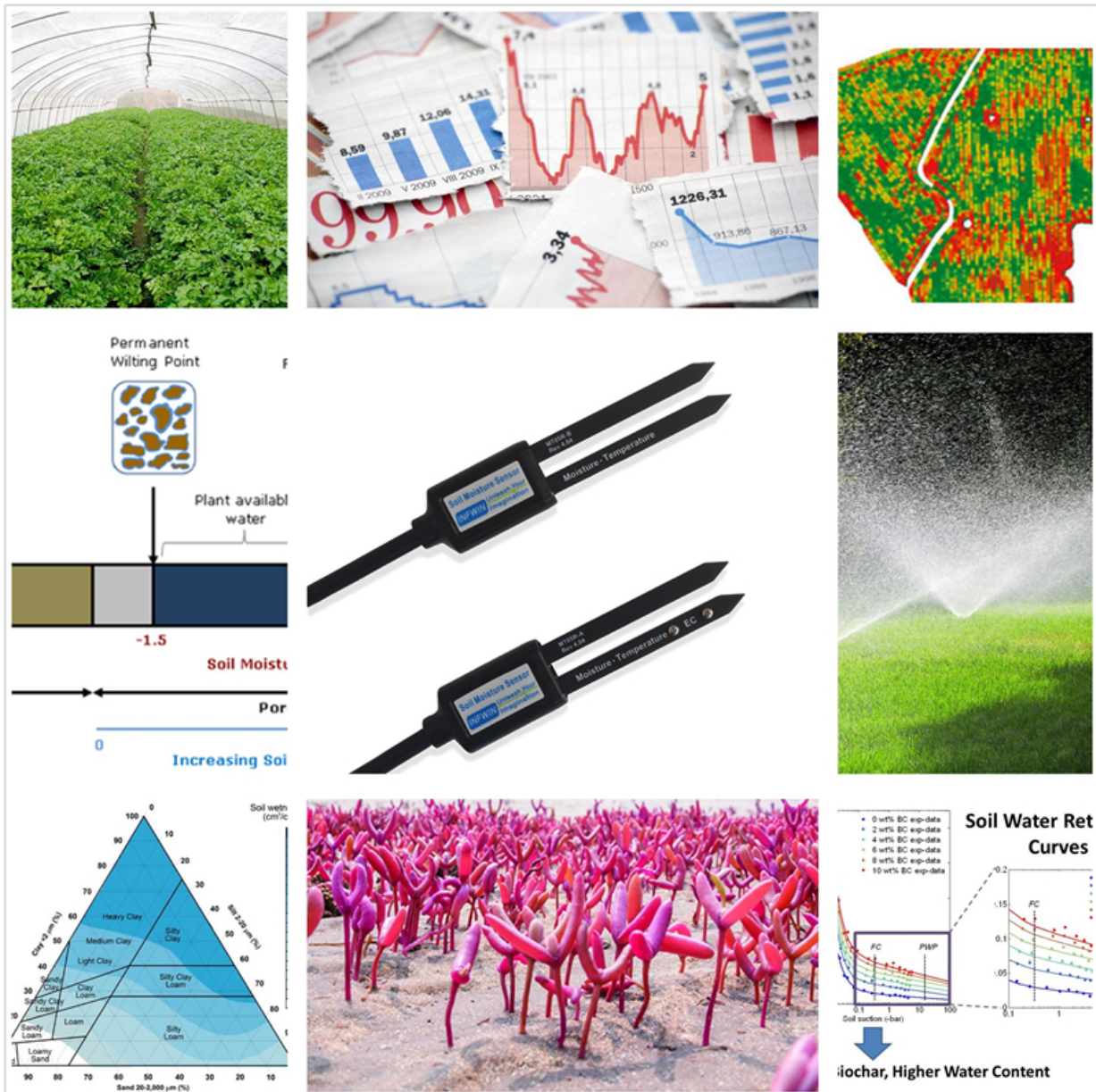


MT05R (RS485 Interface)

Soil Moisture EC and Temperature Sensor (MT05R-A)

Soil Moisture and Temperature Sensor (MT05R-B)



Index

1 Customer Support.....	3
2 Introduction	4
3 Wiring diagrams	7
3.2 RS485 Interface	7
4 Dimension and Ordering Infomation	8
4.1 Dimension	8
4.2 Ordering Information	9
5 Safty ,Care and Installation	10
5.1 Care and Safty	10
5.2 Installation	10
6 RS485 Communication	11
6.1 Modbus Protocol	11
6.2 Modbus Register	11
6.3 Modbus Register Detail Description	14
7. Substrate Volumetric Water Content User Calibration.....	19
Appendix A RS485 Sensor Testing and Settings	20
A.1 Testing RS485 Sensors with RS485 Converter	20
A.2 Testing Example	21
Copyright and Trademark.....	23
Version Control.....	23

1 Customer Support

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Website

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2 Introduction

MT05R Soil Moisture, Temperature, and Electrical Conductivity (EC) sensor is an accurate tool for monitoring volumetric water content (VWC), temperature in soil and soilless substrates, and electrical conductivity. It sealed with resin packaged plastic body with sensing rods which can be insert directly into the soil or substrate with long time stability.

The sensor is applicable for science research, irrigation, greenhouse, smart agriculture etc.

Features

- Integrated with Moisture, EC and Temperature measurement
- Digital sensor communicates over RS485 serial interface
- Modbus-RTU communications protocols
- Low-input voltage requirements for power supply
- Low-power design supports battery-operated data loggers
- Low salinity sensitivity
- Robust epoxy encapsulation resists corrosive environments
- High accuracy with excellent stability
- Reverse power protection and Built-in TVS/ESD protection

Applications

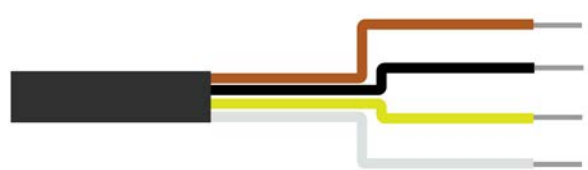
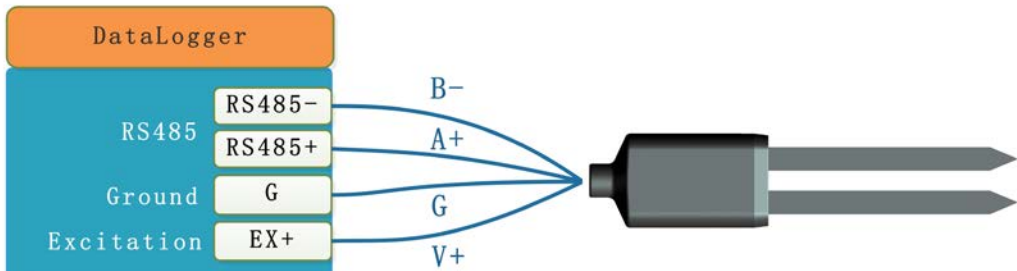
- Smart Agriculture, Hydroponic and Horticulture
- Greenhouse monitoring
- Soil/Substrate water balance
- Irrigation management
- Solute/fertilizer movement

Specifications	
Output Interface	RS485, Modbus-RTU
Power Supply	3.0-28V DC
Power Consumption	Quiescent Current (typical) : <300 uA Measuring Current (typical): <10 mA during 100ms measurement
Substrate Moisture Measurement	Volumetric Water Content (VWC): Range:0-100% (air - water) Resolution: 0%-50%: 0.1%, 50%-100%: 0.5% Accuracy: 0%-50%: ±3%, 50%-100%: ±5% Apparent dielectric permittivity: Range:1-81 (air - water) Resolution: 1.00-40.00: ±0.1, 40.00-81.00: ±0.5 Accuracy: 1.00-40.00: ±1, 40.00-81.00: ±3
Substrate EC Measurement	Range: 0-20ds/m; Resolution: 0-5ds/m, 0.01ds/m; 5-20ds/m, 0.1ds/m Accuracy: 0-5ds/m, ±5%; 5-20ds/m, ±10% Temperature compensation: 0-50°C
Substrate Temperature Measurement	Range: -40-80°C Resolution:0.1°C Accuracy: 0-50°C: ±0.5°C; -40-80°C: ±1.0°C
IP Ratings	IP68
Operating Temperature	-40-80°C
Cable Length	2 meters or Customize
Dimension	20*11*95mm

Electrical and Timing Characteristics			
Item	Minimum	Typical	Maximum
Supply Voltage (V+ to G), 3.0-28V DC	3.0 V DC	N/A	28 V DC
Power Line Slew Rate	1.0 V/ms	N/A	N/A
Current Drain (measuring) , RS485	N/A	10 mA	15 mA
Current Drain (standby) , RS485	N/A	300 μ A	800 μ A
Power-Up Time (RS485)	N/A	500 ms	N/A
Measurement Duration	N/A	100 ms	N/A

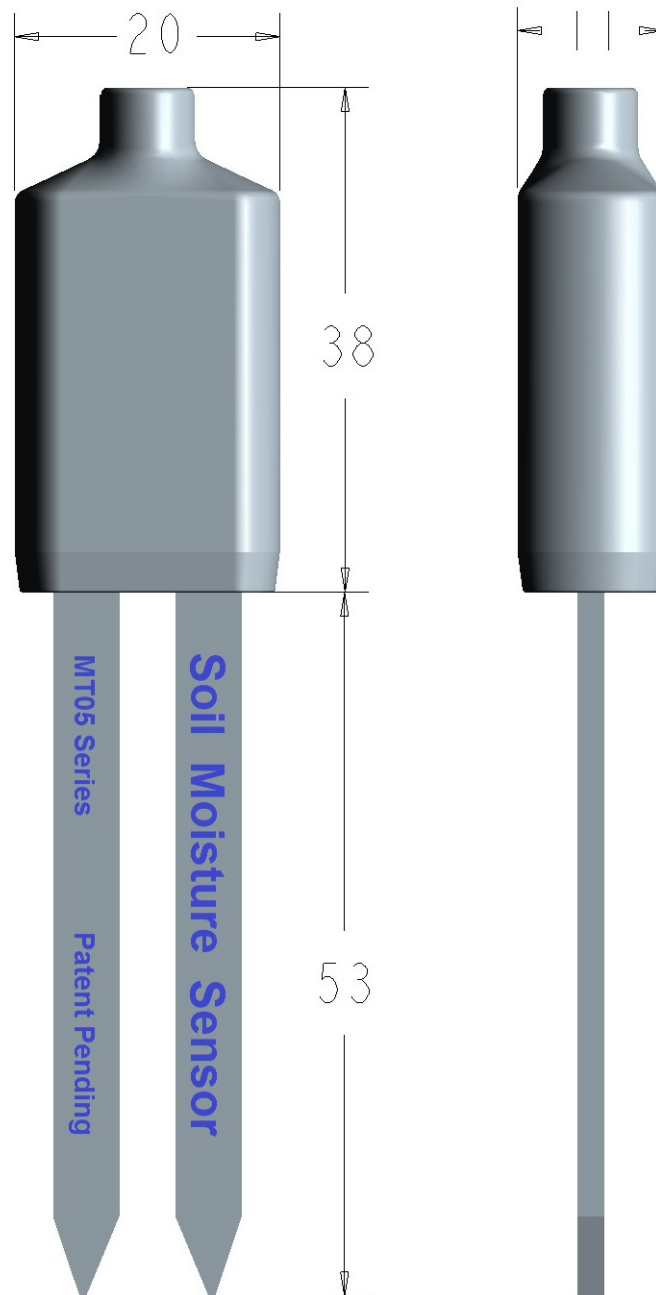
3 Wiring diagrams

3.2 RS485 Interface

Type	Wiring diagram
RS485 Interface	Cold pressed terminal  RED (V+):Power Supply+ BLACK (G):Power supply- YELLOW (RS485):A+ WHITE (RS485):B-
	Tinned lead wires  RED (V+):Power Supply+ BLACK (G):Power supply- YELLOW (RS485):A+ WHITE (RS485):B-
	Wiring Diagram  DataLogger RS485- RS485+ Ground Excitation B- A+ G V+

4 Dimension and Ordering Infomation

4.1 Dimension



Unit: mm

4.2 Ordering Information

Ordering Information		
Parameters	Code	Comments
Code 1: Product Series	MT05R	MT05R Sensor Series
Code 2: Measuring Parameters	A	Substrate Moisture & EC & Temperature
	B	Substrate Moisture & Temperature
Code 3: Power Supply	A	3.0-28V DC
Code 4: Output Interface	A	RS485(Modbus-RTU)
Code 5: Connector	B	Cold pressed terminal
	C	Stripped & tinned lead wires
Code 6: Cable Length	002	2 meters
	XXX	Customize, XXX is required cable length(Unit: meter)
Ordering Code Example: MT05R-AAAB002 Product Series: MT05R Sensor Series; Measuring Parameters: Substrate Moisture & EC & Temperature; Power Supply: 3.0-28V DC Output Interface: RS485(Modbus-RTU); Connector: Cold pressed terminal; Cable Length: 2 Meters		

5 Safty ,Care and Installation

5.1 Care and Safty

- The rods of the Sensor are sharp for ease insertion. Care must be taken and handling precautions followed.
- Avoid touching the rods or exposing them to other sources of static damage, particularly when powered up.
- Do not pull the sensor out of the substrate by its cable.
- If you feel any resistance when inserting the sensor into substrate, Stop pushing and re-insert at a new location.

5.2 Installation

- Clear away any stones. Pre-form holes in very hard soil or substrate before insertion.
- Push the sensor into the substrate until the rods are fully inserted. Ensure good substrate contact.
- If you feel strong resistance when inserting the sensor, you have probably hit a stone. Stop, and re-insert at a new location.

6 RS485 Communication

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 default serial communication settings is slave address 1, modbus rtu, 9600bps, 8 databits and 1 stop bit.

6.2 Modbus Register

Parameters	Register Addr. (HEX/DEC)	Data Type	Modbus Function Code(DEC)	Range and Comments	Default Value
SUBSTRATE_TEMP RATURE	0x0000 /0	INT16 RO	3/4	-4000-8000 indicates -40.00-80.00 (°C); -4000-17600 indicates -40.00-176.00 (°F)	N/A
SUBSTRATE_VWC	0x0001 /1	INT16 RO	3/4	0-10000 indicates 0.00-100.00 (%)	N/A
SUBSTRATE_BULK EC	0x0002 /2	INT16 RO	3/4	0-20000 indicates 0-20000 (us/cm) Note: The value is only applicable for MT05R-A	N/A
RESERVED	0x0003 /3	UINT16 RO	3/4	0-40960 indicates 0.0-4096.0	N/A
SUBSTRATE_EPSILON	0x0004 /4	INT16 RO	3/4	0-8188 indicates 0.00-81.88	N/A
SUBSTRATE_PORE EC	0x0005 /5	INT16 RO	3/4	0-20000 indicates 0-20000 (us/cm) Note: The value is only applicable for MT05R-A	N/A
SUBSTRATE_VWC_RAWAD	0x0006 /6	INT16 RO	3/4	0-4095	N/A
RESERVED	0x0007 /7	INT16 RO	3/4	Reserved	N/A
RESERVED	0x0008 /8	INT16 RO	3/4	Reserved	N/A

RESERVED	0x0009 /9	INT16 RO	3/4	Reserved	N/A
RESERVED	0x000A /10	INT16 RO	3/4	Reserved	N/A
RESERVED	0x000B /11	INT16 RO	3/4	Reserved	N/A
RESERVED	0x000C /12	INT16 RO	3/4	Reserved	0
RESERVED	0x000D /13	INT16 RO	3/4	Reserved	0
RESERVED	0x000E /14	INT16 RO	3/4	Reserved	0
RESERVED	0x000F /15	INT16 RO	3/4	Reserved	0
SUBSTRATE_TYPE	0x0020 /32	UINT16 RW	3/6/16	0: Soil Media 1: Soilless Media 2: User Defined Curve	0
TEMPERATURE_U NIT	0x0021 /33	UINT16 RW	3/6/16	0:°C 1:°F	0
MEASURE_METHO D	0x0022 /34	UINT16 RW	3/6/16	0: Measure Continuously 1: Measure when register read command received	0
FLOATBYTEORDE R	0x0023 /35	UINT16 RW	3/6/16	Configure floating point register byte order. 0: Big-endian [ABCD] 1: Little-endian[DCBA] 2: Big-endian byte swap [BADCB] 3: Little-endian byte swap[CDAB]	3
RESERVED	0x0024 /36	UINT16 RW	3/6/16	RESERVED	0
RESERVED	0x0025 /37	UINT16 RW	3/6/16	RESERVED	0
SLAVEADDRESS	0x0200 /512	UINT16 RW	3/6/16	1-255	1
BAUDRATE	0x0201 /513	UINT16 RW	3/6/16	0-5 0:1200bps 1:2400bps 2:4800bps 3:9600bps 4:19200bps	3:9600bps

				5:38400bps	
PROTOCOL	0x0202 /514	UINT16 RW	3/6/16	0 0:Modbus RTU	0:Modbus RTU
PARITY	0x0203 /515	UINT16 RW	3/6/16	0-2 0:NONE 1:EVEN 2:ODD	0:NONE
DATABITS	0x0204 /516	UINT16 RW	3/6/16	1 1:8 databits	1:8 databits
STOPBITS	0x0205 /517	UINT16 RW	3/6/16	0-1 0:1 stopbit 1:2 stopbits	0:1 stopbit
RESERVED	0x0206 /518	UINT16 RW	3/6/16	Reserved	0
RESERVED	0x0207 /519	UINT16 RW	3/6/16	Reserved	0
USERSN	0x0220 /544 0x0221 /545 0x0222 /546 0x0223 /547	UINT16 RW	3/16	0x0000000000000000- 0xFFFFFFFFFFFFFFFF	N/A
SUBSTRATE_TEMP RATURE_FLOAT	0x1000 /4096	FLOAT RO	3/4	-40.00-80.00 (°C); -40.00-176.00 (°F)	N/A
SUBSTRATE_VWC_ FLOAT	0x1002 /4098	FLOAT RO	3/4	0.00-100.00 (%)	N/A
SUBSTRATE_BULK EC_FLOAT	0x1004 /4100	FLOAT RO	3/4	0-20000 (us/cm) Note: The value is only applicable for MT05R-A	N/A
SUBSTRATE_CALI BRATEDRAWCOUN TS_FLOAT	0x1006 /4102	FLOAT RO	3/4	0.00-4096.00	N/A
SUBSTRATE_EPSIL ON_FLOAT	0x1008 /4104	FLOAT RO	3/4	0.00-81.88	N/A
SUBSTRATE_PORE EC_FLOAT	0x100A /4106	FLOAT RO	3/4	0-32000 (us/cm) Note: The value is only applicable for MT05R-A	N/A
SUBSTRATE_VWC_ RAWAD_FLOAT	0x100C /4108	FLOAT RO	3/4	0-4095	N/A
RESERVED_FLOAT	0x100E /4110	FLOAT RO	3/4	Reserved	N/A
RESERVED_FLOAT	0x1010 /4112	FLOAT RO	3/4	Reserved	N/A

RESERVED_FLOAT	0x1012 /4114	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x1014 /4116	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x1016 /4118	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x1018 /4120	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x101A /4122	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x101C /4124	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x101E /4126	FLOAT 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: Floating point register, the byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register. Please refer to “Modbus Register Detail Descripton” for more details.

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

Error Value	Register Address	Error
-32768	0x0000-0x000F	Sensor Broken
-32768	0x1000-0x101E	Sensor Broken
-32765	0x0000-0x000F	Not Supported Value
-32765	0x1000-0x101E	Not Supported Value

6.3 Modbus Register Detail Description

SUBSTRATE_TEMPERATURE - Substrate Temperature, INT16 Format		
Range	-4000-8000 indicates -40.00-80.00 (Temperature Unit set to °C); -4000-17600 indicates -40.00-176.00 (Temperature Unit set to °F)	Default: N/A
Parameter Storage	N/A	

SUBSTRATE_TEMPERATURE_FLOAT - Substrate Temperature, FLOAT Format		
Range	-40.00-80.00 (Temperature Unit set to °C); -40.00-176.00 (Temperature Unit set to °F)	Default: N/A
Parameter Storage	N/A	

Note: The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

SUBSTRATE_VWC - Substrate Volumetric Water Content, INT16 Format		
Range	0-10000 indicates 0-100.00 (%);	Default: N/A
Parameter Storage	N/A	

SUBSTRATE_VWC_FLOAT - Substrate Volumetric Water Content, FLOAT Format		
Range	0-100.00 (%)	Default: N/A
Parameter Storage	N/A	

Note: The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

SUBSTRATE_BULKEC - Substrate Bulk EC, INT16 Format		
Range	0-20000 indicates 0-20000 (us/cm);	Default: N/A
Parameter Storage	N/A	

Note: The value is only applicable for MT05R-A, It’s always set to -32765 for MT05R-B.

SUBSTRATE_BULKEC_FLOAT - Substrate Bulk EC, FLOAT Format		
Range	0-20000 (us/cm)	Default: N/A
Parameter Storage	N/A	

Note: The value is only applicable for MT05R-A, It’s always set to -32765 for MT05R-B.

Note: The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

SUBSTRATE_EPSILON - Substrate Epsilon, UINT16 Format		
Range	0-20000 indicates 0.00-200.00	Default: N/A
Parameter Storage	N/A	

SUBSTRATE_EPSILON_FLOAT - Substrate Epsilon, FLOAT Format		
Range	0.00-200.00	Default: N/A
Parameter Storage	N/A	

Note: The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

SUBSTRATE_POREEC - Substrate Pore EC, INT16 Format		
Range	0-32000 indicates 0-32000 (us/cm);	Default: N/A
Parameter Storage	N/A	

Note: The value is only applicable for MT05R-A, It's always set to -32765 for MT05R-B.

SUBSTRATE_POREEC_FLOAT - Substrate Pore EC, FLOAT Format		
Range	0-32000 (us/cm)	Default: N/A
Parameter Storage	N/A	

Note: The value is only applicable for MT05R-A, It's always set to -32765 for MT05R-B.

Note: The byte order is configured by "Floating Point Register Byte Order, FLOATBYTEORDER" register.

SUBSTRATE_VWC_RAWAD - Air Temperature, INT16 Format		
Range	0-4095	Default: N/A
Parameter Storage	N/A	

SUBSTRATE_VWC_RAWAD_FLOAT - Air Temperature, FLOAT Format		
Range	0-4095	Default: N/A
Parameter Storage	N/A	

Note: The byte order is configured by "Floating Point Register Byte Order, FLOATBYTEORDER" register.

SUBSTRATE_TYPE--- Substrate Type, INT16 Format		
Data Range	0: Soil Media 1: Soilless Media (like rockwool, cocopeat) 2: User Defined Curve	Default: 1
Parameter Storage	YES	

TEMPERATURE_UNIT--- Temperature Unit, INT16 Format		
Data Range	0:°C 1:°F	Default: 0
Parameter Storage	YES	

MEASURE_METHOD--- Measure Method, INT16 Format		
Data Range	0: Measure continuously (Perform measurement every 500ms) 1: Measure on register reading command received (Perform a measurement when user send data reading command)	Default: 1

Parameter Storage	YES	
-------------------	-----	--

FLOATBYTEORDER: Floating Point Register Byte Order, INT16		
Range	0: Big-endian [ABCD] 1: Little-endian[DCBA] 2: Big-endian byte swap [BADC] 3: Little-endian byte swap[CDAB]	Default: 3
Parameter Save	YES	

Note: Configure floating point register byte order.

Example: The 123456.00 in IEC754 is 0x47F12000 (A=47, B=F1, C=20, D=00), then

0: Big-endian [ABCD]

1: Little-endian[DCBA]

2: Big-endian byte swap [BADC]

3: Little-endian byte swap[CDAB]

SLAVEADDRESS - Modbus Slave Address (16 bit unsigned int)		
Data Range	1-255	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 0:1200bps 1:2400bps 2:4800bps 3:9600bps 4:19200bps 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 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 0:NONE 1:EVEN 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 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 0:1 stopbit 1:2 stopbits	Default: 0
Parameter Storage	YES	

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

USER_SN--- User Serial Number		
Data Range	0x0000000000000000-0xFFFFFFFFFFFFFFFF User Serial Number. These four registers should be read and write together from start address 0x0220 with quantity 4.	Default: N/A
Parameter Storage	YES	

7. Substrate Volumetric Water Content User Calibration

The sensor support user calibration for volumetric water content, you can perform a calibration to achieve best accuracy for specific substrate. Please refer to application note “substrate volumetric water content user calibration procedure”.

Appendix A RS485 Sensor Testing and Settings

User can test the communication or set parameters for the sensors with RS485 interface in the following method.

- Use any kind of master device that supports the RS485 interface (such as data acquisition device, data logger, etc.) to communicate with the sensor or set the parameters.
- Use a computer to communicate with the sensor through the RS485 converter (such as the USB/RS485 converter) to set the parameters.

This chapter mainly introduces the communication or parameter setting on a computer for sensor through the USB/RS485 converter.

A.1 Testing RS485 Sensors with RS485 Converter

RS485 converter is a communication converter between USB master device and RS485 sensor. It supports bidirectional transparent transmission of RS485 communication data and is used to control or test RS485 compatible sensors or devices. The USB master device can be a computer, Raspberry PI and other hosts that support USB interface.

In this example, a computer is used as a USB host to connect the sensor through the USB/RS485 converter for communication testing.



Installation steps:

- Install USB Virtual COM port driver on PC, laptop or other USB master device. After the converter is connected to the PC, a COM port is added to the system port. Use this port number in the debugging software to debug the communication with the converter.
- Connect the converter to a PC, laptop or other USB master device through USB port
- Connect the sensor to the RS485 port to the converter
- The sensor can be powered by the power output that comes with the converter or by an external power supply.
- Users can use any Modbus serial communication software for RS485 communication, such as

QModbus.

Testing Software Download	
QModbus (Modbus Debug Tool (For Serial Port))	https://www.infwin.com/modbus-debug-tool-for-serial-port/
SensorOneSet (sensor configuration utility)	https://www.infwin.com/sensoroneset-configuration-utility-for-rs485-sensors/

A.2 Testing Example

In this example, we use the USB/RS485 converter to communicate between a computer and the rugged temperature sensor DigiTEMP. The power supply of DigiTEMP is also provided by USB/RS485 converter.

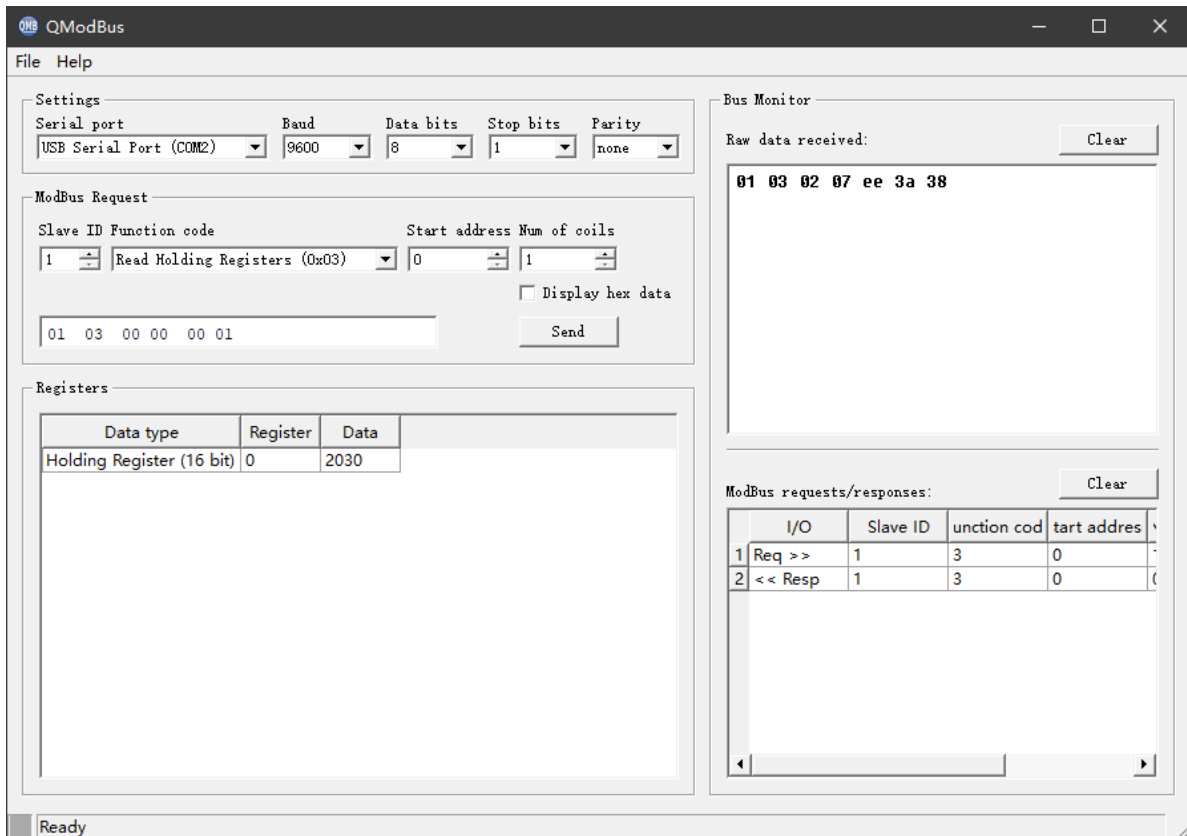
DigiTEMP Rugged Temperature Sensor User Manual
https://www.infwin.com/digitemp-rugged-digital-temperature-sensor-sdi12-rs485-modbus/

■ Connections



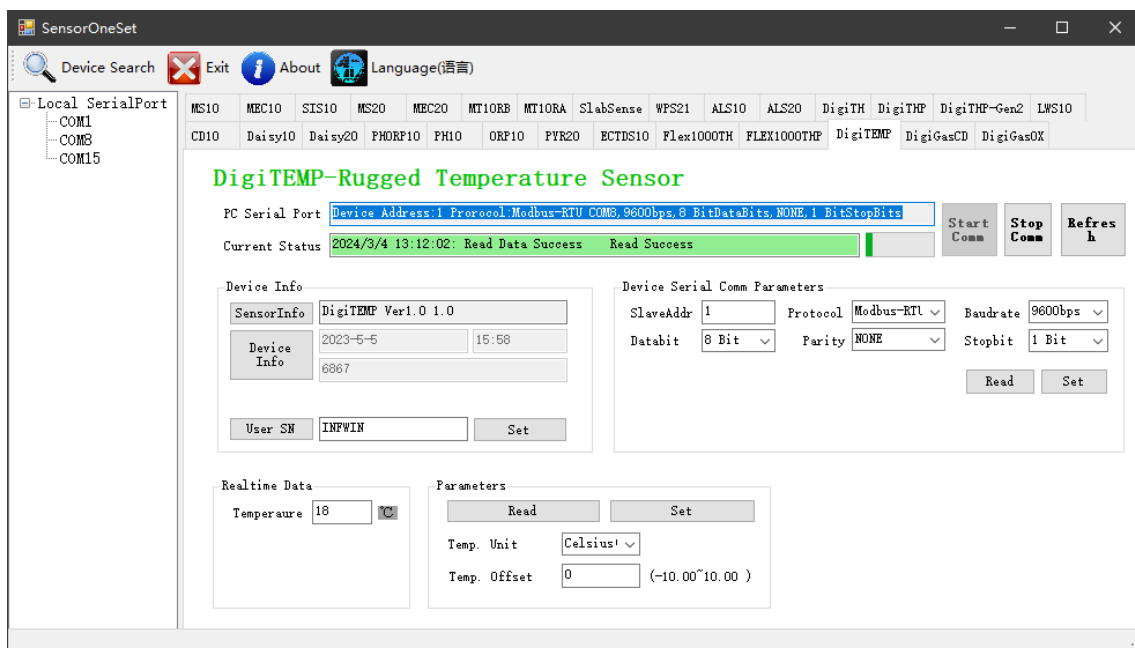
■ Testing with serial port utility “QModbus”

Take “QModbus” as an example, when debugging, please select the corresponding serial port number, baudrate is set to 9600bps, none parity, 8 data bits, 1 stop bit (the default communication Settings of DigiTEMP), open the serial port and input the Modbus-RTU command and send.



■ Testing with RS485 sensor configuration utility “SensorOneSet”

Start up the application, select the corresponding product page DigiTEMP, click "start communication" and choose the proper serial port number, 9600bps, none parity, 8 data bits, 1 stop bit (DigiTEMP default communication Settings) and start communication.



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Version Control

Date	Version	Comment	Updated by
2025-12-09	V1.0	Initial Creation	sl51930