the **frequency modulation bandwidth (B)** is **5.1 GHz**, which determines its **minimum range resolution**. According to the formula

$$\text{Minimum Range Resolution} = C / (2B),$$

where C denotes the speed of light ($\approx 3 \times 10^8$ m/s), the minimum range resolution is about **3 cm**. In other words, the radar can only distinguish two targets if they are more than 3 cm apart—any closer, and it will treat them as a single object and output a blended distance reading.

Chapter 3 Dimension

3.1. Thread connection

Unit: mm

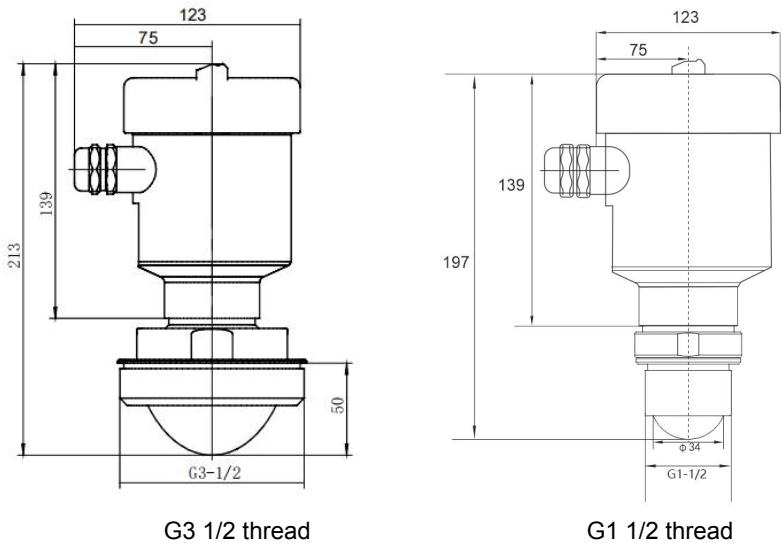


Fig.1 Thread connection with 3°beamwidth (normal temperature)

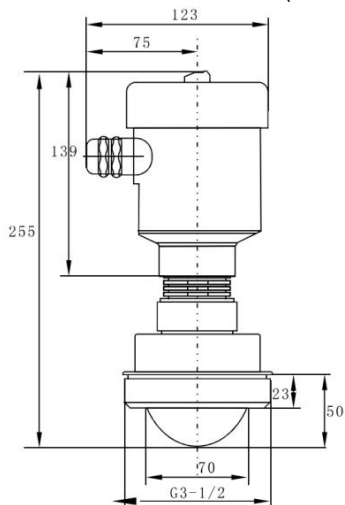
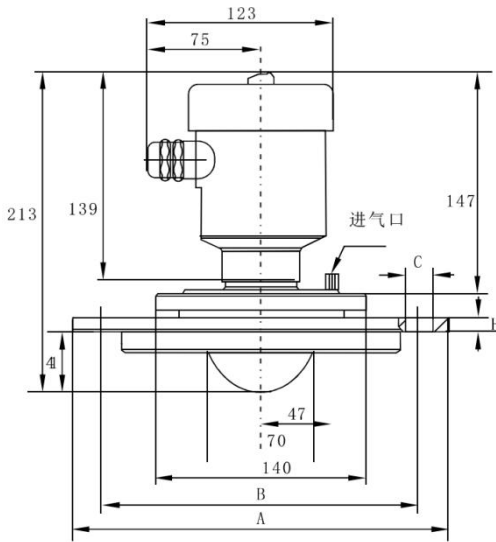


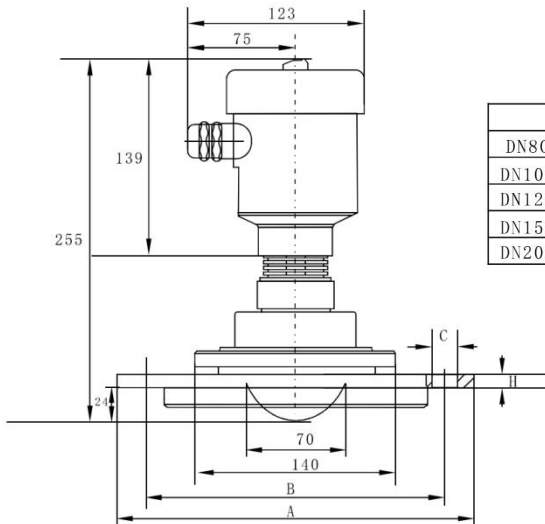
Fig.2 Thread connection with 3°beamwidth (high temperature)

3.2. Universal Type



	A	B	C	H
DN80	φ 200	φ 160	8-φ 18	15
DN100	φ 220	φ 180	8-φ 18	15
DN125	φ 250	φ 210	8-φ 18	17
DN150	φ 285	φ 240	8-φ 18	17
DN200	φ 340	φ 295	8-φ 18	19

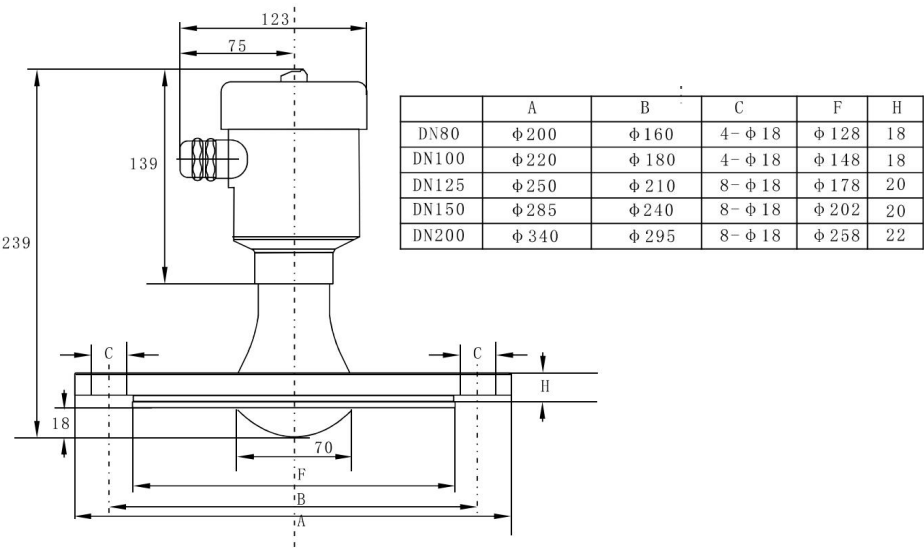
Fig.3 Universal Type (Normal temperature type)



	A	B	C	H
DN80	φ 200	φ 160	4-φ 18	15
DN100	φ 220	φ 180	4-φ 18	15
DN125	φ 250	φ 210	8-φ 18	17
DN150	φ 285	φ 240	8-φ 18	17
DN200	φ 340	φ 295	8-φ 18	19

Fig.4 Universal Type (High temperature type)

3.3. Flange with encapsulated antenna system (normal temperature&press)



Flange with encapsulated antenna system and 3°beamwidth

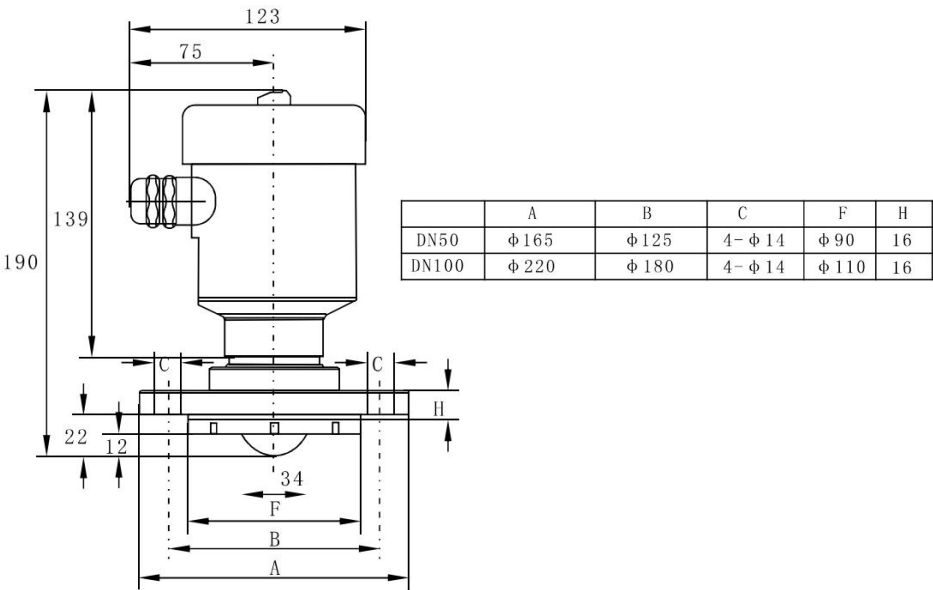
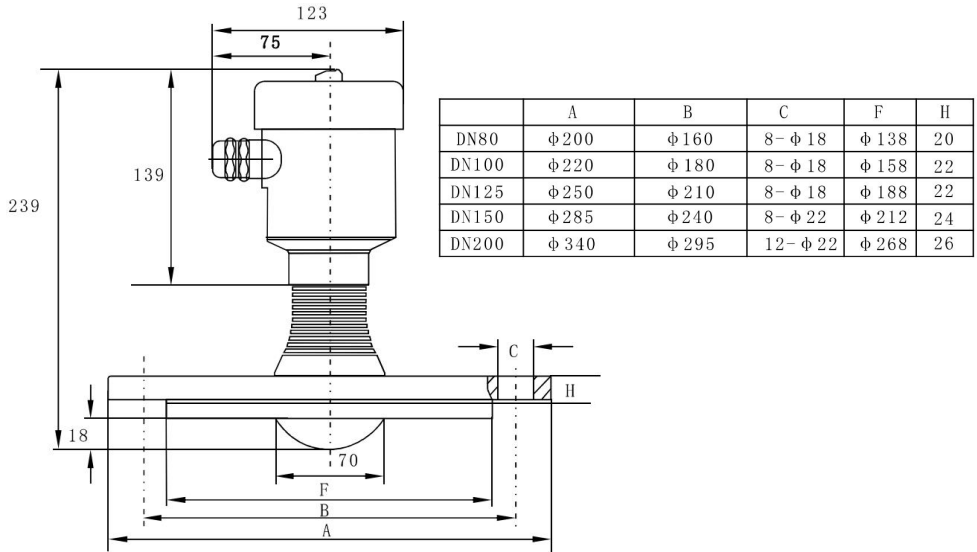


Fig.5 Flange with encapsulated antenna system and 8°beamwidth

3.4. Flange with encapsulated antenna system (high temperature&press)



Flange with encapsulated antenna system and 3° beamwidth

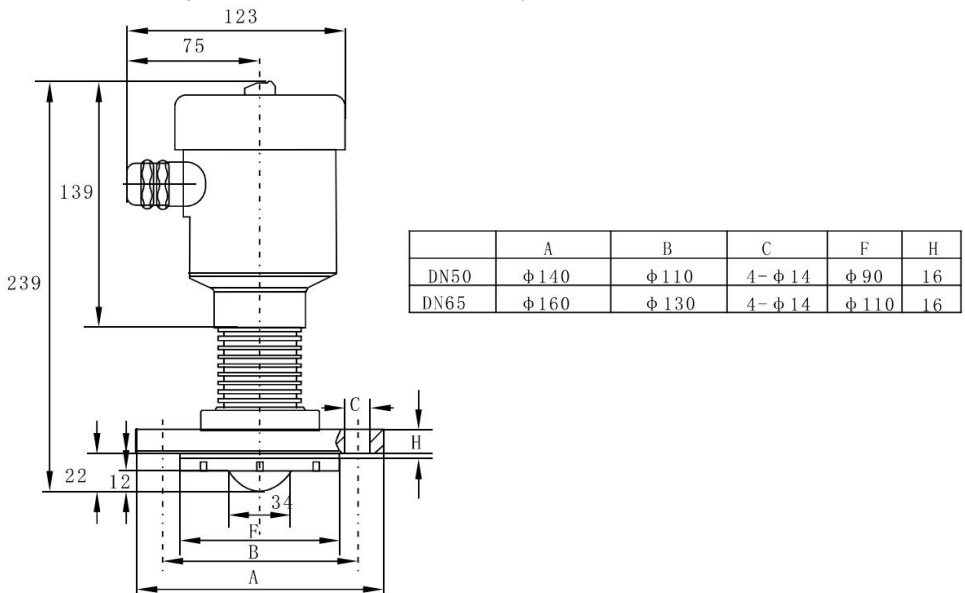


Fig.6 Flange with encapsulated antenna system and 8° beamwidth
(high temperature&press)

Chapter 4 Installation

The main concern of installation is to aim to the material surface under test and on the other hand to avoid false echoes. Typical scenes are list below for correct installation.

- Keep the antenna beam free of any interference such as ladders, pipes, steps, as shown in Fig. 7

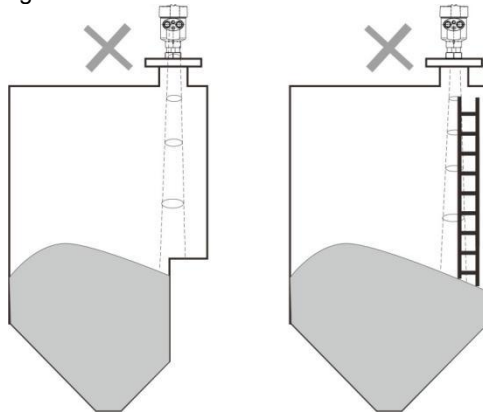


Fig 7 Example for avoiding false echo

- Avoid the contact between antenna beam and feeding flow, as shown in Fig.

8

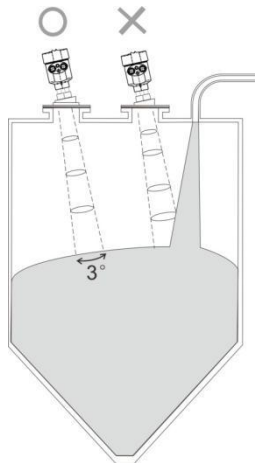


Fig 8 Example for avoiding false echoes

- At least 200mm away from the wall for avoiding false echo.

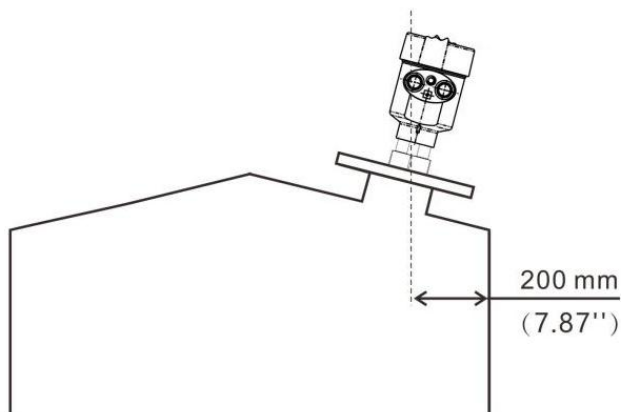


Fig. 9 Example for avoiding false echo

- Aiming the antenna beam to the bottom of tapered vessel for avoiding false echo when the level is at the bottom of the tapered vessel.

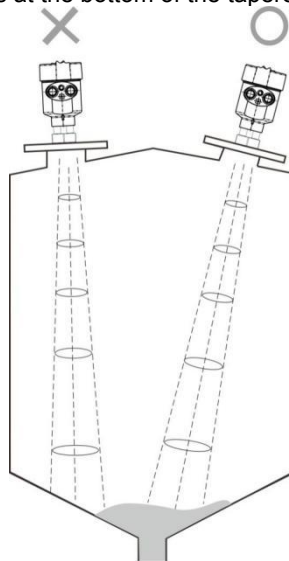


Fig.10 Example for avoiding false echo

Chapter 5 Wiring

5.1. 24VDC power supply

5.1.1. 4-wire product

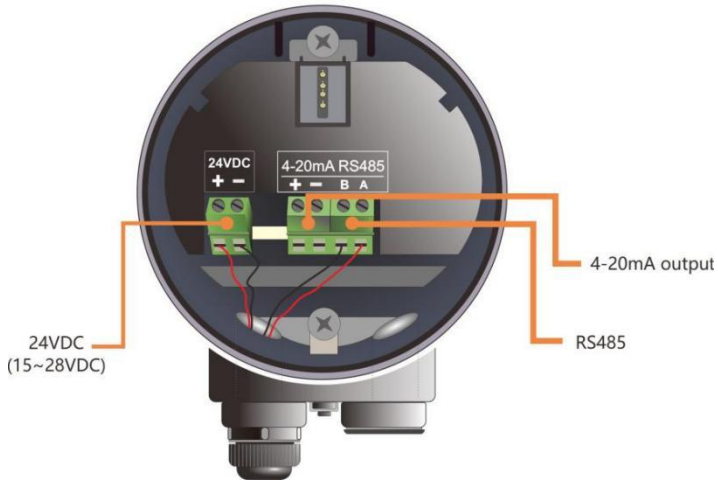


Fig.11 Wiring diagram

5.1.2. 2-wire product

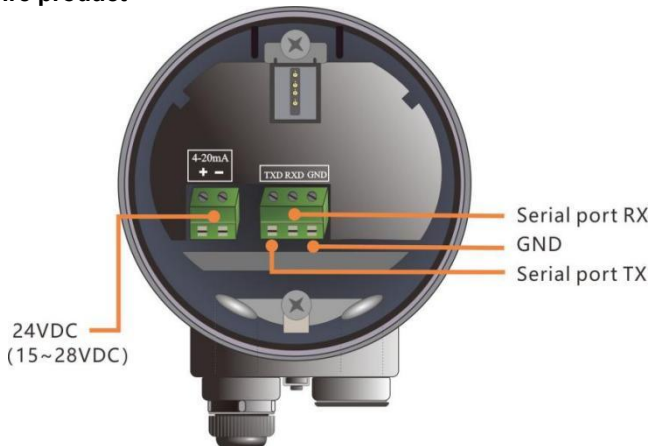


Fig.12 Wiring diagram

5.2. 220VAC power supply

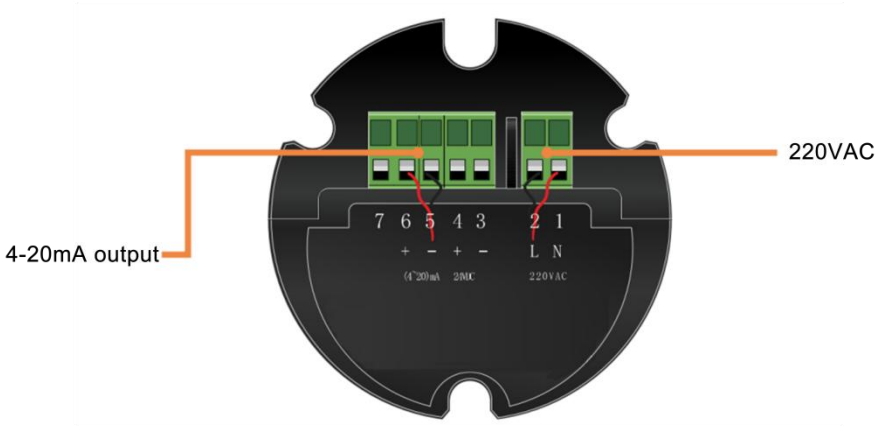


Fig.13 Wiring diagram

Chapter 6 Operation

Carries out its level measurement tasks according to settings, which can be modified locally via the Local Display Module (LDM). LDM consists of an LCD with 4 push buttons.

6.1. Interface Description

LDM has 5 kinds of display interface:

[Main Interface]: Display system running status and current measurement result.

[Echo Interface]: Display the real-time measured echo curve and Time-Vary Threshold (TVT).

[Setup Interface]: Set various system parameters.

[Input Interface]: Take the task of input.

The functions of the 4 keys are different in different display interface.

6.2. Instructions for measurement interface

Measurement Interface is shown below:

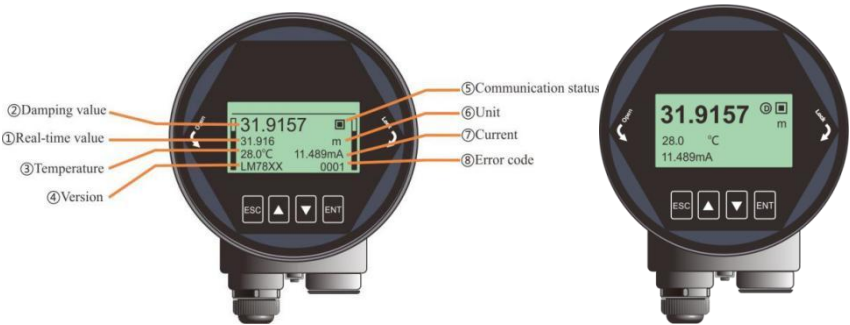


Fig 14 Measurement Interface overview

Table 2 Keys function in Measurement Interface

Keyboard	Features
ESC	-Switch to echo interface
UP	-Parameter overview
DN	-Simplified Main interface
ENT	-Switch to Setup Interface

- (1) It is the Real-Time measurement result, which is converted from the distance information of real-time measurement, corresponding to section 6.5.1.6.
- (2) It is the damping value which is the smooth output of the real-time measurement through the damping filter. See section 6.5.1.5 for details.
- (3) It refers to the temperature of the signal processing board.
- (4) It refers to product model defined in section 1.2.
- (5) It refers to the heartbeat of system communication status. Once a second means that the device is working properly, otherwise the device is abnormal.
- (6) It refers to the system measurement unit, see section 6.4.2 for details.
- (7) It represents the ideal 4-20mA current output value, which is obtained according to the setting of High/ Low Calibration Points and Current function. It should be nearly the same as the real output current. See section 6.5.4 (6-8) for details.
- (8) It is the error code, refer to Error Code for specific meaning.

6.3. Instructions for Echo interface

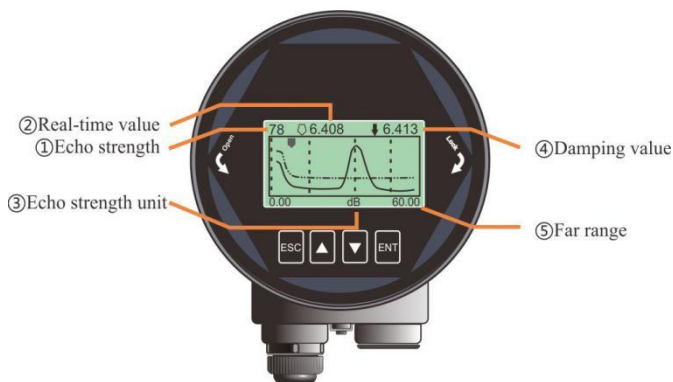


Fig.14 Echo Interface overview

Table 3 Keys function in Echo Interface

Keyboard	Features
ESC	-Switch to Measurement Interface
UP	-No use
DN	-Toggle on/off TVT curve
ENT	-NULL

In **Measurement Interface**, press [ESC] key to enter the **Echo Interface**.

Specially in Echo Interface:

① indicates the maximum echo intensity in the measurement range. For a metal plate at 10m, the echo intensity should be at least 80dB.

③ indicates the echo intensity which is selected by the algorithm. The strength should be at least 30dB for stable operation.

Time Varying Threshold (TVT) and the real-time echo curve are represented in dash line and solid line respectively in Fig6-2. Details for TVT refer to section 6.5.4.10-12.

②Hollow arrow means the real time position and the solid arrow means the damping position. So the hollow one changes faster than the solid one.

6.4. Instructions for Setup interface

- Press [ENT] to switch from the **Measurement Interface** to the **Setup Interface**, as shown in the figure below:



Fig 16 Setup interface overview

Table 4 Keys function in Setup interface

Keyboard	Features
ESC	-Switch to Measurement Interface/Exit
UP	-Move up
DN	-Move down
ENT	-Enter

6.4.1. [Basic]

[Basic] Menu contains the necessary functions for quick start of the level meter, as shown in the following table. The options list is shown in the table below:

Table 5 Menu Item for Basic

Default position	Menu Item
●	Application
	Vessel type
	Material Type / Dielectric Constant
	Low/High Calib.
	Near Range
	Far Range
	Damping
	Sensor mode

6.4.2. [Display]

[Display] Menu contains the necessary functions for setting the system unit. The option list is shown in the following table:

Table 6 Menu Item for display

Default position	Parent menu item	Sub menu item
●	Sensor unit	m/cm/mm/ft/in
	Temperature unit	°C /K
	Language	Chinese/English/Korea
	LCD contrast	

6.4.3. [Diagnostics]

[Diagnostics] Menu contains the necessary functions for historical record of the device. One can review the statistics of current and historical data.

Table 7 Menu Item for Diagnostics

Default position	Menu Item
●	Echo
	False echo curve
	Historical data
	Historical period

Default position	Menu Item
	Historical maximum measurement
	Historical maximum temperature
	Historical Fill rate
	Historical Empty rate

6.4.4. [Advanced]

[Advanced] contains various advanced settings for complicate environment or demand. The option list is shown in the following table:

Table 8 Menu Item for Advanced

Default position	Menu Item
●	False Echo
	Factory.Reset
	Fill/Empty rate
	mA Simulation
	4mA/20mA Setpoint
	mA function
	Bus address
	Sensor offset
	Fail-safe mA
	Fail-safe timer
	Parameter Backup

6.4.5. [Information]

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

Table 9 Menu Item for Information

Default position	Menu Item
●	Model
	S.N.
	Tag

6.5. Menu options

6.5.1. Basic

When the level meter is powered on, LCD enters measurement interface. Press the [ENT] key to enter [Basic] menu.

Note: Default settings indicated with an asterisk (*) unless explicitly stated.

6.5.1.1. Application

Series integrate adaptive algorithm designed for solid and liquid. Corresponding with [Vessel Type] and [Material Type] , One single instrument is enough to cover most of the application. Save your time on choosing.



Fig 17 Application

6.5.1.2. [Vessel Type]

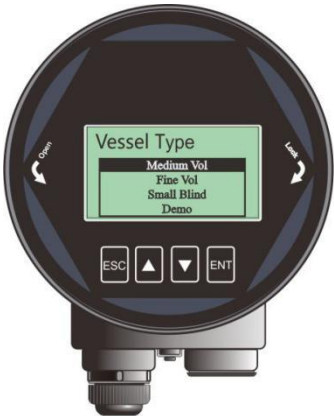


Fig 18 Vessel type overview

[Vessel Type] option has the impact on the radar algorithm based on the table below. Fill/Empty rate, damping time and tracking status are the main factors that would be changed automatically according to [Vessel Type].

Table 10 Details for [Vessel Type]

Parameter name	Vessel type	
Large volume	Filling speed: 0.1m / min Damping time:60s	Filling speed: 0.1m / min Damping time:60s
Medium volume*	Filling speed: 1m / min Damping time:10s	Filling speed: 1m / min Damping time:10s
Fine volume	Filling speed: 10m / min Damping time: 0s	Filling speed: 10m / min Damping time: 0s
Fast Fill(solid app)		Fast fill but slow empty
Agitator(liquid app)		Ripple and fluctuant
Demo	Damping time: 0s	Damping time: 0s

6.5.1.3. [Material Type/Dielectric Constant]



Fig 19 Material type overview

[Material Type] The setting is extremely important in complicate application such as low Dk liquid measurement. It should be selected according to the application.

Table 11 Details for [Material type]

Solid		Liquid
Material type		Dielectric constant
Powder		> 10
Small solid		3-10
Large solid		<3

6.5.1.4. [Low/High calibration point]

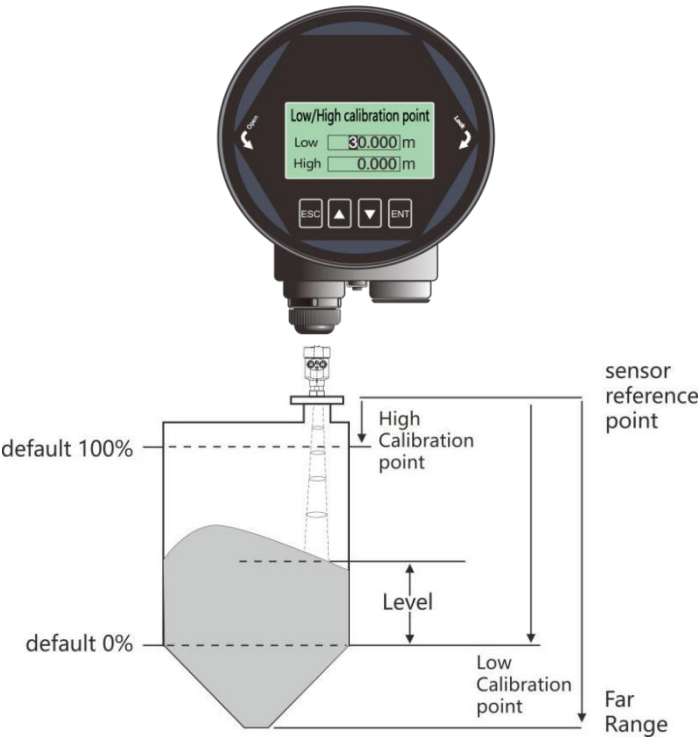


Fig 20 Low calibration point

[Low/High calibration point] maps the corresponding relationship between the measured value and the current output (4-20mA). the detail relationship is shown in the figure above.

For example, the tank is 5m high and level information need to be output. Just input low calibration point=5m, high calibration point=0m.

6.5.1.5. [Near range] and [Far range]

Only the Echoes between the ranges from **[Near Range]** to **[Far Range]** would be considered and has the possibility to be chosen by the algorithm. It exclude the interference echo within the **[Near Range]** and those outside the **[Far Range]**. Reasonable setting is helpful for long term stable running. It should be noticed that these options are not related to the measurement limitation of the instrument, **“Blind zone”** and **“Maximum range”**.

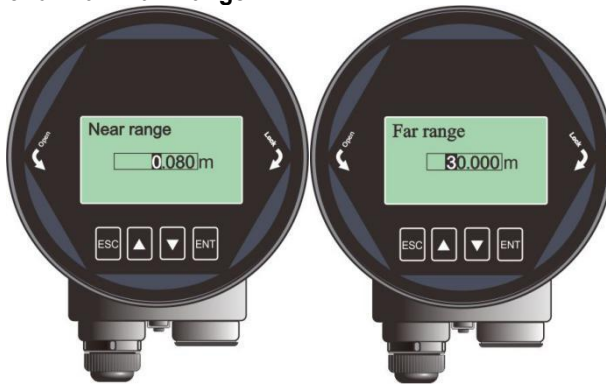


Fig 21 Near range and Far range

6.5.1.6. [Damping]

[Damping] smooths out the response to a sudden change in level. In five time constants, the output rises exponentially: from 63% of the change in the first constant, to almost 100% at the end of the fifth time constant. It is helpful to smooths the historical data curve on DCS. The larger, the smoother.

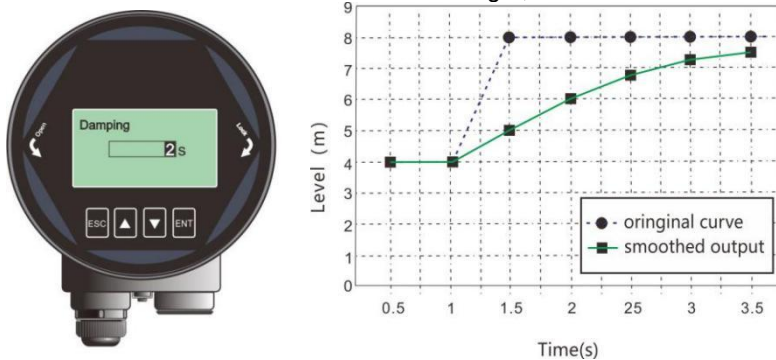


Fig 22 Damping

Table 12 Details for [Damping]

Parameter name	Damping
Parameter range (s)	0~600
Default (s)	60
Related parameters	Null
Option meaning	Smooth out the response to a sudden change in level.
Special matters	Null

6.5.1.7. [Sensor Mode]

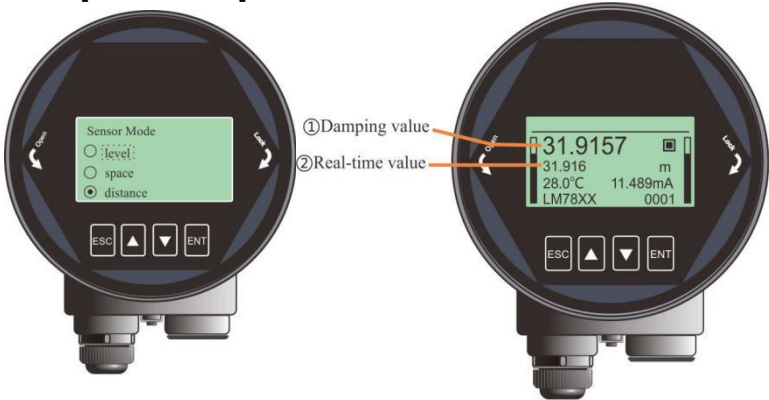


Fig 23 Sensor mode

[Sensor mode] decides the specific display form of the real-time value and damping value. There are three kinds of forms: LEVEL, SPACE and DISTANCE. Detailed definition and calculation method is shown in the table below:

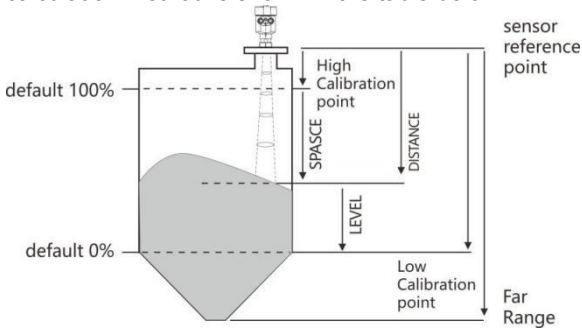


Fig 24 Definition for LEVEL, SPACE, DISTANCE

Table 13 Details for [Sensor mode]

Parameter name	Sensor mode
Default	Distance
Related parameters	Null
Option meaning	Level: Distance from Low Calibration Point to material surface. Space: Distance from High Calibration Point to material surface. Distance: Distance from Sensor Reference Point to material surface.
Special matters	(1)In Distance mode: real-time value = measured distance. (2)In Level mode: Real-time value = [low cal.]-measured distance. If the measured distance is greater than [low cal.], LEVEL=0. (3)In Space mode: Real-time value = measured distance-[high cal.]. If the measured distance is smaller than [high cal.], SPACE=0.

6.5.2. Advanced

6.5.2.1. [False Echo]

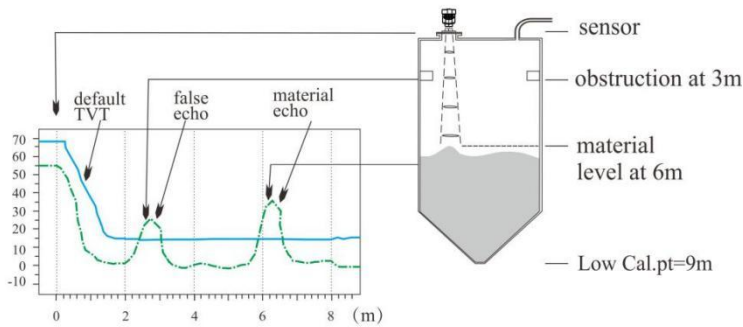


Fig 25 False Echo

[False Echo] is used to form a specific TVT for the current environment with known obstructions or interference, and together with [False echo range] and [False echo mode]. It suppresses the unwanted echoes wherever it appears. Ideally the vessel should be empty or almost empty and thus all the potential false echoes would be learned. And if there is an agitator, it should be running. Example of False Echo

Learning is shown in Fig 6-13. It contains three submenu and the detailed explanation are shown in the table below.

Example before Auto False Echo Suppression



Example after Auto False Echo Suppression

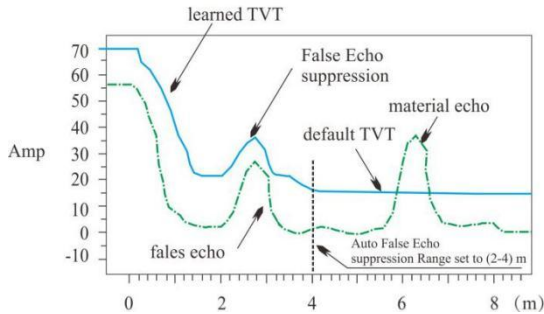


Fig 26 Example of False Echo Learning

Note: A Time Varying Threshold (TVT) hovers above the echo profile to screen out unwanted reflections (false echoes). In most cases the material echo is the only one which rises above the default TVT.

Table 14 Details for False echo mode

	Full range*	Include region	Exclude region
New	false echo is learned from [near range] to [far range]	False echo is learned within 2m ~ 4m and the rest remains the same.	False echo is learned within full range exclude 2~4m and the rest remains the same.
Clear	Clear false echoes learned from [near range] to [far range]	Clear the false echo within 2m ~ 4m and the rest remains the same.	False echo is cleared within full range exclude 2m~4m, the rest remains the same.

6.5.2.2. [Factory 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 **Main Interface** automatically.



Fig 27 Factory reset

6.5.2.3. [Fill/Empty rate]

[Fill/Empty rate] is used to adjust the response rate of the level meter to the increases and the decrease of the actual material level. It need to be set according to the actual situation. There is no need to be so accurate but it should be faster than the real rate. The default setting would be applied as in Section 6.5.1.2 if you don't specify this option. The maximum rate is 300m/min.



Fig 28 Fill/Empty rate

6.5.2.4. [mA simulation]

[mA simulation] is used to check the loop current output accuracy. The loop current will keep the value set by [mA simulation] for testing. Once you exit the interface shown in Fig 6-16, calibration is over and the loop current would be set according to [mA function], which means that the instrument continues the normal measurement.



Fig 29 Current simulation

6.5.2.5. [4mA/20Ma setpoint]

Set the 4mA and 20mA setpoint individually and thus the default corresponding relationship between 4mA/20mA and [low/high cal.] would be discarded as a result. It is not recommended to set this option when just normal level measurement task is carried on.



Fig 30 4mA/20mA setpoint

6.5.2.6. [mA function]

[mA function] decides real-time output loop current according to [4mA/20mA setpoint].

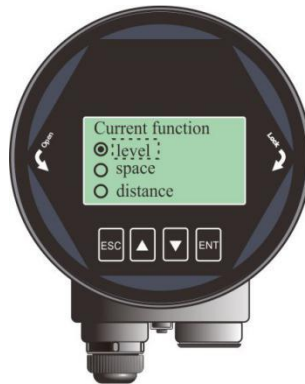


Fig 31 Current function

In different options, 4mA (0%) and 20mA (100%) position is shown in the figure. Choose the option according actual need.

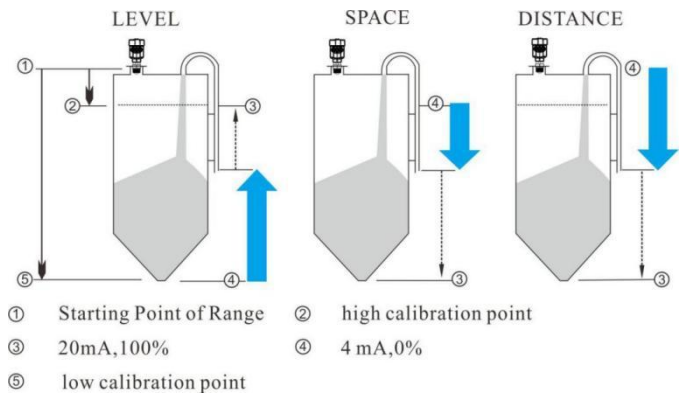


Fig 32 Corresponding relationship between 4/20mA setpoint and low/high calibration point

6.5.2.7. [Bus address]

[Bus Addresses] is used to assigning address for the instrument and guarantee multiple instruments working properly on the bus. Set the bus address according to the corresponding protocol.



Fig 33 Bus address

Table 15 Details for [Bus address]

	(four line type)	(two line type)
Parameter name	Bus address	Hart address
Parameter range	1-247	0-15
Defaults	1	0
Related parameters	Null	Null

	(four line type)	(two line type)
Option meaning	Set the Modbus address.	Set the Hart short address.
Special matters	System will reboot after setting	System will reboot after setting. Output Current will be fixed at 4mA when non-zero values is set.

6.5.2.8. [Sensor Offset]

[Sensor Offset] is used to compensate the shift of sensor reference point according to actual requirement. The default reference point is calibrated to the front end of the lens point “a”. If sensor reference point need to be set to point “b”, just input “h1”; or if it need to be set to point “c”, just input “-h2”. The maximum negative offset is limited $-(Self_offset)$, which is around 0.2m.

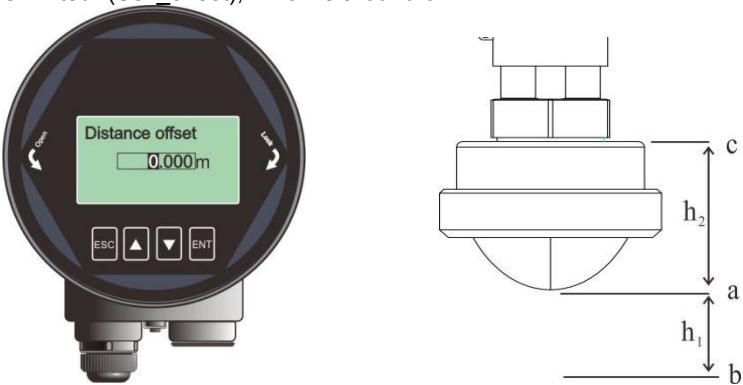


Fig 34 Distance Offset

Table 16 Details for [Distance Offset]

Parameter name	Distance offset
Parameter range (m)	$-(Self_offset) \sim 10m$
Default value (m)	0
Related parameters	Null
Option meaning	Compensate the shift of the sensor reference point.
Special matters	Null

6.5.2.9. [Fail-safe mode]

[Fail-safe mode] is used to set the output current when the level meter encounters the status of lost of echo. The “Keep” option indicates the last valid measured current would be output during this period.



Fig 35 Fail-safe mode

6.5.2.10. [Fail-safe Timer]

It is also known as lost of echo timer (LOE timer). Fail-safe mode would be turned on when [Fail-safe Timer] expires. The default value is 100s and the range is 0-1000s.



Fig 36 Fail-safe timer

6.5.2.11. [Parameter backup]

This option backup all the settings in the current instrument to the memory of the display module. And this display module can be used to configure other instruments on the same type of tank in the same site. “Read” backups all the

setting to the LCD and “Write” send out the parameters to a new instrument.



Fig 37 Parameter backup

6.5.3. Diagnostics

6.5.3.1. [Echo curve]

Refer to [Echo Interface].

6.5.3.2. [False echo curve]

Refer to 6.5.2.1 [False Echo].

6.5.3.3. [Historical data]

According to [Historical period], [Historical data] shows the historical trend of the measurement. The data on the right is newer. The number in the upper left corner shows the maximum peak in the curve and [Historical period] is shown in the upper right corner. Maximum statistical period is 360 hours, i.e. 15 days.



Fig 38 Historical period

6.5.3.4. [Historical period]

[Historical period] sets the time range of [Historical data]. Only even number from 2 to 360 is accepted and the unit is hour.



Fig 39 Historical period

6.5.3.5. [History Maximum Measurement]

[History Maximum Measurement] shows the statistical results of the measured maximum and minimum level since last [Clean]. [Clean] clears the statistical results and then the recording will be restarted.



Fig 40 History Maximum Measurement

6.5.3.6. [Historical Maximum Temperature]

[Historical Maximum Temperature] shows the statistical results of the MCU operating temperature since last [Clean].



Fig 41 History Maximum Temperature

6.5.3.7. [Historical Fill Rate]

[Historical Fill Rate] shows the statistical results of measured maximum and minimum fill rate of the material.



Fig 42 Historical Fill rate

6.5.3.8. [Historical Empty Rate]

[Historical Empty Rate] shows the statistical results of measured maximum and minimum filling rate of the material.



Fig 43 Historical Empty Rate

6.5.4. Display

6.5.4.1. [Sensor unit]

[Sensor Unit] defines the unit of the real-time value and damping value shown in **Measurement Interface**.



Fig 44 Sensor unit

6.5.4.2. [Temperature unit]

[Temperature Unit] defines the unit of temperature shown in **Measurement Interface**.

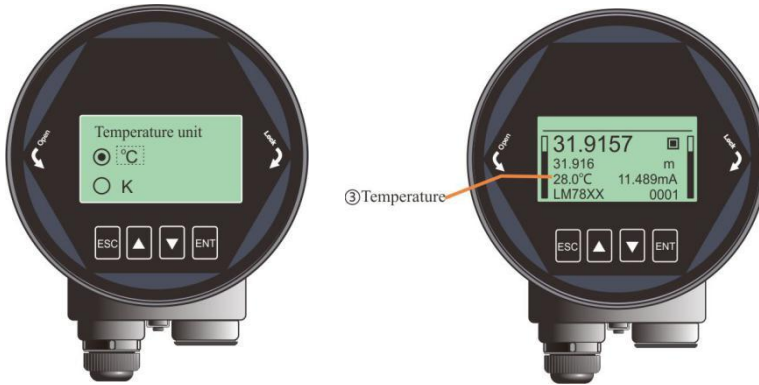


Fig 45 Temperature unit

6.5.4.3. [Language]

[Language] selects the system language to be used on LCD.



Fig 46 Language

6.5.4.4. [LCD contrast]

This option is used to adjust the contrast of LCD.

6.5.5. Information

6.5.5.1. [Model]

[Model] shows the product model which can be set by the debug software on PC.



Fig 47 Sensor model

6.5.5.2. [S.N]

[S. N] indicates the unique number of this instrument.



Fig 48 Serial NO.

6.5.5.3. [Tag]

[Tag] can be used to set the unique identification for each instrument. It contains 16 characters and each character can be set to '0' ~ '9' or 'a' to 'z'.



Fig 49 Tag

6.6.Keyboard input method

This section is to introduce the method of inputting digital number for setup in [Input Interface],

Press [DN] to shift the cursor to the right.



Fig 50 Shift the cursor

- (1) Press [UP] to cycle from 0 to 9.



Fig 51 Cycle from 0 to 9

- (2) Press [ENT] to complete the setting and "OK" will be displayed in the lower right corner of the LCD for 1 second, which means setting is accomplished.



Fig 52 Successful setting

Chapter 7 Menu tree

7.1. First-level menu tree



Fig 53

7.2. Secondary menu tree-basic settings

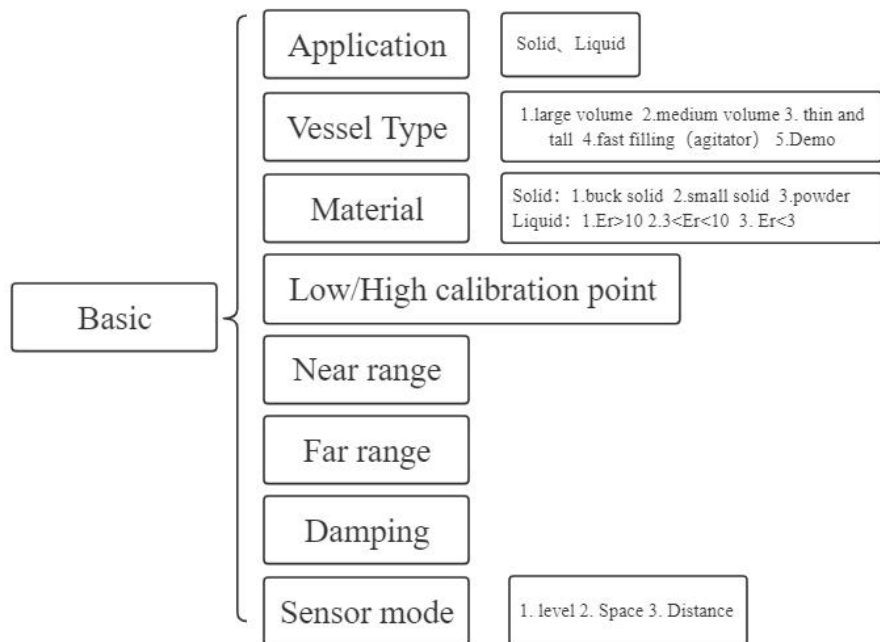


Fig 54

7.3. Secondary menu tree-Advanced

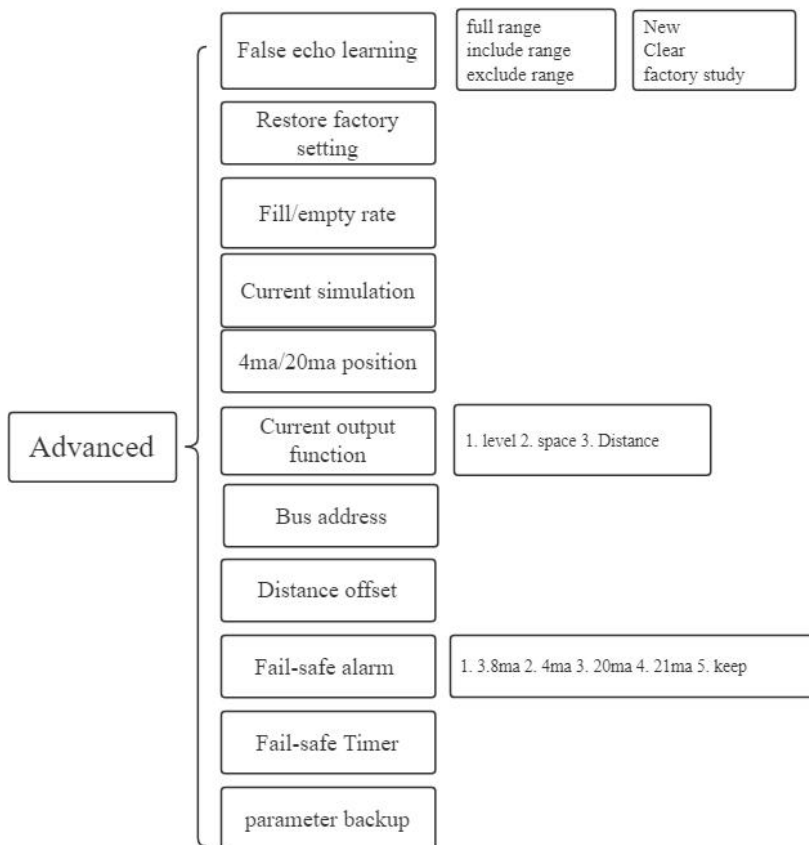


Fig 55

7.4. Secondary menu tree-diagnostics

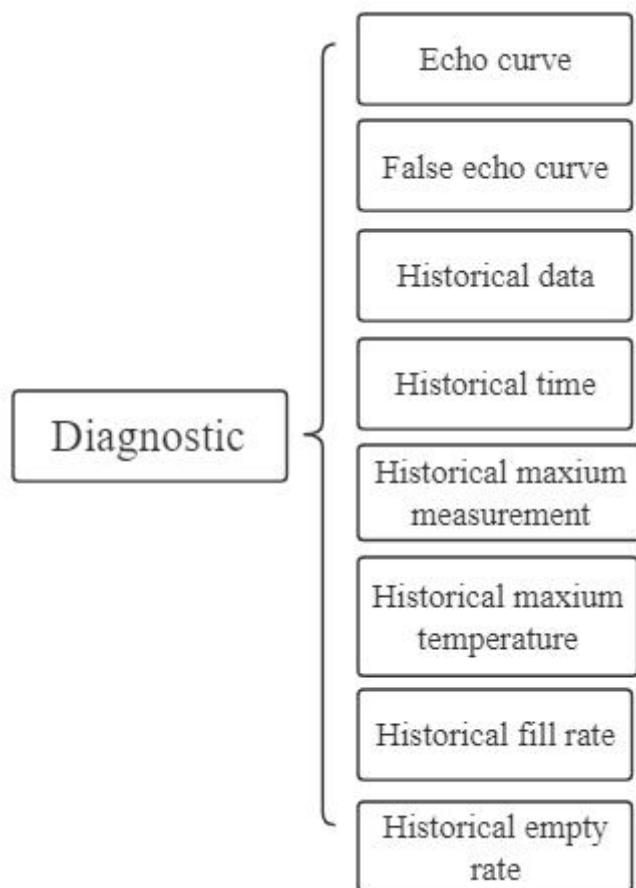


Fig 56

7.5. Secondary menu tree-display

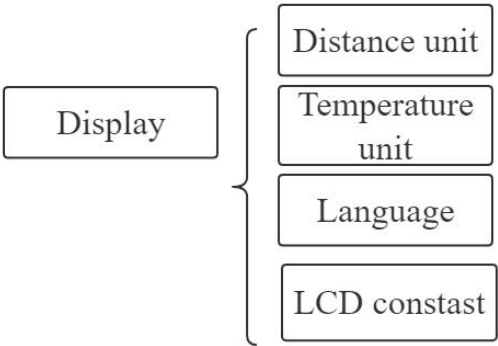


Fig 57

7.6. Secondary menu tree-information

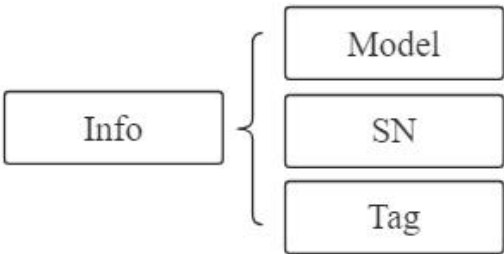


Fig 58

Chapter 8 Error Code

Error code is displayed in the Measurement Interface as shown below



Fig 59 Error code

Table 17 Details for Error code

Index	Binary	Hex	Meaning
1	0000 0000 0000 0000	0000	Work regular
2	0000 0000 0000 0001	0001	Lost echo
3	0000 0000 0000 0010	0002	Communication err with TR
4	0000 0000 0000 0100	0004	No Factory False echo study
5	0000 0000 0000 1000	0008	4-20ma error
6	0000 0000 0001 0000	0010	Current manual output
7	0000 0000 0010 0000	0020	LCD Communication error
8	0000 0000 0100 0000	0040	Connection err with TR
9	0000 0000 1000 0000	0080	MCU Hard fault
10	0000 0001 0000 0000	0100	MCU Hard fault
11	0000 0010 0000 0000	0200	Temperature sensor error
12	0000 0100 0000 0000	0400	MCU Hard fault

Chapter 9 Warranty & After-Sales Service

We guarantee customers that any product quality issues during the warranty period will be covered by our unconditional three-guarantee policy, which includes free repairs, replacements, or returns. Non-customized products can be returned or exchanged within 7 days (excluding products damaged due to misuse), while the warranty terms for customized products are based on the agreements specified in the contract.

Disclaimers:

- During the warranty period, product faults caused by the following reasons are not in the scope of Three Guarantees service
- Product faults caused by improper use by customers.
- Product faults caused by disassembling, repairing and refitting the product.

After-sales service commitment:

- We promise to deal with the customer's technical questions within 2 hours.
- For the instruments returned to the factory for maintenance, we promise to issue the test results within 3 working days and the maintenance results within 7 working days after receiving them.

Chapter 10 Communication

10.1. Communication protocol hardware interface parameters

The radar level meter adopts RS485 (4-wire system) or HART (2-wire system) serial port for external communication, and the default parameters are as follow:

Communication parameters	Level	BAUD (bps)	Parity check	Length (bit)	Stop bit (bit)
Serial port	RS485	9600	无	8	1

10.2. Communication protocol format

The level meter adopts ModBusRTU communication protocol for external communication, and each complete data frame includes address code, function code, data, and packet tail. The end of the packet is the CRC16 checksum data of the data frame, with low bytes before and high bytes after. The factory default address of the level meter radar is 1, and the radar address can be changed through display and control.

The request command format and radar response data format are explained as follows:

(1) Request command format:

Device Address	Function code	Address	CRC
(1 byte)	(1byte)	(4 bytes)	(2 bytes)

(2) Request Command Reply Data Format:

Device Address	Function code	Length	DATA	CRC
(1byte)	(1byte)	(1byte)	(x byte)	(2 bytes)

(3) Format command:

Device Address	Function code	Length	DATA	CRC	Device Address
(1byte)	(1byte)	(4 bytes)	(1byte)	(x byte)	(2 bytes)

(4) Format command reply data:

Device Address	Function code	Address	CRC
(1 byte)	(1byte)	(4 bytes)	(2 bytes)

10.3. Communication Protocol Command Description**10.3.1. Data Query Command****(1) Radar communication test command**

Request command:

Device Address	Function code	Address	CRC
0x01 (default)	0x66	0xAA 55 00 01	0xF9 CA

Response Data:

Device Address	Function code	Length	DATA	CRC
0x01	0x66	0x02	0x00 00	0xA6 88

Explanation: Upon receiving a response, communication is considered normal.

(2) Measurement value (with damping) query command

Request command:

Device Address	Function code	Address	CRC
0x01 (default)	0x04	0x0A 0F 00 02	0x42 10

Response Data:

Device Address	Function code	Length	DATA	CRC
0x01	0x04	0x04	0xFF FF FF FF	0xFF FF

Description: The measured value is Float type data, with a unit of meters and a data length value of 4. The data format is low 16 bit data first and high 16 bit data last. The representative meaning of the measured value is determined based on

the sensor mode.

(3) Measurement value (without damping) query command

Request command:

Device Address	Function code	Address	CRC
0x01 (default)	0x04	0x0A 11 00 02	0x22 16

Response Data :

Device Address	Function code	Length	DATA	CRC
0x01	0x04	0x04	0xXX XX XX XX	0xXX XX

Description: The measured value is Float type data, with a unit of meters and a data length value of 4. The data format is low 16 bit data first and high 16 bit data last. The representative meaning of the measured value is determined based on the sensor mode.

(4) Sensor Mode Command

Request command:

Device address	Function code	Address	CRC
0x01 (default)	0x03	0x20 0A 00 01	0xAF C8

Response Data :

Device address	Function code	Length	DATA	CRC
0x01	0x03	0x02	0xXX XX	0xXX XX

Description: The data value represents the radar sensor mode setting, and the data definition is: 0-level mode 1-air height mode; 2-Distance mode.

(5) High order adjustment query command

Request command:

Device address	Function code	Address	CRC
0x01 (default)	0x03	0x20 4A 00 02	0xEE 1D

Response Data:

Device address	Function code	Length	DATA	CRC
0x01	0x03	0x04	0xFF FF FF FF	0xFF FF

Explanation: The data value is Float type data, with a unit of meters and a data length value of 4. The data format is low 16 bit data first and high 16 bit data last.

(6) Low adjustment query command

Request command:

Device address	Function code	Address	CRC
0x01 (default)	0x03	0x20 48 00 02	0x4F DD

Response Data:

Device address	Function code	Length	DATA	CRC
0x01	0x03	0x04	0xFF FF FF FF	0xFF FF

Explanation: The data value is Float type data, with a unit of meters and a data length value of 4. The data format is low 16 bit data first and high 16 bit data last.

(7) Blind Area Query Command

Request command:

Device address	Function code	Address	CRC
0x01 (default)	0x03	0x20 44 00 02	0x8F DE

Response Data :

Device address	Function code	Length	DATA	CRC
0x01	0x03	0x04	0xXX XX XX XX	0xXX XX

Explanation: The data value is Float type data, with a unit of meters and a data length value of 4. The data format is low 16 bit data first and high 16 bit data last.

(8) Slave address reading

Set command:

Device address	Function code	Address	CRC
0x01 (default)	0x03	0x20 01 00 01	0XX XX

Response Data :

Device address	Function code	Length	DATA	CRC
0x01	0x03	0x02	0xXX XX	0xXX XX

Description: The data length is 2 bytes, and the data definition: the low 8 bits represent the modbus address; The high 8 bits represent the hard address.

10.3.2. Data Setting Command

(1) High adjustment setting

Set command:

Device address	Function code	Address	Length	DATA	CRC
0x01 (default)	0x10	0x20 4A 00 02	0x04	0xXX XX	0xXX XX

Response Data :

Device address	Function code	Address	CRC
0x01	0x10	0x20 4A 00 02	0xXX XX

Explanation: The data value is Float type data, with a unit of meters and a data

length value of 4 bytes. The data format is low 16 bit data first and high 16 bit data last.

(2) Low adjustment setting

Set command:

Device address	Function code	Address	Length	DATA	CRC
0x01 (default)	0x10	0x20 48 00 02	0x04	0xXX XX	0xXX XX

Response Data:

Device address	Function code	Address	CRC
0x01	0x10	0x20 48 00 02	0xXX XX

Explanation: The data value is Float type data, with a unit of meters and a data length value of 4 bytes. The data format is low 16 bit data first and high 16 bit data last.

(3) Blind area setting

Set command:

Device address	Function code	Address	Length	DATA	CRC
0x01 (default)	0x10	0x20 44 00 02	0x04	0xXX XX	0xXX XX

Response Data:

Device address	Function code	Address	CRC
0x01	0x10	0x20 44 00 02	0xXX XX

Explanation: The data value is Float type data, with a unit of meters and a data length value of 4 bytes. The data format is low 16 bit data first and high 16 bit data last.

(4) Distance unit setting

Set command:

Device address	Function code	Address	Length	DATA	CRC
0x01 (default)	0x10	0x20 09 00 01	0x02	0xXX XX	0xXX XX

Response Data:

Device address	Function code	Address	CRC
0x01	0x10	0x20 09 00 01	0xXX XX

Description: Data length 2 bytes, data definition: 0-m; 1-cm; 2-mm; 3-foot; 4-inch.

(5) Slave address setting

Set command:

Device address	Function code	Address	Length	DATA	CRC
0x01 (Default)	0x10	0x20 01 00 01	0x02	0xXX XX	0xXX XX

Response Data:

Device address	Function code	Address	CRC
0x01	0x10	0x20 01 00 01	0xXX XX

Description: The data length is 2 bytes, and the data definition: the low 8 bits represent the modbus address; The high 8 bits represent the hard address.