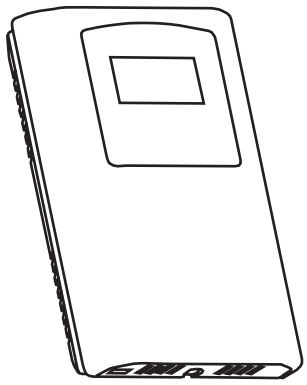
Dewpoint Transmitter

DPRC ModBus - Installation Instructions



INTRODUCTION

The dewpoint transmitters are designed for use in environmental monitoring and control systems where high performance and stability are demanded. It's state-of-the-art design combines digital linearization and temperature compensation with a highly accurate and reliable thermoset polymer based capacitance humidity sensor and curve-matched NTC thermistor temperature sensor for reliability and accuracy in the most critical applications. The dewpoint transmitter has four measurement variables which include dewpoint, dry-bulb temperature, wet-bulb temperature and enthalpy which are available Modbus signal to provide the most efficient monitoring and control solution.

BEFORE INSTALLATION

Read these instructions carefully before installing and commissioning the device. Failure to follow these instructions may result in product damage. Do not use in an explosive or hazardous environment, with combustible or flammable gases, as a safety or emergency stop device or in any other application where failure of the product could result in personal injury. Take electrostatic discharge precautions during installation and do not exceed the device ratings.

MOUNTING

The dewpoint transmitter installs directly on a standard electrical box and should be mounted five feet from the floor of the area to be controlled. Do not mount the sensor near doors, opening windows, supply air diffusers or other known air disturbances. Avoid areas where the detector is exposed to vibrations or rapid temperature changes.

The cover is hooked to the base at the top edge and must be removed from the bottom edge first. Use a small Phillips screwdriver to loosen the security screw as shown in Figure 1. (Complete removal of this screw is not required). Use a screwdriver to carefully pry each bottom corner if necessary. Tip the cover away from the base and sit it aside as shown in Figure 2.

The PCB must be removed from the base to access the mounting holes. Follow usual anti-static procedures when handling the PCB and be careful not to touch the sensors. The PCB is removed by pressing the enclosure base to unsnap the latch near the bottom edge, then the PCB can be lifted out of the base as shown in Figure 3.

Sit the PCB aside until the base is mounted on the wall. For added protection, place the PCB in the supplied anti-static bag.

Mount the base by screwing to an electrical box or directly to the wall as shown in Figure 4. The mounting hole locations are shown on page 4.

After the base is screwed to an electrical box or the wall using the appropriate holes, remove the PCB from the anti-static bag, feed connection wires through center hole and place the top of PCB into the PCB holders on backplate and snap bottom of PCB into place as shown in Figure 4.

Make wire connections as per the Wiring Illustrations on Page 2 and install decorative cover by placing the top of the cover into the cover holder on the top of the backplate and snapping the bottom into place as shown in Figure 4. Tighten security screw with a Phillips screwdriver.

Figure 1

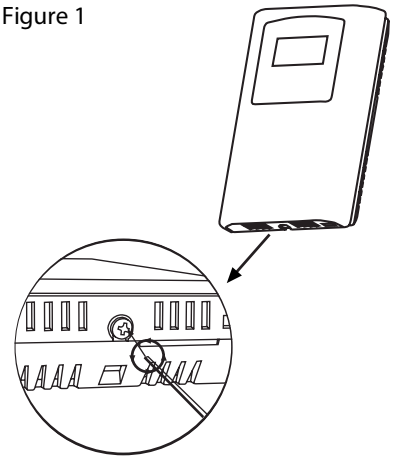


Figure 2

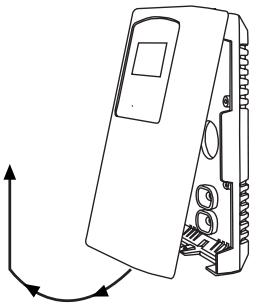


Figure 3

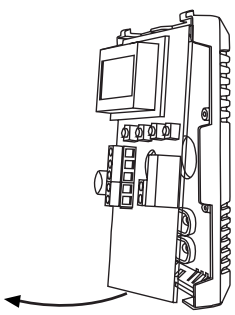
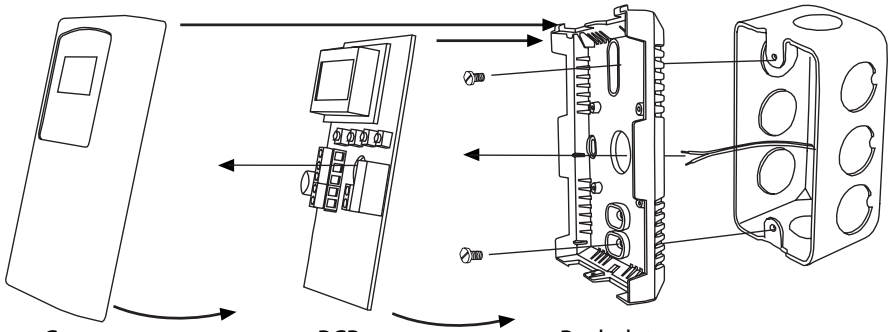


Figure 4



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WIRING

- Deactivate the 24 Vac/dc power supply until all connections are made to the device to prevent electrical shock or equipment damage.
- Follow proper electrostatic discharge (ESD) handling procedures when installing the device or equipment damage may occur.
- Use 22 AWG shielded wiring for all connections and do not locate the device wires in the same conduit with wiring used to supply inductive loads such as motors.
- Make all connections in accordance with national and local codes.

Connect the 24 Vac/dc power supply to the terminals labeled PWR (power) and COM (common) as shown in Figure 6. This device has a half-wave type power supply so use caution when wiring multiple devices so that the circuit ground point is the same on all devices and the controller. Use caution if 24 Vac power is used and one side of the transformer is earth-grounded. In general, the transformer should NOT be connected to earth ground when using devices with RS-485 network connections. The device is reverse voltage protected and will not operate if connected backwards.

Connect the RS-485 network with twisted shielded pair to the terminals marked A-, B+ and SHLD (shield) as shown in Figure 6. The positive wire connects to B(+) and the negative wire connects to A(-) and the cable shield must be connected to the SHLD terminal on each device. If the device is installed at either end of the network, an end-of-line (EOL) termination resistor (121 ohm) should be installed in parallel to the A(-) and B(+) terminals. This device includes a network termination jumper and will connect the resistor correctly on the pcb. Simply move the pcb jumper to the EOL position and no external resistor is required as shown in Figure 7. The ground wire of the shielded pair should be connected to earth ground at the end of the network and the master is not grounded. Do not run bus wiring in the same conduit as line voltage wiring.

A network segment is a single shielded wire loop run between several devices (nodes) in a daisy chain configuration. The total segment length should be less than 4000 feet (1220 meters) and the maximum number of nodes on one segment is 127. Nodes are any device connected to the loop and include controllers, repeaters and sensors such as the RH/T Sensor but does not include the EOL terminators. To install more devices, or to increase the network length, repeaters will be required for proper communication. The maximum daisy chain length (segment) depends on transmission speed (baud rate), wire size and number of nodes. If communication is slow or unreliable, it may be necessary to wire two daisy chains to the controller with a repeater for each segment.

Figure 5

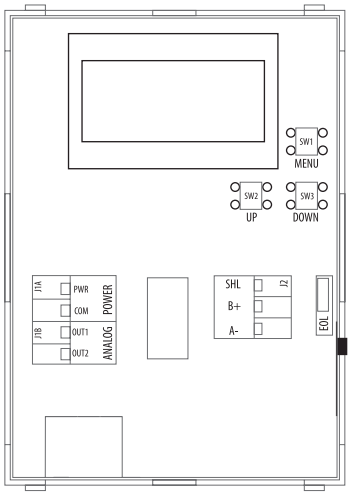


Figure 6

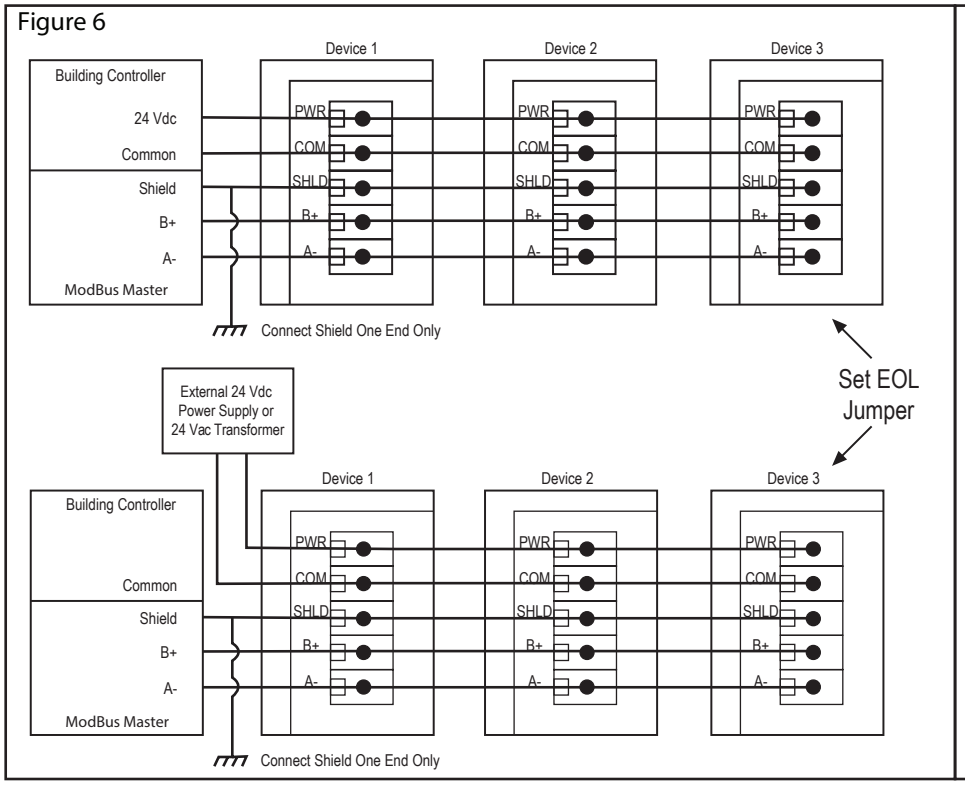
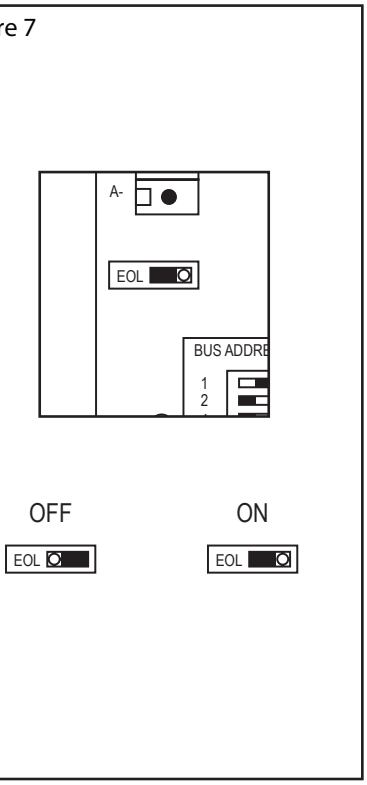


Figure 7



OPERATION

Start-Up Mode
When the device is powered on, it will go through a brief start-up mode. The LCD will display a sequence of information depending on the model. At the end of the start-up sequence, normal operation will begin.

STEP 1 LCD Test
All segments lit for 2 seconds

STEP 2 Model
Displays the model type (modbus) for 2 sec.

STEP 3 Software Version for 2 sec

STEP 4 Address for 2 sec

STEP 5 Baud rate for 2 sec

Normal Mode

In normal operation the device:

- reads the temperature and RH sensors
- calculates values for dewpoint, wet bulb and enthalpy
- updates the LCD values
- updates the Modbus object values
- monitors the menu key for activity

If the <MENU> key is pressed, normal operation is suspended while the menu functions are serviced. The program will automatically exit the menu after a period of inactivity.

MENU

The device has several parameters that can be configured locally via the User menu using the keypad and LCD. All parameters default to typical values but the installer may want to change some values. In some cases, such as the device network address, the installer MUST change the settings before operation. Any changes made are saved in non-volatile memory and are restored in case of a power loss. Only the menu items relevant to the device model will be shown. The menu can be accessed at any time after the start-up mode and if there is 5 minutes of inactivity the menu will close and normal operation will continue.

User Menu - Network Device
To enter the menu, press and release the <MENU> key. This will enter the User menu step 1, pressing the <MENU> key a second time advances to step 2. Each press of the <MENU> key saves the current setting and advances the menu item. The <UP> and <DOWN> keys are used to make changes to program variables by scrolling through the available options. When a value is changed, use the <MENU> key to save it to memory and advance to the next menu item.

<MENU> Press and release to enter the User menu.

ADDRESS (default = 1)
Use <UP> or <DOWN> to set the address 1-255.
°C and Td blink to indicate the mode.

<MENU>

BAUD RATE (default = 9600)
Use <UP> or <DOWN> to select a baud rate of 30 (300), 60 (600), 120 (1200), 240 (2400), 480 (4800), 960 (9600), 192 (19200) or 384 (38400), °F and Tw blink to indicate the mode.

<MENU>

MODBUS PARITY (default = none)
Use <UP> or <DOWN> to select a parity value of n (none), O (odd) or E (even).

<MENU>

MODBUS STOP BITS (default = 1)
Use <UP> or <DOWN> to set the stop bits to 1 or 2.

<MENU>

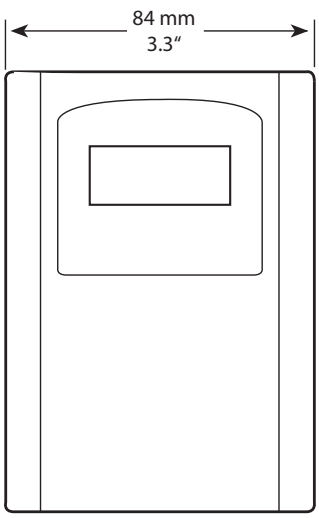
MODBUS CRC (default = 1)
Use <UP> or <DOWN> to select a CRC value of 1 (A001 = CRC-16 reverse), 2 (1021 = CITT), 3 (8005 = CRC-16) or 4 (8408 = CITT reverse).

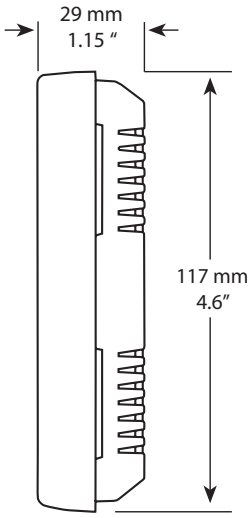
<MENU>

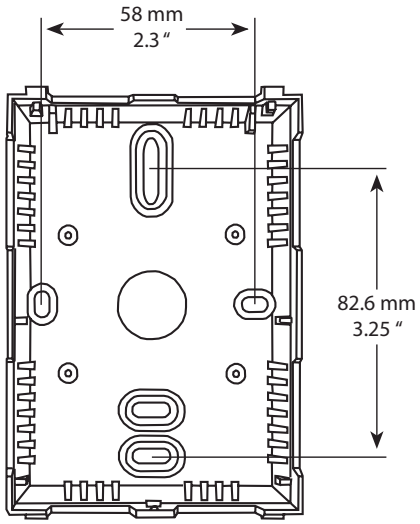
MODBUS DELAY (default = 0)
Use <UP> or <DOWN> to change the value from 0 (minimum) to 50, 100, 150, 200, 250, 300 or 350 ms. BTU/lb blinks to indicate the mode.

<MENU> Exits the menu and returns to normal operation.

DIMENSIONS







SENSOR TYPE:

RH Sensor	Thermoset polymer based capacitive
Temperature Sensor	NTC Thermistor

MEASUREMENT RANGE:

Relative Humidity	0 - 100 %RH
Dry Bulb Temperature	0 – 50 °C (32 – 122 °F)

CALCULATED VALUES:

Dewpoint Temperature	-30 – 50 °C (-22 – 122 °F)
Wet Bulb Temperature	-30 – 50 °C (-22 – 122 °F)
Enthalpy	0 – 340 kJ/kg (0 – 146 BTU/lb)

ACCURACY:

Relative Humidity (RH)	± 2% RH, 10 – 90 %RH @ 25 °C
Dry Bulb Temp.(T)	± 0.2 °C (± 0.4 °F) / 0 – 50 °C (32 – 122 °F)
Dewpoint Temp. (Td)	± 1.0 °C (± 1.8 °F) @ 40 %RH / 25 °C
Wet Bulb Temp.(Tw)	± 1.0 °C (± 1.8 °F) @ 50 %RH / 25 °C
Enthalpy (En)	± 2 kJ/kg (± 1 BTU/lb) @ 50 %RH / 25 °C

INTERFACE:

ModBus Protocol	ModBus RTU, 2-wire RS-485 300, 600, 1200, 2400, 4800, 9600, 19200 or 38400 baud 1-255 slave address range

SPECIFICATIONS:

Power Supply	20 – 27 Vdc, 16 – 27 Vac (non-isolated half-wave rectified)
Consumption	50 mA max @ 24 Vdc, 1.5 VA max @ 24 Vac
Operating Conditions	0 – 50 °C (32 – 122 °F), 0 – 95 %RH non-condensing
Storage Conditions	-20 – 70 °C (-4 – 158 °F), 0 – 95 %RH non-condensing
Wiring Connections	14 – 22 AWG terminal block
Enclosure	Continental
Dimensions	84W x 117H x 29D mm (3.3W x 4.6H x 1.15D in)
Material	White ABS
Weight	105 gm (3.7 oz)
Approvals	CE, RoHS

LCD DISPLAY VALUES:

Temperature	0.0 – 50.0 °C (0.5 °C resolution) or 32 – 122 °F (1 °F resolution)
Dewpoint	-30.0 – 50.0 °C Td (0.5 °C resolution) or -22 – 122 °F Td (1 °F resolution)
Wet Bulb	-10.0 – 50.0 °C Tw (0.5 °C resolution) or 14 – 122 °F Tw (1 °F resolution)
Enthalpy	0 – 340 kJ/kg (1 kJ/kg resolution) or 0 – 146 BTU/lb (1 BTU/lb resolution)

MODBUS

MODBUS ADDRESS	TYPICAL OFFSET	UNITS	DATA TYPE	ACCESS	NOTES
40001	+0	°C/°F	Word	Read	16-bit integer, Temperature value x 10 (multiplier = 10) -300 to 500 for -30.0 to 50.0 °C, -220 to 1220 for -22.0 to 122.0 °F
40002	+1	%RH	Word	Read	16-bit integer, %RH value x 10 (multiplier = 10) 0 to 1000 for 0 to 100.0 %RH
40003	+2	°C/°F	Word	Read	16-bit integer, Dewpoint Temperature value x 10 (multiplier = 10) -300 to 500 for -30.0 to 50.0 °C, -220 to 1220 for -22.0 to 122.0 °F
40004	+3	°C/°F	Word	Read	16-bit integer, Wet Bulb Temperature x 10 (multiplier = 10) -300 to 500 for -30.0 to 50.0 °C, -220 to 1220 for -22.0 to 122.0 °F
40005	+4	kJ/Kg BTU/lb	Word	Read	16-bit integer, Enthalpy value (multiplier = 1) 0 to 340 kJ/kg, 0 to 146 BTU/lb
40006	+5	°C/°F	Word	R/W	16-bit integer, Temperature Offset (multiplier = 10) -100 to 100 for -10.0 to 10.0 °F or -50 to 50 for -5.0 to 5.0 °C (Note: resolution is 10 for °F and 5 for °C)
40007	+6	%RH	Word	R/W	16-bit integer, RH Offset (multiplier = 10) -100 to 100 for -10.0 to 10.0 %RH (Note: resolution is 10)
40008	+7	hPa	Word	R/W	16-bit integer, Atmospheric Pressure 812 to 1013 hPa
40009	+8	Feet	Word	R/W	16-bit integer, Altitude 0 to 6000 ft
40010	+9		Word	R/W	16-bit integer, Display Mode 0 to 10
40011	+10		Word	R/W	16-bit integer, Temperature Units 0 = °C, 1 = °F
40012	+11		Word	R/W	16-bit integer, Enthalpy Units 0 = kJ/kg, 1 = BTU/lb

This section describes the implementation of the Modbus protocol. This device communicates on standard Modbus networks using RTU mode transmission. It operates as a slave device (address from 1 to 255) and expects a Modbus master device to transmit queries, which it will answer.

RTU Message Format

MODBUS FRAMING	8 BIT BINARY
Data Bits	start bits --- 1 data bits --- 8 parity bits --- none, odd or even stop bits --- 1or 2
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19200 or 38400
Duplex	Half duplex
Error Checking	Cyclical Redundancy Check (CRC) CRC-16 --- polynomial x16+x15+x2+x0 0x8005 or reversed version 0xA001 or CRC-CITT --- polynomial x16+x12+x5+x0 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

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

* Starting address = 0x0000 to 0xFFFF, Quantity of registers = 0x0000 to 0x007D

Response

Slave address (0x01 to 0xFF)	Function code (0x03)	Byte count 2N	Register value MSB	Register value LSB	…	CRC LSB	CRC MSB

* 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

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

* Register address = 0x0000 to 0xFFFF, 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

* An exception response is only returned if the CRC is correct
Exception code 01 --- illegal function, 02 --- illegal address, 03 --- illegal data value

The RTU function codes supported by the dewpoint sensor are shown below.

0x03 --- Read TEMPERATURE_VALUE

Query

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

Response

Slave address (0x01 to 0xFF)	0x03	0x02	Register value MSB	Register value LSB	CRC LSB	CRC MSB

* Register value = 0xFED4 to 0x01F4, corresponding to -30.0 to 50.0 °C (multiplier = 10)
or = 0xFF24 to 0x04C4, corresponding to -22.0 to 122.0 °F (multiplier = 10)

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

0x03 --- Read RELATIVE_HUMIDITY_VALUE

Query

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

Response

Slave address (0x01 to 0xFF)	0x03	0x02	Register value MSB	Register value LSB	CRC LSB	CRC MSB

* 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 DEWPOINT_TEMPERATURE_VALUE

Query

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

Response

Slave address (0x01 to 0xFF)	0x03	0x02	Register value MSB	Register value LSB	CRC LSB	CRC MSB

* Register value = 0xFED4 to 0x01F4, corresponding to -30.0 to 50.0 °C (multiplier = 10)
or = 0xFF24 to 0x04C4, corresponding to -22.0 to 122.0 °F (multiplier = 10)

The dewpoint temperature value is either in °C (default) or °F depending on the value of the TEMPERATURE_UNITS register.

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

0x03 --- Read WET_BULB_TEMPERATURE_VALUE

Query

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

Response

Slave address (0x01 to 0xFF)	0x03	0x02	Register value MSB	Register value LSB	CRC LSB	CRC MSB

* Register value = 0xFED4 to 0x01F4, corresponding to -30.0 to 50.0 °C (multiplier = 10)
or = 0xFF24 to 0x04C4, corresponding to -22.0 to 122.0 °F (multiplier = 10)

The wet bulb temperature value is either in °C (default) or °F depending on the value of the TEMPERATURE_UNITS register.

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

0x03 --- Read ENTHALPY_VALUE

Query

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

Response

Slave address (0x01 to 0xFF)	0x03	0x02	Register value MSB	Register value LSB	CRC LSB	CRC MSB

* Register value = 0x0000 to 0x0154, corresponding to 0 to 340 kJ/kg (multiplier = 1)
or = 0x0000 to 0x0092, corresponding to 0 to 146 BTU/lb (multiplier = 1)

The enthalpy value is either in kJ/kg (default) or BTU/lb depending on the value of the ENTHALPY_UNITS register.

0x06 --- Write TEMPERATURE_OFFSET

Query

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

Response

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

* This register is used to add or subtract an offset to the temperature value if necessary to conform to a local reference.

For °F operation, Register value = 0xFF9C to 0x0064 for -100 to 100,
corresponds to T_OFFSET / 10 = -10.0 to 10.0 °F. ie: 0xFFC4 => -60/10 = -6.0 °F offset
resolution is 10, ie: °F offset must be -1.0, 0, +1.0, +2.0, etc. -1.3 is not valid

For °C operation, Register value = 0xFFCE to 0x0032 for -50 to 50,
corresponds to T_OFFSET / 10 = -5.0 to 5.0 °C. ie: 0x0023 => 35/10 = +3.5 °C offset
resolution is 5, ie: °C offset must be -1.5, -1.0, -0.5, 0, +0.5, +1.0, etc. +2.3 is not valid

The operating temperature units (°C or °F) for the device should be selected first, and then add any offset if necessary.

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

0x06 --- Write RH_OFFSET

Query

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

Response

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

* This register is used to add or subtract an offset to the RH value if necessary to conform to a local reference.

Register value = 0xFF9C to 0x0064 for -100 to 100, corresponding to RH_OFFSET = -10.0 to 10.0 %RH.
ie: 0x001E => 30/10 = +3.0 %RH offset.
resolution is 10, ie: offset must be -5.0, -4.0, -3.0, -2.0, etc. -4.3 is not valid

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

0x06 --- Write ATMOSPHERIC_PRESSURE

Query

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

Response

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

* This register is used to set the atmospheric pressure value to conform to local conditions. This value is used in calculations.

Register value = 0x032C to 0x03F5, corresponding to ATMOSPHERIC_PRESSURE = 812 to 1013 hPa.

0x06 --- Write ALTITUDE

Query

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

Response

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

* This register is used to set the altitude value to conform to local conditions. This value is used in calculations.
Note that atmospheric pressure and altitude are linked, changing one also changes the other.

Register value = 0x0000 to 0x1770, corresponding to ALTITUDE = 0 to 6000 feet.

0x06 --- Write DISPLAY_MODE

Query

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

Response

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

* This register is used to set the parameters displayed on the local LCD in the normal operating mode.
The available settings are:

0 = no display (menu will still display if key pressed)
1 = Temperature
2 = Dewpoint temperature
3 = Wet Bulb temperature
4 = Enthalpy
5 = Temperature plus dewpoint toggle every 5 seconds
6 = Temperature plus wet bulb toggle
7 = Temperature plus enthalpy toggle
8 = Dewpoint plus wet bulb toggle
9 = Dewpoint plus enthalpy toggle
10 = Wet bulb plus enthalpy toggle

0x06 --- Write TEMPERATURE_UNITS

Query

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

Response

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

* Register value = 0x0000 = sets the device to °C operation
= 0x0001 = sets the device to °F operation

0x06 --- Write ENTHALPY_UNITS

Query

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

Response

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

* Register value = 0x0000 = sets the device to kJ/kg operation
= 0x0001 = sets the device to BTU/lb operation

Exception response

Slave address (0x01 to 0xFF)	Function code + 0x80	Exception code * 0x01, 0x02 or 0x03	CRC LSB	CRC MSB

* An exception response is only returned if the CRC is correct
Exception code 01 --- illegal function
Exception code 02 --- illegal address
Exception code 03 --- illegal data value

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