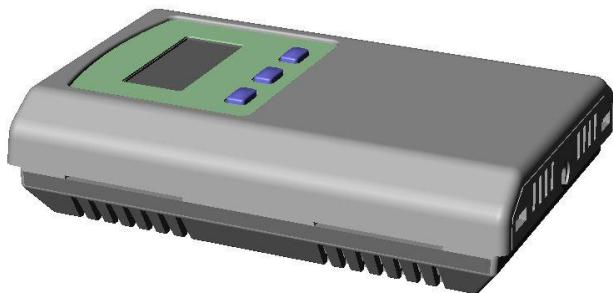


INNOTECH BACNET / MODBUS SENSORS

NTRC SERIES - INSTALLATION INSTRUCTIONS





Introduction

The Network Sensor features embedded BACnet and ModBus communication and is available in several configurations for the most efficient monitoring and control solution. The basic unit accurately measures room temperature and can also include RH measurement, up/down setpoint control, a local override function, a control relay output, a digital input and a fan speed switch.

The device connects to an RS-485 MS/TP network to offer a single-point solution for control of indoor air quality and comfort. Features include a back-lit LCD and user menu for easy installation, field-proven sensors and user input controls to add local setpoint and override functions at the same network point.

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.

Set-up

The device parameters must be set before connection to the network and will ensure each device will have a unique address and the correct baud rate.

For BACnet, the MAC address is appended to the Device Object : Vendor Identifier to create the unique Device Instance (Device Object : Object Identifier). Once connected to a network, the Device Object : Object Identifier can be written to any unique value via BACnet.

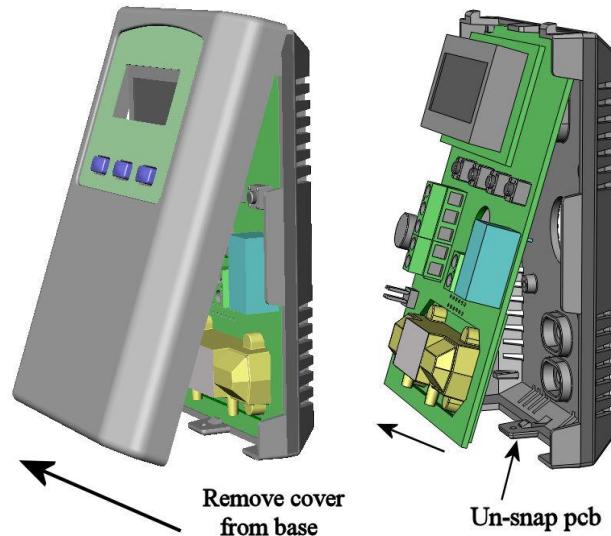
Once set, all parameters are saved in non-volatile memory. The local menu and LCD are used to set the BACnet MAC device address (0-127) or the ModBus address (1-255) and the baud rate. The factory defaults are address 3 and 9600 baud. The menu and setup procedure is described in the Setup Menu section.

Mounting

The room type sensor 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.

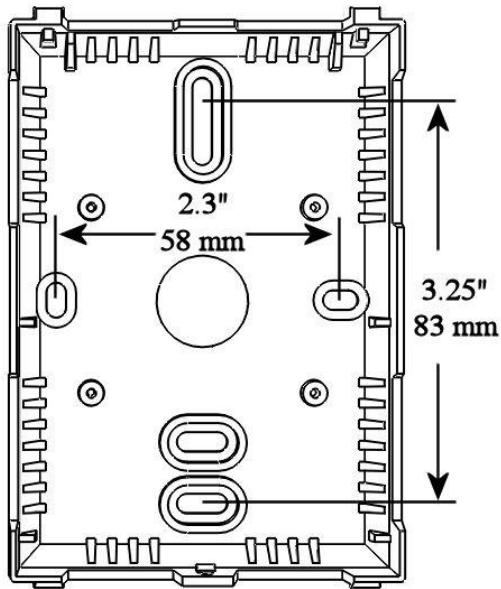
The cover is hooked to the base at the top edge and must be removed from the bottom edge first. Use a small screwdriver to carefully pry each bottom corner if necessary. If a security screw is installed on the bottom edge, then it may have to be loosened or removed also. Tip the cover away from the base and sit it aside.

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. Sit the pcb aside until the base is mounted on the wall.



After the base is screwed to an electrical box or the wall using the appropriate holes, pull the wires through the wiring hole in the center of the pcb and then reinstall it in the enclosure base. Ensure the pcb is snapped into the base securely and correctly.

The mounting hole locations are shown in the following drawing.



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 **POWER** and **COMMON**. 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.

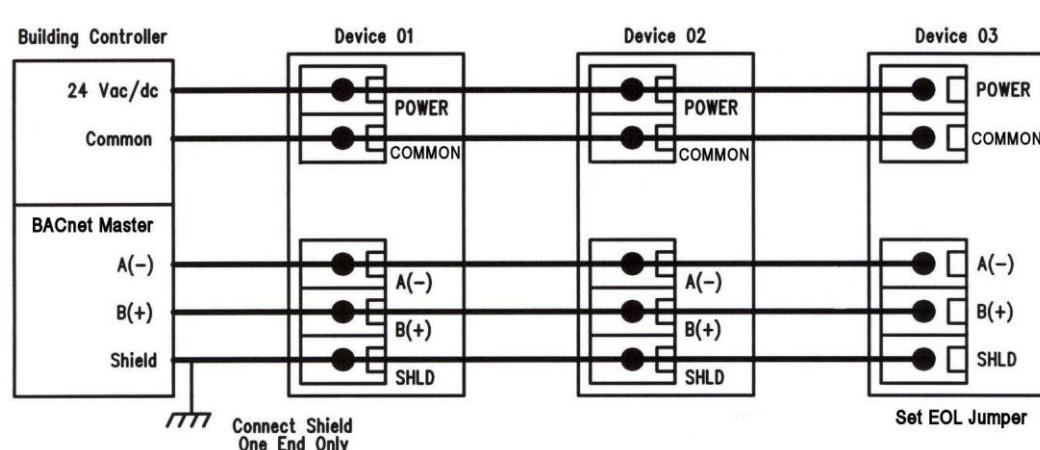
Connect the RS-485 network with twisted shielded pair to the terminals marked **A(-)**, **B(+)** and **SHIELD**.

The positive wire connects to **B(+)** and the negative wire connects to **A(-)** and the cable shield must be connected to the **SHIELD** terminal on each device. If the device is installed at either end of an RS-485 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 121 ohm resistor correctly on the pcb. Simply move the jumper to the EOL position and no external resistor is required. 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 or other wiring that switches power to highly inductive loads such as contactors, coils or motors.

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 64. Nodes are any device connected to the loop and include controllers, repeaters and sensors such as this one but do not include the EOL terminators. To install more than 64 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.

An optional signal is the relay output available on the **RELAY** terminals. The relay output is completely isolated and has a Normally Open (NO) signal. This signal can be used to directly control an alarm or ventilation fan.

The optional **D INPUT** (digital input) signal accepts a dry-contact only with respect to **COMMON** and registers in BACnet or ModBus.



Start-up

Verify the transmitter is properly wired and connections are tight. Apply power and note that the LCD will indicate the software version number and then the device will begin reading the sensor values and display them on the LCD.

Operation

In normal operation the device reads the temperature and RH (if installed) sensors and updates the object (BACnet) or register (ModBus) values accordingly. The LCD displays the sensor values as determined by the display mode object for either temperature only, RH only, both or none. Temperature units can be set to either C or F and the display resolution can be set also.

If the device has the optional Up/Down setpoint switches installed, pressing either the <UP> or <DOWN> keys will cause the LCD to change to show the setpoint value. The first key press will display the current setting of the Up/Down control for about 5 seconds and then revert back to the sensor values again if neither the <UP> or <DOWN> keys are pressed again. To increase the setpoint, press the <UP> key while the LCD is in setpoint mode and each press will increase the setpoint up to the maximum value. To decrease the setpoint, press the <DOWN> key while the LCD is in setpoint mode and each press will decrease the setpoint down to the minimum value. After 5 seconds of no key activity, the display will revert back to normal and the new setpoint value will be saved.

The setpoint minimum and maximum values can be configured via the network as can the units for either °C, °F or %RH values.

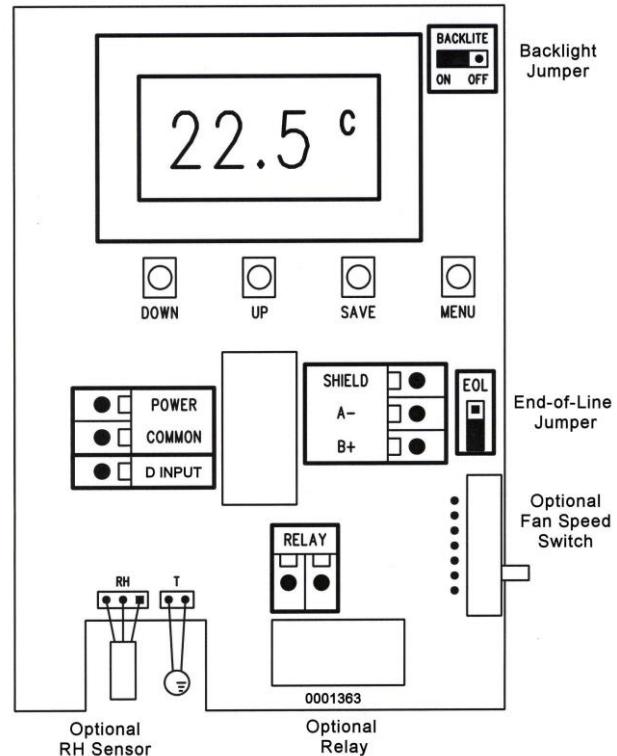
If the device has the optional Override switch installed, pressing the <OVERRIDE> key will cause the Override object status to change and it can be reset via the network.

Network objects are available to control the OCC (occupied) LCD segment and the relay output.

If the optional Fan Speed switch is installed, its output setting can be queried via a network object also.

Shorting the optional D Input terminal to COMMON will cause the DI BACnet object or ModBus register status to change.

More details on the above features can be found in the following sections.



Setup Menu

To enter the menu, press and release the <MENU> key while in normal operation. This will enter the Setup menu step 1, pressing the <MENU> key a second time advances to step 2. Each press of the <MENU> key advances the menu item. No values are saved or changed by using the <MENU> key. 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 <SAVE> key to save it to memory and advance to the next menu item. Actual menu displays with the default value are shown.

<MENU> Press and release the <MENU> key to enter the Setup menu.

1. **Network Protocol**

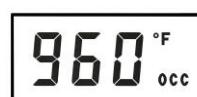
Use <UP> or <DOWN> to select either bAC (BACnet) or bUS (ModBus) protocol. Press <SAVE> to save the value. The default is bAC (BACnet).

<MENU>

2. **Network Address**

Press <UP> or <DOWN> to select a unique network address. It can be set from 1-255 for ModBus or from 0-127 for BACnet. The default address is 3. Press <SAVE> to save the setting and advance the menu.

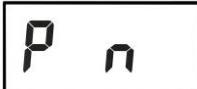
<MENU>

3. **Baud Rate**

Use <UP> or <DOWN> to select a baud rate of 30 (300), 60 (600), 120 (1200), 240 (2400), 384 (38400), 480 (4800), 960 (9600) or 192 (19200) for ModBus or 960 (9600), 192 (19200), 384 (38400) or 768 (76800) for BACnet. The default baud rate is 960 (9600). Press <SAVE> to save the setting and advance the menu.

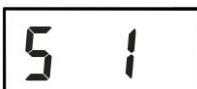
<MENU>

Items 4 to 7 are only shown if the protocol is set to ModBus RTU in Step 1

4. **ModBus Parity**

Use <UP> or <DOWN> to select a parity value of n (none), O (odd) or E (even). The default ModBus parity bit is n (none). Press <SAVE> to save the value.

<MENU>

5. **ModBus Stop Bits**

Use <UP> or <DOWN> to set the stop bits to 1 or 2. The default ModBus stop bits is 1.

<MENU>

6. **ModBus CRC**

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). The default CRC is 1 (polynomial is 0XA001).

<MENU>

7. **ModBus Delay**

Use <UP> or <DOWN> to change the value from 0 (minimum) to 50, 100, 150, 200, 250, 300 or 350 ms. The factory default slave response delay is 0 (minimum). *Minimum delay means just more than 3.5 character time delays, 4ms for 9600 baud rate, for example.*

<MENU>

Exits the menu and returns to normal operation.

BACnet Protocol

Using the BACnet system software, only map the point objects that are installed and required. Excessive point mapping will lower the network performance. Some objects will not be available if the hardware option is not installed. For example, AI 3 will not be available if there is no Fan Speed control installed. This could also be the case if the device has no RH, setpoint, digital input or relay options.

This can be determined via BACnet by checking the Reliability, Event State or Status Flags properties of the optional objects.

If the hardware is not installed, the Reliability property will return NO_SENSOR and the Event_State property will indicate FAULT if the related hardware is not installed. To reduce network traffic, these points should not be polled.

The device has several BACnet objects to identify the device, read current values, configure the device and calibrate the sensors. There are five standard supported BACnet object types as shown below.

Object Type	Dynamically Creatable	Dynamically Deletable	Object Identifier	Object Name
Device	No	No	381003	STAT 003
Analog Input	No	No	AI 1 AI 2 AI 3	Temperature Relative Humidity Fan Speed
Analog Value	No	No	AV 1 AV 2 AV 3 AV 4 AV 5 AV 6 AV 7 AV 8	Setpoint Temperature Offset RH Offset Setpoint Minimum Setpoint Maximum Display Mode Override Mode Override Mode Time
Binary Value	No	No	BV 1 BV 2 BV 3 BV 4 BV 5 BV 6 BV 7	Temperature Units Temperature Resolution OCC Enable Override Status Relay Enable Setpoint Mode Setpoint Resolution
Binary Input	No	No	BI 1	DI On

- BI 1 is only available on devices with the Digital Input Option

The BACnet Device object allows configuration of the device. Device object properties are shown below.

Property	Default Value	Property Data Type	Access
Object Identifier	381003	BACnetObjectIdentifier(numeric)	Read / Write
Object Name	STAT 003	CharacterString (32)	Read / Write
Object Type	DEVICE (8)	BACnetObjectType	Read
System Status	OPERATIONAL (0)	BACnetDeviceStatus	Read
Vendor Name	Greystone Energy Systems	CharacterString	Read
Vendor Identifier	381	Unsigned16	Read
Model Name	STAT	CharacterString	Read
Firmware Revision	1.3	CharacterString	Read
Application Software Version	V1.0	CharacterString	Read
Location	150 English Drive, Moncton, NB	CharacterString (32)	Read / Write
Description	Greystone Temperature Sensor	CharacterString (32)	Read / Write
Protocol Version	1	Unsigned	Read
Protocol Revision	14	Unsigned	Read
Protocol Services Supported	See description below	BACnetServicesSupported	Read
Protocol Object Types Supported	See description below	BACnetObjectTypesSupported	Read
Object List	See description below	BACnetArray	Read
Maximum APDU Length Accepted	50, B'0000'	Unsigned	Read
Segmentation Supported	NO SEGMENTATION (3)	BACnetSegmentation	Read
APDU Timeout	6,000	Unsigned	Read / Write
Number of APDU Retries	3	Unsigned	Read / Write
Max Master	127	Unsigned	Read / Write
Max Info Frames	1	Unsigned	Read
Device Address Binding	empty	BACnetAddressBinding	Read
Database Revision	0	Unsigned	Read
Property List		BACnetArray	Read

Object Identifier Initial default number is 381003, where 381 is the vendor ID and 003 is the default network MAC address. When the MAC address is initially changed the value is updated and saved. For example, if the MAC address is set to 50 via the Setup Menu for startup, then the device instance will be set to 381050. This property is also writable via BACnet. If the Device:Object_Identifier is written to via BACnet then the MAC address is no longer appended to the vendor ID to create this value.

Object Name Initial string is “STAT 003” where STAT is the device model name and 003 is the default network address. Can be written with a new string of maximum length of 32 characters and the value is saved. The “003” is the MAC address as set by the menu and is automatically changed if the MAC address is changed. Once written to via BACnet, the MAC address no longer gets appended to the value.

Protocol Services Supported readProperty, writeProperty, deviceCommunicationControl, who-Has, who-Is
Binary bit string = {00000000 00001001 01000000 00000000 01100000 0}

Protocol Object Types Supported Analog_Input, Analog_Value, Binary_Value, Binary_Input, Device
Binary bit string = {10110100 10000000 00000000 00000000 00000000 00000000}

Object List ((Device, Instance 3), (Analog Input, Instance 1, 2 and 3), (Analog Value, Instance 1, 2, 3, 4, 5, 6, 7 and 8), (Binary Value, Instance 1, 2, 3, 4, 5, 6 and 7), (Binary Input, Instance 1))

APDU Timeout Value is 6,000. Can be modified from 1 to 10,000.

Number Of APDU Retries Value is 3. Can be modified from 1 to 10.

Max Master Value is 127. Value is saved. Can be modified from 1 to 127.

Database Revision Value is 0 to 255.

The **analog input BACnet objects** allow reading of sensor values and indicate which options are present via the Reliability property. Analog input object properties are shown below.

Analog Input Object

Temperature

(Present Value is current temperature sensor reading in °F or °C, resolution is 0.1°)

(The temperature units can be changed to °C or °F using BV1)

Property	Default Value	Property Data Type	Access
Object Identifier	AI1 (Analog Input 1)	BACnetObjectIdentifier	Read
Object Name	Temperature	CharacterString (32)	Read
Object Type	ANALOG_INPUT (0)	BACnetObjectType	Read
Present Value	current reading	Real	Read
Description	Temperature	CharacterString (32)	Read
Device Type	Space Temperature Sensor	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000)	BACnetStatusFlags	Read
Event State	NORMAL (0)	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Units	degrees-Fahrenheit (64) or degrees-Celsius (62)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

Analog Input Object

Relative Humidity

(Present Value is current RH sensor reading in %RH, resolution is 1%)

(If this option is not installed, the Status Flags, Event State and Reliability property values change)

Property	Default Value	Property Data Type	Access
Object Identifier	AI2 (Analog Input 2)	BACnetObjectIdentifier	Read
Object Name	Relative Humidity	CharacterString (32)	Read
Object Type	ANALOG_INPUT (0)	BACnetObjectType	Read
Present Value	current reading	Real	Read
Description	Relative Humidity	CharacterString (32)	Read
Device Type	0-100 %RH Sensor	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000) or (1100) if no sensor	BACnetStatusFlags	Read
Event State	NORMAL (0) or FAULT (1) if no sensor	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0) or NO_SENSOR (1)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Units	Percent-relative-humidity (29)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

Analog Input Object

Fan Speed

(Present Value is current fan speed switch setting, Auto=0, Off=1, Low=2, Med=3, High=4)

(If this option is not installed, the Status Flags, Event State and Reliability property values change)

Property	Default Value	Property Data Type	Access
Object Identifier	AI3 (Analog Input 3)	BACnetObjectIdentifier	Read
Object Name	Fan Speed	CharacterString (32)	Read
Object Type	ANALOG_INPUT (0)	BACnetObjectType	Read
Present Value	current reading	Real	Read
Description	Fan Speed	CharacterString (32)	Read
Device Type	Auto/Off/Low/Med/High Fan Speed	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000) or (1100) if no sensor	BACnetStatusFlags	Read
Event State	NORMAL (0) or FAULT (1) if no sensor	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0) or NO_SENSOR (1)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Units	no-units (95)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

The **analog value BACnet objects** allow device configuration, sensor offset calibration and indicate which options are present via the Event State and Status Flags properties. Analog value object properties are shown below.

Analog Value Object (Default Present Value is current value from 18-24 °C or 65-75 °F. Resolution is 1°)
Setpoint (If this option is not installed, the Status Flags and Event State property values change)

Property	Default Value	Property Data Type	Access
Object Identifier	AV1 (Analog Value 1)	BACnetObjectIdentifier	Read
Object Name	Setpoint	CharacterString (32)	Read
Object Type	ANALOG_VALUE (2)	BACnetObjectType	Read
Present Value	current reading	Real	Read / Write
Description	Setpoint Value	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000) or (1100) if no sensor	BACnetStatusFlags	Read
Event State	NORMAL (0) or FAULT (1) if no sensor	BACnetEventState	Read
Out of Service	FALSE (0)	Boolean	Read
Units	°C (62) or °F (64) or %RH (29)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

The Setpoint object can be configured in various ways as required by the application:

- Use BV6 to configure the Setpoint Mode to either Temperature or RH.
- Use AV4 to configure the Setpoint Minimum value.
- Use AV5 to configure the Setpoint Maximum value.
- Use BV7 to set the Setpoint Resolution (for Temperature Setpoint Mode only).

Note that the Temperature Setpoint Mode units are the same as the Temperature Analog Input (AI1) units as controlled by BV1 (Temperature Units).

See the descriptions for AV4, AV5, BV6 and BV7 for more details.

If installed, the factory default setpoint operation is 18 to 24 °C or 65 to 75 °F in 1° increments.

Analog Value Object (Present Value defaults to 0 for no offset. Can be set from -10 to +10 Δ°F or -5.0 to +5.0 Δ°C)
Temperature Offset (Units depend on the device units, either °C or °F), (°C resolution = 0.5, °F resolution = 1)

Property	Default Value	Property Data Type	Access
Object Identifier	AV2 (Analog Value 2)	BACnetObjectIdentifier	Read
Object Name	Temperature Offset	CharacterString (32)	Read
Object Type	ANALOG_VALUE (2)	BACnetObjectType	Read
Present Value	0	Real	Read / Write
Description	Temperature Offset Calibration	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000)	BACnetStatusFlags	Read
Event State	NORMAL (0)	BACnetEventState	Read
Out of Service	FALSE (0)	Boolean	Read
Units	delta-degrees-Fahrenheit (120) or Δ°C (121)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

Analog Value Object
RH Offset

(Present Value defaults to 0 for no offset. Can be set from -10 to +10 %RH, resolution = 1)
 (If the RH option is not installed, the Status Flags and Event State property values change)

Property	Default Value	Property Data Type	Access
Object Identifier	AV3 (Analog Value 3)	BACnetObjectIdentifier	Read
Object Name	RH Offset	CharacterString (32)	Read
Object Type	ANALOG_VALUE (2)	BACnetObjectType	Read
Present Value	0	Real	Read / Write
Description	RH Offset Calibration	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000) or (1100) if no RH sensor	BACnetStatusFlags	Read
Event State	NORMAL (0) or FAULT (1) if no RH sensor	BACnetEventState	Read
Out of Service	FALSE (0)	Boolean	Read
Units	percent-relative-humidity (29)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

Analog Value Object
Setpoint Minimum

(Present Value default changes depending on the Setpoint Mode and Temperature Units settings)
 (If the setpoint option is not installed, the Status Flags and Event State property values change)

Property	Default Value	Property Data Type	Access
Object Identifier	AV4 (Analog Value 4)	BACnetObjectIdentifier	Read
Object Name	Setpoint Minimum	CharacterString (32)	Read
Object Type	ANALOG_VALUE (2)	BACnetObjectType	Read
Present Value	* See notes below	Real	Read / Write
Description	Setpoint Minimum Value	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000) or (1100) if no setpoint	BACnetStatusFlags	Read
Event State	NORMAL (0) or FAULT (1) if no setpoint	BACnetEventState	Read
Out of Service	FALSE (0)	Boolean	Read
Units	°C (62) or °F (64) or %RH (29)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

* Notes The factory default Setpoint Mode is Temperature and either 18-24 °C or 65-75 °F with 1° increments.

Factory default Setpoint Minimum is 18 °C, 65 °F or 40 %RH.

The Setpoint Mode can be set to either Temperature or RH using BV6.

In Temperature mode, Setpoint Minimum : Present Value may be set from 10.0 to 20.0 °C or 50.0 to 68.0 °F.

In RH mode, Setpoint Minimum : Present Value may be set from 10 to 60 %RH.

The temperature setpoint resolution may be changed from 1° to 0.5° using BV7.

**Analog Value Object
Setpoint Maximum**(Present Value default changes depending on the Setpoint Mode and Temperature Units settings)
(If the setpoint option is not installed, the Status Flags and Event State property values change)

Property	Default Value	Property Data Type	Access
Object Identifier	AV5 (Analog Value 5)	BACnetObjectIdentifier	Read
Object Name	Setpoint Maximum	CharacterString (32)	Read
Object Type	ANALOG_VALUE (2)	BACnetObjectType	Read
Present Value	** See notes below	Real	Read / Write
Description	Setpoint Maximum Value	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000) or (1100) if no setpoint	BACnetStatusFlags	Read
Event State	NORMAL (0) or FAULT (1) if no setpoint	BACnetEventState	Read
Out of Service	FALSE (0)	Boolean	Read
Units	°C (62) or °F (64) or %RH (29)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

** Notes The factory default Setpoint Mode is Temperature and either 18-24 °C or 65-75 °F with 1° increments.
 Factory default Setpoint Maximum is 24 °C, 75 °F or 60 %RH.
 The Setpoint Mode can be set to either Temperature or RH using BV6.
 In Temperature mode, Setpoint Maximum : Present Value may be set from 20.0 to 30.0 °C or 68.0 to 86.0 °F.
 In RH mode, Setpoint Maximum : Present Value may be set from 30 to 80 %RH.
 The temperature setpoint resolution may be changed from 1° to 0.5° using BV7.

*** Notes The following setpoint conditions are enforced:
 Setpoint Maximum must be > Setpoint Minimum.
 For Temperature Setpoint Mode, the minimum span (Setpoint Maximum - Setpoint Minimum) = 4 °C / °F.
 For RH Setpoint Mode, the minimum span = 10 %RH.
 Writing to BV1 (Temperature Units) or BV6 (Setpoint Mode) always resets Setpoint Min and Max to the factory defaults, so configure these values first.

**Analog Value Object
Display Mode**

(Present Value defaults change depending on the device hardware configuration)

Property	Default Value	Property Data Type	Access
Object Identifier	AV6 (Analog Value 6)	BACnetObjectIdentifier	Read
Object Name	Display Mode	CharacterString (32)	Read
Object Type	ANALOG_VALUE (2)	BACnetObjectType	Read
Present Value	* See note below	Real	Read / Write
Description	LCD Display Mode	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000)	BACnetStatusFlags	Read
Event State	NORMAL (0)	BACnetEventState	Read
Out of Service	FALSE (0)	Boolean	Read
Units	no-units (95)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

* Notes This object controls the information that is displayed on the LCD in the normal operating mode.
 The available settings are: 0 = no display, no backlight (menu and backlight will still display for setup)
 (setpoint and backlight will still display if UP or DOWN pressed, if installed)
 1 = Temperature value only displayed
 2 = RH value only displayed
 3 = Temperature and RH values toggle every 5 seconds
 A temperature only device will not have options 2 or 3 (the default = 1).
 A temperature plus RH device has default = 3.

Analog Value Object**Override Mode**

(If the override option is not installed, the Status Flags and Event State properties change)

Property	Default Value	Property Data Type	Access
Object Identifier	AV7 (Analog Value 7)	BACnetObjectIdentifier	Read
Object Name	Override Mode	CharacterString (32)	Read
Object Type	ANALOG_VALUE (2)	BACnetObjectType	Read
Present Value	* See note below	Real	Read / Write
Description	Override Switch Mode	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000) or (1100) if no override	BACnetStatusFlags	Read
Event State	NORMAL (0) or FAULT (1) if no override	BACnetEventState	Read
Out of Service	FALSE (0)	Boolean	Read
Units	no-units (95)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

* Notes

This object controls the way that the front panel override switch functions.

The available settings are: 0 = LATCH, reset the override by writing 0 to Override Status (BV4)
(this is the default value)1 = TOGGLE, the override status changes state whenever the switch is pressed
(there is a minimum time of 10 sec enforced between state changes)2 = MOMENTARY, the override status self-resets after a time period
(the time period is set with AV7)**Analog Value Object****Override Mode Time**

(If the override option is not installed, the Status Flags and Event State properties change)

(Present_Value defaults to 1 minute. Can be set from 1 to 60 minutes. Resolution is 1 min)

Property	Default Value	Property Data Type	Access
Object Identifier	AV8 (Analog Value 8)	BACnetObjectIdentifier	Read
Object Name	Override Mode Time	CharacterString (32)	Read
Object Type	ANALOG_VALUE (2)	BACnetObjectType	Read
Present Value	1	Real	Read / Write
Description	Override Mode Time	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000) or (1100) if no override	BACnetStatusFlags	Read
Event State	NORMAL (0) or FAULT (1) if no override	BACnetEventState	Read
Out of Service	FALSE (0)	Boolean	Read
Units	Minutes (72)	BACnetEngineeringUnits	Read
Property List		BACnetArray	Read

* Notes

AV8 only has effect if AV7 is set to 2 = MOMENTARY. In this case, the Override Status value will reset to 0 after AV8 has expired.

The **binary value BACnet objects** allow configuration of the device, override switch status and relay control. The Event State, Status Flags and Reliability properties will indicate which options are present. Binary value object properties are shown below.

Binary Value Object (Present Value defaults to either 0 (INACTIVE) for Celsius or 1 (ACTIVE) for Fahrenheit)
Temperature Units

Property	Default Value	Property Data Type	Access
Object Identifier	BV1 (Binary Value 1)	BACnetObjectIdentifier	Read
Object Name	Temperature Units	CharacterString (32)	Read
Object Type	BINARY_VALUE (5)	BACnetObjectType	Read
Present Value	INACTIVE (0)	BACnetBinaryPV	Read / Write
Description	Celsius (0) or Fahrenheit (1)	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000)	BACnetStatusFlags	Read
Event State	NORMAL (0)	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Property List		BACnetArray	Read

Binary Value Object (Present Value defaults to 0 (INACTIVE) for 1°. Can be set to 1 (ACTIVE) for 0.5°)
Temperature Resolution

Property	Default Value	Property Data Type	Access
Object Identifier	BV2 (Binary Value 2)	BACnetObjectIdentifier	Read
Object Name	Temperature Resolution	CharacterString (32)	Read
Object Type	BINARY_VALUE (5)	BACnetObjectType	Read
Present Value	INACTIVE (0)	BACnetBinaryPV	Read / Write
Description	1 Degree (0) or 0.5 Degree (1)	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000)	BACnetStatusFlags	Read
Event State	NORMAL (0)	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Property List		BACnetArray	Read

- * Notes The default temperature resolution is 1°. This applies to the LCD temperature display only.
 For example: The LCD will display 22, 23, 24 °C for the temperature reading.
 The resolution can be changed to 0.5° for the LCD temperature reading.
 For example: The LCD will display 22.0, 22.5, 23.0 °C for the temperature reading.
 This setting has no effect on the AII (Temperature) object value which has a 0.1° resolution.
 This setting has no effect on the setpoint display resolution which is set independently.

Binary Value Object (Present Value defaults to 0 (INACTIVE) for OCC Off. Can be set to 1 (ACTIVE) for OCC On)
OCC Enable (This controls the OCC segment display on the LCD, OCC will not display if Display Mode = 0)

Property	Default Value	Property Data Type	Access
Object Identifier	BV3 (Binary Value 3)	BACnetObjectIdentifier	Read
Object Name	OCC Enable	CharacterString (32)	Read
Object Type	BINARY_VALUE (5)	BACnetObjectType	Read
Present Value	INACTIVE (0)	BACnetBinaryPV	Read / Write
Description	OCC Off (0) or OCC On (1)	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000)	BACnetStatusFlags	Read
Event State	NORMAL (0)	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Property List		BACnetArray	Read

Binary Value Object
Override Status

(Present Value is normally 0, changes to 1 if the override switch has been pressed)
 (If the override option is not installed, the Status Flags, Event State and Reliability properties change)

Property	Default Value	Property Data Type	Access
Object Identifier	BV4 (Binary Value 4)	BACnetObjectIdentifier	Read
Object Name	Override Status	CharacterString (32)	Read
Object Type	BINARY_VALUE (5)	BACnetObjectType	Read
Present Value	INACTIVE (0)	BACnetBinaryPV	Read / Write *
Description	Override Switch	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000) or (1100) if no switch	BACnetStatusFlags	Read
Event State	NORMAL (0) or FAULT (1) if no switch	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0) or NO_SENSOR (1)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Property List		BACnetArray	Read

* Notes Present Value changes to 1 (ACTIVE) if the override switch has been pressed.

The Override Status has three operating modes as set by AV7 (Override Mode).
 It can be either manually reset by writing 0(INACTIVE) back to BV4 Present Value, or
 it can be toggled with the override switch (press ON, press OFF), or
 it can be self-resetting after a time period as set by AV8 (Override Mode Time).

If AV7 is set for toggle (AV7 Present Value = 1) or momentary (AV7 Present Value = 2) operation, then
 BV4 Present Value is set to Read only.

Binary Value Object
Relay Enable

(Present Value defaults to 0 (INACTIVE) for Relay Off. Can be set to 1 (ACTIVE) for Relay On)
 (This controls the optional relay, some properties change if the relay is not installed)

Property	Default Value	Property Data Type	Access
Object Identifier	BV5 (Binary Value 5)	BACnetObjectIdentifier	Read
Object Name	Relay Enable	CharacterString (32)	Read
Object Type	BINARY_VALUE (5)	BACnetObjectType	Read
Present Value	INACTIVE (0)	BACnetBinaryPV	Read / Write
Description	Relay Off (0) or Relay On (1)	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000) or (1100) if no relay	BACnetStatusFlags	Read
Event State	NORMAL (0) or FAULT (1) if no relay	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0) or NO_SENSOR (1)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Property List		BACnetArray	Read

Binary Value Object
Setpoint Mode

(Present Value defaults to 0 (INACTIVE) for Temperature. Can be set to 1 (ACTIVE) for %RH)
 (If the setpoint option is not installed, the Status Flags, Event State and Reliability properties change)

Property	Default Value	Property Data Type	Access
Object Identifier	BV6 (Binary Value 6)	BACnetObjectIdentifier	Read
Object Name	Setpoint Mode	CharacterString (32)	Read
Object Type	BINARY_VALUE (5)	BACnetObjectType	Read
Present Value	INACTIVE (0)	BACnetBinaryPV	Read / Write
Description	Temperature (0) or %RH (1)	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000) or (1100) if no setpoint	BACnetStatusFlags	Read
Event State	NORMAL (0) or FAULT (1) if no setpoint	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0) or NO_SENSOR (1)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Property List		BACnetArray	Read

* Notes This object determines if the front panel setpoint controls will be used to control Temperature or Relative Humidity within limits set by the Setpoint Minimum and Setpoint Maximum objects. The Setpoint AV1 object values and LCD display will change depending on the setting.

Binary Value Object
Setpoint Resolution

(Present Value defaults to 0 (INACTIVE) for 1°. Can be set to 1 (ACTIVE) for 0.5°)
 (If the setpoint option is not installed, the Status Flags, Event State and Reliability properties change)

Property	Default Value	Property Data Type	Access
Object Identifier	BV7 (Binary Value 7)	BACnetObjectIdentifier	Read
Object Name	Setpoint Resolution	CharacterString (32)	Read
Object Type	BINARY_VALUE (5)	BACnetObjectType	Read
Present Value	INACTIVE (0)	BACnetBinaryPV	Read / Write
Description	1 Degree (0) or 0.5 Degree (1)	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000) or (1100) if no setpoint	BACnetStatusFlags	Read
Event State	NORMAL (0) or FAULT (1) if no setpoint	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0) or NO_SENSOR (1)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Property List		BACnetArray	Read

* Notes The default setpoint resolution is 1°. This applies to the setpoint temperature display and Setpoint object only.
 For example: The LCD will display 22, 23, 24 °C for the setpoint setting.
 The resolution can be changed to 0.5° for the setpoint display and value.
 For example: The LCD will display 22.0, 22.5, 23.0 °C for the setpoint.
 This setting has no effect on the AI1 (Temperature) object value or temperature display.

The **binary input BACnet object** allows reading of the digital input status. Binary input object properties are shown below.

Note: This object is only available for models with the Digital Input feature.

Binary Input Object
DI On

(Present Value is 1 (ACTIVE) if the DI is activated (pulled to common).
 (Present Value is 0 (INACTIVE) if the DI is not activated (floating).
 (If the digital input option is not installed, the Status Flags, Event State and Reliability properties change)

Property	Default Value	Property Data Type	Access
Object Identifier	BI1 (Binary Input 1)	BACnetObjectIdentifier	Read
Object Name	DI On	CharacterString (32)	Read
Object Type	BINARY_INPUT (3)	BACnetObjectType	Read
Present Value	INACTIVE (0)	BACnetBinaryPV	Read
Description	DI Status	CharacterString (32)	Read
Device Type	Indicates On/Off Status of DI	CharacterString (32)	Read
Status Flags	{false, false, false, false} (0000) or (1100) if no DI	BACnetStatusFlags	Read
Event State	NORMAL (0) or FAULT (1) if no DI	BACnetEventState	Read
Reliability	NO_FAULT_DETECTED (0) or NO_SENSOR (1)	BACnetReliability	Read
Out of Service	FALSE (0)	Boolean	Read
Polarity	Normal (0)	BACnetPolarity	Read
Property List		BACnetArray	Read

BACnet Trouble-shooting

This network device operates as a slave. It will not communicate unless a master is connected to the network and sends a request for information, then the slave will answer. If the device does not communicate properly, first check that the communication wires are not reversed. Then check communication parameters set in the menu.

The default BACnet MAC address is 3 and each device must have a unique address to communicate properly. Use the Setup menu to change the MAC address to a unique number for each unit. Ensure the device object name and device object identifier are unique on the entire BACnet network, not just on the MS/TP sub-network. Both of these properties are writable in the device object.

The device automatically selects a device object name for itself using the format STAT_003, where 003 is the MS/TP MAC address (000 to 127) as set in the menu. If this name is changed by writing to the device Object_Name property via BACnet, then the MAC number will no longer be appended to the object name.

The device also automatically selects a device object identifier for itself using the format 381xxx, where xxx is the MS/TP MAC address (000 to 127) as set by the menu. If this ID is changed by writing to the device Object_Identifier property via BACnet, then the MAC number will no longer be appended to the object ID.

The default BACnet baud rate is 9600. Use the Setup menu to change the baud rate to the correct setting.

Ensure the application software (graphical interface) is not set to poll the devices too frequently. For example, if the software is polling the devices every 500 mS, the network could be heavily congested with the network traffic and may not operate reliably. A slower polling rate such as 5 to 10 seconds will usually produce better results on a typical network segment.

Use care when setting the MS/TP MAC address (via the menu) and the device object Max_Master property since both can have a significant effect on the network efficiency. Some MAC address and Max_Master combinations will operate more efficiently than others. MAC addresses should be selected sequentially, starting at the lowest possible value.

For example, on a five node segment, the device MAC addresses should be set to 1, 2, 3, 4 and 5. In this case, if the Max_Master property value is left at the 127 default, then there will be a lot of wasted time on the network polling for masters that are not present. In this example, the five nodes should be set such that Max_Master is equal to 5. The Max_Master value initially defaults to 127 so that any master can be found when the device first starts.

ModBus Protocol

This section describes the implementation of the Modbus protocol. It is intended to assist control system programmers who may need to add support to their systems to communicate with this device. 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.

Only map the registers that are installed and required. Excessive point mapping will lower the network performance. Some registers will not be available if the hardware option is not installed. For example, register 40004 will always read 0 if there is no Fan Speed control installed. This could also be the case if the device has no RH, setpoint, digital input or relay options.

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	300, 600, 1200, 2400, 4800, 9600, 19200 or 38400
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	Access	Notes
40001	+0		Word	Read	Unsigned 16-bit integer, DI_STATUS 0x0000 = OFF status, 0x0001 = ON status
40002	+1	°C/°F	Word	Read	Unsigned 16-bit integer, TEMPERATURE_VALUE x 10 Multiplier = 10 0 to 500 °C, 320 to 1220 °F
40003	+2	%RH	Word	Read	Unsigned 16-bit integer, RELATIVE_HUMIDITY_VALUE 0 to 100
40004	+3		Word	Read	Unsigned 16-bit integer, FAN_SPEED_VALUE Auto=0, Off=1, Low=2, Med=3, High=4
40005	+4		Word	Read	Unsigned 16-bit integer, OVERRIDE_STATUS 0 = override not activated, 1 = override activated Note this value is latched when the switch is pressed
40006	+5	°C/°F %RH	Word	Read Write	Unsigned 16-bit integer, SETPOINT_VALUE For °C and °F multiplier = 10, ie: 23.5 °C = 235 For %RH multiplier = 1, ie: 60 %RH = 60
40007	+6	°C/°F	Word	Read Write	Unsigned 16-bit integer, TEMPERATURE_OFFSET = 0 to 0x14 C_OFFSET = TEMPERATURE_OFFSET / 2 - 5 = -5.0 to 5.0 °C F_OFFSET = TEMPERATURE_OFFSET - 10 = -10 to 10 °F
40008	+7	%RH	Word	Read Write	Unsigned 16-bit integer, RH_OFFSET = 0 to 0x14 RH_OFF = RH_OFFSET - 10 = -10 to 10 %RH
40009	+8	°C/°F %RH	Word	Read Write	Unsigned 16-bit integer, SETPOINT_MIN See register description 10 to 20 °C or 50 to 68 °F or 10 to 60 %RH
40010	+9	°C/°F %RH	Word	Read Write	Unsigned 16-bit integer, SETPOINT_MAX See register description 20 to 30 °C or 68 to 86 °F or 30 to 80 %RH
40011	+10		Word	Read Write	Unsigned 16-bit integer, DISPLAY_MODE = 0 to 0x03 0 = None, 1 = Temp, 2 = RH, 3 = Temp + RH
40012	+11		Word	Read Write	Unsigned 16-bit integer, TEMPERATURE_UNITS 0 = °C, 1 = °F
40013	+12		Word	Read Write	Unsigned 16-bit integer, TEMPERATURE_RESOLUTION 0 = 1°, 1 = 0.5° (for LCD display)
40014	+13		Word	Read Write	Unsigned 16-bit integer, OCC_ENABLE 0 = OCC Off, 1 = OCC On (for LCD display)
40015	+14		Word	Read Write	Unsigned 16-bit integer, OVERRIDE_RESET write 0 to reset OVERRIDE_STATUS to 0
40016	+15		Word	Read Write	Unsigned 16-bit integer, RELAY_ENABLE 0 = relay Off, 1 = relay On
40017	+16		Word	Read Write	Unsigned 16-bit integer, SETPOINT_MODE 0 = temperature, 1 = %RH

40018	+17		Word	Read Write	Unsigned 16-bit integer, SETPOINT_RESOLUTION 0 = 1°, 1 = 0.5° (for temperature setpoint only)			
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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 0x0011, Quantity of registers = 0x0001 to 0x0012

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
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* Register address = 0x0005 to 0x0011, 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

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
---------------------------------	------	------	------------------	------	-----------------	------------	------------

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 0x0011. The read multiple feature will read all registers from the starting address forward. If the starting address is 0x0000 then registers 40001 to 40018 can be read. If the starting address is 0x000A then registers 40011 to 40018 can be read.

Note 2: The quantity of registers (N) may be 0x0001 to 0x0012, but must be limited to 18 – A. If the starting address (A) is set to 0x0000 then N may be 0x0001 to 0x0012. If the starting address is set to 0x000A then N may be 0x0001 to 0x0008.

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 DI_STATUS

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 0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------------------------	-----------------------	------------	------------

* Register value = 0x0000 in OFF status, ie: the Digital Input terminal is open or floating
0x0001 in ON status, ie: the Digital Input terminal is shorted to COMMON via a dry-contact

The register will always read 0x0000 if the Digital Input option is not installed.

0x03 --- Read TEMPERATURE_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 0x01F4, corresponding to 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 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	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 = 0x0000 to 0x0064, corresponding to 0 to 100 %RH (multiplier = 1)

The register will always read 0x0000 if the Relative Humidity option is not installed.

0x03 --- Read FAN_SPEED_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 = 0x0000 corresponding to the AUTO switch setting,
 = 0x0001 corresponding to the OFF switch setting,
 = 0x0002 corresponding to the LOW switch setting,
 = 0x0003 corresponding to the MED switch setting,
 = 0x0004 corresponding to the HIGH switch setting.

The register will always read 0x0000 if the Fan Speed option is not installed.

0x03 --- Read OVERRIDE_STATUS

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 0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------------------------	-----------------------	------------	------------

* Register value = 0x0000 override not pressed, 0x0001 override has been pressed.

The register will always read 0x0000 if the override option is not installed.

0x03 --- Read SETPOINT_VALUE

Query

Slave address (0x01 to 0xFF)	0x03	0x00	0x05	0x00	0x01	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	------	------------	------------

Response

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

* The setpoint may be configured in various ways as required by the application.

The setpoint may be set to control either temperature or RH using the SETPOINT_MODE register.

For temperature, Register value = 0x0064 to 0x012C, corresponding to 10.0 to 30.0 °C (multiplier = 10)
 or = 0x01F4 to 0x035C, corresponding to 50.0 to 86.0 °F (multiplier = 10)

For RH, Register value = 0x000A to 0x0050, corresponding to 10 to 80 %RH (multiplier = 1)

If SETPOINT_MODE is set to temperature, then the SETPOINT_VALUE units will be the same as the TEMPERATURE_UNITS, either °C or °F.

The SETPOINT_VALUE is limited by the SETPOINT_MIN and SETPOINT_MAX registers. When the setpoint is adjusted with the front panel UP/DOWN switches, it cannot go below SETPOINT_MIN or above SETPOINT_MAX.

The SETPOINT_VALUE must step according to the setting of the SETPOINT_RESOLUTION register, either in 1° or 0.5° steps. When the setpoint is adjusted with the front panel UP/DOWN switches, it will step by either 1° or 0.5°.

The register will always read 0x0000 if the Setpoint option is not installed.

All additional registers from 40007 to 40018 may be read in the same way, with only the register address changing.

0x06 --- Write SETPOINT_VALUE

Query

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

Response

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

* The setpoint may be configured in various ways as required by the application.

The setpoint may be set to control either temperature or RH using the SETPOINT_MODE register.

For temperature, Register value = 0x0064 to 0x012C, corresponding to 10.0 to 30.0 °C (multiplier = 10)
or = 0x01F4 to 0x035C, corresponding to 50.0 to 86.0 °F (multiplier = 10)

For RH, Register value = 0x000A to 0x0050, corresponding to 10 to 80 %RH (multiplier = 1)

If SETPOINT_MODE is set to temperature, then the SETPOINT_VALUE units will be the same as the TEMPERATURE_UNITS, either °C or °F.

The SETPOINT_VALUE is limited by the SETPOINT_MIN and SETPOINT_MAX registers. When writing to the SETPOINT_VALUE register, the value cannot go below SETPOINT_MIN or above SETPOINT_MAX.

The SETPOINT_VALUE must step according to the setting of the SETPOINT_RESOLUTION register, either in 1° or 0.5° steps. When writing to the SETPOINT_VALUE register, the value must step by either 1° or 0.5°.

If the Setpoint option is not installed, attempting to write to the register will return an exception response of illegal address.

0x06 --- Write TEMPERATURE_OFFSET

Query

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

Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x06	0x00	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.

Register value = 0x0000 to 0x0014

For °C operation, this corresponds to $T_OFFSET / 2 - 5 = -5.0$ to 5.0 °C. ie: 0x0003 => $3/2 - 5 = -3.5$ °C offset.

For °F operation, this corresponds to $T_OFFSET - 10 = -10$ to 10 °F. ie: 0x0003 => $3 - 10 = -7$ °F offset.

The operating temperature 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	0x07	0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	-----------------------	------------	------------

Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x07	0x00	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 = 0x0000 to 0x0014, corresponding to RH_OFFSET - 10 = -10 to 10 %RH.
ie: 0x0003 => 3 - 10 = -7 %RH offset.

The value of this register will have no effect if the Relative Humidity option is not installed.

0x06 --- Write SETPOINT_MIN

Query

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

Response

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

* This register sets the minimum value of adjustment for the Setpoint option.

The setpoint may be set to control either temperature or RH using the SETPOINT_MODE register.

For temperature, Register value = 0x0064 to 0x00C8, corresponding to 10.0 to 20.0 °C (multiplier = 10)
or = 0x01F4 to 0x02A8, corresponding to 50.0 to 68.0 °F (multiplier = 10)

For RH, Register value = 0x000A to 0x003C, corresponding to 10 to 60 %RH (multiplier = 1)

If SETPOINT_MODE is set to temperature, then the SETPOINT_VALUE units will be the same as the TEMPERATURE_UNITS, either °C or °F.

The SETPOINT_VALUE is limited by the SETPOINT_MIN and SETPOINT_MAX registers. When the setpoint is adjusted with the front panel UP/DOWN switches, it cannot go below SETPOINT_MIN or above SETPOINT_MAX.

The SETPOINT_VALUE must step according to the setting of the SETPOINT_RESOLUTION register, either in 1° or 0.5° steps. When the setpoint is adjusted with the front panel UP/DOWN switches, it will step by either 1° or 0.5°.

The register will have no effect if the Setpoint option is not installed.

0x06 --- Write SETPOINT_MAX

Query

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

Response

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

* This register sets the maximum value of adjustment for the Setpoint option.

The setpoint may be set to control either temperature or RH using the SETPOINT_MODE register.

For temperature, Register value = 0x00C8 to 0x012C, corresponding to 20.0 to 30.0 °C (multiplier = 10)
or = 0x02A8 to 0x035C, corresponding to 68.0 to 86.0 °F (multiplier = 10)

For RH, Register value = 0x001E to 0x0050, corresponding to 30 to 80 %RH (multiplier = 1)

Conditions and operation are the same as for SETPOINT_MIN.

The register will have no effect if the Setpoint option is not installed.

0x06 --- Write DISPLAY_MODE

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 = no display, no backlight (except for menu operation)
= 0x0001 = temperature value only is displayed
= 0x0002 = RH value only is displayed
= 0x0003 = temperature and RH values toggle every 5 seconds

A temperature only device will not have options 2 or 3 (the default = 1).

A temperature plus RH device has default = 3.

0x06 --- Write TEMPERATURE_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 °C operation
= 0x0001 = sets the device to °F operation

0x06 --- Write TEMPERATURE_RESOLUTION

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x0C	0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	-----------------------	------------	------------

Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x0C	0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	-----------------------	------------	------------

* Register value = 0x0000 = sets the LCD display temperature resolution to 1° (ie: 23 °C)
 = 0x0001 = sets the LCD display temperature resolution to 0.5° (ie: 23.5 °C)

0x06 --- Write OCC_ENABLE

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x0D	0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	-----------------------	------------	------------

Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x0D	0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	-----------------------	------------	------------

* Register value = 0x0000 = turns the LCD OCC symbol off , = 0x0001 = turns the LCD OCC symbol on

0x06 --- Write OVERRIDE_RESET

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x0E	0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	-----------------------	------------	------------

Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x0E	0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	-----------------------	------------	------------

* If the OVERRIDE_STATUS has been activated, write 0x0000 to this register to reset it back to 0x0000.
 The register will have no effect if the Override option is not installed.

0x06 --- Write RELAY_ENABLE

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x0F	0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	-----------------------	------------	------------

Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x0F	0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	-----------------------	------------	------------

* Register value = 0x0000 = turns the relay off
 = 0x0001 = turns the relay on
 The register will have no effect if the Relay option is not installed.

0x06 --- Write SETPOINT_MODE

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x10	0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	-----------------------	------------	------------

Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x10	0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	-----------------------	------------	------------

- * Register value = 0x0000 = sets the setpoint mode to temperature
- = 0x0001 = sets the setpoint mode to %RH

The register will have no effect if the Setpoint option is not installed.

0x06 --- Write SETPOINT_RESOLUTION

Query

Slave address (0x01 to 0xFF)	0x06	0x00	0x11	0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	-----------------------	------------	------------

Response

Slave address (0x01 to 0xFF)	0x06	0x00	0x11	0x00	Register value LSB	CRC LSB	CRC MSB
---------------------------------	------	------	------	------	-----------------------	------------	------------

- * Register value = 0x0000 = sets the temperature setpoint resolution to 1° (ie: 23 °C)
- = 0x0001 = sets the temperature setpoint resolution to 0.5° (ie: 23.5 °C)

This setting has no effect if the SETPOINT_MODE is set to %RH.

The register will have no effect if the Setpoint option is not installed.

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

Modbus Trouble-shooting

The device operates as a slave. It will not communicate unless a master is connected to the network and sends a request for information, then the slave will answer. If the device does not communicate properly, first check that the communication wires are not reversed. Then check the communication parameters in the menu in the following sequence: Network address, baud rate, parity bit, stop bit, CRC polynomial and slave response delay.

The factory default Modbus address is 03 and each device must have its unique address to communicate properly on the bus. Use the menu to change the Slave address to a unique number for each unit.

The default Modbus baud rate is 9600. Use the menu to change the baud rate to the correct setting.

The default Modbus parity is None. If this is not correct, use the menu to change the parity from None to Odd or Even.

The default stop bits is 1. Use the menu to change the stop bit setting to 2. For some configurations the value is fixed.

The default Modbus CRC value is A001. The menu can be used to change this setting. It is the CRC polynomial setting and can be changed between A001, 1021, 8005 or 8408.

The default Modbus delay is minimum (0). This can be changed in the menu. It is the slave response delay and can be set from minimum to 350ms. For example, the minimum delay means 3.5 character time delays or 4ms for 9600 baud rate.

General Specifications

Power Supply 20 – 28 Vac/dc (non-isolated half-wave rectified)
Consumption 35 mA max @ 24 Vdc
Protection Circuitry Reverse voltage protected, overvoltage protected
Operating Conditions 32-122 °F (0-50 °C), 0-95 %RH non-condensing
Wiring Connections Screw terminal block (14 to 22 AWG)
Enclosure Wall mount enclosure, 3.3”w x 4.7”h x 1.15”d (84 x 119 x 29 mm)

Temperature

Sensing Element 10K thermistor, ± 0.4 °F (± 0.2 °C)
Range 32-122 °F (0-50 °C)

Interface

Hardware 2-wire RS-485
Software Native BACnet or ModBus MS/TP protocol
Baud Rate Locally set from 300 - 76800
Network Address Range Locally set to 0-127 for BACnet, 1-255 for ModBus (factory default is 3)
(63 devices max on one daisy chain)

LCD Display

Resolution 0.5°/1°C or 0.5°/1° F (selectable), 1 %RH
Size 1.5” w x 0.65” h (38.1 x 16.5 mm) 3 digit
Backlight Auto-dimming, enable or disable via jumper

Optional RH Signal

Sensor Thermoset polymer based capacitive
Accuracy ± 2 %RH
Range 0-100 %RH, non-condensing
Resolution 1 %RH
Hysteresis ± 1.5 %RH
Response Time 15 seconds typical
Stability ± 1.2 %RH typical @ 50 %RH in 5 years

Optional Relay Output

Contact Ratings Form A contact (N.O.), 2 Amps @ 30 Vdc
Relay Control Via BACnet or ModBus

Optional Override Switch .. Front panel push-button available via BACnet or ModBus

Optional Setpoint Control .. Front panel push-buttons available via BACnet or ModBus

Optional Fan Speed Switch . Off, Auto, Low, Medium, High via BACnet or ModBus

Optional Digital Input Dry-contact only (relay contact), short to COMMON to activate

BACnet Protocol Implementation Conformance Statement (PICS)

Date :	Oct 4, 2017
Vendor Name :	Greystone Energy Systems Inc.
Product Name :	RH/T Network Sensor
Product Model Number :	NTRC Series
Application Software Version :	1.3
Firmware Revision :	1.4
BACnet Protocol Revision :	14

Product Description : The Greystone RH/T Network Sensor is a smart room sensor with native BACnet MS/TP protocol for network communication. It measures room temperature levels and reports this value back to a building automation system (BAS). The device may also be configured with a relative humidity (RH) sensor to measure room %RH, a setpoint control, an override switch, an alarm relay output, a digital input and a fan speed switch.

BACnet Standardized Device Profile (Annex L) : BACnet Application Specific Controller (B-ASC)

BACnet Interoperability Building Blocks Supported (Annex K) : DS-RP-B, DS-WP-B,
DM-DDB-B, DM-DOB-B
DM-DCC-B

Segmentation Capability : Not supported

Standard Object Types Supported :

Object Type	Dynamically Creatable	Dynamically Deletable	Optional Properties Supported	Writable Properties
Device	No	No	Location, Description, Max_Master, Max_Info_Frames	Object_Identifier, Object_Name, Location, Description, APDU_Timeout, Max_Master, Number_Of_APDU_Retries
Analog Input	No	No	Description, Reliability, Device_Type	
Analog Value	No	No	Description	Present_Value
Binary Value	No	No	Description, Reliability	Present_Value
Binary Input	No	No		

Data Link Layer Options : MS/TP master (Clause 9), baud rates : 9600, 19200, 38400, 76800

Device Address Binding : Not supported

Networking Options : None

Character Set Supported : ISO 10646 (UTF-8)

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