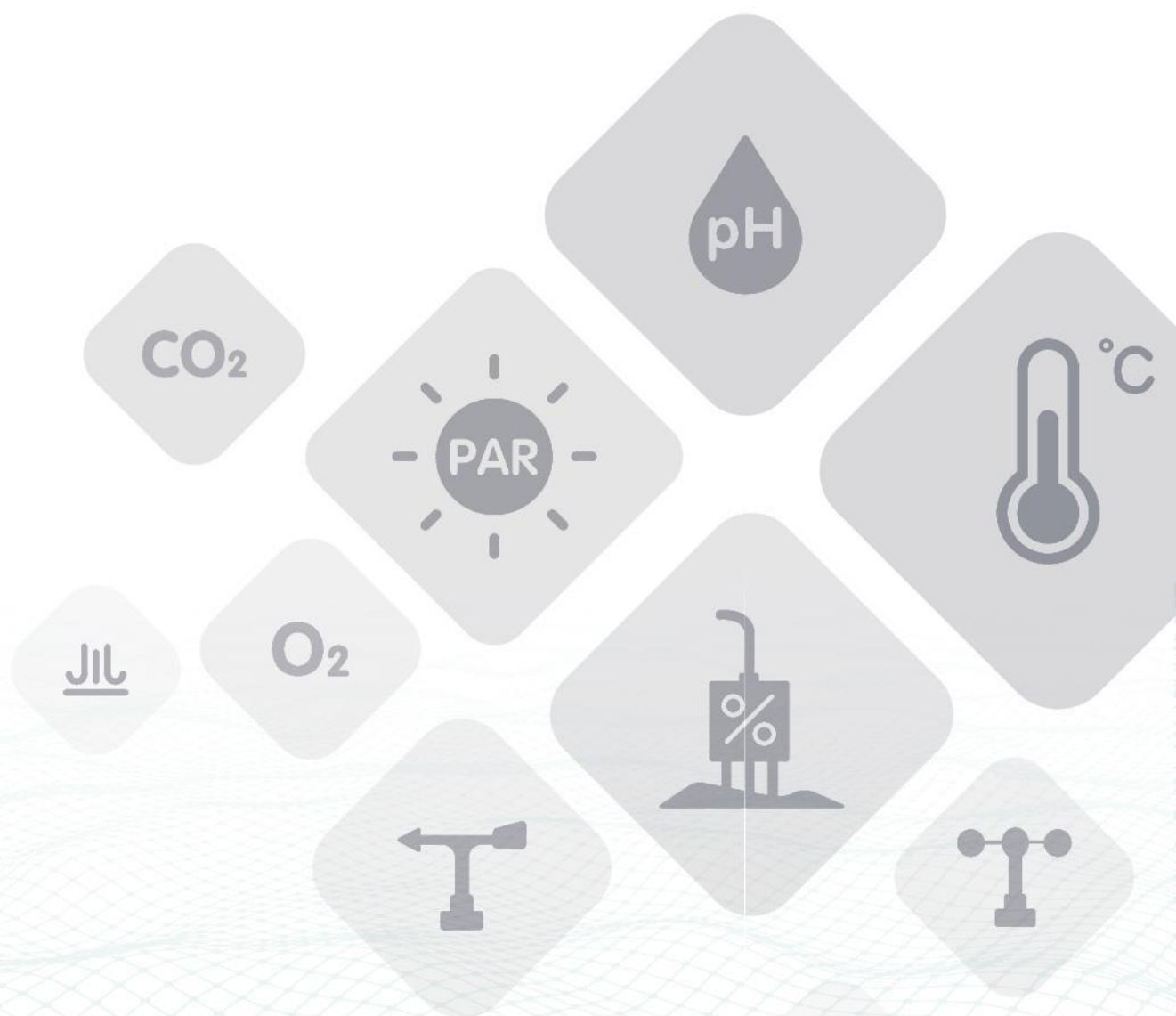




SENSECAP

# Leaf Wetness and Temperature Sensor User Guide

Version: V1.0



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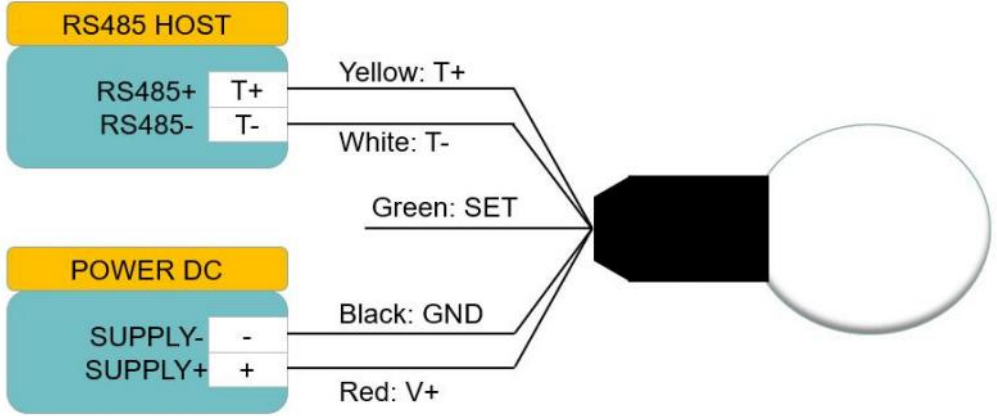
# 1. Introduction

S-YM-01 measures leaf wetness and temperature. It sealed with resin packaged plastic body can be used for long time monitor. Wetness measurement value is proportional to the percentage of sensing area covered with water. The output signal can be RS485, Analog Voltage or Analog Current. The sensor is applicable for science research, bacteria prevention, foliage dressing spraying, greenhouse, smart agriculture etc.

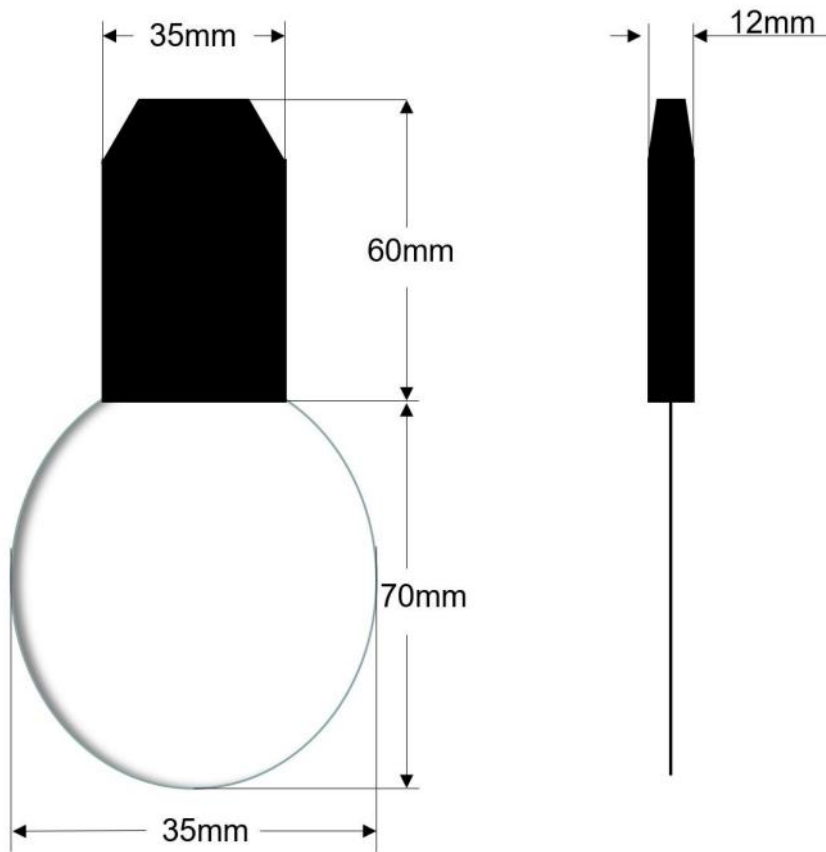
- Integrated with leaf wetness and temperature measurement
- Output Interface with RS485, Voltage, Current
- Mimics the real leaf thermal resistance by sensing shape and thickness
- Water, ice, foggy detection
- Water proof to IP68 ratings
- High accuracy with excellent stability
- Reverse power protection and Built-in TVS/ESD protection

| Specifications           |                                                     |
|--------------------------|-----------------------------------------------------|
| Output Interface         | RS485 Modbus-RTU                                    |
| Power Supply             | 3.6-30V/DC                                          |
| Power Consumption        | 6mA@24V DC                                          |
| Leaf wetness Measurement | Range: 0-100%, Resolution: 0.1%, Accuracy:5%        |
| Temperature Compensation | Range: -40~80°C, Resolution:0.1°C, Accuracy: ±0.5°C |
| Measurement Technique    | FDR                                                 |
| IP Ratings               | IP68                                                |
| Operating Temperature    | -40~85°C                                            |
| Sensor Sealed            | Epoxy resin                                         |
| Installation             | Mounting kit                                        |
| Cable Length             | 2 meters                                            |
| Dimension                | 65*13*145mm                                         |

## 2. Wiring diagrams

| Type                          | Wiring diagram                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>RS485</b><br><b>Modbus</b> | <p>Red (V+): Power Supply +<br/> Black (G): Power Supply -<br/> Yellow (T+): RS485+/A/T+<br/> White (T-): RS485-/B/T-<br/> Green (SET): SETTING mode. When sensor power-up with the SET wire connected to Power Supply +, then sensor using setting mode communication parameters for RS485. When sensor power-up with the SET wire connected to Power Supply - or unconnected, the sensor using communication parameters in register for RS485. Please refer to the usage below.</p>  <p>ALL RS485 communication parameters (Modbus Slave Address, baud rate, parity, data bits, stop bits ) are set in internal register and can be saved when power down, the factory setting is ADDRESS=1, BAUDRATE=9600bps, PARITY=NONE, DATABITS=8bits, STOPBITS=1bit;</p> <p>Sometimes you may FORGET the communication settings, In this case, you can connect the GREEN &amp; RED wire together to Power Supply+, black wire to Power Supply-, then re-power up the sensor, then the sensor start-up with a fixed communication settings(we call it setting mode) ADDRESS=0, BAUDRATE=9600bps, PARITY=NONE, DATABITS=8bits, STOPBITS=1bit; Communicate with the sensor using this parameters and then set your desired communication parameters, then disconnect the green wire from Power Supply+, then re-power up the sensor, and the sensor will communicate with your settings.</p> |

### 3. Dimension



## 4. Safety ,Care and Installation

Sensor can be mounted on the branch of plants or on the weather station. Please keep the sensing area on the upside and form an angle with ground.

For foliage dressing spraying, use multiple sensor at different level of plant to guarantee the spraying effect.

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## 5. Output Signal Conversion

| Output Interface    | Parameters Range      | Conversion Formula                                                                       |
|---------------------|-----------------------|------------------------------------------------------------------------------------------|
| RS485<br>Modbus-RTU | Temperature: -40-80°C | TEMP=(REGISTER VALUE)/100. When REGISTER VALUE=2013, then TEMP= 2013/100=20.13°C.        |
|                     | Wetness: 0-100%       | WETNESS =(REGISTER VALUE)/100. When REGISTER VALUE=2013, then WETNESS = 2013/100=20.13%. |

## 6. RS485 Modbus Protocol

### 6.1 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 data bits 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.

## 6.2 Modbus Register

| Parameters           | Register Addr.<br>(HEX/DEC) | Data<br>Type  | Modbus<br>Function<br>Code(DEC<br>) | Range and<br>Comments                                                               | Default<br>Value |
|----------------------|-----------------------------|---------------|-------------------------------------|-------------------------------------------------------------------------------------|------------------|
| TEMPRATURE           | 0x0000 /0                   | INT16<br>RO   | 3/4                                 | -4000-8000 for<br>-40.00~80.00°C.                                                   | N/A              |
| WETNESS              | 0x0001 /1                   | UINT16<br>RO  | 3/4                                 | 0-10000 for 0-100%                                                                  | N/A              |
|                      |                             |               |                                     |                                                                                     |                  |
| TEMPUNIT             | 0x0020 /32                  | UINT16<br>R/W | 3/6/16                              | 0: °C<br>1: °F                                                                      | 0                |
| TEMPCALIB            | 0x0021 /33                  | INT16<br>R/W  | 3/6/16                              | -999-999 for<br>-9.99~9.99°C                                                        | 0                |
|                      |                             |               |                                     |                                                                                     |                  |
| SLAVEADDRESS         | 0x0200 /512                 | UINT16<br>R/W | 3/6/16                              | 0-255                                                                               | 1                |
| BAUDRATE             | 0x0201 /513                 | UINT16<br>R/W | 3/6/16                              | 0-6<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>R/W | 3/6/16                              | 0-1<br>0: Modbus RTU<br>1: Modbus ASCII                                             | 0: Modbus<br>RTU |
| PARITY               | 0x0203 /515                 | UINT16<br>R/W | 3/6/16                              | 0-2<br>0:None<br>1:Even<br>2:Odd                                                    | 0:None<br>Parity |
| DATABITS             | 0x0204 /516                 | UINT16<br>R/W | 3/6/16                              | 1<br>1:8 databits                                                                   | 1:8<br>databits  |
| STOPBITS             | 0x0205 /517                 | UINT16<br>R/W | 3/6/16                              | 0-1<br>0:1 stopbit<br>1:2 stopbits                                                  | 0:1 stopbit      |
| RESPONSEDELAY        | 0x0206 /518                 | UINT16<br>R/W | 3/6/16                              | 0-255 for 0-2550<br>milliseconds                                                    | 0                |
| ACTIVEOUTPUTINTERVAL | 0x0207 /519                 | UINT16<br>R/W | 3/6/16                              | 0-255 for 0-255<br>seconds.                                                         | 0                |

NOTE: UINT16:16 bit unsigned integer, INT16:16bit signed integer

NOTE: RO: Register is Read Only, R/W: Register is Read/Write

NOTE: HEX is Hexadecimal (data with 0x/0X prefix), DEC is Decimal

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## 6.3 Modbus Register Detail Description

| TEMPERATURE     |                               |              |
|-----------------|-------------------------------|--------------|
| Data Range      | -4000-8000 For -40.00~80.00°C | Default: N/A |
| Power Down Save | N/A                           |              |

Note: Temperature value (Binary complement).

Example: When REGISTER = 0x0702 (HEX format), then  $VALUE = (0x07 * 256 + 0x02) / 100 = 17.94^{\circ}\text{C}$ . When REGISTER = FF05H (HEX format), then  $VALUE = ((0xFF * 256 + 0x05) - 0xFFFF - 0x01) / 100 = (0xFF05 - 0xFFFF - 0x01) / 100 = -2.51^{\circ}\text{C}$ .

| WETNESS         |                    |              |
|-----------------|--------------------|--------------|
| Data Range      | 0-10000 For 0-100% | Default: N/A |
| Power Down Save | N/A                |              |

Note: Leaf wetness measurement value, is proportional to the percentage of sensing area covered with water.

Example: When REGISTER = 0x0702 (HEX format), then  $VALUE = (0x07 * 256 + 0x02) / 100 = 17.94\%$

| TEMPUNIT        |              |            |
|-----------------|--------------|------------|
| Data Range      | 0:°C<br>1:°F | Default: 0 |
| Power Down Save | YES          |            |

Note: Temperature Unit

| TEMPCALIB       |                           |            |
|-----------------|---------------------------|------------|
| Data Range      | -999-999 for -9.99~9.99°C | Default: 0 |
| Power Down Save | YES                       |            |

Note: Temperature Calibration Value

| SLAVEADDRESS --- Modbus Slave Address |       |            |
|---------------------------------------|-------|------------|
| Data Range                            | 0-255 | Default: 1 |
| Power Down Save                       | YES   |            |

Note: Please re-power on the sensor to take effective after set.

| <b>BAUDRATE --- Serial Comm Baudrate</b> |                                                                                                                                            |            |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Data Range                               | <b>0-5</b><br><b>0:</b> 1200bps<br><b>1:</b> 2400bps<br><b>2:</b> 4800bps<br><b>3:</b> 9600bps<br><b>4:</b> 19200bps<br><b>5:</b> 38400bps | Default: 3 |
| Power Down<br>Save                       | YES                                                                                                                                        |            |

Note: Please re-power on the sensor to take effective after set.

| <b>PROTOCOL --- Serial Comm Protocol</b> |                                       |            |
|------------------------------------------|---------------------------------------|------------|
| Data Range                               | 0-1<br>0:Modbus RTU<br>1:Modbus ASCII | Default: 0 |
| Power Down<br>Save                       | YES                                   |            |

Note: Please re-power on the sensor to take effective after set.

| <b>PARITY --- Serial Comm Parity</b> |                                  |            |
|--------------------------------------|----------------------------------|------------|
| Data Range                           | 0-2<br>0:NONE<br>1:EVEN<br>2:ODD | Default: 0 |
| Power Down<br>Save                   | YES                              |            |

Note: Please re-power on the sensor to take effective after set.

| <b>DATABITS --- Serial Comm Databits</b> |                   |            |
|------------------------------------------|-------------------|------------|
| Data Range                               | 1<br>1:8 databits | Default: 1 |
| Power Down<br>Save                       | YES               |            |

Note: Please re-power on the sensor to take effective after set.

**STOPBITS --- Serial Comm Stopbits**

|                    |                                    |            |
|--------------------|------------------------------------|------------|
| Data Range         | 0-1<br>0:1 stopbit<br>1:2 stopbits | Default: 0 |
| Power Down<br>Save | YES                                |            |

Note: Please re-power on the sensor to take effective after set.

**RESPONSEDELAY --- Serial Comm Response Delay**

|                    |                                               |            |
|--------------------|-----------------------------------------------|------------|
| Data Range         | 0-255 for 0-2550 milliseconds, 0 for disabled | Default: 0 |
| Power Down<br>Save | YES                                           |            |

Note: Please re-power on the sensor to take effective after set.

Note: Sensor will delay a period before response to master request command.

Example: When set to 5 and receive a request from master device, then sensor will delay  $5 \times 10\text{ms} = 50\text{ms}$ , then response to master.

**ACTIVEOUTPUTINTERVAL --- Serial Comm Active Output Interval time**

|                    |                                         |            |
|--------------------|-----------------------------------------|------------|
| Data Range         | 0-255 for 0-255 seconds, 0 for disabled | Default: 0 |
| Power Down<br>Save | YES                                     |            |

Note: Please re-power on the sensor to take effective after set.

Note: Sensor will output the data actively without any master request command.

Note: Only ONE sensor should be on RS485 network, or there will be data collision and corrupt the data on line.

Note: Refer to SETTING mode to exit the Active Output Mode.

Example: When set to 5 then sensor will output the data every 5 seconds without any master request command.

## 6.4 Modbus Function Code

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

### 6.4.1 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 Byte Count | 1 byte | 0x04              |
| Register Value:          | 2 byte | 0x00(HIGH 8 Bits) |
| Address                  |        | 0x01(LOW8 Bits)   |
| Register Value:          | 2 byte | 0x00(HIGH 8 Bits) |
| Baud rate                |        | 0x03(LOW8 Bits)   |
| Checksum                 | 2 byte | 0xEBF2            |

## 6.4.2 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 0x0000-0x0001,that is temperature, wetness.**

**Master Request:01 04 0000 0002 71CB**

|                              |        |        |
|------------------------------|--------|--------|
| Slave Addr.                  | 1 byte | 0x01   |
| Function Code                | 1 byte | 0x04   |
| Starting Register Addr.      | 2 byte | 0x0000 |
| Quantity of Register to read | 2 byte | 0x0002 |
| Checksum                     | 2 byte | 0x71CB |

**Slave Response: 01 04 04 07 E0 0F 01 09 23 F5 AF**

|                               |        |                   |
|-------------------------------|--------|-------------------|
| Slave Addr.                   | 1 byte | 0x01              |
| Function Code                 | 1 byte | 0x04              |
| Register Data Byte Count      | 1 byte | 0x04              |
| Register Value: Temperature   | 2 byte | 0x07(HIGH 8 Bits) |
|                               |        | 0xE0(LOW8 Bits)   |
| Register Value: Soil Moisture | 2 byte | 0x0F(HIGH 8 Bits) |
|                               |        | 0x01(LOW8 Bits)   |
| Checksum                      | 2 byte | 0x3F36            |

Temperature =(0x07\*256+0x E0)/100=2016/100=20.16 °C

Wetness=(0x0F\*256+0x01)/100=3841/100=38.41%

### 6.4.3 Function Code 6 Protocol Example

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

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

### Slave Response: AA 06 RRRR VVV CCCC

|      |        |                                  |
|------|--------|----------------------------------|
| AA   | 1 byte | Slave Address,0-255              |
| 0x06 | 1 byte | Function Code 6                  |
| RRRR | 2 byte | Register Addr (High8bits first)  |
| VVV  | 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 |

## 6.4.4 Function Code 16 Protocol Example

### Master Request: AA 10 RRRR NNNN MM VVV1 VVV2 ...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        |
| VVV1 | 2 byte | Register Value(High8bits first) |
| VVV2 | 2 byte | Register Value(High8bits first) |
| ...  | ...    | Register Value(High8bits 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.**

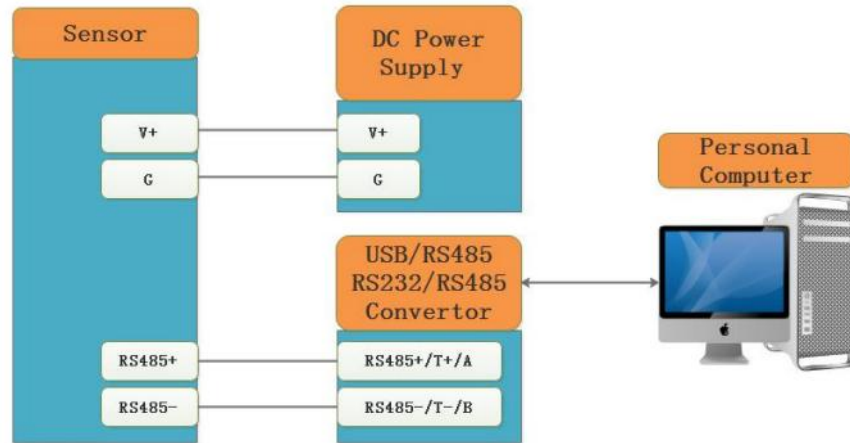
### Master Request:01 10 0200 0002 04 0001 0004 BACC

|           |        |                                    |
|-----------|--------|------------------------------------|
| 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: Baud rate 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                                   |

## 7. Software Configuration Utility



You can use software listed below to try reading/writing the register of sensor,  
<https://github.com/ed-chemnitz/qmodbus/releases>