

76-81GHz FMCW Radar Level Meter Operating Instructions

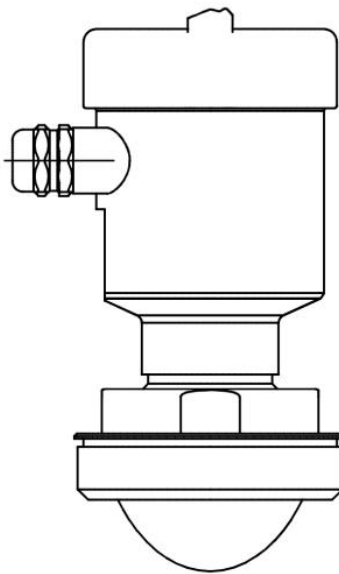


Table of Contents

1. Product introduction	3
1.1 Features	3
2. Technical specifications	4
Dimensions	5
4. Installation	12
5. Wiring	15
5.1 4-wire product with 24 VDC supply in single cavity housing	15
5.2 2-wire product with 24 VDC supply in single cavity housing	15
6. Local operation	17
6.1 Interfaces description	17
6.2 Main interface description	17
6.3 Echo interface description	18
6.4 Setup interface description	20
6.4.1 Basic	20
6.4.2 Advanced	21
6.4.3 Diagnostics	21
6.4.4 Display	21
6.4.5 Information	22
6.5 Menu operating instructions	23
6.5.1 Basic	23
6.5.2 Advanced	28
6.5.3 Diagnostics	38
6.5.4 Display	41
6.5.5 Information	43
6.6 Keyboard	45
7. Menu tree	47
7.1 First-level menu tree	47
7.2 Secondary menu tree-basic settings	47
7.3 Secondary menu tree-Advanced	48
7.4 Secondary menu tree-diagnostics	49
7.5 Secondary menu tree-display	49
7.6 Secondary menu tree-information	50
8. Problem diagnosis	51
9. Software version history	52
10. Error Code	53
11. Glossary	54

1. Product introduction

1.1 Features

The 80GHz radar level meter series of products are the Frequency Modulated Continuous Wave (FMCW) radar products operating at 76 - 81 GHz and supporting both 4-wire and 2-wire applications. The products are available in several models with the measuring range up to 120m.

The key benefits are described as follows:

- A more compact RF architecture, a higher signal-to-noise ratio, and a smaller blind zone are realized based on the self-developed Complementary Metal-Oxide-Semiconductor (CMOS) millimeter wave Radio Frequency (RF) chip.
- No fear of attenuation of radar echoes by vapour and dust.
- Stable measurements for substances with weak reflective properties or low dielectric constants.
- 5GHz working bandwidth allowing for higher measurement resolution and accuracy.
- A minimum antenna beam angle of 3°. The interference in the installation environment has less impact on the instrument, making it easier to install and more suitable for mixing conditions.
- Shorter wavelength. It yields better reflection properties on solid surfaces, and it significantly reduces the reliance on universal flanges.
- Support for remote setting up and remote upgrade. It reduces waiting time and increases work efficiency.
- Support for Bluetooth setting up on mobile phones for easy maintenance by field personnel.

Communication and setting up

You can set up the instrument on site via the LCD or on the PC via the software. You can achieve the communication between the 80GHz radar level meter series of products and the PC through the following ways:

- USB to RS485 serial cable in 4-wire system.
- USB to TTL serial cable in 2-wire system.
- USB to Hart-modem in 2-wire system.
- Set up via Bluetooth on mobile phones. It makes on-site setting up safer and more convenient.
- 4G network for remote setting up via remote modules.

2. Technical specifications

Table 2-1. Technical specifications

Transmitting frequency	76GHz ~ 81GHz
Measurement range*	10m; 20m; 30m; 60m; 120m
Measurement accuracy	± 1mm
Measurement interval	Up to 100ms
Beam angle	3°/8°/20°
Dielectric constant	≥2
Supply range	12 ~ 28.0 VDC
Communication	MODBUS; HART
Signal output	4 ~ 20mA or RS-485
Fault output	3.8mA, 4mA, 20mA, 21mA, hold
Field operation and programming	128 × 64 dot matrix display/4 keys; configurable software for PC setup
Process temperature and humidity	T0: -40~85°C/humidity≤95%RH; T1: -40~200°C; T2:-40~500°C; T3:-40~1000°C
Housing material	Aluminum alloy, stainless steel
Process connection type	Pipe threads/universal flanges/anti-corrosion flanges/sanitary chucks/quartz isolation flanges
Process pressure	-0.1 ~ 2MPa
Product size	Ø100*270mm
Cable entry	M20*1.5
Recommended cables	AWG18 or 0.75mm ²
Protection grade	IP67
Explosion-proof grade	Ex-ia-IIC-T6
Installation method	Threaded or flanged
Net weight	2.480Kg
Gross weight	2.995Kg
Packaging box size	370*270*180mm

Note: The measurement blind spot depends on the antenna selected and the reflective properties of the object to be measured. Laboratory blind spot tests are based on water or metal plates.

3. Dimensions

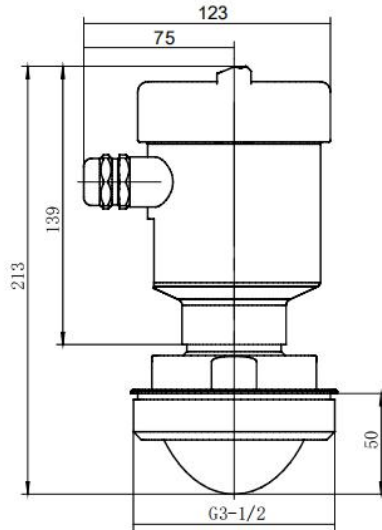


Figure 3-1. Thread connection with 3° beam angle in normal temperature

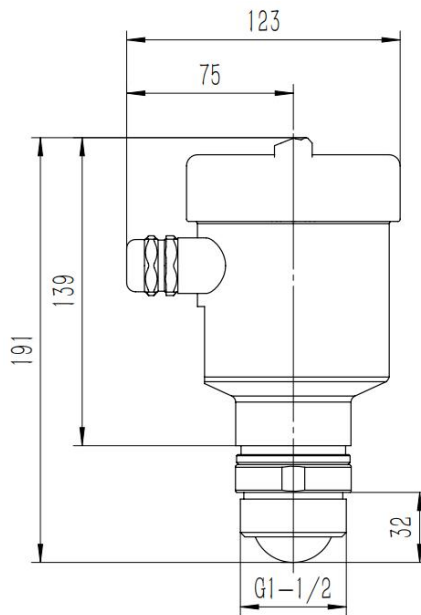
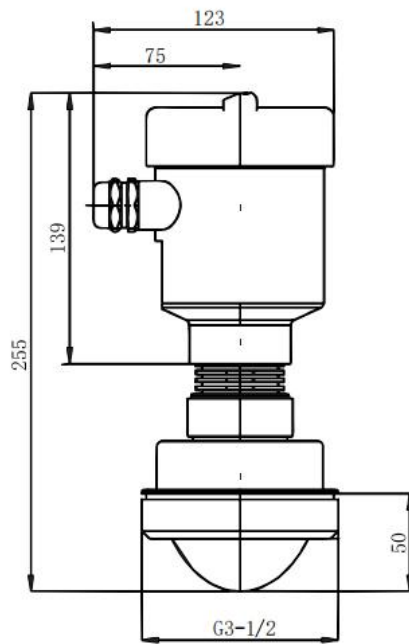
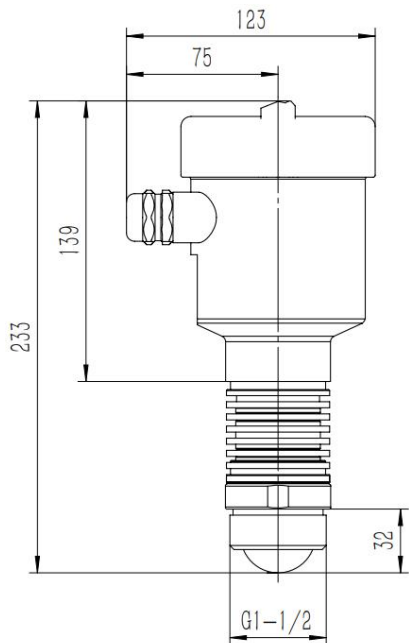


Figure 3-2. Thread connection with 8° beam angle in normal temperature



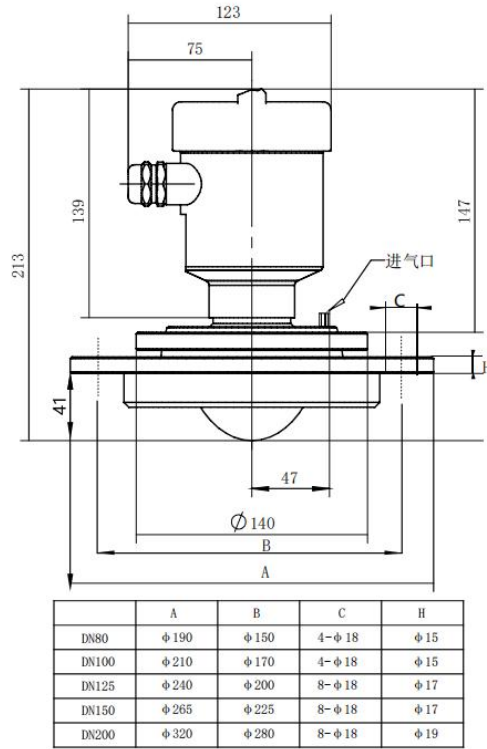
Note: This model requires a high temperature version of the electronic module.

Figure 3-3. Thread connection with 3° beam angle in -40 ~ 200°C



Note: This model requires a high temperature version of the electronic module.

Figure 3-4. Thread connection with 8° beam angle in -40 ~ 200°C



Note: The minimum of universal flange is DN80.

Figure 3-5. Universal flange with 3° beam angle in normal temperature

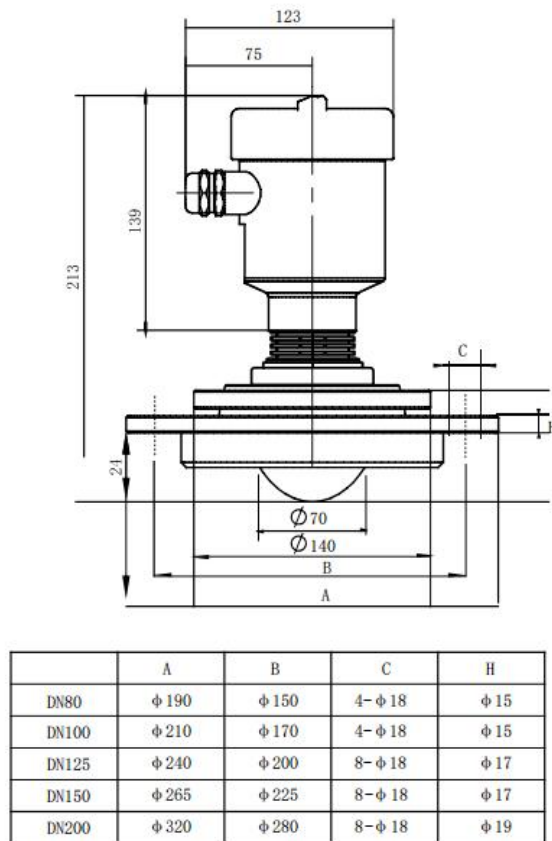


Figure 3-6. Universal flange with 3° beam angle in -40 ~ 200°C

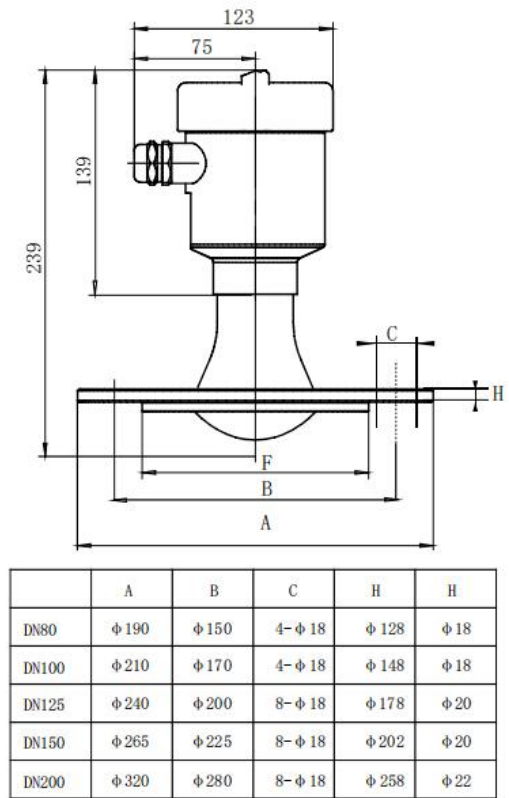


Figure 3-7. Anti-corrosion flange with 3° beam angle in normal temperature

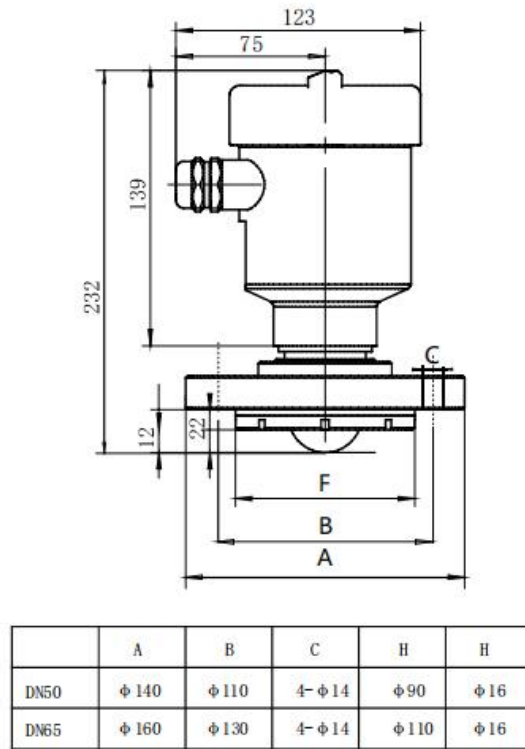


Figure 3-8. Anti-corrosion flange with 8° beam angle in normal temperature

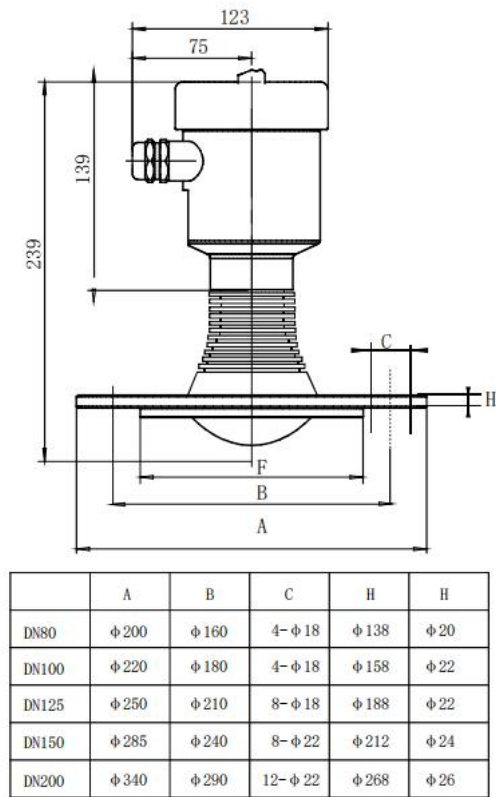
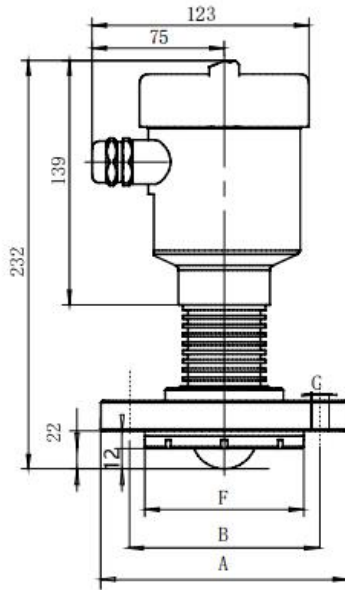


Figure 3-9. Anti-corrosion flange with 3° beam angle in -40 ~ 200°C



	A	B	C	H	H
DN50	φ 140	φ 110	4-φ 14	φ 90	φ 16
DN65	φ 160	φ 130	4-φ 14	φ 110	φ 16

Note: The DN50 and DN65 model requires a high temperature version of the electronic module.

Figure 3-10. Anti-corrosion flange with 8° beam angle in -40 ~ 200°C

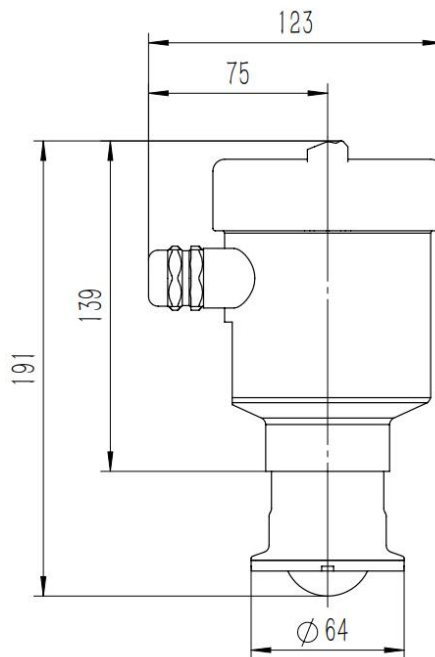


Figure 3-11. Sanitary chuck construction

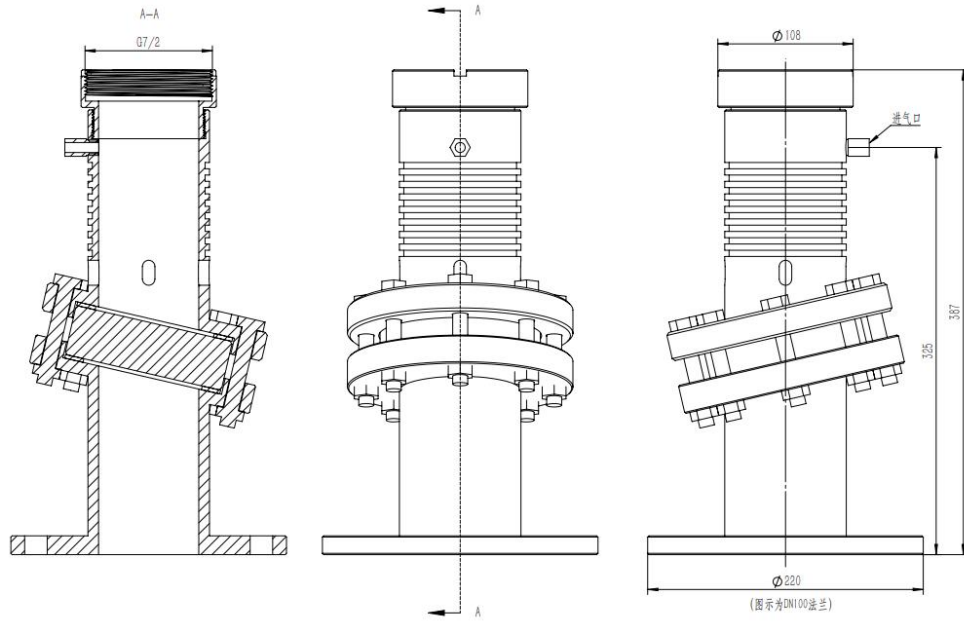


Figure 3-12. Insulation flange in $-40 \sim 1000^{\circ}\text{C}$

4. Installation

Pay attention to the following points during installation:

- For liquid applications, try to ensure that the mounting flange is parallel to the liquid surface so that the transmitted electromagnetic wave is incident perpendicular to the liquid surface.
- For solid applications, you can suitably relax the installation angle. If the material accumulation angle is relatively large and the blind spot that is required to measure is relatively small, it is recommended to use a universal structure to adjust the transmitting direction to be nearly vertical to the inclined material surface.

During installing, try to avoid interfering objects within the radar beam range, such as mixing blades, protrusions and other objects. Interfering objects can easily generate interference signals and affect the normal operation of the radar.

See below for typical working conditions:

- Keep the antenna beam range free of any interference, such as ladders and steps:

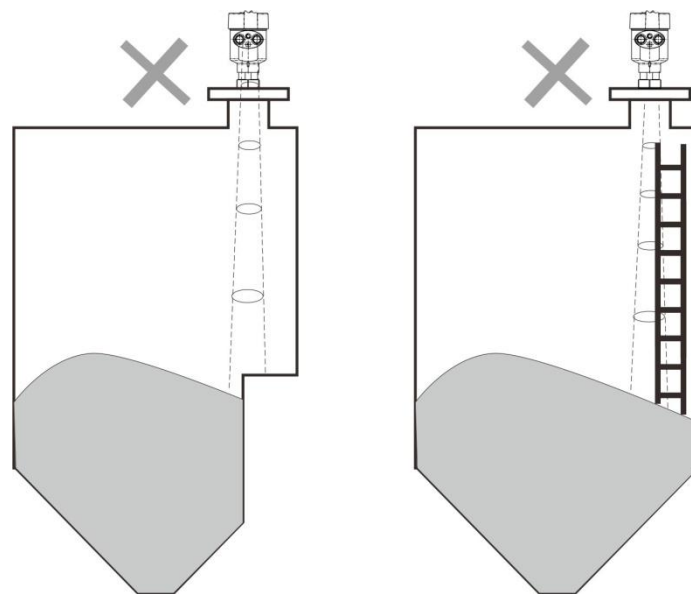


Figure 4-1. Installation position of the instrument

- Avoid the contact between antenna beam and feeding inlet:

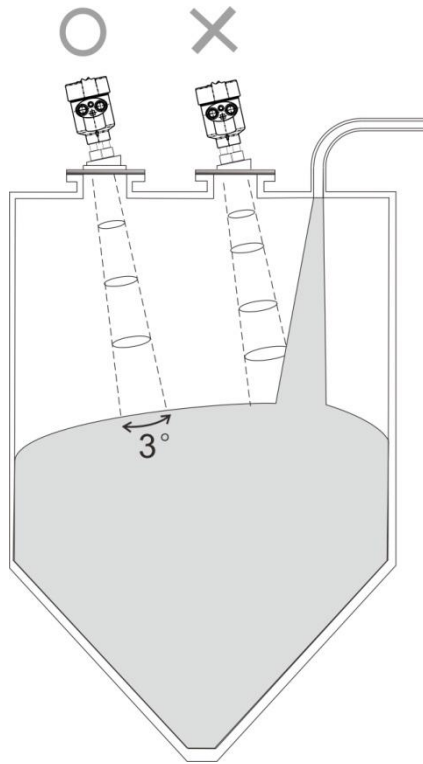


Figure 4-2. Antenna beam avoiding the feeding inlet

- At least 20cm away from the vessel wall when mounting to avoid incorrect readings:

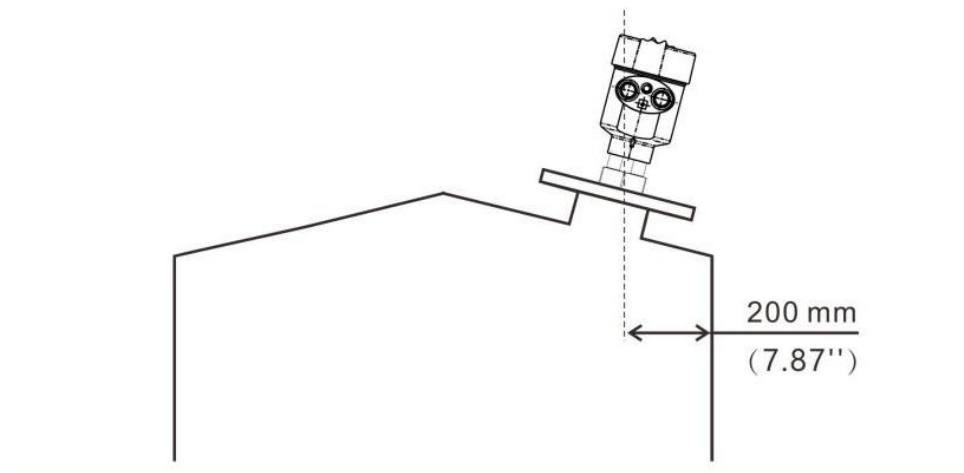


Figure 4-3. Mounting at least 20cm from the vessel wall

- Conical vessels that wish to monitor the complete loading and unloading process require the use of a gimballed flange to ensure that the beam is directed to the bottom of the vessel as far as possible, otherwise measurements at the bottom of the vessel may be inaccurate, as shown in Figure 4-4. If the bottom material level is negligible, there is no need to use a gimballed structure.

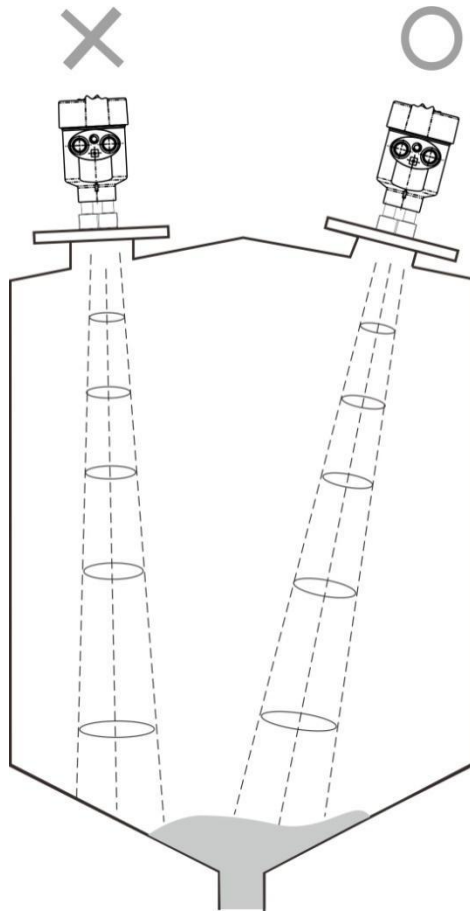


Figure 4-4. Ensuring the beam is directed to the bottom of the vessel

5. Wiring

5.1 4-wire product with 24 VDC supply in single cavity housing

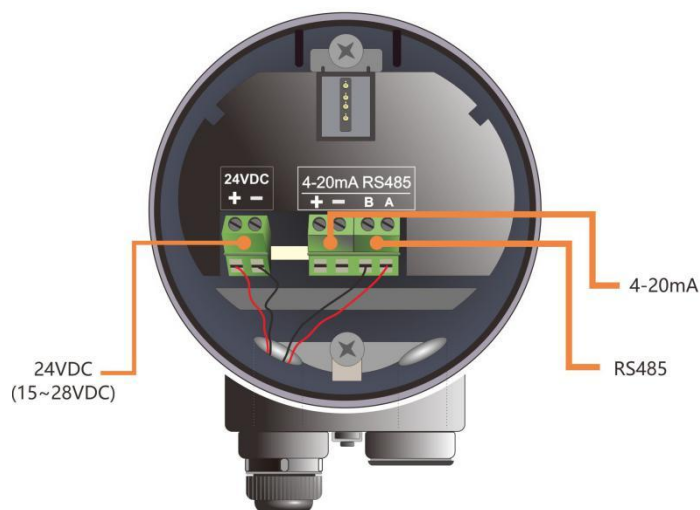


Figure 5-1. 4-wire product wiring diagram

In 4-wire applications, the 4-20mA analog output is 2 separate terminals, in addition to the 24v supply terminal. The 4-wire system also provides a 485 output terminal to connect to a PC for setting up or for sites where a 485 interface is required.

5.2 2-wire product with 24 VDC supply in single cavity housing



Figure 5-2. 2-wire product wiring diagram

In 2-wire applications, in addition to the traditional 4-20mA output supply terminals, the instrument also has a serial communication terminal to connect to the current mainstream IOT devices or pass-through devices for remote control and setting up.

6. Local operation

The 80 GHz radar level meter series of products perform level or liquid measurement tasks according to the settings. You can modify locally via the Local Display Module (LDM). LDM consists of 4 keys and a 128*64 dot matrix LCD.

6.1 Interfaces description

LDM offers 4 interface modes. The 4 keys in different interface modes have different functions.

- **Main interface** displays system running status and current measurement result.
- **Echo interface** displays the real-time measured echo of the system.
- **Setup interface** sets various data parameters for system operation.
- **Input interface** enters the values, numbers or characters of parameters.

6.2 Main interface description

Figure 6-1 shows the main interface:

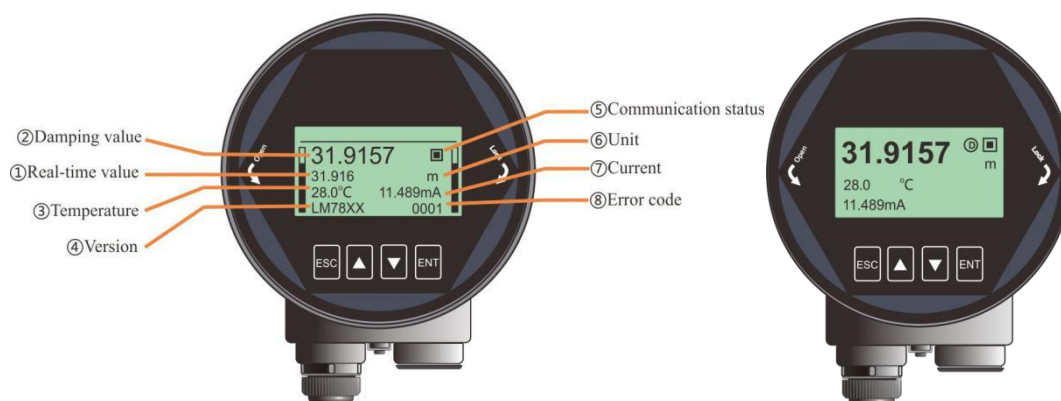


Figure 6-1. Main interface overview

Table 6-1 describes the functions of the 4 keys in the main interface:

Table 6-1. Key functions in the main interface

Key	Function
ESC	Switch to the echo interface
Up/up arrow	Switch to parameter overview
DN/down arrow	Switch to simplified main interface
ENT	Switch to setup interface

The parameters on the main interface are described as follows:

1. **Real-time value.** It indicates the result of the process quantity measured by the system in real time, including level, height and distance. See section [6.4.3](#) for display settings.

2. **Damping value.** It is the smooth output of the real time value through the damping filter. See section [6.5.1.7](#) for details.
3. **Temperature.** It indicates the internal circuit temperature of the instrument.
4. **Version.** It indicates the model number of the product customized by you.
5. **Communication status.** It indicates the heartbeat of the system. It blinks once every second meaning that the instrument is working properly. If it does not blink or blinks only once in a long time, the communication is abnormal.
6. **Unit.** It indicates the system measurement units. See section [6.4.3](#) for detailed settings.
7. **Current.** It indicates the ideal 4-20mA current output value corresponding to the analog quantity to be measured. It is obtained according to the **Low/High calibration points** and **Current function**. See section [6.5.1.4](#) and [6.5.2.6](#) for detailed conversion relations.
8. **Error code.** See [Appendix A](#) for detailed definitions.

6.3 Echo interface description

In the main interface, press **ESC** key to enter the echo interface. Figure 6-2 shows the echo interface:

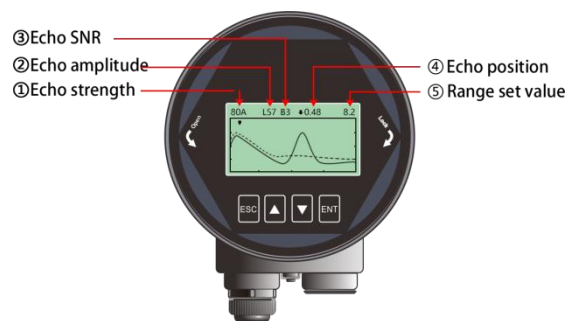


Figure 6-2. Echo interface overview

Table 6-2 describes the functions of the 4 keys in the echo interface:

Table 6-2. Key functions in the echo interface

Key	Function
ESC	Switch to the main interface
UP/up arrow	Show/hide the coordinate grid
DN/down arrow	Re-search echo within range
ENT	Switch to different ordinate scale

The parameters on the main interface are described as follows:

1. **Echo strength.** It indicates the maximum echo intensity in the measurement range. For a metal plate at 10m, the echo intensity should be at least 80dB..
2. **Echo amplitude.** It indicates the information on the intensity of the radar-selected echo indicated by the black arrow. A good metal reflector should have around 90dB echo strength.If the echo strength is less than 30dB, it indicates a weak echo signal. It is required that a technician to carry out the appropriate troubleshooting

3. **Echo SNR.** It indicates the information on the difference between **Echo amplitude and threshold curve**.
4. **Echo position.** The arrows in the echo interface are divided into 2 types: hollow and solid. Hollow indicates the radar's real-time selected echo position, while solid indicates the radar's final output selected echo position. The number following this arrow is unaffected by the **Sensor mode** setting and always gives distance information, pointing to the selected echo crest. Normally the two arrows overlap to form a black arrow, but in the event of strong interference or sudden movement of the target, the solid black and white arrows may become separated. This is normal.
5. **Range set value.**

6.4 Setup interface description

In the main interface, press **ENT** key to enter the setup interface. Figure 6-3 shows the setup interface:



Figure 6-3. Setup interface overview

Table 6-3 describes the functions of the 4 keys in the setup interface:

Table 6-3. Key functions in the setup interface

Key	Function
ESC	Switch to the main interface/return to the parent directory
UP/up arrow	Move up
DN/down arrow	Move down
ENT	Enter the selected entry

6.4.1 Basic

Basic menu contains the necessary functions required for the normal operation of the instrument. In general operating conditions, you can set these parameters to enable a quick start-up of the instrument. Select **Basic** and press **ENT** key to enter the options interface. Table 6-4 shows the list of options:

Table 6-4. Menu items for Basic

Default position	Menu Item
●	Application type
	Vessel type
	Material type/Dielectric constants
	Low/high calibration point
	Blind spot setting
	Range setting
	Damping
	Sensor mode

6.4.2 Advanced

Select **Advanced** and press **ENT** key to enter the options interface. The advanced settings are best operated by a professional who is more familiar with the working principles of radar. Table 6-5 shows the list of options:

Table 6.5 Menu items for Advanced

Default position	Menu Item
●	False echo leaning
	Factory reset
	Fill/empty rate
	Current simulation
	4mA/20mA set point
	Current function
	Bus address
	Sensor offset
	Fail-safe mode
	Fail-safe timer
	Parameter backup

6.4.3 Display

Display menu can realize the switching between **Distance units**, **Temperature units** and **Display language**. Table 6-7 shows the list of options:

Table 6-7. Menu items for Display

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

6.4.4 Diagnosis

Diagnosis menu can realize the statistics of historical data and summarize the characteristics of working conditions. Select **Diagnosis** and press **ENT** key to enter the options interface. Table 6-6 shows the list of options:

Table 6-6 Menu items for Diagnostics

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

	Historical period
	Historical maximum measurement
	Historical maximum temperature
	Historical fill rate
	Historical empty rate

6.4.5 Information

Information interface tracks the product information of the instrument, such as sensor model, serial number, and other information. Select **Information** and press **ENT** key to enter the options interface. Table 6-8 shows the list of options:

Table 6-8. Menu items for Information

Default position	Menu Item
●	Sensor model
	S.N.
	Tag

6.5 Menu operating instructions

6.5.1 Basic

The basic settings allow for a quick start-up of the instrument.

Note:

- Unless explicitly stated, default settings are indicated with an asterisk (*).
- Unless explicitly stated, the entered parameters in all position-related settings of the instrument are distance information. It is the distance from the sensor to the material/liquid level, for example, **Low/High calibration point**.

6.5.1.1. Application type

The 80GHz radar series of instruments integrate an adaptive algorithm for solid and liquid application. You can configure the instruments according to the actual measurement object on site. After configuration, the **Vessel type** and **Material type** menus are automatically adjusted. Figure 6-4 shows the **Application type** interface:



Figure 6-4. Application

6.5.1.2. Vessel type



Fig 6-5 Vessel type overview

Vessel type has a variety of radar operating modes to suit different on-site applications. At the same time, it provides customer-friendly demonstration modes for in-field tests. Table 6-9 describes the details of **Vessel type**:

Table 6-9. Vessel type details

Parameter name	Vessel type
Large volume	Slow fill and empty rates, and great damping. Suitable for a smooth output of the measurement.
Medium volume*	Medium fill and empty rates, and medium damping. Suitable for most operating conditions.
Fine volume	Fast fill and empty rates, and minimal damping. Suitable for applications requiring a fast response time.
Fast fill (for solid app only)	Suitable for fast filling hoppers.
Agitator (for liquid app only)	Suitable for undulating liquid level measurement, and applications with agitators.
Demonstration	0 delay response. Suitable for in-field testing, and quick understanding of instrument characteristics.
<p>Note: Except for the demonstration mode, all other modes are customized for stable measurements on actual site. Therefore, instantaneous large span jumps in the result of the position of the object to be measured are not accepted.</p>	

6.5.1.3. Material type/Dielectric constant



Fig 6-6 Material type overview

Different substances to be measured generates different echo characteristics. You can set a wide range of built-in substance type options in the instrument. The **Material type** affects the echo selection and the correct setting enables the measurement to be more accurate and stable.

When you switches the **Application type** option, the **Material type** option is automatically switched. Table 6-10 describes the specific parameters:

Table 6-10. Material type details

Solid		Liquid (Dielectric constant)
Powder*		> 10*
Small solid		3-10
Large solid		<3

6.5.1.4. Low/High calibration point

In **Low/High calibration point**, the high level corresponds to the full material position and the low level corresponds to the empty position. Low level - high level = DCS system range. **Low/High calibration point** map the corresponding relationship between the measured value and the current output (4-20mA). Figure 6-7 shows the **Low/High calibration point** interface and definitions:

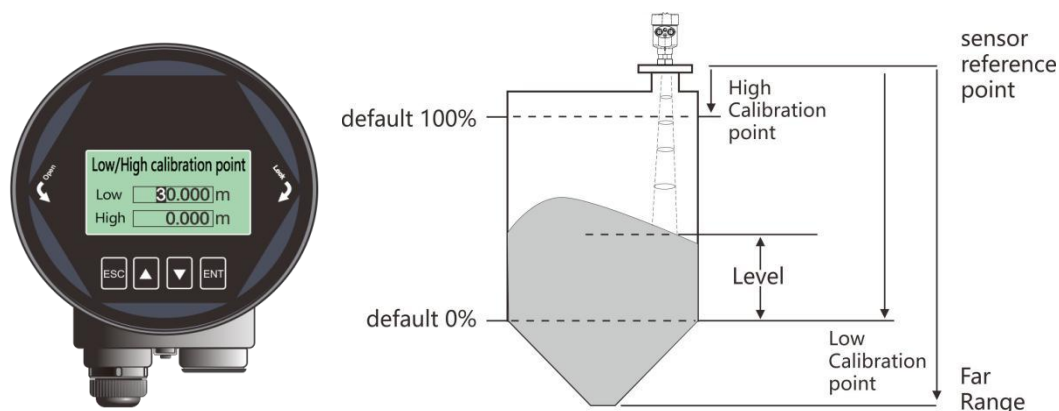


Figure 6-7. Low/High calibration point interface and definitions

For example:

The vessel to be measured is 5m high; then the **High calibration point** is set to 0m, the **Low calibration point** is set to 5m. The input number is the distance from radar to the specified point

6.5.1.5. Near range

The **Near Range** and the **Far Range setting** together determine the valid area of echo that can be identified by the algorithm. The algorithm ignores echoes within the blind spot. You can use this option to avoid the interference from the near end and prevent material level from jumping to 100% as well.



Figure 6-8. Near range interface

6.5.1.6. Far range

The range defines the operating area of the algorithm and does not refer to the remote measurement limits of the instrument or the range of the DCS system.

The algorithm ignores echoes-m that are outside the range when processing. Setting the range appropriately can avoid multiple reflective interference and possible interference signals that are out of range. The range should be 1-2m greater than the actual vessel height, especially for vessels with a conical bottom, so that the instrument can obtain the full echo characteristics. Figure 6-9 shows the **Far range** interface:



Figure 6-9. Far range interface

6.5.1.7. Damping

Damping smooths out the sudden changes in measurement results, and reflects more accurate average positions. Figure 6-10 shows the **Damping** interface and a smoothing result:

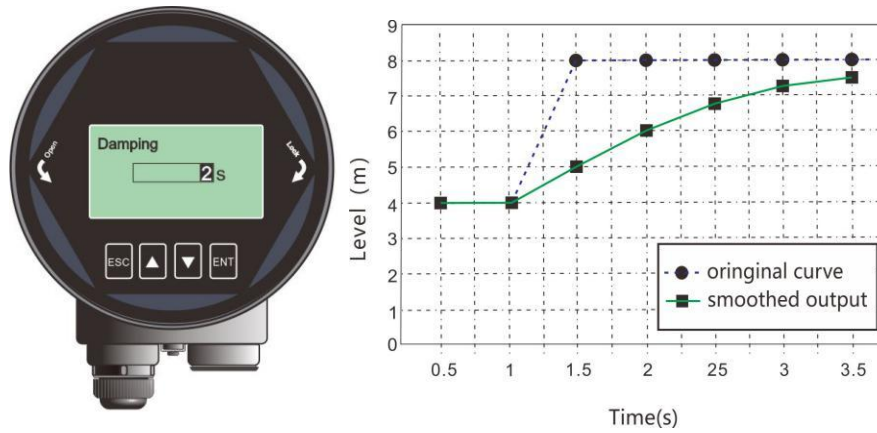


Figure 6-10. Damping interface

Table 6-11 describes the details of **Damping**:

Table 6-11. Damping details

Parameter name	Damping
Parameter range (S)	0 ~ 600 (display and control terminal)
Default value (S)	Null
Related configuration	Null
Option meaning	Damping output for improved signal stability
Special matters	Null

6.5.1.8. Sensor mode

Figure 6-11 shows the **Sensor mode** interface:

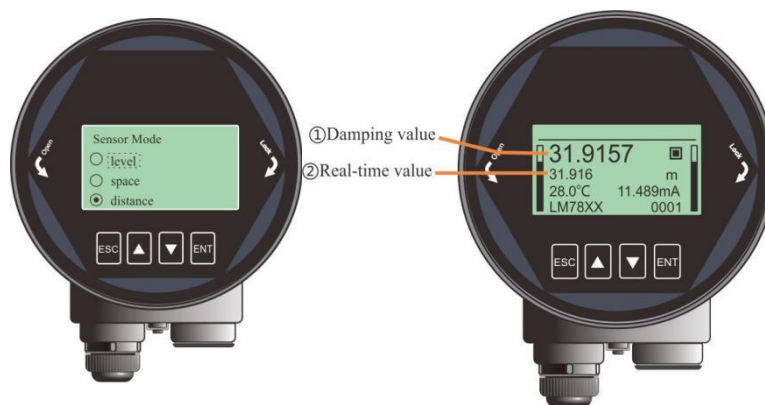


Figure 6-11. Sensor mode interface

Sensor mode only changes the type of the real-time value and damping value displayed in the main interface, and does not change the type of current output from the instrument. To change the current output type, see [Current function](#). Table 6-12 describes the calculation method for the level,

distance and space:

Table 6-12. Sensor mode details

Parameter name	Sensor mode
Default value	Distance
Related configuration	Null
Option meaning	Distance mode: real-time value = distance Level mode: real-time value = Low calibration - distance (the minimum is 0) Space mode: real-time value = distance - High calibration (the minimum is 0)
Special matters	If the measured distance is greater than Low calibration , the level is 0. The measurement result exceeds the Low calibration and the instrument outputs empty vessel. If the measured distance is smaller than High calibration , the space=0. The measurement result exceeds High calibration and the instrument outputs full vessel.

6.5.2 Advanced

6.5.2.1. False echo learning

False Echo learning can block interference echoes caused by interfering objects in the vessel and form a background screening curve, which is threshold curve TVT. This option contains 2 levels of guidance menus, **False echo range** and **False echo mode**. There are 3 methods that can be selected in **False echo mode**:

- Full range. It indicates that false echo learning is performed within the default full range of the instrument.
- Range include. It indicates that false echo learning is performed only within the set range.
- Range exclude . It indicates that false echo learning is performed only outside the set range.

After selecting **Range include** or **Range exclude**, further enter the range **Start** and **End** points. Figure 6-12 shows the menu interfaces:



Figure 6-12. False echo

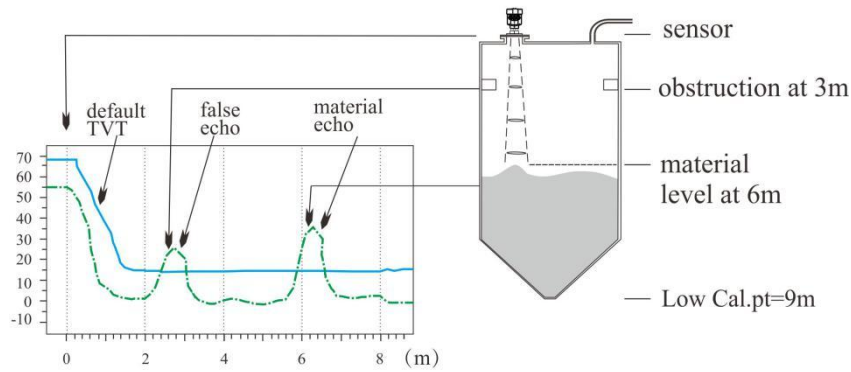
For example:

In working conditions if there is an interference signal within 2m-4m range from the instrument, you need to create a new TVT curve to suppress the interference. To create a new TVT curve, follow these steps:

1. Select **Range include** in **False echo mode**.
2. Set the **Start** to 2m and the **End** to 4m in **False echo range**.
3. Select **New** in **False echo learning**. Confirm and wait for the **OK** prompt to pop up. This indicates that you have successfully created a new TVT curve.

Figure 6-13 shows the principle and effect of false echo learning. The learned false echo curve is perfectly overlaid on top of the real-time measurement curve, so that you can only see the true material level echoes. You can observe through the echo interface or analyze more fully on the host computer.

Example before Auto False Echo Suppression



Example after Auto False Echo Suppression

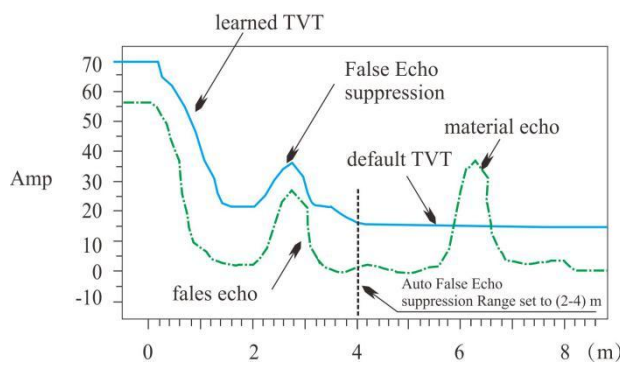


Figure 6-13. An example of false echo learning

Table 6-13 describes the other meanings under different combinations of options:

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 6.13 False echo mode details

	Full range	Range include	Range exclude
New	Learn false echos within the full range (0 ~ instrument measurement limit).	Learn false echos within 2m ~ 4m range. The rest remains the same.	Learn false echos outside 2 ~ 4m range within the full range. The rest remains the same.
Clear	Clear false echos within the full range.	Clear the false echos within 2m ~ 4m. The rest remains the same.	Clear false echos within the full range except the 2m ~ 4m range. The rest remains the same.

6.5.2.2. Factory reset

Factory reset restores the default factory settings of the instrument. The recovery time is about 30s. After the reset, the system jumps to **Main interface** automatically. You are recommended to use this option first when the instrument does not measure properly due to improper operations. Figure 6-14 shows the **Factory reset** interface:



Figure 6-14. Factory reset interface

6.5.2.3.Fill/Empty rate

Fill/Empty rate adjusts the response rate of the instrument to the actual material level. When the fill rate setting is changed, the response rate is automatically changed. Figure 6-15 shows the **Fill/Empty rate** interface:

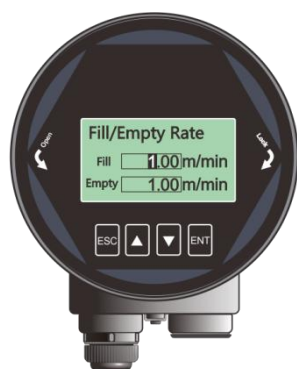


Figure 6-15. Fill/Empty rate interface

Table 6-14 describes the **Fill/Empty rate** details:

Parameter name	Fill rate and empty rate
Parameter range (m/min)	0 ~ 300
Default value (m/min)	1
Related configuration	Null
Option meaning	Set the response rate for material tracking
Special matters	<ol style="list-style-type: none"> 1. The demonstration mode is invalid. 2. Vessel type options contains the system default settings for fill/empty rate. You can set the appropriate fill/empty rate in this menu to override the instrument default settings according to the on-site conditions. This can make the instrument response to the level more timely and accurate.

6.5.2.4. mA simulation

mA simulation enables the loop current to output a specific current value fixedly for checking that the 4-20mA output loop current is accurate and normal. Figure 6-16 shows the **mA simulation** interface:



Figure 6-16. mA simulation interface

Table 6-15 describes the details of input value in **mA simulation**:

Parameter name	mA simulation
Parameter range (mA)	4 ~ 20
Default value (mA)	4
Related configuration	
Option meaning	Set the current output value manually. Check if the 4-20mA output loop current is accurate and normal.
Special matters	Exit this option menu and the system returns to normal analog output operation.

6.5.2.5. 4mA/20mA setpoint

4mA setpoint is the 0% point of the analog quantity. 20mA setpoint is the 100% point of the analog quantity. You can customize the 4mA/20mA setpoint based on the actual needs. This setting has a higher priority than **Low/High calibration**. The system outputs the analog current at the end based on this setting.

Note: It is not recommended that you set this option individually. You only need to set the **Low/High calibration**.

Figure 6-17 shows the 4mA/20mA setpoint interface:



Figure 6-17. 4mA/20mA setpoint interface

6.5.2.6. Current function

Current function decides whether 4-20mA or 20-4mA is output on the bus. Figure 6-18 shows the **current function** interface:

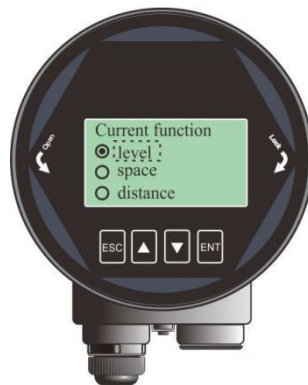


Figure 6-18. Current function interface

For example:

The vessel to be measured is 5m high; then the high level is set to 0 and the low level is set to 5. If the current output function selects the level, the empty vessel current outputs 4mA, full vessel outputs 20mA. If the current output function selects the space, the empty vessel current outputs 20mA, full vessel outputs 4mA.

Figure 6-19 shows the corresponding relations of the loop output current and this option:

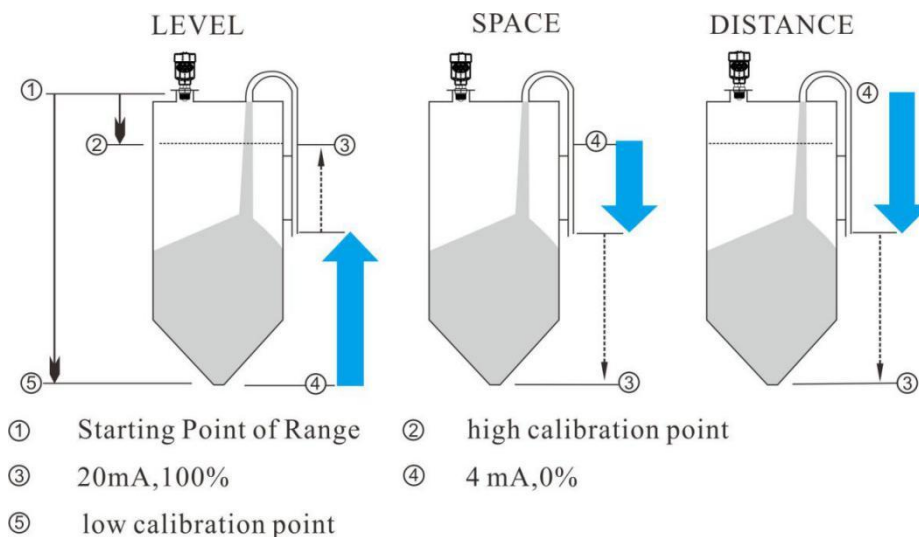


Figure 6-19. Current output function

6.5.2.7. Bus address

According to the communication protocol supported by the instrument, set the specific **Bus address** and incorporate the instrument into the bus on site. Figure 6-20 shows the **Bus address** interface:



Figure 6-20. Bus address interface

Table 6-14 describes the details of **Bus address**:

Table 6-14. Bus address details

Parameter name	Modbus address	Hart address
Parameter range	1-247	0-15
Default value	1	0
Related configuration	Null	Null
Option meaning	Set the RS485 communication address in the instrument.	Set the Hart communication short address in the instrument.
Special matters	System will reboot after setting.	System will reboot after setting. Output current is fixed at 4mA when Hart short address is not 0.

6.5.2.8.Distance offset

Distance offset corrects the reference point of the sensor. Figure 6-21 shows the Distance offset interface. The default reference point is calibrated to the point ‘a’ shown in the figure, which is the lens tip. If you want to set reference point to point ‘b’, enter ‘h1’ in the setting.

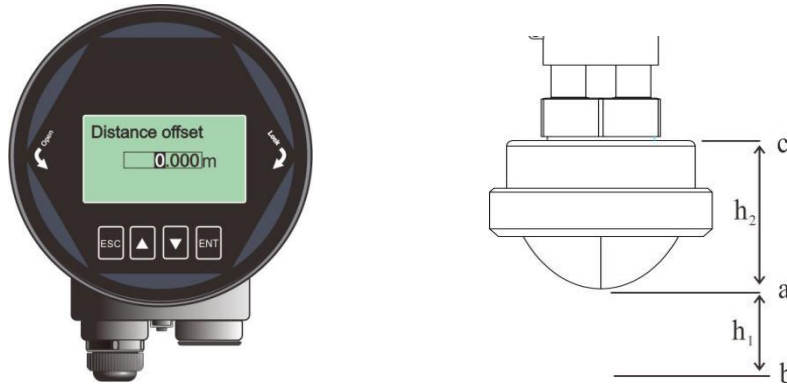


Figure 6-21. Distance offset interface

Table 6-15 describes the details of **Distance offset**:

Table 6-15. Distance offset details

Parameter name	Distance offset
Parameter range (m)	Self offset ~ 10m
Default value (m)	0
Related configuration	Null
Option meaning	Correct the 0 point of the sensor reference point. The range of the sensor output value remains between Near range and Range . The actual sensor measurement range is normalized to the initial reference point: Distance offset + Near range ~ Distance Offset + Far Range .
Special matters	Null

6.5.2.9.Fail-safe mode

Fail-safe mode set the actual output current value when the level meter loses echoes. See [Appendix A](#) for detailed error code. Figure 6-22 shows the Fail-safe mode interface. The Keep option indicates that the output maintains the last valid measured current.



Figure 6-22. Fail-safe mode interface

6.5.2.10. Fail-safe timer

Fail-safe timer is also known as lost of echo timer (LOE timer). When the duration of echo loss exceeds the set value of Fail-safe timer, the 4-20mA terminal outputs according to the set value of **Fail-safe mode** option, and the main interface displays 0001 error code. The default value is 100s and the range is 0-1000s. Enter **Advanced** and select **Fail-safe timer**. Figure 6-23 shows the **Fail-safe timer** interface:



Figure 6-23. Fail-safe timer interface

6.5.2.11. Parameter backup

The 'Read' option backs up all the current configurations in the instrument to the display module. The 'Write' option sends the saved configurations in display module to the current instrument. These options are designed for the operation of several similar vessels on site. You can back up the parameters to the display module when setting up the radar for one vessel; then set up other similar vessels.

Figure 6-24 shows the **Parameter backup** interface:



Figure 6-24. Parameter backup interface

6.5.3 Diagnosis

6.5.3.1. Echo curve

See [Echo interface description](#).

6.5.3.2. False echo curve

You can view the false echo curves that have been generated.

6.5.3.3. Historical data

Historical data records the sensor measurement value based on the current **Sensor mode**, counts within the **Historical period**, and draws curves. Figure 6-25 shows the **Historical data** interface:

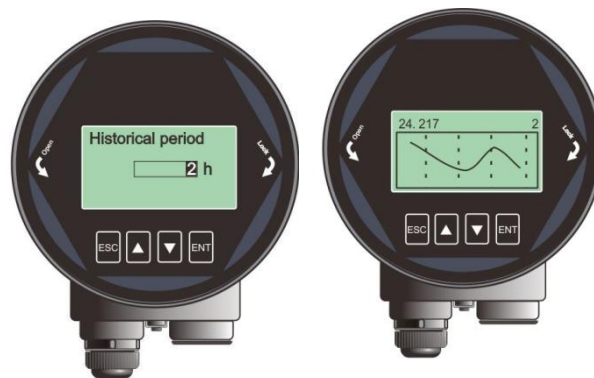


Figure 6-25. Historical data interface

Note: The right side displays the more recent data. The number in the upper left corner indicates the maximum value of the history measurement. The number in the upper right corner indicates the set **Historical period**. The maximum count is 360 hours, which is 15 days.

6.5.3.4. Historical period

See [Historical data](#) for the definition.

6.5.3.5. Historical maximum measurement

Historical maximum measurement counts the highest and lowest values of measurement results after leaving the factory. The result type is based on the **Sensor type**, such as level, distance, and space. Enter **Diagnostics** menu, select **Historical maximum measurement** and select **Read** to read the lowest and highest historical measurement values.

Select **Clean** to clear the historical statistics, and then the system starts counting again. Figure 6-26 shows the **Historical maximum measurement** interface:



Figure 6-26. History maximum measurement interface

6.5.3.6. Historical maximum temperature

Historical maximum temperature counts the highest and lowest values of the operating temperature on the core circuit board after leaving the factory. See [Historical maximum measurement](#) for operating instructions. Figure 6-27 shows the **Historical maximum temperature** interface:



Figure 6-27. History maximum temperature interface

6.5.3.7. Historical fill rate

Historical fill rate counts the highest and lowest values of the fill rate after leaving the factory. See [Historical maximum measurement](#) for operating instructions. Figure 6-28 shows the **Historical fill rate** interface:



Figure 6-28. Historical fill rate interface

6.5.3.8. Historical empty rate

Historical empty rate counts the highest and lowest values of the empty rate after leaving the factory. See [Historical maximum measurement](#) for operating instructions. Figure 6-29 shows the **Historical empty rate** interface:



Figure 6-29. Historical empty rate interface

6.5.4 Display

6.5.4.1. Sensor unit

Sensor unit determines the unit of the **real-time value** and **damping value** in measurement interface. The default unit is meters. Enter **Display** menu and select **Sensor unit**. Figure 6-30 shows the **Sensor unit** interface:

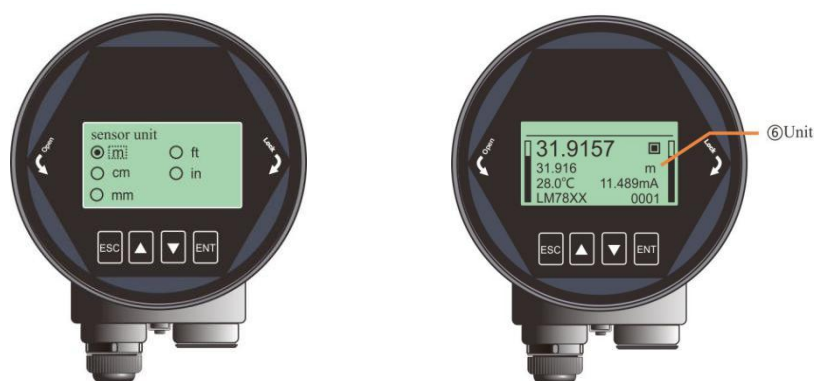


Figure 6-30. Sensor unit interface

6.5.4.2. Temperature unit

Temperature unit determines the unit of temperature in measurement interface. The default unit is °C. Enter **Display** menu and select **Temperature unit**. Figure 6-31 shows the **Temperature unit** interface:

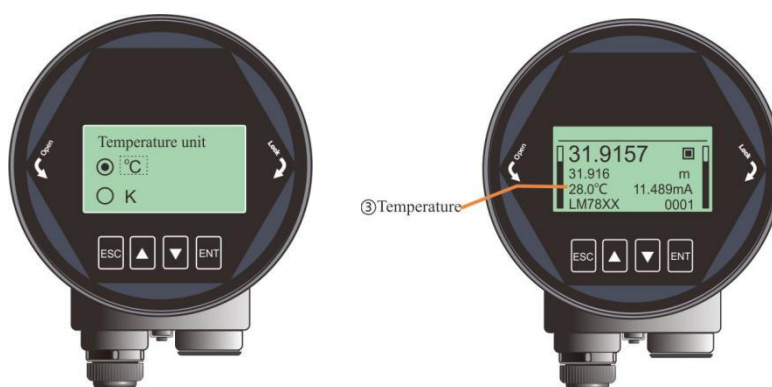


Figure 6-31. Temperature unit interface

6.5.4.3. Language

Language determines the display language of all interfaces to suit your needs. Currently Chinese and English are available. The default language is Chinese. Enter **Display** menu and select **Language**. Figure 6-32 shows the **Language** interface:



Figure 6-32. Language interface

6.5.4.4. LCD contrast

LCD contrast adjusts the display contrast of LCD. The range is 0-127. The higher the value, the darker the color displayed. Figure 6-33 shows the **LCD contrast** interface:



Figure 6-33. LCD contrast interface

6.5.4.5. Current percentage

Current percentage is a switch. When switched on, the main interface shows the percentage of the analog quantity. Figure 6-34 shows the **Current percentage** interface:

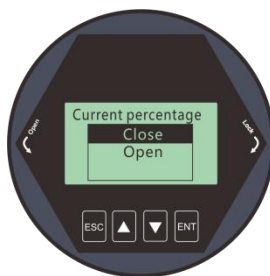


Figure 6-34. Current contrast interface

6.5.5 Information

6.5.5.1. Sensor model

Sensor model is the product model of the instrument. Select **Sensor model** and press **ENT** to enter. Figure 6-35 shows the **Sensor model** interface:



Figure 6-35. Sensor model interface

6.5.5.2. S.N. (Serial number)

S.N. is the product serial number of the instrument. Select **S.N.** and press **ENT** to enter. Figure 6-36 shows the **S.N.** interface:



Figure 6-36. S.N. interface

6.5.5.3. Tag

Tag identifies different sensors in the filed. It contains 16 characters and you can set each character to 0 ~ 9 or A to Z. Figure 6-37 shows the **Tag** interface:

6.6 Keyboard

The following describes the instructions on how to use the keyboard, using the **Near range** setting as an example:

1. Press **DN/down arrow** to shift the cursor to the right. After moving right to the last position, the cursor returns to the far left. Figure 6-38 shows how the cursor shifts:



Figure 6-38. Shifting the cursor

2. Press **UP/up arrow** to cycle the cursor from 0 to 9. Figure 6-39 shows how the cursor cycles:



Figure 6-39. Cycling the cursor

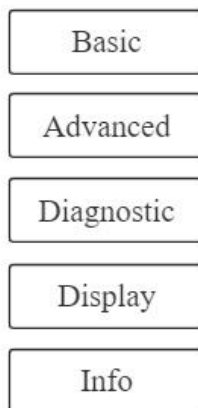
3. Press **ENT** to complete the setting. The LCD returns to the confirmation status and you can see the OK in the lower right corner of the interface, meaning the setting is accomplished. Figure 6-40 shows the interface when the setting is accomplished:



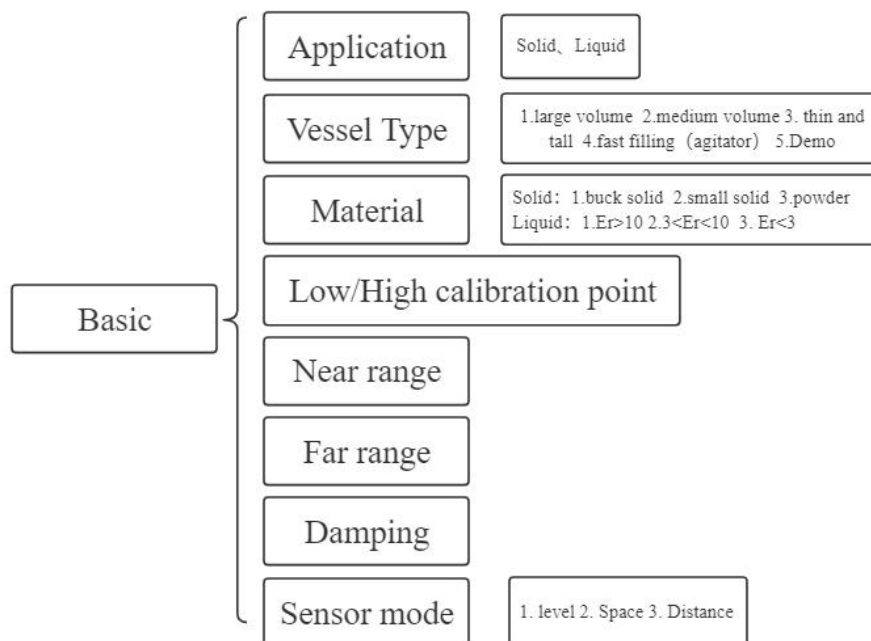
Figure 6-40. Setting accomplished

7. Menu tree

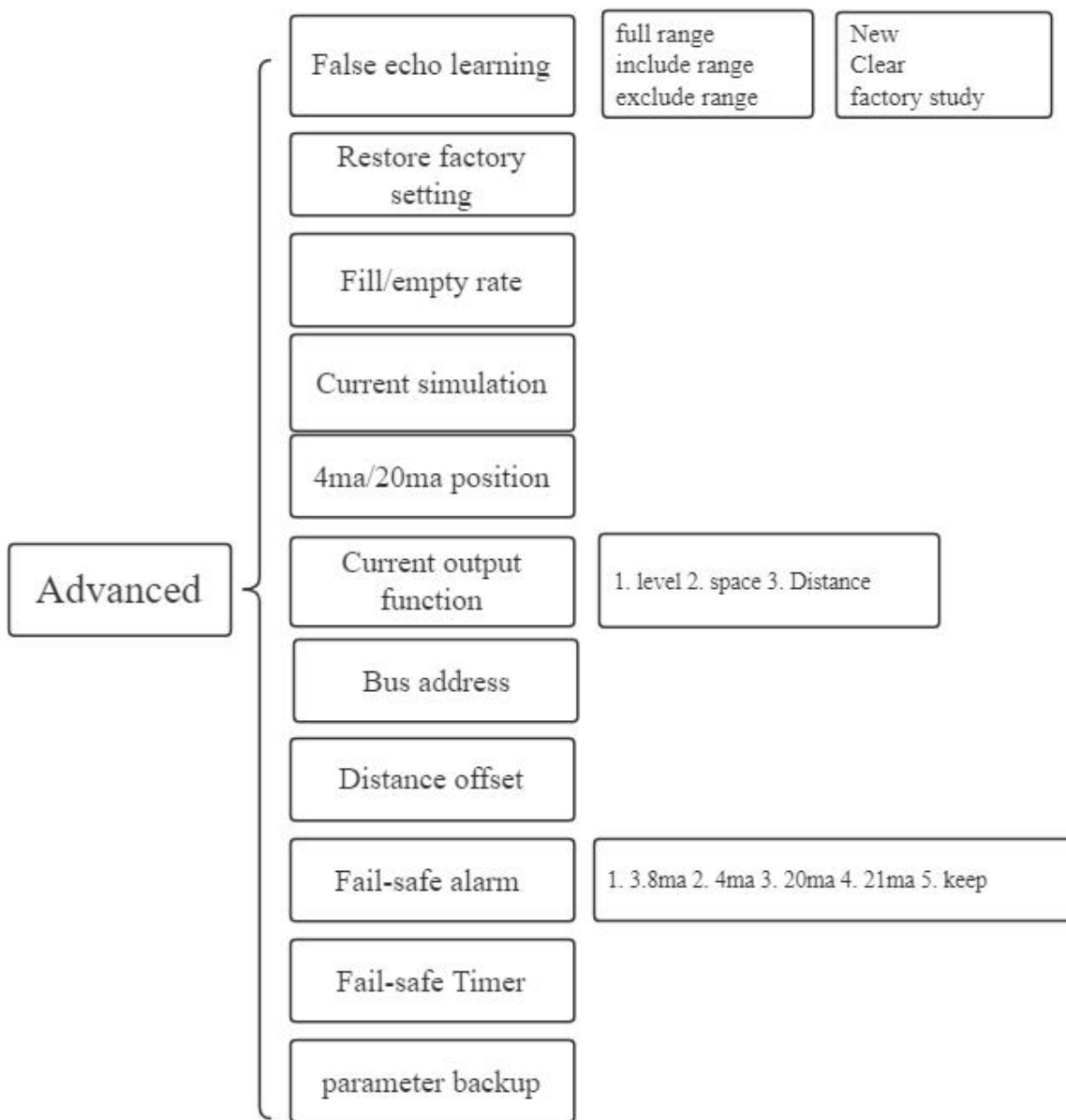
7.1 First-level menu tree



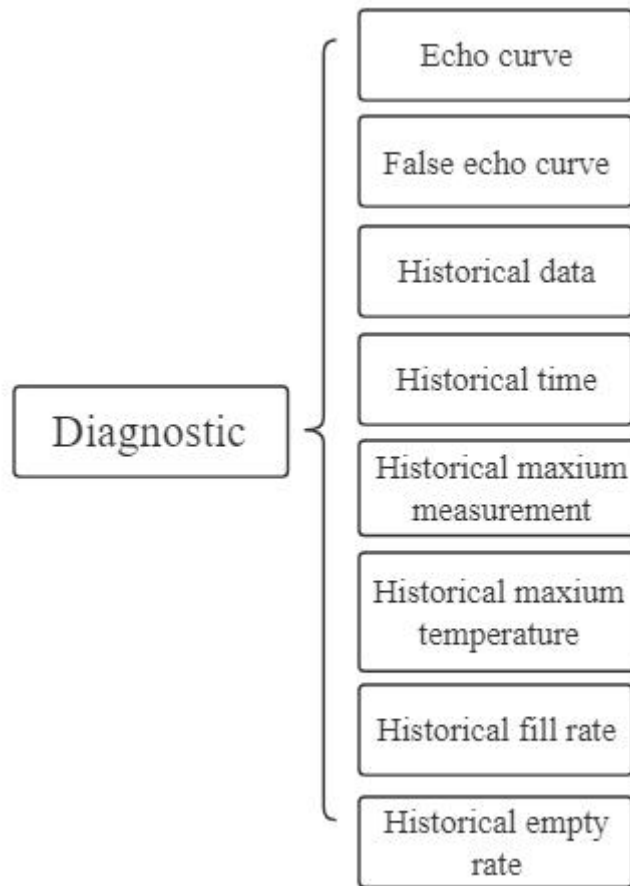
7.2 Secondary menu tree-basic settings



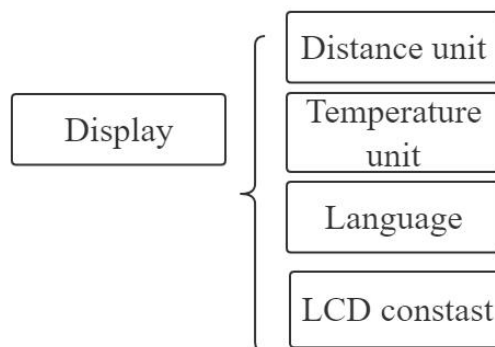
7.3 Secondary menu tree-Advanced



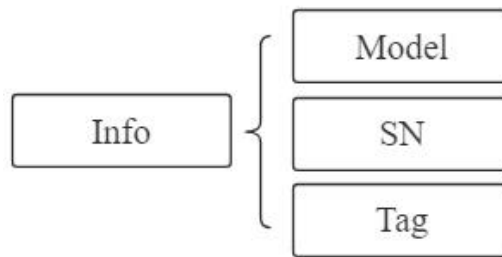
7.4 Secondary menu tree-diagnostics



7.5 Secondary menu tree-display



7.6 Secondary menu tree-information



8. Problem diagnosis

Phenomenon	Possible reason	Actions

9. Software version history

Slave computer version	Release date	Description
1.1.84	January 2021	
1.2.31	October 2021	
1.2.48/1.4.08/1.5.18	January 2023	Adjusted internal algorithm parameters

Display version	Release date	Update description
4.2.27	October 2021	
4.2.37	January 2023	Updated the Echo interface display

Document version	Release date	Update description
V1	October 2021	
V1.1	January 2023	Updated chapter 6.3 Echo interface display

10. Error Code

Error code is displayed in the Measurement Interface as shown below



Fig 10-1 Error code

Table 10.1 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

11. Glossary

Beam Angle: Half power beamwidth. Lm78xx has 3° beamwidth and the divergence of the beam is only ±2.6m at a distance of 100m.

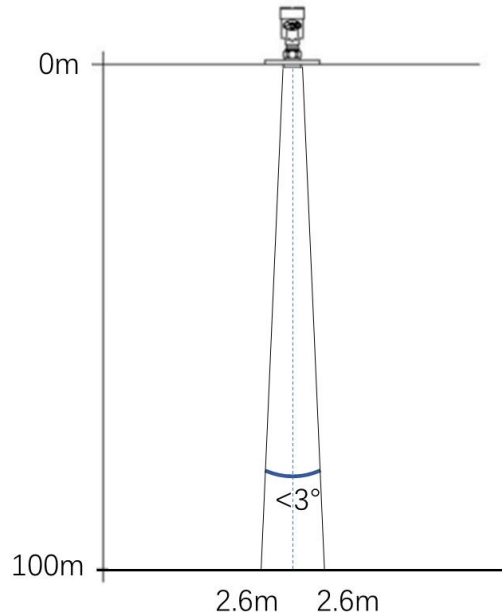


Fig 11-1 Beam spread

Range resolution: It refers to the minimum distance that two objects can be distinguished by the level radar. LM78xx has a 5.1GHz bandwidth, and thus the ideal **Range resolution**= $C/2B \approx 3\text{cm}$.

Measurement Accuracy: The minimum shift that can be distinguished by the level radar. LM78xx's echo signal is analyzed by unique algorithm, and the accuracy is 0.5mm.

Ambient temperature: The temperature of the surrounding air that comes in contact with the equipment.

Blind zone: the limitation of the level meter, that is to say, the radar cannot give the right measured result within Blind zone.

dB (decibel): A unit representing the amplitude of a signal.

Dielectric constant (DK): The ability of a dielectric to store electrical energy. The increase in dielectric constant is directly proportional to the increase in reflection amplitude. The dielectric constant of air is 1.

Echo: A reflected signal with amplitude large enough to be distinguished from the transmitted signal by a certain method is called an echo.

False echo: Generally speaking, false echoes are generated by obstacles in the container or multiple reflection.

Multiple echoes: Multiple echoes due to multiple reflections between the radar and the target

Polarization: The properties of the emitted electromagnetic waves, describing the direction and amplitude of the electric field vector changes over time.

Repeatability: The variance of multiple measurements of the same variable in the same situation.

Speed of light: The speed of electromagnetic waves in free space is 299,792,458 meters per second.