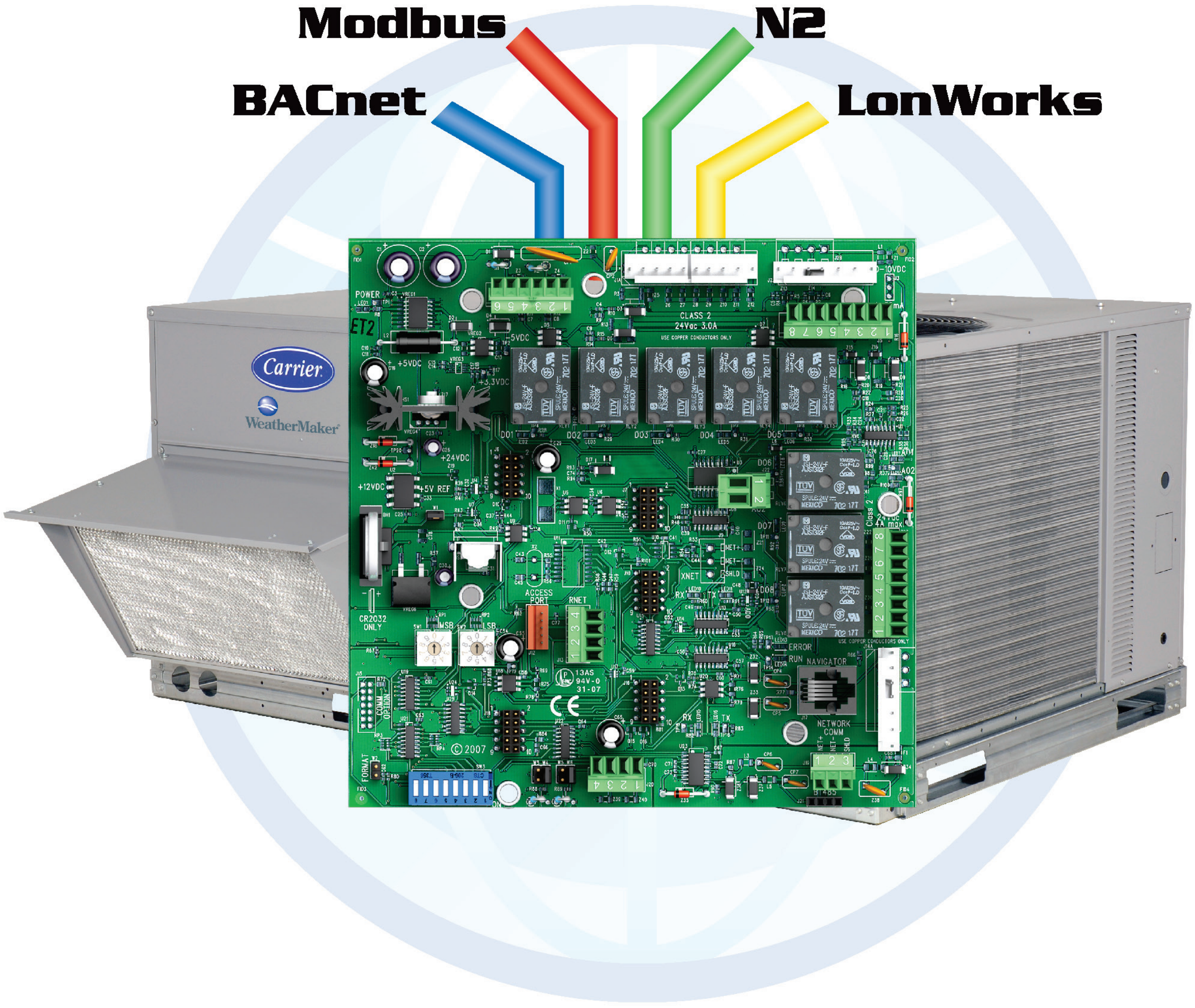
RTU Open v5

Integration Guide



Verify that you have the most current version of this document from **www.hvacpartners.com** or your local Carrier office.

Important changes are listed in **Document revision history** at the end of this document.

Contents

Introduction

What is the RTU Open controller?

The RTU Open controller (part# OPN-RTUM2) is available as an integrated component of a Carrier rooftop unit, or as a field-installed retrofit product.

NOTE The RTU Open controller is available in both English or Metric units. The metric version has (-M) appended to the part number. Everything in this document applies to both versions.

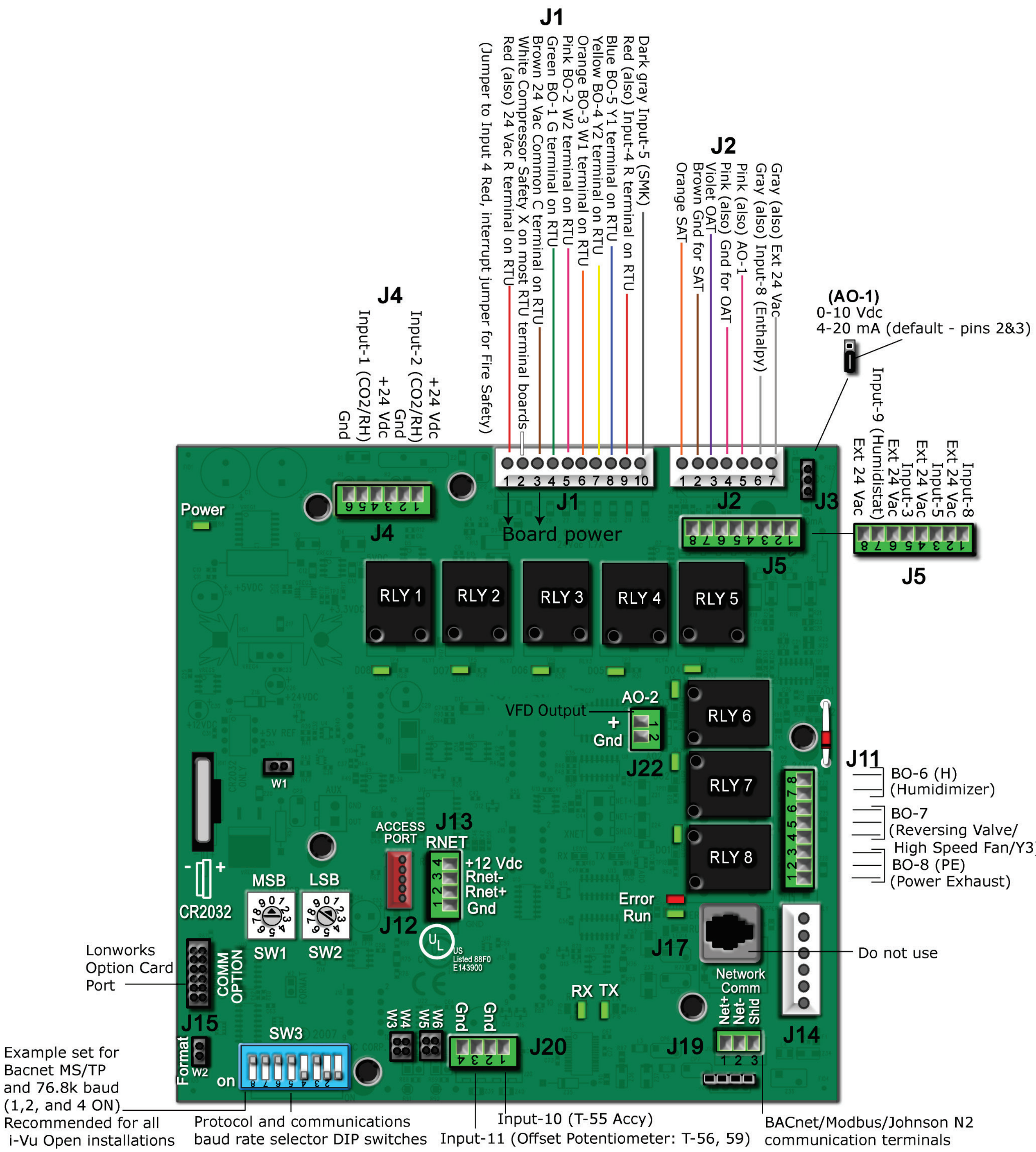
Its internal application programming provides optimum rooftop performance and energy efficiency. RTU Open enables the unit to run in 100% stand-alone control mode or it can communicate to the Building Automation System (BAS).

The RTU Open supports the following:

- **SPT, ZS, and Carrier wireless sensors** - Models are available for monitoring space temperature, space relative humidity, and space IAQ/CO2. Sensors provide:
  - Space setpoint offset adjustment
  - Pushbutton override
  - Occupancy indicator
- **BACnet** and **third party protocols** - On-board DIP switches allow you to select the baud rate and choose one of the following protocols:
  - BACnet MS/TP
  - BACnet ARC156
  - Modbus
  - Johnson N2
  - LonWorks
- **Mixed systems** - Supports CCN air terminals using Linkage to BACnet RTU Open Air Source
- **California Title 24** - Includes advanced Fault Detection and Diagnostic Logic for Economizer Operation in accordance with California Title 24 requirements
- **Equipment Touch** - The Equipment Touch is a user interface that is a touchscreen device with a 4.3 in. color LCD display that you connect to the RTU Open (driver v6.00:082 or later) to view or change property values, equipment schedules, trends and alarms, and more, without having to access the system's i-Vu® server.

  The RTU Open's application supports detailed color graphics, status, properties, alarms, trends, performance, configuration, and Help on the Equipment Touch. In addition, an RTU Open Startup Wizard has specific screens to facilitate initial RTU Open configuration.

  For more details about the Equipment Touch, see the *Equipment Touch Installation and Setup Guide*.


J1
Dark gray Input-5 (SMK)
Red (also) Input-4 R terminal on RTU
Blue BO-5 Y1 terminal on RTU
Yellow BO-4 Y2 terminal on RTU
Orange BO-3 W1 terminal on RTU
Pink BO-2 W2 terminal on RTU
Green BO-1 G terminal on RTU
Brown 24 Vac Common C terminal on RTU
White Compressor Safety X on most RTU terminal boards
Red (also) 24 Vac R terminal on RTU
(Jumper to Input 4 Red, interrupt jumper for Fire Safety)
J2
Gray (also) Ext 24 Vac
Gray (also) Input-8 (Enthalpy)
Pink (also) AO-1
Pink (also) Gnd for OAT
Violet OAT
Brown Gnd for SAT
Orange SAT
(AO-1)
0-10 Vdc
4-20 mA (default - pins 2&3)
J4
+24 Vdc
Input-2 (CO2/RH)
Gnd
+24 Vdc
Input-1 (CO2/RH)
Gnd
Power
Board power
J3
J5
Input-8
Ext 24 Vac
Input-5
Ext 24 Vac
Input-3
Ext 24 Vac
Input-9 (Humidistat)
Ext 24 Vac
RLY 1
RLY 2
RLY 3
RLY 4
RLY 5
RLY 6
RLY 7
RLY 8
AO-2
VFD Output
+
Gnd
J22
J11
BO-6 (H)
(Humidimizer)
BO-7
(Reversing Valve/
High Speed Fan/Y3)
BO-8 (PE)
(Power Exhaust)
W1
CR2032
MSB
LSB
SW1
SW2
ACCESS PORT
J12
J13
RNET
+12 Vdc
Rnet-
Rnet+
Gnd
Error
Run
J17
Do not use
Network Comm
Net+
Net-
Shld
J19
J14
Lonworks
Option Card
Port
COMM OPTION
J15
Format
W2
SW3
on
W3
W4
W5
W6
Gnd
Gnd
J20
RX TX
Example set for
Bacnet MS/TP
and 76.8k baud
(1,2, and 4 ON)
Recommended for all
i-Vu Open installations
Protocol and communications
baud rate selector DIP switches
Input-10 (T-55 Accy)
Input-11 (Offset Potentiometer: T-56, 59)
BACnet/Modbus/Johnson N2
communication terminals

Safety considerations & handling warning

WARNING

When you handle the RTU Open:

- Do not contaminate the printed circuit board with fingerprints, moisture, or any foreign material.
- Do not touch components or leads.
- Handle the board by its edges.
- Isolate from high voltage or electrostatic discharge.
- Ensure that you are properly grounded.

Communications wiring

Protocol overview

Protocols are the communication languages spoken by the control devices. The main purpose of a protocol is to communicate information in the most efficient method possible. Different protocols exist to provide specific information for different applications.

In the BAS, many different protocols might be used, depending on manufacturer. Different protocols do not change the function of the controller, but they typically require the owner to change systems or components in order to change from one protocol to another. communicates different types of protocols.

The RTU Open can communicate 1 of 5 different protocols:

- *BACnet MS/TP* (page 5)
- *BACnet ARC156* (page 9)
- *Modbus* (page 11)
- *Johnson N2* (page 14)
- *LonWorks* (page 16)

The default setting is BACnet MS/TP. You set the protocol and baud rate using the **SW3** DIP switches. The rotary switches **MSB** (**SW1**) and **LSB** (**SW2**) set the board's network address. See table below for specific switch settings. The third party connects to the controller through port **J19** for BACnet MS/TP, BACnet ARC156, Modbus, and N2, and through **J15** for the LonWorks Option Card.

NOTE You must cycle power after changing the rotary switches or after connecting the LonWorks Option Card to **J15**.

SW3 DIP switch settings

		Unused	**Comm Option port**	**Protocol**				**Baud rate**	
		8	**7**	**6**	**5**	**4**	**3**	**2**	**1**
BACnet MS/TP (Default)	Master	N/A	Off	Off	Off	On	Off	Select Baud	Select Baud
BACnet ARC156		N/A	Off	Off	Off	Off	Off	N/A	N/A
Modbus	Slave	N/A	Off	Off	On	On	Off	Select Baud	Select Baud
N2	Slave	N/A	Off	Off	Off	On	On	Off	Off
Lonworks		N/A	On	On	Off	On	Off	Off	On

Baud DIP switch settings

Baud Rate	DIP switch 2	DIP switch 1
9,600 bps	Off	Off
19.2 kbps	On	Off
38.4 kbps	Off	On
76.8 kbps (Default)	On	On

BACnet MS/TP

To set up the RTU Open for BACnet MS/TP

Refer to *Appendix B* (page 54) for the Protocol Implementation Conformance Statement, or download the latest from *BACnet International http://www.bacnetinternational.net/catalog/index.php?m=28*.

NOTE This controller counts as a full load on the MS/TP bus.

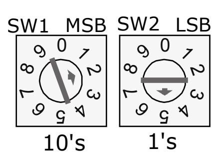
1 Turn **off** the RTU Open's power.

NOTE Changes made to the switches when the controller is on will <u>not</u> take effect until the power is cycled!

2 Using the rotary switches **MSB** (**SW1**) and **LSB** (**SW2**), set a unique BACnet MS/TP MAC address for the RTU Open. Set the **MSB** (**SW1**) switch to the tens digit of the address, and set the **LSB** (**SW2**) switch to the ones digit. Valid addresses are 01-99.

NOTE The rotary switches also determine the BACnet device instance of the controller on the BACnet network. The BACnet device instance is automatically generated based on the scheme 16101xx, where “16” is the BACnet vendor ID for Carrier Corporation, and xx equals the rotary switch address.

EXAMPLE To set the controller’s MS/TP MAC address to 01, point the arrow on the **MSB** (**SW1**) switch to 0 and the arrow on the **LSB** (**SW2**) switch to 1. Internally, the BACnet device instance is automatically generated as 1610101.



3 Set the **SW3** DIP switches **1** and **2** for the appropriate communications speed (9600, 19.2k, 38.4k, or 76.8k bps).

NOTE Use the same baud rate and communication settings for all controllers on the network segment. The RTU Open is fixed at 8 data bits, No Parity, and 1 Stop bit for this protocol's communications.

Baud DIP switch settings

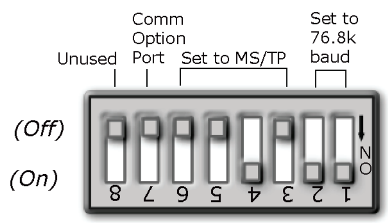
Baud rate	2	1
9,600 bps	Off	Off
19.2 kbps	On	Off
38.4 kbps	Off	On
76.8 kbps	On	On

4 Set the remaining DIP switches as follows:

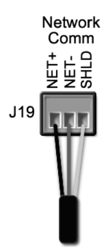
BACnet MS/TP DIP switch settings

8	7	6	5	4	3
Off	Off	Off	Off	On	Off

The following example shows the DIP switches set for 76.8k (Carrier default), and BACnet MS/TP.



5 Connect the BACnet MS/TP network to the controller's **J19 Network Comm** port. Connect to **Net+**, **Net-**, and **SHLD**.



Wire specifications

- A dedicated 22 AWG shielded twisted pair wire (EIA 485)
- Maximum wire length 2000 feet (610 meters) or 32 nodes
- Devices should be daisy-chained and not star-wired
- Attach the drain/shield wire to both ends of the network segment and through every controller

NOTE Use the same polarity throughout the network segment.

6 Turn **on** the RTU Open's power.

Adjusting BACnet MS/TP properties using an Equipment Touch

You may need to adjust the following BACnet MS/TP protocol timing settings using the Equipment Touch.

Max Masters - defines the highest MS/TP Master MAC address on the MS/TP network.

For example, if there are 3 master nodes on an MS/TP network, and their MAC addresses are 1, 8, and 16, then Max Masters would be set to 16 (since this is the highest MS/TP MAC address on the network).

This property optimizes MS/TP network communications by preventing token passes and "poll for master" requests to non-existent Master nodes.

In the above example, MAC address 16 knows to pass the token back to MAC address 1, instead of counting up to MAC address 127. Each MS/TP master node on the network must have their Max Masters set to this same value. The default is 127.

Max Info Frames - defines the maximum number of responses that will be sent when the RTU Open receives the token. Any positive integer is a valid number. The default is 10 and should be ideal for the majority of applications. In cases where the RTU Open is the target of many requests, this number could be increased as high as 100 or 200.

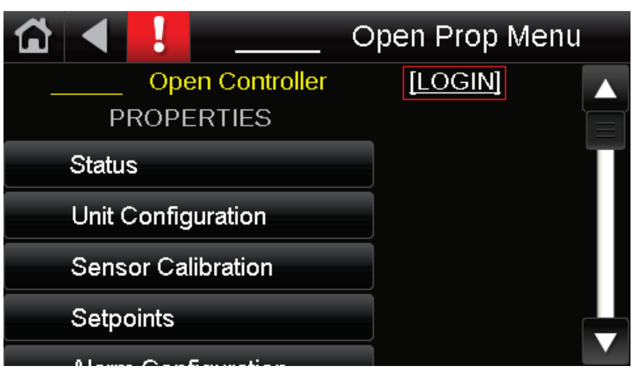
NOTES

- BACnet MS/TP networks can be comprised of both master and slave nodes. Valid MAC addresses for master nodes are 0 – 127 and valid addresses for Slave nodes are 0 - 254.
- If the third party attempts to communicate to the controller but does not get a response, make sure the controller is set as a BACnet MS/TP (m) master. The BACnet software asks the controllers, "Who Is?" This is to auto-locate devices on the network. Only controllers set as masters will answer this request.
- See Appendix A for Network Points List.
- See *Appendix B* (page 54) for the BACnet Protocol Implementation Conformance Statement (PICS).

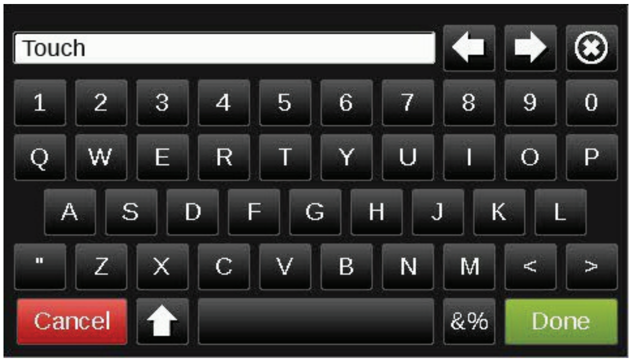
To set the Device Instance number or adjust the Max Masters or Max Info Frames using an Equipment Touch

1 In the Equipment Touch interface, navigate to the **Properties Menu** screen and click **Login**.

NOTE The following graphic is generic and not specific to your system.



2 Type **Touch** for the password and click **Done**.



3 On the **Properties Menu** screen, scroll to the bottom of the list and click **ET System**.

4 On the **ET System** screen, click **Setup**.

5 On the **Setup** screen, click **Module Setup**.

6 On the **Module Setup** screen, click **Communication**.

On the **Communication** screen, edit the fields as needed:

7 Click the property box next to **BACnet Device Instance**, type the new number, and click **Done**.

8 Click the property box next to **Max Masters** and/or **Max Info Frames**, type a new value (1-127), and click **Done**.

9 Click **Save**.

Troubleshooting BACnet MS/TP communication

For detailed troubleshooting and a list of supported objects, get the controller's BACnet PICS from the *Carrier BACnet PICS website http://www.bacnetinternational.net/catalog/index.php?m=28*. You must get your BACnet Object list from the manufacturer.

The most common communication problems are the result of not properly following the configuration steps outlined in this manual. Review all of the steps and use the following list to check your settings.

Verify accuracy of the following:

Hardware settings for BACnet MS/TP (8 Data bits, No Parity, and 1 Stop bit):

- Baud rate DIP switches DS2 and DS1
- BACnet MS/TP protocol DIP switches DS3 - DS6
- Jumper set to EIA-485
- Proper connection wiring
- Unique rotary address switches 1 – 99. If controllers have duplicate addresses, network communication can be lost.
- Unique BACnet Device Instance numbers. Default is 16101XX, with the rotary address switches defining XX. If controllers have duplicate device instance numbers, network communication can be lost.

NOTES

- The controller recognizes physical changes (DIP switches, rotary switches, and jumpers) upon power up.
- If RX LED is solid, then the terminations are incorrect.
- If the network has greater than 32 devices or exceeds 2,000 feet, a Repeater should be installed.
- If a controller begins or ends a network segment, a terminating resistor may be needed.

BACnet ARC156

To set up the RTU Open for BACnet ARC156

The RTU Open's latest supported function codes and capabilities are listed on the associated Protocol Implementation Conformance Statement (PICS), *Carrier BACnet PICS website http://www.bacnetinternational.net/catalog/index.php?m=28*.

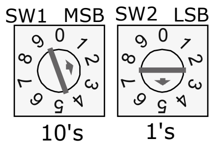
1 Turn **off** the RTU Open's power.

NOTE Changes made to the switches when the controller is on will not take effect until the power is cycled!

2 Using the rotary switches **MSB** (**SW1**) and **LSB** (**SW2**), set a unique BACnet MS/TP MAC address for the RTU Open. Set the **MSB** (**SW1**) switch to the tens digit of the address, and set the **LSB** (**SW2**) switch to the ones digit. Valid addresses are 01-99.

NOTE The rotary switches also determine the BACnet device instance of the controller on the BACnet network. The BACnet device instance is automatically generated based on the scheme 16101xx, where "16" is the BACnet vendor ID for Carrier Corporation, and xx equals the rotary switch address.

EXAMPLE To set the controller's MAC address to 01, point the arrow on the **MSB** (**SW1**) switch to 0 and the arrow on the **LSB** (**SW2**) switch to 1. Internally, the BACnet device instance is automatically generated as 1610101.

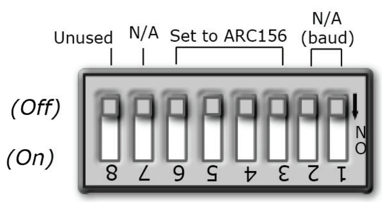


3 Set the remaining DIP switches as follows:

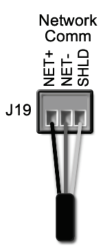
BACnet ARC156 DIP switch settings

8	7	6	5	4	3
Off	Off	Off	Off	N/A	N/A

The following example shows the DIP switches set for BACnet ARC156.



4 Connect the BACnet ARC156 network to the controller's **J19 Network Comm** port. Connect to **Net+**, **Net-**, and **SHLD**.



Wire specifications

- A dedicated 22 AWG shielded twisted pair wire (EIA 485)
- Maximum wire length 2000 feet (610 meters) or 32 nodes
- Devices should be daisy-chained and not star-wired
- Attach the drain/shield wire to both ends of the network segment and through every controller

NOTE Use the same polarity throughout the network segment.

5 Turn **on** the RTU Open's power.

Troubleshooting ARC156 communication

The most common communication problems result from not properly following the configuration steps outlined above in this manual. Review all of the steps and use the following list to check your settings.

Verify accuracy of the following:

- Protocol DIP switches DS3 - DS6
- Proper connection wiring
- Unique rotary address switches 1 – 99. If controllers have duplicate addresses, network communication can be lost.
- Unique BACnet Device Instance numbers. Default is 16101XX, with the rotary address switches defining XX. If controllers have duplicate device instance numbers, network communication can be lost.

NOTES

- The controller recognizes physical changes (DIP switches, rotary switches, and jumpers) upon power up.
- If RX LED is solid, then the terminations are incorrect.
- If the network has greater than 32 devices or exceeds 2,000 feet, a Repeater should be installed.
- If a controller begins or ends a network segment, a terminating resistor may be needed.

Software settings defined through the Equipment Touch device. To confirm settings, obtain a Modstat of the device. On the Equipment Touch, click the link to the Modstat.

Modbus

To set up the RTU Open for Modbus

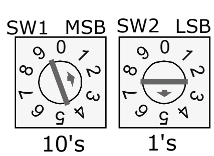
Refer to *Appendix C* (page 55) for the Modbus Protocol Implementation Conformance Statement (PICS).

1 Turn **off** the RTU Open's power.

NOTE Changes made to the switches when the controller is on will not take effect until the power is cycled!

2 Using the rotary switches, set a unique Modbus slave address for the RTU Open. Set the **MSB** (**SW1**) switch to the tens digit of the address, and set the **LSB** (**SW2**) switch to the ones digit. Valid Modbus slave addresses are 01-99.

EXAMPLE To set the controller's Modbus slave address to 01, point the arrow on the **MSB** (**SW1**) switch to 0 and the arrow on the **LSB** (**SW2**) switch to 1.



3 Set the **SW3** DIP switches **1** and **2** for the appropriate communications speed (9600, 19.2k, 38.4k, or 76.8k bps).

NOTE Use the same baud rate and communication settings for all controllers on the network segment. The RTU Open is fixed at 8 data bits, No Parity, and 1 Stop bit for this protocol's communications.

Baud DIP switch settings

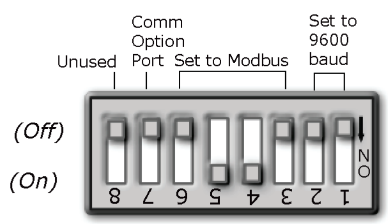
Baud rate	2	1
9,600 bps	Off	Off
19.2 kbps	On	Off
38.4 kbps	Off	On
76.8 kbps	On	On

4 Set the remaining DIP switches as follows:

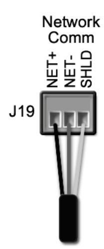
Modbus DIP switch settings

8	7	6	5	4	3
Off	Off	Off	On	On	Off

The following example shows the DIP switches set for 9600 baud and Modbus.



5 Connect the Modbus EIA-485 network to the RTU Open's **J19 Network Comm** port. Connect to **Net+**, **Net-**, and **SHLD**.



Wire specifications

- ○ A dedicated 22 AWG shielded twisted pair wire (EIA 485)
- ○ Maximum wire length 2000 feet (610 meters) or 32 nodes
- ○ Devices should be daisy-chained and not star-wired
- ○ Attach the drain/shield wire to both ends of the network segment and through every controller

NOTE Use the same polarity throughout the network segment.

6 Turn **on** the RTU Open's power.

Troubleshooting Modbus communication

The most common communication problems result from not properly following the configuration steps outlined above in this manual. Review all of the steps and use the following list to check your settings.

Verify accuracy of the following:

Hardware settings for speaking Modbus (8 Data bits, No Parity, and 1 Stop bit):

- Baud rate DIP switches DS2 and DS1
- Protocol DIP switches DS3 - DS6
- Proper connection wiring
- Wiring specifications are 18 - 28 AWG; twisted pair, and 50 feet (15.4 meters) maximum
- Unique rotary address switches 1 – 99. If controllers have duplicate addresses, network communication can be lost.

NOTES

- If RX LED is solid, then the terminations are incorrect.
- If the network has greater than 32 devices or exceeds 2,000 feet, a Repeater should be installed.
- If a controller begins or ends a network segment, a terminating resistor may be needed.
- The controller recognizes physical changes (DIP switches, rotary switches, and jumpers) upon power up.

BAS must be:

- Set for the same baud rate
- Sending requests to the proper address
- Reading or writing to the proper point addresses on the controller
- Set for the same communication settings (8 Data bits, No Parity, and 1 Stop bit)
- Speaking 2-wire 485 to the controller

Software settings defined through the Equipment Touch device. To confirm settings, obtain a Modstat of the device. On the Equipment Touch, click the link to the Modstat.

NOTES

- Refer to *Appendix A* (page 42) for the Network Points list.
- Refer to *Appendix C* (page 55) for the Protocol Implementation Conformance Statement.

Modbus Exception Codes that might be returned from this controller

Codes	Name	Description
01	Illegal Function	The Modbus function code used in the query is not supported by the controller.
02	Illegal Data Address	The register address used in the query is not supported by the controller.
04	Slave Device Failure	The Modbus Master has attempted to write to a non-existent register or a read-only register in the controller.

Johnson N2

To set up the RTU Open for N2

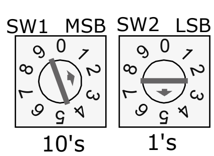
Refer to *Appendix D* (page 57) for the N2 Protocol Implementation Conformance Statement (PICS).

1 Turn **off** the RTU Open's power.

NOTE Changes made to the switches when the controller is on will <u>not</u> take effect until the power is cycled!

2 Using the rotary switches, set a unique N2 slave address for the RTU Open. Set the **MSB** (**SW1**) switch to the tens digit of the address, and set the **LSB** (**SW2**) switch to the ones digit. Valid N2 slave addresses are 01-99.

EXAMPLE To set the N2 slave address to 01, point the arrow on the **MSB** (**SW1**) switch to 0 and the arrow on the **LSB** (**SW1**) switch to 1.



3 Set the DIP switches **1** and **2** for 9600 bps baud.

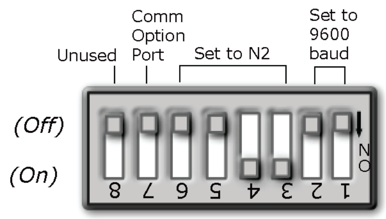
NOTE Use the same baud rate and communication settings for all controllers on the network segment. The RTU Open is fixed at 9600 bps baud, 8 data bits, No Parity, and 1 Stop bit.

4 Set the remaining DIP switches as follows:

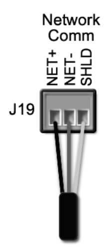
N2 DIP switch settings

8	7	6	5	4	3	2	1
Off	Off	Off	Off	On	On	On	On

The following example shows the DIP switches set for 9600 baud and N2.



5 Connect the N2 EIA-485 network to the controller's **J19 Network Comm** port. Connect to **Net+**, **Net-**, and **SHLD**.



Wire specifications

- A dedicated 22 AWG shielded twisted pair wire (EIA 485)
- Maximum wire length 2000 feet (610 meters) or 32 nodes
- Devices should be daisy-chained and not star-wired
- Attach the drain/shield wire to both ends of the network segment and through every controller

NOTE Use the same polarity throughout the network segment.

6 Turn **on** the RTU Open's power.

Troubleshooting N2 communication

The most common communication problems result from not properly following the configuration steps outlined above in this manual. Review all of the steps and use the following list to check your settings.

Verify accuracy of the following:

Hardware settings for N2 (8 Data bits, No Parity, and 1 Stop bit):

- Baud rate DIP switches DS2 and DS1 set to 9600 bps
- Protocol DIP switches DS3 - DS6
- Jumper set to EIA-485
- Proper connection wiring
- Unique rotary address switches 1 – 99. If controllers have duplicate addresses, network communication can be lost.
- Unique BACnet Device Instance numbers. Default is 16101XX, with the rotary address switches defining XX. If controllers have duplicate device instance numbers, network communication can be lost.

NOTES

- If RX LED is solid, then the terminations are incorrect.
- If the network has greater than 32 devices or exceeds 2,000 feet, a Repeater should be installed.
- If a controller begins or ends a network segment, a terminating resistor may be needed.
- The controller recognizes physical changes (DIP switches, rotary switches, and jumpers) upon power up.
- Refer to *Appendix A* (page 42) for the Network Points list.
- Refer to *Appendix D* (page 57) for the Protocol Implementation Conformance Statement.

Software settings defined through the Equipment Touch device. To confirm settings, obtain a Modstat of the device. On the Equipment Touch, click the link to the Modstat.

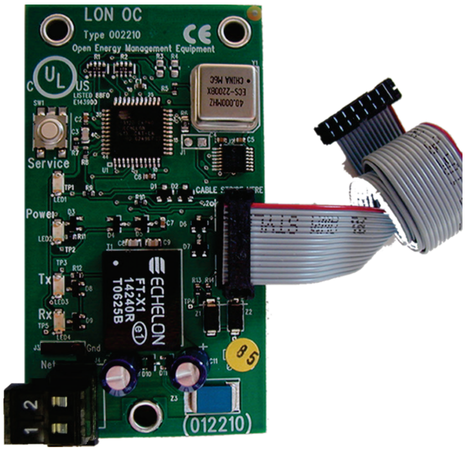
LonWorks

WARNING

When you handle the LonWorks Option Card:

- Do not contaminate the printed circuit board with fingerprints, moisture, or any foreign material.
- Do not touch components or leads.
- Handle the board by its edges.
- Isolate from high voltage or electrostatic discharge.
- Ensure that you are properly grounded.

Refer to *Appendix E* (page 59) for the LonWorks Protocol Implementation Conformance Statement (PICS).



To set up the RTU Open for the LonWorks Option Card (Part #LON-OC)

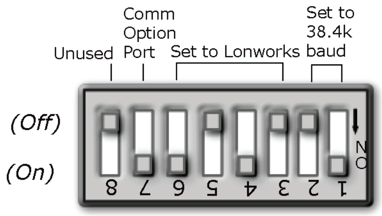
1 Turn **off** the RTU Open's power.

NOTES

- Changes made to the switches when the controller is on will <u>not</u> take effect until the power has been cycled!
- The controller's rotary address switches are not used when the LON-OC is installed. That's because each LON-OC has a 48-bit Neuron ID that makes it unique on the LonWorks network.

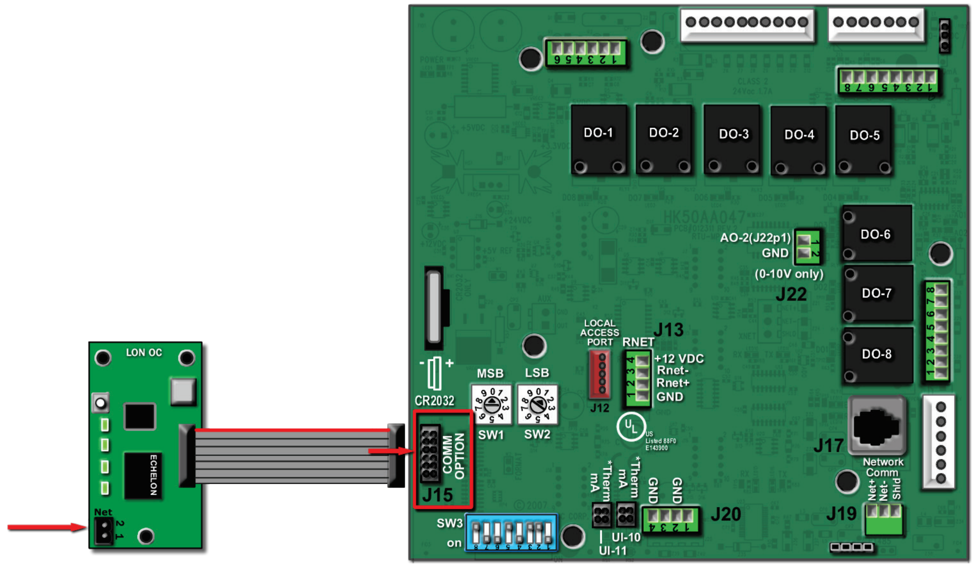
2 Set the SW3 DIP switches for LonWorks as follows:

8	7	6	5	4	3	2	1
Off	On	On	Off	On	Off	Off	On



3 Plug the LonWorks Option Card's ribbon cable into Comm Option port **J15** on the controller. See illustration below.

CAUTION! The controller must be **OFF** before being connected.



4 Connect the LonWorks network to the LonWorks Option Card via the 2-pin **Net** port.

NOTE The 2-pin **Net** port provides TP/FT-10 channel compatibility. The TP/FT-10 or "Free Topology" network type is **polarity insensitive**. Use 24 to 16 AWG twisted pair wire.

5 Turn **on** the RTU Open's power.

6 Commission the controller for LonWorks communication. See instructions below.

Commissioning the controller for LonWorks communication

Before a device can communicate on a LonWorks network, it must be commissioned. Commissioning allows the system integrator to associate the device hardware with the LonWorks system's network layout diagram. This is done using the device's unique Neuron ID.

A network management tool such as Echelon's LonMaker is used to commission each device, as well as, to assign addressing. Specific instructions regarding the commissioning of LonWorks devices should be obtained from documentation supplied with the LonWorks Network Management Tool.

When a new device is first commissioned onto the LonWorks network, the system integrator must upload the device's External Interface File (XIF) information. LonWorks uses the XIF to determine the points (network variables) that are available from a device. The RTU Open has a set of predefined network variables. These variables can be bound or accessed by the Network Management Tool.

The **Browse** feature of the Network Management Tool allows you to read real-time values from the RTU Open. The Network Management Tool allows you to test integration prior to binding the controller's network variables to other LonWorks nodes.

Troubleshooting LonWorks communication

The most common communication problems result from not properly following the configuration steps outlined above in this manual. Review all of the steps and use the following list to check your settings.

Verify accuracy of the following:

Hardware settings for speaking LonWorks (8 Data bits, No Parity, and 1 Stop bit):

- Baud rate DIP switches 1 and 2 set to 38.4 kbps
- Protocol DIP switches DS3 - DS6
- LON network terminated on LonWorks Option Card pins 1 and 2
- The BAS is connected properly to the LonWorks Option Card's 2-wire TP/FT-10 Net port, which is polarity insensitive. The BAS may have to configure jumper or DIP switches on their end to support TP/FT-10.

NOTES

- If RX LED is solid, then the terminations are incorrect.
- If the network has greater than 32 devices or exceeds 2,000 feet, a Repeater should be installed.
- If a controller begins or ends a network segment, a terminating resistor may be needed.
- The RTU Open must be properly commissioned onto the LonWorks network. See *Commissioning the controller for LonWorks communication* (page 18).
- The BAS must be connected properly to the LonWorks Option Card's 2-wire TP/FT-10 Net port, which is polarity insensitive.

Software settings defined through the Equipment Touch device. To confirm settings, obtain a Modstat of the device. On the Equipment Touch, click the link to the Modstat.

Start-up

Use one of the following interfaces to start up, access information, read sensor values, and test the controller.

This interface...	Provides a...
Field Assistant application - Runs on a laptop that connects to controller's Local Access port [1]	Temporary interface
Equipment Touch device - Connects to controller's Rnet port [2]	Temporary or permanent interface
i-Vu® application Available for BACnet systems only	Permanent interface
System Touch device Available only for BACnet MS/TP systems. Wire to a BACnet MS/TP network connector and a 24 Vac power supply [3]	Temporary or permanent interface

[1] Requires a USB Link (Part #USB-L).
[2] See the *Equipment Touch Installation and Setup Guide* for detailed instructions.
[3] See the *System Touch Installation and Setup Guide* for detailed instructions.

CAUTION If multiple controllers share power but polarity was not maintained when they were wired, the difference between the controller's ground and the computer's AC power ground could damage the USB Link and the controller. If you are not sure of the wiring polarity, use a USB isolator between the computer and the USB Link. Purchase a USB isolator online from a third-party manufacturer.

Sequence of Operation

The RTU Open supports various types of constant volume and Staged Air Volume (SAV) air source configurations:

- Standard heat/cool unit types with up to 2-stages of mechanical cooling and gas or electric heating
- Heat pump units utilizing a reversing valve output for heating and cooling control
- Heat pump unit (Carrier) with an OEM defrost control board
- Economizer, CO2, Demand Limiting, and RH control strategies are available for appropriately equipped units
- LC WeatherExpert™ unit with 3-stage compressor control and SAV variable speed supply fan control
- SAV energy saving operation which utilizes a standard heat/cool rooftop unit with a fan equipped with a VFD that provides variable speed fan control in both heating and cooling modes. This operation provides variable air flow but not VAV operation and does not provide duct static pressure control. It must be used with standard constant volume duct systems or VVT.

The RTU Open may operate as part of a VVT system using Airside Linkage or as a stand-alone controller.

Occupancy

The RTU Open's operation depends upon its occupancy state (**Occupied**/**Unoccupied**). The RTU Open operates continuously in the **Occupied** mode until you configure an occupancy schedule.

An occupancy schedule may be:

- A local schedule configured in the controller using an Equipment Touch or Field Assistant
- A BACnet schedule configured for the RTU Open in the i-Vu® application.
- A BACnet or local schedule configured in the VVT Zones that are subordinate to the RTU Open and employing Linkage

To set up occupancy schedules, see the documentation for your user interface.

NOTE A BACnet schedule, downloaded from the i-Vu® application will overwrite a local schedule that was set up with an Equipment Touch or Field Assistant.

Occupancy Source - the following settings determine occupancy.

Options:

- **Always Occupied** – (default) Controller operates continuously, regardless of any configured schedule
- **BACnet Schedule** – Uses a local BACnet occupancy schedule configured within the controller
- **BAS On/Off** – Occupancy is set over the network by another device or a third party BAS. Refer to the *RTU Open Integration Guide* for additional instructions in communication protocols.
- **Remote Occ Input** – Controller monitors an input contact connected to one of the available binary inputs configured to receive it. You must set **Unit Configuration** > **Occupancy Source** to **Remote Occ Input** and one **Input Switch Configuration** to **Remote Occupancy**.

Supply fan

The RTU Open supply fan may be configured for 1 of 3 **Fan Control modes**:

- **Single** - The fan operates at one speed only and provides on/off operation
- **Two Speed** - The fan operates at 1 of 2 speeds depending on the mode of operation and load conditions. During fan only or single stage cooling, the fan operates at low speed. During heating, second stage cooling, dehumidification, or if maximum economizer operation is required, the fan operates at high speed.
- **Variable Speed** - The fan operates at a variable speed to maintain the desired supply air conditions when heating or cooling are operating. Variable speed fan control provides Staged Air Volume (SAV) operation by maximizing energy savings and minimizing fan horsepower consumption. Fan speed is NOT controlled to maintain duct static pressure.

The RTU Open supply fan may be configured for 1 of 3 **Fan Modes**:

- **Auto** - The fan cycles on/off in conjunction with heating or cooling
- **Continuous** - The fan runs continuously during occupancy and intermittently during unoccupied periods with heating or cooling
- **Always On** - The fan runs continuously regardless of occupancy or calls for heating and cooling

Occupancy can be determined by Linkage, BACnet schedules, BAS schedules, or in response to a remote occupancy switch.

A **Fan Off Delay** allows the supply fan to continue operating after heating or cooling stops.

If the following alarms are active, the fan turns off immediately, regardless of the occupancy state or demand:

- **Fire Shutdown**
- **Safety chain**
- **Supply Air Temp Sensor** alarm
- **Space Temp Sensor** alarm

The RTU Open does not include smoke-control functions such as smoke-purge, zone-pressurization, or smoke-ventilation.

The RTU Open may be configured to accept a **Supply Fan Status** input to provide proof the supply fan is operating. When enabled, a loss or lack of fan status will stop heating and cooling operation.

A **Supply Fan Alarm Service Timer** function is available to track the number of supply fan run hours and generate an alarm when the accumulated runtime exceeds the set threshold.

Vent / Fan Only mode – When the space temperature is between the heating and cooling setpoints, the fan operates at the minimum VFD speed (**IDF Min Speed Voltage** / **Min VFD Output**) configured under normal operating conditions.
NOTE SAT must be above the **SA Vent / Temper Setpoint** if **SA Tempering** is disabled or SAT must be above the **SA Vent / Temper Setpoint -**7.5°F (-21.9°C) if **SA Tempering** is **Enabled** and OAT is below the **Minimum Cooling SAT**.

Fan Only Override w/Variable Speed fan control — The RTU Open monitors the SAT in fan only mode to ensure the SAT remains above an acceptable minimum value. Fan Override typically occurs when the outdoor air is cold in winter and the economizer increasingly opens at lower fan speeds to maintain a constant amount of outdoor air. **If SA Tempering** is disabled, then when the SAT drops below the **SA Vent / Temper Setpoint**, the fan speed increases up to the maximum configured speed (while at the same time, the economizer position will correspondingly decrease from the **Low Fan Econ Min Pos** toward the **Vent Dmpr Pos / DCV Min Pos**. The **Vent Dmpr Pos / DCV Min Pos** is used when the fan is at the configured maximum fan speed. The **Low Fan Econ Min Pos** is used when the fan is at the lowest speed and depends on which value, minimum vfd speed or heating speed, is set lower.

Cooling

The RTU Open's application and configuration determines the specific cooling sequence. The RTU Open can control up to 2 stages of cooling with an additional output for a reversing valve (heat pump applications). The number of stages is configurable or is defined by unit type.

The following conditions must be true for the cooling algorithm to operate:

- **Outdoor Air Temperature**, if valid, is greater than the **Cooling Lockout Temperature** setpoint
- The indoor fan is on
- The unit has a valid **Supply Air Temperature** input
- The unit has a valid **Space Temperature** input
- Heat mode is not active and the 5-minute time guard between modes has expired
- Economizer is unavailable, or if the Economizer is active, mechanical cooling is available if the economizer is open > 90% for at least 7.5 minutes, the SAT and OAT > [**Minimum Cooling SAT** + 5Δ°F (2.7Δ°)] and SPT > [**Effective Cooling Setpoint** + 0.5Δ°F (.27Δ°C)].

The cooling relays are controlled by the Cooling Control PID Loop and Cooling Capacity algorithm. They calculate the desired number of stages needed to satisfy the space by comparing the **Space Temperature** to the:

- **Effective Occupied Cooling Setpoint** when occupied
- **Effective Unoccupied Cooling Setpoint** when unoccupied

When the cooling algorithm preconditions have been met, the compressors are energized in stages, as applicable. Anti-recycle timers are employed to protect the equipment from short-cycling. There are fixed 3 minute minimum on-times, and 5 minute off-times for each compressor output.

During compressor operation, the RTU Open may reduce the number of active stages if the rooftop supply air temperature falls below the **Minimum Cooling SAT Setpoint**. A compressor staged off in this fashion may be started again after the normal time-guard period has expired, if the **Supply Air Temperature** has increased above the **Minimum Cooling SAT Setpoint**.

Compressor Service Alarm Timer functions are available (1 for each stage of compression). This function tracks the number of compressor run hours and generates an alarm when the accumulated runtime exceeds the threshold set by the adjustable compressor service alarm timers.

SAV Cooling Mode - When the space temperature rises above the cooling setpoint and the cooling mode becomes active, the cooling capacity is calculated by the Cooling PID and the outputs are enabled as required. Initially, the fan runs at the configured minimum airflow (**IDF Min Speed Voltage / Min VFD Output**) and VFD speed as long as the SAT remains above the appropriate cooling stage setpoint (**Stage 'x' SAT Stpt**). As the SAT drops below the configured **Stage ‘x’ SAT Stpt**, the fan speed increases as required up to the configured maximum VFD speed (**IDF Max Speed Voltage / Max VFD Output**) to provide sufficient airflow across the coil and maintain the desired SAT setpoint. The number of setpoints displayed and used depends on the unit type and configuration.The specific setpoint used is based on how many stages of cooling are actively operating.

Economizer

The RTU Open provides an analog economizer output for rooftop units with economizer dampers. Economizer dampers may be used to provide indoor air quality control and free cooling when outside air conditions are suitable.

The following conditions must be true for economizer operation:

- The **Outdoor Air Temperature** is less than the **Space Temperature** and less than the **Economizer High OAT Lockout Temp** setpoint
- The indoor fan is on
- The unit has a valid **Supply Air Temperature** input
- The unit has a valid **Space Temperature** input

If the RTU Open is configured for VFD or 2-speed fan, the economizer minimum position is adjusted to provide a constant amount of outdoor air. If the fan is on high speed or is configured for single-speed fan, the economizer minimum position will be set to the **Vent Dmpr Pos / DCV Min Pos** setpoint. If it is configured for VFD or 2-speed fan, and the fan is on low speed, the economizer minimum position will be set to the **Low Fan Econ Min Pos**.

If all preceding conditions are true, the economizer PID loop modulates the damper between the minimum position and 100% open.

The economizer will modulate to maintain the configured **Minimum Cooling SAT** limit when the unit is in an economizer only mode and will modulate closed only when the SAT drops below the **Minimum Cooling SAT** limit - 5Δ°F (-2.8Δ°C) when mechanical cooling is also operating.

SAV Economizer Mode - When the economizer mode becomes active, the fan runs at the configured minimum airflow (**IDF Min Speed Voltage / Min VFD Output**). The economizer algorithm will first modulate the economizer to lower the SAT until reaching the configured **Minimum Cooling SAT** limit, while maintaining the minimum fan airflow. If this alone is insufficient to maintain the space temperature, the RTU Open increases the fan speed to provide more OA for cooling. As necessary, the fan speed may increase up to the configured maximum VFD speed (**IDF Max Speed Voltage / Max VFD Output**) to provide the required cooling.

Economizer Fault Detection & Diagnostics (FDD)

The RTU Open provides FDD (Fault Detection and Diagnostics) for economizer operation in compliance with California Title 24. The FDD logic detects 4 economizer faults:

- fails to close
- fails to open
- stuck fully open
- fails to fully open

Each condition causes an Economizer Operation alarm and displays the specific fault condition.

The following must be true to enable the FDD logic:

- RTU Open must be in Economizer mode
- 30 minutes must elapse since the last time heating or cooling was active
- OAT must be < (OAT economizer lockout - 15°F)

Failed to Fully Open

If the damper command is > 95%, the SAT must equal the OA temperature +/- 5°F, otherwise the **Full Open Fail** flag is set. If this condition continues for more than 30 minutes, the Economizer FDD alarm is active. This indicates that the damper failed to fully open when needed, since the SAT failed to reach the OA temperature +/- 5°F.

Stuck Open

If the damper is commanded to < 40% and the SAT is still equal to the OAT +/- 5°F, the **Stuck Open** flag is set. If this condition continues for more than 30 minutes, then the Economizer FDD alarm is active. This indicates the damper failed to close when needed, since the SAT failed to increase in temperature.

When the damper is modulating (MUST be above any minimum configured position) and between 25% and 100%, the FDD logic monitors the current and previous SAT, economizer-commanded position, and the OAT:

Failed to Open

If the FDD logic detects an increase in damper position, for example from 50% to 65%, it expects to also detect a decrease in SAT. If the SAT failed to decrease, or no change in SAT is detected, the FDD logic generates a **Failed to Open** alarm after 10 minutes.

Failed to Close

If the FDD logic detects a decrease in damper position, for example from 80% to 65%, it expects to also detect an increase in SAT. If the SAT failed to increase, or no change in SAT is detected, the FDD logic generates a **Failed to Close** alarm after 10 minutes.

Power Exhaust

The RTU Open may enable and disable an exhaust fan, based on either the controller's occupancy or its economizer damper position. If the **Fan Control** is set to **Two Speed** or **Variable Speed**, the **Power Exhaust Setpoint** is automatically adjusted based on the fan's air delivery. The **Calculated PE Setpoint** used for control is displayed in the **Maintenance** section.

If **Continuous Occupied Exhaust** is **Yes**, the **Power Exhaust** binary output (BO-8) is energized while the RTU Open is occupied and de-energized when unoccupied.

If **Continuous Occupied Exhaust** is **No**, the **Power Exhaust** binary output (BO-8) is energized when the economizer damper output exceeds the **Calculated Power Exhaust (PE) Setpoint** value. The output remains energized until the economizer output falls below the **Power Exhaust Setpoint** value by a fixed hysteresis of 10%.

Pre-Occupancy Purge

Pre Occupancy Purge allows the rooftop equipment with an economizer damper to use outdoor air to purge the space of contaminants just prior to the beginning of the occupied period.

The following conditions must be true for pre-occupancy purge to operate:

- **Pre-Occupancy Purge** set to **Enable**
- **Economizer Exists** set to **Yes**
- A local time schedule is configured
- The local time schedule is currently unoccupied and the remaining time is less than the configured **Purge Time**

When the RTU Open schedule is unoccupied and the remaining unoccupied time is less than the purge time, the supply fan starts. The economizer damper opens to the configured **Economizer Purge Min Pos**. The RTU Open continues to operate in this mode until the occupied start time is reached. The **Pre-Occ Purge** state is displayed in the **Maintenance** section.

Unoccupied Free Cooling

Unocc Free Cool Enable allows rooftop equipment with an economizer damper to use 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** setpoint
- 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 1Δ°F (.5Δ°C) 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 use either of 2 different **Optimal Start** methods. **Learning Adaptive Optimal Start** is used for heat pump applications and adjusts the effective setpoints to achieve the occupied setpoints by the time scheduled occupancy begins. This prevents or minimizes the need for auxiliary heat. 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.

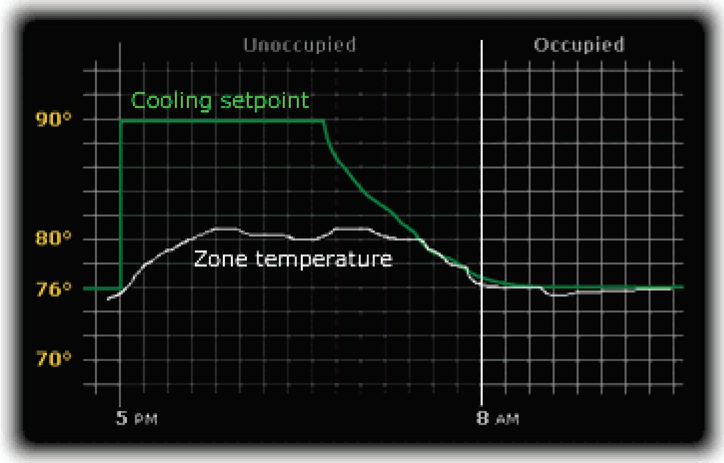
The following conditions must be true for learning adaptive optimal start to operate:

- On the **Properties** page > **Control Program** tab > **Configuration** > **Setpoints** > **Optimal Start**, the default value is set to 1 and must be set greater than **0** (**0.00** disables **Optimal Start**) and less than or equal to **4**.
- The system is unoccupied

NOTE If the controller does not have a valid outside air temperature, then a constant of 65°F (18.3°C) is used. This value is not adjustable.

The actual equation that the controller uses to calculate **Learning Adaptive Optimal Start** is nonlinear. An approximation of the result is shown below.

NOTE The values in the graph below are Fahrenheit.



To change **Learning Adaptive Optimal Start** settings:

1 In the navigation tree, select the equipment that you want to change.

2 Click **Properties** page > **Control Program** tab > **Configuration** > **Setpoints**.

Temperature Compensated Optimal Start is a second start method used for gas or electric heating applications. It switches from unoccupied to the occupied setpoints at a calculated time prior to occupancy. This minimizes the operation of the unit's fan. The Optimal Start recovery period may begin as early as 4 hours prior to occupancy. The time at which the setpoints move is based on the difference between the current space temperature and the desired setpoint, multiplied by the "K" factor, or recovery rate, for the required mode of operation.

The following conditions must be true for Temperature Compensated Optimal Start to operate:

- On the **Properties** page > **Control Program** tab > **Configuration** > **Setpoints** > **Optimal Start**, the default value is set to 1 and must be set greater than **0** (**0.00** disables **Optimal Start**) and less than or equal to **4**.
- The system is unoccupied

To change Temperature Compensated Optimal Start settings:

1 In the navigation tree, select the equipment that you want to change.

2 On the **Properties** page > **Control Program** tab > **Configuration** > **Setpoints**, click **Heat Start K factor** or **Cool Start K factor**. This defines the equipment's recovery rate in minutes / deg.

Enthalpy control

You may use an enthalpy switch to indicate the suitability of outdoor air for economizer cooling. You can use either an outdoor air or differential enthalpy switch. A differential enthalpy switch has a sensing device in both the outdoor and return air streams. A differential enthalpy switch indicates when outside air is more suitable to be used than the return air and is available for economizer cooling. If no enthalpy switch is configured, a network point (Object Name: oae) is available. This point is displayed in the i-Vu® application and an Equipment Touch as **Enthalpy** (BACnet).

The sequence of operation for economizer cooling is the same with or without an enthalpy switch, except that an enthalpy switch imposes one more validation on the suitability of outside air for economizer cooling. An **Enthalpy Status** that is **High** disables the economizer and the outside air damper goes to its minimum position. An **Enthalpy Status** that is **Low** enables the economizer if a call for cooling exists and the remaining preconditions are met.

Indoor Air CO2

Indoor Air CO2 is controlled on rooftop equipment with an economizer. **Indoor Air CO2** sequence is enabled by installing an air quality (CO2) sensor. A CO2 sensor may be terminated at the RTU Open, or a subordinate zone controller, when part of a zoned system.

An outdoor air quality sensor may also be installed and terminated at the RTU Open, but it is not required. When an outdoor air quality sensor is not installed, the algorithm uses 400ppm as the fixed outdoor air CO2 level.

The following conditions must be true for the **Indoor Air CO2** algorithm to operate:

- The system is occupied
- The supply fan has been started for at least 30 seconds
- The CO2 sensor has a valid reading

As the air quality within the space changes, the minimum position of the economizer damper changes, which allows more or less outdoor air into the space, depending on the relationship of the indoor air CO2 level to the differential setpoint.

The **Indoor Air CO2** algorithm calculates a minimum position value using a PID loop. The CO2 minimum damper position is then compared against the **Vent Dmpr Pos / DCV Min Pos** setpoint and the greatest value becomes the final minimum damper position of the economizer output.

The degree to which the outside air damper may be opened by the **Indoor Air CO2** algorithm is limited by the **DCV Max Vent Damper Pos** setpoint, which is adjustable between ten and sixty percent (10 – 60%).

Heating

The specific heating sequence is determined by the controller's application and configuration. The RTU Open controls up to 2 stages of gas or electric heating with an additional output for a **Reversing Valve** (Heat Pump applications).

The following conditions must be true for the heating algorithm to operate:

- The **Outdoor Air Temperature** is less than the **Heating Lockout Temperature** setpoint
- The indoor fan has been ON for at least 30 seconds
- The unit has a valid **Supply Air Temperature** input
- The unit has a valid **Space Temperature** input
- Neither Cool mode nor economizer are active and the time guard between modes has expired

The heating relays are controlled by the Heating Control PID Loop and Heating Stages Capacity algorithm, which calculate the desired number of stages to satisfy the space by comparing the **Space Temperature** to the:

- **Effective Occupied Heating Setpoint** when occupied
- **Effective Unoccupied Heating Setpoint** when unoccupied

When the heating algorithm preconditions have been met, the heating is energized in stages. Anti-recycle timers are employed to protect the equipment from short-cycling. There are fixed one minute minimum on and off times for each heating output.

During heating operation, the RTU Open may reduce the number of active stages if the rooftop **Supply Air Temperature** exceeds the **Maximum Heating SAT** setpoint. A heat stage turned off in this fashion may be started again after the normal time-guard period has expired, if the **Supply Air Temperature** has decreased below the **Maximum Heating SAT** setpoint.

SAV Heating Mode — When the space temperature is below the heating setpoint and the heating mode becomes active, the heating capacity is calculated by the Heating Control PID Loop and the outputs are enabled as required. Initially, the fan operates at the configured heat airflow (**IDF Heat Speed Voltage/Heating VFD Output**), whether higher or lower than the minimum VFD speed (**IDF Min Speed Voltage / Min VFD Output**), as long as the SAT remains below the **Maximum Heating SAT** minus 3°F (1.67°C). As the SAT increases above this value, the fan speed increases up to the configured maximum VFD speed (**IDF Max Speed Voltage / Max VFD Output**) to provide sufficient airflow across the coil and maintain the **Maximum Heating SAT** minus 3°F (1.67°C) setpoint. As the SAT exceeds the **Maximum Heating SAT**, the heat stages will be reduced or disabled.

Supply Air Tempering

The RTU Open can provide supply air tempering to warm the discharge air under conditions where no heating or cooling is required, the outdoor air is cold, and the volume of outdoor air required for minimum ventilation causes the supply air temperature to fall below the adjustable **SA Vent / Temper Setpoint**.

To enable the tempering function, **SA Tempering** must be set to **Enable**.

The following conditions must be true for the algorithm to operate:

- The unit cannot be a heat pump type (**HP O/B Ctrl or HP Y1/W1 Ctrl**)
- The unit has been operating for at least 5 minutes
- The unit has a valid **Supply Air Temperature** input
- The unit is configured for gas or electric heat
- The Outdoor Air Temperature is less than the **Minimum Cooling SAT**
- The current operation mode is either **Fan Only**, **IAQ Override**,or **Pre-occ Purge**
- The fan status is True (if configured for the fan status option)
- The supply air temperature falls below the configured **SA Vent / Temper Setpoint**

When the algorithm preconditions above have been met, the first stage of heating is energized. The heating operates to maintain the desired **SA Vent / Tempering Setpoint** subject to the minimum on timer and anti-recycle timer to protect the equipment from short-cycling and ensure minimum burn time for gas heat. There are fixed one-minute minimum on and off times for the heating output.

Heat Pump operation

The RTU Open can control heat pumps **HP O/B** and **Y1/W1**.

HP O/B provides a separate output (BO-7) to control a reversing valve. The reversing valve control may be configured to be energized with a call for heating **(B)**, or energized with a call for cooling (**O**).

The sequence of operations are as previously described for heating and cooling except that the **Y1** and **Y2** outputs are compressor outputs, energizing mechanical heating or cooling, depending on the state of the reversing valve. **W1** and **W2** are used for auxiliary heat. Up to 2 stages are available.

For heat pumps configured as **HP O/B**, the RTU Open provides a reverse cycle lockout that prevents reverse cycle operation when the OAT falls below the configured **HP Rev Cycle Lockout Temp**. Whenever the OA temperature is below this value, the RTU Open will immediately operate the auxiliary heat and disable the compressor operation whenever heating is required.

Select **Y1/W1** for heat pumps that do not require a **O** terminal to energize the reversing valve. The sequences of operations are as described for Heating and Cooling. The reversing valve output is not used in this application. **W2** is used for auxiliary heat. Up to 2 stages are available.

For all heat pump types, the RTU Open will prevent auxiliary heat operation whenever the OA temp is greater than the configured **HP Aux Heat Lockout Temp**. This allows the RTU Open to utilize the more efficient heating from the reverse cycle operation and prevents the operation of the auxiliary heat source.

IMPORTANT! All heat pump unit types **(HP O/B** and **Y1/W1**) require a valid OA Temperature value. This value may be a local sensor connected to the RTU Open or a value received from the network.

Dehumidification

The RTU Open provides occupied and unoccupied dehumidification on units that are equipped with the Carrier Humidi-MiZer™ option from the factory. This requires a space relative humidity sensor or a humidistat for control.

The following conditions must be true for the dehumidification control to operate:

- The **Outside Air Temperature** is greater than the **Cooling Lockout Temperature** setpoint
- The **Indoor Fan** has been on for at least 30 seconds
- The unit has a valid **Supply Air Temperature** input
- The unit has a valid **Space Temperature** input
- The unit has a valid **Space Relative Humidity Sensor** or **Humidistat** input
- Heat mode is not active and the time guard between modes has expired

When using a relative humidity sensor to control dehumidification, occupied and unoccupied dehumidification setpoints are used.

When using a humidistat, the setpoints are not used. The humidistat indicates a high-humidity condition.

When a high indoor relative humidity condition is indicated and the above conditions are satisfied, the RTU Open enters the dehumidification mode, energizing the Humidi-MiZer™ output.

The mode continues until the space relative humidity falls below the active setpoint by a 5% fixed Hysteresis when a humidity sensor is used, or when there is no longer a call for dehumidification where a humidistat is used.

See the base unit / Humidi-MiZer™ operations manual for additional information.

Demand Limiting

The RTU Open may employ a demand limit strategy. Demand limiting in the RTU Open works through setpoint expansion. The controller's heating and cooling setpoints are expanded in steps or levels. The degree to which the setpoints are expanded is defined by the **Demand Level Setpoints**.

Each **Demand Level** (1 through 3) adjusts the heating and cooling setpoints outwards. By default, **Demand 1** yields a 1∆°F (.5∆°C) expansion, **Demand 2** yields a 2∆°F (1.1∆°C) expansion, and **Demand 3** yields a 4∆°F (2.2∆°C) expansion.

The BACnet **Demand Limit** variable sets the desired level of setpoint expansion in the receiving controller. **Level 0** leaves the standard occupied and unoccupied heating and cooling setpoints in effect. Levels 1 through 3 expands occupied heating and cooling setpoints.

Door switch

A **Door Contact** may be configured on any unused binary input. A typical application is a door or window contact mounted within the space served by a single zone rooftop. The **Door Contact** disables mechanical cooling and any heating, when active (an open door or window is detected). Economizer cooling, if available, continues to operate. The input provides a configurable alarm delay (60 second default) before heating and cooling is disabled.

Remote Occupancy

Remote occupancy may be configured on any unused binary input channel. A typical application is a remote contact, controlled by a third party, or an occupancy sensor to set the controller's occupied mode. The **Remote Occupancy** function requires both an input configured for **Remote Occupancy**, and **Occupancy Source** set to **Remote Occ Input** to operate.

Once configured, the controller will operate in the occupied or unoccupied mode, as determined by the state of the **Remote Occupancy** input.

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** is shown on **Properties** page > **Control Program** tab > **Alarms** and 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.

Alarms

NOTE Some of the **Alarms** functions described in this section will only be visible on the **Properties** page > **Equipment** tab > **Alarms** when the appropriate inputs are configured. Alarms are not initiated when the input is not configured.

Safety Chain - You may use the RTU Open's safety chain circuit to shut down the unit for a safety condition. Examples: Low or High Temperature Cutouts (Freezestat / Firestat). This alarm indicates the safety chain circuit (Input 4) is open. Cooling, heating, and supply fan operation stop after appropriate time guards. Normal operation resumes when the safety chain circuit is complete.

Fire/Smoke Shutdown - You may configure the RTU Open to accept a **Fire Shutdown** contact on Input 5. Examples: Smoke detectors or fire shutdown relays. This alarm indicates this device (Input 5) has tripped. Cooling, heating, and supply fan operation immediately stop. Reset fire shutdown contact to resume normal operation.

Gas Valve – If configured for the IGC input function, the RTU Open will compare the state of this input with the requirement for heat (W1 or W2). If the IGC input, which detects an active flame in the gas heat section, is present 1 minute after any call for heating has ended, a gas valve failure alarm will occur, indicating a stuck gas valve.

Compressor Status – You may configure the RTU Open to monitor the base unit's compressor safety circuit. 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 a HP O/B Ctrl type and is in the heating mode, it will automatically replace the compressor stage(s) with the equivalent number of auxiliary heat stages, as available.

- If it's a Carrier Heat Pump HP Y1/W1 Ctrl, there is only 1 auxiliary heat stage output and the staging is done by the machine itself. The RTU Open control does not take any action.
- For a non-Carrier Heat Pump, when configured for 2 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 not operating. See Heat Pump operation for further information.

Space Temperature – This alarm indicates if the space temperature is outside the configured alarm limits. If active (Alarm), displays additional values for the space temperature when the alarm condition occurred and the alarm limit exceeded.

The following values are related to the **Space Temperature** alarm:

- **Alarming Temperature** – Displays the value of the space temperature that caused the alarm condition to occur and is only visible when the **Space Temperature** is in an alarm state.
- **Alarm Limit Exceeded** – Displays the value of the alarm setpoint that was exceeded by the alarming temperature and is only visible when the **Space Temperature** is in an alarm state.

SPT Sensor – This alarm indicates a communication failure of a connected SPT sensor that previously had been actively communicating. The alarm is reset when normal SPT sensor communications resume, if power is cycled to the controller, or if the **Shutdown** point is set to **Active**.

ZS Sensor – This alarm indicates a communication failure of a connected ZS sensor that had previously been actively communicating. The alarm is reset when normal ZS sensor communications resume, if power is cycled to the controller, or if the **Shutdown** point is set to **Active**.

ZS Configuration – This alarm indicates that at least 1 ZS sensor is configured in the Sensor Binder properties and is not communicating. The alarm is reset when the configured ZS sensor is communicating or the configuration is changed to reflect the sensor is no longer connected to the Rnet.

Space Temp Sensor – This alarm indicates an invalid sensor condition in a physically connected space temperature sensor (SPT Sensor/T5*). Cooling, heating, and supply fan operation stop after the appropriate time guards. Normal operation resumes when the controller detects a valid sensor.

Supply Air Temperature – This alarm indicates that the supply air temperature is outside the configured alarm limits. The alarm is reset to normal when the supply air temperature returns within the configured alarm limits plus a 3Δ°F (1.6.Δ°C) hysteresis. This alarm is inhibited until the fan has been running for 15 minutes to allow for system stabilization after startup.

Supply Air Temp Sensor – This alarm indicates a shorted or open circuit in the SAT input. Cooling, heating, and supply fan operation stops after the appropriate time guards. Normal operation resumes when the controller detects a valid sensor.

Indoor Air Quality – The RTU Open generates an **Indoor Air Quality** alarm if the CO_2 level exceeds the configured alarm limits. (This alarm is only shown when a valid indoor air quality sensor value is available).

Indoor Air Quality Sensor – The RTU Open generates an **Indoor Air Quality Sensor** alarm if a valid sensor value is no longer available. For locally connected sensors, the mA input at the associated channel falls below 3.5 mA or rises above 21 mA. For network sensors, the controller is no longer receiving a value from the network. Cooling, heating, and supply fan continue to operate. However, the controller's IAQ control function is disabled until the fault condition is corrected.

Space Relative Humidity – The RTU Open generates a **Space Relative Humidity** alarm if the space humidity level exceeds the configured low or high alarm limits. (This alarm is only shown when a valid relative humidity sensor value is available).

Space Relative Humidity Sensor – The RTU Open generates a **Space Relative Humidity Sensor** alarm if a valid sensor value is no longer available. For locally connected sensors, the mA input at the associated channel falls below 3.5 mA or rises above 21 mA. For network sensors, the controller is no longer receiving a value from the network. Cooling, heating, and supply fan operation continues, however, the controller's Humidi-MiZer™ binary output is disabled until the fault condition is corrected.

Filter – If the RTU Open is configured to monitor the filter through a hardware input switch contact, it generates a **Filter** alarm if the associated input channel detects a dirty filter condition (opposite state of the **Input** "x" **Switch Configuration**). Otherwise, if no hardware switch monitoring is used, the RTU Open generates a filter alarm when 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** > **Reset Filter Runtime Alarm** to **On**, back to **Off**, and clicking **OK** after each setting. Set **Unit Configuration** > **Filter Service Alarm Timer** value to **0** to disable the filter service alarm function.

Local OAT Sensor – This alarm indicates a shorted or open circuit in the locally connected OAT input.

Outdoor Air Temp Sensor – This alarm indicates a valid OAT sensor value is no longer available. An alarm condition can occur from a failed locally connected sensor or if a network OAT value is no longer being received by the controller. Cooling, heating, and supply fan operation continues. OAT lockouts will not operate while the sensor is in alarm. Normal operation resumes when the controller detects a valid sensor.

Economizer Operation – This alarm is active when an economizer fault is detected, as required by the CEC Title 24 Economizer FDD logic. Once detected, this alarm will stay active until the **Shutdown** input is set to **Active** or the fan is stopped.

Economizer – This point indicates the specific fault detected and announced by the Economizer Operation alarm above. Detected fault conditions include **Failed to Fully Open**, **Failed to Open**, **Failed to Close**, and **Stuck Open**.

Outdoor Air Quality Sensor – The RTU Open generates an **Outdoor Air Quality Sensor** alarm if the mA input at the associated channel falls below 3.5 mA or rises above 21 mA. For network sensors, the controller is no longer receiving a value from the network. Cooling, heating, and supply fan operation continues. However, the controller's IAQ control function uses 400ppm as the fixed outdoor air CO_2 level until the fault condition is corrected.

Setpoint Slider – The RTU Open generates this alarm when an open circuit is detected at Input 11 and the RTU Open **Configuration** > **Unit Configuration** > **Input Configuration** > **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 in the **Unit Configuration** > **Setpoint Adjustment Range**.

Switch Configuration - The RTU Open generates this alarm when any two of the **Unit Configuration** > **Input Functions 3**, **5**, **8,** or **9** are configured identically. Neither input may work reliably and downstream control may be affected, depending on the function duplicated. The alarm clears and normal control is restored when the input function duplication is corrected.

Analog Input Configuration - The RTU Open generates this alarm when the **Unit Configuration** > **Input Functions 1** and **2** are configured identically. Neither input may work reliably and downstream control may be affected, depending on the function duplicated. The alarm clears and normal control is restored when the input function duplication is corrected.

Supply Fan Runtime - The RTU Open generates a this alarm when 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** > **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 - The RTU Open generates this alarm when 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** > **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 - The RTU Open generates this alarm when the accumulated runtime exceeds the **Unit Configuration** > **Compressor 2 Service Alarm Time**r 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** > **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 States** value is not set to **Two Stages**.

Airside Linkage Alarm - An RTU Open may act as an air source in a zoned system. Carrier systems use a function called Linkage™ to pass data between a master zone and its air source over an MS/TP network connection. When the RTU Open is part of a linked system, it will indicate an airside linkage alarm if it loses communications with its linkage master or if it receives data from more than 1 master zone.

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_2 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 System Mode, Supply Air Temperature, and Outside Air Temperature (if available), and passes that information to all linked controllers.

The RTU Open is capable of operating in an SAV (Staged Air Volume) mode that is ideally suited to VVT systems. SAV requires the unit's fan be controlled by a VFD to provide variable speed fan operation. SAV operation is standard on the Carrier 3-stage LC Weather Expert units but can also be used with other 2-stage heat/cool units. To obtain SAV operation on those units, the **Fan Control** must be set to **Variable Speed**. In this mode, the fan runs at the lowest speed possible, saving energy and preventing excessive air from being bypassed during heating or cooling operation. Refer to the fan control and heating/cooling sequences for details on the specific operation. Note that using variable speed fan control does NOT eliminate the need for a Bypass damper.

NOTE The following paragraphs describe the interaction between the air source (RTU Open) and its subordinate zones. Additional information regarding Open Zoned Systems may be found in the *VVT Zone and VVT Bypass Controller Installation Guides*.

The VVT Master determines system operation by prioritizing heating and cooling requirements from all the zones based on their occupancy and demand. The VVT Master scans the system continuously to determine if any zones are occupied. Occupied zones are a higher priority than unoccupied zones. The VVT Master evaluates all the occupied zones' heating or cooling demands and sends a request to the air source (RTU Open) for:

- Cooling, if the number of occupied zones with cooling demands exceeds the number of occupied zones with heating demands, and the demand is greater than or equal to the number of configured **Linkage Callers**.
- Heating, if the number of occupied zones with a heating demand exceeds or is equal to the number of **Linkage Callers**.

If no zones are occupied or no occupied zones require heating or cooling, the VVT Master performs the evaluation described above for the unoccupied zones.

The VVT Master then gathers the following information and sends it to the air source (RTU Open):

- The setpoints and zone temperature from the zone with the greatest demand for the requested air source mode (heating or cooling). (This zone is called the reference zone.)
- The system occupancy status
- Most open damper position from any zone
- RH and CO2 values (if applicable)

The air source responds by sending the air source mode, supply air temperature, and outside air temperature. The air source verifies the mode by comparing its supply air temperature to the space temperature of the reference zone received through Linkage. See the air source documentation for operation and parameters used to verify its mode. This verification allows the VVT system to determine if the desired air source mode is actually being provided. For example, if the VVT Master sends a request for heating and the air source does not have heat or its heat has failed, the air source's actual mode indicates that and it's current mode is sent to the zones so that they can control accordingly.

The system remains in that mode until all zones of that demand are satisfied or until the system mode reselect timer (default 30 minutes) causes a forced re-evaluation of the system. If there is no demand for the opposite mode, the reselect timer starts again and the current mode continues until all zones are satisfied or until the reselect timer expires, repeating the process. If there is a demand for the opposite mode, the VVT Master sends the reference zone's space temperature and setpoints to the air source and restarts the reselect timer. The air source re-evaluates its demand based on the new information and goes to the Vent mode until the new mode can be verified as described above. The amount of time this takes is determined by the air source’s operating parameters.

The VVT Master continuously evaluates the system and updates the air source with the most current system demand. Based on the evaluation, the reference zone can change from one zone to another. The evaluation process continues until there is no demand from any zone or the system mode reselect timer causes a re-evaluation of the system conditions.

If no heating or cooling is required or the current air source mode is satisfied, the VVT Master calculates the weighted average of the occupied and unoccupied heating and cooling setpoints. It also calculates a zone temperature that is midway between the setpoints (occupied or unoccupied based on the system’s current occupancy status). This information, plus the occupancy status, is sent to the air source so that its current mode is disabled and the unit ceases heating or cooling operation. If the system is occupied, the air source fan and OA damper, if applicable, operate to maintain proper ventilation.

Linkage also provides a safety and system override function during any RTU heating mode. Whenever the RTU Open is in a heating mode, the control monitors the supply air temperature (SAT). Normally (and initially) during heating, the RTU sends the Linkage Heat mode which causes only those zones that require heat to modulate their dampers to utilize the heated primary air. If during heating the SAT increases and exceeds the Maximum Heating SAT plus 4Δ°F, Linkage transmits the Linkage Warm-up mode to all terminals. This allows more zones to utilize the heated primary air and attempts to prevent any further SAT increase. If this is insufficient, then the rooftop’s heat stages cycle off and on, subject to the minimum on and off timers specific to the product and the type of heat provided.

CAUTION It is important to properly set the value for the **Maximum Heating SAT** to match the value specified from the equipment product data recommendations. Many rooftops have heat capacity that provide a higher heat rise, resulting in an SAT in excess of the **Maximum Heating SAT** default value (120°F).

Linkage air source mode determination

Linked air source modes – In a linked system, the air source determines its operating mode and qualifies that mode based on its own SAT. The following modes can be sent by the air source depending on its capability and configuration:

OFF	Air source fan is off. All zone dampers will open to 70% to facilitate the fan restarting.
WARMUP	Air source fan is on and typically used when providing the first cycle of heat when changing from unoccupied to occupied operation. It may also be used as a safety to increase airflow during a heating mode. All zones will modulate airflow to maintain the zone temperature at the midpoint between the occupied heat and occupied cool setpoints.
HEAT	Air source fan is on and providing heat. Equipment SAT is above the reference zone temperature and all zones modulate airflow to maintain the zone temperature at the appropriate (occ/unocc) heating setpoint.
FREECOOL	Air source fan is on and providing cooling using only the economizer and usually during an unoccupied period. All zones modulate airflow to maintain the zone temperature at the occupied cooling setpoint regardless of the zone's actual occupancy status.
COOL	Air source fan is on and providing cooling. Equipment SAT is below the reference zone temperature and all zones modulate airflow to maintain the zone temperature at the appropriate (occ/unocc) cooling setpoint.
PRESSURIZATION	Air source supply fan is on usually as a result of a fire-life safety input being active. It may also be used as a safety to increase airflow during a heating mode. All zones modulate airflow to maintain the zone's maximum cooling airflow.
EVACUATION	Air source supply fan is off usually as a result of a fire-life safety input being active. All zone dampers close and local terminal fans are disabled.
VENT	Air source fan is on and providing ventilation without heating or cooling.

See the air source's installation manual for more specific operation.

Troubleshooting

The RTU Open controller acts as an intelligent embedded thermostat to the rooftop unit, but can be monitored and controlled from a third party network. For this reason, there are 3 distinct components for troubleshooting.

The three parts to the system are:

- The mechanical systems of the rooftop unit
- The RTU Open controller
- The third party network connected

Determining which component needs troubleshooting is the first step.

The RTU Open controller can be used to troubleshoot itself with service test, communicating LED's, and built-in alarms, which are discussed in the unit Controls and Troubleshooting instructions. Disconnecting the RTU Open from the unit control inputs can be valuable in determining whether the problem is related to the unit/equipment, the controller/equipment, or the controller/network. Generally, this should be the first step in troubleshooting operational problems. When disconnected from the unit control inputs, simple 24V signals can be used to activate the units G, Y1, Y2, W1, W2, etc. and verify proper unit operation. If the problem occurs without the RTU Open connected, then the operator should begin troubleshooting the unit/equipment rather than the RTU Open or network.

Third party network may also help in troubleshooting the controller and rooftop unit. Third party network troubleshooting may also be required.

LED's

The LED's indicate if the controller is speaking to the other 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.

The LED's on the show the status of certain functions.

If this LED is on...	Status is...
Power	The RTU Open has power.
Rx	The RTU Open is receiving data from the network segment
Tx	The RTU Open is transmitting data over the network segment
BO#	The binary output is active

NOTE If Tx is not lit, the MS/TP token is not being passed between controllers.

The **Run** and **Error** LED's indicate controller 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 **Run** LED	Five minute auto-restart delay after system error
2 flashes per second	3 flashes, then off	Controller has just been formatted
2 flashes per second	On	Two or more devices on this network have the same network address
2 flashes per second	On	Firmware halted after frequent system errors or control programs halted
5 flashes per second	Off	Firmware transfer in progress, Boot is running
7 flashes per second	7 flashes per second, alternating with **Run** LED	Ten second recovery period after brownout
14 flashes per second	14 flashes per second, alternating with **Run** LED	Brownout
On	On	Failure. Try the following solutions: • Turn the RTU Open off, then on. • Replace the RTU Open.

Compliance

FCC Compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

CAUTION Changes or modifications not expressly approved by the responsible party for compliance could void the user's authority to operate the equipment.

BACnet Compliance

Compliance of listed products to requirements of ASHRAE Standard 135 is the responsibility of BACnet International. BTL® is a registered trademark of BACnet International.

CE Compliance

WARNING This is a Class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

Appendix A: Network Points List for RTU Open

Network points list for BACnet and Modbus

				BACnet		Modbus	
Point Name	Point Access	Units	Default Value	BACnet Point Name	BACnet Object ID	Modbus Register Type	Modbus Register #
SA Vent / Temper Setpoint	R/W	°F	65	tempering_stpt	AV:3032	Holding Register (Float)	174
VFD Speed Config	R/W	%/V	%	vfd_spd_cfg	AV:1030		
Heating VFD Output	R/W	%	100	heat_vfd_spd	AV:3033		
Voltage Used to Set IDF VFD Heat Speed	R/W	V	4.4	ht_spd_volt	AV:83010		
Voltage Used to Set IDF VFD Maximum Speed	R/W	V	10	max_spd_volt	AV:83011		
Voltage Used to Set IDF VFD Minimum Speed	R/W	V	5.2	min_spd_volt	AV:83012		
Tempering Enable	R/W		Disable	sa_tempering_en	AV:83016		
VFD Speed Test	R/W	V	0	vfd_spdv_test	AV:81003		
Supply Fan VFD Voltage	R	V		vfd_volt_output	AV:2032		
VFD Analog Input Channel Type	R/W	Vdc	2 to 10	vfd_in_type	AV:91010		
Active Heat Stages	R			heat_run	AV:2003	Input Register (Float)	33
Effective Cool Setpoint	R	°F		eff_cl_stpt	AV:3005	Input Register (Float)	55
High Space Temperature	R	0=Normal 1=Alarm		spt_hi_alarm	BV:7011	Discrete Input	35
Low Space Temperature	R	0=Normal 1=Alarm		spt_lo_alarm	BV:7012	Discrete Input	39
Input_6	R	°F		ai_6	AI:1006		
Supply Fan Relay State	R	0=Off 1=On		sfan	BV:2001	Discrete Input	23
Supply Fan Status	R	0=Off 1=On		sfan_status	BV:1003	Discrete Input	24
Economizer Output	R	%Open		econ_output	AV:2022	Input Register (Float)	51
Outdoor Air Quality Sensor	R	0=Normal 1=Alarm		oaq_fail	BV:7006	Discrete Input	41
DCV Max Vent Damper Pos	R/W	%Open	50	iaq_dpr_max	AV:9011	Holding Register (Float)	47
Space Temperature - Prime Variable	R	°F		space_temp	AV:2007	Input Register (Float)	107
HP Rev Cycle Lockout Temp	R/W	°F	-3	hp_rev_cycle_lockout	AV:9004	Holding Register (Float)	71
System Outdoor Air Temperature	R/W	°F	-999	system_oat	AV:1901	Holding Register (Float)	119

				BACnet		Modbus	
Point Name	Point Access	Units	Default Value	BACnet Point Name	BACnet Object ID	Modbus Register Type	Modbus Register #
Economizer Purge Min Pos	R/W	%Open	40	econ_purge_min	AV:9029	Holding Register (Float)	75
Active Compressor Stages	R			comp_run	AV:2020	Input Register (Float)	31
System Mode	R	1=Off 2=Fan Only 3=Economizer Cooling 4=Cooling 5=Heating 6=Dehumidification 7=Test 8=Shutdown 9=Unocc Free Cooling 10=Fire Shutdown 11=IAQ Override 12=Pre-occ Purge 13=IGC Override		run_status	MSV:2002	Input Register (Signed)	1
Supply Air Temperature	R	°F		sa_temp	AV:1008	Input Register (Float)	109
DCV Max Ctrl Setpoint	R/W	ppm	650	iaq_stpt_max	AV:3013	Holding Register (Float)	45
Occ Relative Humidity Setpoint	R/W	%rh	60	occ_dehum_stpt	AV:3011	Holding Register (Float)	83
Occupancy Status	R	0=Unoccupied 1=Occupied		occ_status	BV:2008	Discrete Input	18
Optimal Start Type	R/W	1=None 2=Temp Compensated 3=Learning Adaptive	2	start_type	MSV:2009	Holding Register (Signed)	154
Setpoint	R/W	°F		unocc_ht_stpt	AV:3004	Holding Register (Float)	17
Economizer Test	R/W	%Open	0	econ_test	AV:81001		
Space Relative Humidity Sensor	R	0=Normal 1=Alarm		sprh_sensor_fail	BV:7022	Discrete Input	45
Setpoint Adjustment	R	°F		stpt_adj	AV:1006	Input Register (Float)	99
Effective Heat Setpoint	R	°F		eff_ht_stpt	AV:3006	Input Register (Float)	57
Low Fan Econ Min Pos	R/W	%Open	33	econ_min_2	AV:9030	Holding Register (Float)	89
Fire / Smoke Shutdown	R	0=Normal 1=Alarm		fire_alarm	BV:7007	Discrete Input	32
Reset Filter Alarm	R/W	0=Off 1=On	Inactive (0)	filter_rntm_clr	BV:7517	Coil	22
Setpoint	R/W	°F		unocc_cl_stpt	AV:3003	Holding Register (Float)	15
ZS Sensor Configuration	R	0=Normal 1=Alarm		zs_config_fail	BV:7055	Discrete Input	63
Space Relative Humidity	R	%rh		space_rh	AV:1011	Input Register (Float)	103
Outdoor Air Temperature	R	°F		oa_temp	AV:1003	Input Register	87

				BACnet		Modbus	
Point Name	Point Access	Units	Default Value	BACnet Point Name	BACnet Object ID	Modbus Register Type	Modbus Register #
						(Float)	
Cooling Lockout Temperature	R/W	°F	45	oat_cl_lockout	AV:9002	Holding Register (Float)	43
Power Exhaust Setpoint	R/W	%Open	50	pexh_stpt	AV:3010	Holding Register (Float)	97
BAS On / Off	R/W	1=Inactive 2=Occupied 3=Unoccupied	1	keypad_ovrde	MSV:1001	Holding Register (Signed)	133
System Space AQ	R/W	ppm	-999	system_iaq	AV:1903	Holding Register (Float)	149
System Space RH	R/W	%	-999	system_rh	AV:1904	Holding Register (Float)	151
Compressor Status	R	0=Normal 1=Alarm		comp_alarm	BV:7013	Discrete Input	30
Filter Service Alarm Timer	R/W	hr	600	filter_service_hrs	AV:2019	Holding Register (Float)	67
Indoor Air Quality Sensor	R	0=Normal 1=Alarm		iaq_sensor_fail	BV:7039	Discrete Input	37
Heating Lockout Temperature	R/W	°F	65	oat_ht_lockout	AV:9003	Holding Register (Float)	69
Dehumidification	R	0=Inactive 1=Active		dehum	BV:2006	Discrete Input	9
Reversing Valve Relay State	R	0=Off 1=On		aux_1	BV:2007	Discrete Input	20
Password Protected Output Variable	R/W		0	ppo	AV:90000		
Vent Dmpr Pos / DCV Min Pos	R/W	%Open	20	econ_min	AV:9005	Holding Register (Float)	131
Filter	R	0=Clean 1=Dirty		filter_alarm	BV:7017	Discrete Input	31
Safety Chain	R	0=Normal 1=Alarm		safety_alarm	BV:7024	Discrete Input	43
Unocc Relative Humidity Setpoint	R/W	%rh	95	unocc_dehum_stpt	AV:3012	Holding Register (Float)	129
Setpoint	R/W	°F		occ_ht_stpt	AV:3002	Holding Register (Float)	19
Supply Air Temp Sensor	R	0=Normal 1=Alarm		loc_sat_sensor_fail	BV:7020	Discrete Input	51
Override Time Remaining	R	min		ovrde_time	AV:2016	Input Register (Float)	93
Setpoint Adjustment	R/W	0=Disable 1=Enable	Active (1)	stpt_adj_enable	BV:1013	Coil	26
System Space Temperature	R/W	°F	-999	system_spt	AV:1902	Holding Register (Float)	123
Space Temperature Offset Pot	R	°F		stpt_adj_offset	AV:91006		
System Outdoor AQ	R/W	ppm	-999	system_oaq	AV:1908	Holding Register (Float)	155
Outdoor Air Temp Sensor	R	0=Normal 1=Alarm		oat_fail	BV:7029	Discrete Input	27
SPT Sensor	R	0=Normal 1=Alarm		spt_sensor_fail	BV:7032	Discrete Input	38
Fan / Speed	R	1=Off 2=Low		fan_run	MSV:2004	Input Register (Signed)	175

				BACnet		Modbus	
Point Name	Point Access	Units	Default Value	BACnet Point Name	BACnet Object ID	Modbus Register Type	Modbus Register #
		3=Med 4=High 5=On					
Setpoint Adjustment Range	R/W	°^F	5	stpt_adj_range	AV:9015	Holding Register (Float)	101
Enthalpy (BACnet)	R/W	0=High 1=Low	Active (1)	oae	BV:1901	Coil	6
Optimal Start	R/W	hr	1	optm_start	AV:9026	Holding Register (Float)	147
System Cooling Demand Level	R			cool_demand_level	AV:9006		
System Heating Demand Level	R			heat_demand_level	AV:9036		
System OAT Master	R	°F		mstr_oa_temp	AV:80001		
T5x Override Duration	R/W	hr	1	ovr_dur	AV:9023		
VFD Speed Test	R/W	%	0	vfd_spd_test	AV:81002		
input_3	R	0=Off 1=On		di_3	BI:1003		
input_4	R	0=Off 1=On		di_4	BI:1004		
input_5	R	0=Off 1=On		di_5	BI:1005		
input_8	R	0=Off 1=On		di_8	BI:1008		
input_9	R	0=Off 1=On		di_9	BI:1009		
Airside Linkage	R	0=Normal 1=Alarm		air_linkage_fail	BV:7030		
Analog Input Configuration	R	0=Normal 1=Alarm		ai_cfg_alarm	BV:7026		
Compressor 1 Runtime	R	0=Normal 1=Alarm		comp1_rntm_alarm	BV:7014		
Compressor 1 Relay State	R	0=Off 1=On		comp_1	BV:2005		
Compressor 1 Test	R/W	0=Disable 1=Enable	Inactive (0)	comp1_test	BV:81005		
Compressor 2 Relay State	R	0=Off 1=On		comp_2	BV:2004		
Compressor 2 Runtime	R	0=Normal 1=Alarm		comp2_rntm_alarm	BV:7015		
Compressor 2 Test	R/W	0=Disable 1=Enable	Inactive (0)	comp2_test	BV:81004		
Compressor Safety Status	R	0=Normal 1=Trouble		comp_status	BV:1008		
Continuous Occupied Exhaust	R/W	0=No 1=Yes	Inactive (0)	occ_exh	BV:9002		
DCV Control	R/W		Inactive (0)	dcv_enable	BV:1027		
Dehumidification Test	R/W	0=Disable 1=Enable	Inactive (0)	dehum_test	BV:81006		
Door Contact Status	R	0=Off 1=On		door_contact_status	BV:1010		
Economizer Exists	R/W	0=No 1=Yes	Inactive (0)	econ_exist	BV:99001		

				BACnet		Modbus	
Point Name	Point Access	Units	Default Value	BACnet Point Name	BACnet Object ID	Modbus Register Type	Modbus Register #
Enthalpy Status	R	0=High 1=Low		enthalpy_status	BV:1002		
Factory Test	R/W	0=Off 1=On	Inactive (0)	fac_test_enable	BV:91000		
Factory Test Relay 1 Control	R/W	0=Off 1=On	Inactive (0)	relay1_fac_test	BV:91001		
Factory Test Relay 2 Control	R/W	0=Off 1=On	Inactive (0)	relay2_fac_test	BV:91002		
Factory Test Relay 3 Control	R/W	0=Off 1=On	Inactive (0)	relay3_fac_test	BV:91003		
Factory Test Relay 4 Control	R/W	0=Off 1=On	Inactive (0)	relay4_fac_test	BV:91004		
Factory Test Relay 5 Control	R/W	0=Off 1=On	Inactive (0)	relay5_fac_test	BV:91005		
Factory Test Relay 6 Control	R/W	0=Off 1=On	Inactive (0)	relay6_fac_test	BV:91006		
Factory Test Relay 7 Control	R/W	0=Off 1=On	Inactive (0)	relay7_fac_test	BV:91007		
Factory Test Relay 8 Control	R/W	0=Off 1=On	Inactive (0)	relay8_fac_test	BV:91008		
Filter Status	R	0=Clean 1=Dirty		filter_status	BV:1004		
Fire Shutdown Status	R	0=Run Enabled 1=Shutdown		firedown_status	BV:1005		
Heat 1Test	R/W	0=Disable 1=Enable	Inactive (0)	heat1_test	BV:81003		
Heat 2Test	R/W	0=Disable 1=Enable	Inactive (0)	heat2_test	BV:81002		
Heat Stage 1 Relay State	R	0=Off 1=On		heat_1	BV:2003		
Heat Stage 2 Relay State	R	0=Off 1=On		heat_2	BV:2002		
Heat Type	R/W	0=Electric 1=Gas	Inactive (0)	heat_type	BV:99002		
High Speed Fan Test	R/W	0=Disable 1=Enable	Inactive (0)	hi_spd_test	BV:81010		
Humidistat Input Status	R	0=High 1=Low		humstat_status	BV:1006		
IGC Override	R	0=Off 1=Active		igcovr_status	BV:1022		
Local OAT Sensor	R	0=Normal 1=Alarm		loc_oat_sensor_fail	BV:7003		
Occupancy Contact	R	0=Off 1=On		occ_contact_status	BV:1007		
Power Exhaust Relay State	R	0=Off 1=On		pexh	BV:2010		
Power Exhaust Test	R/W	0=Disable 1=Enable	Inactive (0)	pexh_test	BV:81008		
Reset Comp 1 Runtime Alarm	R/W	0=Run 1=Clear	Inactive (0)	comp1_rntm_clr	BV:7514		
Reset Comp 2 Runtime Alarm	R/W	0=Run 1=Clear	Inactive (0)	comp2_rntm_clr	BV:7515		
Reset Supply Fan Runtime Alarm	R/W	0=Run 1=Clear	Inactive (0)	sfan_rntm_clr	BV:7510		

				BACnet		Modbus	
Point Name	Point Access	Units	Default Value	BACnet Point Name	BACnet Object ID	Modbus Register Type	Modbus Register #
Reversing Valve Output	R/W		Inactive (0)	rev_vlv_type	BV:1026		
RH Control	R/W		Inactive (0)	rh_enable	BV:1025		
Safety Chain Feedback	R	0=Off 1=On		safety_status	BV:1009		
Schedule	R/W	0=Unoccupied 1=Occupied	0	schedule	BV:8000		
Service Test	R/W	0=Disable 1=Enable	Inactive (0)	test_enable	BV:81000		
Setpoint Slider	R	0=Normal 1=Alarm		slidepot_alarm	BV:7002		
Shutdown	R/W	0=Inactive 1=Active	Inactive (0)	shutdown	BV:9001		
Supply Fan Failure	R	0=Normal 1=Alarm		sfan_fail_alarm	BV:7008		
Supply Fan in Hand	R	0=Normal 1=Alarm		sfan_hand_alarm	BV:7009		
Supply Fan Runtime	R	0=Normal 1=Alarm		sfan_rntm_alarm	BV:7010		
Switch Configuration	R	0=Normal 1=Alarm		di_cfg_alarm	BV:7025		
System is shut down	R	0=No 1=Yes		shutdown_status	BV:2011		
Unocc Free Cool	R/W	0=Disable 1=Enable	Inactive (0)	ntfc_ena	BV:80001		
Air Source Mode	R	1=Off 2=Warmup 3=Heating 4=Cooling 5=Freecool 6=Pressure 7=Evac 8=Vent		link_ahu_mode	MSV:2005		
Compressor Stages	R/W	1=One Stage 2=Two Stages	2	comp_stages	MSV:91003		
Equipment Status	R	1=Disabled 2=Test 3=Run		mode_status	MSV:2001		
Fan Control	R/W	1=Single Speed 2=Two Speed 3=Variable Speed	3	fan_type	MSV:9031		
Fan Mode	R/W	1=Auto 2=Continuous 3=Always On	2	fan_mode	MSV:9032		
Input 1 Function	R/W	1=No Sensor 2=IAQ Sensor 3=OAQ Sensor 4=Space RH Sensor	1	ai1_function	MSV:81001		
Input 2 Function	R/W	1=No Sensor 2=IAQ Sensor 3=OAQ Sensor 4=Space RH Sensor	1	ai2_function	MSV:81002		

				BACnet		Modbus	
Point Name	Point Access	Units	Default Value	BACnet Point Name	BACnet Object ID	Modbus Register Type	Modbus Register #
Input 3 Function	R/W	1=No Function 2=Compressory Safety 3=Fan Status 4=Filter Status 5=Remote Occupancy 6=Door Contact	2	di3_function	MSV:81003		
Input 3 Switch Configuration	R/W	1=NO 2=NC	1	di3_type	MSV:81013		
Input 5 Function	R/W	1=No Function 2=Fire Shutdown 3=Fan Status 4=Filter Status 5=Remote Occupancy 6=Door Contact	2	di5_function	MSV:81005		
Input 5 Switch Configuration	R/W	1=NO 2=NC	1	di5_type	MSV:81015		
Input 8 Function	R/W	1=No Function 2=Enthalpy Switch 3=Fan Status 4=Filter Status 5=Remote Occupancy 6=Door Contact	2	di8_function	MSV:81008		
Input 8 Switch Configuration	R/W	1=NO 2=NC	1	di8_type	MSV:81018		
Input 9 Function	R/W	1=No Function 2=HumidiStat 3=Fan Status 4=Filter Status 5=Remote Occupancy 6=Door Contact	2	di9_function	MSV:81009		
Input 9 Switch Configuration	R/W	1=NO 2=NC	1	di9_type	MSV:81019		
Number Of Heat Stages	R/W	1=1 2=2 3=0	2	heat_stages	MSV:91004		
Occupancy Source	R/W	1=Always Occupied 2=BACnet Schedule 3=BAS On/Off 4=Remote Occ Input	1	occ_source	MSV:1002		
Space sensor type	R/W	1=T55 2=T56 3=SPT Sensor 4=None	1	spt_type	MSV:9001		
Space Temp Source	R	1=Sensor Failure 2=SPT Sensor 3=T55 / T56 4=Network 5=Airside Linkage 6=Locked Value		spt_status	MSV:2003		

				BACnet		**Modbus**	
Point Name	Point Access	Units	Default Value	BACnet Point Name	BACnet Object ID	Modbus Register Type	Modbus Register #
Unit Type	R/W	1=Heat / Cool 2=LC WeatherExpert 3=HP O/B Ctrl 4=HP Y1/W1 Ctrl	2	unit_type	MSV:9018		
ZS Temp Sensor	R	0=Normal 1=Alarm		zst_sensor_fail	BV:7051		
Economizer Operation	R	0=Normal 1=Fault Detected		econ_opr	BV:7054		
Space Temperature Alarm Status	R	0=Normal 1=Alarm		spt_alrm_status	BV:7056		
SPT Sensor	R	°F		zone_temp_zone_temp	AI:1		
SPT Sensor	R	min		zone_temp_override_time_remaining	AV:1		
input_10	R	°F		ai_10	AI:1010		
Factory Test Analog 1 Control	R/W	%	0	ao1_fac_test	AV:91001		
Economizer High OAT Lockout Temp	R/W	°F	75	oat_ec_lockout	AV:9008		
Maximum Heating SAT	R/W	°F	120	sat_ht_max	AV:83004		
Compressor 2 Runtime	R	hr		comp2_rntm	AV:2018		
Linkage Max Damper Position	R	%		link_max_dmpr	AV:2611		
Air Source Supply Air Temp	R	°F		link_sat	AV:2608		
Max VFD Output	R/W	%	100	max_vfd_spd	AV:3026		
Dehum Min VFD Output	R/W	%	100	dehum_min_vfd	AV:3028		
Air Source Outdoor Air Temp	R	°F		link_ahu_oat	AV:2609		
Stage 3 SAT Stpt	R/W	°F	56	stg_3_sat	AV:83010		
Stage 1 SAT Stpt	R/W	°F	57	stg_1_sat	AV:83008		
HP Aux Heat Lockout Temp	R/W	°F	40	oat_auxht_lockout	AV:3025		
input_1	R			ai_1	AI:1001		
Factory Test Analog 2 Control	R/W	V	0	ao2_fac_test	AV:91002		
Compressor 2 Service Alarm Timer	R/W	hr	0	comp2_service_hrs	AV:83007		
Compressor 1 Service Alarm Timer	R/W	hr	0	comp1_service_hrs	AV:83006		
Compressor 1 Runtime	R	hr		comp1_rntm	AV:2017		
Min VFD Output	R/W	%	40	min_vfd_spd	AV:3027		
Stage 2 SAT Stpt	R/W	°F	57	stg_2_sat	AV:83009		
slidepot voltage reading	R			slidepot_volts	AI:1012		
Filter Runtime	R	hr		filter_rntm	AV:2015		
Fan Off Delay	R/W	seconds	90	fan_delay_off	AV:9024		
input_7	R	°F		ai_7	AI:1007		
input_11	R			ai_11	AI:1011		
input_2	R			ai_2	AI:1002		
Minimum Cooling SAT	R/W	°F	50	sat_cl_min	AV:83003		
Power Fail Restart Delay	R/W	seconds	5	start_delay	AV:9007	Holding Register	127

				BACnet		Modbus	
Point Name	Point Access	Units	Default Value	BACnet Point Name	BACnet Object ID	Modbus Register Type	Modbus Register #
						(Float)	
Supply Fan Service Alarm Timer	R/W	hr	0	sfan_service_hrs	AV:83005		
Supply Fan Runtime	R	hr		sfan_rntm	AV:2014		
Indoor Air Quality CO2 (ppm)	R	ppm		iaq	AV:1009	Input Register (Float)	73
Supply Fan VFD	R	%		vfd_output	AV:2027		
Indoor Air Quality	R	0=Normal 1=Alarm		iaq_alarm	BV:7005	Discrete Input	33
Supply Air Temperature	R	0=Normal 1=Alarm		sat_alarm	BV:7004	Discrete Input	47
Space Relative Humidity	R	0=Normal 1=Alarm		sprh_hi_alarm	BV:7018	Discrete Input	34
Space Temp Sensor	R	0=Normal 1=Alarm		spt_fail	BV:7001	Discrete Input	46
Outdoor Air Quality CO2 (ppm)	R	ppm		oaq	AV:1012	Input Register (Float)	85
Gas Valve	R	0=Normal 1=Alarm		igc_alarm	BV:7050	Discrete Input	40
Setpoint	R/W	°F		occ_cl_stpt	AV:3001	Holding Register (Float)	9

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Network points list for N2 and LonWorks

				N2		Lonworks	
Point Name	Point Access	Units	Default Value	N2 Network Point Type	N2 Network Point Address	SNVT Type	SNVT Name
SA Vent / Temper Setpoint	R/W	°F	65	ADF	77		
Active Heat Stages	R			ADF	11	SNVT_count_inc(9)	nvoHtStgs
Effective Cool Setpoint	R	°F		ADF	22	SNVT_temp_p(105)	nvoEffCoolSP
High Space Temperature	R	0=Normal 1=Alarm		BI	35	SNVT_switch(95)	nvoHiSpTemp
Low Space Temperature	R	0=Normal 1=Alarm		BI	39	SNVT_switch(95)	nvoLoSpTmp
Supply Fan Relay State	R	0=Off 1=On		BI	23		
Supply Fan Status	R	0=Off 1=On		BI	24	SNVT_switch(95)	nvoFanStatus
Economizer Output	R	%Open		ADF	20	SNVT_lev_percent(81)	nvoEconOut
Outdoor Air Quality Sensor	R	0=Normal 1=Alarm		BI	41	SNVT_switch(95)	nvoOAQSensor
DCV Max Vent Damper Pos	R/W	%Open	50	ADF	18	SNVT_lev_percent(81)	nviDCVMaxPos
Space Temperature - Prime Variable	R	°F		ADF	48	SNVT_temp_p(105)	nvoSpaceTemp
HP Rev Cycle Lockout Temp	R/W	°F	-3	ADF	30	SNVT_temp_p(105)	nviHPRvClLk
System Outdoor Air Temperature	R/W	°F	-999	ADF	54	SNVT_temp_p(105)	nviSysOAT
Economizer Purge Min Pos	R/W	%Open	40	ADF	5	SNVT_lev_percent(81)	nvoEcnPrgMin
Active Compressor Stages	R			ADF	10	SNVT_count_inc(9)	nvoCmpStages
System Mode	R	1=Off 2=Fan Only 3=Economizer Cooling 4=Cooling 5=Heating 6=Dehumidification 7=Test 8=Shutdown 9=Unocc Free Cooling 10=Fire Shutdown 11=IAQ Override 12=Pre-occ Purge 13=IGC Override		ADI	13	SNVT_count_inc(9)	nvoOpMode
Supply Air Temperature	R	°F		ADF	49	SNVT_temp_p(105)	nvoSAT
DCV Max Ctrl Setpoint	R/W	ppm	650	ADF	17	SNVT_ppm(29)	nviDCVMaxPPM
Occ Relative Humidity Setpoint	R/W	%rh	60	ADF	36	SNVT_lev_percent(81)	nviOcRHSP
Occupancy Status	R	0=Unoccupied 1=Occupied		BI	18	SNVT_switch(95)	nvoOccStatus
Optimal Start Type	R/W	1=None 2=Temp Compensated 3=Learning Adaptive	2	ADI	20	SNVT_count_inc(9)	nviOptStType
Setpoint	R/W	°F		ADF	8	SNVT_temp_p(105)	nviUnoccHtSP

				N2		Lonworks	
Point Name	Point Access	Units	Default Value	N2 Network Point Type	N2 Network Point Address	SNVT Type	SNVT Name
Space Relative Humidity Sensor	R	0=Normal 1=Alarm		BI	45	SNVT_switch(95)	nvoSpRHSenr
Setpoint Adjustment	R	°F		ADF	44	SNVT_temp_p(105)	nvoSPAdjust
Effective Heat Setpoint	R	°F		ADF	23	SNVT_temp_p(105)	nvoEffHeatSP
Low Fan Econ Min Pos	R/W	%Open	33	ADF	32	SNVT_lev_percent(81)	nviLwFnEcnMn
Fire / Smoke Shutdown	R	0=Normal 1=Alarm		BI	32	SNVT_switch(95)	nvoFrShtdwn
Reset Filter Alarm	R/W	0=Off 1=On	Inactive (0)	BO	22	SNVT_switch(95)	nviRstFilAlm
Setpoint	R/W	°F		ADF	7	SNVT_temp_p(105)	nviUnoccClSP
ZS Sensor Configuration	R	0=Normal 1=Alarm		BI	63	SNVT_switch(95)	nvoZsCfgFail
Space Relative Humidity	R	%rh		ADF	46	SNVT_lev_percent(81)	nvoSpaceRH
Outdoor Air Temperature	R	°F		ADF	38	SNVT_temp_p(105)	nvoOAT
Cooling Lockout Temperature	R/W	°F	45	ADF	16	SNVT_temp_p(105)	nviClLckTemp
Power Exhaust Setpoint	R/W	%Open	50	ADF	43	SNVT_lev_percent(81)	nviPwrExhSP
BAS On / Off	R/W	1=Inactive 2=Occupied 3=Unoccupied	1	ADI	1	SNVT_count_inc(9)	nviBASOnOff
System Space AQ	R/W	ppm	-999	ADF	39	SNVT_count_inc(9)	nviSysSpAQ
System Space RH	R/W	%	-999	ADF	40	SNVT_lev_percent(81)	nviSysSpRH
Compressor Status	R	0=Normal 1=Alarm		BI	30	SNVT_switch(95)	nvoCmpSafety
Filter Service Alarm Timer	R/W	hr	600	ADF	28	SNVT_count_inc(9)	nviFltAlmTm
Indoor Air Quality Sensor	R	0=Normal 1=Alarm		BI	37	SNVT_switch(95)	nvoIAQSensor
Heating Lockout Temperature	R/W	°F	65	ADF	29	SNVT_temp_p(105)	nviHtLckTmp
Dehumidification	R	0=Inactive 1=Active		BI	9		
Reversing Valve Relay State	R	0=Off 1=On		BI	20		
Vent Dmpr Pos / DCV Min Pos	R/W	%Open	20	ADF	60	SNVT_lev_percent(81)	nviDCVMinPos
Filter	R	0=Clean 1=Dirty		BI	31	SNVT_switch(95)	nvoFilter
Safety Chain	R	0=Normal 1=Alarm		BI	43	SNVT_switch(95)	nvoSftyChain
Unocc Relative Humidity Setpoint	R/W	%rh	95	ADF	59	SNVT_lev_percent(81)	nviUnoccRHSP
Setpoint	R/W	°F		ADF	9	SNVT_temp_p(105)	nviOccHeatSP
Supply Air Temp Sensor	R	0=Normal 1=Alarm		BI	51	SNVT_switch(95)	nvoSATSensor
Override Time Remaining	R	min		ADF	41	SNVT_count_inc(9)	nvoOvrTmRem
Setpoint Adjustment	R/W	0=Disable 1=Enable	Active (1)	BO	26	SNVT_switch(95)	nviSPAdjEnbl
System Space Temperature	R/W	°F	-999	ADF	56	SNVT_temp_p(105)	nviSysSpTmp
System Outdoor AQ	R/W	ppm	-999	ADF	63		

				N2		Lonworks	
Point Name	Point Access	Units	Default Value	N2 Network Point Type	N2 Network Point Address	SNVT Type	SNVT Name
Outdoor Air Temp Sensor	R	0=Normal 1=Alarm		BI	27		
SPT Sensor	R	0=Normal 1=Alarm		BI	38		
Fan / Speed	R	1=Off 2=Low 3=Med 4=High 5=On		ADI	4		
Setpoint Adjustment Range	R/W	°^F	5	ADF	45	SNVT_count_inc(9)	nviSPAdjRng
Enthalpy (BACnet)	R/W	0=High 1=Low	Active (1)	BO	6	SNVT_switch(95)	nviSysEnth
Optimal Start	R/W	hr	1	ADF	61	SNVT_count_inc(9)	nviOptmStart
Power Fail Restart Delay	R/W	seconds	5	ADF	58	SNVT_count_inc(9)	nviUntStrDly
Indoor Air Quality CO2 (ppm)	R	ppm		ADF	31	SNVT_ppm(29)	nvoIAQ
Indoor Air Quality	R	0=Normal 1=Alarm		BI	33	SNVT_switch(95)	nvoIAQAlm
Supply Air Temperature	R	0=Normal 1=Alarm		BI	47	SNVT_switch(95)	nvoSATAlm
Space Relative Humidity	R	0=Normal 1=Alarm		BI	34	SNVT_switch(95)	nvoHiSPRHAlm
Space Temp Sensor	R	0=Normal 1=Alarm		BI	46	SNVT_switch(95)	nvoSPTmpSen
Outdoor Air Quality CO2 (ppm)	R	ppm		ADF	37	SNVT_ppm(29)	nvoOAQ
Gas Valve	R	0=Normal 1=Alarm		BI	40	SNVT_switch(95)	nvoGasVlvAlm
Setpoint	R/W	°F		ADF	4	SNVT_temp_p(105)	nviOccCoolSP

Appendix B: BACnet Protocol Implementation Conformance Statement

The PIC statements are updated regularly. Please refer to the *BACnet website http://www.bacnetinternational.net/catalog/index.php?m=28* for the latest information.

Appendix C: Modbus Protocol Implementation Conformance Statement

Date: 11/12/2013

Vendor Name: **Carrier**

Product Names: **RTU Open**

Product Model Number: **RTU Open**

Protocol Description:

The RTU Open controller speaks the Modicon Modbus RTU/ASCII Protocol as described in the *Modicon Modbus Protocol Reference Guide, PI-MBUS-300 Rev.J.* Further details on the Modbus implementation are described below.

Product Description:

The RTU Open is a factory-installed rooftop controller that is capable of speaking multiple protocols.

Serial Transmission Mode:	Supported?
RTU	Slave only
ASCII	Not supported

Communication Types:	Baud rates:	Data Bits:	Parity:	Stop Bits:
2-wire EIA-485,	9600, 19200, 38400, 76800	8	None	1

Function Codes:	Purpose:	Used with Register Numbers:
01 – Read Coil Status	Read Discrete Outputs	00001 - 65535
02 – Read Input Status	Read Discrete Inputs	00001 - 65535
03 – Read Holding Registers	Read Holding Registers	00001 - 65535
04 – Read Input Registers	Read Input Registers	00001 - 65535
05 – Force Single Coil	Write Discrete Outputs (single)	00001 - 65535
06 – Preset Single Register	Write Holding Registers (single)	00001 - 65535
15 – Force Multiple Coils	Write Discrete Outputs	00001 - 65535
16 – Preset Multiple Coils	Write Holding Registers	00001 - 65535

Register Type:	**Range:**	**Function Codes Used with this Register Type:**
Float Value (FLOAT)	Single-Precision IEEE floating point value	3 – Read Holding Register 6 – Preset Single Register 16 – Preset Multiple Register
Unsigned Integer (UINT)	0 - 65535	3 – Read Holding Register 6 – Preset Single Register 16 – Preset Multiple Register
Signed Integer (SINT)	-32768 - 32767	3 – Read Holding Register 6 – Preset Single Register 16 – Preset Multiple Register
Discrete Input (DI)	0 = Off, 1 = On	2 – Read Input Status
Discrete Output (DO)	0 = Off, 1 = On	1 – Read Coil Status 5 – Force Single Coil 15 – Force Multiple Coils

Appendix D: Johnson N2 Protocol Implementation Conformance Statement

Vendor Name: **Carrier**

Product Names: **RTU Open**

Product Model Number: **RTU Open**

Protocol Description:

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. The N2 slave address can be set from 01 to 99.

Product Description:

The RTU Open is a factory-installed rooftop controller that is capable of speaking multiple protocols. The RTU Open controller speaks the Johnson N2 Open Protocol as described in the *Metasys N2 System Protocol Specification (for Vendors) document*, revision 6/13/96. Further details on the N2 supported implementation are described below.

Communication Types:	**Baud rates:**	**Data Bits:**	**Parity:**	**Stop Bits:**
2-wire EIA-485	9600	8	None	1

Network Point Types:
Analog Inputs (AI)
Binary Inputs (BI)
Analog Outputs (AO)
Binary Outputs (BO)
Internal Floats (ADF)
Internal Integers (ADI)
Internal Bytes (BD)

Protocol Commands:
Identify Device Type
Sync Time
Poll Without Acknowledge
Poll With Acknowledge
Read Analog Input
Read Binary Input
Read Analog Output
Read Binary Output
Read Internal Parameter
Write Analog Input
Write Binary Input

Write Analog Output
Write Binary Output
Write Internal Parameter
Override Analog Input
Override Binary Input
Override Internal Parameter
Override Release Request

Appendix E: LonWorks Protocol Implementation Conformance Statement

Date: 11/12/2013

Vendor Name: **Carrier**

Product Names: **RTU Open**

Product Model Number: **RTU Open**

Product Description:

The RTU Open is a factory-installed rooftop controller that is capable of speaking multiple protocols. When the LonWorks Option Card (LON-OC), is installed in the field, it enables the RTU Open to communicate over a LonTalk network. The RTU Open does not conform to a standard LonWorks profile, but is self-documenting and any network management tool can manage and configure it over the network. An external interface file (.XIF), is also available so that any network management tool can design and configure the RTU Open prior to installation. Contact your Carrier representative for this .XIF file.

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

This accessory card must be ordered separately and is connected by attaching its ribbon cable into the **J15** connector on the RTU Open. The RTU Open's baud rate (**DS1** and **DS2** on **SW3**) must be set to 38.4k to communicate with the LON-OC. The address switches (**SW1** and **SW2**) are not used with LonWorks.

Transceiver Type: TP/FT 10

Document revision history

Important changes to this document are listed below. Minor changes such as typographical or formatting errors are not listed.

Date	Topic	Change description	Code*
		New document. No changes yet.	

* For internal use only