



GREYSTONE
ENERGY SYSTEMS INC

G03 Series

Horticulture Sensor

SETUP GUIDE Modbus COMMUNICATION



1.1 ModBus Specification

RTU Message Format

Modbus Framing	8 bit binary
Data Bits	start bits --- 1 data bits --- 8 parity bits --- none, odd or even stop bits --- 1 or 2
Baud Rate	9600, 19200, 38400, 57600, 76800 or 115200
Duplex	Half duplex
Error Checking	Cyclical Redundancy Check (CRC) CRC-16 --- polynomial $x^{16}+x^{15}+x^2+x^0$ 0x8005 or reversed version 0xA001 or CRC-CITT --- polynomial $x^{16}+x^{12}+x^5+x^0$ 0x1021 or reversed version 0x8408
Latency	More than 3.5 characters --- minimum, 50, 100, 150, 200, 250, 300 or 350 mS

RTU Framing Support and Bit Sequences

Start	1	2	3	4	5	6	7	8	Stop	
Start	1	2	3	4	5	6	7	8	Stop	Stop
Start	1	2	3	4	5	6	7	8	Odd	Stop
Start	1	2	3	4	5	6	7	8	Even	Stop

Modbus Register Addressing

Modbus Address	Typical Offset	Units	Data Type		Notes
40001	+0		Word	Read	16-bit integer, Relay Status 0 = relay not activated, 1 = relay activated
40002	+1	PPM	Word	Read	16-bit integer, CO2 Value 0 to 20000 ppm
40003	+2	°C °F	Word	Read	16-bit integer, Temperature Value x 10 (multiplier = 10) 0 to 500 for 0.0 to 50.0 °C, 320 to 1220 for 32.0 to 122.0 °F
40004	+3	%RH	Word	Read	16-bit integer, RH Value x 10 (multiplier = 10) 0 to 1000 for 0.0 to 100.0 %RH
40005	+4	ft	Word	Read Write	16-bit integer, Altitude 0 to 5000 ft
40006	+5	PPM	Word	Read Write	16-bit integer, Relay Setpoint 500 to 5000 ppm for auto-cal sensor 500 to 15000 ppm for dual-beam sensor
40007	+6	PPM	Word	Read Write	16-bit integer, Relay Hysteresis 25 to 200 ppm for auto-cal sensor 25 to 500 ppm for dual beam sensor
40008	+7	sec	Word	Read Write	16-bit integer, Relay On Delay 0 to 255 seconds
40009	+8	°C °F	Word	Read Write	16-bit integer, Temperature Offset -5 to 5 °C, -10 to 10 °F
40010	+9	%RH	Word	Read Write	16-bit integer, RH Offset -10 to 10 %RH
40011	+10		Word	Read Write	16-bit integer, TEMP Units 0 = °C, 1 = °F
40012	+11		Word	Read Write	16-bit integer, Auto Cal Enable 0 = Disable, 1 = Enable (auto-cal sensor only)

RTU Function Codes

0x03 --- Read holding registers

Query

Slave address (0x01 to 0xFF)	Function code (0x03)	Starting address MSB	Starting address LSB	Quantity of registers MSB	Quantity of registers LSB	CRC LSB	CRC MSB
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* Starting address = 0x0000 to 0x000C, Quantity of registers = 0x0001 to 0x000D

Response

Slave address (0x01 to 0xFF)	Function code (0x03)	Byte count 2N	Register value MSB	Register value LSB	...	CRC LSB	CRC MSB
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* N= Quantity of registers

0x06 --- Write single register

Query

Slave address (0x01 to 0xFF)	Function code 0x06	Register address MSB	Register address LSB	Register value MSB	Register value LSB	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	Function code 0x06	Register address MSB	Register address LSB	Register value MSB	Register value LSB	CRC LSB	CRC MSB
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* Register address = 0x0004 to 0x000C, Registers value = 0x0000 to 0xFFFF

Exception response

Slave address (0x01 to 0xFF)	Function code + 0x80	Exception code 0x01, 0x02 or 0x03	CRC LSB	CRC MSB
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* An exception response is only returned if the CRC is correct
Exception code 01 --- illegal function, 02 --- illegal address, 03 --- illegal data value

Note that the registers may be read individually or multiple registers may be read at the same time by changing the query as shown below.

To read several registers with one query...

0x03 --- Read ALL REGISTERS

Query

Slave address (0x01 to 0xFF)	0x03	0x00	0x00 (Note 1)	0x00	0x05 (Note2)	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x03	0x0A (Note 3)	Register value MSB	Register value LSB	...	CRC LSB	CRC MSB
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Note 1: The starting address (A) may be 0x0000 to 0x000B. The read multiple feature will read all registers from the starting address forward. If the starting address is 0x0000 then registers 40001 to 40012 can be read. If the starting address is 0x000A then registers 40011 to 40012 can be read.

Note 2: The quantity of registers (N) may be 0x0001 to 0x000B, but must be limited to 12 – A. If the starting address (A) is set to 0x0000 then N may be 0x0001 to 0x000B. If the starting address is set to 0x000A then N may be 0x0001 to 0x0002.

Note 3: The byte count (B) will always be 2N. If the quantity of registers (N) is 0x0001 then B will be 0x02. If N is 0x0005 then B will be 0x0A.

The RTU function codes supported are shown below.

0x03 --- Read Relay Status

Query

Slave address (0x01 to 0xFF)	0x03	0x00	0x00	0x00	0x01	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x03	0x02	Register value 0x00	Register value LSB *	CRC LSB	CRC MSB
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* Register value = 0x0000 for relay not activated, 0x0001 for relay activated

0x03 --- Read CO2 Value

Query

Slave address (0x01 to 0xFF)	0x03	0x00	0x01	0x00	0x01	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x03	0x02	Register value MSB *	Register value LSB *	CRC LSB	CRC MSB
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* Register value = 0x0000 to 0x4E20, corresponding to 0 to 20000 ppm

0x03 --- Read Temperature Value

Query

Slave address (0x01 to 0xFF)	0x03	0x00	0x02	0x00	0x01	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x03	0x02	Register value MSB *	Register value LSB *	CRC LSB	CRC MSB
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* Register value = 0x0000 to 0x01F4, corresponding to 0.0 to 50.0 °C (multiplier = 10)
or = 0x0140 to 0x04C4, corresponding to 32.0 to 122.0 °F (multiplier = 10)

The temperature value is either in °C (default) or °F depending on the value of the TEMP Units register. This register has a multiplier of 10, the application must divide by 10 to obtain the correct value.

0x03 --- Read RH Value

Query

Slave address (0x01 to 0xFF)	0x03	0x00	0x03	0x00	0x01	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x03	0x02	Register value MSB *	Register value LSB *	CRC LSB	CRC MSB
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* Register value = 0x0000 to 0x03E8, corresponding to 0 to 100 %RH (multiplier = 10)

This register has a multiplier of 10, the application must divide by 10 to obtain the correct value.

0x03 --- Read Altitude

Query

Slave address (0x01 to 0xFF)	0x03	0x00	0x04	0x00	0x01	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x03	0x02	Register value MSB *	Register value LSB *	CRC LSB	CRC MSB
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* Register value = 0x0000 to 0x1388, corresponding to 0 to 5000 feet

NOTE: All registers may be read in the same manner as shown above.

0x06 --- Write Altitude

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x04	Register value MSB *	Register value LSB *	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x04	Register value MSB	Register value LSB	CRC LSB	CRC MSB
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* This register is used to set the local altitude to improve sensor accuracy
Register value = 0x0000 to 0x1388, corresponding to 0 to 5000 feet

0x06 --- Write Relay Setpoint

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x05	Register value MSB *	Register value LSB *	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x05	Register value MSB	Register value LSB	CRC LSB	CRC MSB
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* This register is used to set the setpoint for the relay
Register value is 0x01F4 to 0x1388, corresponding to 500 to 5000 ppm for the auto-cal sensor
Register value is 0x01F4 to 0x3A98, corresponding to 500 to 15000 ppm for the dual-beam sensor

0x06 --- Write Relay Hysteresis

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x06	Register value MSB *	Register value LSB *	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x06	Register value MSB	Register value LSB	CRC LSB	CRC MSB
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* This register is used to set the hysteresis for the relay setpoint

Register value is 0x0019 to 0x00C8, corresponding to 25 to 200 ppm for the auto-cal sensor

Register value is 0x0019 to 0x01F4, corresponding to 25 to 500 ppm for the dual-beam sensor

0x06 --- Write Relay On Delay

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x07	Register value MSB *	Register value LSB *	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x07	Register value MSB	Register value LSB	CRC LSB	CRC MSB
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* This register is used to set the on delay time for the relay

Register value is 0x0000 to 0x00FF, corresponding to 0 to 255 seconds

0x06 --- Write Temperature Offset

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x08	Register value MSB *	Register value LSB *	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x08	Register value MSB	Register value LSB	CRC LSB	CRC MSB
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* This register is used to add or subtract an offset to the temperature value if necessary to conform to a local reference

For °C operation, Register value = 0xFFFFB to 0x0005 for -5 to 5 °C

For °F operation, Register value = 0xFFFF6 to 0x000A for -10 to 10 °F (resolution is 1°)

The TEMP Units (°C or °F) for the device should be selected first, and then add any offset if necessary

0x06 --- Write RH Offset

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x09	Register value MSB *	Register value LSB *	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x09	Register value MSB	Register value LSB	CRC LSB	CRC MSB
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* This register is used to add or subtract an offset to the RH value if necessary to conform to a local reference

Register value = 0xFFFF6 to 0x000A for -10 to 10 %RH.

0x06 --- Write TEMP Units

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x0A	0x00	Register value LSB*	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x0A	0x00	Register value LSB*	CRC LSB	CRC MSB
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* Registers value = 0x0000 to 0x0001, corresponding to 0 = °C and 1 = °F

0x06 --- Write Auto Cal Enable

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x0B	0x00	Register value LSB*	CRC LSB	CRC MSB
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Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x0B	0x00	Register value LSB*	CRC LSB	CRC MSB
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* Registers value = 0x0000 to 0x0001, corresponding to 0 = Disable and 1 = Enable
This setting applies to the auto-cal sensor only