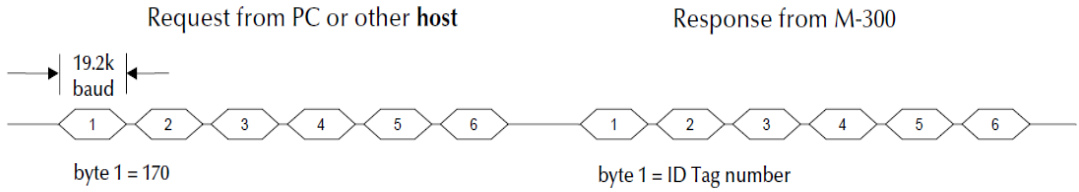
# KUS550 Series Ultrasonic Sensor MODBUS Protocol（version V2.4）

| Version | Record | Date |
|---|---|---|
| V1.0 | Public | 2014.8.7 |
| V2.4 | Modify the register address and add some FAQs | 2020.9.1 |

# 1.Communications Protocol

The data rate defaults to 19.2 K baud. Each byte contains 10 bits that include a start bit, 8 bit data, and1 stop bit and no parity bit. There are a total of 6 bytes required to access the KUS550. The KUS550 will respond back with 6 bytes that include status (range to target, temperature, target strength, etc), Data Memory read requests, and sensor error messages on the RS-485 bus. Transmitted values are in binary.



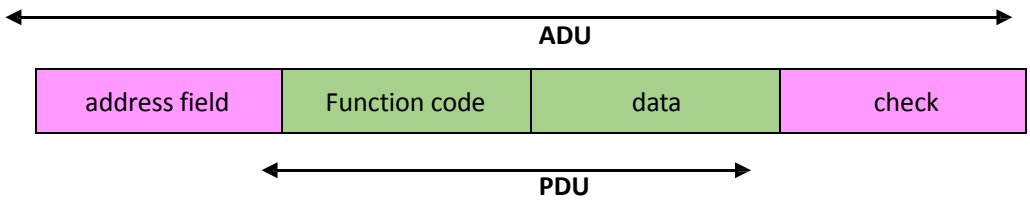

# 2. Sensor Commands

Each command has a total of 6（or 8）bytes, and all sensor commands are sent and displays by HEX. The sensor ID Tag uses 01 as an example

## 2.1 modbus Commands

### 2.1.1 Protocol description

MODBUS protocol defines a simple protocol data unit (PDU) independent of the underlying communication layer.On a particular bus or network MODBUS protocol mapping can introduce additional domains on application data units (ADU).




Clients that initiate MODBUS transaction processing create MODBUS application data units. The function code indicates to the server where to execute Kind of operation.

## 2.1.2 Modbus Message Framing

**1）Request command**

| Sensor ID | Function code | Data address | Data length | Check sum(CRC16) |
|---|---|---|---|---|
| 1 byte | 1byte | 2 byte | 2 byte | 2 byte |

Supported function code:

(1) Read Holding Register (03)

(2) Preset Single Register (06)

Example for Read Holding Register (03).

Command is 010300000001840A for reading 00 register length = 1

0103010000030437 for reading status info(0x100)and distance(0x101) and temperature(0x102)

Command is 0103010100029437 for reading distance and temperature

Command is 010301010001D436 for reading distance(0x101)

**2）Response**

| Sensor ID | Function code | Data length | Data | Check sum(CRC16) |
|---|---|---|---|---|
| 1 byte | 1byte | 1 byte | (Data length)*2 byte | 2 byte |

Example: Response is 000036-Rx:01030206017A24 (The contents of register 0D are 00AA）

Tx:01 03 00 00 00 0A C5 CD

Rx:01 03 14 06 01 00 00 0E 01 13 A5 00 01 07 D0 00 00 00 00 03 FF 19 16 5F 27

Tx:01 03 01 00 00 03 04 37

Rx:01 03 06 00 08 18 6D 00 0A D7 CE

Tx:01 03 01 01 00 02 94 37

Rx:01 03 04 18 78 00 0B 3D 4D

Tx:01 03 01 01 00 01 D4 36

Rx:01 03 02 18 6A 32 6B

Example for Preset Single Register (06)

As the physical register is 8bits width and the 2 bytes wrote or read by the modus protocol, so the physical register is joint together, if the address n register should be wrote, the acceptable operation is read the address n and get the value of registers n and n+1, keep the register n+1 still and modify the register n, write the value of register n and n+1 back.

A), Change the baud rate to 38400bps,

Step1: Read the register 0x00

Tx:01 03 00 00 00 01 84 0A

Rx:01 03 02 06 01 7A 24

Step2: write 0x0701 to 0x00and 0x01; address

Tx:01 06 00 00 07 01 4A 3A

Rx:01 06 00 00 07 01 4A 3A

Setp3: write 0x00 to address 0x100 to reboot the sensor

Tx:01 06 01 00 00 00 88 36

Rx:01 06 01 00 00 00 88 36

Step4: Change the host baud rate to 38400bps and reconnect

## 2.2 Normal operation for the sensor

Below is some normal operation of the sensor. Such as change the distance sensor working as level sensor, change the measure result unit, change the measure period, change the baud rate.

### 2.2.1), Reboot the sensor

Write to the register 0x100 any value to reset the sensor.

Step1: write 0x00 to the register 0x100 to reset the sensor.

Tx:01 06 01 00 00 00 88 36

Rx:01 06 01 00 00 00 88 36

### 2.2.2), Change the slave sensor ID

Step1: inquiry the sensor ID the default is 0x01

Tx:01 03 00 2A 00 01 A5 C2

Rx:01 03 02 01 00 B9 D4 01 00 is the value in the 0x2A and 0x2B 8-bits-long registers.

Step2: change the ID to 2,

Tx: 01 06 00 2A 02 00 A9 62 write 0x02 to 0x2Aregister and write 0x00 to 0x02Bregister.

Rx:01 06 00 2A 02 00 A9 62

Step3: Active the new ID by reboot the sensor by reset the sensor.

Tx:01 06 01 00 00 00 88 36

Rx:01 06 01 00 00 00 88 36

### 2.2.3), Change the measure type from distance mode to liquid level mode.

Step1: read the measure result

Tx:01 03 00 47 00 01 34 1F inquiry 0x47 and 0x48 register, the 0x48 is the measure type register ==0 the measure result is distance ==1 the measure result is level.

Rx:01 03 02 FF 00 F9 B4 inquiry result the 0x47 is 0xff, and the 0x48 is 00, indicate the measure result is distance.

Step2:set the tank depth ( the depth is 20000mm)

Tx:01 06 00 4B 4E 20 CD A4 set register 0x4b as 0x4e, set 0x4c is 0x20, 0x4e20 is 20000 0.1mm in decimal that means 2000mm

Rx:01 06 00 4B 4E 20 CD A4 The result. Is 0x4e20.

Step3: change the measure result type

Tx:01 06 00 47 FF 01 B9 EF set the register0x47 as 0xff(keep default) and set 0x48 register as 0x01to set measure result as level.

Rx:01 06 00 47 FF 01 B9 EF The result. Is 0xFF01.

Step4: Reboot to active the settings.

Tx:01 06 01 00 00 00 88 36

Rx:01 06 01 00 00 00 88 36

### 2.2.4), Change the measure type as distance.

Step1: read the measure result

Tx:01 03 00 47 00 01 34 1F inquiry 0x47 and 0x48 register, the 0x48 is the measure type register ==0 the measure result is distance ==1 the measure result is level.

Rx:01 03 02 FF 01 38 74 inquiry result the 0x47 is 0xff, and the 0x48 is 01, indicate the measure result is level.

Step2: change the measure result type to distance

Tx:01 06 00 47 FF 00 78 2F set the register0x47 as 0xff(keep default) and set 0x48 register as 0x01to set measure result as level.

Rx:01 06 00 47 FF 00 78 2F The result. Is 0xFF01.

Step4: Reboot to active the settings.

Tx:01 06 01 00 00 00 88 36

Rx:01 06 01 00 00 00 88 36

### 2.2.5), Inquiry the slave address(ID) of the sensor *

This operation is used when the sensor ID is unknown. The method is sending broadcasting command to read the 0x2A register for the slave address

Tx: 01 03 00 2A 00 01 A5 C2

Rx:01 03 02 01 00 B9 D4 Get the salve address(ID) is 0x01.

*:the memory address of slave address(ID) is 0x28 if the software version is less than V2.4*

### 2.2.6), Modify the measure period.

The default measure result is 5Hz, that means the period of measure is 200ms, the 1 LSB is 25ms,

Step1 inquiry the period registers 0x64,0x65,0x66.

Tx:01 03 00 64 00 02 85 D4 Inquiry the 0x64,0x65,0x66,0x67 4 registers.

Rx:01 03 04 00 00 08 FF BD B3 the result is 0x000008, is the period parameter, the period is 8*25ms=200ms

Step2 set the new period number to 0x000009 to modify the period to 225ms

Tx:01 06 00 66 09 FF 2F C5 set the register 0x66 to 0x09, keep the 0x60 still.

Rx:01 06 00 66 09 FF 2F C5. The result is 0x09ff.

Step3: Reboot to active the settings.

Tx:01 06 01 00 00 00 88 36

Rx:01 06 01 00 00 00 88 36

### 2.2.7), Modify UART Baud rate as you want

Look up the appendix table for the register 0 and get the right baud rate settings. The default baud rate is 19200bps, the parameter is 6, for example change the baud rate from 19200 to 57600, should change the register 0 from 6 to 8.

Step1: inquiry the 0x00 and 0x01 register value,

Tx:01 03 00 00 00 01 84 0A

Rx:01 03 02 06 01 7A 24

Step2: set the register 0x00 to 8 and leave register 0x01 alone.

Tx:01 06 00 00 08 01 4F CA

Rx:01 06 00 00 08 01 4F CA

Step3: Reboot to active the settings.

Tx:01 06 01 00 00 00 88 36

Rx:01 06 01 00 00 00 88 36

Step4: modify the host baud rate to the same57600.

### 2.2.8), Change the analog output as switch output

The analog output can work in switch output mode, look up the register catalogue, 0x55(85) register define analog output type =0x00 voltage output in liner mode, =0x01, Voltage Output as switch， there are 2 the switch set points, switch near set point called A1 and switch Far Set point called A2. The output changes according the distance or level. We take below as a result to demonstrate the setting method.

The user want define the output 0v when the distance less than A1(500mm), and output 10V when the distance between A1(500mm) and A2(2000mm), and 0V the distance more than A2(2000mm).

If the analogue output is 4-20mA, the0v and 10v will be 4mA and 20mA instead,

Step1: Inquiry and set A1 as 500mm,(write 5000 (0x1388)to 0x51 and 0x52 register)
Tx:01 03 00 51 00 01 D5 DB
Rx:01 03 02 07 D0 BB E8
Tx:01 06 00 51 13 88 D5 4D
Rx:01 06 00 51 13 88 D5 4D
Step2: Inquiry and set A2 as 2000mm,(write 20000(0x4E20) to 0x53 and 0x54 register)
Tx:01 03 00 53 00 01 74 1B
Rx:01 03 02 61 A8 90 6A
Tx:01 06 00 53 4E 20 4D A3
Rx:01 06 00 53 4E 20 4D A3
Step3: inquiry the Switch Mode Output Operation register(0x58) ,and write 0x05 into it.
Tx:01 03 00 58 00 01 05 D9
Rx:01 03 02 12 FF F4 A4
Tx:01 06 00 58 05 FF 4B 09
Rx:01 06 00 58 05 FF 4B 09
Step4: Inquiry and Set the output as switch out( write 0x01 into 0x55(85)register)
Tx:01 03 00 55 00 01 94 1A inquiry the 0x55(85) and 0x56(86)registers.
Rx:01 03 02 00 28 B8 5A
Tx:01 06 00 55 01 28 98 54 set 0x55register as 0x01 and keep 0x56(86 register still)
Rx:01 06 00 55 01 28 98 54
Step5: Reboot to active the settings.
Tx:01 06 01 00 00 00 88 36
Rx:01 06 01 00 00 00 88 36

### 2.2.9),How to change the range

The product range can be modified according to the demand. However, please note that the modified range should not exceed the maximum measurement range of this product, and should not be less than the measurement blind area of this product.

Address 73 and address 75 represent the minimum distance and maximum distance(unit:0.1mm)respectively(The analog output is modified by 0x73 and 0x75,and the switching output is modified by 0x81and 0x83).Here,the modified range of 4-20mA product is introduced as an example.For example,modify the detection range to 2000-10000(unit:0.1mm):

Step1: modify the register of 0x73 to 2000 or modify the register of 0x81 to 2000;
Step2: modify the register of 0x75 to 10000 or modify the register of 0x83 to 10000;
Step3: send reset instruction 0x256 address,click OK.
And there is an example:
The original range is 2000-30000(unit:0.1mm)product,the customer requires to change the range to 2000-6000(unit:0.1mm)and 3000-7000(unit:0.1mm),and the cpecific steps are as

follow:
Change range to 2000-6000(unit:0.1mm):
Step1:Tx:01 06 00 49 07 D0 5B B0 change 73 address to 2000
Rx:01 06 00 49 07 D0 5B B0
Step2:Tx:01 06 00 51 07 D0 DB B7 change 81 address to 2000
Rx:01 06 00 51 07 D0 DB B7
Step3:Tx:01 06 00 4B 17 70 F7 C8 change 75 address to 5000
Rx:01 06 00 4B 17 70 F7 C8
Step4:Tx:01 06 00 53 17 70 77 CF change 83 address to 5000
Rx:01 06 00 53 17 70 77 CF
Step5:Tx:01 06 01 00 17 70 86 22 reset
Rx:01 06 01 00 17 70 86 22

Change range to 3000-7000(unit:0.1mm):
Step1:Tx:01 06 00 49 0B B8 5F 5E change 73 address to 3000
Rx:01 06 00 49 0B B8 5F 5E
Step2:Tx:01 06 00 51 0B B8 DF 59 change 81 address to 3000
Rx:01 06 00 51 0B B8 DF 59
Step3:Tx:01 06 00 4B 1B 58 F2 D6 change 75 address to 7000
Rx:01 06 00 4B 1B 58 F2 D6
Step4:Tx:01 06 00 53 1B 58 72 D1 change 83 address to 7000
Rx:01 06 00 53 1B 58 72 D1
Step5:Tx:01 06 01 00 1B 58 83 3C reset
Rx:01 06 01 00 1B 58 83 3C

### 2.2.10) How to modify the measuring period

In the actual measurement process, the customer may need to modify the measurement period. The default detection period of our product is 200 ms, (the default register value is 0x000008, and 1lsb=25ms). Of course, the customer can modify the measurement time according to his actual situation. There measurement period defined by a 24-bit register, which is a combo by the registers 0x64, 0x65 and 0x66. So the maxim period is 0xFFFFFF*25ms=419430 seconds and the minimum period is 0 ms ( the register value is 0 and the real period is around 15ms).

Here is an example of how to make a measurement every 5 minutes.

If we want to modify the period to 5 minutes, the register value can be calculated by:

5*60 *1000 /25= 12000 (0x002EE0), so the value in registers 0x64 0x65 and 0x66 is 0x002E00. The modification as follows:

Step1: Tx:01 06 00 65 2E E0 85 FD
Rx:01 06 00 65 2E E0 85 FD Modified measurement time (5 minutes)
Step2: Tx:01 06 01 00 2E E0 94 1E
Rx:01 06 01 00 2E E0 94 1E reset

And there is a rule should concern here, as the average window is minimize the error of measurement by make average for the last server time measure result. if the measurement period goes too long, the average will make no sense. So the average window should be modified to 0. This example is a requirement actually proposed by the customer. We have modified the period and changed the default average window size of the software from 10 to 0 (This means that the output value has been changed from the average of 16 tests to a single test value). Customer request once every 5 minutes output measurements, if the average output, then the last output will be the average of several measurements, because the customer measure requirement, the liquid level is continuously produce small changes, so with the increase of time, the change of liquid level will be more and more big, the last

time this will lead to the average output of produce error, so we should make each output a single test value.

Note: How to change the average window from 10 to 1:

Step1: Tx:01 06 00 5D 00 00 18 18

Rx:01 06 00 5D 00 00 18 18

Step2: Tx:01 06 01 00 00 00 88 36

Rx:01 06 01 00 00 00 88 36 reset

# 3. working in the low power mode

There is 3 kinds of working mode,

## 3.1: Ultrasound normal measuring mode

The KUS550L ultra low power consumption ultrasound waterproof sensor will keep measuring for a determined period, the default period is 200ms, and the smallest period is around 25ms. The KUS550L ultra low power consumption ultrasound waterproof sensor will keep transmitting the ultrasound to measure the distance. this mode is usually used to measure when the application field ask quick response for the distance change. Or during the system adjustment and match. also the limitation of this mode is only 1 sensor for one place and direction, on the same RS485 bus.

## 3.2: ultrasonic standby measuring mode

The sensor will standby till the distance inquiry command sent from the host. The same to say, we can control the senor when and how to transmit ultrasound to measure, so it is very useful when there are more than 2 sensor in a limited space to measure the different direction and position. It's very easy to use during this kind of application field, it's acceptable for 254 sensors in one RS485 bus with the different address 0x01-0x254.

## 3.3: Sleep and waken able for measuring mode

This is the lowest power consumption mode, the sensor will be sleep after power on, the sensor will be wakened up when there is high to low or low to high change on the RXD pin of the sensor, and the sensor will receive the UART frame to process. If the command is distance inquiry command the sensor will trigger a measuring and response to the host and then go to sleep. The sensor will keep wakened around 10ms, so the host must send 2 parts signals to the senor, lead code and then the Modbus-RTU command in 10 ms.

So, there are some methods to save power as follows, if just consider the software configuration.

1 modify the measure period to as long as the customer can accept by modify the register 0x64-0x66

2 the KUS550L and KUS600 is Low power consumption product.

First the KUS550L and KUS600 are low power consumption type product, which just have RS485 or TTL logic UART output signals.

There is some little different for the protocol of KUS550L and KUS600 comparing with other related product such as KUS500.and KUS3000.

The sensor first will be set working in mode 2, by which the sensor will sleep after measure each time.

# 4 FAQ

## Question 1: What can I do, as I cannot connect to the sensor by RS485.

If the user cannot get any echo from sensor UART, there may be something wrong, pls check as below.

Step 1, Check the sensor if it's working, by listen the sound of the probe.

If you can listen the click sound when you go near the sensor around several centimeters, the means the sensor is working well. Else you can also check the power consumption, the current is around 10mA-20mA, if the current goes too high or too low, maybe there is something wrong with the sensor please contact KACISE for more support. Or if the product is 550L or 600, the sleep mode power consumption is less than 0.2mA, it's normal. The 550L 600 usually is set to mod0 before delivered, except was asked by customer set to mode 2.

Step 2, Check if the slave ID (slave address) is matched with the host command.

The sensor doesn't react to the command which with the wrong slave ID (slave address), unless the slave ID is the broadcasting address,0x00. So, the user can send the broadcasting hexadecimal string 00 03 00 2A 00 01 A4

13 to the sensor, the sensor will echo to the host with the right slave address (ID). Note, we don't thinks is wise to use the broadcasting address 0x00 when the sensor working in RS485 the bus, because it there will be the bus conflict occurred.

Step 3, Check the UART baud rate.

The sensor can only accept the command on condition of the baud rate is match well. the default UART baud rate is 19200bps unless asked by the customer. The baud rate can be changed by modify the register 0x00 and reboot the sensor. May be the register be changed wrongly, so the sensor has no action to the command. This problem can be solved by try to find the right baud rate by modify the host baud rate and to try if can get a right action from the sensor, so there is a better method by send the hexadecimal string 00 03 00 2A 00 01 A4 13 to the sensor during trying different baud rate.

The answer will be clear after the three steps finished.

# Appendix A: KUS550 Data Memory

***Table A-1 KUS550 Data Memory***

| Address Hex(Dec) | **Definition** | **Variable Description** | **Default Value (Hex)** |
|---|---|---|---|
| 0x00(0) | Baud Rate | Values in this location must be between 1 and 9. 1=300bps; 2=600bps; 3=1200 bps; 4=2400bps; 5=4800bps;<br>5= 9600; 6= 19200; 7=38400; 8= 57600; 9= 115200bps. | 0x06 |
| 0x02(2) | Unit | 0= the measure result unit is 0.1mm<br>Means the measure distance or level range is 0-6553.5mm<br>1= the measure result unit is 1/128inch<br>Means the measure distance or level range is 0-512inch<br>2= the measure result unit is 1mm Means the measure distance or level range is 0-65.535meters | 0x00 |
| 0x2A(42) | Sensor address | Values in this location must be between **1** and **253** | 0x01 |
| 0x5E(94) | Trigger Mode | This location is defined as follows:<br>"**0**" establishes normal operation or internal self-triggering at a rate programmed by the Sample Rate.<br>"**1**" in this location places the sensor in a software trigger mode where a computer or other host is required to initiate the sensor to measure and transmit the measure result. It's also called working in the low power consumption mode Other value is reserved. | 0x00 |

| Address Hex(Dec) | Definition | Variable Description | Default Value (Hex) |
|---|---|---|---|
| 0x49(73) | Zero Set point Distance (MSB) | This 2-byte memory location represents the distance for the Zero Set point Voltage Value for the voltage output operating in the Linear Mode. The Voltage Output will operate linearly when a target is detected between this Zero Set point Distance and the Span Set point Distance. These 2 bytes are defined as 74 being the LSB and 73 being the MSB having a value of 128 times the range in inches1.Thedefault value is the Sensor's minimum specified distance and the limits are the sensors minimum and maximum specified ranges and must not equal the Span Set point Distance. | 0xEC |
| 0x4A(74) | Zero Set point Distance (LSB) | | 0x04 |
| 0x4B(75) | Span Set point Distance (MSB) | This 2 bytes memory location represents the distance for the Span Set point Voltage Value for the voltage output operating in the Linear Mode. The Voltage Output will operate linearly when a target is detected between the Zero Set point Distance and this Span Set point. Distance. These 2 bytes are defined as **76** being the MSB and **75** being the LSB having a value of 128 times the range in inches The default value is the specified ranges and must not equal the Zero set point Distance. | 0x5F |
| 0x4C(76) | Span Set point Distance (LSB) | | 0x27 |
| 0x4D(77) | Zero Set point Voltage Value (MSB) | This 2 byte memory location is the voltage value for the Zero Set point Distance and is used when operating in the Linear Mode. The resolution for this 2 byte value is 1mV/bit with address **78** being LSB and **77** being MSB. | 0x00 |
| 0x4E(78) | Zero Set point Voltage Value (LSB) | | 0x00 |

| Address | Definition | Variable Description | Default Value (Hex) |
|---|---|---|---|
| 0x4F(79) | Span Set point Voltage Value (MSB) | This 2 byte memory location is the voltage value for the Span Set point Distance and is used when operating in the Linear Mode. The resolution for this 2 byte value is 1mV/bit with address **79** being MSB and **80** being LSB. The default is 10,000 (10.25V). | 0x10 |
| 0x50(80) | Span Set point Voltage Value (LSB) | | 0x27 |
| 0x51(81) | Close Set point Distance (MSB) | This 2 byte memory location is the distance used to establish a zone for the Voltage output when operating in the Switch Mode. The 2nd set point used to create these zones is the Far Set point Distance. See Switch Mode Output Operation below for details on how the voltage output will operate.<br>These 2 bytes are defined as **82** being the LSB and **81** being the MSB having a value of 128 times the range in inches (see note 1). This value must be less than the Far Set point Distance. The default value is the Sensor's minimum specified distance. | 0xEC |
| 0x52(82) | Close Set point Distance (LSB) | | 0x04 |
| 0x53(83) | Far Set point Distance (MSB) | This 2 byte memory location is the distance used to establish a zone for the Voltage output when operating in the Switch Mode. The 2nd set point used to create these zones is the Close Set point Distance. See Switch Mode Output Operation below for details on how the voltage output will operate.<br>These 2 bytes are defined as **84** being the LSB and **83** being the MSB(see note 1). This value must be less than the Close Set point Distance. The default value is the Sensor's maximum specified distance. | 0x75 |
| 0x54(84) | Far Set point Distance (LSB) | | 0x30 |

Note 1 the unit of the value is 0.1mm, for example if the value is 0x7530= 30000, that means the far set point is 30000x0.1mm=3000mm.

| Data Memory Address | Definition | Variable Description | Default Value (Hex) |
|---|---|---|---|
| 0x55(85) | Voltage Output Operating Mode | This location defines the operating mode of the Sensor's Voltage Output. A "0" in this location operates the Voltage Output in a linear mode. The parameters that control the slope and min/max voltage values of Voltage output are located in data memory locations Zero Set point Distance, Zero Set point Voltage Value, Span Set point Distance, and Span Set point Voltage Value. A "**1**" in this location operates the Voltage Output as switch. The parameters that control the switch points are located in data memory Close Set point Distance, Far Set point Distance, and Switch Mode Output Operation and Set point Output Hysteresis. | 0x00 |
| 0x56(86) | Loss of Echo Voltage Value (MSB) | This value represents the voltage output when the sensor is in the No Echo Condition. The resolution for this 2 byte value is 1mV/bit with address **87** being MSB and **86** being LSB. The default value is 10000(10V). | 0x0A |
| 0x57(87) | Loss of Echo Voltage Value (LSB) | | 0x28 |

| Data Memory Address Decimal (HEX) | Definition | Variable Description | Default Value (Hex) |
|---|---|---|---|
| 0x58(88) | Switch Mode Output definition | This data location is used to establish what state the voltage output will be in when a target is detected within a particular zone created by the Close and Far Set point Distances (subject to Hysteresis, see below) when operating in the Switch Mode. The data byte is parsed as follows:<br>bit 0:No Echo<br>0=No Echo Vout=0V, Echo present Vout=10V;<br>**1**=No Echo Vout=10V, Echo present Vout=0V.<br>**bit 1:** Target > Far Setpoint Distance<br>**0**=If Target > Far Setpoint Distance, then Vout = 0V;<br>**1**=If Target > Far Setpoint Distance, then Vout = 10V.<br>**bit 2***: Target between Close and Far Setpoint Distances (*bit 3=0 for this function, else see bit 3)<br>**0**=Target Present between Close and Far Setpoint Distances, Vout=0V;<br>**1**=Target Present between Close and Far Setpoint Distances, Vout=10V. **bit 3:** No Change for Target between Close and Far Setpoint Distances.<br>**0**=See bit 2 for operation of targets between Close and Far Setpoint Distances;<br>**1**=No change in voltage output when targets enter between Close & Far Setpoint Distances.<br>(setting this to 1 will disable function of bit 2)<br>**bit 4:** Target<Close Setpoint Distance<br>**0**=If Target<Close Setpoint Distance, then Vout=0V;<br>**1**=If Target<Close Setpoint Distance, then Vout = 10V. | 0x12 |

| | | | |
|---|---|---|---|
| 0x5E (94) | Working mode | 0: normal working mode, the sensor always measuring and update the measure result, update the analogue output (if the analogue out is hardware selected) the host can get the result by read command. In this mode the address 0x64-0x66 is the definition of ultrasound transmitting interval. 1lst is 25ms.0 means the sensor working without delay.<br>1: software triggered mode, the sensor will take active and stand by till get the command from the host, then the sensor will emit the ultrasound to measure and send the result back to the hos.<br>2: sleep mode. The sensor will weak up after get a 0x00 on the UART, the week period is around 5ms, during which the host must send the Complete data frame (0xxx 03 01 01 00 01 CRCH CRCL) then the sensor will emit the ultrasound to measure the result and send it back to the host. | 0 |

| Register address | Definition | Variable Description | Default Value (Hex) |
|---|---|---|---|
| 0x64 | Var_measurePeriod(MSB) | The time interval between twice measurement, the value 0x000000 (3-byte-length) means the time is zero, the measurement will begin after the last measurement finished. A lsb means 25ms time gap. | 0x00 |
| 0x65 | Var_measurePeriod(msb) | | 0x00 |
| 0x66 | Var_measurePeriod(LSB) | | 0x08 |
| 0x100(256) | Error and status indicator | Read the note2 for details, write to this register will trigger the sensor reset. **note2** | NULL |
| 0x101(257) | Measure distance | The unit of the measure distance or level will be indicated by bit5and bit4 of the register 0x100. | NULL |
| 0x102(258) | Temperature result | The Unit is degree centigrade 8 bits signed integer the high 8bits always 0s. | NULL |

**Note 2**

| Bit15 | | | | | | | | | | | | | | | | Bit0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bits** | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Flag** | HPER | LPER | RSV | | | TE | RSV | IERR | C | M T | Unit | | Target | Vout | SWT | ERR |

**Bit0: =1 there is some error occurred.**
**=0 there is no error occurred.**
**Bit1: if bit2 =0, this bit is no means, if bit2=1, means the switch status for PNP or NPN output type.**
**= 0 the switch is off,**
**= 1 the switch is on,**
**Bit2 =0 the analogue output is linear.**
**=1 the analogue output is switch.**
**Bit3 the echo status report,**
**= 0 the echo lost,**
**= 1 the echo received,**
**Bit5,4 the measure result unit indicator,**
**= 00 the measure result unit is0.1mm**
**= 01 the measure result unit is1/128inch**
**=10 the measure result unit 1mm**
**=11 RSV**

**Bit6 the measure result type indicator**
**= 0 the measure result is distance**
**= 1 the measure result is level.**
**bit8 =0 the inner parameters working well**
**=1 the inner parameters sensor error**
**Bit10 =0 the inner temperature sensor working well**
**=1 the inner temperature sensor error**
**Other bits are reserved for debug.**