

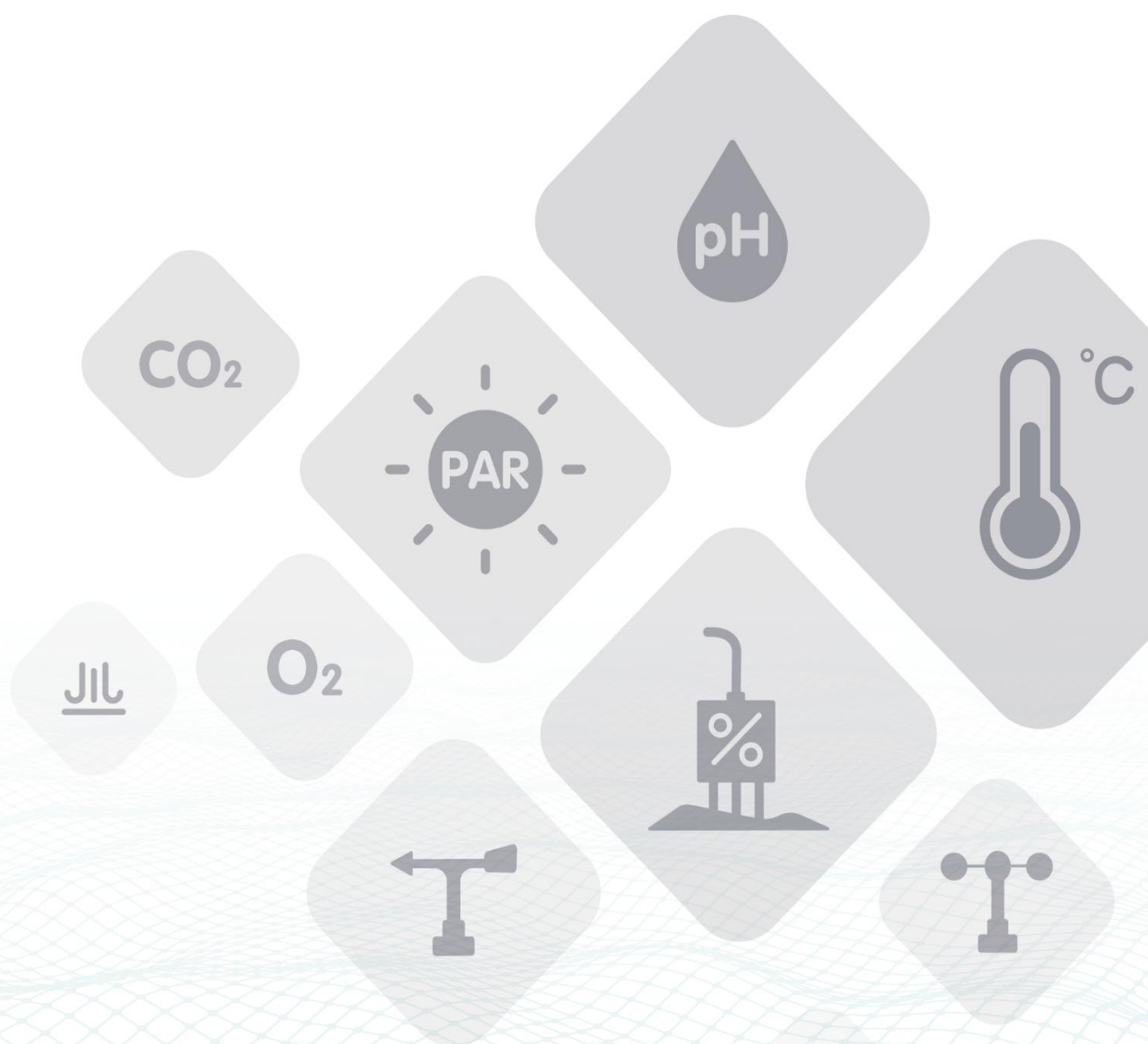


SENSECAP

# Air Temperature & Humidity & Barometric Pressure Sensor User Guide

Product Model: S-THP-01A

Version: V1.0



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# 1 Introduction

S-THP-01A is an air humidity, temperature and barometric pressure sensor. The sensing elements are located on a PCB in the tip of the sensor. The acquisition circuit is completely over-moulded. Temperature and humidity sensor is based on a precision SENSIRION® sensor. An additional BOSCH®MEMS chip measures barometric pressure. Each sensor is individually factory-calibrated. With dimensions of only 108mm x 16mm, the sensor can easily be fitted into many standard radiation shields and field application.

The sensor supports RS485 interface (Modbus-RTU protocol), compatible with a variety of data collectors that support RS485 communication, for long-distance multi-point monitoring and recording.

## Features:

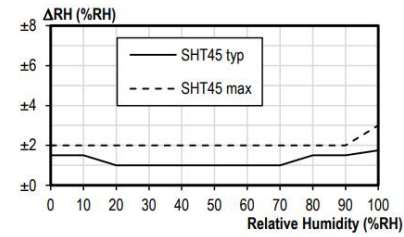
- High precision SENSIRION humidity/Temperature sensor and BOSCH barometric sensor
- Secondary measurements including dew point, frost point, vapor pressure, vapor concentration, cloud base height and altitude, etc.
- Digital Output RS485 with built-in surge protection
- Small size with high accuracy with excellent stability
- Cleanable 10um Copper sintering filter cap
- Wall mounting or Pipe flange insertion installation
- Reverse power protection and Built-in TVS/ESD protection
- Excellent price-performance ratio

## 2 Specifications

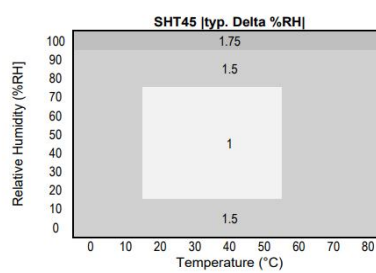
| Temperature           |                                                                        |                                                                                                         |
|-----------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Range                 | -40 °C to +125 °C                                                      |                                                                                                         |
| Accuracy              | ±0.1°C                                                                 |                                                                                                         |
| Resolution            | 0.01 °C                                                                |                                                                                                         |
| Humidity              |                                                                        |                                                                                                         |
| Range                 | From completely dry to fully saturated (from 0% to 100% of saturation) |                                                                                                         |
| Accuracy              | ±1.0%RH                                                                |                                                                                                         |
| Resolution            | 0.01%                                                                  |                                                                                                         |
| Barometric            |                                                                        |                                                                                                         |
| Range                 | 300-1100hPa                                                            |                                                                                                         |
| Accuracy              | ±0.15hPa(Relative Accuracy) ,±0.1hPa(Absolute Accuracy)                |                                                                                                         |
| Resolution            | 0.1hPa                                                                 |                                                                                                         |
| General Parameters    |                                                                        |                                                                                                         |
| Product Model         | S-THP-01A                                                              |                                                                                                         |
| Output Interface      | RS-485                                                                 |                                                                                                         |
| Protocol              | MODBUS-RTU RS485                                                       |                                                                                                         |
| Power Supply          | 4.5 ~ 18V DC                                                           |                                                                                                         |
| Power Consumption     | Quiescent Current : <300uA                                             | Measurement current: 10mA for 50ms during measurement, then returns to static sleep current consumption |
| Response Time         | Less than 1 second                                                     |                                                                                                         |
| IP Rating             | IP56                                                                   |                                                                                                         |
| Encapsulation         | Standard (ABS+ Copper sintering filter)                                |                                                                                                         |
| Connector             | Cold pressed terminal                                                  |                                                                                                         |
| Cable Length          | 2 meters                                                               |                                                                                                         |
| Operating Temperature | -40 ~ 80°C                                                             |                                                                                                         |
| Installation          | Wall mounting or Pipe flange insertion                                 |                                                                                                         |
| Dimension             | Sensor Body 110*16mm                                                   |                                                                                                         |

## 2.1 Accuracy

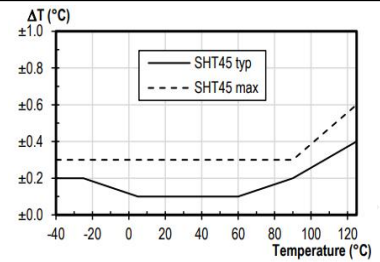
### SHT45 – Temperature & Humidity accuracy



SHT45 typical and maximal relative humidity accuracy at 25 °C.



Typical RH accuracy tolerance over humidity and temperature for SHT45.



SHT45 typical and maximal temperature accuracy.

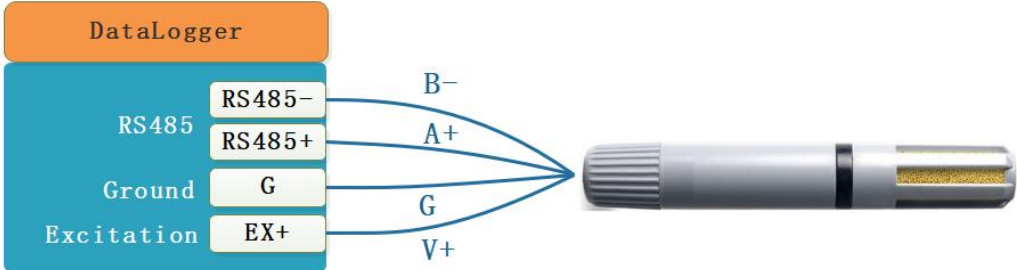
### BMP280 – Barometric Sensor

Absolute Accuracy (300-1100hPa) :  $\pm 1.7\text{hPa}$  ( $-20\sim 0^{\circ}\text{C}$ ) ,  $\pm 1.0\text{hPa}$  ( $0\sim 65^{\circ}\text{C}$ )

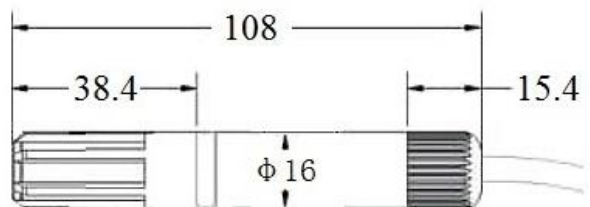
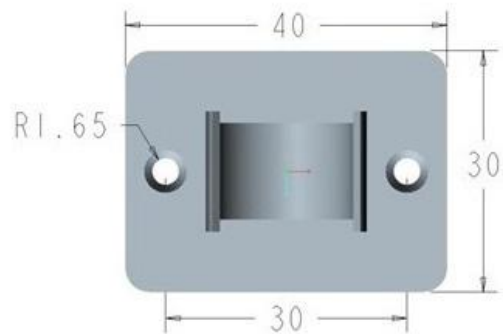
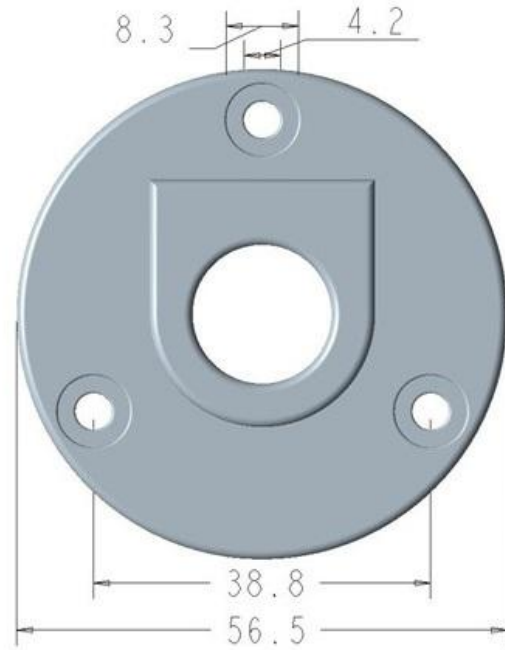
Relative Accuracy (700-900hPa) :  $\pm 0.12\text{hPa}$  ( $25\sim 40^{\circ}\text{C}$ )

## 3 Wiring

### 3.1 RS485 Interface

| Type                               | Wiring diagram                                                                                                                                                                                                                               |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RS485 Interface Signal definition  | <p><b>Cold pressed terminal</b></p>  <p>RED (V+) : Power Supply+</p> <p>BLACK (G) : Power supply-</p> <p>YELLOW (RS485) : A+</p> <p>WHITE (RS485) : B-</p> |
| RS485 Interface connection diagram | <p><b>Wiring Diagram For RS485</b></p>  <p>DataLogger</p> <p>RS485- B-</p> <p>RS485+ A+</p> <p>Ground G</p> <p>Excitation EX+ V+</p>                      |

## 4 Dimension



Unit: mm

## 5 RS485 Communication

Seeed Technology Co., Ltd. Authorised

## 5.1 Modbus Protocol

Modbus Protocol is widely used to establish master-slave communication between intelligent devices or sensors. A Modbus message sent from a master to a slave contains the address of the slave, the function code (e.g. 'read register' or 'write register'), the data, and a check sum (LRC or CRC).

The sensor is RS485 interface with Modbus protocol. The default serial communication settings is slave address 1, Modbus-RTU, 9600bps, 8 databits and 1 stop bit. All communication settings can be changed with Modbus command, and take effective after re-power up the sensor.

Following Modbus function code are supported by sensor.

Modbus Function Code 0x03 : used for reading holding register.

Modbus Function Code 0x04 : used for reading input register.

Modbus Function Code 0x06 : used for writing single holding register.

Modbus Function Code 0x10: used for writing multiple holding register.

## 5.2 Modbus Register

| Parameters                                  | Register Addr.<br>(HEX/DEC) | Data<br>Type | Modbus<br>Function<br>Code(DEC) | Range and<br>Comments                                                              | Default<br>Value |
|---------------------------------------------|-----------------------------|--------------|---------------------------------|------------------------------------------------------------------------------------|------------------|
| TEMPERATURE                                 | 0x0000 /0                   | INT16<br>RO  | 3/4                             | -4000-12500 for<br>-40.00-125.00 (°C);<br>-4000-25700 for<br>-40.00-257.00 (°F)    | N/A              |
| HUMIDITY                                    | 0x0001 /1                   | INT16<br>RO  | 3/4                             | 0-10000 for<br>0.00-100.00 (%)                                                     | N/A              |
| DEWPOINT                                    | 0x0002 /2                   | INT16<br>RO  | 3/4                             | -10000-12500 for<br>-100.00-125.00 (°C)<br>-14800-25700 for<br>-148.00-257.00 (°F) | N/A              |
| Atmospheric<br>Pressure                     | 0x0003 /3                   | INT16<br>RO  | 3/4                             | 3000-11000 for<br>300.0-1100.0 (hPa)                                               | N/A              |
| Frost Point                                 | 0x0004 /4                   | INT16<br>RO  | 3/4                             | -10000-12500 for<br>-100.00-125.00 (°C)<br>-14800-25700 for<br>-148.00-257.00 (°F) | N/A              |
| Vapor Pressure                              | 0x0005 /5                   | INT16<br>RO  | 3/4                             | 0-24000 for<br>0.0-2400.0 (hPa)                                                    | N/A              |
| Vapor<br>Concentration                      | 0x0006 /6                   | INT16<br>RO  | 3/4                             | 0-13000 for<br>0.0-1300.0 (g/m3)                                                   | N/A              |
| Cloud base<br>Estimation Ref By<br>Station  | 0x0007 /7                   | INT16<br>RO  | 3/4                             | 0-20500 for<br>0-20500 (m)                                                         | N/A              |
| Elevation<br>Estimation Ref By<br>Sea Level | 0x0008 /8                   | INT16<br>RO  | 3/4                             | -700-9200 for<br>-700-9200 (m)                                                     | N/A              |
| RESERVED                                    | 0x0009 /9                   | INT16<br>RO  | 3/4                             | Reserved                                                                           | 0                |
| RESERVED                                    | 0x000A /10                  | INT16<br>RO  | 3/4                             | Reserved                                                                           | 0                |
| RESERVED                                    | 0x000B /11                  | INT16<br>RO  | 3/4                             | Reserved                                                                           | 0                |
| RESERVED                                    | 0x000C /12                  | INT16<br>RO  | 3/4                             | Reserved                                                                           | 0                |
| RESERVED                                    | 0x000D /13                  | INT16        | 3/4                             | Reserved                                                                           | 0                |

|                                     |                                                          |              |        |                                                                                     |              |
|-------------------------------------|----------------------------------------------------------|--------------|--------|-------------------------------------------------------------------------------------|--------------|
|                                     |                                                          | RO           |        |                                                                                     |              |
| RESERVED                            | 0x000E /14                                               | INT16<br>RO  | 3/4    | Reserved                                                                            | 0            |
| RESERVED                            | 0x000F /15                                               | INT16<br>RO  | 3/4    | Reserved                                                                            | 0            |
|                                     |                                                          |              |        |                                                                                     |              |
| TEMPUNIT                            | 0x0020 /32                                               | UINT16<br>RW | 3/6/16 | 0:°C<br>1:°F                                                                        | 0            |
|                                     |                                                          |              |        |                                                                                     |              |
| SLAVEADDRESS                        | 0x0200 /512                                              | UINT16<br>RW | 3/6/16 | 0-255                                                                               | 1            |
| BAUDRATE                            | 0x0201 /513                                              | UINT16<br>RW | 3/6/16 | 0-5<br>0:1200bps<br>1:2400bps<br>2:4800bps<br>3:9600bps<br>4:19200bps<br>5:38400bps | 3:9600bps    |
| PROTOCOL                            | 0x0202 /514                                              | UINT16<br>RW | 3/6/16 | 0<br>0:Modbus RTU                                                                   | 0:Modbus RTU |
| PARITY                              | 0x0203 /515                                              | UINT16<br>RW | 3/6/16 | 0-2<br>0:NONE<br>1:EVEN<br>2:ODD                                                    | 0:NONE       |
| DATABITS                            | 0x0204 /516                                              | UINT16<br>RW | 3/6/16 | 1<br>1:8 databits                                                                   | 1:8 databits |
| STOPBITS                            | 0x0205 /517                                              | UINT16<br>RW | 3/6/16 | 0-1<br>0:1 stopbit<br>1:2 stopbits                                                  | 0:1 stopbit  |
| RESERVED                            | 0x0206 /518                                              | UINT16<br>RW | 3/6/16 | Reserved                                                                            | 0            |
| RESERVED                            | 0x0207 /519                                              | UINT16<br>RW | 3/6/16 | Reserved                                                                            | 0            |
|                                     |                                                          |              |        |                                                                                     |              |
| User-defined serial number (USERSN) | 0x0220 /544<br>0x0221 /545<br>0x0222 /546<br>0x0223 /547 | UINT16<br>RW | 3/16   | 0x0000000000000000<br>000-<br>0xFFFFFFFFFFFFFFF<br>FF                               | N/A          |
|                                     |                                                          |              |        |                                                                                     |              |
| TEMPRATURE_FLOAT                    | 0x1000 /4096                                             | FLOAT<br>RO  | 3/4    | -40.00-125.00 (°C)<br>-40.00-257.00 (°F)                                            | N/A          |
| HUMIDITY_FLOAT                      | 0x1002 /4098                                             | FLOAT<br>RO  | 3/4    | 0.00-100.00 (%)                                                                     | N/A          |

|                                                   |              |                         |     |                                            |     |
|---------------------------------------------------|--------------|-------------------------|-----|--------------------------------------------|-----|
| DEWPOINT_FLOAT                                    | 0x1004 /4100 | FLOAT<br>RO             | 3/4 | -100.00-125.00 (°C)<br>-148.00-257.00 (°F) | N/A |
| Atmospheric<br>Pressure_FLOAT                     | 0x1006 /4102 | FLOAT<br>RO             | 3/4 | 300.00-1100.00 (hPa)                       | N/A |
| Frost<br>Point_FLOAT                              | 0x1008 /4104 | FLOAT<br>RO             | 3/4 | -100.00-125.00 (°C)<br>-148.00-257.00 (°F) | N/A |
| Vapor<br>Pressure_FLOAT                           | 0x100A /4106 | FLOAT<br>RO             | 3/4 | 0.00-2400.00 (hPa)                         | N/A |
| Vapor<br>Concentration_FLOAT                      | 0x100C /4108 | FLOAT<br>RO             | 3/4 | 0.00-1300.00 (g/m3)                        | N/A |
| Cloud base<br>Estimation Ref By<br>Station_FLOAT  | 0x100E /4110 | FLOAT<br>RO             | 3/4 | 0.00-20500.00 (m)                          | N/A |
| Elevation<br>Estimation Ref By<br>Sea Level_FLOAT | 0x1010 /4112 | FLOAT<br>RO             | 3/4 | -700.00-9200.00 (m)                        | N/A |
| RESERVED_FLOAT                                    | 0x1012 /4114 | FLOAT<br>RO             | 3/4 | Reserved                                   | 0   |
| RESERVED_FLOAT                                    | 0x1014 /4116 | FLOAT<br>RO             | 3/4 | Reserved                                   | 0   |
| RESERVED_FLOAT                                    | 0x1016 /4118 | FLOAT<br>RO             | 3/4 | Reserved                                   | 0   |
| RESERVED_FLOAT                                    | 0x1018 /4120 | FLOAT<br>RO             | 3/4 | Reserved                                   | 0   |
| RESERVED_FLOAT                                    | 0x101A /4122 | FLOAT<br>RO             | 3/4 | Reserved                                   | 0   |
| RESERVED_FLOAT                                    | 0x101C /4124 | FLOAT<br>RO             | 3/4 | Reserved                                   | 0   |
| RESERVED_FLOAT                                    | 0x101E /4126 | FLOAT<br>RO             | 3/4 | Reserved                                   | 0   |
|                                                   |              |                         |     |                                            |     |
| TEMPERATURE_FLOAT_INVERSE                         | 0x1100 /4352 | FLOAT<br>_INVERSE<br>RO | 3/4 | -40.00-125.00 (°C)<br>-40.00-257.00 (°F)   | N/A |
| HUMIDITY_FLOAT_INVERSE                            | 0x1102 /4354 | FLOAT<br>_INVERSE<br>RO | 3/4 | 0.00-100.00 (%)                            | N/A |
| DEWPOINT_FLOAT_INVERSE                            | 0x1104 /4356 | FLOAT<br>_INVERSE<br>RO | 3/4 | -100.00-125.00 (°C)<br>-148.00-257.00 (°F) | N/A |

|                                                     |              |                  |     |                                            |     |
|-----------------------------------------------------|--------------|------------------|-----|--------------------------------------------|-----|
| Atmospheric Pressure_FLOAT_INVERSE                  | 0x1106 /4358 | FLOAT_INVERSE RO | 3/4 | 300.00-1100.00 (hPa)                       | N/A |
| Frost Point_FLOAT_INVERSE                           | 0x1108 /4360 | FLOAT_INVERSE RO | 3/4 | -100.00-125.00 (°C)<br>-148.00-257.00 (°F) | N/A |
| Vapor Pressure_FLOAT_INVERSE                        | 0x110A /4362 | FLOAT_INVERSE RO | 3/4 | 0.00-2400.00 (hPa)                         | N/A |
| Vapor Concentration_FLOAT_INVERSE                   | 0x110C /4364 | FLOAT_INVERSE RO | 3/4 | 0.00-1300.00 (g/m3)                        | N/A |
| Cloud base Estimation Ref By Station_FLOAT_INVERSE  | 0x110E /4366 | FLOAT_INVERSE RO | 3/4 | 0.00-20500.00 (m)                          | N/A |
| Elevation Estimation Ref By Sea Level_FLOAT_INVERSE | 0x1110 /4368 | FLOAT_INVERSE RO | 3/4 | -700.00-9200.00 (m)                        | N/A |
| RESERVED_FLOAT_INVERSE                              | 0x1112 /4370 | FLOAT_INVERSE RO | 3/4 | Reserved                                   | 0   |
| RESERVED_FLOAT_INVERSE                              | 0x1114 /4372 | FLOAT_INVERSE RO | 3/4 | Reserved                                   | 0   |
| RESERVED_FLOAT_INVERSE                              | 0x1116 /4374 | FLOAT_INVERSE RO | 3/4 | Reserved                                   | 0   |
| RESERVED_FLOAT_INVERSE                              | 0x1118 /4376 | FLOAT_INVERSE RO | 3/4 | Reserved                                   | 0   |
| RESERVED_FLOAT_INVERSE                              | 0x111A /4378 | FLOAT_INVERSE RO | 3/4 | Reserved                                   | 0   |

|                        |              |                  |     |          |   |
|------------------------|--------------|------------------|-----|----------|---|
|                        |              | RO               |     |          |   |
| RESERVED_FLOAT_INVERSE | 0x111C /4380 | FLOAT_INVERSE RO | 3/4 | Reserved | 0 |
| RESERVED_FLOAT_INVERSE | 0x111E /4382 | FLOAT_INVERSE RO | 3/4 | Reserved | 0 |

UINT16:16 bit unsigned integer

INT16:16bit signed integer

RO: Register is Read Only

R/W: Register is Read/Write

HEX: Hexadecimal (data with 0x/0X prefix)

DEC: Decimal

FLOAT: If IEEE754 little-endian byte order is [A,B,C,D], the FLOAT format is [C,D,A,B]

FLOAT\_INVERSE: If IEEE754 little-endian byte order is [A,B,C,D], the FLOAT\_INVERSE format is [A,B,C,D]

The register value will be set as following when there is sensor error:

| Error Value | Register Address | Error  |
|-------------|------------------|--------|
| -32768      | 0x0000-0x000F    | -32768 |
| -32768      | 0x1000-0x101E    | -32768 |
| -32768      | 0x1100-0x111E    | -32768 |

## 5.3 Modbus Register Detail Description

| TEMPERATURE --- Temperature Value (16 bit signed int) |                                                                                                                                                    |              |
|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Range                                                 | -4000-12500 corresponds to -40.00-125.00 (The temperature Unit is set to °C);<br>-4000-25700 for -40.00-257.00 (The temperature Unit is set to °F) | Default: N/A |
| Parameter Storage                                     | N/A                                                                                                                                                |              |

| TEMPERATURE_FLOAT --- Temperature Value, FLOAT Format<br>TEMPERATURE_FLOAT_INVERSE --- Temperature Value, FLOAT_INVERSE Format |                                                                                                         |              |
|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|--------------|
| Range                                                                                                                          | -40.00-125.00 (The temperature Unit is set to °C);<br>-40.00-257.00 (The temperature Unit is set to °F) | Default: N/A |
| Parameter Storage                                                                                                              | N/A                                                                                                     |              |

| HUMIDITY --- Humidity (16 bit unsigned int) |                                        |              |
|---------------------------------------------|----------------------------------------|--------------|
| Range                                       | 0-10000 corresponds to 0.00-100.00 (%) | Default: N/A |
| Parameter Storage                           | N/A                                    |              |

| HUMIDITY_FLOAT --- Humidity, FLOAT Format<br>HUMIDITY_FLOAT_INVERSE --- Humidity, FLOAT_INVERSE Format |                 |              |
|--------------------------------------------------------------------------------------------------------|-----------------|--------------|
| Range                                                                                                  | 0.00-100.00 (%) | Default: N/A |
| Parameter Storage                                                                                      | N/A             |              |

| DEWPOINT --- Dew Point (16 bit signed int) |                                                                          |              |
|--------------------------------------------|--------------------------------------------------------------------------|--------------|
| Range                                      | -10000-12500 corresponds to -100.00-125.00 (The temp Unit is set to °C); | Default: N/A |

|                   |                                                                         |  |
|-------------------|-------------------------------------------------------------------------|--|
|                   | -14800-25700 corresponds to -148.00-257.00 (The temp Unit is set to °F) |  |
| Parameter Storage | N/A                                                                     |  |

**DEWPOINT\_FLOAT --- Dew Point, FLOAT Format**
**DEWPOINT\_FLOAT\_INVERSE --- Dew Point, FLOAT\_INVERSE Format**

|                   |                                                                                             |              |
|-------------------|---------------------------------------------------------------------------------------------|--------------|
| Range             | -100.00-125.00 (The temp Unit is set to °C);<br>-148.00-257.00 (The temp Unit is set to °F) | Default: N/A |
| Parameter Storage | N/A                                                                                         |              |

**Atmospheric Pressure--- Atmospheric Pressure (16 bit unsigned int)**

|                   |                                              |              |
|-------------------|----------------------------------------------|--------------|
| Range             | 3000-11000 corresponds to 300.0-1100.0 (hPa) | Default: N/A |
| Parameter Storage | N/A                                          |              |

**Atmospheric Pressure\_FLOAT --- Atmospheric Pressure, FLOAT Format**
**Atmospheric Pressure\_FLOAT\_INVERSE --- Atmospheric Pressure, FLOAT\_INVERSE Format**

|                   |                    |              |
|-------------------|--------------------|--------------|
| Range             | 300.0-1100.0 (hPa) | Default: N/A |
| Parameter Storage | N/A                |              |

**Frost Point--- Frost Point (16 bit signed int)**

|                   |                                                                                                                                        |              |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Range             | -10000-12500 corresponds to -100.00-125.00 (Temp Unit set to °C);<br>-14800-25700 corresponds to -148.00-257.00 (Temp Unit set to °F); | Default: N/A |
| Parameter Storage | N/A                                                                                                                                    |              |

**Frost Point\_FLOAT --- Frost Point, FLOAT Format**

| Frost Point_FLOAT_INVERSE --- Frost Point, FLOAT_INVERSE Format |                                                                                                |              |
|-----------------------------------------------------------------|------------------------------------------------------------------------------------------------|--------------|
| Range                                                           | -100.00-125.00 (The temp Unit is set to °C); ;<br>-148.00-257.00 (The temp Unit is set to °F); | Default: N/A |
| Parameter Storage                                               | N/A                                                                                            |              |

| VaporPressure---Vapor Pressure (16 bit signed int) |                                         |              |
|----------------------------------------------------|-----------------------------------------|--------------|
| Range                                              | 0-24000 corresponds to 0.0-2400.0 (hPa) | Default: N/A |
| Parameter Storage                                  | N/A                                     |              |

| VaporPressure_FLOAT --- Vapor Pressure, FLOAT Format<br>VaporPressure_FLOAT_INVERSE ---Vapor Pressure, FLOAT_INVERSE Format |                    |              |
|-----------------------------------------------------------------------------------------------------------------------------|--------------------|--------------|
| Range                                                                                                                       | 0.00-2400.00 (hPa) | Default: N/A |
| Parameter Storage                                                                                                           | N/A                |              |

| VaporConcentration---Vapor Concentration/ Absolute Humidity (16 bit signed int) |                                          |              |
|---------------------------------------------------------------------------------|------------------------------------------|--------------|
| Range                                                                           | 0-13000 corresponds to 0.0-1300.0 (g/m3) | Default: N/A |
| Parameter Storage                                                               | N/A                                      |              |

| VaporConcentration_FLOAT ---Vapor Concentration/ Absolute Humidity, FLOAT Format<br>VaporConcentration_FLOAT_INVERSE ---Vapor Concentration/ Absolute Humidity, FLOAT_INVERSE Format |                     |              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------|
| Range                                                                                                                                                                                | 0.00-1300.00 (g/m3) | Default: N/A |
| Parameter Storage                                                                                                                                                                    | N/A                 |              |

| CloudbaseEstimationRefByStation---Cloud base estimation (16 bit signed int) |                                    |              |
|-----------------------------------------------------------------------------|------------------------------------|--------------|
| Range                                                                       | 0-20500 corresponds to 0-20500 (m) | Default: N/A |
| Parameter Storage                                                           | N/A                                |              |

|         |  |  |
|---------|--|--|
| Storage |  |  |
|---------|--|--|

Note: Cloud base estimation ( Reference by station)

|                                                                                                                                                                                            |                   |              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|--------------|
| <b>CloudbaseEstimationRefByStation_FLOAT ---Cloud base estimation, FLOAT Format</b><br><b>CloudbaseEstimationRefByStation_FLOAT_INVERSE ---Cloud base estimation, FLOAT_INVERSE Format</b> |                   |              |
| Range                                                                                                                                                                                      | 0.00-20500.00 (m) | Default: N/A |
| Parameter                                                                                                                                                                                  | N/A               |              |
| Storage                                                                                                                                                                                    |                   |              |

Note: Cloud base estimation ( Reference by station)

|                                                                                    |                                        |              |
|------------------------------------------------------------------------------------|----------------------------------------|--------------|
| <b>ElevationEstimationRefBySeaLevel---Elevation estimation (16 bit signed int)</b> |                                        |              |
| Range                                                                              | -700-9200 corresponds to -700-9200 (m) | Default: N/A |
| Parameter                                                                          | N/A                                    |              |
| Storage                                                                            |                                        |              |

Note: Cloud base estimation ( Reference by sea level)

|                                                                                                                                                                                          |                     |              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------|
| <b>ElevationEstimationRefBySeaLevel_FLOAT---Elevation estimation, FLOAT Format</b><br><b>ElevationEstimationRefBySeaLevel_FLOAT_INVERSE---Elevation estimation, FLOAT_INVERSE Format</b> |                     |              |
| Range                                                                                                                                                                                    | -700.00-9200.00 (m) | Default: N/A |
| Parameter                                                                                                                                                                                | N/A                 |              |
| Storage                                                                                                                                                                                  |                     |              |

Note: Cloud base estimation ( Reference by sea level)

|                                                           |              |            |
|-----------------------------------------------------------|--------------|------------|
| <b>TEMPUNIT--- Temperature Unit (16 bit unsigned int)</b> |              |            |
| Data Range                                                | 0:°C<br>1:°F | Default: 0 |
| Parameter                                                 | YES          |            |
| Storage                                                   |              |            |

Note: Temperature Unit

|                                                                    |  |  |
|--------------------------------------------------------------------|--|--|
| <b>SLAVEADDRESS --- Modbus Slave Address (16 bit unsigned int)</b> |  |  |
|--------------------------------------------------------------------|--|--|

|                   |       |            |
|-------------------|-------|------------|
| Data Range        | 0-255 | Default: 1 |
| Parameter Storage | YES   |            |

Note: Please power up the sensor to take effective after set.

| BAUDRATE --- Serial Comm Baudrate (16 bit unsigned int) |                                                                                     |            |
|---------------------------------------------------------|-------------------------------------------------------------------------------------|------------|
| Data Range                                              | 0-5<br>0:1200bps<br>1:2400bps<br>2:4800bps<br>3:9600bps<br>4:19200bps<br>5:38400bps | Default: 3 |
| Parameter Storage                                       | YES                                                                                 |            |

Note: Please power up the sensor to take effective after set.

| PROTOCOL --- Serial Comm Protocol (16 bit unsigned int) |                   |            |
|---------------------------------------------------------|-------------------|------------|
| Data Range                                              | 0<br>0:Modbus RTU | Default: 0 |
| Parameter Storage                                       | YES               |            |

Note: Please power up the sensor to take effective after set.

| PARITY --- Serial Comm Parity (16 bit unsigned int) |                                  |            |
|-----------------------------------------------------|----------------------------------|------------|
| Data Range                                          | 0-2<br>0:NONE<br>1:EVEN<br>2:ODD | Default: 0 |
| Parameter Storage                                   | YES                              |            |

Note: Please power up the sensor to take effective after set.

| DATABITS --- Serial Comm Databits (16 bit unsigned int) |                   |            |
|---------------------------------------------------------|-------------------|------------|
| Data Range                                              | 1<br>1:8 databits | Default: 1 |
| Parameter Storage                                       | YES               |            |

Note: Please power up the sensor to take effective after set.

| STOPBITS --- Serial Comm Stopbits (16 bit unsigned int) |                                    |            |
|---------------------------------------------------------|------------------------------------|------------|
| Data Range                                              | 0-1<br>0:1 stopbit<br>1:2 stopbits | Default: 0 |
| Parameter Storage                                       | YES                                |            |

Note: Please power up the sensor to take effective after set.

## 5.4 Modbus Function Code

For description below, data started with 0X/0x means that it's in HEX format.

### 5.4.1 Function Code 3 Protocol Example

**Master Request:AA 03 RRRR NNNN CCCC**

|      |        |                              |
|------|--------|------------------------------|
| AA   | 1 byte | Slave Address,0-255          |
| 0x03 | 1 byte | Function Code 3              |
| RRRR | 2 byte | Starting Register Addr       |
| NNNN | 2 byte | Quantity of Register to read |
| CCCC | 2 byte | CRC CHECKSUM                 |

**Slave Response:AA 03 MM VV0 VV1 VV2 VV3... CCCC**

|         |        |                                  |
|---------|--------|----------------------------------|
| AA      | 1 byte | Slave Address,0-255              |
| 0x03    | 1 byte | Function Code 3                  |
| MM      | 1 byte | Register Data Byte Count         |
| VV0,VV1 | 2 byte | Register Value (High8bits first) |
| VV2,VV3 | 2 byte | Register Value (High8bits first) |
| ...     | ...    | Register Value (High8bits first) |
| CCCC    | 2 byte | CRC CHECKSUM                     |

**Example:Read register 0x0200-0x0201,that is slave address and baudrate.**

**Master Request:01 03 0200 0002 C5B3**

|                              |        |        |
|------------------------------|--------|--------|
| Slave Addr.                  | 1 byte | 0x01   |
| Function Code                | 1 byte | 0x03   |
| Starting Register Addr.      | 2 byte | 0x0200 |
| Quantity of Register to read | 2 byte | 0x0002 |
| Checksum                     | 2 byte | 0xC5B3 |

**Slave Response:01 03 04 00 01 00 03 EB F2**

|             |        |      |
|-------------|--------|------|
| Slave Addr. | 1 byte | 0x01 |
|-------------|--------|------|

|                             |        |                                      |
|-----------------------------|--------|--------------------------------------|
| Function Code               | 1 byte | 0x03                                 |
| Register Data<br>Byte Count | 1 byte | 0x04                                 |
| Register Value:<br>Address  | 2 byte | 0x00(HIGH 8 Bits)<br>0x01(LOW8 Bits) |
| Register Value:<br>Baudrate | 2 byte | 0x00(HIGH 8 Bits)<br>0x03(LOW8 Bits) |
| Checksum                    | 2 byte | 0xEBF2                               |

### 5.4.2 Function Code 4 Protocol Example

#### Master Request:AA 04 RRRR NNNN CCCC

|      |        |                              |
|------|--------|------------------------------|
| AA   | 1 byte | Slave Address,0-255          |
| 0x04 | 1 byte | Function Code 4              |
| RRRR | 2 byte | Starting Register Addr       |
| NNNN | 2 byte | Quantity of Register to read |
| CCCC | 2 byte | CRC CHECKSUM                 |

#### Slave Response:AA 04 MM VV0 VV1 VV2 VV3... CCCC

|         |        |                                  |
|---------|--------|----------------------------------|
| AA      | 1 byte | Slave Address,0-255              |
| 0x04    | 1 byte | Function Code 4                  |
| MM      | 1 byte | Register Data Byte Count         |
| VV0,VV1 | 2 byte | Register Value (High8bits first) |
| VV2,VV3 | 2 byte | Register Value (High8bits first) |
| ...     | ...    | Register Value (High8bits first) |
| CCCC    | 2 byte | CRC CHECKSUM                     |

Example:Read register 0x0000-0x0003,that is temperature, humidity, dew point, Atmospheric Pressure.

#### Master Request:01 04 0000 0004 F1C9

|                            |        |        |
|----------------------------|--------|--------|
| Slave Addr.                | 1 byte | 0x01   |
| Function Code              | 1 byte | 0x04   |
| Starting<br>Register Addr. | 2 byte | 0x0000 |

|                              |        |        |
|------------------------------|--------|--------|
| Quantity of Register to read | 2 byte | 0x0003 |
| Checksum                     | 2 byte | 0xF1C9 |

**Slave Response: 01 04 08 0B 1E 12 AB 06 60 26 FE 26 63**

|                                |        |                                      |
|--------------------------------|--------|--------------------------------------|
| Slave Addr.                    | 1 byte | 0x01                                 |
| Function Code                  | 1 byte | 0x04                                 |
| Register Data<br>Byte Count    | 1 byte | 0x08                                 |
| Register Value:<br>Temperature | 2 byte | 0x0B(HIGH 8 Bits)<br>0x1E(LOW8 Bits) |
| Register Value:<br>Reserved    | 2 byte | 0x12(HIGH 8 Bits)<br>0xAB(LOW8 Bits) |
| Register Value:<br>Reserved    | 2 byte | 0x06(HIGH 8 Bits)<br>0x60(LOW8 Bits) |
| Register Value:<br>Reserved    | 2 byte | 0x26(HIGH 8 Bits)<br>0xFE(LOW8 Bits) |
| Checksum                       | 2 byte | 0x2663                               |

### 5.4.3 Function Code 6 Protocol Example

**Master Request: AA 06 RRRR VVVV CCCC**

|      |        |                                  |
|------|--------|----------------------------------|
| AA   | 1 byte | Slave Address,0-255              |
| 0x06 | 1 byte | Function Code 6                  |
| RRRR | 2 byte | Register Addr (High8bits first)  |
| VVVV | 2 byte | Register Value (High8bits first) |
| CCCC | 2 byte | CRC CHECKSUM                     |

**Slave Response: AA 06 RRRR VVVV CCCC**

|      |        |                                  |
|------|--------|----------------------------------|
| AA   | 1 byte | Slave Address,0-255              |
| 0x06 | 1 byte | Function Code 6                  |
| RRRR | 2 byte | Register Addr (High8bits first)  |
| VVVV | 2 byte | Register Value (High8bits first) |
| CCCC | 2 byte | CRC CHECKSUM                     |

**Example: Write Register 0x0200, that is change modbus slave address to 2.**

**Master Request: 01 06 0200 0002 09B3**

|                |        |        |
|----------------|--------|--------|
| Slave Addr.    | 1 byte | 0x01   |
| Function Code  | 1 byte | 0x06   |
| Register Addr. | 2 byte | 0x0200 |
| Register Value | 2 byte | 0x0002 |
| Checksum       | 2 byte | 0x09B3 |

**Slave Response: 01 06 0200 0002 09B3**

|                |        |        |
|----------------|--------|--------|
| Slave Addr.    | 1 byte | 0x01   |
| Function Code  | 1 byte | 0x06   |
| Register Addr. | 2 byte | 0x0200 |
| Register Value | 2 byte | 0x0002 |
| Checksum       | 2 byte | 0x09B3 |

#### 5.4.4 Function Code 16 Protocol Example

**Master Request: AA 10 RRRR NNNN MM VVVV1 VVVV2 ... CCCC**

|       |        |                                    |
|-------|--------|------------------------------------|
| AA    | 1 byte | Slave Address, 0-255               |
| 0x10  | 1 byte | Function Code 0x10                 |
| RRRR  | 2 byte | Starting Register Addr             |
| NNNN  | 2 byte | Quantity of Register to write      |
| MM    | 1 byte | Register Data Byte Count           |
| VVVV1 | 2 byte | Register Value (High 8 bits first) |
| VVVV2 | 2 byte | Register Value (High 8 bits first) |
| ...   | ...    | Register Value (High 8 bits first) |
| CCCC  | 2 byte | CRC CHECKSUM                       |

**Slave Response: AA 10 RRRR NNNN CCCC**

|      |        |                               |
|------|--------|-------------------------------|
| AA   | 1 byte | Slave Address, 0-255          |
| 0x10 | 1 byte | Function Code 0x10            |
| RRRR | 2 byte | Starting Register Addr        |
| NNNN | 2 byte | Quantity of Register to write |

|      |        |              |
|------|--------|--------------|
| CCCC | 2 byte | CRC CHECKSUM |
|------|--------|--------------|

Example:Write Register 0x0200-0x0201,that is set slave address to 1,and baudrate to 19200bp.

Master Request:01 10 0200 0002 04 0001 0004 BACC

|           |        |                                   |
|-----------|--------|-----------------------------------|
| 0x01      | 1 byte | Slave Addr.                       |
| 0x10(HEX) | 1 byte | Function Code 0x10                |
| 0x0200    | 2 byte | Starting Register Addr            |
| 0x0002    | 2 byte | Quantity of Register to write     |
| 0x04      | 1 byte | Register Data Byte Count          |
| 0x0001    | 2 byte | Register Value: Slave Address 1   |
| 0x0004    | 2 byte | Register Value: Baudrate 19200bps |
| 0xBACC    | 2 byte | CRC CHECKSUM                      |

Salve Response:01 10 0200 0002 4070

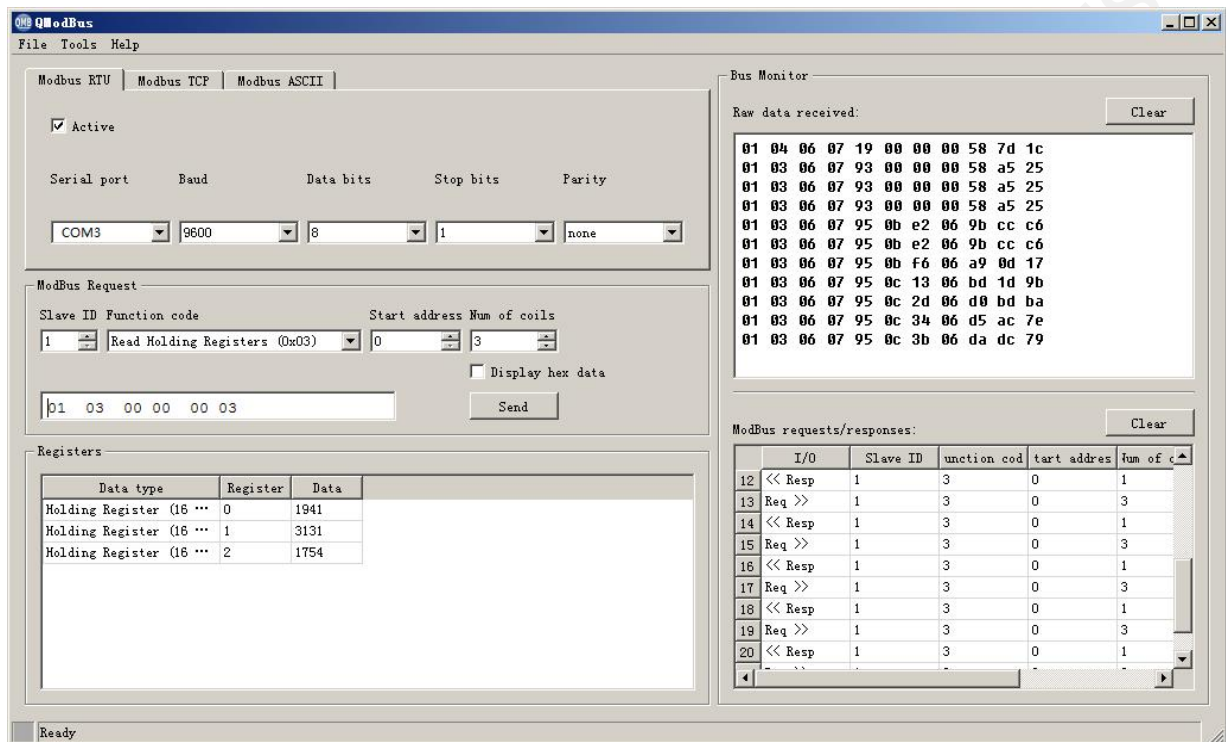
|           |        |                                                |
|-----------|--------|------------------------------------------------|
| 0x01      | 1 byte | Slave Addr.                                    |
| 0x10(HEX) | 1 byte | Function Code 0x10                             |
| 0x0200    | 2 byte | Starting Register Addr(High8bits first)        |
| 0x0002    | 2 byte | Quantity of Register to write(High8bits first) |
| 0x4070    | 2 byte | CRC CHECKSUM                                   |

## 5.5 Software Configuration Utility

### 5.5.1 Universal Modbus Comm Utility

You can use software listed below to try reading/writing the register of sensor,

<https://github.com/ed-chemnitz/qmodbus/releases>



## 6 Document version

| Version | Date | Description   | Editor      |
|---------|------|---------------|-------------|
| V1.0    |      | First Version | Yvonne.Meng |