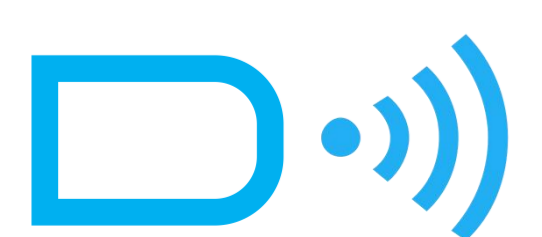


DYP
Smart Sensor



L08 SERIES SENSOR MODULE (V3.0)

DATASHEET



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SHENZHEN DIANYINGPU TECHNOLOGY Co.,LTD.

1. Production introduction

1.1 Overview

The L08 series module is an ultrasonic underwater obstacle avoidance sensor designed for underwater applications, featuring a compact size, small blind zone, high waterproof grade.

It supports the modbus protocol, allowing for the modification of corresponding baud rate parameters, and has the function of identifying whether the machine is submerged in water.

It is a simple-to-operate, high-performance and highly reliable commercial-grade functional module.

1.2. Product Features

- Operating voltage: 5V
- Strong anti-interference ability and stable and reliable data output.
- Fast response time and high precision.
- Operating temperature: 0°C to 50°C.
- The connection pins are designed with electrostatic protection.
- IP68 waterproof grade.
- Detection function of immersing in and exiting from water for machine.
- Ultra-low standby power consumption.
- Small size.
- The minimum blind zone is 5cm.
- The maximum range is 8 meters.
- The communication interface can be selected as UART or RS485
- Support modification of the baud rate for module communication

1.3. Scope of application

- Obstacle avoidance and automatic control of underwater robots
- Underwater ranging equipment
- Underwater cleaning robot
- Underwater detector

1.4. Basic parameters

| Parameters | L081MTW | L081M4W | L08B50TW | L08B504W | Unit | Remarks |
|-------------------------|-----------------|---------|-----------------|----------|------|---------|
| Working voltage | 5 | | | | V | DC |
| Standby current | <0.005 | <14 | <0.005 | <14 | mA | |
| Average working current | <13 | <15 | <13 | <15 | mA | (1) |
| Dead band | ≤5 | | ≤8 | | cm | |
| Flat object range | 5~800 | | 8~800 | | cm | (2) |
| Output response time | 18 | 20 | 18 | 20 | ms | (3) |
| Power working hours | <600 | | | | ms | |
| Connection type | UART Controlled | RS485 | UART Controlled | S485 | | (4) |
| Measurement accuracy | ±(1+S*1%) | | | | cm | (2) |
| Angle | 15±5 | | 25±5 | | deg | (5) |
| Case color | Gray | | | | | |
| Case material | ASA | | | | | |

Remarks: (1) : Typical data obtained from test with DC 5V supply; the trigger period is 100ms.

(2): The data was obtained when the module is stationary at 30cm underwater, at 25°C, with surroundings of calm water surface, the object under test is a planar object. The sensor should be as vertical as possible to the object being measured, with the very front end of the case as the starting point. "S" represents the actual distance measured.

(3): Response time measured at 115200 baud rate.

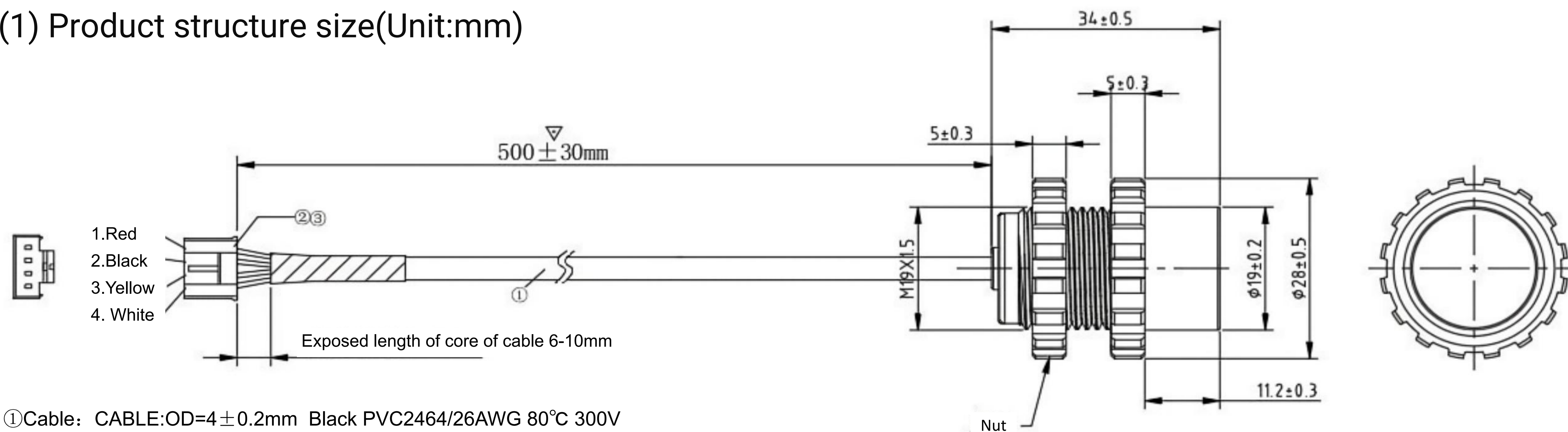
(4): The standard of UART controlled Communication level is TTL5V;

(5): Reference data obtained at a distance of 50cm under and still water at a temperature of 20° C, a calm surface, and no current, with using the default angle level 4. The measured object is a φ42mm, 1000mm high steel pipe.

2. Structure Description

2.1. Mechanical characteristics

(1) Product structure size(Unit:mm)

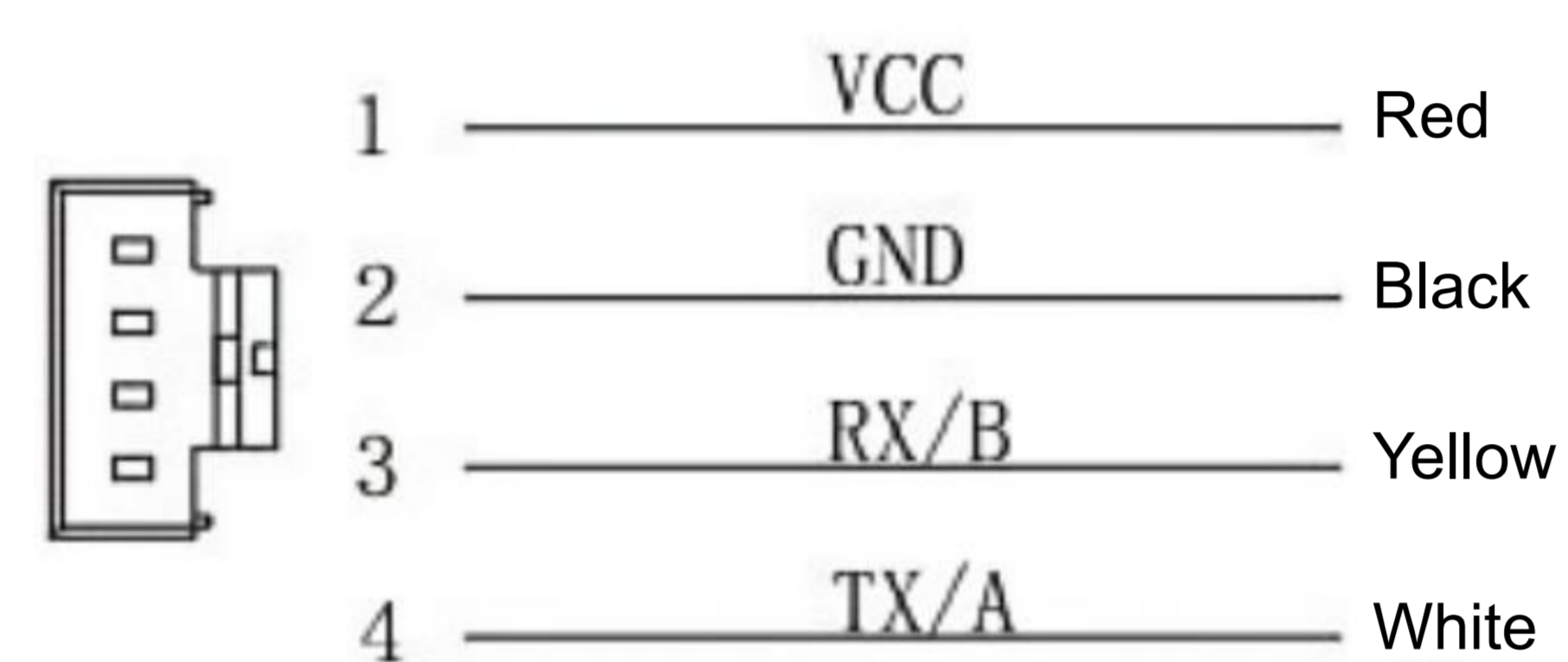


① Cable: CABLE:OD=4±0.2mm Black PVC2464/26AWG 80°C 300V

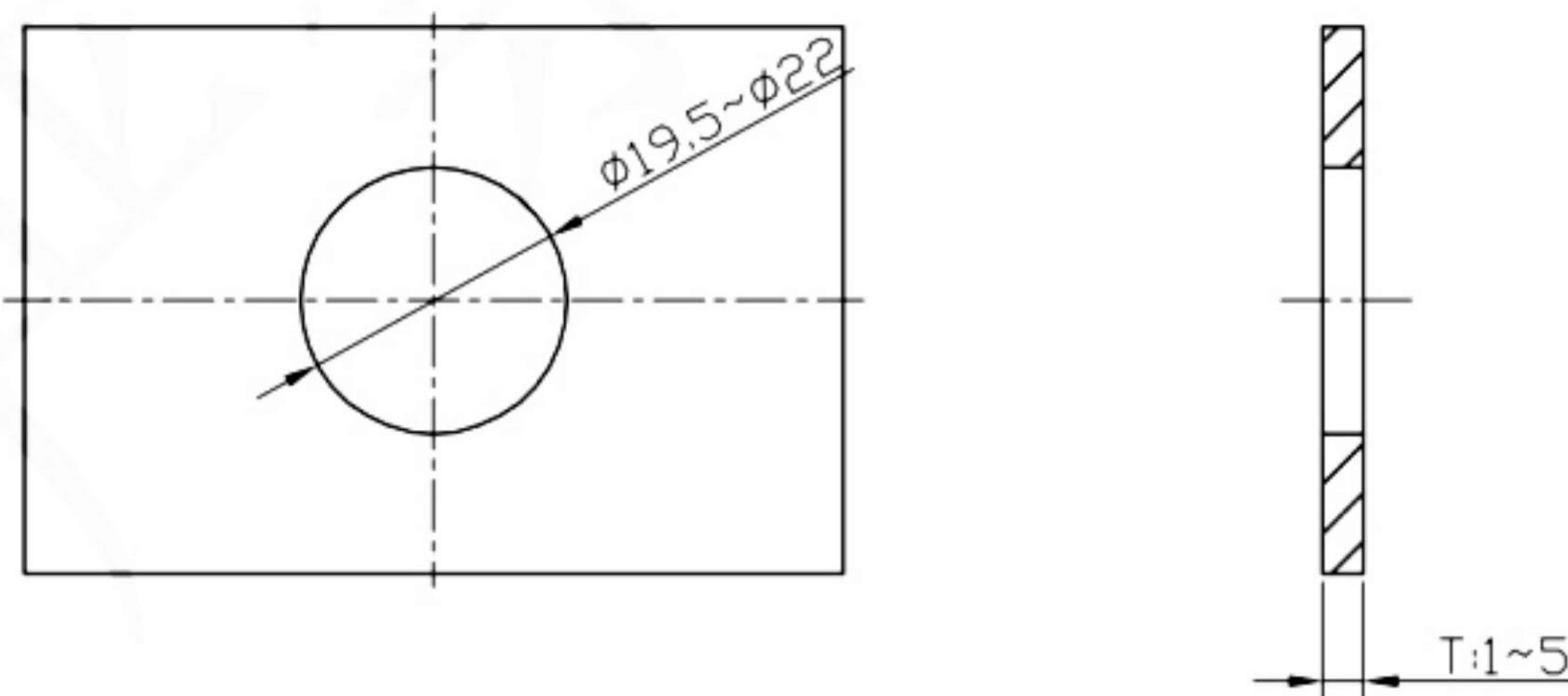
② Case: HY2.0mm×4pin/White lock type

③ Connector: HY2.0 Crimping Terminal 0.2mm Tin plating distance

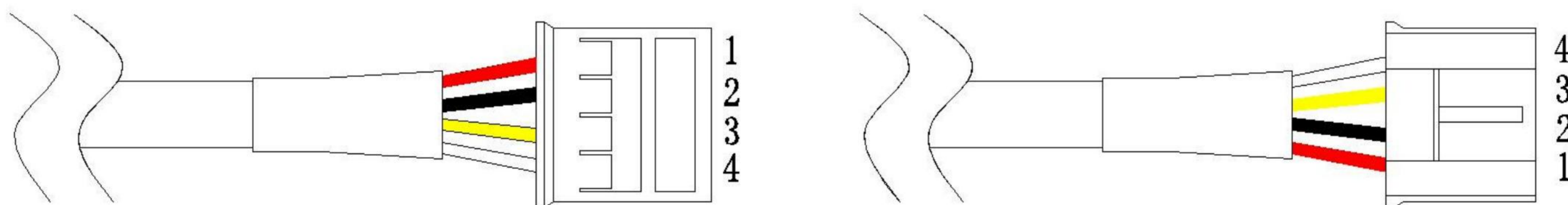
Interface Definition



(2) Recommendations of installing the opening: (Unit: mm)



2.2. Interface Definition



| PIN # | Lead name | Lead description | Lead color |
|-------|-----------|-------------------|------------|
| 1 | VCC | Power input lead | Red |
| 2 | GND | Power supply lead | Black |
| 3 | RX/B | Function lead | Yellow (1) |
| 4 | TX/A | Function lead | White (1) |

Note: (1) The communication level voltage of the RX and TX leads of UART is VCC and is not allowed to exceed the input voltage.

Remarks: Lead wire, pin function and output mode of product model correspond one-to-one, and cannot coexist with other output modes.

3. Output format

3.1. UART controlled output description

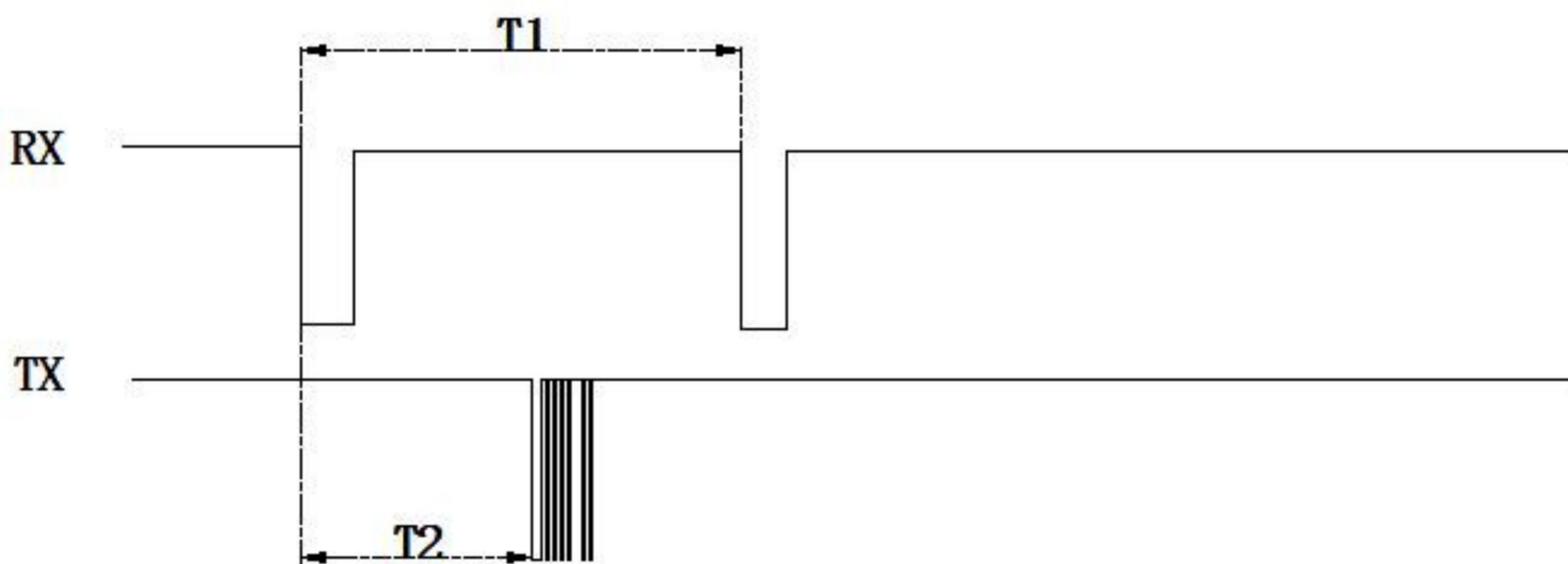
3.1.1. Output pin definition:

When the trigger input lead "RX" receives a low pulse signal, it will trigger the module to work, and a real-time measurement value data will be output by the communication output lead "TX", and the trigger ranging period must be greater than 33ms (under a baud rate of 115,200 BPS).

When the trigger pulse from the "RX" pin is not received within 5 seconds, the module will enter a sleep state with the lowest power consumption. When receiving an "RX" trigger pulse during sleep mode, the module will wake up immediately, but the response time will increase by 12ms compared to module the device is not in sleep mode.

| Interface | Baud rate | Data bit | Stop bit | Parity check |
|-----------|-----------|----------|----------|--------------|
| TTL5V | 115200bps | 8 | 1 | No |

3.1.2. Timing diagram:



Remark: $T1 > T2 + 15\text{ms}$; $T2 \approx 18\text{ms}$.

3.1.3.UART output format:

| Frame Data | State | Bytes |
|------------------|---------------------------------------|--------|
| FH(frame header) | Frame head, fixed to 0XFF | 1 byte |
| Data_H | The high 8 bits of the distance data | 1 byte |
| Data_L | The lower 8 bits of the distance data | 1 byte |
| SUM | Communication checksum | 1 byte |

3.1.4.UART output example:

| Frame header | Data_H | Data_L | SUM |
|--------------|--------|--------|------|
| 0XFF | 0X01 | 0X10 | 0X10 |

$SUM = (Frame\ header + Data_H + Data_L) \& 0x00FF$

$= (0XFF + 0X01 + 0X10) \& 0x00FF$

$= 0X10;$

$distance\ value = Data_H * 256 + Data_L = 0X0110;$

Converted to decimal is equal to 272mm..

3.2.RS485 interface protocol

3.2.1.RS485 interface parameters:

| Interface | Data bit | Stop bit | Parity check | Baud rate |
|-----------|----------|----------|--------------|--------------------|
| RS485 | 8 | 1 | No | 115200bps(default) |

3.2.2.RS485 interface protocol

Adopt the Modbus protocol, please refer to the “Modbus protocol specification” chapter.

3.2.3.RS485 output lead definition

| PIN # | PIN name | PIN description | Remarks |
|-------|----------|--|---------|
| 1 | VCC | Power input | |
| 2 | GND | Ground | |
| 3 | B | 485Communication anti-phase terminal | (1) |
| 4 | A | 485 Communication in the same terminal | (1) |

Remarks: (1) Lead wire, pin function and output mode of product model correspond one-to-one, and cannot coexist with other output modes.

3.3.Modbus protocol description

3.3.1.The Modbus protocol parameters:

| Model | Check | Sensor address | Read the function code | Write the function code |
|------------|---------------|-----------------------|------------------------|-------------------------|
| Modbus-RTU | CRC-16/MODBUS | Setable, default 0x01 | 0x03 | 0x06 |

3.3.2.The Modbus protocol format:

The user machine is the host machine equipment, and this module is the slave equipment.

Host sent(read):

| Name | Device address | Function code 0x03 | Register address | Register number | CRC16 check |
|--------------|----------------|--------------------|------------------|-----------------|-------------|
| Length(Byte) | 1 | 1 | 2 | 2 | 2 |

Slave response(read):

| Name | Device address | Function code 0x03 | Return bytes number | Data field | CRC16 check |
|--------------|----------------|--------------------|---------------------|------------|-------------|
| Length(Byte) | 1 | 1 | 1 | N | 2 |

Host sent(write):

| Name | Device address | Function code 0x06 | Register address | Data field | CRC16 check |
|---------------|----------------|--------------------|------------------|------------|-------------|
| Length (Byte) | 1 | 1 | 2 | 2 | 2 |

Slave response(write):

| Name | Device address | Function code 0x06 | Register address | Data field | CRC16 check |
|---------------|----------------|--------------------|------------------|------------|-------------|
| Length (Byte) | 1 | 1 | 2 | 2 | 2 |

3.3.3. The Modbus register

(1) Modbus register table 1

| Status | Register address | Register function | Data type | Instruction |
|------------|------------------|-------------------|---------------------|--|
| Only read | 0x0100 | Processing value | Unsigned int, 16bit | After receiving the command, the module starts distance measurement and, after algorithm processing, outputs the distance value in mm. The response time is approximately 135ms (varies depending on the range). |
| Only read | 0x0101 | Real-time value | Unsigned int, 16bit | After receiving the command, the module starts the distance measurement once and outputs the real-time distance value in mm. The response time is about 20ms (depending on the range). |
| Only read | 0x0123 | Echo 1 distance | Unsigned int, 16bit | After receiving the instruction, the module initiates a distance measurement once and outputs the real-time echo 1 distance value, with the unit being mm. |
| Only read | 0x0124 | Echo 2 distance | Unsigned int, 16bit | After receiving the instruction, the module initiates a distance measurement once and outputs the real-time echo 2 distance value. The Unit: mm. |
| Only read | 0x0125 | Echo 3 distance | Unsigned int, 16bit | After receiving the instruction, the module initiates a distance measurement once and outputs the real-time echo 3 distance value. The Unit: mm. |
| Only read | 0x0126 | Echo 1 Amplitude | Unsigned int, 16bit | After receiving the instruction, the module initiates a distance measurement once and outputs a real-time echo of 1 amplitude. The Unit: mm. |
| Only read | 0x0127 | Echo 2 Amplitude | Unsigned int, 16bit | After receiving the instruction, the module initiates a distance measurement once and outputs a real-time echo of 2 amplitude. The Unit: mm. |
| Only read | 0x0128 | Echo 3 Amplitude | Unsigned int, 16bit | After receiving the instruction, the module initiates a distance measurement once and outputs a real-time echo of 3 amplitude. The Unit: mm. |
| Read-write | 0x0200 | Slave address | Unsigned int, 16bit | Range: 0x01 to 0xFE(default 0x01), 0xFF is a broadcast address. |
| Read-write | 0x0201 | Baud rate | Unsigned int, 16bit | Default 0x09, 115200bps; 0x02-4800, 0x03-9600, 0x04-14400, 0x05-19200, 0x06-38400, 0x07-57600, 0x08-76800, 0x09-115200 |

| | | | | |
|---|--------|--|---------------------|--|
| Read-write | 0x0208 | Angle grade | Unsigned int, 16bit | The angle level can be set from 1 to 4, with level 4 being the default. The higher the level, the larger the detection angle, the more sensitive the sensor, and the easier it is to detect small objects. The lower the angle level, the less effective the detection effect. |
| Read-write(Only UART controlled output valid) | 0x0207 | Output Format | Unsigned int, 16bit | 0x00: Regular protocol output (default output) 0x01: Customized protocol output (three echo distances And the three rebound amplitudes, check 0X123 ~ "0X128 register |
| Read-write | 0x021F | Distance measurement range | Unsigned int, 16bit | Default: 10 000 (10 meters) Setting range: 300 to 15 000, unit: mm |
| Only write(Only UART controlled output valid) | 0x023C | Hibernate | Unsigned int, 16bit | After writing 1, the module immediately enters hibernate mode |
| Read-write | 0x0401 | Detection switch of in the water or out of the water | Unsigned int, 16bit | Write 1 to enable the function of detecting whether the machine is in water, write 0 to disable this function, the default is 0. |

Note :

1. Register data for high bytes in front and low bytes after.
2. The instruction reading time must be longer than the instruction response time to ensure the integrity of the data frame sending and receiving.

(2)Effect of baud rate on single-packet communication duration

| Serial | Baud rate | Communication time | Remarks |
|--------|-----------|--------------------|---------|
| 1 | 4800 | 16ms | |
| 2 | 9600 | 8ms | |
| 3 | 14400 | 5.6ms | |
| 4 | 19200 | 4ms | |
| 5 | 38400 | 2.4ms | |
| 6 | 57600 | 1.6ms | |
| 7 | 76800 | 0.8ms | |
| 8 | 115200 | 0.6ms | |

Note : The higher the port rate, the shorter the single-packet communication time.

3.3.4. Modbus communication example

Example 1: Read the processing value data

Host : 01 03 01 00 00 01 85 F6

Slave: 01 03 02 02 F2 38 A1

Instruction: The sensor address is 0x01, and the processing distance value is 0x02F2, that convert to decimal to 754mm.

Example 2: Read real-time value data

Host : 01 03 01 01 00 01 D4 36

Slave: 01 03 02 02 EF F8 A8

Instruction: The sensor address is 0x01, and the real-time distance value is 0x02EF, that convert to decimal to 751mm.

Example 3: Modify baud rate

Host : 01 06 02 01 00 03 99 B3

Slave: 01 06 02 01 00 03 99 B3

instruction: The sensor address is 0x01, and the baud rate is modified to 0x03, that is 9600bps.

Example 4: Modify the ranging range

Host : 01 06 02 1F 03 E8 B9 0A

Slave: 01 06 02 1F 03 E8 B9 0A

instruction: The sensor address is 0x01, and the ranging range is modified to 0x03E8, that is 1000mm.

3.4. Description of immersing in and exiting from water detection function

3.4.1 Instructions for immersing in and exiting from water detection function

The module has a detection function of immersing in and exiting from water. This function must be enabled and calibrated before using. The sensor is tested in room with regular temperature water in a container with a length, width, and depth ≥ 50 cm, with no obstructions within 30 cm in front and a distance value measured to the container's inner wall. The sensor is first calibrated successfully. The sensor is then submerged in water (10 cm deep) for 1 second (at which point the sensor displays the distance value). It is then held out of the water (10 cm above the surface, with no water stains or water droplets less than 1 mm in diameter) for 1 second (at which point the sensor displays the module's out-of-water status).

Module for out-of-water status: Output: 0xFFFFB.

3.4.2. Calibration steps for immersing in and exiting from water detection function

The parameters for underwater entry and exit collected in different environments and waters may vary. Therefore, when the sensor is used in a new environment, it is necessary to re-calibrate the entry and exit water detection.

The following operation requires the sensor to be completely placed underwater in relatively still water, with no obstacles within 30cm in front.

Specific steps:

1. Connect the product to a serial port assistant or other communication device;
2. Send the command: 0xBF 0x01 0xAA 0x6A (01 is the device address, FF is the broadcast address);
3. Wait for the response data;
4. Response data: 0xBF + device address + 0x2A + success flag + checksum;

If the feedback flag is 0, calibration failed; if it is 1, calibration succeeded.

3.4.3. Examples of successful calibration

TX: BF 01 AA 6A

RX: BF 01 2A 01 EB

4. Limit parameters

4.1. Rated environment conditions

| Item | Minimum | Typical value | Maximum | Unit | Remark |
|-----------------------|---------|---------------|---------|------|--------|
| Storage temperature | -25 | 25 | 70 | °C | (1) |
| Storage humidity | - | 65% | 95% | RH | (1) |
| Operating temperature | 0 | 20 | 50 | °C | (2) |
| Operating humidity | - | - | - | RH | |

Remark: (1) a. When the ambient temperature is -25° C ~ 40° C, the maximum humidity is 95%.

b. When the ambient temperature is 40° C~70° C, the maximum humidity is the maximum natural.

(2) When working at low temperatures underwater, water must not be in a condensed state.

4.2. Rated electrical conditions

| Parameter | Specification | | | Unit | Remarks |
|-------------------|---------------|---------------|-----------------|------|--------------|
| | Minimum | Typical value | Maximum | | |
| Operating voltage | 4.75 | 5 | 5.25 | V | (1) |
| Peak current | | | 40 | mA | Peak to peak |
| Input ripple | | | 50 | mV | V-pp |
| Input noise | | | 100 | mV | V-pp |
| ESD | | | $\pm 4K/\pm 8K$ | V | (2) |

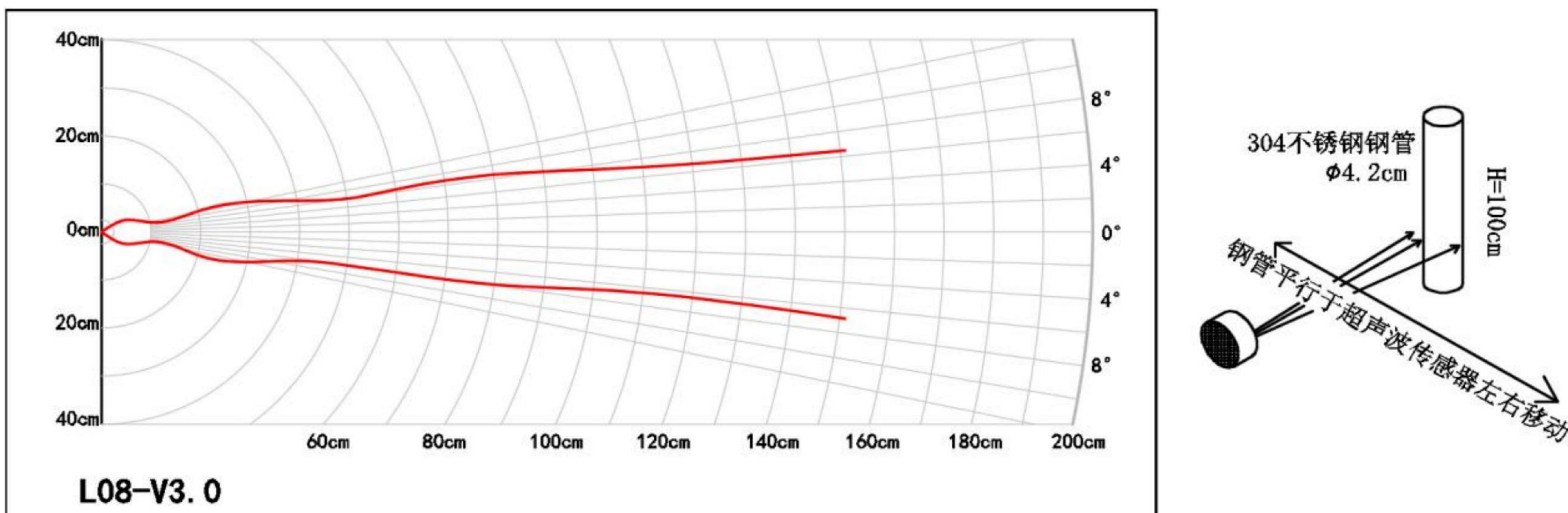
Remarks:

(1) If the supply voltage exceeds the range, it may cause permanent damage to the sensor.

(2) The connection leads and pins comply with the IEC61000-4-2 standard.

5. Reference of effective detection range

Data obtained from testing 304 stainless steel tube with OD 4.2 cm, high 100cm, and the steel pipe moves left and right parallel to the ultrasonic sensor.



Note: The above data is the default angle level 4 and was tested in the DYP Technology laboratory. In actual use, various factors such as product installation method and usage environment may differ from laboratory data. Please refer to the actual application environment for testing.

6. Model selection description

L08-module can be divided into two series according to different application scenarios, the output format is also divided into a variety of users can choose the corresponding model according to the actual application needs.

| Module name | Product module | Function point name | Remarks |
|-------------|-------------------|-------------------------|---------------------------------|
| L08-module | DYP-L081MTW-V3.0 | UART Controlled output | Range: 5 ~ 800 cm Angle: 15° |
| | DYP-L081M4W-V3.0 | RS485 Controlled output | |
| L08B-module | DYP-L08B50TW-V3.0 | UART Controlled output | Range: 8 ~ 800 cm Angle: 25° |
| | DYP-L08B504W-V3.0 | RS485 Controlled output | |

7. Matters needing attention

1. The company reserves the right to change this document and update the functions without notice;
2. Please pay attention to the structural tolerances when designing. Unreasonable structural design may cause transient abnormalities in module functions;
3. Please pay attention to the evaluation of electromagnetic compatibility when designing. Unreasonable system design may cause abnormal module function;
4. Other external factors interfere with ultrasonic transmission, which may cause the ultrasonic transmission to be mismeasured or impossible to measure, such as bubbles, turbidity, high velocity vortex water, mixtures of different media, etc.;
5. When the boundary application of the product limit parameter is involved, you can contact our FAE to confirm the relevant precautions.

8. Packaging specification

1. The default is Dianyongpu's conventional packaging method;
2. Packaging materials can be customized according to customer IQC related standards;
3. The container transportation method needs to adopt the staggered consolidation method, and at the same time, the outer edge of the single stack needs to be wrapped with a reinforced gusset to provide sufficient support.