

# Controls, Start–Up, Operation and Troubleshooting Instructions

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## SAFETY CONSIDERATIONS

Installation and servicing of air-conditioning equipment can be hazardous due to system pressure and electrical components. Only trained and qualified service personnel should install, repair, or service air-conditioning equipment. Untrained personnel can perform the basic maintenance functions of replacing filters. Trained service personnel should perform all other operations.

When working on air-conditioning equipment, observe precautions in the literature, tags and labels attached to the unit, and other safety precautions that may apply. Follow all safety codes. Wear safety glasses and work gloves.

Follow all safety codes. Wear safety glasses and work gloves. Have fire extinguisher available. Read these instructions thoroughly and follow all warnings or cautions attached to the unit. Consult local building codes and National Electrical Code (NEC) for special requirements.

Recognize safety information. This is the safety-alert symbol . When you see this symbol on the unit and in instructions or manuals, be alert to the potential for personal injury.

Understand the signal words DANGER, WARNING, and CAUTION. These words are used with the safety-alert symbol. DANGER identifies the most serious hazards which **will** result in severe personal injury or death. WARNING signifies a hazard which **could** result in personal injury or death. CAUTION is used to identify unsafe practices which **may** result in minor personal injury or product and property damage. NOTE is used to highlight suggestions which **will** result in enhanced installation, reliability, or operation.

### WARNING

#### ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

Disconnect all power to the unit before performing maintenance or service. Unit may automatically start if power is disconnected.

## GENERAL

The RTU-OPEN controller is an integrated component of the Carrier rooftop unit. Its internal application programming provides optimum performance and energy efficiency. RTU-OPEN enables the unit to run in 100% stand-alone control mode, Carrier's I-Vu Open network, or a Third Party Building Automation System (BAS). On-board DIP switches allow you to select your protocol (and baud rate) of choice among the four most popular protocols in use today: BACnet, Modbus, Johnson N2 and LonWorks. (See Fig. 1.)

Carrier's diagnostic display tools such as Field Assistant BACview6 Handheld or Virtual BACview can be used with the RTU-OPEN controller. Access is available via a 5-pin J12 access port.

## SENSOR/ACCESSORY INSTALLATION

There are a variety of sensors and accessories available for the RTU-OPEN. Some of these can be factory or field installed, while others are only field installable. The RTU-OPEN controller may also require connection to a building network system or building zoning system. All field control wiring that connects to the RTU-OPEN must be routed through the raceway built into the corner post of the unit or secured to the unit control box with electrical conduit. The unit raceway provides the UL required clearance between high and low-voltage wiring. Pass the control wires through the hole provided in the corner post, then feed the wires thorough the raceway to the RTU-OPEN. Connect the wires to the removable Phoenix connectors and then reconnect the connectors to the board. See Fig. 1 and Table 1 for board connections and Fig. 2 for Typical Factory RTU-OPEN wiring.

**IMPORTANT:** Refer to the specific sensor or accessory instructions for its proper installation and for rooftop unit installation refer to base unit installation instructions and the unit's wiring diagrams.

### WARNING

#### ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury, death and/or equipment damage.

Disconnect electrical power and use lock-out tags before wiring the RTU-OPEN controller.

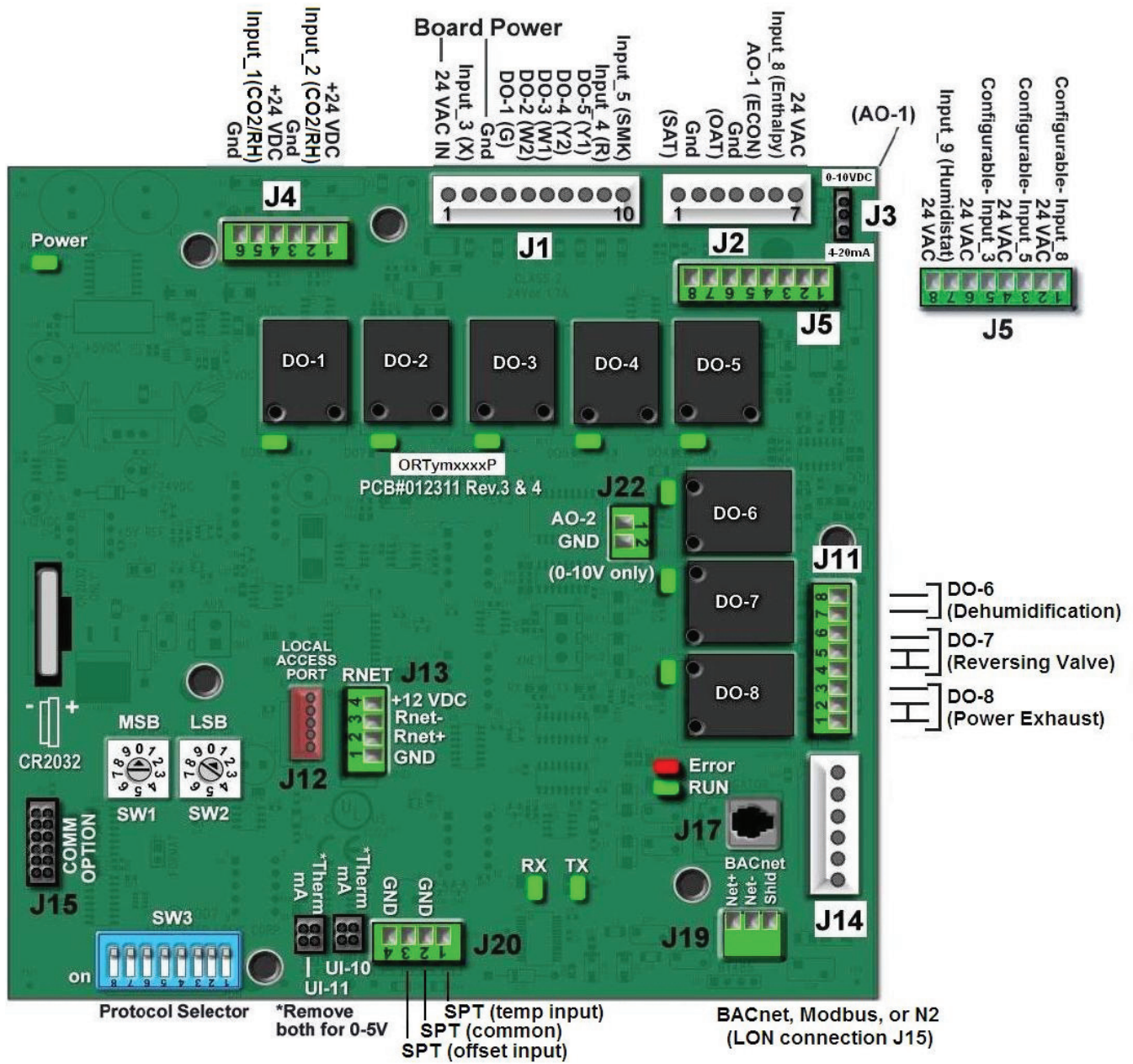


Fig. 1 - RTU-OPEN Control Module

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**Table 1 – RTU-OPEN Inputs and Outputs**

| POINT NAME                   | BACnet OBJECT NAME  | TYPE OF I/O             | CONNECTION PIN NUMBER(S)        |
|------------------------------|---------------------|-------------------------|---------------------------------|
| DEDICATED INPUTS             |                     |                         |                                 |
| Space Temp / Zone Temp       | zone_temp           | AI (10K Thermistor)     | J20–1, 2                        |
| Supply Air Temperature       | sa_temp             | AI (10K Thermistor)     | J2–1, 2                         |
| Outdoor Air Temperature      | oa_temp             | AI (10K Thermistor)     | J2–3, 4                         |
| Space Temperature Offset Pot | stpt_adj_offset     | AI (100K Potentiometer) | J20–3                           |
| Safety Chain Feedback        | safety_status       | DI (24 VAC)             | J1–9                            |
| Compressor Safety Status     | comp_status         | DI (24 VAC)             | J1–2                            |
| Fire Shutdown Status         | firedown_status     | DI (24 VAC)             | J1–10                           |
| Enthalpy Status              | enthalpy_status     | DI (24 VAC)             | J2–6                            |
| Humidistat Input Status      | humstat_status      | DI (24 VAC)             | J5–7                            |
| CONFIGURABLE INPUTS          |                     |                         |                                 |
| Indoor Air CO2               | iaq                 | AI (4–20 ma)            | J4–2 or J4–5                    |
| Outdoor Air CO2              | oaq                 | AI (4–20 ma)            |                                 |
| Space Relative Humidity      | space_rh            | AI (4–20 ma)            |                                 |
| Supply Fan Status*           | sfan_status         | DI (24 VAC)             | J5–1 or J5–3 or<br>J5 5 or J5–7 |
| Filter Status*               | filter_status       | DI (24 VAC)             |                                 |
| Door Contact Input*          | door_contact_status | DI (24 VAC)             |                                 |
| Occupancy Contact*           | occ_contact_status  | DI (24 VAC)             |                                 |
| OUTPUTS                      |                     |                         |                                 |
| Economizer Output            | econ_output         | AO (4–20ma)             | J2–5                            |
| Supply Fan Relay State       | sfan                | DO Relay (24VAC , 1A)   | J1–4                            |
| Compressor 1 Relay State     | comp_1              | DO Relay (24VAC , 1A)   | J1–8                            |
| Compressor 2 Relay State     | comp_2              | DO Relay (24VAC , 1A)   | J1–7                            |
| Heat Stage 1 Relay State     | heat_1              | DO Relay (24VAC , 1A)   | J1–6                            |
| Heat Stage 2 Relay State     | heat_2              | DO Relay (24VAC , 1A)   | J1–5                            |
| Power Exhaust Relay State    | pexh                | DO Relay (24VAC , 1A)   | J11–3                           |
| Dehumidification Relay State | dehum               | DO Relay (24VAC , 1A)   | J11–7, 8                        |

\* These inputs (if installed) take the place of the default input on the specific channel  
Parallel pins J5–1 = J2–6, J5–3 = J1–10, J5–5 = J1–2 are used for field installation.  
Refer to the input configuration and accessory sections for more detail.

## Sensors and Accessories

The RTU-OPEN controller is configurable with the following field-supplied sensors:

**NOTE:** Supply air temperature sensor (33ZCSENSAT) is factory-installed.

- Space temperature sensor (SPS, SPPL, SPP, SPPF, 33ZCT55SPT, 33ZCT56SPT, or 33ZCT59SPT)
- Indoor air quality sensor (33ZCSENCO2, 33ZCT55CO2, 33ZCT56CO2) required for demand control ventilation.
- Outdoor air quality sensor (33ZCTSENCO2)
- CO<sub>2</sub> aspirator box (C33ZCCASPCO2) required for CO<sub>2</sub> return duct/outside air applications
- Outdoor air enthalpy switch (33CSENTHSW)
- Return air enthalpy sensor (33CSENTSEN) required for differential enthalpy control
- Space relative humidity sensor (33ZCSENSRH-01)
- Duct relative humidity (33ZCSENDNRH-01)
- Humidistat (--HL--38MG-029)
- Smoke Detectors (CRSMKSEN002A00, CRSMKKIT002A00)
- Fan and/or Filter Status (CRSTATUS001A00, CRSTATUS005A00)

## User Interfaces

- BACview 6 Handheld (BV6H)

- Virtual BACview (USB-L or USB-TKIT required)
- Field Assistant (USB-TKIT required)

## Install Analog Sensors

### Supply Air Sensor (SAT)

The factory supplies the discharge (supply) air sensor with the unit and is pre-wired. On 04-16 size units, the SAT is secured to the unit's supply duct opening. This sensor must be relocated into the supply duct during unit installation. On 17-30 size units, the SAT is mounted through the side of the heat chamber below the fan deck, and does NOT require relocation.

### Outdoor Air Sensor (OAT)

The OAT is supplied with the economizer option or accessory. It is wired through the 12-pin plug (PL6) in the return air section of the unit and is mounted on the economizer assembly.

### Space Temperature Sensor (SPT)

There are 2 types of SPT sensors available from Carrier, resistive input non-communicating (T55, T56, and T59) and Rnet communicating (SPS, SPPL, SPP, and SPPF) sensors. Each type has a variety of options consisting of: timed override button, set point adjustment, a LCD screen, and communication tie in. Space temperature can be also be written to from a building network or zoning system. However, it is still recommended that return air duct sensor be installed to allow stand-alone operation for back-up. Refer to the configuration section for details on controller configurations associated with space sensors.

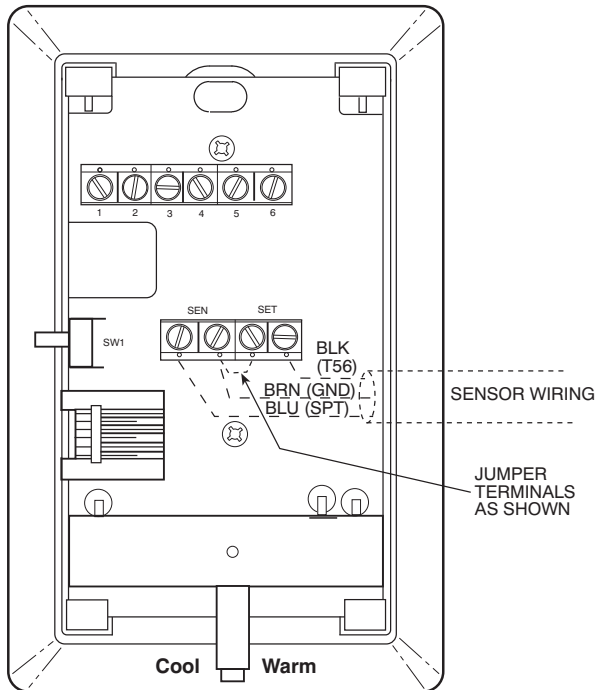


### Resistive Non-Communicating Sensor Wiring

For sensor with setpoint adjustment up to 500 ft (152m), use three-conductor shielded cable 20 gauge wire to connect the sensor to the controller. For non set point adjustment (slidebar) or return air duct sensor, an unshielded, 18 or 20 gauge, two-conductor, twisted pair cable may be used. Below is the list of the connections of the SPT to the RTU-OPEN, refer to Fig. 3 and 4 for typical connections at the sensor.

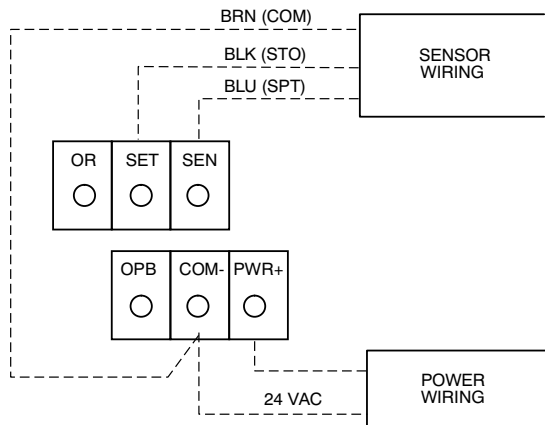
- J20-1 = temperature sensor input (SEN)
- J20-2 = sensor common
- J20-3 = Setpoint adjustment input (SET)

**NOTE:** See Fig. 5 for space temperature sensor averaging. T55/56 Override button will no longer function when sensors are averaged. Only Sensor 1 T56 STO input can be used.



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**Fig. 3 - Space Temperature Sensor Typical Wiring (33ZCT56SPT)**



**NOTE:** Must use a separate isolated transformer.

**Fig. 4 - Space Temperature Sensor Typical Wiring (33ZCT59SPT)**

### Rnet Communicating Sensor Wiring

The Rnet bus allows local communication with the RTU-OPEN, including communicating sensors. The Rnet bus can hold up to 6 devices in the following combinations wired in daisy-chain or hybrid configuration:

- 1-4 SPS sensor(s)
- 1 SPPL, SPP, or SPPF sensor
- 1-4 SPS sensor(s), and 1 SPPL, SPP, or SPPF sensor
- Any of the above combinations, plus up to 2 BACview<sup>6</sup>s

**NOTE:** Additional SPS sensors and BACview<sup>6</sup> must be addressed. Use the jumpers on the SPS sensor's circuit board and refer to the BACview<sup>6</sup>'s installation instructions for addressing.

For Rnet wiring up to 500ft (152m), use 18 AWG 4 conductor unshielded plenum rated cable. The RTU-OPEN's J13-RNET connection has a 4 pin Phoenix connector wired as described below, Fig. 6 shows sensor Rnet wiring.

- RNET - 1 = Signal ground (GND)
- RNET - 2 = Signal (Rnet+)
- RNET - 3 = Signal (Rnet-)
- RNET - 4 = Power (+12v)

### CO<sub>2</sub> Sensor(s) (IAQ and OAQ)

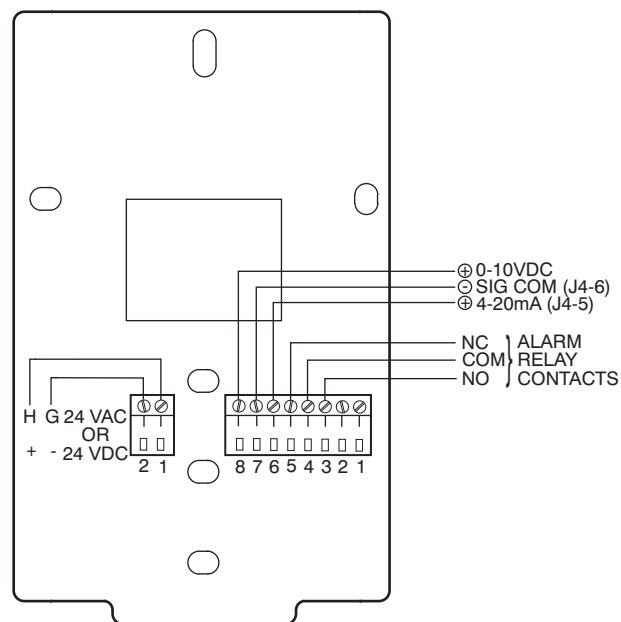
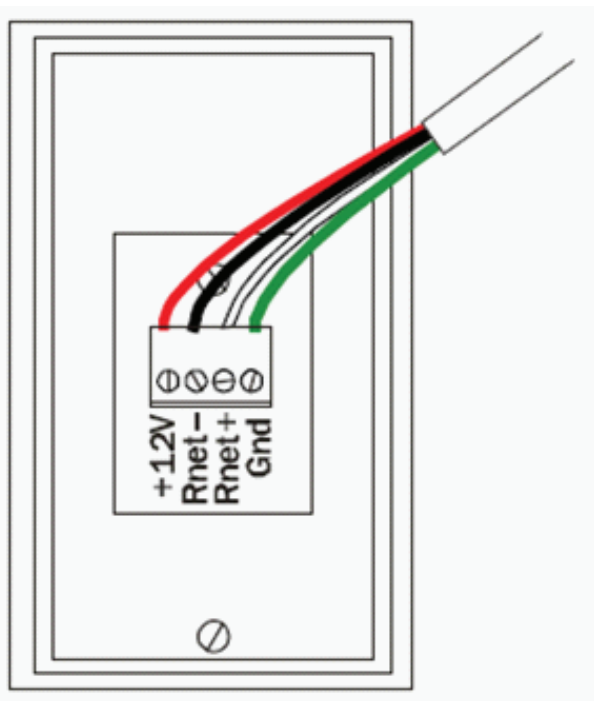
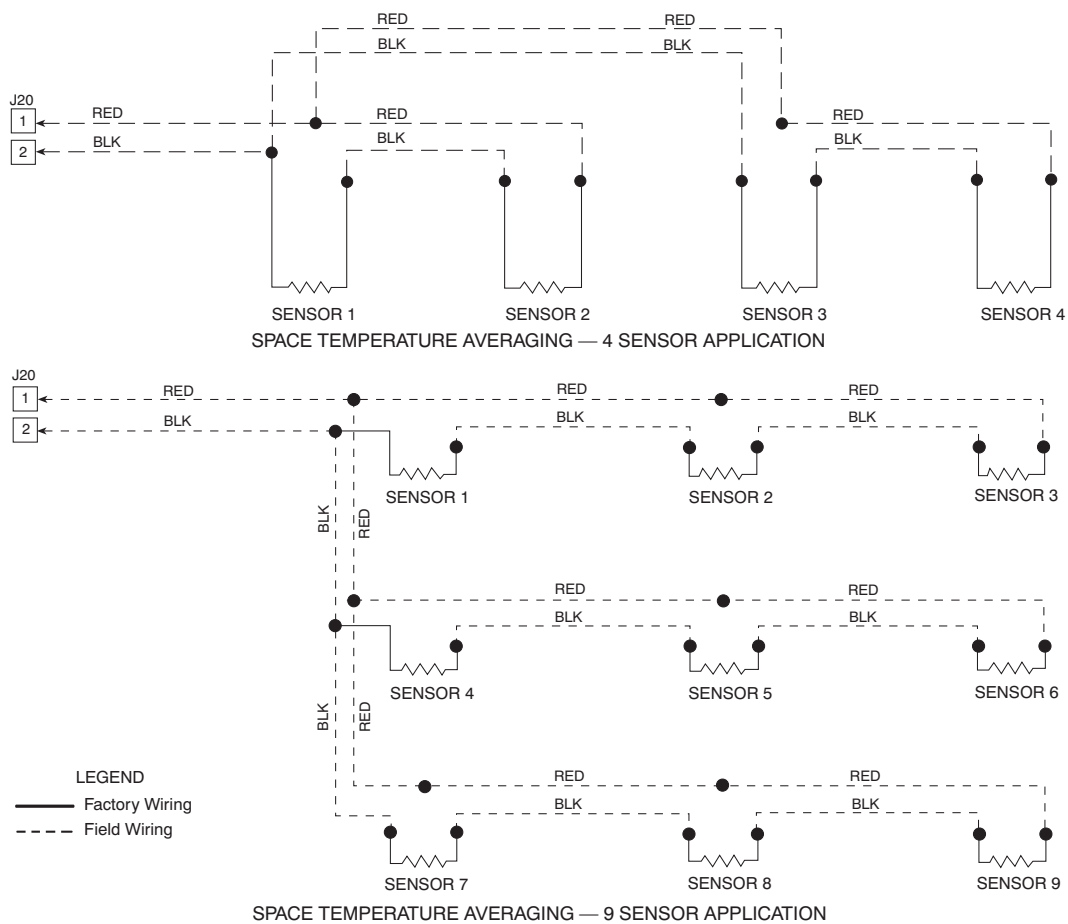
The indoor air quality (IAQ) and outdoor air quality (OAQ) sensors monitor carbon dioxide (CO<sub>2</sub>) levels. This information is used to monitor the quality of air in terms of parts per million (PPM). The same sensor is used for inside, outside, and duct monitoring, except an aspirator box is required for outside and duct mounting. The CO<sub>2</sub> sensor is preset for a range of 0 to 2000 ppm and a linear mA output of 4 to 20. The rooftop unit may have a factory installed CO<sub>2</sub> sensor on the side of the economizer assembly in the return air section of the unit and is pre-wired and pre-configured at the factory. For field installed sensors, a field supplied transformer must be used to power the sensor. Refer to the instructions supplied with the CO<sub>2</sub> sensor for electrical requirements and terminal locations. RTU-OPEN configurations must be changed after adding a CO<sub>2</sub> sensor. See below and Fig. 7 for typical CO<sub>2</sub> sensor wiring.

- J4-2 or J4-5 = 4-20mA signal input
- J4-3 or J4-6 = signal common

**NOTE:** The factory used J4-2&3 for CO<sub>2</sub> (IAQ) sensor inputs.

### Combination Temperature and CO<sub>2</sub> Sensor

If using a combination temperature and CO<sub>2</sub> sensor (33ZCT55CO2 or 33ZCT56CO2), refer to the installation instructions provided with the sensor.



### **Relative Humidity Sensors (Space or Duct Mounted)**

The accessory space humidity sensor or duct humidity sensor is used to measure the relative humidity of the air within the space or return air duct. The RH reading is used to control the Humidi-Mizer™ option of the rooftop unit. For wiring distances up to 500 ft (152m), use a 3-conductor, 18 or 20 AWG shielded cable. The shield must be removed from the sensor end of the cable and grounded at the unit end. The current loop power for the sensor is provided by the RTU-OPEN controller as 24vdc. Refer to the instructions supplied with the RH sensor for electrical requirements and terminal locations. RTU-OPEN configurations must be changed after adding a RH sensor. See below and Fig. 8 and 9 for typical RH sensor wiring.

- J4-1 or J4-4 = 24vdc loop power
- J4-2 or J4-5 = 4-20mA signal input

**NOTE:** The factory default for dehumidification control is a normally open humidistat.

### **Installing Discrete Inputs**

#### **Compressor Safety**

The compressor safety input provides the RTU-OPEN with feedback to when the compressor is not running and should be. This feedback is usually provided by a Compressor Lock-Out (CLO) device. Compressor safety is a dedicated input on the configurable input 3 and tells the RTU-OPEN when the compressor is locked out. The normal condition for compressor safety is good operation. A normally open compressor safety is the factory default for all units. Follow specific accessory instructions if installing a CLO device. The CLO should wire into the unit's Low Voltage terminal Board (LVTB).

**NOTE:** Input 3 can also be wired into J-5.

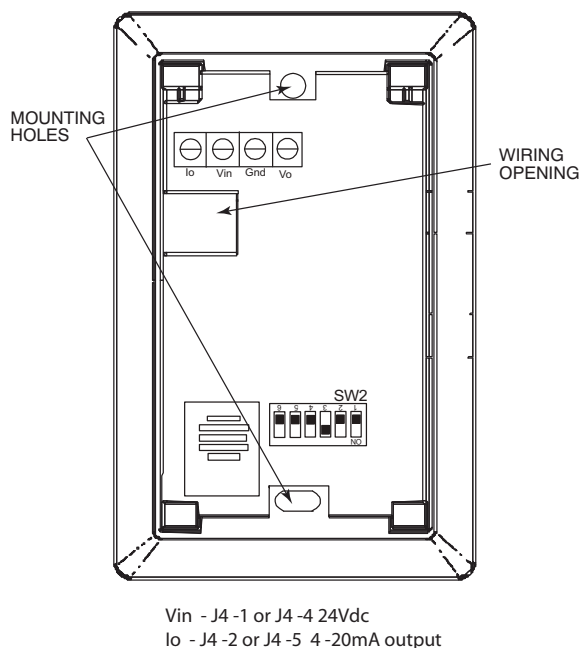


**Fig. 8 - Space Relative Humidity Sensor Typical Wiring**

### **Humidistat**

The accessory humidistat provides the RTU-OPEN insight to the relative humidity in the space. The humidistat reads the RH level in the space and compares it to its setpoint to operate a dry contact. The humidistat is a dedicated input on the configurable input 9 and tells the RTU-OPEN when the RH level is HIGH or LOW. The normal condition for humidity is LOW. A normally open humidistat is the factory default control for the Humidi-MiZer™ option. To wire in the field:

- J5-8 = 24 VAC source for dry contact
- J5-7 = Signal input

### **Single Enthalpy (Outdoor Enthalpy)**

The outdoor enthalpy switch/receiver (33CSENTHSW) senses temperature and humidity of the air surrounding the device and calculates the enthalpy when used without an enthalpy sensor. The relay is energized when enthalpy is high (above 28 BTU/lb OR dry bulb temperature is above 75°F) and de-energized when enthalpy is low (below 27 BTU/lb AND dry bulb temperature is below 74.5°F). The enthalpy input is dedicated to input 8 and tells the RTU-OPEN when the outside air enthalpy is HIGH or LOW. The normal condition for the enthalpy input is HIGH. Enthalpy is configured on input 8 in the factory when it is added as an option.

**NOTE:** The enthalpy calculation is done using an average altitude of 1000 ft above sea level.

For field installation, refer to the enthalpy accessory instructions. For wiring see below and Fig. 10. The RTU-OPEN board provides 24vac on one of the two loose grey wires in the return air section of the rooftop near the 12-pin economizer plug. To determine the correct grey, measure the voltage on the wires with power applied to the unit. If 24-vac is sensed, then that is the grey wire that is connected to the RTU-OPEN board at J2-7. The other is the signal for input 8, connect it to the LOW Enthalpy terminal on the enthalpy switch/receiver. Tie into the 12-pin economizer plug on pin 4 or the black wire connected to the actuator for the enthalpy's GND connection. Power can also be provided direct from the unit transformer and J5 terminal on the RTU-OPEN.

- J2-7 or J5-2 = 24 VAC for enthalpy switch power
- J2-6 or J5-1 = input signal

### **Differential Enthalpy**

Differential enthalpy control requires both an enthalpy switch/receiver (33CSENTHSW) and an enthalpy sensor (33CSENTSEN). The enthalpy sensor must be installed in the field as the factory can only provide single enthalpy. The enthalpy sensor must be mounted in the return airstream and calculates the enthalpy of the indoor air. The relay is energized when the enthalpy detected by the return air enthalpy sensor is less than the enthalpy at the enthalpy switch/receiver. The relay is de-energized when the enthalpy detected by the return air enthalpy sensor is greater than the enthalpy at the enthalpy switch/receiver (differential enthalpy control).

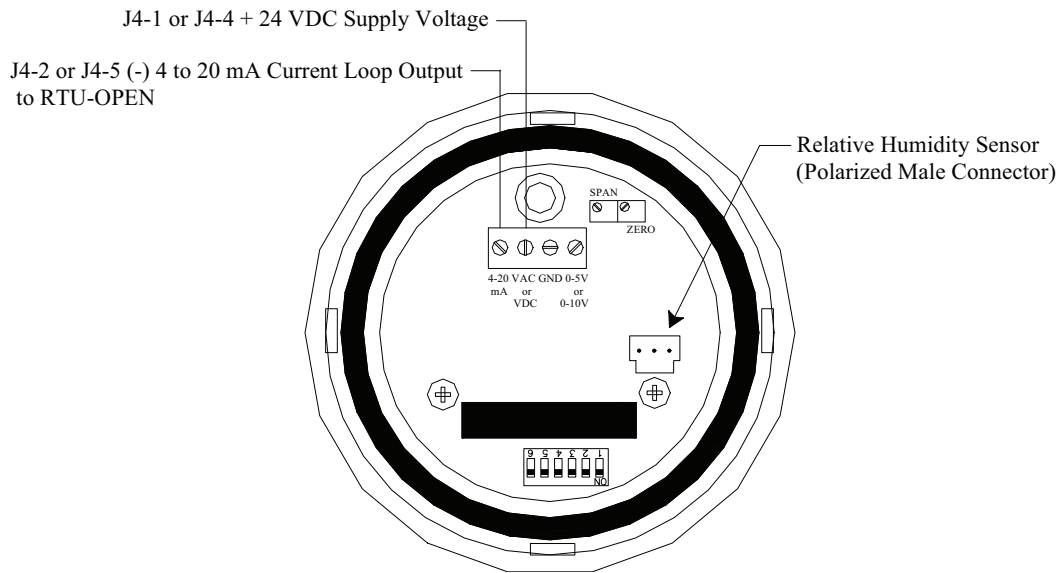


**Fig. 9 - Duct Relative Humidity Sensor Typical Wiring**

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To wire return air enthalpy sensor:

Connect the 4-20 mA In terminal on the enthalpy switch/receiver to the 4-20 mA Out terminal on the return air enthalpy sensor. Connect the 24-36 VDC Out terminal on the enthalpy switch/receiver to the 24-36 VDC In terminal on the return air enthalpy sensor. (See Fig 10.)

### **Fire Shutdown**

The fire shutdown input is provided for unit shutdown in response to a fire alarm or smoke detector. The fire shutdown input is dedicated to input 5 and tells the RTU-OPEN when to shutdown due to smoke detection or fire alarm system. The normal condition for fire shutdown is there is no fire alarm. The unit may have factory installed smoke detector(s); refer to the base unit installation instructions for details on any adjustments required during unit installation. Fire shutdown is always factory configured for a normally open smoke detector.

For field installation of a smoke detector see instructions for that specific accessory. See below and the troubleshooting section for wiring at the unit's Low Voltage Terminal Board (LVTB).

- LVTB - UNIT SHUTDOWN - 24v OUT = 24 VAC source
- LVTB - UNIT SHUTDOWN - Smoke Alarm = Signal input to RTU-OPEN

**NOTE:** Input 5 can also be wired into J5-3.

### **Filter Status**

The filter status accessory is a field-installed accessory. This accessory detects plugged filters. When installing this accessory, the unit must have a free input (input 3, 5, 8, or 9). One of the dedicated functions (Humidistat, Fire shutdown, Enthalpy, or Compressor safety) must not be in use to configure Filter Status. Refer to the configuration section for details on configuring inputs for specific functions and state. Refer to Fig. 1 for wire terminations at J5.

### **Fan Status**

The fan status accessory is a field-installed accessory. This accessory detects when the indoor fan is moving air. When installing this accessory, the unit must have a free input (input 3, 5, 8, or 9). One of the dedicated functions (Humidistat, Fire shutdown, Enthalpy, or Compressor safety) must not be in use to configure Fan Status. Refer to the configuration section for details on configuring inputs for specific functions and state. Refer to Fig. 1 for wire terminations at J5.

### **Remote Occupancy**

The remote occupancy accessory is a field-installed accessory. This accessory provides an input to change the units occupancy status. When installing this accessory, the unit must have a free input (input 3, 5, 8, or 9). One of the dedicated functions (Humidistat, Fire shutdown, Enthalpy, or Compressor safety) must not be in use to configure remote occupancy. Refer to the configuration section for details on configuring inputs for specific functions and state. Refer to Fig. 1 for wire terminations at J5.

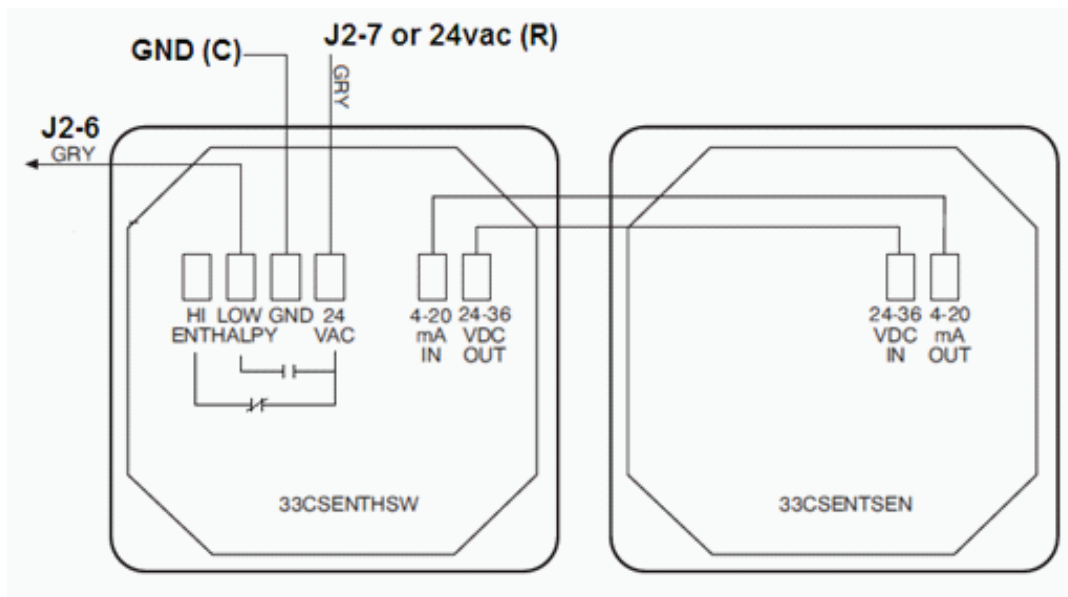


Fig. 10 - Enthalpy Switch and Sensor Wiring

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## Communication Wiring-Protocols

### General

Protocols are the communication languages spoken by control devices. The main purpose of a protocol is to communicate information in the most efficient method possible. Different protocols exist to provide different kinds of information for different applications. In the BAS application, many different protocols are used, depending on manufacturer. Protocols do not change the function of a controller; just make the front end user different.

The RTU-OPEN can be set to communicate on four different protocols: BACnet, Modbus, N2, and LonWorks. Switch 3 (SW3) on the board is used to set protocol and baud rate. Switches 1 and 2 (SW1 and SW2) are used to set the board's network address. See Fig. 11 and 12 for protocol switch settings and address switches. The 3rd party connection to the RTU-OPEN is through plug J19. See Fig. 13 for wiring. Refer to the *RTU-OPEN 3rd Party Integration Guide* for more detailed information on protocols, 3rd party wiring, and networking.

**NOTE:** Power must be cycled after changing the SW1-3 switch settings.

### I-Vu OPEN

I-Vu OPEN is a Carrier front-end and Building Automation System (BAS). It is a web based network system that uses a native BACnet over MS/TP communication protocol. The speed of the network can range from 9600 to 76,800 baud. OPEN devices communicate with a proprietary language called Linkage on I-Vu OPEN. Linkage is established automatically and allows the flow of specific data across OPEN devices. Refer to I-Vu OPEN literature for more information on I-Vu.

### BACnet MS/TP

BACnet Master Slave/Token Passing (MS/TP) is used for communicating BACnet over a sub-network of BACnet-only controllers. This is the default Carrier communications protocol. Each RTU-OPEN module acts as an MS/TP Master. The speed of an MS/TP network can range from 9600 to 76.8K baud. Physical Addresses can be set from 01 to 99.

### SW3 Protocol Selection

| PROTOCOL              | DS8    | DS7 | DS6 | DS5 | DS4 | DS3 | DS2         | DS1         |
|-----------------------|--------|-----|-----|-----|-----|-----|-------------|-------------|
| BACnet MS/TP (Master) | Unused | OFF | OFF | OFF | ON  | OFF | Select Baud | Select Baud |
| Modbus (Slave)        | Unused | OFF | OFF | ON  | ON  | OFF | Select Baud | Select Baud |
| N2 (Slave)            | Unused | OFF | OFF | OFF | ON  | ON  | OFF         | OFF         |
| LonWorks              | Unused | ON  | ON  | OFF | ON  | OFF | OFF         | ON          |

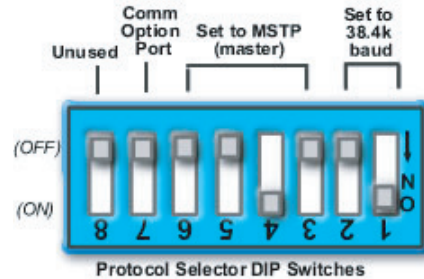
NOTE:

DS = Dip Switch

BACnet MS/TP SW3 example shown

#### Baud Rate Selections

| BAUD RATE | DS2 | DS1 |
|-----------|-----|-----|
| 9600      | OFF | OFF |
| 19,200    | ON  | OFF |
| 38,400    | OFF | ON  |
| 76,800    | ON  | ON  |



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Fig. 11 - RTU-OPEN SW3 Dip Switch Settings



Fig. 12 - RTU-OPEN Address Switches

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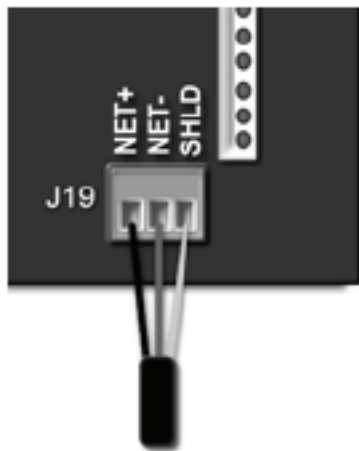


Fig. 13 - Network Wiring

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### Modbus

The RTU-OPEN module can speak the Modicon Modbus RTU Protocol as described in the Modicon Modbus Protocol Reference Guide, PI--MBUS--300 Rev. J. The speed of a Modbus network can range from 9600 to 76.8K baud. Physical Addresses can be set from 01 to 99.

### Johnson N2

N2 is not a standard protocol, but one that was created by Johnson Controls, Inc. that has been made open and available to the public. The speed of N2 network is limited to only 9600 baud. Physical Addresses can be set from 01 to 99.

### LonWorks

LonWorks is an open protocol that requires the use of Echelon's Neuron microprocessor to encode and decode the LonWorks packets. In order to reduce the cost of adding that hardware on every module, a separate LonWorks Option Card (LON-OC) was designed to connect to the RTU-OPEN.

This accessory card is needed for LonWorks and has to be ordered and connected using the ribbon cable to plug J15. The RTU-OPEN's baud rate must be set to 38.4k to communicate with the LON-OC. The address switches (SW1 & SW2) are not used with LonWorks.

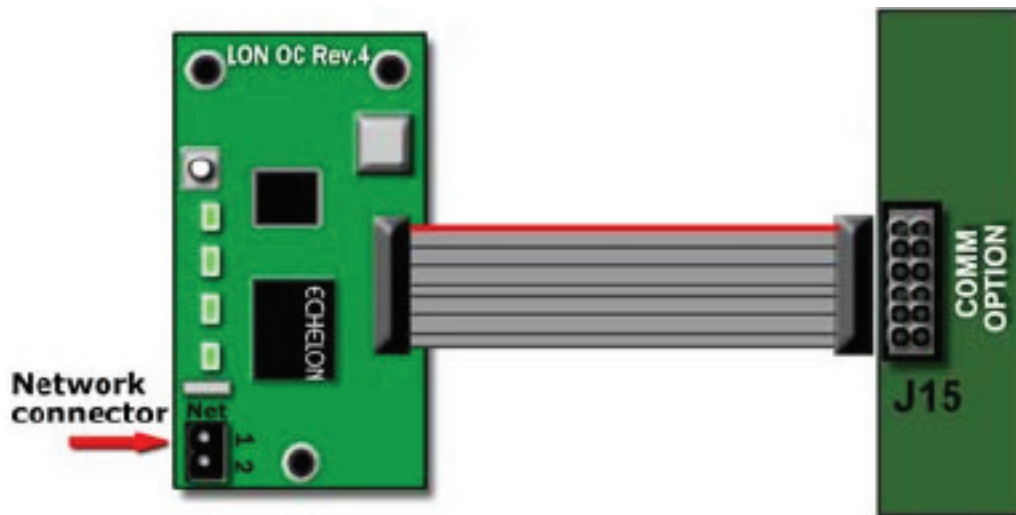


Fig. 14 - LON-OC and LON Network Wiring

C10817

## Local Access

### BACview<sup>6</sup> Handheld

The BACview<sup>6</sup> is a keypad/display interface used to connect to the RTU-OPEN to access the control information, read sensor values, and test the RTU. (See Fig. 15.) This is an accessory interface that does not come with the RTU-OPEN controller. You connect the BACview<sup>6</sup> to the RTU-OPEN's J12 local access port or one of the communicating space sensor's access port. There are 2 password protected levels in the display (User and Admin). The user password is defaulted to 0000, but can be changed. The Admin password is 1111 and cannot be changed. There is a 10 minute auto logout if a screen is left idle. See Appendix A for navigation and screen content.

### Virtual BACview

Virtual BACview is a freeware computer program that functions as the BACview<sup>6</sup> Handheld. The USB Link interface (USB-L) is required to connect a computer to the RTU-OPEN board. The link cable connects a USB port to the J12 local access port. This program functions and operates identical to the handheld.

### Field Assistant

Field Assistant is a computer program included with the purchase of the USB Link Tech Kit (USB-TKIT). This is a field Tech Tool to set-up, service, or download the RTU-OPEN controller. The link cable connects a USB port to the J12 local access port. The menu structure is similar to the BACview, but accessed and functions the same as I-Vu.

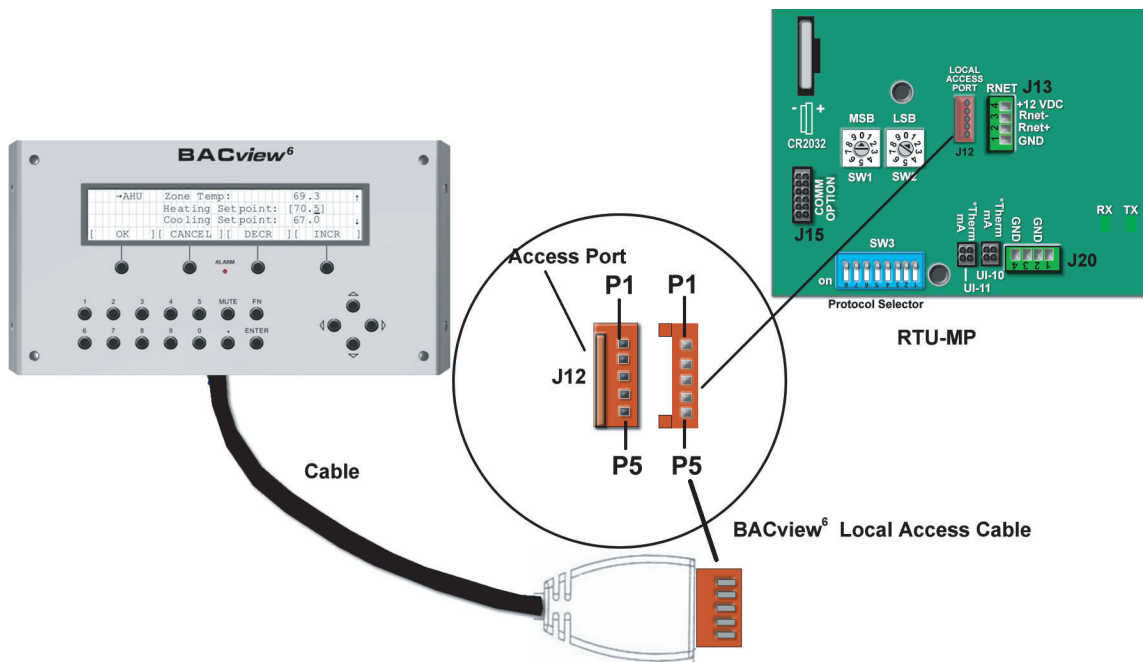


Fig. 15 - BACview<sup>6</sup> Handheld Connections

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## START-UP

**IMPORTANT:** Follow the base unit's start-up sequence documented in its specific instructions. Use the base unit's start-up check list when performing the start-up. At the end of this manual there is an additional RTU-OPEN Start-up Sheet to be completed and included with the base unit check list.

Besides the base unit start-up, there are a few steps to take to properly start-up the controls. RTU-OPEN's Service Test function should be used to assist in the base unit start-up and also allows verification of output operation. Controller configuration is also part of start-up. This is especially important when field accessories have been added to the unit. The factory pre-configures options installed at the factory. There may also be additional installation steps or inspection required during the start-up process.

### **Additional Installation/Inspection**

Inspect the field installed accessories for proper installation, making note of which ones do or do not require configuration changes. Inspect the RTU-OPEN's Alarms for initial insight to any potential issues. See troubleshooting section for alarms. Inspect the SAT sensor for relocation as intended during installation. Inspect special wiring as directed below.

### **Humidi-MiZer™ Control Wiring**

In units equipped with the optional Humidi-MiZer option there are 2 pink wires loose in the control box used to control the dehumidification function of the unit. These pink wires are meant to be tied to a space humidistat or thermidstat on an electromechanical unit. On RTU-OPEN equipped units these pink wires must be connected to J11-7 & 8 to allow the OPEN board to operate the dehumidification function of the unit. Disconnect the J11 Phoenix style connector from the board and use the plug screws to secure the pink wires in pins 7 and 8, reconnect the plug to the board at J11.

### **Power Exhaust Relay Power**

The relay used by the RTU-OPEN board to control power exhaust is a dry contact which means it does not have 24vac. This 24vac must be connected to the relay to allow it operate the power exhaust relay in the PE accessory. A 24vac source should be provided to the J11-2 pin on the RTU-OPEN. This can be provided by the unit's transformer from various sources. The "R" terminal on the unit's low voltage terminal board (LVTB) is a logical source.

### **Service Test**

The Service Test function can be used to verify proper operation of compressors, heating stages, indoor fan, power exhaust fans, economizer, and dehumidification. Use of Service Test is recommended at initial system start up and during troubleshooting. See Appendix A for Service Test Mode table.

Service Test mode has the following changes from normal operation:

- Outdoor air temperature limits for cooling circuits, economizer, and heating are ignored.
- Normal compressor time guards and other staging delays are ignored.
- The status of Alarms (except Fire and Safety chain) is ignored, but all alerts and alarms are still broadcasted on the network.

Service Test can be turned ON/OFF at the unit display or from the network. Once turned ON, other entries may be made with the display or through the network. To turn Service Test on, change the value of Test Mode to ON, to turn Service Test off, change the value of Test Mode to OFF.

**NOTE:** Service Test mode is password protected when accessing from the display. Depending on the unit model, factory-installed options, and field-installed accessories, some of the Service Test functions may not apply.

### **Fan Test**

This point allows the board's fan output to be manually turned On (Enable) and Off (Disable). Other test points that require the fan for operation will automatically turn the fan on and this point will still show "Disable." Fan test can operate simultaneously with other Service Test Points.

### **Compressor 1 and Compressor 2 Test**

The compressor test points are used to change output status for the individual compressors. Compressor starts are not staggered. The fan and heating service test outputs are reset to "Disable" for the compressor service tests. The Indoor fan and outdoor fans are controlled normally to maintain proper unit operation. All normal cooling alarms and alerts are functional.

**NOTE:** Compressor 1 is always operated with Compressor 2 due to outdoor fan control on Compressor 1. Always test Compressor 1 first, and leave it on to test Compressor 2.

### **Heat 1 and Heat 2 Test**

The heat test points are used to change output status for the individual heat stages, gas or electric. The fans and cooling service test outputs are reset to "Disable" for the heat service tests. Indoor and outdoor fans are controlled normally to maintain proper unit operation. All normal heating alarms and alerts are functional.

### **Reversing Valve Test**

This test point activates the DO7 relay at J11. These rooftop units do not use reversing valve control for heat pumps, therefore this test is not used.

## **Dehumidification Test**

For units with the factory Reheat option, the dehumidification relay is used to change the output status to operate the circuits in different Reheat modes. Dehumidification relay on by itself puts all circuits running in Hot Gas Reheat dehumidification mode; dehumidification relay on and the cooling test (compressor test relays) on puts unit and or individual circuits in subcooling dehumidification mode. The fans and heating service test outputs are reset to “Disable” for the dehumidification service test. Indoor and outdoor fans are controlled normally to maintain proper unit operation. All normal cooling/dehum alarms and alerts are functional.

## **Power Exhaust Test**

This point allows the board’s power exhaust (PE) output to be manually turned On (Enable) and Off (Disable). Power Exhaust test can operate simultaneously with other Service Test Points.

## **Economizer Test**

This point allows the board’s economizer output to be manually controlled from 0 to 100 % Open. Economizer test can operate simultaneously with other Service Test Points.

## **Analog Output 2 Test**

This test point activates the AO2 0-10vdc analog output at J22. These rooftops do not use this output, therefore this test is not used.

**NOTE:** Service Test Mode does not timeout. Be sure to turn off test mode or cycle power to the RTU to return to normal operation.

## **Configuration**

The RTU-OPEN controller’s configuration points effect the unit’s inputs and operation. Review and understand the meaning and purpose of each configuration point before changing it from the factory default value. Use the RTU-OPEN Start-up Sheet during configuration; fill in changed values if changed from factory default. There are three main configurations menus: SETPOINT, UNIT, and SERVICE. Each configuration point is described below under its according menu. See Appendix A for BACview menu structure.

## **Setpoint**

**Occupied Heating Setpoint** - The heating setpoint the controller maintains during the occupied period.

Range = 40-90°F

**Occupied Cooling Setpoint** – The cooling setpoint the controller maintains during the occupied period.

Range = 55-99°F

**Unoccupied Heating Setpoint** – The heating setpoint the controller maintains during the unoccupied period.

Range = 40-90°F

**Unoccupied Cooling Setpoint** – The cooling setpoint the controller maintains during the unoccupied period.

Range = 55-99°F

**Effective Heating Setpoint** – The current setpoint value heating operation will control to.

**Effective Cooling Setpoint** – The current setpoint value cooling operation will control to.

**Optimal Start** - The earliest time prior to occupancy, at which the Optimal Start function may begin to adjust the effective setpoints. Setting this to 0 will disable optimal start.

Range = 0-4 hours      Default = 4 hours

**Occ Relative Humidity Setpoint** – The space RH setpoint the controller maintains during the occupied period.

Range = 0 to the Unocc RH setpoint  
Default 60%

**Unocc Relative Humidity Setpoint** – The space RH setpoint the controller will maintain during the unoccupied period.

Range = 30-100%      Default = 90%

**DCV Max Ctrl Setpoint** – The difference between indoor and outdoor CO<sub>2</sub> level which results in maximum ventilation damper position.

Range = 0-9999ppm      Default = 650ppm

**Power Exhaust Setpoint** – When the economizer damper position opens above this point the power exhaust operation will begin. When the damper position falls below this point and 5% lower the power exhaust will shutdown.

Range = 20-90%      Default = 50%

**NOTE:** This point is only used when Continuous Occupied Exhaust = NO

## **Unit**

**Fan Mode** – Sets the operation of the indoor fan when not in cooling or heating mode. Refer to fan operation for details on each operation.

Range = Auto, Continuous, or Always On  
Default = Continuous

**Unit Start Delay** – Refers to the time delay the unit will wait after power up or when transitioning from unoccupied to occupied before it pursues any specific operation.

Range = 0-30 sec      Default = 5 sec

**Fan Off Delay** – Time delay in which the fan will continue run after being commanded off.

Range = 0-180sec      Default = 90sec

**Minimum Cooling SAT** – The supply air temperature must remain above this value to allow cooling with the economizer and/or compressors. There is 5°F plus and minus deadband to this point. If the SAT falls below this value during cooling a compressor stage will be removed and/or the economizer will return to minimum position.

Range = 45-70°F      Default = 50°F

**Maximum Heating SAT** – The supply air temperature must remain below this value to allow heating. There is 5°F plus and minus deadband to this point. If the SAT falls below this value during heating the heat stages will begin to decrease until the SAT has dropped below this value.

Range = 95-150°F      Default = 120°F

**Vent Dmpr Pos / DCV Min Pos** – Minimum damper position for ventilation during the occupied period

Range = 95-150°F      Default = 120°F

**DCV Max Vent Damper Pos** – This is the greatest position the economizer can open to while trying to control the indoor air quality levels

Range = 10-60%open      Default = 50%open

**S Fan Service Alarm Timer** – The timer set for the Supply Fan Runtime Alarm. After the number of hours set on this point is exceeded the corresponding alarm will be generated, and must be manually cleared in the maintenance menu after the maintenance has been completed. The timer will then begin counting its runtime again for the next due maintenance.

**NOTE:** Default = 0 hours, if set = 0 hr this point is disabled and its alarm will never be generated.

**Comp 1 Service Alarm Timer** – The timer set for the Compressor 1 Runtime Alarm. After the number of hours set on this point is exceeded the corresponding alarm will be generated, and must be manually cleared in the maintenance menu after the maintenance has been completed. The timer will then begin counting its runtime again for the next due maintenance.

**NOTE:** Default = 0 hours, if set = 0 hr this point is disabled and its alarm will never be generated.

**Comp 2 Service Alarm Timer** – The timer set for the Compressor 2 Runtime Alarm. After the number of hours set on this point is exceeded the corresponding alarm will be generated, and must be manually cleared in the maintenance menu after the maintenance has been completed. The timer will then begin counting its runtime again for the next due maintenance.

**NOTE:** Default = 0 hours, if set = 0 hr this point is disabled and its alarm will never be generated.

**Filter Service Alarm Timer** – The timer set for the Dirty Filter Alarm. After the number of hours set on this point is exceeded the corresponding alarm will be generated, and must be manually cleared in the maintenance menu after the maintenance has been completed. The timer will then begin counting its runtime again for the next due maintenance.

**NOTE:** Default = 600 hours, if set = 0 hr this point is disabled and its alarm will never be generated.

**Pushbutton Override** – Set to enable or disable the pushbutton override function of the locally installed space sensor.

Default = Enable

**Setpoint Adjustment** – Set to enable or disable the setpoint adjustment function of the locally installed space sensor.

Default = Enable

**Setpoint Adjustment Range** – Sets the slider range of a space sensor (with built in function). The slider is used to offset the control setpoint.

Range = +/-0-5Δ°F      Default = 5Δ°F

**Cooling Lockout Temperature** – This defines the minimum outdoor air temperature that cooling mode can be enabled and run. If the OAT falls below this number during cooling the compressors will be de-energized.

Range = 0-80°F      Default = 45°F

**Economizer High OAT Lockout Temp** – If the outdoor air temperature rises above this value, economizer cooling will be disabled and dampers will return and stay at minimum position.

Range = 55-80°F      Default = 75°F

**HP Rev Cycle Lockout Temp** – If the outdoor air temperature falls below this value, the compressors will not be allowed to run for heating. Unit Type must be set to Heat pump for this to be active.

Range = -20-30°F      Default = -3°F

**Heating Lockout Temperature** – This defines the maximum outdoor air temperature that heating mode can be enabled and run. If the OAT rises above this number during heating the heat stages will be de-energized.

Range = 35-150°F      Default = 65°F

**Unocc Free Cool Enable** – Set to enable or disable the economizer for night time free cooling (NTFC) operation. Default = Disable

**Setpoint Separation** – Sets the minimum separation gap in which setpoints can be set.

Range = 2-10°F      Default = 5°F

**Occupancy Source** – Tells the controller which method of occupancy control to use in determining occupancy of the rooftop. Refer to Occupancy in the operation section for detail on each specific operation function.

Range = Always Occupied, BACnet Schedule, BAS On/Off, or Remote Occ Input

Default = Always occupied

## Inputs

**Input 1 Function** – This input is an analog input and can be configured to be one of four different inputs: No Sensor, IAQ Sensor, OAQ Sensor, or Space RH Sensor. Input 1 is wired to pin J4-5.

Default = No Sensor

**Input 2 Function** – This input is an analog input and can be configured to be one of four different inputs: No Sensor, IAQ Sensor, OAQ Sensor, or Space RH Sensor. Input 2 is wired to pin J4-2.

Software Default = No Sensor

Factory Default = IAQ Sensor with factory installed CO<sub>2</sub> sensor

**Input 3** – This input is a discrete input and can be configured to be one of six different functions: No Function, Compressor Safety, Fan Status, Filter Status, Remote Occupancy, or Door Contact. This input can also be configured to be either a Normally Open (N/O) or a Normally Closed (N/C) switch. Input 3 is factory wired to pin J1-2. Field accessories can be wired to its parallel pin J5-5.

Factory Default = Compressor Safety and N/O

**Input 5** - This input is a discrete input and can be configured to be one of six different functions: No Function, Fire Shutdown, Fan Status, Filter Status, Remote Occupancy, or Door Contact. This input can also be configured to be either a Normally Open (N/O) or a Normally Closed (N/C) switch. Input 5 is factory wired to pin J1-10. Field accessories can be wired to its parallel pin J5-3.

Software Default = Fire Shutdown and N/C

Factory Default = Fire Shutdown and N/O

**Input 8** - This input is a discrete input and can be configured to be one of six different functions: No Function, Enthalpy Switch, Fan Status, Filter Status, Remote Occupancy, or Door Contact. This input can also be configured to be either a Normally Open (N/O) or a Normally Closed (N/C) switch. Input 8 is factory wired to pin J2-6. Field accessories can be wired to its parallel pin J5-1.

Software Default = Enthalpy Switch and N/O

Factory Default = No Function and N/O without factory installed enthalpy sensor

**Input 9** - This input is a discrete input and can be configured to be one of six different functions: No Function, Humidistat, Fan Status, Filter Status, Remote Occupancy, or Door Contact. This input can also be configured to be either a Normally Open (N/O) or a Normally Closed (N/C) switch. Input 9 is factory and field wired to pin J5-7.

Factory Default = Humidistat and N/O

**Space Sensor Type** - This tells the controller what type of space sensor is installed to run the unit. The three types that can be used are: a standard 10k Type II thermistor (T55), sensor with a setpoint offset slider bar (T56), or a communicating sensor (SPT Sensor).

Range = T55, T56, or SPT Sensor

Default = T55

**T5x Override Duration** - Sets the override time duration the unit will change from unoccupied to occupied when the override button is pushed on the space sensor.

Range = 0-24 hours      Default = 1 hour

## **Service**

**Unit Type** - This tells the control what type of unit it is controlling. Heat/Cool refers to gas and electric heat units. HP O/B Ctrl refers to a heat pump unit which requires reversing valve control. HP Y1/W1 Ctrl refers to a heat pump unit whose reversing valve is built in to the cooling or heating call.

Factory Default = Heat/Cool for non-heat pump units, or HP Y1/W1 Ctrl for heat pump units.

**Compressor Stages** - This refers to the number of mechanical cooling stages available on a specific unit. Set this point to "One Stage" if there is one compressor in the specific unit, set to "Two Stage" if there are two compressors in the unit, and set to "None" if economizer cooling ONLY is desired.

Factory Default = "One Stage" for 1 compressor units, or "Two Stages" for 2 compressor units

**Economizer Exists** - This tells the controller if there is an economizer installed on the unit.

Factory Default = NO if no economizer, or YES if there is an economizer installed

**Reversing Valve Type** - Sets the heat pump's (HP O/B Ctrl type) reversing valve function. O output type refers to a valve that is energized for cooling, and B output type refers to a valve that is energized for heating.

Default = O output type

**Heat Type** - Tells the controller which type of heat the unit is capable of. Electric is any unit without gas and a Gas unit is one which requires gas input for heating.

Factory Default = Electric for cooling only units and heat pumps, or Gas for gas units.

**Number of Heat Stages** - Tells the controller how many heat stages outputs are available for use. See configuration in Appendix A for details on specific unit configuration.

Factory Default = 1 for single heat stage units, 2 for dual stage units, or 0 for cooling only units.

**Continuous Occupied Exhaust** - This point tells the controller when to run the power exhaust if equipped on the unit.

If set to YES, the power exhaust will be on all the time when in occupied mode and will be off when in unoccupied mode. If set to NO the power exhaust will be controlled by the Power Exhaust Setpoint.

Default = NO

**Indoor CO<sub>2</sub> Sensor Value @ Min mA** - Sets the indoor CO<sub>2</sub> value when the board reads 4 mA at input 1 or 2.

Default 0 ppm

**Indoor CO<sub>2</sub> Sensor Value @ Max mA** - Sets the indoor CO<sub>2</sub> value when the board reads 20 mA at input 1 or 2.

Default 2000 ppm

**Outdoor CO<sub>2</sub> Sensor Value @ Min mA** - Sets the outdoor CO<sub>2</sub> value when the board reads 4 mA at input 1 or 2.

Default 0 ppm

**Outdoor CO<sub>2</sub> Sensor Value @ Max mA** - Sets the outdoor CO<sub>2</sub> value when the board reads 20 mA at input 1 or 2.

Default 2000 ppm

**NOTE:** The indoor and outdoor min and max mA setting are used to set the linear curve of mA vs. PPM.

## **Clockset**

This submenu screen allows you to set the date and time manually. The Daylight Savings Time (DST) can also be changed here. The date and time is automatically set whenever software is downloaded. The clock is a 24 hour clock and not am/pm. The time should be verified (and maybe changed) according to unit location and time zone.

Factory Default = Eastern Standard Time

## **USERPW**

This submenu screen allows you to change the user password to a four number password of choice. The User password change screen is only accessible with the Administrator Password (1111). The ADMIN password will always override the user password.

Factory Default = 0000

Range = 0000-9999

## **OPERATION**

The RTU-OPEN will control the compressors, economizer and heating outputs based on its space temperature input and setpoints. It can also be controlled by a building control system or zoning system. An optional CO<sub>2</sub> IAQ sensor mounted in the space can influence the economizer minimum position. The RTU-OPEN has a hardware clock that can allow scheduling for stand-alone operation. The RTU-OPEN's default is to control to occupied setpoints all the time, until a type of occupancy control is set. The following sections describe the operation for the functions of the RTU-OPEN.

### **Occupancy**

Occupancy is the fundamental overall control of equipment. The unit can be in one of two states: Occupied or Unoccupied. These are usually referred to as periods because they represent periods of any given day. Before RTU-OPEN can operate specific functions of the equipment it is installed on, occupancy must be determined. There are four different ways RTU-OPEN can determine occupancy. These are described below and selected by the configuration point Occupancy Source.

#### **Always Occupied (Default)**

The unit will not determine occupancy and continuously run in the occupied state or period. RTU-OPEN ships from the factory with this setting to allow immediate operation.

#### **BACnet Schedule**

When Occupancy Source is set to BACnet Schedule, RTU-OPEN will use a schedule to change occupancy based upon a day of week and a time period. Local time and date should be set in the RTU-OPEN for this function to operate properly. This function applies if setting a local schedule in the RTU-OPEN or if applying the unit to an I-Vu Open network or an OPEN zoning system. An OPEN network schedule can override a local schedule within the unit. A space sensor push button override is only available when running a local or OPEN schedule. The push button will override an unoccupied period to occupied for the specified time duration.

## **BAS On/Off**

When Occupancy Source is set to BAS On/Off, RTU-OPEN follows occupancy based on an On/Off command to the BAS ON/OFF software point. An on command sets the occupancy to occupied, and an off command sets it to unoccupied. The Building Automation System can be speaking BACnet, Modbus, N2, or LON and is writing to the BAS On/Off point in the open protocol point map.

### **Remote Occ Input**

When Occupancy Source is set to Remote Occ Input, RTU-OPEN follows occupancy based on the remote occupancy switch input. Inputs 3, 5, 8, and 9 on plug J5 can be hard-wired to command the unit's occupancy. The Occupancy Contact point show the status as on or off, on is occupied and off is unoccupied.

### **Indoor (Supply) Fan**

The indoor fan can be configured to operate in three different manors. The configuration point Fan Mode determines how the fan will run. The fan will always be disabled if a fire shutdown or safety chain alarm is active. A valid space temperature and supply air temperature must be available for the fan to operate. There is a unit start delay in effect when the unit is transitioning from unoccupied to occupied. The following describes specific fan operation based on the Fan Mode configuration value.

#### **Auto**

When Fan Mode is set to Auto, RTU-OPEN will cycle the fan on and off based on the demand for heating, cooling, and dehumidification. There is a configurable fan off delay that is upheld before shutting the fan off after conditioning has ended.

#### **Continuous**

When Fan Mode is set to Continuous, RTU-OPEN will cycle the fan based on occupancy. The fan will run the whole occupied period and operate in the auto mode during the unoccupied period.

#### **Always On**

When Fan Mode is set to Always On, RTU-OPEN will run the fan all the time regardless of occupancy or demand.

The RTU-OPEN has an optional Supply Fan Status input to provide proof of airflow. If this is enabled, the point will look for a contact change whenever the Supply Fan Relay is on. If it is not enabled then it will always be the same state as the Supply Fan Relay. The cooling, economizer, heating, dehumidification, CO<sub>2</sub> and power exhaust routines will use this input point for fan status.

## Cooling

The compressor outputs are controlled by the Cooling Control PID Loop and Cooling Stages Capacity algorithm. They will be used to calculate the desired number of stages needed to satisfy the space by comparing the Space Temperature (SPT) to the Occupied Cool Setpoint plus the T56 slider offset when occupied and the Unoccupied Cool Setpoint (UCSP) plus the T56 slider offset, if unoccupied. The economizer, if available, will be used for cooling in addition to the compressors. The following conditions must be true in order for this algorithm to run:

- Indoor Fan has been ON for at least 30 seconds.
- Heat mode is not active and the time guard between modes equals zero.
- If occupied and the  $SPT > (\text{occupied cool setpoint plus the T56 slider offset})$ .
- Space Temperature and supply air temperature values are available.
- If it is unoccupied and the  $SPT > (\text{unoccupied cool setpoint plus the T56 slider offset})$ . The indoor fan will be turned on by the staging algorithm.
- If economizer is available and active and economizer open  $> 85\%$  and  $SAT > (SAT \text{ low limit} + 5^{\circ}F)$  and  $SPT > \text{effective set point} + 0.5^{\circ}F$ .

OR

Economizer is available, but not active

OR

Economizer is not available

- $OAT > DX \text{ Lockout temperature}$

If all of the above conditions are met, the controller uses a PID logic loop to energize or de-energize compressors to satisfy the cooling demand.

There is a fixed 3-minute minimum on time and a 5-minute off time for each compressor output and a 3-minute minimum time delay between staging up or down.

Any time the compressors are running the RTU-OPEN will stage down the compressors if the SAT becomes less than the cooling low supply air setpoint. After a compressor is staged off, it may be started again after a normal time-guard period and the supply air temperature has increased above the low supply air setpoint.

## Economizer

The Economizer dampers are used to provide free cooling and Indoor Air Quality, if optional CO<sub>2</sub> sensor is installed, when the outside conditions are suitable.

The following conditions must be true for economizer operation:

- Indoor Fan has been on for at least 30 seconds.
- Enthalpy is Low if the Enthalpy input is enabled.
- SAT reading is available.
- OAT reading is available.
- SPT reading is available.
- $OAT \leq \text{High OAT economizer lockout configuration}$  (default = 75).
- $OAT \leq SPT$

If any of the mentioned conditions are not true, the economizer will be set to its configured minimum position. The minimum damper position can be overridden by the IAQ routine described later in this section.

If the above conditions are true, the Economizer control will calculate a damper position starting with a minimum vent position and based on current space temperature and a setpoint that is halfway between the effective cool and heat setpoints. If the SAT drops below the cooling low supply air setpoint ( $+ 5^{\circ}F$ ), the economizer will ramp down to minimum position.

## Power Exhaust

If RTU-OPEN is also controlling an exhaust fan, it can be enabled based on damper position or by occupancy. If configured for continuous occupied operation, it will be energized whenever the controller is in the occupied mode and disabled when in the unoccupied mode. If configured for damper position control, it will be energized whenever the economizer exceeds the power exhaust setpoint and disabled when the economizer drops below the setpoint by a fixed hysteresis of 10%.

## Heating

The heat outputs are controlled by the Heating Control PID Loop and Heating Stages Capacity algorithm. They will be used to calculate the desired number of stages needed to satisfy the space by comparing the SPT to the Occupied Heat Setpoint the T56 slider offset when occupied and the Unoccupied Heat Setpoint plus the T56 slider offset if unoccupied. The following conditions must be true in order for this algorithm to run:

- Indoor Fan has been ON for at least 30 seconds.
- Cool mode is not active and the time guard between modes equals zero.
- If occupied and  $SPT < (\text{occupied heat setpoint plus T56 slider offset})$
- SPT and supply air temperature values are available
- If it is unoccupied and the  $SPT < (\text{unoccupied heat setpoint plus T56 slider offset})$ . The indoor fan will be turned on by the staging algorithm.
- $OAT < \text{High OAT lockout temperature}$ .

If all of the above conditions are met, the controller uses a PID logic loop to energize or de-energize heat outputs to satisfy the heat demand. If the SAT begins to exceed the high supply air setpoint, a ramping function will cause the Heat Stages Capacity algorithm to decrease the number of stages until the SAT has dropped below the setpoint. There is a fixed one minute minimum on time and a one minute off time for each heat output. Heat staging has a 2 minute stage up and 30 second stage down delay.

Heat pump operation is the same as above except for what is explained below. There is a fixed 3 minute on and 5 minute off time for the first heat stage output, and a one minute on and one minute off time for the second heat stage output. There is a 10 minute minimum stage up delay if the heat demand is  $\leq 3^{\circ}\text{F}$ , and a 2 minute minimum stage up delay if heat demand is  $> 3^{\circ}\text{F}$ . The stage down delay is still 30 seconds. If the Compressor Safety Alarm is active, the second heat stage will come on with the first stage with no delay.

### Indoor Air Quality

If the optional indoor air quality sensor is installed, the RTU-OPEN will maintain indoor air quality within the space at the user configured differential set point. The set point is the difference between the indoor air quality and an optional outdoor air quality sensor. If the outdoor air quality is not present then a fixed value of 400ppm is used. The following conditions must be true in order for this algorithm to run:

- The mode is occupied.
- Indoor Fan has been ON for at least 30 seconds.
- Indoor Air Quality sensor has a valid reading.

As air quality within the space changes, the minimum position of the economizer damper will be changed thus allowing more or less outdoor air into the space depending on the relationship of the indoor air quality to the differential setpoint. If all the above conditions are true, the IAQ algorithm will run and calculates an IAQ minimum position value using a PID loop. The IAQ minimum damper position is then compared against the user configured economizer minimum position and the greatest value becomes the final minimum damper position of the economizer output.

If the calculated IAQ minimum position is greater than the DCV Max Vent Damper Pos configuration, then it will be clamped to the configured value.

### Dehumidification

The RTU-OPEN will provide occupied and unoccupied dehumidification only on units that are equipped with the Humidi-MiZer™ option from the factory. This function requires a space relative humidity sensor or a humidistat for control. The space relative humidity sensor can be installed and configured as one of the two analog input channels (inputs 1 or 2 on J4), or a humidistat can be installed and configured as switch input 9 on J5. When using a relative humidity sensor to control dehumidification, occupied or unoccupied dehumidification setpoints are used accordingly. When using a humidistat, setpoints are not used and the dehumidification call comes when the humidistat indicates high humidity.

When the indoor relative humidity becomes greater than the dehumidification setpoint (or switches from low to high), a dehumidification demand will be acknowledged. Compressor state is monitored and time guards are honored. If a compressor was just turned off prior to the dehum call the dehumidification output will be delayed the 5 minute minimum off time of the compressor. When ok to dehumidify, the dehumidification output (J11-7, 8) will be energized. This will bring on the supply fan, all compressors, and the dehumidification relay placing the unit in Hot Gas Reheat dehumidification mode. If dehumidification is called for during cooling or cooling is called for during dehumidification, the unit will run in Subcooling dehumidification mode. Individual unit circuits can be in different dehumidification modes based on the demand. Refer to the base units operation for additional information.

**NOTE:** There is a fixed 5% hysteresis that the indoor relative humidity must drop below the active setpoint to end the dehumidification mode and de-energize the dehumidification output. The output will also de-energize if the fan relay is de-energized.

### Demand Limit

If the RTU-OPEN receives a level 1 (one degree offset), 2 (two degree offset), or a 3 (4 degree offset) to the BACnet demand limit variable, the controller will outwardly expand the heating and cooling setpoints by the configured demand limit setpoint value and remain in effect until the BACnet demand limit variable receives a 0 value.

### Unoccupied Free Cooling

When the unit is equipped with an economizer, the control can run a night time free cooling (NTFC) mode called Unocc Free Cooling. In this mode the damper is utilized to bring in outdoor air for free cooling during unoccupied periods. The following conditions must be true for unoccupied free cooling to operate:

- Unocc Free Cool Enable set to Enable
- The system is unoccupied
- The outside air temperature is below the Economizer High OAT Lockout Temp
- The outside air temperature is less than the space temperature
- Enthalpy (if enabled) is Low

When the RTU-OPEN schedule is unoccupied and the space temperature rises at least 1 degree above the Occupied Cooling Setpoint, the supply fan starts. The economizer damper opens as necessary to cool the space. The RTU-OPEN continues to operate in this mode until the space is satisfied or the outside air conditions are no longer suitable for free cooling.

## Optimal Start

The RTU-OPEN may utilize Optimal Start, which adjusts the effective setpoints to achieve the occupied setpoints by the time scheduled occupancy begins. The Optimal Start recovery period may begin as early as 4 hours prior to occupancy. The algorithm works by moving the unoccupied setpoints toward the occupied setpoints. The rate at which the setpoints move is based on the outside air temperature, design temperatures, and capacities. The following conditions must be true for unoccupied free cooling to operate:

- Under SETPOINT, Optimal Start Value must be set greater than zero and less than or equal to four (0 disables Optimal Start.)
- The system is unoccupied
- The RTU-OPEN has a valid outside air temperature
- The RTU-OPEN is running occupancy based on a schedule, where next time occupied is known.

## Fire Shutdown

Fire Shutdown may be configured on Binary Input 5. A typical application involves a smoke detector or fire shutdown contact, which, when active, immediately shuts down equipment operation.

## Compressor Safety

Compressor Safety may be configured on Binary Input 3. A compressor safety tripped indicator circuit is available on most Carrier rooftop equipment. A Compressor Safety Alarm indicates that the equipment requires attention. Cooling, heating, and supply fan outputs are not interrupted except where the RTU-OPEN is configured for Heat Pump operation. When configured for Heat Pump, and in the heating mode, a compressor safety fault will cause the available stages of electric heating to be enabled in place of mechanical heating. Normal operation resumes when the compressor safety circuit is de-energized.

## Fan Status

Fan Status may be configured on any unused binary input channel. A typical application would be an airflow switch, current sensing relay, or other device that provides a supply fan running verification. Enabling this function displays the supply fan's status on the equipment graphic. If the controller loses fan status during operation, heating and cooling are disabled, the economizer damper (if available) is closed, and an alarm for loss of status is indicated. If the fan status is on when the controller is commanding the fan off, the unit remains in the off state. An alarm is generated indicating that the fan is running when it should be off.

## Filter Status

Filter status may be configured on any unused binary input channel. A typical application is a differential pressure switch that senses the pressure drop across a filter bank. When the pressure across the filter bank exceeds the setpoint of the differential pressure switch, the Filter status is displayed as Dirty on the controller graphic. An alarm indicates a dirty filter.

## Door Switch

A Door Contact may be configured on any unused binary input. A typical application is an occupancy sensor mounted within the space served by a single zone rooftop. Door Contact disables mechanical cooling and electric or gas heating, when active. Economizer cooling, if available, continues to operate.

## Linkage

The RTU-OPEN may serve as an air source to an OPEN Variable Volume Terminal (VVT) system. When the RTU-OPEN is part of a VVT system and the controllers are wired together to form a network, the controllers may use a method of communication known as Linkage™. Linkage is a method by which an air source and its subordinate zone terminals exchange data to form a coordinated HVAC system. The system's air source controller, zone controllers, and bypass controller are linked so that their data exchange can be managed by one zone controller configured as the VVT Master. The VVT Master gathers the following information from the slave zone controllers:

- occupancy status
- setpoints
- zone temperature
- relative humidity
- CO<sub>2</sub> level
- damper position
- optimal start data

The VVT Master performs mathematical calculations and algorithms on the data and then sends the composite information to the air source. The VVT Master receives information from the air source such as mode, supply air temperature, and outside air temperature, and passes that information to all linked controllers.

## Linkage Air Source Modes

In a linked system, the air source determines its operating mode and qualifies that mode based on its own Supply Air Temperature (SAT). The following modes can be sent by the air source depending on its configuration:

- Off – Air source fan is off
- Fan Only – Air source fan is on and providing ventilation (neutral SAT) without heating or cooling
- Economizer Cooling – Air source fan is on and providing cooling, using economizer only
- Cooling – Air source fan is on and cooling is provided by economizer and mechanical cooling
- Heating – Air source fan is on and heating is provided (gas or electric)
- Dehumidification – Air source fan is on and Humidi-MiZer] is active
- Test – The RTU Open Service Test mode is active
- Shutdown – Air source fan is off due to Safety Chain, Fire Shutdown, or invalid SAT sensor
- Unocc Free Cooling – Air source fan is on, with the economizer providing cooling while unoccupied

# TROUBLESHOOTING

## General

The RTU-OPEN controller acts as an intelligent imbedded thermostat to the rooftop unit, but can be monitored and controlled from I-Vu Open (Linkage) or a 3rd party network. This causes the system as a whole to be troubleshot from three points of view. The three parts to the system are the rooftop unit, the OPEN controller, and the network connected. Determining which part needs to be troubleshot is the first step.

The OPEN controller can be used to troubleshoot the rooftop unit and/or itself with service test, communicating LED's, and built in alarms. Disconnecting the RTU-OPEN from the network may also help troubleshooting the controller and rooftop unit. Third Party Network troubleshooting may also be required. For base unit troubleshooting, refer to specific base unit Service Maintenance manual.

There is an on-board battery that is used for RAM and clock back-up. It is a 3-volt lithium battery (CR2032). The average life is 7 years with a minimum of 10,000 hours of back-up. When the RTU-OPEN board is powered up, the battery is not being used. If power is lost, the battery backs up the time clock. Battery replacement should be done with the board powered up.

## Thermistor Troubleshooting

RTU-OPEN uses thermistors to sense temperatures for control operation of the unit. Resistances at various temperatures are listed in Table 2. Thermistor pin connections are shown in Table 1. Thermistors are used for supply air temperature (SAT), outdoor air temperature (OAT), and space temperature (SPT) and all must be a 10 kilo-ohm type II sensor.

To check accuracy, use a high quality digital volt-ohmmeter. Connect the meter to the thermistor leads to obtain a resistance value. Use Table 2 to convert that resistance to a temperature. Next step is to measure temperature at probe location with an accurate thermocouple-type temperature-measuring instrument. Temperature measured by thermocouple and temperature determined from thermistor voltage reading should be close, within 5°F if care was taken in applying thermocouple and taking readings. If a sensor must be corrected, use the RTU-OPEN's calibration function to offset the temperature reading.

**Table 2 – Thermistor Resistance vs Temperature Values for Space Temperature Sensor, Supply Air Temperature Sensor, and Outdoor Air Temperature Sensor**

| TEMP (C) | TEMP (F) | RESISTANCE (Ohms) |
|----------|----------|-------------------|
| -40      | -40      | 335,651           |
| -35      | -31      | 242,195           |
| -30      | -22      | 176,683           |
| -25      | -13      | 130,243           |
| -20      | -4       | 96,974            |
| -15      | 5        | 72,895            |
| -10      | 14       | 55,298            |
| -5       | 23       | 42,315            |
| 0        | 32       | 32,651            |
| 5        | 41       | 25,395            |
| 10       | 50       | 19,903            |
| 15       | 59       | 15,714            |
| 20       | 68       | 12,494            |
| 25       | 77       | 10,000            |
| 30       | 86       | 8,056             |
| 35       | 95       | 6,530             |
| 40       | 104      | 5,325             |
| 45       | 113      | 4,367             |
| 50       | 122      | 3,601             |
| 55       | 131      | 2,985             |
| 60       | 140      | 2,487             |
| 65       | 149      | 2,082             |
| 70       | 158      | 1,752             |

## Software Version

During Start-up and throughout the life of the equipment, it may be necessary to obtain the RTU-OPEN's software version. To do this a Modstat must be run on the controller. This can be done from the BACview user interface by holding the function (FN) key and pressing the period (.) key. An example of the beginning lines of a Modstat is shown in Fig. 16. The application software version shows the current running software of the board. In this case the rtu\_open-20100409 refers to RTU-OPEN software version 20100409. This 8 digit number refers to a date (YYYYMMDD). The first 4 digits are the year (2010) and the month and day (0409), so this version is April 9<sup>th</sup> 2010.

```

07/30/2010  18:12:12          CM: 0

Device Instance: 1610100

Application Software Version: PRG:rtu_open-20100409

1 PRGs loaded.  1 PRGs running.

Module status:
Firmware sections validated in flash memory
=====
Boot16-H_IAR      - v2.09:016   Aug 13 2009
RTU-OPEN DRIVER  - v3.04:101   Mar  8 2010

```

C10825

**Fig. 16 - Example Modstat**

## Communication LED's

The LED's indicate if the controller is speaking to the devices on the network. The LED's should reflect communication traffic based on the baud rate set. The higher the baud rate the more solid the LED's will appear.

**Table 3 – LED's**

The LED's on the RTU-OPEN show the status of certain functions

| If this LED is on... | Status is...                                               |
|----------------------|------------------------------------------------------------|
| <b>Power</b>         | The RTU-OPEN has power                                     |
| <b>Rx</b>            | The RTU-OPEN is receiving data from the network segment    |
| <b>Tx</b>            | The RTU-OPEN is transmitting data over the network segment |
| <b>DO#</b>           | The digital output is active                               |

The **Run** and **Error** LED's indicate control module and network status

| If Run LED shows...   | And Error LED shows...                                 | Status is...                                                                                                                                                          |
|-----------------------|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 flashes per second  | Off                                                    | Normal                                                                                                                                                                |
| 2 flashes per second  | 2 flashes, alternating with <b>Run</b> LED             | Five minute auto-restart delay after system error                                                                                                                     |
| 2 flashes per second  | 3 flashes, then off                                    | Control module has just been formatted                                                                                                                                |
| 2 flashes per second  | 4 flashes, then pause                                  | Two or more devices on this network have the same ARC156 network address                                                                                              |
| 2 flashes per second  | On                                                     | Exec halted after frequent system errors or control programs halted                                                                                                   |
| 5 flashes per second  | On                                                     | Exec start-up aborted, Boot is running                                                                                                                                |
| 5 flashes per second  | Off                                                    | Firmware transfer in progress, Boot is running                                                                                                                        |
| 7 flashes per second  | 7 flashes per second, alternating with <b>Run</b> LED  | Ten second recovery period after brownout                                                                                                                             |
| 14 flashes per second | 14 flashes per second, alternating with <b>Run</b> LED | Brownout                                                                                                                                                              |
| On                    | On                                                     | Failure. Try the following solutions:<br>– Turn the RTU-OPEN off, then on.<br>– Format the RTU-OPEN.<br>– Download memory to the RTU-OPEN.<br>– Replace the RTU-OPEN. |

**Table 4 – RTU-OPEN Alarms**

| POINT NAME                                                         | BACnet Object NAME | ACTION TAKEN BY CONTROL                                 | RESET METHOD            | PROBABLE CAUSE                                                                                              |
|--------------------------------------------------------------------|--------------------|---------------------------------------------------------|-------------------------|-------------------------------------------------------------------------------------------------------------|
| Safety Chain                                                       | safety_alarm       | Immediate Shutdown                                      | Automatic               | Over load Indoor Fan or Electric Heater overheat                                                            |
| Fire Shutdown                                                      | fire_alarm         | Immediate Shutdown                                      | Automatic               | Smoke detected by smoke detector or configuration incorrect                                                 |
| Supply Fan Failure                                                 | sfan_fail_alarm    | Immediately disable Operation                           | Automatic               | Tripped Circuit Breaker, Broken belt, Bad indoor fan motor, Configuration incorrect, Bad fan status switch. |
| Supply Fan in Hand                                                 | sfan_hand_alarm    | Ramp down Operations                                    | Automatic               | Bad Fan Status Switch, Configuration incorrect.                                                             |
| Compressor Safety                                                  | comp_alarm         | Alert Generated                                         | Automatic               | Compressor would not start                                                                                  |
| Space Temp Sensor                                                  | spt_fail           | Ramp down Operations                                    | Automatic               | Faulty, shorted, or open thermistor caused by wiring error or loose connection.                             |
| Supply Air Temp Sensor                                             | sat_alarm          | Economizer Disabled                                     | Automatic               | Faulty, shorted, or open thermistor caused by wiring error or loose connection.                             |
| Outdoor Air Temp Sensor Alarm                                      | oat_alarm          | Economizer and Low ambient DX cooling lockout disabled. | Automatic               | Faulty, shorted, or open thermistor caused by wiring error or loose connection.                             |
| Space Relative Humidity Sensor                                     | sprh_alarm         | Dehumidification disabled                               | Automatic               | Sensor reading is out of range. Bad sensor, bad wiring, or sensor configured incorrectly.                   |
| IAQ Sensor                                                         | iaq_alarm          | No IAQ Operation                                        | Automatic               | Sensor reading is out of range. Bad sensor, bad wiring, or sensor configured incorrectly.                   |
| OAQ Sensor                                                         | oaq_alarm          | Set OAQ to 400                                          | Automatic               | Sensor reading is out of range. Bad sensor, bad wiring, or sensor configured incorrectly.                   |
| Space Temperature<br><br>Alarming Temperature Alarm Limit Exceeded | spt_alm_status     | Alert Generated                                         | Automatic               | Space value is less then the low allowed value or Space value is greater then the high allowed value        |
|                                                                    | spt_alm_temp       | Shows temperature that caused alarm                     | N/A                     | N/A                                                                                                         |
|                                                                    | spt_alm_lmt        | Shows the limit that was exceeded                       | N/A                     | N/A                                                                                                         |
| High Supply Air Temperature                                        | sat_hi_alarm       | Alert Generated                                         | Automatic               | SAT is greater then the configuration for more then 5 minutes                                               |
| Low Supply Air Temperature                                         | sat_lo_alarm       | Alert Generated                                         | Automatic               | SAT is less then the configuration for more then 5 minutes                                                  |
| Setpoint Slider                                                    | slidepot_alarm     | Set Offset to zero                                      | Automatic               | STO sensor is open for more then 5 seconds                                                                  |
| Switch Configuration                                               | di_cfg_alarm       | Disable only wrong switch functions                     | Configure correctly     | More then one discrete input is configured to provide the same function.                                    |
| Analog Input Configuration                                         | ai_cfg_alarm       | Disable 4 selectable analog inputs                      | Configure correctly     | More then one analog input is configured to provide the same function.                                      |
| High Space Relative Humidity                                       | sprh_hi_alarm      | Alert Generated                                         | Automatic               | IRH is greater then the configuration for more then 15 minutes                                              |
| Low Space Relative Humidity                                        | sprh_lo_alarm      | Alert Generated                                         | Automatic               | IRH is less then the configuration for more then 5 minutes                                                  |
| High CO2                                                           | co2_alarm          | Alert Generated                                         | Automatic               | CO2 reading is above the configuration for 1 minute                                                         |
| Supply Fan Runtime                                                 | sfan_rntm_alarm    | Alert Generated                                         | zero the timer          | Supply fan run time exceeded user defined limit                                                             |
| Compressor 1 Runtime                                               | comp1_rntm_alarm   | Alert Generated                                         | zero the timer          | Compressor run time limit is exceeded                                                                       |
| Compressor 2 Runtime                                               | comp2_rntm_alarm   | Alert Generated                                         | zero the timer          | Compressor run time limit is exceeded                                                                       |
| Filter                                                             | filter_alarm       | Alert Generated                                         | Automatic / reset timer | Dirty Filter, supply fan run time exceeded, filter switch configuration wrong.                              |
| Airside Linkage Alarm                                              | air_linkage_fail   | Alert Generated                                         | Automatic               | Linkage communication failed                                                                                |

## **Alarms**

Alarms are provided to indicate a possible problem with the controller or unit. Alarms can be checked through a network and/or the local access device. All alarms are listed in Table 4 with name, object name, action taken by control, reset method, and possible cause. Some alarms can occur based on specific configurations.

### **Safety Chain Alarm**

This alarm occurs immediately if the supply-fan internal overload trips or if an electric-heat limit switch trips. The Unit Status will be Shutdown and the System Mode will be Disable. All unit operations stop immediately and will not restart until the alarm automatically clears. There are no configurations for this alarm; it is all based on internal wiring. This alarm will not occur if Fire Shutdown Alarm is active. Normal operation resumes when the safety chain circuit is complete.

### **Fire Shutdown Alarm**

This alarm occurs immediately when the smoke detector senses smoke. The Unit Status will be Shutdown and the System Mode will be Disable. All unit operations stop immediately and will not restart until the alarm automatically clears. If there is not a smoke detector installed or the smoke detector did not trip, check input configurations. NOTE: The default function for input 5 is a normally open Fire Shutdown input.

### **Supply Fan Failure**

This alarm occurs when the indoor fan is being command on and the fan status switch feedback is showing the fan off. This will end current operating mode and disable unit operation. This alarm requires a fan status switch to be configured on one of the inputs.

### **Supply Fan in Hand**

This alarm occurs when the indoor fan is being commanded off and the fan status switch feedback is showing the fan is on. This will prevent any operating mode and disable unit operation. This alarm requires a fan status switch to be configured on one of the inputs.

### **Compressor Safety**

This alarm indicates the base unit's compressor safety circuit is energized. Cooling, heating, and supply fan outputs are not interrupted except when the RTU-OPEN is configured for Heat Pump. Normal operation resumes when the compressor safety circuit is de-energized. If the Heat Pump is in the heating mode, it will automatically replace the compressor stage(s) with the equivalent number of auxiliary heat stages, as available.

For Heat Pump's with O/B, when configured for two stages of aux heat and two compressors, Compressor 1 is replaced by Aux Heat Stage 1 and Compressor 2 is replaced by Aux Heat Stage 2. The compressor output stays on when the safety alarm is present. For cooling, the alarm indicates the compressors are down.

### **Space Temp Sensor**

This alarm occurs if the space sensor wired to the RTU-OPEN is disconnected or shorted for more than 10 seconds. When this occurs the Unit Status will be Shutdown and the System Mode will be Run. Sensor, sensor connections, wiring, board connection, and configurations should be checked for faults or errors. Alarm will reset automatically when cause is fixed.

### **Supply Air Temp Sensor**

This alarm occurs immediately when the supply air temperature sensor wired to the RTU-OPEN is disconnected or shorted. When this occurs the Unit Status will be Shutdown and the System Mode will be Run. Sensor, sensor connections, wiring, board connection, and configurations should be checked for faults or errors. Alarm will reset automatically when cause is fixed.

### **Outdoor Air Temp Sensor Alarm**

This alarm indicates a shorted or open circuit in the OAT input. Cooling, heating, and supply fan operation continues. OAT lockouts will not operate while the sensor is in alarm. Economizer cooling and optimal start functions are disabled. Normal operation resumes when the controller detects a valid sensor.

### **Space Relative Humidity Sensor**

This alarm indicates the mA input at the associated channel falls below 3.5 mA or rises above 21 mA. Cooling, heating, and supply fan operation continues, however, the controller's Humidi-MiZer™ binary output is disabled until the fault condition is corrected.

### **IAQ Sensor**

This alarm indicates the mA input at the associated channel falls below 3.5 mA or rises above 21 mA. Cooling, heating, and supply fan operation continues. However, the controller's IAQ control function is disabled until the fault condition is corrected.

### **OAQ Sensor**

This alarm indicates the mA input at the associated channel falls below 3.5 mA or rises above 21 mA. Cooling, heating, and supply fan operation continues. However, the controller's IAQ control function uses 400ppm as the fixed outdoor air CO2 level until the fault condition is corrected.

### **Space Temperature**

When Occupied, a Low Space Temperature alarm is generated if the space temperature falls below the lower limit or a High Space Temperature alarm is generated if the space temperature rises above the upper limit.

When Unoccupied, an unoccupied low space temperature alarm is generated when the space temperature falls below the alarm configuration Unoccupied Low SPT Alarm Limit or an unoccupied high space temperature alarm is generated when the space temperature rises above the alarm configuration Unoccupied High SPT Alarm Limit.

The following values are related to the Space Temperature alarm:

**Alarming Temperature** – This variable displays the value of the space temperature that is in alarm and is only visible when the space temperature is in an alarm state.

**Alarm Limit Exceeded** – This variable displays the value of the alarm setpoint that is exceeded by the alarming space temperature and is only visible when the space temperature is in an alarm state.

### **High Supply Air Temperature**

This alarm indicates the supply air temperature exceeds the alarm configuration High SAT Alarm Limit for 5 minutes. This alarm is inhibited until the RTU has been running for 30 minutes to allow for system stabilization after startup.

### **Low Supply Air Temperature**

This alarm indicates the supply air temperature falls below the alarm configuration Low SAT Alarm Limit for 5 minutes. This alarm is inhibited until the RTU has been running for 30 minutes to allow for system stabilization after startup.

### **Setpoint Slider**

This alarm indicates an open circuit is detected at the setpoint adjustment input. This can only occur if the Space Sensor Type is set to T56. Note that only an open circuit results in an alarm. A short across this input offsets the setpoints negatively by the amount configured by configuration Setpoint Adjustment Range.

### **Switch Configuration**

This occurs if more than one binary input (inputs 3, 5, 8, and 9) is configured for the same function. When this happens the two inputs (or more) configured wrong will be disabled as an inputs. This alarm will automatically be cleared when configuration is corrected.

An example of this would be: Input 3 = Compressor Safety, input 5 = Fan Status, input 8 = Fan Status, and input 9 = Humidistat; the alarm would be active, unit would run, compressor safety and humidistat would function normally, and Fan Status (inputs 5 & 8) will be interpreted as “No Function.”

### **Analog Input Configuration**

This occurs if more than one analog input (inputs 1 & 2) is configured for the same sensor. When this happens the two inputs will be disabled as inputs. This alarm will automatically be cleared when configuration is corrected.

An example of this would be: Input 1 = IAQ Sensor, input 2 = IAQ Sensor; the alarm would be active, unit would run, but the IAQ Sensor (inputs 1 & 2) will be interpreted as “No Function.”

### **High Space Relative Humidity**

This alarm indicates the space humidity exceeds the alarm configuration High Space Humidity Alarm Limit for 10 minutes. This alarm is inhibited until the RTU runs for 15 minutes to allow for system stabilization after startup.

### **Low Space Relative Humidity**

This alarm indicates the space humidity falls below the alarm configuration Low Space Humidity Alarm Limit for 5 minutes. This alarm is inhibited until the RTU runs for 5 minutes to allow for system stabilization after startup.

### **High CO<sub>2</sub>**

This alarm indicates the space CO<sub>2</sub> level exceeds the alarm configuration Occupied High CO<sub>2</sub> Alarm Limit for 1-minute. This alarm will be inhibited until the RTU has been running for 2-minutes to allow for system stabilization after startup.

### **Supply Fan Runtime**

This alarm indicates the accumulated runtime exceeds the unit configuration Supply Fan Service Alarm Timer value (when not set to 0). This alarm is most commonly used to indicate an equipment maintenance interval is due. The supply fan runtime accumulator may be reset by setting the maintenance point Reset Supply Fan Runtime Alarm to Clear, and then back to Run – acknowledging each selection by clicking the OK button when it appears. Setting unit configuration Supply Fan Service Timer value to 0 disables the supply fan runtime alarm function.

### **Compressor 1 Runtime**

This alarm indicates the accumulated runtime exceeds the unit configuration Compressor 1 Service Alarm Timer value (when not set to 0). This alarm is most commonly used to indicate an equipment maintenance interval is due. The Compressor 1 Runtime accumulator may be reset by setting the maintenance point Reset Comp 1 Runtime Alarm to Clear, and then back to Run – acknowledging each selection by clicking the OK button when it appears. Setting unit configuration Compressor 1 Service Timer value to 0 disables the Compressor 1 Runtime alarm function.

### **Compressor 2 Runtime**

This alarm indicates the accumulated runtime exceeds the unit configuration Compressor 2 Service Alarm Timer value (when not set to 0). This alarm is most commonly used to indicate an equipment maintenance interval is due. The Compressor 2 runtime accumulator may be reset by setting the maintenance point Reset Comp 2 Runtime Alarm to Clear, and then back to Run – acknowledging each selection by clicking the OK button when it appears. Setting unit configuration Compressor 2 Service Timer value to 0 disables the Compressor 2 runtime alarm function. Note that this function is unavailable if the service configuration Compressor Stages value is not set to Two Stages.

### **Filter**

This alarm indicates the accumulated runtime exceeds the unit configuration Filter Service Alarm Timer value (when not set to 0). This alarm is most commonly used to indicate a filter replacement is due. Reset the filter service runtime accumulator by setting the maintenance point Reset Filter Runtime Alarm to On, back to Off, and clicking the OK button after each setting. Setting unit configuration Filter Service Alarm Timer value to 0 disables the filter service alarm function.

## Airside Linkage Alarm

This alarm indicates that RTU-OPEN was connected to a zoned system called Linkage™ and it lost communications with its linkage master or if it receives invalid data.

## Third Party Networking

Third party communication and networking troubleshooting should be done by or with assistance from the front end 3rd party technician. A Module Status Report (Modstat) can be run from the BACview6 or Virtual BACview (see Table 5 to perform). This lists information about the board status and networking state. For basic troubleshooting, see Table 6. Refer to the *RTU-OPEN 3rd Party Integration Guide* for additional information.

**Table 5 – Manufacture Date**

When troubleshooting, you may need to know a control module's manufacture date.

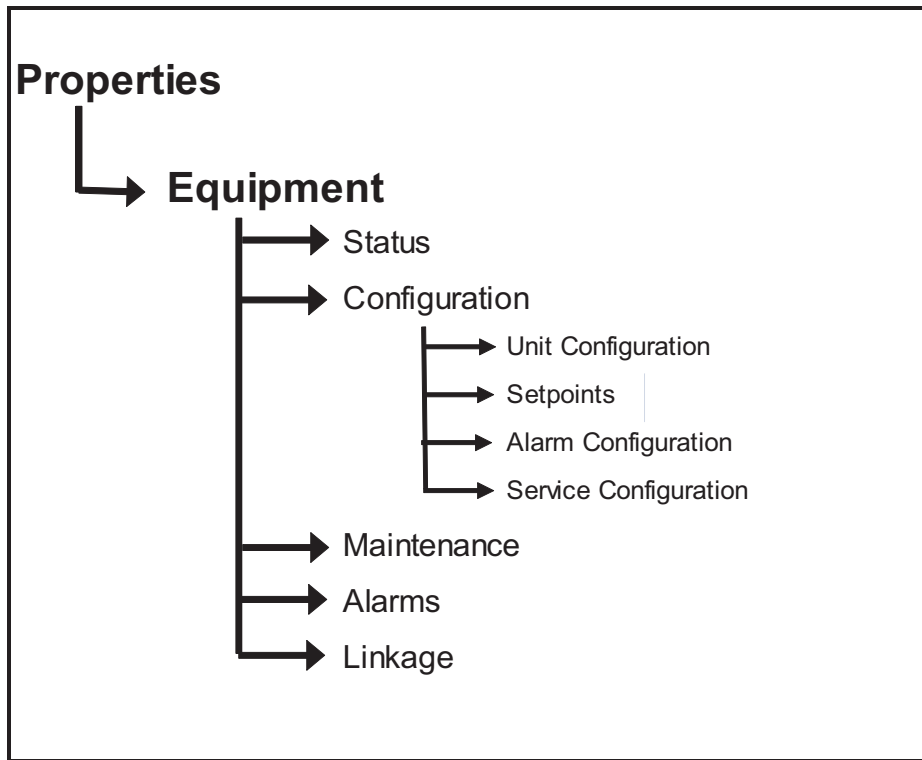
| Obtain the manufacture date from a...                                                 | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Module status report (modstat)                                                        | To obtain a modstat with BACview6:<br>1. Press Function (FN) key and hold.<br>2. Then press period (.)<br>3. Release both buttons.<br>The report shows the date under <b>Main board hardware</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Sticker on the control board<br>"Serial No: ORTYMxxxxN"<br>(Bar Coded & Typed Number) | The serial numbers are unique and contain embedded information:<br><div> <div>"ORT"</div> <div>–</div> <div>These first three digits are unique to RTU–OPEN and are used as an identifier.</div> </div> <div> <div>"YM"</div> <div>–</div> <div>These two digits identify the last digit of the year and month (in hex, A=10/Oct) of manufacture. "74" would represent a date of manufacture of "April 2007".</div> </div> <div> <div>"xxxx"</div> <div>–</div> <div>These four digits represent the sequential number of units produced for a given product for the mentioned manufacturing time period.</div> </div> <div> <div>"N"</div> <div>–</div> <div>This final digit represents the decade and toggles between "N" and "M" every ten years.</div> </div> |

**Table 6 – Basic Protocol Troubleshooting**

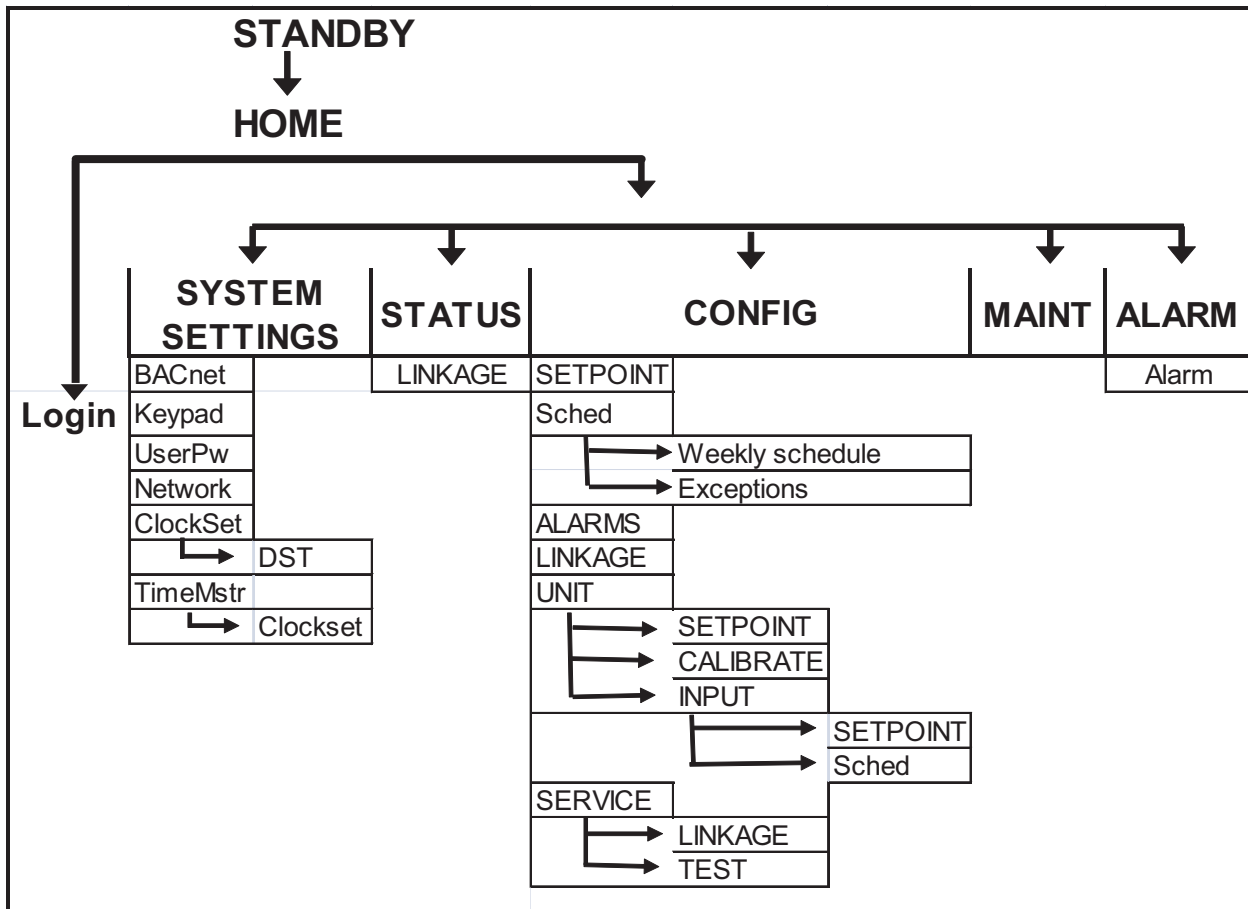
| Problem                                | Possible cause                                                                               | Corrective action                                                                            |
|----------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| No communication with 3rd party vendor | Incorrect settings on SW1, SW2 and SW3                                                       | Verify and correct switch settings. Cycle power to RTU–OPEN after changing switch settings.  |
|                                        | RS485 Port has no voltage output                                                             | Verify RTU–OPEN has correct power supply.                                                    |
|                                        | (check with RTU–OPEN disconnected from RS485 communication bus):                             | Possible bad driver on board.                                                                |
|                                        | • Bacnet @ 9600/19.2K – .01 to .045vdc                                                       | Check RS485 bus for external voltage before reconnecting to the bus.                         |
|                                        | • Bacnet @ 38.4K – .06 to .09vdc                                                             |                                                                                              |
|                                        | • Bacnet @ 76.8K – .1vdc                                                                     |                                                                                              |
|                                        | • Modbus @ 9600 – 76.8K – .124vdc                                                            |                                                                                              |
|                                        | • N2 @ 9600 – .124vdc                                                                        | Check 3rd party vendor RS485 communication wiring guidelines and troubleshooting procedures. |
|                                        | Verify devices are daisy chained and repeaters and bias terminators are correctly installed. |                                                                                              |

# APPENDIX A - USER INTERFACE MENUS

## Field Assistant Navigation



## BACview Navigation



Modstat screen only reached by (FN + .)

# APPENDIX A - USER INTERFACE MENUS (CON'T)

## Standby BACview Screen and Login Screen

| BACview MENU | POINT NAME                          | BACnet OBJECT                                                           | VALUE                                                                                                                                                 |
|--------------|-------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| STANDBY      | Operating Mode<br>Space Temperature | RTU – OPEN<br><br>run_status<br>space_temp<br>Press any key to activate | 1=Off<br>2=Fan Only<br>3=Economizer<br>4=Cooling<br>5=Heating<br>6=Dehumidification<br>7=Test<br>8=Shutdown<br>9=Unocc Free Cooling (NTFC)<br>xxx ° F |
| HOME         | Select function below               |                                                                         |                                                                                                                                                       |
| LOGIN/LOGOUT | Admin or User<br>Password           |                                                                         | user: 0000 Admin:1111                                                                                                                                 |

## System Settings Menu

| BACview MENU    | POINT NAME                                                                             | BACnet OBJECT                                                                               | RANGE                                                     | DEFAULT                                                                      |
|-----------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------------|
| HOME            | Select function below                                                                  |                                                                                             |                                                           |                                                                              |
| SYSTEM SETTINGS | SYSTEM SETTINGS                                                                        |                                                                                             |                                                           |                                                                              |
| BACnet          | BACnet Device Instance:<br>Base BACnet Device ID:<br>Autogenerate Device ID?           | xxxxxxx<br>xxxxxxx<br>Y/N                                                                   |                                                           | 1610100<br>1610100<br>Y                                                      |
| Keypad          | Inactivity Timeout:<br>BACnet Write Priority:                                          | Keypad Configuration                                                                        |                                                           |                                                                              |
|                 |                                                                                        |                                                                                             | 1 – 255 minutes<br>0 – 16                                 | 10<br>0                                                                      |
| UserPw          | View/Set User<br>Password:                                                             |                                                                                             | xxxx                                                      | 0000                                                                         |
| Network         | Max Masters<br>Max Info Frames<br>APDU Timeout (ms)<br>APDU Retries<br>MS/TP Baud Rate | this_device/64<br>this_device/63<br>this_device/11<br>this_device/73<br>this_device/4161(1) | 1 – 127<br>1 – 999<br>1 – 10000<br>1 – 10<br>9600 – 76800 | 127<br>10<br>3000<br>3<br>76800                                              |
| ClockSet        | Time (hh:mm:ss):<br>Date (dd-mm-yy):                                                   | Set Current Time/Date (24 hr clock)                                                         |                                                           |                                                                              |
| DST             | Start Time:<br>Amount:<br>Entry #<br>Beg (mm-dd-yy)<br>End (mm-dd-yy)                  | DST                                                                                         |                                                           |                                                                              |
| TimeMstr        | Time Sync Mode<br>Time Sync Interval                                                   | BACnet Time Master                                                                          |                                                           | No Broadcast<br>Local Broadcast<br>Global Broadcast<br>1 – 9999 minutes<br>5 |

# APPENDIX A - USER INTERFACE MENUS (CON'T)

## Status Menus

| BACview MENU | POINT NAME                                                                                                                                                                                                                                                        | BACnet OBJECT                                                                                                                                                                            | RANGE                                                                                                                                                                                                                                                                                   | FIELD ASSISTANT MENU |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| HOME         | Select function below                                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                         | Properties/Equipment |
| STATUS       | System Mode<br><br>Operating Mode<br><br><br>Supply Fan Status<br>Space Temperature – Prime Variable<br>Supply Air Temperature<br>Outdoor Air Temperature<br>Space Relative Humidity<br>Indoor Air CO2<br>Outdoor Air CO2<br>Economizer Output                    | STATUS<br>mode_status<br><br>run_status<br><br><br>sfan_status<br><br>space_temp<br>sa_temp<br>oa_temp<br>space_rh<br>iaq<br>oaq<br>econ_output                                          | 1=Disabled<br>2=Test<br>3=Run<br><br>1=Off<br>2=Fan Only<br>3=Economizer<br>4=Cooling<br>5=Heating<br>6=Dehumidification<br>7=Test<br>8=Shutdown<br>9=Unocc Free Cooling (NT-FC)<br>Off/Running<br><br>xxx °F<br>xxx °F<br>xxx °F<br>0–100 %<br>0–5000 ppm<br>0–5000 ppm<br>0–100 %open | Status               |
| LINKAGE      | Airside Linkage Status<br>Number of Providers<br>Occupancy Status<br>Space Temperature<br>Occupied Cooling Setpoint<br>Occupied Heating Setpoint<br>Unoccupied Cooling Setpoint<br>Unoccupied Heating Setpoint<br>Indoor Air CO2 (ppm)<br>Space Relative Humidity | AIR LINKAGE<br>a_link_status<br>link_collector/4602<br>link_occ<br>link_spt<br>link_occ_cl_stpt<br>link_occ_ht_stpt<br>link_unocc_cl_stpt<br>link_unocc_ht_stpt<br>link_iaq<br>link_sprh | Not Active/Active<br>xx<br>Unoccupied/Occupied<br>xxx °F<br>55–80 °F<br>55–80 °F<br>75–130 °F<br>55–85 °F<br>xxxx ppm<br>xxx %                                                                                                                                                          | Linkage              |

# APPENDIX A - USER INTERFACE MENUS (CON'T)

## Configuration Menus

| BACview MENU | POINT NAME                       | BACnet OBJECT        | RANGE                 | DEFAULT | FIELD ASSISTANT MENU |
|--------------|----------------------------------|----------------------|-----------------------|---------|----------------------|
| HOME         | Select function below            |                      |                       |         | Properties/Equipment |
| CONFIG       | CONFIGURATION                    |                      |                       |         | Configuration        |
| SETPOINT     | SETPOINTS                        |                      |                       |         | Setpoints            |
|              | Occupied Heating Setpoint        | occ_ht_stpt          | 40–90 °F              | 70      |                      |
|              | Occupied Cooling Setpoint        | occ_cl_stpt          | 55–99 °F              | 74      |                      |
|              | Unoccupied Heating Setpoint      | unocc_ht_stpt        | 40–90 °F              | 55      |                      |
|              | Unoccupied Cooling Setpoint      | unocc_cl_stpt        | 55–99 °F              | 90      |                      |
|              | Effective Cool Setpoint          | eff_cl_stpt          | xx °F                 |         |                      |
|              | Effective Heat Setpoint          | eff_ht_stpt          | xx °F                 |         |                      |
|              | Optimal Start                    | optm_start           | 0–4 hr                | 4       |                      |
|              | Occ Relative Humidity Setpoint   | occ_dehum_stpt       | 0–unocc set-point %rh | 60      |                      |
|              | Unocc Relative Humidity Setpoint | unocc_dehum_stpt     | 30–100 %rh            | 95      |                      |
|              | DCV Max Ctrl Setpoint            | iaq_stpt_max         | 0–9999 ppm            | 650     |                      |
|              | Power Exhaust Setpoint           | pexh_stpt            | 20–90 %Open           | 50      |                      |
| Sched        | Weekly schedule                  |                      | MON–SUN               | none    | (BACview Only)       |
|              | Exceptions                       |                      |                       | none    |                      |
| ALARMS       | ALARM CONFIGURATION              |                      |                       |         | Alarm Configuration  |
|              | SPACE TEMPERATURE ALARM          |                      |                       |         |                      |
|              | Occupied Alarm Hysteresis        | occ_spt_alarm_hyst   | 2–20 °F               | 3       |                      |
|              | Alarm Delay (min/deg)            | spt_alarm_delay      | 0–30 minutes          | 10      |                      |
|              | Unoccupied Low SPT Alarm Limit   | uno_spt_alarm_lo_lmt | 35–90 °F              | 45      |                      |
|              | Unoccupied High SPT Alarm Limit  | uno_spt_alarm_hi_lmt | 45–100 °F             | 95      |                      |
|              | SUPPLY AIR TEMPERATURE ALARM     |                      |                       |         |                      |
|              | Low SAT Alarm Limit              | sat_lo_alarm_lim     | 15–90 °F              | 35      |                      |
|              | High SAT Alarm Limit             | sat_hi_alarm_lim     | 90–175 °F             | 160     |                      |
|              | SPACE HUMIDITY ALARM             |                      |                       |         |                      |
|              | Low Space Humidity Alarm Limit   | sprh_lo_alarm_lim    | 0–99 %rh              | 30      |                      |
|              | High Space Humidity Alarm Limit  | sprh_hi_alarm_lim    | 0–99 %rh              | 70      |                      |
|              | IAQ / VENTILATION ALARM          |                      |                       |         |                      |
|              | Occ High CO2 Alarm Limit (ppm)   | iaq_occ_hi_lmt       | 0–9999 ppm            | 1200    |                      |

# APPENDIX A - USER INTERFACE MENUS (CON'T)

## Configuration Menus (con't)

| BACview MENU | POINT NAME                       | BACnet OBJECT        | RANGE                                                                        | DEFAULT         | FIELD ASSISTANT MENU |
|--------------|----------------------------------|----------------------|------------------------------------------------------------------------------|-----------------|----------------------|
| HOME         | Select function below            |                      |                                                                              |                 | Properties/Equipment |
| UNIT         | UNIT CONFIGURATION               |                      |                                                                              |                 | Unit Configuration   |
|              | Fan Mode                         | fan_mode             | 1=Auto<br>2=Continuous<br>3=Always On                                        | Continuous      |                      |
|              | Unit Start Delay                 | start_delay          | 0–30 sec                                                                     | 5               |                      |
|              | Fan Off Delay                    | fan_delay_off        | 0–180 sec                                                                    | 90              |                      |
|              | Minimum Cooling SAT              | sat_cl_min           | 45–75 ° F                                                                    | 50              |                      |
|              | Maximum Heating SAT              | sat_ht_max           | 95–150° F                                                                    | 120             |                      |
|              | Vent Dmpr Pos / DCV Min Pos      | econ_min             | 0–100<br>%Open                                                               | 20              |                      |
|              | DCV Max Vent Damper Pos          | iaq_dpr_max          | 10–60<br>%Open                                                               | 50              |                      |
|              | S Fan Service Alarm Timer        | sfan_service_hrs     | 0–9999 hr                                                                    | 0               |                      |
|              | Comp 1 Service Alarm Timer       | comp1_service_hrs    | 0–9999 hr                                                                    | 0               |                      |
|              | Comp 2 Service Alarm Timer       | comp2_service_hrs    | 0–9999 hr                                                                    | 0               |                      |
|              | Filter Service Alarm Timer       | filter_service_hrs   | 0–9999 hr                                                                    | 600             |                      |
|              | Pushbutton Override              | pb_enable            | Disable/Enable                                                               | Enable          |                      |
|              | Setpoint Adjustment              | stpt_adj_enable      | Disable/Enable                                                               | Enable          |                      |
|              | Setpoint Adjustment Range        | stpt_adj_range       | +/- 0–5<br>° F                                                               | 5               |                      |
|              | Cooling Lockout Temperature      | oat_cl_lockout       | 0–80° F                                                                      | 45              |                      |
|              | Economizer High OAT Lockout Temp | oat_ec_lockout       | 55–80° F                                                                     | 75              |                      |
|              | HP Rev Cycle Lockout Temp        | hp_rev_cycle_lockout | –20–30° F                                                                    | –3              |                      |
|              | Heating Lockout Temperature      | oat_ht_lockout       | 35–150° F                                                                    | 65              |                      |
|              | Unocc Free Cool Enable           | ntfc_ena             | Disable/Enable                                                               | Disable         |                      |
|              | Setpoint Separation              | min_stpt_sep         | 2–10 ° F                                                                     | 5               |                      |
|              | Occupancy Source                 | occ_source           | 1=Always occupied<br>2=BACnet Schedule<br>3=BAS On/Off<br>4=Remote Occ Input | Always Occupied |                      |
| CALIBRATE    | SENSOR CALIBRATION               |                      |                                                                              |                 |                      |
|              | Space Temperature                | lcl_space_temp       |                                                                              |                 |                      |
|              | Space Temp Calibration           | spt_offset           | –9.9–10° F                                                                   | 0               |                      |
|              | Supply Air Temperature           | lcl_sa_temp          |                                                                              |                 |                      |
|              | Supply Air Temp Calibration      | sat_offset           | –9.9–10° F                                                                   | 0               |                      |
|              | Outdoor Air Temperature          | lcl_oa_temp          |                                                                              |                 |                      |
|              | Outdoor Air Temp Calibration     | oat_offset           | –9.9–10° F                                                                   | 0               |                      |

# APPENDIX A - USER INTERFACE MENUS (CON'T)

## Configuration Menus (con't)

| BACview MENU | POINT NAME                   | BACnet OBJECT         | RANGE                                                                                                           | DEFAULT                 | FIELD ASSISTANT MENU |
|--------------|------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------|----------------------|
| HOME         |                              | Select function below |                                                                                                                 |                         | Properties/Equipment |
| INPUT        |                              | INPUT CONFIGURATION   |                                                                                                                 |                         |                      |
|              | Input 1 Function             | ai1_function          | 1=No Sensor<br>2=IAO Sensor<br>3=OAQ Sensor<br>4=Space RH Sensor                                                | No Sensor               |                      |
|              | Input 2 Function             | ai2_function          | 1=No Sensor<br>2=IAO Sensor<br>3=OAQ Sensor<br>4=Space RH Sensor                                                | 1 (No FIOP)<br>2 (FIOP) |                      |
|              | Input 3 Function             | di3_function          | 1=No Function<br>2=Compressor Safety<br>3=Fan Status<br>4=Filter Status<br>5=Remote Occupancy<br>6=Door Contact | Compressor Safety       |                      |
|              | Input 3 Switch Configuration | di3_type              | N/O<br>N/C                                                                                                      | N/O                     |                      |
|              | Input 5 Function             | di5_function          | 1=No Function<br>2=Fire Shutdown<br>3=Fan Status<br>4=Filter Status<br>5=Remote Occupancy<br>6=Door Contact     | Fire Shutdown           |                      |
|              | Input 5 Switch Configuration | di5_type              | N/O<br>N/C                                                                                                      | N/O                     |                      |
|              | Input 8 Function             | di8_function          | 1=No Function<br>2=Enthalpy Switch<br>3=Fan Status<br>4=Filter Status<br>5=Remote Occupancy<br>6=Door Contact   | 1 (No FIOP)<br>2 (FIOP) |                      |
|              | Input 8 Switch Configuration | di8_type              | N/O<br>N/C                                                                                                      | N/O                     |                      |
|              | Input 9 Function             | di9_function          | 1=No Function<br>2=Humidistat<br>3=Fan Status<br>4=Filter Status<br>5=Remote Occupancy<br>6=Door Contact        | Humidistat              |                      |
|              | Input 9 Switch Configuration | di9_type              | N/O<br>N/C                                                                                                      | N/O                     |                      |
|              | Space sensor type            | spt_type              | 1=T55<br>2=T56 (use for T59)<br>3=SPT Sensor                                                                    | T55                     |                      |
|              | T5x Override Duration        | ovr_dur               | 0-24 hours                                                                                                      | 1                       |                      |

Unit Configuration

# APPENDIX A - USER INTERFACE MENUS (CON'T)

## Configuration Menus (con't)

| BACview MENU           | POINT NAME                        | BACnet OBJECT     | RANGE                                            | DEFAULT                                                                                                                                                                                                                                                                | FIELD ASSISTANT MENU  |
|------------------------|-----------------------------------|-------------------|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| HOME                   | Select function below             |                   |                                                  |                                                                                                                                                                                                                                                                        | Properties/Equipment  |
| SERVICE                | SERVICE CONFIGURATION             |                   |                                                  |                                                                                                                                                                                                                                                                        | Service Configuration |
|                        | Unit Type                         | unit_type         | 1 =Heat/Cool<br>2=HP O/B Ctrl<br>3=HP Y1/W1 Ctrl | Heat/Cool (TC and HC models)<br>HP Y1/W1 Ctrl (TCQ and HCQ models)                                                                                                                                                                                                     |                       |
|                        | Compressor Stages                 | comp_stages       | One stage/ Two Stage                             | One Stage (sizes 04–07, and A08–A12)<br>Two Stages (sizes 08–30)                                                                                                                                                                                                       |                       |
|                        | Economizer Exists                 | econ_exist        | No/Yes                                           | No (No FIOP)<br>Yes (FIOP)                                                                                                                                                                                                                                             |                       |
|                        | Reversing Valve Type              | rev_vlv_type      | O output type/B output type                      | O output type                                                                                                                                                                                                                                                          |                       |
|                        | Heat Type                         | heat_type         | Electric/Gas                                     | Gas (48 Series Units)<br>Electric (50 Series Units)                                                                                                                                                                                                                    |                       |
|                        | Number of Heat Stages             | heat_stages       | 1 / 2 / 0 (no heat)                              | 0 (50 series cooling only units)<br>1 (All TCQs and HCQs, Low Nox units, single phase gas units, TC04–09 low and TC05–07 med heat 3 phase gas units)<br>2 (TC04 and 08–09 med, TC05–09 high heat 3 phase gas units, HC04–09 3 phase gas units and All 12–30 gas units) |                       |
|                        | Continuous Occupied Exhaust       | occ_exh           | No/Yes                                           | No                                                                                                                                                                                                                                                                     |                       |
|                        | Indoor CO2 Sensor Value @ Min mA  | iaq_ref_lo_ppm    | 0–9999ppm                                        | 0                                                                                                                                                                                                                                                                      |                       |
|                        | Indoor CO2 Sensor Value @ Max mA  | iaq_ref_hi_ppm    | 0–9999ppm                                        | 2000                                                                                                                                                                                                                                                                   |                       |
|                        | Outdoor CO2 Sensor Value @ Min mA | oaq_ref_lo_ppm    | 0–9999ppm                                        | 0                                                                                                                                                                                                                                                                      |                       |
|                        | Outdoor CO2 Sensor Value @ Max mA | oaq_ref_hi_ppm    | 0–9999ppm                                        | 2000                                                                                                                                                                                                                                                                   |                       |
| (Field Assistant Only) | System Space Temperature          | system_spt        |                                                  |                                                                                                                                                                                                                                                                        |                       |
|                        | System Cooling Demand Level       | cool_demand_level | 0–3                                              | 0                                                                                                                                                                                                                                                                      |                       |
|                        | System Heating Demand Level       | heat_demand_level | 0–3                                              | 0                                                                                                                                                                                                                                                                      |                       |
|                        | System Outdoor Air Temperature    | system_oat        |                                                  |                                                                                                                                                                                                                                                                        |                       |
| TEST                   | SERVICE TEST                      |                   |                                                  |                                                                                                                                                                                                                                                                        |                       |
|                        | Service Test                      | test_enable       | Disable/Enable                                   | Disable                                                                                                                                                                                                                                                                |                       |
|                        | Fan Test                          | fan_test          | Disable/Enable                                   | Disable                                                                                                                                                                                                                                                                |                       |
|                        | Compressor 1 Test                 | comp1_test        | Disable/Enable                                   | Disable                                                                                                                                                                                                                                                                |                       |
|                        | Compressor 2 Test                 | comp2_test        | Disable/Enable                                   | Disable                                                                                                                                                                                                                                                                |                       |
|                        | Heat 1 Test                       | heat1_test        | Disable/Enable                                   | Disable                                                                                                                                                                                                                                                                |                       |
|                        | Heat 2 Test                       | heat2_test        | Disable/Enable                                   | Disable                                                                                                                                                                                                                                                                |                       |
|                        | Reversing Valve Test              | rev_vlv_test      | Disable/Enable                                   | Disable                                                                                                                                                                                                                                                                |                       |
|                        | Dehumidification Test             | dehum_test        | Disable/Enable                                   | Disable                                                                                                                                                                                                                                                                |                       |
|                        | Power Exhaust Test                | pexh_test         | Disable/Enable                                   | Disable                                                                                                                                                                                                                                                                |                       |
|                        | Economizer Test                   | econ_test         | 0–100 %Open                                      | 0                                                                                                                                                                                                                                                                      |                       |
|                        | Analog Output 2 Test              | ao2_test          | 0–100 %                                          | 0                                                                                                                                                                                                                                                                      |                       |

# APPENDIX A - USER INTERFACE MENUS (CON'T)

## Maintenance Menu

| BACview MENU | POINT NAME                                                                                                                                                                                                                                                                                                           | BACnet OBJECT                                                                                                                                                                                               | RANGE                                                                                                                      | FIELD ASSISTANT MENU |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|----------------------|
| HOME         | Select function below                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                             |                                                                                                                            | Properties/Equipment |
| MAINT        | UNIT MAINTENANCE                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                             |                                                                                                                            | Maintenance          |
|              | Occupancy Status<br>Space Temp Sensor                                                                                                                                                                                                                                                                                | occ_status<br>spt_status                                                                                                                                                                                    | Occupied/Unoccupied<br>1 =Sensor Failure<br>2=SPT Sensor<br>3=T55/T56<br>4=Network<br>5=Airside Linkage<br>6=Locked Value  |                      |
|              | Setpoint Adjustment<br>System Cooling Demand Level<br>System Heating Demand Level<br>Safety Chain Feedback                                                                                                                                                                                                           | stpt_adj<br>cool_demand_level<br>heat_demand_level<br>safety_status                                                                                                                                         | x ° F<br>x<br>x<br>Off/Run Enabled<br>Run Enabled/Shut-down                                                                |                      |
|              | Fire Shutdown Status<br>Compressor Safety Status<br>Active Compressor Stages<br>Active Heat Stages<br>Enthalpy Status<br>Humidistat Input Status<br>Filter Status<br>Door Contact Status<br>Reset Supply Fan Runtime Alarm<br>Reset Comp 1 Runtime Alarm<br>Reset Comp 2 Runtime Alarm<br>Reset Filter Runtime Alarm | firedown_status<br>comp_status<br>comp_run<br>heat_run<br>enthalpy_status<br>humstat_status<br>filter_status<br>door_contact_status<br>sfan_rntm_clr<br>comp1_rntm_clr<br>comp2_rntm_clr<br>filter_rntm_clr | Normal/Trouble<br>x<br>x<br>High/Low<br>Low/High<br>Clean/Dirty<br>Off/On<br>Run/Clear<br>Run/Clear<br>Run/Clear<br>Off/On |                      |
|              | OCCUPANCY MAINTENANCE                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                             |                                                                                                                            |                      |
|              | BAS On / Off                                                                                                                                                                                                                                                                                                         | keypad_ovrde                                                                                                                                                                                                | 1=Inactive<br>2=Occupied<br>3=Unoccupied                                                                                   |                      |
|              | Schedule<br>Pushbutton Override<br>Occupancy Contact<br>Override Time Remaining                                                                                                                                                                                                                                      | schedule<br>pb_status<br>occ_contact_status<br>ovrde_time                                                                                                                                                   | Unoccupied/Occupied<br>Off/Active<br>Off/On<br>xxx min                                                                     |                      |
|              | RUNTIME                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                             |                                                                                                                            |                      |
|              | Supply Fan Runtime<br>Compressor 1 Runtime<br>Compressor 2 Runtime<br>Filter Runtime                                                                                                                                                                                                                                 | sfan_rntm<br>comp1_rntm<br>comp2_rntm<br>filter_rntm                                                                                                                                                        | xxxxx<br>xxxxx<br>xxxxx<br>xxxxx                                                                                           |                      |

# APPENDIX A - USER INTERFACE MENUS (CON'T)

## Alarm Menus

| BACview MENU | POINT NAME                             | BACnet OBJECT    | RANGE        | FIELD ASSISTANT MENU |
|--------------|----------------------------------------|------------------|--------------|----------------------|
| HOME         | Select function below                  |                  |              | Properties/Equipment |
| ALARM        | CURRENT ALARMS                         |                  |              | Alarms               |
|              | Safety Chain                           | safety_alarm     | Normal/Alarm |                      |
|              | Fire Shutdown                          | fire_alarm       | Normal/Alarm |                      |
|              | Supply Fan Failure                     | sfan_fail_alarm  | Normal/Alarm |                      |
|              | Supply Fan in Hand                     | sfan_hand_alarm  | Normal/Alarm |                      |
|              | Compressor Safety                      | comp_alarm       | Normal/Alarm |                      |
|              | Space Temp Sensor                      | spt_fail         | Normal/Alarm |                      |
|              | Supply Air Temp Sensor                 | sat_alarm        | Normal/Alarm |                      |
|              | Outdoor Air Temp Sensor Alarm          | oat_alarm        | Normal/Alarm |                      |
|              | Space Relative Humidity Sensor         | sprh_alarm       | Normal/Alarm |                      |
|              | IAQ Sensor                             | iaq_alarm        | Normal/Alarm |                      |
|              | OAQ Sensor                             | oaq_alarm        | Normal/Alarm |                      |
|              | Space Temperature                      | spt_alrm_status  | Normal/Alarm |                      |
|              | Alarming Temperature                   | spt_alrm_temp    | xxx ° F      |                      |
|              | Alarm Limit Exceeded                   | spt_alrm_lmt     | xxx ° F      |                      |
|              | High Supply Air Temperature            | sat_hi_alarm     | Normal/Alarm |                      |
|              | Low Supply Air Temperature             | sat_lo_alarm     | Normal/Alarm |                      |
|              | Setpoint Slider                        | slidepot_alarm   | Normal/Alarm |                      |
|              | Switch Configuration                   | di_cfg_alarm     | Normal/Alarm |                      |
|              | Analog Input Configuration             | ai_cfg_alarm     | Normal/Alarm |                      |
|              | High Space Relative Humidity           | sprh_hi_alarm    | Normal/Alarm |                      |
|              | Low Space Relative Humidity            | sprh_lo_alarm    | Normal/Alarm |                      |
|              | High CO2                               | co2_alarm        | Normal/Alarm |                      |
|              | Supply Fan Runtime                     | sfan_rntm_alarm  | Normal/Alarm |                      |
|              | Compressor 1 Runtime                   | comp1_rntm_alarm | Normal/Alarm |                      |
|              | Compressor 2 Runtime                   | comp2_rntm_alarm | Normal/Alarm |                      |
|              | Filter                                 | filter_alarm     | Clean/Dirty  |                      |
|              | Airside Linkage Alarm                  | air_linkage_fail | Normal/Alarm |                      |
| Alarm        | Module Event History (100 most recent) |                  |              | (BACview only)       |
|              | Active Alarms                          | Buffer           |              |                      |
|              | Active Faults                          | Buffer           |              |                      |
|              | Returned – To – Normal (RTN)           | Buffer           |              |                      |
|              | Manually Cleared (CLR)                 | Buffer           |              |                      |

## APPENDIX B - THIRD PARTY POINTS LIST (IN ALPHABETICAL ORDER)

|                                  |            | BACnet              |           | Modbus        |            | N2                 |                       | LON Works             |                 |
|----------------------------------|------------|---------------------|-----------|---------------|------------|--------------------|-----------------------|-----------------------|-----------------|
| Point Name                       | Read/Write | BACnet Point Name   | OBJECT ID | Register Type | Register # | Network Point Type | Network Point Address | SNVT Type             | SNVT Name       |
| Active Compressor Stages         | R          | comp_run            | AV:2020   | float value   | 40031      | ADF                | 10                    | SNVT_count_inc (9)    | nvo-CompStages  |
| Active Heat Stages               | R          | heat_run            | AV:2003   | float value   | 40033      | ADF                | 11                    | SNVT_count_inc (9)    | nvoHeatStages   |
| Airside Linkage Alarm            | R          | air_link-age_fail   | BV:7030   |               |            |                    |                       |                       |                 |
| Analog Input Configuration       | R          | ai_cfg_alarm        | BV:7026   |               |            |                    |                       |                       |                 |
| BAS On / Off                     | R/W        | keypad_ovrde        | MSV:1001  | un-signed int | 40133      | ADI                | 1                     | SNVT_count_inc (9)    | nviBASOnOff     |
| Compressor 1 Relay State         | R          | comp_1              | BV:2005   |               |            |                    |                       |                       |                 |
| Compressor 1 Runtime             | R          | comp1_rntm          | AV:2017   |               |            |                    |                       |                       |                 |
| Compressor 1 Runtime             | R          | comp1_rntm_alarm    | BV:7014   |               |            |                    |                       |                       |                 |
| Compressor 1 Service Alarm Timer | R/W        | comp1_service_hrs   | AV:83006  |               |            |                    |                       |                       |                 |
| Compressor 1 Test                | R/W        | comp1_test          | BV:81005  |               |            |                    |                       |                       |                 |
| Compressor 2 Relay State         | R          | comp_2              | BV:2004   |               |            |                    |                       |                       |                 |
| Compressor 2 Runtime             | R          | comp2_rntm          | AV:2018   |               |            |                    |                       |                       |                 |
| Compressor 2 Runtime             | R          | comp2_rntm_alarm    | BV:7015   |               |            |                    |                       |                       |                 |
| Compressor 2 Service Alarm Timer | R/W        | comp2_service_hrs   | AV:83007  |               |            |                    |                       |                       |                 |
| Compressor 2 Test                | R/W        | comp2_test          | BV:81004  |               |            |                    |                       |                       |                 |
| Compressor Safety                | R          | comp_alarm          | BV:7013   | discrete in   | 10030      | BI                 | 30                    | SNVT_switch (95)      | nvo-CompSafety  |
| Compressor Safety Status         | R          | comp_status         | BV:1008   |               |            |                    |                       |                       |                 |
| Continuous Occupied Exhaust      | R/W        | occ_exh             | BV:9002   |               |            |                    |                       |                       |                 |
| Cooling Lockout Temperature      | R/W        | oat_cl_lockout      | AV:9002   | float value   | 40043      | ADF                | 16                    | SNVT_temp_p (105)     | nviCoolLck-Temp |
| DCV Max Ctrl Set-point           | R/W        | iaq_stpt_max        | AV:3013   | float value   | 40045      | ADF                | 17                    | SNVT_ppm (29)         | nviD-CVMaxPPM   |
| DCV Max Vent Damper Pos          | R/W        | iaq_dpr_max         | AV:9011   | float value   | 40047      | ADF                | 18                    | SNVT_lev_percent (81) | nviDCVMax-Pos   |
| Dehumidification Relay State     | R          | dehum               | BV:2006   | discrete in   | 10009      | BI                 | 9                     | SNVT_switch (95)      | nvoDehumRelay   |
| Dehumidification Test            | R/W        | dehum_test          | BV:81006  |               |            |                    |                       |                       |                 |
| Door Contact Status              | R          | door_contact_status | BV:1010   |               |            |                    |                       |                       |                 |
| Economizer Exists                | R/W        | econ_exist          | BV:99001  |               |            |                    |                       |                       |                 |
| Economizer High OAT Lockout Temp | R/W        | oat_ec_lockout      | AV:9008   |               |            |                    |                       |                       |                 |
| Economizer Output                | R          | econ_output         | AV:2001   | float value   | 40051      | ADF                | 20                    | SNVT_lev_percent (81) | nvoEconOutput   |
| Economizer Test                  | R/W        | econ_test           | AV:81001  |               |            |                    |                       |                       |                 |
| Effective Cool Set-point         | R          | eff_cl_stpt         | AV:3005   | float value   | 40055      | ADF                | 22                    | SNVT_temp_p (105)     | nvoEffCoolSP    |
| Effective Heat Set-point         | R          | eff_ht_stpt         | AV:3006   | float value   | 40057      | ADF                | 23                    | SNVT_temp_p (105)     | nvoEffHeatSP    |
| Enthalpy (BACnet)                | R/W        | oae                 | BV:1901   |               |            |                    |                       |                       |                 |
| Enthalpy Status                  | R          | enthalpy_status     | BV:1002   |               |            |                    |                       |                       |                 |
| Factory Test                     | R/W        | fac_test_enable     | BV:91000  |               |            |                    |                       |                       |                 |
| Factory Test Analog 1 Control    | R/W        | ao1_fac_test        | AV:91001  |               |            |                    |                       |                       |                 |
| Factory Test Analog 2 Control    | R/W        | ao2_fac_test        | AV:91002  |               |            |                    |                       |                       |                 |

## APPENDIX B - THIRD PARTY POINTS LIST (CON'T)

### (IN ALPHABETICAL ORDER)

|                                  |            | BACnet               |           | Modbus        |            | N2                 |                       | LON Works            |                     |
|----------------------------------|------------|----------------------|-----------|---------------|------------|--------------------|-----------------------|----------------------|---------------------|
| Point Name                       | Read/Write | BACnet Point Name    | OBJECT ID | Register Type | Register # | Network Point Type | Network Point Address | SNVT Type            | SNVT Name           |
| Factory Test Relay 1 Control     | R/W        | re-lay1_fac_test     | BV:91001  |               |            |                    |                       |                      |                     |
| Factory Test Relay 2 Control     | R/W        | re-lay2_fac_test     | BV:91002  |               |            |                    |                       |                      |                     |
| Factory Test Relay 3 Control     | R/W        | re-lay3_fac_test     | BV:91003  |               |            |                    |                       |                      |                     |
| Factory Test Relay 4 Control     | R/W        | re-lay4_fac_test     | BV:91004  |               |            |                    |                       |                      |                     |
| Factory Test Relay 5 Control     | R/W        | re-lay5_fac_test     | BV:91005  |               |            |                    |                       |                      |                     |
| Factory Test Relay 6 Control     | R/W        | re-lay6_fac_test     | BV:91006  |               |            |                    |                       |                      |                     |
| Factory Test Relay 7 Control     | R/W        | re-lay7_fac_test     | BV:91007  |               |            |                    |                       |                      |                     |
| Factory Test Relay 8 Control     | R/W        | re-lay8_fac_test     | BV:91008  |               |            |                    |                       |                      |                     |
| Fan Off Delay                    | R/W        | fan_delay_off        | AV:9024   |               |            |                    |                       |                      |                     |
| Filter                           | R          | filter_alarm         | BV:7017   | discrete in   | 10031      | BI                 | 31                    | SNVT_switch (95)     | nvoFilter           |
| Filter Runtime                   | R          | filter_rntm          | AV:2015   |               |            |                    |                       |                      |                     |
| Filter Service Alarm Timer       | R/W        | filter_service_hrs   | AV:2019   | float value   | 40067      | ADF                | 28                    | SNVT_time_hour (124) | nviFilter-AlarmTime |
| Filter Status                    | R          | filter_status        | BV:1004   |               |            |                    |                       |                      |                     |
| Fire Shutdown                    | R          | fire_alarm           | BV:7007   | discrete in   | 10032      | BI                 | 32                    | SNVT_switch (95)     | nvoFireShutdown     |
| Fire Shutdown Status             | R          | fire-down_status     | BV:1005   |               |            |                    |                       |                      |                     |
| Heat Stage 1 Relay State         | R          | heat_1               | BV:2003   |               |            |                    |                       |                      |                     |
| Heat Stage 2 Relay State         | R          | heat_2               | BV:2002   |               |            |                    |                       |                      |                     |
| Heating Lockout Temperature      | R/W        | oat_ht_lock-out      | AV:9003   | float value   | 40069      | ADF                | 29                    | SNVT_temp_p (105)    | nviHeatLck-Temp     |
| High CO2                         | R          | co2_alarm            | BV:7016   | discrete in   | 10033      | BI                 | 33                    | SNVT_switch (95)     | nvoHiCO2Alm         |
| High Space Relative Humidity     | R          | sprh_hi_alarm        | BV:7018   | discrete in   | 10034      | BI                 | 34                    | SNVT_switch (95)     | nvoHiS-PRHAlm       |
| High Space Temp Alarm            | R          | spt_hi_alarm         | BV:7011   | discrete in   | 10035      | BI                 | 35                    | SNVT_switch (95)     | nvoHiS-paceTemp     |
| High Supply Air Temperature      | R          | sat_hi_alarm         | BV:7020   | discrete in   | 10036      | BI                 | 36                    | SNVT_switch (95)     | nvoHiSATAIm         |
| HP Rev Cycle Lock-out Temp       | R/W        | hp_rev_cycle_lockout | AV:9004   | float value   | 40071      | ADF                | 30                    | SNVT_temp_p (105)    | nviPRevClick-Temp   |
| Humidistat Input Status          | R          | hum-stat_status      | BV:1006   |               |            |                    |                       |                      |                     |
| IAQ Sensor                       | R          | iaq_alarm            | BV:7005   | discrete in   | 10037      | BI                 | 37                    | SNVT_switch (95)     | nvoIAQSensor        |
| Indoor Air CO2                   | R          | iaq                  | AV:1009   | float value   | 40073      | ADF                | 31                    | SNVT_ppm (29)        | nvoIAQ              |
| Indoor CO2 Sensor Value @ Max mA | R/W        | iaq_ref_hi_ppm       | AV:9010   |               |            |                    |                       |                      |                     |
| Indoor CO2 Sensor Value @ Min mA | R/W        | iaq_ref_lo_ppm       | AV:9009   |               |            |                    |                       |                      |                     |

## APPENDIX B - THIRD PARTY POINTS LIST (CON'T) (IN ALPHABETICAL ORDER)

|                                   |            | BACnet             |           | Modbus        |            | N2                 |                       | LON Works             |                   |
|-----------------------------------|------------|--------------------|-----------|---------------|------------|--------------------|-----------------------|-----------------------|-------------------|
| Point Name                        | Read/Write | BACnet Point Name  | OBJECT ID | Register Type | Register # | Network Point Type | Network Point Address | SNVT Type             | SNVT Name         |
| Input 1 Function                  | R/W        | ai1_function       | MSV:81001 |               |            |                    |                       |                       |                   |
| Input 2 Function                  | R/W        | ai2_function       | MSV:81002 |               |            |                    |                       |                       |                   |
| Input 3 Function                  | R/W        | di3_function       | MSV:81003 |               |            |                    |                       |                       |                   |
| Input 3 Switch Configuration      | R/W        | di3_type           | MSV:81013 |               |            |                    |                       |                       |                   |
| Input 5 Function                  | R/W        | di5_function       | MSV:81005 |               |            |                    |                       |                       |                   |
| Input 5 Switch Configuration      | R/W        | di5_type           | MSV:81015 |               |            |                    |                       |                       |                   |
| Input 8 Function                  | R/W        | di8_function       | MSV:81008 |               |            |                    |                       |                       |                   |
| Input 8 Switch Configuration      | R/W        | di8_type           | MSV:81018 |               |            |                    |                       |                       |                   |
| Input 9 Function                  | R/W        | di9_function       | MSV:81009 |               |            |                    |                       |                       |                   |
| Input 9 Switch Configuration      | R/W        | di9_type           | MSV:81019 |               |            |                    |                       |                       |                   |
| input_1                           | R          | ai_1               | AI:1001   |               |            |                    |                       |                       |                   |
| input_10                          | R          | ai_10              | AI:1010   |               |            |                    |                       |                       |                   |
| input_11                          | R          | ai_11              | AI:1011   |               |            |                    |                       |                       |                   |
| input_2                           | R          | ai_2               | AI:1002   |               |            |                    |                       |                       |                   |
| input_3                           | R          | di_3               | BI:1003   |               |            |                    |                       |                       |                   |
| input_4                           | R          | di_4               | BI:1004   |               |            |                    |                       |                       |                   |
| input_5                           | R          | di_5               | BI:1005   |               |            |                    |                       |                       |                   |
| input_7                           | R          | ai_7               | AI:1007   |               |            |                    |                       |                       |                   |
| input_8                           | R          | di_8               | BI:1008   |               |            |                    |                       |                       |                   |
| input_9                           | R          | di_9               | BI:1009   |               |            |                    |                       |                       |                   |
| Low Space Relative Humidity       | R          | sprh_lo_alarm      | BV:7019   | discrete in   | 10038      | BI                 | 38                    | SNVT_switch (95)      | nvoLoS-PRHAlm     |
| Low Space Temp Alarm              | R          | spt_lo_alarm       | BV:7012   | discrete in   | 10039      | BI                 | 39                    | SNVT_switch (95)      | nvo-LoSpaceTemp   |
| Low Supply Air Temperature        | R          | sat_lo_alarm       | BV:7021   | discrete in   | 10040      | BI                 | 40                    | SNVT_switch (95)      | nvoLoSATAIm       |
| Maximum Heating SAT               | R/W        | sat_ht_max         | AV:83004  |               |            |                    |                       |                       |                   |
| Min Setpoint Separation           | R/W        | min_stpt_sep       | AV:63     |               |            |                    |                       |                       |                   |
| Minimum Cooling SAT               | R/W        | sat_cl_min         | AV:83003  |               |            |                    |                       |                       |                   |
| OAQ Sensor                        | R          | oaq_alarm          | BV:7006   | discrete in   | 10041      | BI                 | 41                    | SNVT_switch (95)      | nvoOAQSens or     |
| Occ Relative Humidity Setpoint    | R/W        | occ_dehum_stpt     | AV:3011   | float value   | 40083      | ADF                | 36                    | SNVT_lev_percent (81) | nviOccRHSP        |
| Occupancy Contact                 | R          | occ_contact_status | BV:1007   |               |            |                    |                       |                       |                   |
| Occupancy Source                  | R/W        | occ_source         | MSV:1002  |               |            |                    |                       |                       |                   |
| Occupancy Status                  | R          | occ_status         | BV:2008   | discrete in   | 10018      | BI                 | 18                    | SNVT_switch (95)      | nvoOccStatus      |
| Operating Mode                    | R          | run_status         | MSV:2002  | unsigned int  | 30001      | ADI                | 13                    | SNVT_count_inc (9)    | nvoOperating-Mode |
| Optimal Start                     | R/W        | optm_start         | AV:9026   | float value   | 40147      | ADF                | 61                    | SNVT_time_hour (124)  | nviOptimal-Start  |
| Outdoor Air CO2                   | R          | oaq                | AV:1010   | float value   | 40085      | ADF                | 37                    | SNVT_ppm (29)         | nvoOAQ            |
| Outdoor Air Temp Sensor Alarm     | R          | oat_alarm          | BV:7003   |               |            |                    |                       |                       |                   |
| Outdoor Air Temperature           | R          | oa_temp            | AV:1003   | float value   | 40087      | ADF                | 38                    | SNVT_temp_p (105)     | nvoOAT            |
| Outdoor CO2 Sensor Value @ Max mA | R/W        | oaq_ref_hi_ppm     | AV:9014   |               |            |                    |                       |                       |                   |
| Outdoor CO2 Sensor Value @ Min mA | R/W        | oaq_ref_lo_ppm     | AV:9013   |               |            |                    |                       |                       |                   |

## APPENDIX B - THIRD PARTY POINTS LIST (CON'T)

### (IN ALPHABETICAL ORDER)

|                                        |            | BACnet                  |           | Modbus        |            | N2                 |                       | LON Works             |                   |
|----------------------------------------|------------|-------------------------|-----------|---------------|------------|--------------------|-----------------------|-----------------------|-------------------|
| Point Name                             | Read/Write | BACnet Point Name       | OBJECT ID | Register Type | Register # | Network Point Type | Network Point Address | SNVT Type             | SNVT Name         |
| Override Time Remaining                | R          | ovrde_time              | AV:2016   | float value   | 40093      | ADF                | 41                    | SNVT_time_min (123)   | nvoOvrTimeRemain  |
| Password Protected Output Variable     | R/W        | ppo                     | AV:90000  |               |            |                    |                       |                       |                   |
| Power Exhaust Relay State              | R          | pexh                    | BV:2010   |               |            |                    |                       |                       |                   |
| Power Exhaust Setpoint                 | R/W        | pexh_stpt               | AV:3010   | float value   | 40097      | ADF                | 43                    | SNVT_lev_percent (81) | nviPwrExhSp       |
| Power Exhaust Test                     | R/W        | pexh_test               | BV:81008  |               |            |                    |                       |                       |                   |
| Pushbutton Override                    | R          | pb_status               | BV:31     |               |            |                    |                       |                       |                   |
| Reset Comp 1 Runtime Alarm             | R/W        | comp1_rntm_clr          | BV:7514   |               |            |                    |                       |                       |                   |
| Reset Comp 2 Runtime Alarm             | R/W        | comp2_rntm_clr          | BV:7515   |               |            |                    |                       |                       |                   |
| Reset Filter Runtime Alarm             | R/W        | filter_rntm_clr         | BV:7517   | discrete out  | 22         | BO                 | 22                    | SNVT_switch (95)      | nvoSafety-Chain   |
| Reset Supply Fan Runtime Alarm         | R/W        | sfan_rntm_clr           | BV:7510   |               |            |                    |                       |                       |                   |
| Safety Chain                           | R          | safety_alarm            | BV:7024   |               |            |                    |                       |                       |                   |
| Safety Chain Feedback                  | R          | safety_status           | BV:1009   |               |            |                    |                       |                       |                   |
| Schedule                               | R/W        | schedule                | BV:8000   |               |            |                    |                       |                       |                   |
| Service Test                           | R/W        | test_enable             | BV:81000  |               |            |                    |                       |                       |                   |
| Setpoint / Cooling Occupied Setpoint   | R/W        | occ_cl_stpt             | AV:3001   | float value   | 40009      | ADF                | 4                     | SNVT_temp_p (105)     | nviOccCoolSP      |
| Setpoint / Cooling Setpoint Adjust     | R/W        | cl_stpt_adj             | AV:2      |               |            |                    |                       |                       |                   |
| Setpoint / Cooling Unoccupied Setpoint | R/W        | unocc_cl_stpt           | AV:3003   | float value   | 40015      | ADF                | 7                     | SNVT_temp_p (105)     | nviUnoccCoolSP    |
| Setpoint / Effective Cooling Setpoint  | R/W        | eff_cl_stpt             | AV:4      |               |            |                    |                       |                       |                   |
| Setpoint / Effective Heating Setpoint  | R/W        | eff_ht_stpt             | AV:5      |               |            |                    |                       |                       |                   |
| Setpoint / Heating Occupied Setpoint   | R/W        | occ_ht_stpt             | AV:3002   | float value   | 40019      | ADF                | 9                     | SNVT_temp_p (105)     | nviOccHeatSP      |
| Setpoint / Heating Setpoint Adjust     | R/W        | ht_stpt_adj             | AV:3      |               |            |                    |                       |                       |                   |
| Setpoint / Heating Unoccupied Setpoint | R/W        | unocc_ht_stpt           | AV:3004   | float value   | 40017      | ADF                | 8                     | SNVT_temp_p (105)     | nviUnoccHeatSP    |
| Setpoint Adjust                        | R/W        | stpt_adj_enable         | BV:1013   | discrete out  | 26         | BO                 | 26                    | SNVT_switch (95)      | nviSPAdjEnable    |
| Setpoint Adjustment                    | R          | stpt_adj                | AV:1006   | float value   | 40099      | ADF                | 44                    | SNVT_temp_p (105)     | nvoSPAdjust       |
| Setpoint Adjustment Range              | R/W        | stpt_adj_range          | AV:9015   | float value   | 40101      | ADF                | 45                    | SNVT_temp_p (105)     | nviSPAdjRange     |
| Setpoint Slider                        | R          | slidepot_alarm          | BV:7002   |               |            |                    |                       |                       |                   |
| Shutdown                               | R/W        | shutdown                | BV:9001   |               |            |                    |                       |                       |                   |
| Space Relative Humidity                | R          | space_rh                | AV:1011   | float value   | 40103      | ADF                | 46                    | SNVT_lev_percent (81) | nvoSpaceRH        |
| Space Relative Humidity Sensor         | R          | sprh_alarm              | BV:7022   | discrete in   | 10045      | BI                 | 45                    | SNVT_switch (95)      | nvoSpaceRH-Sensor |
| Space sensor type                      | R/W        | spt_type                | MSV:9001  |               |            |                    |                       |                       |                   |
| Space Temp / Override Time Remaining   | R/W        | override_time_remaining | AV:1      |               |            |                    |                       |                       |                   |
| Space Temp / Zone Temp                 | R          | zone_temp               | AI:1      |               |            |                    |                       |                       |                   |
| Space Temp Sensor                      | R          | spt_fail                | BV:7001   | discrete in   | 10046      | BI                 | 46                    | SNVT_switch (95)      | nvoSPTemp-Sensor  |
| Space Temp Sensor                      | R          | spt_status              | MSV:2003  |               |            |                    |                       |                       |                   |
| Space Temperature                      | R          | spt_alarm_statuses      | BV:37     |               |            |                    |                       |                       |                   |
| Space Temperature – Prime Variable     | R          | space_temp              | AV:2007   | float value   | 40107      | ADF                | 48                    | SNVT_temp_p (105)     | nvoSpaceTemp      |
| Space Temperature Offset Pot           | R          | stpt_adj_offset         | AV:91006  |               |            |                    |                       |                       |                   |

## APPENDIX B - THIRD PARTY POINTS LIST (CON'T) (IN ALPHABETICAL ORDER)

|                                  |            | BACnet            |           | Modbus        |            | N2                 |                       | LON Works             |                  |
|----------------------------------|------------|-------------------|-----------|---------------|------------|--------------------|-----------------------|-----------------------|------------------|
| Point Name                       | Read/Write | BACnet Point Name | OBJECT ID | Register Type | Register # | Network Point Type | Network Point Address | SNVT Type             | SNVT Name        |
| Supply Air Temp Sensor           | R          | sat_alarm         | BV:7004   | discrete in   | 10047      | BI                 | 47                    | SNVT_switch (95)      | nvoSAT-Sensor    |
| Supply Air Temperature           | R          | sa_temp           | AV:1008   | float value   | 40109      | ADF                | 49                    | SNVT_temp_p (105)     | nvoSAT           |
| Supply Fan Failure               | R          | sfan_fail_alarm   | BV:7008   |               |            |                    |                       |                       |                  |
| Supply Fan in Hand               | R          | sfan_hand_alarm   | BV:7009   |               |            |                    |                       |                       |                  |
| Supply Fan Relay State           | R          | sfan              | BV:2001   | discrete in   | 10023      | BI                 | 23                    | SNVT_switch (95)      | nvoSFRelay       |
| Supply Fan Runtime               | R          | sfan_rntm         | AV:2014   |               |            |                    |                       |                       |                  |
| Supply Fan Runtime               | R          | sfan_rntm_alarm   | BV:7010   |               |            |                    |                       |                       |                  |
| Supply Fan Service Alarm Timer   | R/W        | sfan_service_hrs  | AV:83005  |               |            |                    |                       |                       |                  |
| Supply Fan Status                | R          | sfan_status       | BV:1003   | discrete in   | 10024      | BI                 | 24                    | SNVT_switch (95)      | nvoFanStatus     |
| Switch Configuration             | R          | di_cfg_alarm      | BV:7025   |               |            |                    |                       |                       |                  |
| System Cooling Demand Level      | R          | cool_demand_level | AV:9006   |               |            |                    |                       |                       |                  |
| System Heating Demand Level      | R          | heat_demand_level | AV:9036   |               |            |                    |                       |                       |                  |
| System is shut down              | R          | shut-down_status  | BV:2011   |               |            |                    |                       |                       |                  |
| System Mode                      | R          | mode_status       | MSV:2001  |               |            |                    |                       |                       |                  |
| System OAT Master                | R          | mstr_oa_temp      | AV:80001  |               |            |                    |                       |                       |                  |
| System Outdoor Air Temperature   | R/W        | system_oat        | AV:1901   | float value   | 40119      | ADF                | 54                    | SNVT_temp_p (105)     | nviSysOAT        |
| System Space Temperature         | R/W        | system_spt        | AV:1902   | float value   | 40123      | ADF                | 56                    | SNVT_temp_p (105)     | nviSysSpaceTemp  |
| T5x Override Duration            | R/W        | ovr_dur           | AV:9023   |               |            |                    |                       |                       |                  |
| Unit Start Delay                 | R/W        | start_delay       | AV:9007   | float value   | 40127      | ADF                | 58                    | SNVT_time_sec (107)   | nviUnit-StartDly |
| Unit Type                        | R/W        | unit_type         | MSV:9018  |               |            |                    |                       |                       |                  |
| Unocc Free Cool Enable           | R/W        | ntfc_ena          | BV:80001  |               |            |                    |                       |                       |                  |
| Unocc Relative Humidity Setpoint | R/W        | unocc_dehum_stpt  | AV:3012   | float value   | 40129      | ADF                | 59                    | SNVT_lev_percent (81) | nviUnoccRHSP     |
| Vent Dmpr Pos / DCV Min Pos      | R/W        | econ_min          | AV:9005   | float value   | 40131      | ADF                | 60                    | SNVT_lev_percent (81) | nviDCVMin-Pos    |

# RTU-OPEN START-UP SHEET

|                            |                  |
|----------------------------|------------------|
| RTU Model Number:          | Date:            |
| RTU Serial Number:         | Performed by:    |
| RTU-OPEN Software Version: | Company:         |
| Protocol and Baud Rate:    | Network Address: |

## CONFIGURATION POINTS

| BACview<br>MENU | POINT NAME                       | BACnet<br>OBJECT     | RANGE                   | DEFAULT | ENTRY |
|-----------------|----------------------------------|----------------------|-------------------------|---------|-------|
| HOME            | Select function below            |                      |                         |         |       |
| CONFIG          | CONFIGURATION                    |                      |                         |         |       |
| SET-<br>POINT   | SETPOINTS                        |                      |                         |         |       |
|                 | Occupied Heating Setpoint        | occ_ht_stpt          | 40–90 ° F               | 70      |       |
|                 | Occupied Cooling Setpoint        | occ_cl_stpt          | 55–99 ° F               | 74      |       |
|                 | Unoccupied Heating Setpoint      | unocc_ht_stpt        | 40–90 ° F               | 55      |       |
|                 | Unoccupied Cooling Setpoint      | unocc_cl_stpt        | 55–99 ° F               | 90      |       |
|                 | Effective Cool Setpoint          | eff_cl_stpt          | xx ° F                  |         |       |
|                 | Effective Heat Setpoint          | eff_ht_stpt          | xx ° F                  |         |       |
|                 | Optimal Start                    | optm_start           | 0–4 hr                  | 4       |       |
|                 | Occ Relative Humidity Setpoint   | occ_dehum_stpt       | 0–unocc setpoint<br>%rh | 60      |       |
|                 | Unocc Relative Humidity Setpoint | unocc_dehum_stpt     | 30–100 %rh              | 95      |       |
|                 | DCV Max Ctrl Setpoint            | iaq_stpt_max         | 0–9999 ppm              | 650     |       |
|                 | Power Exhaust Setpoint           | pexh_stpt            | 20–90 %Open             | 50      |       |
| ALARMS          | ALARM CONFIGURATION              |                      |                         |         |       |
|                 | SPACE TEMPERATURE ALARM          |                      |                         |         |       |
|                 | Occupied Alarm Hysteresis        | occ_spt_alarm_hyst   | 2–20° F                 | 3       |       |
|                 | Alarm Delay (min/deg)            | spt_alarm_delay      | 0–30 minutes            | 10      |       |
|                 | Unoccupied Low SPT Alarm Limit   | uno_spt_alarm_lo_lmt | 35–90 ° F               | 45      |       |
|                 | Unoccupied High SPT Alarm Limit  | uno_spt_alarm_hi_lmt | 45–100 ° F              | 95      |       |
|                 | SUPPLY AIR TEMPERATURE ALARM     |                      |                         |         |       |
|                 | Low SAT Alarm Limit              | sat_lo_alarm_lim     | 15–90 ° F               | 35      |       |
|                 | High SAT Alarm Limit             | sat_hi_alarm_lim     | 90–175 ° F              | 160     |       |
|                 | SPACE HUMIDITY ALARM             |                      |                         |         |       |
|                 | Low Space Humidity Alarm Limit   | sprh_lo_alarm_lim    | 0–99 %rh                | 30      |       |
|                 | High Space Humidity Alarm Limit  | sprh_hi_alarm_lim    | 0–99 %rh                | 70      |       |
|                 | IAQ / VENTILATION ALARM          |                      |                         |         |       |
|                 | Occ High CO2 Alarm Limit (ppm)   | iaq_occ_hi_lmt       | 0–9999 ppm              | 1200    |       |

## CONFIGURATION POINTS (CON'T)

| BACview<br>MENU | POINT NAME                       | BACnet<br>OBJECT          | RANGE                                                                                  | DEFAULT         | ENTRY |
|-----------------|----------------------------------|---------------------------|----------------------------------------------------------------------------------------|-----------------|-------|
| HOME            | Select function below            |                           |                                                                                        |                 |       |
| CONFIG          | CONFIGURATION                    |                           |                                                                                        |                 |       |
| UNIT            | UNIT CONFIGURATION               |                           |                                                                                        |                 |       |
|                 | Fan Mode                         | fan_mode                  | 1=Auto<br>2=Continuous<br>3=Always On                                                  | Continuous      |       |
|                 | Unit Start Delay                 | start_delay               | 0–30 sec                                                                               | 5               |       |
|                 | Fan Off Delay                    | fan_delay_off             | 0–180 sec                                                                              | 90              |       |
|                 | Minimum Cooling SAT              | sat_cl_min                | 45–75 °F                                                                               | 50              |       |
|                 | Maximum Heating SAT              | sat_ht_max                | 95–150° F                                                                              | 120             |       |
|                 | Vent Dmpr Pos / DCV Min Pos      | econ_min                  | 0–100 %Open                                                                            | 20              |       |
|                 | DCV Max Vent Damper Pos          | iaq_dpr_max               | 10–60 %Open                                                                            | 50              |       |
|                 | S Fan Service Alarm Timer        | sfan_service_hrs          | 0–9999 hr                                                                              | 0               |       |
|                 | Comp 1 Service Alarm Timer       | comp1_ser-<br>vice_hrs    | 0–9999 hr                                                                              | 0               |       |
|                 | Comp 2 Service Alarm Timer       | comp2_ser-<br>vice_hrs    | 0–9999 hr                                                                              | 0               |       |
|                 | Filter Service Alarm Timer       | filter_service_hrs        | 0–9999 hr                                                                              | 600             |       |
|                 | Pushbutton Override              | pb_enable                 | Disable/Enable                                                                         | Enable          |       |
|                 | Setpoint Adjustment              | stpt_adj_enable           | Disable/Enable                                                                         | Enable          |       |
|                 | Setpoint Adjustment Range        | stpt_adj_range            | +/- 0–5 °F                                                                             | 5               |       |
|                 | Cooling Lockout Temperature      | oat_cl_lockout            | 0–80° F                                                                                | 45              |       |
|                 | Economizer High OAT Lockout Temp | oat_ec_lockout            | 55–80° F                                                                               | 75              |       |
|                 | HP Rev Cycle Lockout Temp        | hp_rev_cycle_lock-<br>out | –20–30° F                                                                              | –3              |       |
|                 | Heating Lockout Temperature      | oat_ht_lockout            | 35–150° F                                                                              | 65              |       |
|                 | Unocc Free Cool Enable           | ntfc_ena                  | Disable/Enable                                                                         | Disable         |       |
|                 | Setpoint Separation              | min_stpt_sep              | 2–10 °F                                                                                | 5               |       |
|                 | Occupancy Source                 | occ_source                | 1=Always occupied<br>2=BACnet Sched-<br>ule<br>3=BAS On/Off<br>4=Remote Occ In-<br>put | Always Occupied |       |
| CAL-<br>IBRATE  | SENSOR CALIBRATION               |                           |                                                                                        |                 |       |
|                 | Space Temp Calibration           | spt_offset                | –9.9–10° F                                                                             | 0               |       |
|                 | Supply Air Temp Calibration      | sat_offset                | –9.9–10° F                                                                             | 0               |       |
|                 | Outdoor Air Temp Calibration     | oat_offset                | –9.9–10° F                                                                             | 0               |       |

## CONFIGURATION POINTS (CON'T)

| BACview<br>MENU | POINT NAME                   | BACnet<br>OBJECT | RANGE                                                                                                                | DEFAULT                 | ENTRY |
|-----------------|------------------------------|------------------|----------------------------------------------------------------------------------------------------------------------|-------------------------|-------|
| HOME            | Select function below        |                  |                                                                                                                      |                         |       |
| CONFIG          | CONFIGURATION                |                  |                                                                                                                      |                         |       |
| INPUT           | INPUT CONFIGURATION          |                  |                                                                                                                      |                         |       |
|                 | Input 1 Function             | ai1_function     | 1=No Sensor<br>2=IAO Sensor<br>3=OAQ Sensor<br>4=Space RH Sensor                                                     | No Sensor               |       |
|                 | Input 2 Function             | ai2_function     | 1=No Sensor<br>2=IAO Sensor<br>3=OAQ Sensor<br>4=Space RH Sensor                                                     | 1 (No FIOP)<br>2 (FIOP) |       |
|                 | Input 3 Function             | di3_function     | 1=No Function<br>2=Compressor Safety<br>3=Fan Status<br>4=Filter Status<br>5=Remote Occu-<br>pancy<br>6=Door Contact | Compressor Safety       |       |
|                 | Input 3 Switch Configuration | di3_type         | N/O<br>N/C                                                                                                           | N/O                     |       |
|                 | Input 5 Function             | di5_function     | 1=No Function<br>2=Fire Shutdown<br>3=Fan Status<br>4=Filter Status<br>5=Remote Occu-<br>pancy<br>6=Door Contact     | Fire Shutdown           |       |
|                 | Input 5 Switch Configuration | di5_type         | N/O<br>N/C                                                                                                           | N/O                     |       |
|                 | Input 8 Function             | di8_function     | 1=No Function<br>2=Enthalpy Switch<br>3=Fan Status<br>4=Filter Status<br>5=Remote Occu-<br>pancy<br>6=Door Contact   | 1 (No FIOP)<br>2 (FIOP) |       |
|                 | Input 8 Switch Configuration | di8_type         | N/O<br>N/C                                                                                                           | N/O                     |       |
|                 | Input 9 Function             | di9_function     | 1=No Function<br>2=Humidistat<br>3=Fan Status<br>4=Filter Status<br>5=Remote Occu-<br>pancy<br>6=Door Contact        | Humidistat              |       |
|                 | Input 9 Switch Configuration | di9_type         | N/O<br>N/C                                                                                                           | N/O                     |       |
|                 | Space sensor type            | spt_type         | 1=T55<br>2=T56 (use for T59)<br>3=SPT Sensor                                                                         | T55                     |       |
|                 | T5x Override Duration        | ovr_dur          | 0-24 hours                                                                                                           | 1                       |       |

## CONFIGURATION POINTS (CON'T)

| BACview<br>MENU | POINT NAME                        | BACnet<br>OBJECT | RANGE                                            | DEFAULT                                                                                                                                                                                                                                                                | ENTRY |
|-----------------|-----------------------------------|------------------|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| HOME            | Select function below             |                  |                                                  |                                                                                                                                                                                                                                                                        |       |
| CONFIG          | CONFIGURATION                     |                  |                                                  |                                                                                                                                                                                                                                                                        |       |
| SERVICE         | SERVICE CONFIGURATION             |                  |                                                  |                                                                                                                                                                                                                                                                        |       |
|                 | Unit Type                         | unit_type        | 1 =Heat/Cool<br>2=HP O/B Ctrl<br>3=HP Y1/W1 Ctrl | Heat/Cool (TC and HC models)<br>HP Y1/W1 Ctrl (TCQ and HCQ models)                                                                                                                                                                                                     |       |
|                 | Compressor Stages                 | comp_stages      | One stage/ Two Stage                             | One Stage (sizes 04–07, and A08–A12)<br>Two Stages (sizes 08–30)                                                                                                                                                                                                       |       |
|                 | Economizer Exists                 | econ_exist       | No/Yes                                           | No (No FIOP)<br>Yes (FIOP)                                                                                                                                                                                                                                             |       |
|                 | Reversing Valve Type              | rev_vlv_type     | O output type/B output type                      | O output type                                                                                                                                                                                                                                                          |       |
|                 | Heat Type                         | heat_type        | Electric/Gas                                     | Gas (48 Series Units)<br>Electric (50 Series Units)                                                                                                                                                                                                                    |       |
|                 | Number of Heat Stages             | heat_stages      | 1 / 2 / 0 (no heat)                              | 0 (50 series cooling only units)<br>1 (All TCQs and HCQs, Low Nox units, single phase gas units, TC04–09 low and TC05–07 med heat 3 phase gas units)<br>2 (TC04 and 08–09 med, TC05–09 high heat 3 phase gas units, HC04–09 3 phase gas units and All 12–30 gas units) |       |
|                 | Continuous Occupied Exhaust       | occ_exh          | No/Yes                                           | No                                                                                                                                                                                                                                                                     |       |
|                 | Indoor CO2 Sensor Value @ Min mA  | iaq_ref_lo_ppm   | 0–9999ppm                                        | 0                                                                                                                                                                                                                                                                      |       |
|                 | Indoor CO2 Sensor Value @ Max mA  | iaq_ref_hi_ppm   | 0–9999ppm                                        | 2000                                                                                                                                                                                                                                                                   |       |
|                 | Outdoor CO2 Sensor Value @ Min mA | oaq_ref_lo_ppm   | 0–9999ppm                                        | 0                                                                                                                                                                                                                                                                      |       |
|                 | Outdoor CO2 Sensor Value @ Max mA | oaq_ref_hi_ppm   | 0–9999ppm                                        | 2000                                                                                                                                                                                                                                                                   |       |