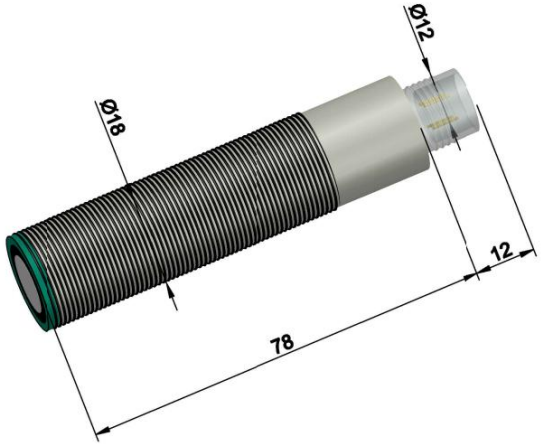
USER MANUAL

ONE-STOP SOLUTION ONE-STOP SERVICE

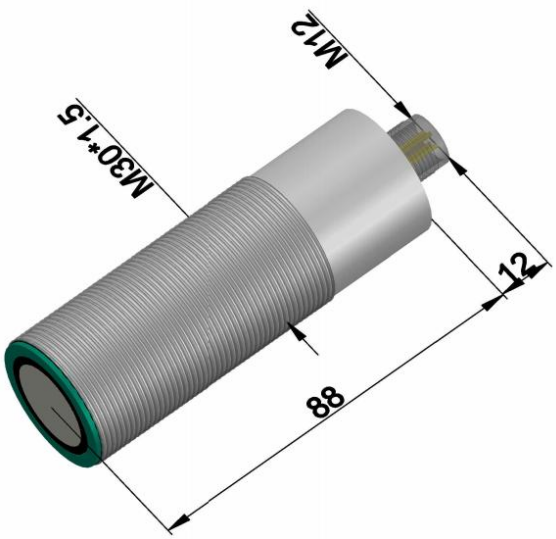
User Manual For Ultrasonic Level Sensor UL106

1. Dimension (Unit,mm)

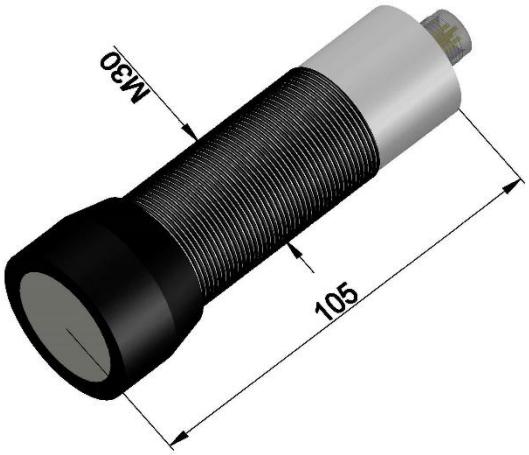
1m Range Sensor Size:



2m Range Sensor Size:



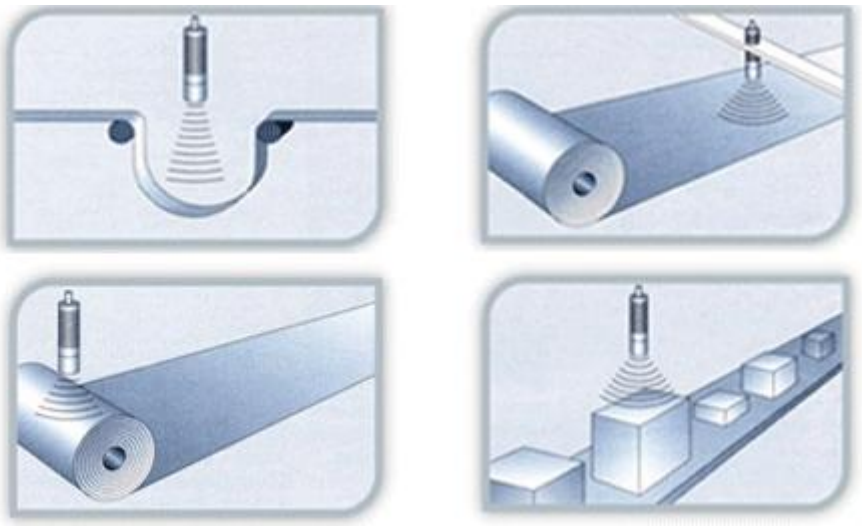
4m Range Sensor Size:



The sensor size may change without prior notice. Please consult relevant staff for details.

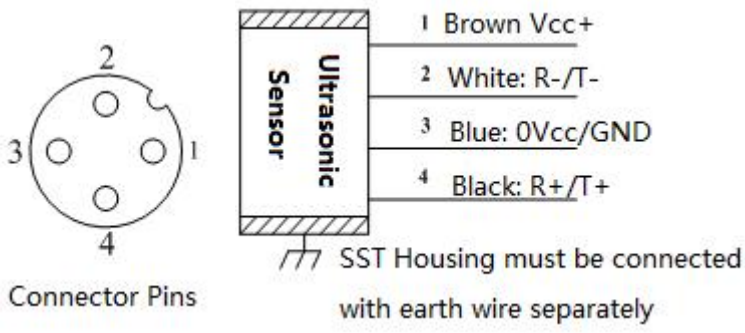
2.Installation Method

Ultrasonic wave has directivity, so it is recommended that the installation position is best perpendicular to the measured object to increase the measurement accuracy. (With mounting fixed nut)



3. Electronic Wires Connection

Sensors using metal enclosures/Housing are best to connect the metal enclosures to the earth to increase their ability to resist electromagnetic interference. If the sensor is installed on the equipment with strong electrostatic, it is recommended to choose plastic shell products to avoid electrostatic breakdown damage to the sensor.



4. Technical Specifications

Range	60~1000mm	100~2000mm	250~4000mm
Angle	15-25°		
Repeat Accuracy	0.3%		
Resolution	0.1%F.S.(0.5mm min.)		
Temp drift	0.05%/ºC (build-in temperature compensation.)		
Linearity	<1%		
PCBA Protections	Anti-reverse connection protection, instantaneous overvoltage protection		
Power Supply	10~30VDC or 15-30Vdc		
Power consumption	20mA		
Signal Output	RS485 (Modbus RTU protocol)		
	4-20mA		
	0-5V		
	0-10V		
Working Temp.	-20°C~+80°C		
Storage Temp.	-40°C~+80°C		
Material of housing	Copper nickel plating or Plastic option		
Load	Current output:<500Ω Voltage output:>5kΩ		
Water Proof	IP67		
Cable Length	2m		

4.1 Temperature Influence 1:

The speed of sound depends on the composition of the gas being transmitted, the pressure of the air, the humidity of the air, and the temperature. For most ultrasonic applications, gas composition and pressure are relatively constant, while temperature may vary (for every 6°C change in average temperature, the speed of sound in the air varies by 1%).In the air, the air propagation velocity is approximately equal to the following formula:

$$C_{m/s} = 20\sqrt{273 + T_c}$$

$C_{m/s}$ = speed of sound in meters per second
T_c = temperature in °C

Temperature compensation can compensate for 80 to 90% of the errors due to temperature effects (the compensation effect will be reduced if there is a temperature gradient in the measurement range).

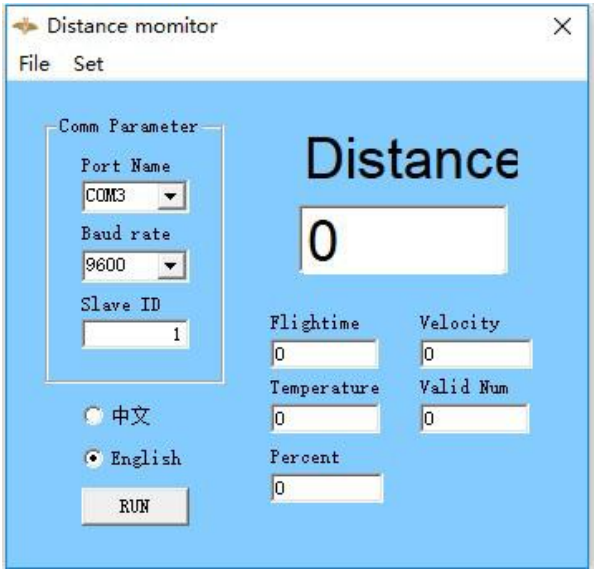
4.2 Temperature Influence 2:
The temperature compensation device located inside the sensor cannot adapt to the environment temperature change as quickly as the external temperature compensation device. When the temperature fluctuates rapidly, it is better to use external temperature monitor to correct the distance measurement that the sensor fails to compensate in time, so as to complete the accuracy requirements required by the detection control. When temperature compensation is used, direct exposure to sunlight will affect the temperature compensation accuracy of the sensor due to the change of temperature. In addition, the temperature compensation function has a certain lag, about 30 minutes.

4.3 Measurements: different measured objects have different reflection intensity of sound. For materials like wool and corduroy, which are easy to absorb sound, it is suggested to select some sensors with a longer measurement; range and lower frequency. Please keep a certain margin when you measure.

4.4 influence of airflow: when airflow exceeds 5~10m/s in the environment, it may affect the sensor's measuring sensitivity and accuracy.

5. Introduction to communication and testing software

5.1 Main interface of the software



Three communication parameters, "serial port number", "baud rate" and "device number", are displayed on

the main interface of the software. You need to set these three parameters before using the software to access the device.

Serial port number: serial port number on PC machine

Baud rate: baud rate of the equipment to be communicated

Device number: Modbus device number of the communication device to be communicated

"Transmission time", "distance", "effective data volume", "temperature" and other observation parameters are displayed on the main interface of the software to read the contents transmitted by the device.The meaning of parameters is as follows:
Time (us): the time interval between the ultrasonic wave emitted by the Sensor and the echo received. The user can use this parameter directly when making temperature compensation outside the device.

Temperature (℃) : The internal temperature value of the Sensor, which is used to compensate the effect of temperature on the speed of sound. Because the Sensor is hot, the internal temperature of the Sensor is higher than the ambient temperature. If the user wants more accurate temperature compensation, the distance value can be calculated by propagation time after the temperature is measured externally.

Distance (mm): the distance value calculated by the Sensor through internal temperature compensation and filtering algorithm. This value is displayed as 0 when the object under test is within a blind area. When the range is exceeded, the value is shown as 6553.5.

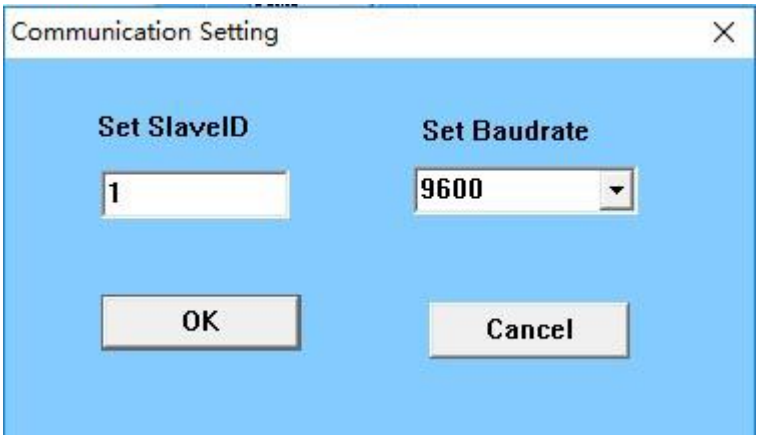
Effective number: the effective data quantity in the filtering window, which must be less than or equal to the filtering window length N set in the Sensor.

Percentage (%): the distance 1 of the yellow LED is 0%, and the distance 2 is 100%. Calculate the percentage of the current distance.
Velocity (mm/s): the moving speed of the measured object relative to the Sensor. The velocity is positive when distance increases, and negative when distance decreases.

5.2 Product Setting Interface

5.2.1 Device Communication Setting

Open the "Settings" on the main interface of the software -- > "communication Settings" and enter the modbus setting window of the product.



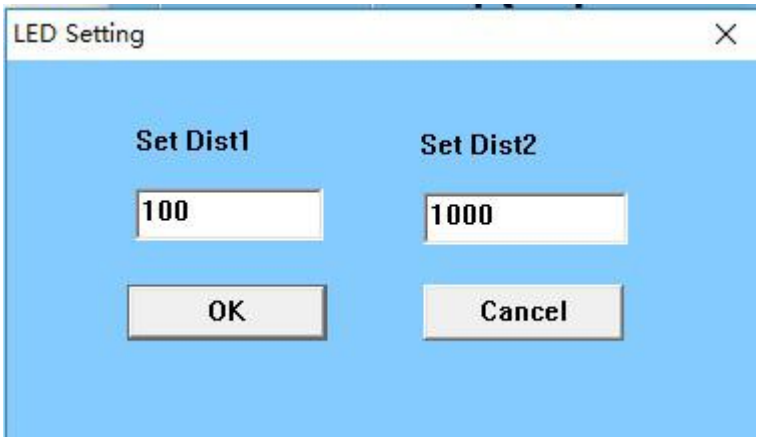
Setting device number: reset Modbus serial number from 1 to 247 (factory setting 1).

Set baud rate: reset communication baud rate (factory set to 9600).

Note: power off and restart the device to complete any changes to the product Settings.

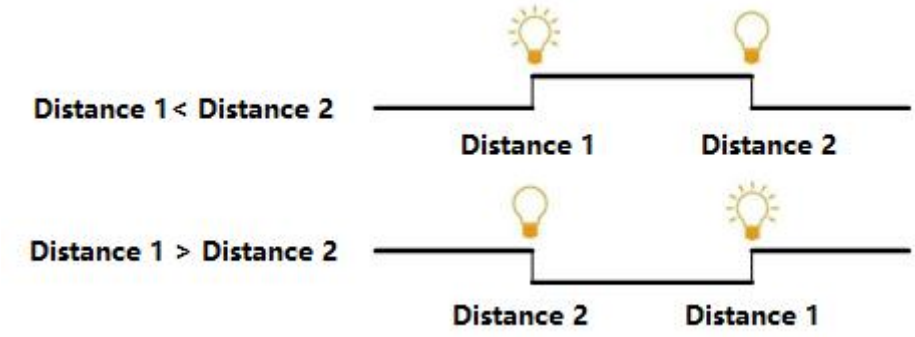
5.2.2 Indicator Light Setting

Open "product Settings" -- > "product indicator Settings" on the main interface of the software, and enter the setting window of LED indicator of Sensor.



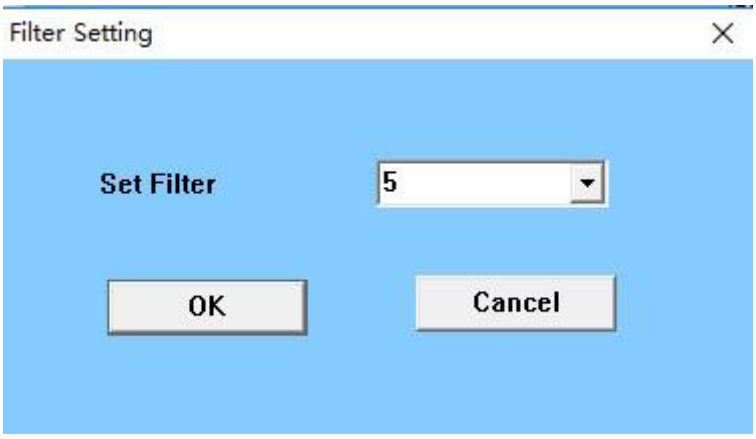
Setting distance 1 (mm): the distance point where the yellow LED indicator is turned ON (factory setting is 100.0).

Setting distance 2 (mm): the distance point where the yellow LED indicator is turn OFF (factory setting is 1000.0).

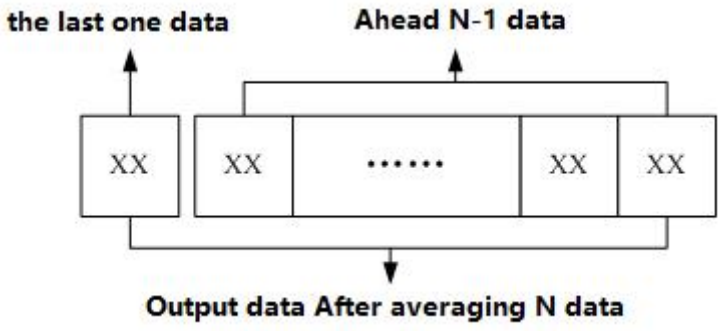


5.2.3 Filter Setting

Open "Settings" -- > "filter Settings" on the main interface of the software and enter the filter Settings window.

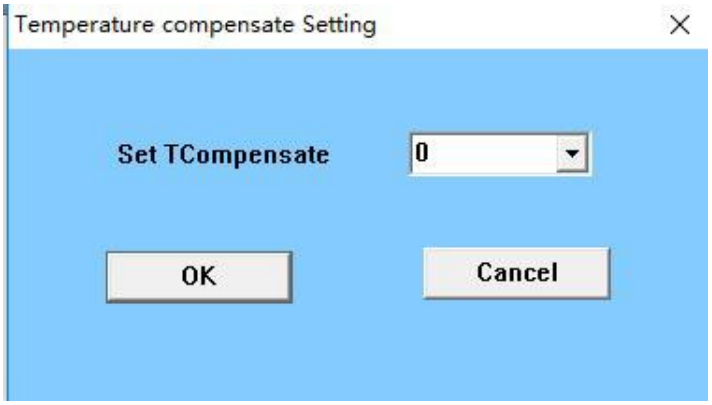


The Sensor is equipped with a digital window filter, whose calculation method is the distance value of the current collection and the first n-1 value, after removing the collected abnormal points, the accumulation to calculate the average. The filter window size N can be set by software, and the setting range is 1~10 (factory setting is 5).When set to 1, the product directly outputs the original data without filtering calculation.



5.2.4 Temperature correction setting

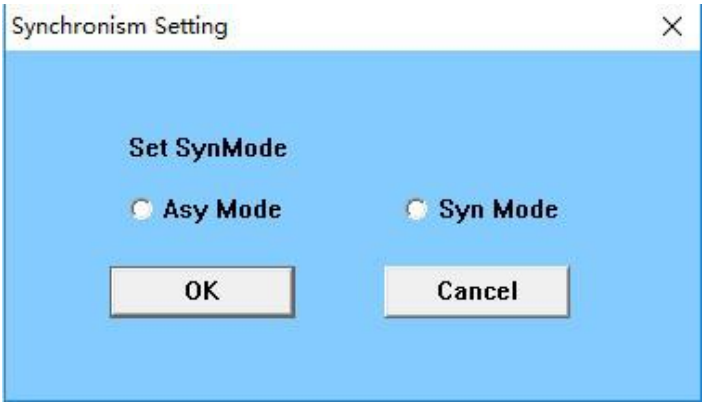
Open "setting" -- > "temperature calibration setting" on the main interface of the software and enter the temperature calibration setting window.



Because the circuit will be hot, so the range finder internal temperature and air temperature will have errors. The temperature sensor in the Sensor has been designed to uniformly calibrate this error. However, if the user needs more accurate ambient temperature values, the temperature correction register can be used to calibrate each Sensor individually. The calibration temperature resolution accuracy is 1℃, the range is -10℃~10℃.

5.2.5 Synchronous mode setting

Open the "Settings" -- > "synchronization Settings" on the main interface of the software and enter the synchronization mode setting window.

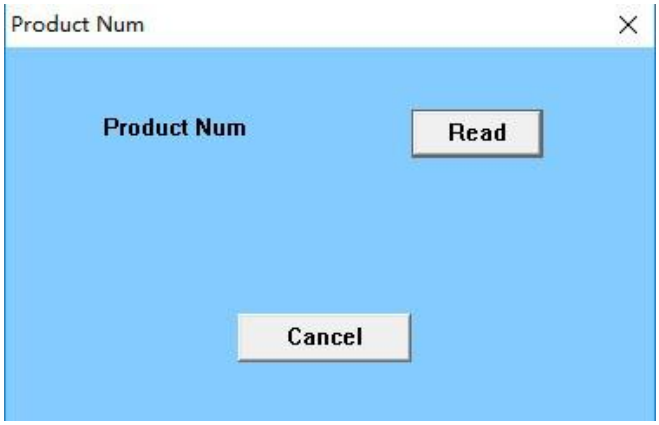


Asynchronous mode: the Sensor synchronizes according to the internal clock, and measures at the frequency of 16Hz after energizing.

Synchronous mode: the Sensor does not take the initiative to measure after electrification. Whenever the modbus host sends a query of the command of input register, the Sensor will send an ultrasonic wave for a measurement and reply the measured value to the host. When multiple Sensors are close to each other, synchronous mode is recommended to prevent ultrasonic interference from each other. The velocity value measured by the instrument in synchronous mode is invalid.

5.2.6 Synchronous mode setting

Open "Settings" -- > "factory number" on the main interfaces of the software and enter the setting window of factory number. The unique factory number of each product can be read.



6. Communication format

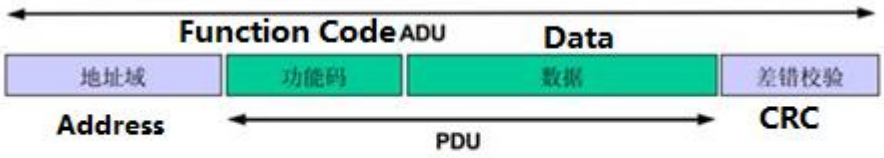
6.1 Serial port format

8 bit data bit, 1 bit stop bit, no even check.

6.2 Modbus Introduction of agreement

Modbus is a common communication protocol in the industry, including RTU, ASCII, TCP, this product USES modbus-rtu protocol. Modbus is a protocol of request/reply mode, which is to send request commands to slave devices through the master device and return reply commands from slave devices. On a standard RS485 hardware bus, there is only one master, one slave, or more, and each slave has a unique non-zero slave number. Master devices can send access commands to slave devices by slave number or to all slave devices by broadcast. When accessing a single device, the slave device returns a reply on the bus, and the slave device does not respond when broadcasting.

Each command sent by Modbus is a string of data, called a frame message. Each frame consists of address field, function code, data and error checking. For example: 01 06 00 01 00 17 98 04 in this frame message, the address field is 01, the function code is 06 (write a single register), the data is 00 01 00 17, and the error check is 98 04.



General MODBUS frame

The Sensor supports Modbus access to two registers, the input register and the hold register, the difference as shown in the table.

Register Type	Size	Read/Write Type	Support Commands	Function
Input Register	16-bit	Just Reading	0x04	Storage the measuring data

				of sensor
Hold Register	16-bit	Read/Write	0x03,0x06,0x10	Storage the sensor setting parameters

This article provides only a basic introduction to Modbus. There are many aspects of Modbus protocol.

6.3 Command code introduction

6.3.1 03(0x03) Read hold register

Use this function code to read the contents of a contiguous block of registers. The request PDU specifies the starting register address and register number. Registers are addressed from zero, so the address of the addressable input registers 1 through 16 should be 0 through 15.The register data in the response message is divided into two bytes per register and the binary contents are directly grounded in each byte. For each register, the first byte contains the high-order bits and the second contains the low-order bits.

Request

Function Code	1 bit	0x03
Start address	2 bits	0x0000 ~ 0xFFFF
Num of register	2 bits	1 ~ 125（0x7D）

Response

Function Code	1 bit	0x03
Num of bits	1 bit	2×N*
Value of register	N*×2 bits	

*N＝Numbers of register

6.3.2 04(0x04)Read the Input register

From 1 to 125pcs consecutive input registers can be read using this function code. The request PDU specifies the starting address and register number. Registers are addressed from zero, so the address of the addressable input registers 1 through 16 should be 0 through 15.The register data in the response message is divided into two bytes per register and the binary contents are directly grounded in each byte. For each register, the first byte contains the high-order bits and the second contains the low-order bits.

Request:

Function Code	1 bit	0x04
Start address	2 bits	0x0000~0xFFFF
Number of register	2 bits	0x0001 ~ 0x007D

Response:

Function Code	1 bit	0x04

Num of bits	1 bit	2×N*
Value of register	N*×2 bits	

*N＝Numbers of register

6.3.3 06 (0x06) Write a single hold register

Use this function code to write a single hold register. The request PDU specifies the address to be written to the register. Addressing from register zero, so addressing input register 1 address is 0.The response requested during a normal response is the same as when the register contents are written.

Request:

Function Code	1 bit	0x06
Register address	2 bits	0x0000 ~ 0xFFFF
Value of register	2 bits	0x0000 ~ 0xFFFF

Response：

Function Code	1 bit	0x06
Register address	2 bits	0x0000 to 0xFFFF
Value of register	2 bits	0x0000 to 0xFFFF

6.3.4 16 (0x10) Write multiple hold registers

Use this function code to write continuous register blocks (1 to approximately 120 registers).Specifies the value that the request writes in the request data field. Each register divides the data into two bytes. The normal response returns the function code, the starting address, and the number of registers written.

Request the PDU

Function Code	1 bit	0x10
Start address	2 bits	0x0000 to 0xFFFF
Number of register	2 bits	0x0001 to 0x0078
Number of bits	1 bit	2×N*
Value of register	N*×2 bits	Value

*N＝Numbers of register

Response PDU

Function Code	1 bit	0x10
Start address	2 bits	0x0000~0xFFFF
Number of register	2 bits	1~123(0x7B)

6.4 Register Contents

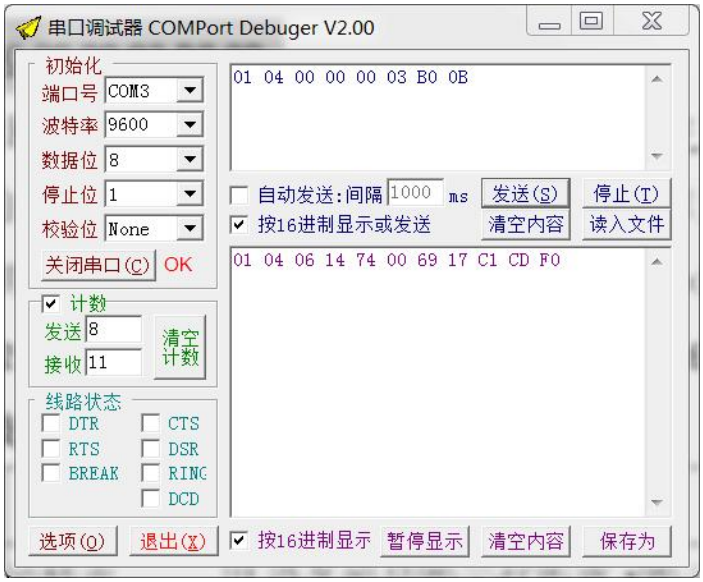
Input register (support access command 0x04)

Register address	00	01	02	03	04	05
Register contents	Acoustic time of flight	Inner Temp	Measuring distance	Effective data volume	Distance percentage	Moving speed
Unit of data	1/1.44 us	0.0625℃	0.1mm	Non	%	mm/s

Example: the command to query the values of the first three registers from device 1 simultaneously is (hexadecimal representation):

01 04 00 00 00 03 B0 0B

Sensor response： 01 04 0614 74 006917C1CD F0



The data answered by the equipment is 16-bit signed shaping data, which needs to be converted into decimal system and the unit in the table to measure the actual value.0x1474 represents flight time t=5236/1.44=3636.11us;0x0069 means internal temperature T=105*0.0625=6.5625℃;0x17C1 means the distance L=6081*0.1=608.1mm.0xCDF0 is a CRC check value.

6.5 Hold register (support access command 0x03 0x06 0x10)

Register address	00	01	02	03	04	05	
Register contents	Acoustic time of flight	Inner Temp	Measuring distance	Effective data volume	Distance percentage	Moving speed	
Unit of data	1/1.44 us	0.0625℃	0.1mm	Non	%	mm/s	
Register address	08	09	10	11	12	13	14
Register	Baud rate	Sensor No.	Indicator	Indicator	Filter length	The temp	Synchronous

contents			distance 1	distance 2		calibration	mode
Span of setting	The 9 values are as follows	1~247	600~10000	600~10000	1~10	-30~30	0:asynchronous 1:synchronous

Example: write baud rate to device broadcast command 9600 from device number 01 (hexadecimal representation): 00 10 00 08 00 02 04 25 80 00 01 3d d1.

Device return: No devices return value.

The baud rate range of product support is 1,200, 2,400, 48,000, 9600, 14400, 19200, 38400, 56000and 57600.The setting range of indicator light distance is 600~10000, with the unit of 0.1mm.

7. Common troubleshooting

The software doesn't send out data	1. Poor quality or incorrect installation of USB to RS485 cable on PC 2. Compatibility between software and PC can be replaced by serial wizard
Software can send data, the sensor does not return	1. Poor contact of RS485 communication line 2. Baud rate or from the device number does not match, can be reset after the connection
The software can send data, and the sensor returns an error	1. There is a short circuit or other interference on the bus 2. There is a slave device with the same name on the bus
The sensor occasionally beats a large number while working	The obstacle plane is not perpendicular to the ultrasonic wave, or the obstacle size is too small, which makes the echo signal very weak
The distance output of sensor varies periodically	If more than two rangefinders are close enough, one of them will send ultrasonic reflections into the other sensor, causing interference

8. Precautions

A) The sensor is a precision instrument, do not damage the surface.
B) The outer shell material of this sensor is ABS. Do not use it under strong acid and alkaline conditions.
C) Do not use the product in the environment of strong mechanical vibration or strong electromagnetic interference.
D) The products are forbidden to be opened without permission. Otherwise, the company will not be responsible for any consequences.
E) Do not use the product in the vacuum or explosion-proof area, otherwise the user shall bear the consequences.
The company reserves the right of final interpretation. If you have any questions, please feel free to contact us.

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