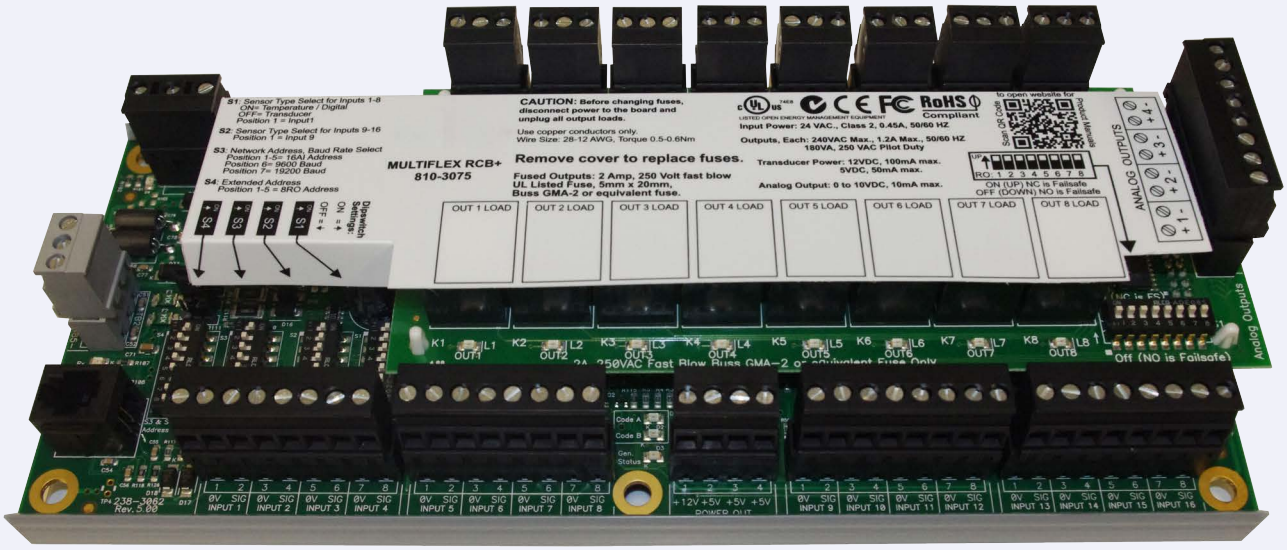
USER MANUAL

# MultiFlex RCB/RCB-P Rooftop Controller

*Installation and Operation User Manual*

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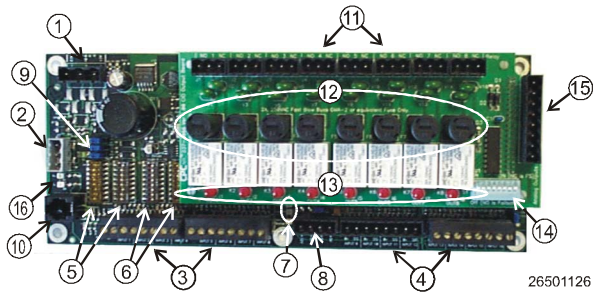
# 1 Overview of the MultiFlex RCB




| LEGEND | | | |
|---|---|---|---|
| 1 | INPUT POWER (24VAC) | 9 | RS485 I/O TERMINATION JUMPERS |
| 2 | RS485 I/O NETWORK | 10 | HAND-HELD TERMINAL JACK |
| 3 | RCB INPUTS 1-8 | 11 | RELAY OUTPUT CONNECTORS |
| 4 | RCB INPUTS 9-16 | 12 | RELAY OUTPUT FUSES (2A rated, 250V slow-blow) |
| 5 | NETWORK ID DIP SWITCHES (S3, S4) | 13 | RELAY STATUS LEDs |
| 6 | INPUT TYPE DIP SWITCHES (S1, S2) | 14 | OUTPUT FAIL-SAFE SWITCHES |
| 7 | BOARD STATUS LEDs (Code A, Code B, General Status) | 15 | ANALOG OUTPUTS |
| 8 | DC POWER OUTPUTS (3 at +5VDC, 1 at +12VDC) | 16 | NETWORK STATUS LEDs |

*Figure 1-1 - MultiFlex RCB*

The MultiFlex Rooftop Control Board (RCB) (*P/N 810-3062*) is a rooftop HVAC control board for use either as a stand-alone controller or in zone control applications using a Copeland E2 BX building control system. The MultiFlex RCB is capable of controlling heat and cool stages, fans, humidification and dehumidification devices, economizers using on-board I/O and control algorithms, as well as monitor and interact with other building control systems and peripherals (such as smoke alarms and $CO_2$ sensors).Differences Between the MultiFlex RCB and the MultiFlex RTU

## 1.1 Differences Between the MultiFlex RCB and the MultiFlex RTU

The RCB is an improved version of the MultiFlex RTU. The RCB has sixteen fully configurable analog and digital input points, whereas the RTU has only eight inputs, two of which are configurable. The RCB has four analog outputs for use in controlling variable speed fans, economizers or modulating heating and/or cooling valves, whereas the RTU has only two analog outputs for use only with VS fans and economizers. The RCB also features a more sophisticated HHT interface and updated algorithms for controlling heating, cooling, dehumidification, and air quality.

### 1.1.1 MultiFlex RCB-P (Pulse) Board

The MultiFlex RCB-P (pulse control board (*P/N 810-3074*) uses an alternate control strategy for the heating and cooling function. Instead of staging heats or cools On/Off based solely on the space temperature, the stages follow a pulse modulation scheme to maintain an average supply temperature, resulting in smaller space temperature swings and potentially increasing energy efficiency. The algorithm supports up to 4 heat and 4 cool stages. The stages are turned on in a sequential manner: Stage1 is turned on first, then Stage2, Stage3, and lastly Stage4. Only one stage at a time can be operated in pulse mode and that stage is always the highest number stage ON. For example, if two stages are set ON, only Stage 2 can be operated in Pulse Mode.

The MultiFlex RCB application must be configured to communicate with an RCB-P by setting the RCB Type parameter to Pulse under the Setup screen.

**⚠ CAUTION**

**When changing the defaults for Pulse Cool Mode, use caution. Some Pulse Cool Mode parameters affect the compressor cycling and could have a negative impact on the compressor life. Refer to Section 7.4.1 RCB-P Pulse Control Setpoints Setup for more information**

## 1.2 The RCB's I/O Points

The compact size of the RCB allows technicians to easily field-mount the RCB in a rooftop unit or enclosure close to it, allowing for easy local connection of sensors and transducers. The board has sixteen analog inputs, with default configurations pre-loaded for quick connection to space temperature sensors, supply and return air temperature sensors, and fan and compressor proofs. Its eight relay outputs, rated 2.0 amps max, are used for activating and deactivating fans, heat and cool stages, economizers, and other systems or devices. Its four analog outputs may be used for air damper, modulated heat and cool control, and variable-speed fan control.

## 1.3 Independent System Control

The RCB can control a rooftop unit independently without the need of a central controller (such as Copeland E2 BX Building Controller). However, the RCB is designed to interface with an E2 to allow it to work with other RCBs together to control large zones. Networking the RCB to a central controller also allows you to view status on E2 and UltraSite32 status screens, report alarms, and log point values.

The RCB's configuration can be programmed either with a Hand-Held Terminal (HHT) or through the E2 front panel.

# 2 Mounting and Powering

The MultiFlex boards are usually mounted by the refrigeration equipment manufacturer. Therefore, the installer need only make the necessary connections between the boards and the site controller(s).

In some instances, an installer may be required to mount an I/O board. There are no restrictions on the location of these boards; however, for ease of network configuration, it is recommended that the boards be located adjacent to the E2. I/O boards may be mounted without an enclosure, but they should be mounted in a location that is not easily accessible to avoid tampering or damage.

## 2.1 Snap-Track Installation

MultiFlex boards not supplied in a custom panel or other enclosure are supplied with a snap-track for easy installation. The insulation sheet and I/O board must be removed from the track before the track is mounted. The snap-track is mounted using the 0.1875" mounting slots. **Figure 2-1** shows this installation procedure.

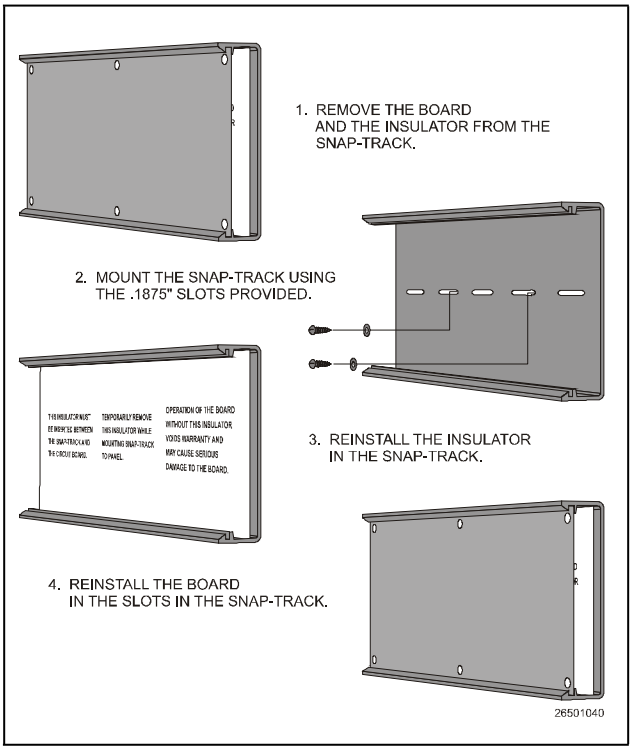



*Figure 2-1 - MultiFlex Snap-Track Mounting*

**Figure 2-2** provides mounting dimensions for the MultiFlex board.

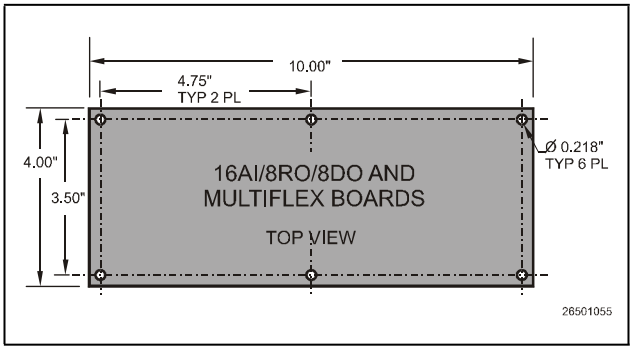



*Figure 2-2 - MultiFlex Board Dimensions*

## 2.2 The Plug-In Output Board

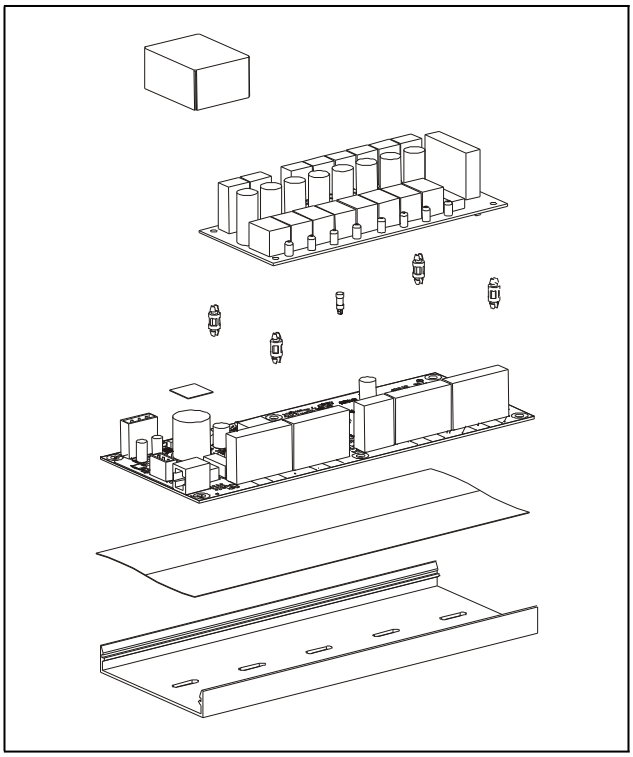


*Figure 2-3 - Exploded View — MultiFlex RCB*

The MultiFlex RCB has an output sub-board that plugs to the top of the base board. Typically, these boards are shipped with the output board pre-installed on the board using stand-offs, so no additional hardware setup should be necessary.

The additional board makes the MultiFlex RCB boards considerably taller than the MultiFlex 16 and other Copeland I/O boards. If you will be mounting these boards in an enclosure, the board will need at least 2.5" of clearance between the base board and the panel door.

## 2.3 Powering the MultiFlex RCB Board

**⚠ WARNING** **All models of MultiFlex require a 24VAC Class 2 input power source. The MultiFlex RCB requires the power source to be non-center-tapped. Refer to Section 2.3.1 Choosing Transformer Sizes for center tap usage.**

Copeland supplies a wide variety of 24VAC transformers with varying sizes and either with or without center taps. **Table 2-1** shows the transformer sizes and whether they are center-tapped or non-center-tapped.

**Table 2-1 - Transformers Compatible with MultiFlex**

| Xformer P/N | VA Rating | Primary Voltage | Center Tap? |
|---|---|---|---|
| 640-0041 | 50 VA | 110 VAC | No |
| 640-0042 | 50 VA | 220 VAC | No |
| 640-0056 | 56 VA | Multi-tap (120/208/240 VAC) | Yes |
| 640-0050 | 75 VA | 110 VAC | No |
| 640-0045 | 75 VA | 220 VAC | No |
| 640-0080 | 80 VA | Multi-tap (120/208/240 VAC) | Yes |

### 2.3.1 Choosing Transformer Sizes

In most site installations, a single transformer will power multiple devices. Choose a transformer with a VA rating large enough to power all devices that will be attached to it. **Table 2-2** gives the VA ratings of the MultiFlex RTU in conjunction with other MultiFlex boards. Refer to your site controller's manual for VA ratings of the other I/O boards that may be powered by one of these transformers.

**Table 2-2 - Device Power Requirements**

| Unit | VA | VAC | Center tapped? |
|---|---|---|---|
| MultiFlex 16 | 6 | 24 | Yes |
| MultiFlex 88, 88AO, 168, 168AO, and 168DO | 15 | 24 | NO |
| MultiFlex RTU and RCB | 15 | 24 | NO |

## 2.3.2 MultiFlex RCB Power Wiring

The MultiFlex RCB boards can be connected to any of the center-tapped transformers mentioned in **Table 2-1**, provided the 0V terminal of the board is connected to an Earth ground.

A center-tapped transformer may power both center-tapped and non-center-tapped devices at the same time, as long as none of the non-center-tapped MultiFlex boards are old-style MultiFlex boards (characterized by no green power LED in the upper right corner of the board). If an old-style MultiFlex shares the same center-tapped transformer as a device that uses the center tap, the old-style MultiFlex will be damaged. **Figure 2-4** shows how to wire a non-center tapped device to a center-tapped transformer.

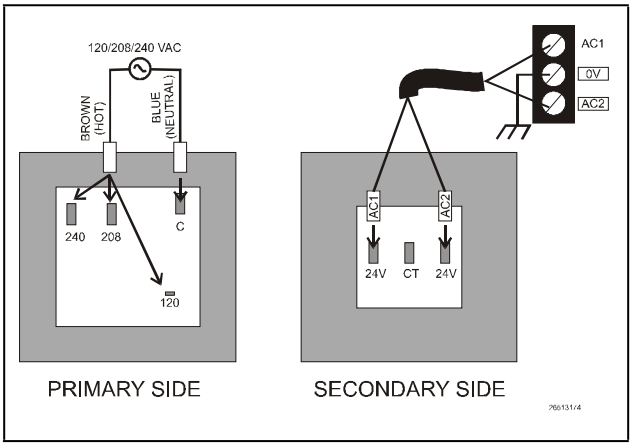



*Figure 2-4 - Wiring Non-Center Tapped MultiFlex Boards to Transformers With a Center Tap*

In addition, the MultiFlex RCB boards can be powered by one of the 50VA or 75VA non-center-tapped transformers listed in **Table 2-1 on page -3**. **Figure 2-5** shows how to wire the transformers to the MultiFlex boards.

You may also tie one side of the secondary (but NOT BOTH sides) to an earth ground, provided none of the boards powered by the same transformer are old-style MultiFlex boards.

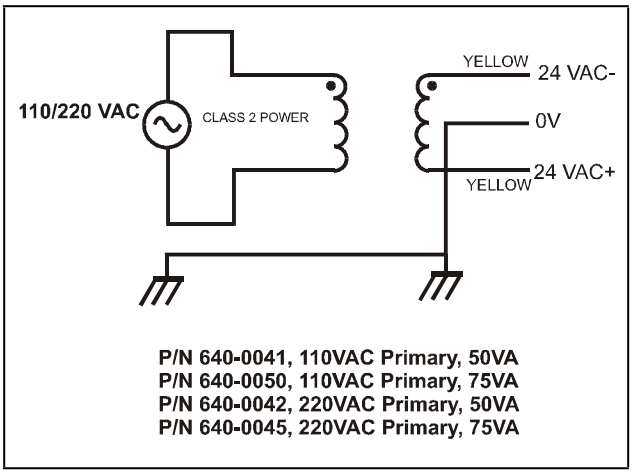



*Figure 2-5 - Non-Center-Tapped Transformer Wiring*

## 2.3.3 Wire Types and Maximum Distances

For powering I/O boards, use only the listed wire types from **Table 2-3**. Three-conductor non-shielded cables are the recommended wire for connecting between the center-tapped transformer and the I/O boards. Shielded cable should not be used for power wiring. The center tap should be wired with the third conductor to earth ground at the transformer.

**Table 2-3 - Power Wiring Types**

| Power Wiring Types | |
|---|---|
| 14 AWG | Belden 9495 |
| 18 AWG | Belden 9493 |

The wire length from the transformer and the number of boards connected to the same wire determines the type wire gauge used. In most cases, the distance between the I/O boards and the transformer that supplies power to them is not enough to be concerned with. But it is very important not exceed this maximum wire length or the boards will malfunction.

Use these formulas to determine if the wire gauge you are using fits within specification:

**14 AWG:**
Feet = 1920/VA

**18 AWG:**
Feet = 739/VA
(VA is the total VA rating of the I/O boards)
For example, if you had an 80 VA load:
14 AWG: 24 ft.
18 AWG: 9 ft. (rounded down)

**Table 2-4 - Power Wire Lengths**

Sensors requiring 24VAC can be powered from the same transformer powering the input board as long as the resulting total load of both the input board(s) and the sensor(s) connected to the transformer does not exceed the transformer's VA rating, and the sensors have an isolated power supply. If the sensors do not have an isolated power supply, they could become damaged if connected with center-tapped or grounded-secondary transformers.

## 2.4 The MultiFlex RCB Battery and Battery Enable Jumper

The RCB uses battery-backed memory. The battery for the MultiFlex RCB is located either underneath the output plug-in board (for old-style MultiFlex boards) or on the rear side of the input board layer facing the snap-track (**Figure 2-6**).

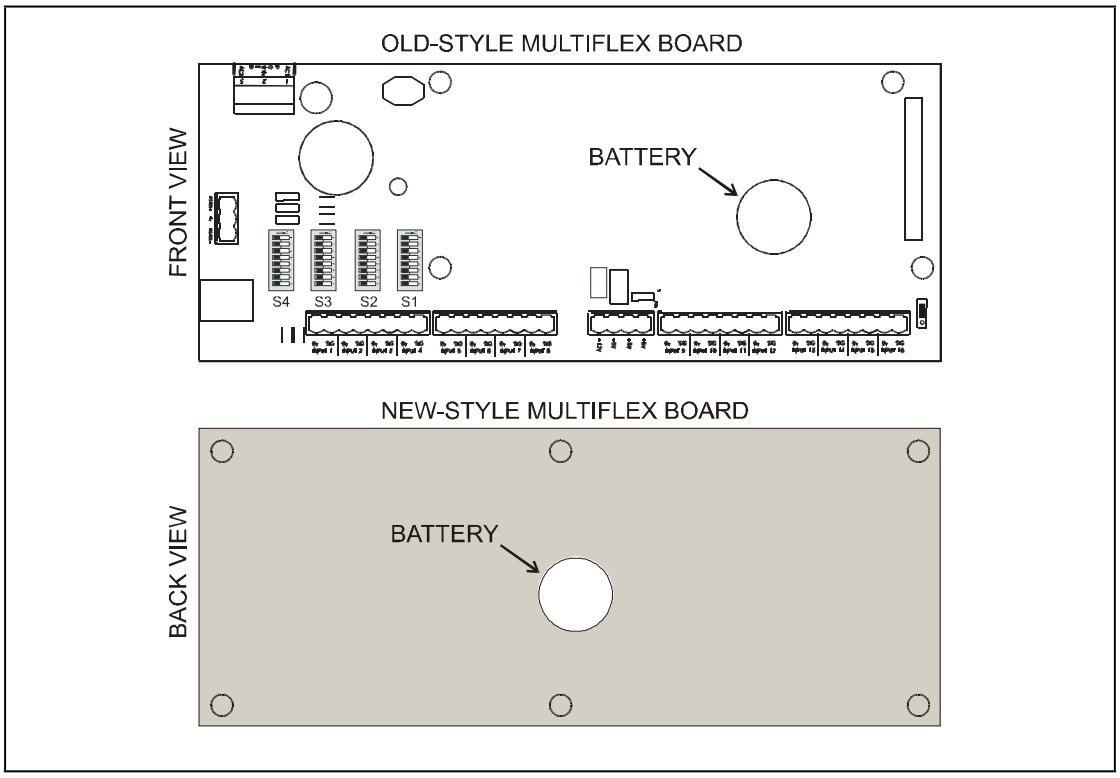



*Figure 2-6 - MultiFlex Battery Location*

Battery-backed memory is enabled by the ENABLE BATTERY jumper (JP5) located at the bottom right corner of the input board layer (**Figure 2-7**). This jumper is shipped from Copeland in the DISABLE position. The jumper should be set to the ENABLE position (UP) before installation. To preserve battery life, when storing the MultiFlex RCB, the jumper should be set to the DISABLE position.

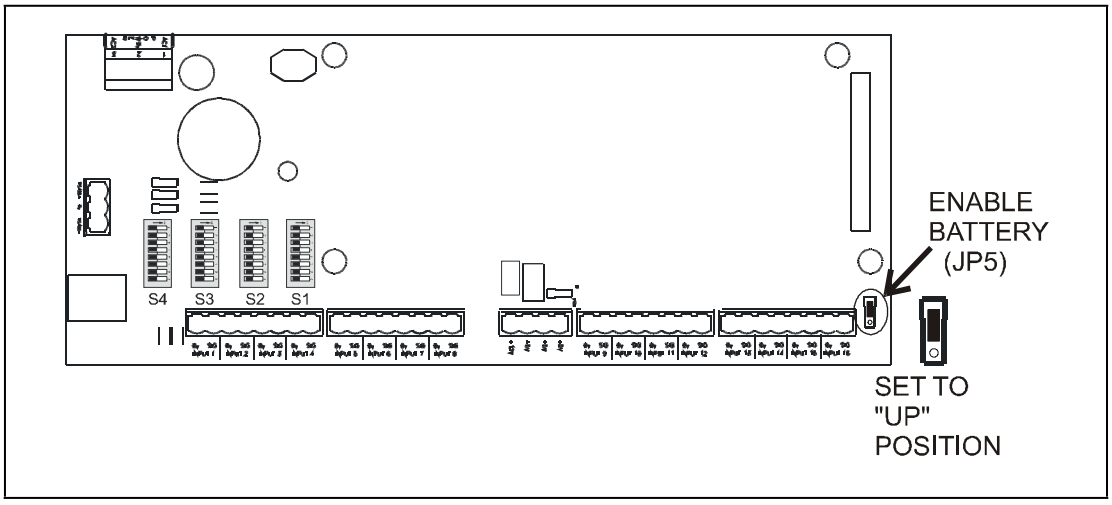



*Figure 2-7 - Enable Battery Jumper on MultiFlex Board*

# 3 The I/O Network

Although the MultiFlex RCB can operate as a stand-alone controller, it relies on an E2 unit for advanced features such as remote dial-in/dial-out, logging, and alarm control. All MultiFlex boards and controllers use an RS485 network connection to communicate with E2 site controllers.

## 3.1 Wiring Types

Copeland specs Belden #8761 shielded twisted pair cables for use as I/O network wiring (or Belden #82761 and Belden #88761 for plenum installations).

If the recommended cable is not available in your area, be sure the wiring meets or exceeds the following specs:

**Table 3-1 - RS485 I/O Network Wiring Specifications**

| | |
|---|---|
| **Shielded?** | Yes |
| **Conductor Type** | Twisted Pair |
| **Gauge** | 18 - 24 AWG |
| **Capacitance between signal wires** | 31 pF/ft or less |
| **Capacitance between signal and shield** | 59 pF/ft or less |
| **Nominal Impedance** | 120Ω±50Ω |

### 3.1.1 Daisy Chains

The RS485 Input/Output (I/O) network connects all input and output communication boards together in a single open communications loop. This loop, or "daisy chain," connects the E2 to multiple input and output communication boards, and terminates at the last input or output board on the network. A diagram of this network arrangement is shown in **Figure 3-1**.

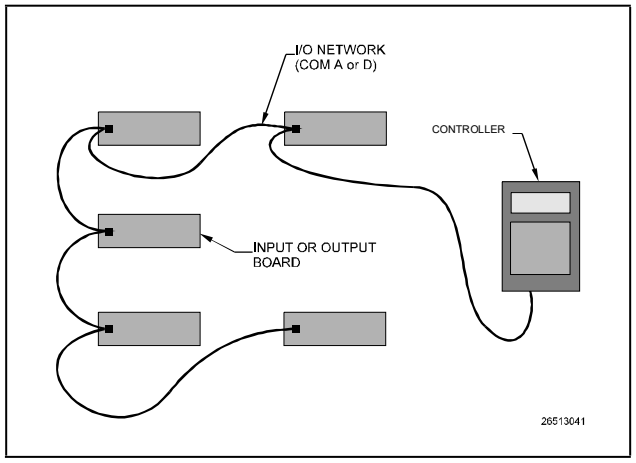



*Figure 3-1 - I/O Network Configurations*

### 3.1.2 Network ID Numbers

Each device on an RS485 segment has a network dip switch that must be used to assign the board a unique network ID number.

The network ID number makes a board unique from other boards on the network of the same type. This allows the site controller to find it and communicate with it easily.

Boards of the same type should be numbered in sequence, starting with one and continuing with two, three, and so forth.

### 3.1.2.1 Numbering the MultiFlex RCB

The MultiFlex RCB is a unique board type on the RS485 Network by the Copeland controllers. Each RCB that will be associated with an E2 must have a unique number from 1 to 31, which is configured by setting the first five switches on dip switch bank S3.

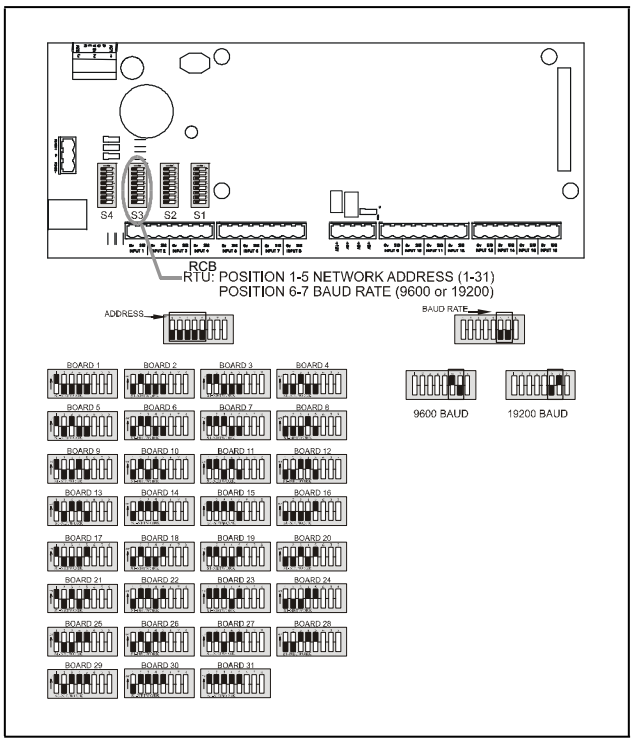



*Figure 3-2 - RCB Baud Rate Switches*

## 3.1.3 Setting the Baud Rate

All I/O boards have dip switches that determine the baud rate at which they communicate. Currently, the baud rate dip switch in network components may be set at either 9600 or 19200 baud. Either may be used — refer to your site controller's user manual for the baud rate recommendation (currently 9600 baud for both REFLECS and E2 controllers).

On all MultiFlex boards, switches 6 and 7 on S3 are used to set the baud rate. To communicate at 9600 baud, set switch #6 UP and #7 DOWN. For 19200 baud, set switch #6 DOWN and #7 UP. Refer to **Figure 3-2** for a visual look at how the switches must be set.

## 3.1.4 Setting the Terminating Resistance Jumpers

All MultiFlex boards and other RS485 devices have a set of terminating resistance jumpers (one jumper for each wire lead). These jumpers are labeled JP2, JP3, and JP4 on the MultiFlex board.

The purpose of the jumpers is to indicate the two ends, or termination points, of the segment. On a daisy chain, one device at the beginning and one device on the end must be terminated by placing all three termination jumpers in the OUT (toward the left edge of the board) position. All other devices on the daisy chain must be set to the IN (toward the center of the board) position. **Figure 3-3** shows the proper terminating resistance jumper settings for the E2 and for all I/O boards.

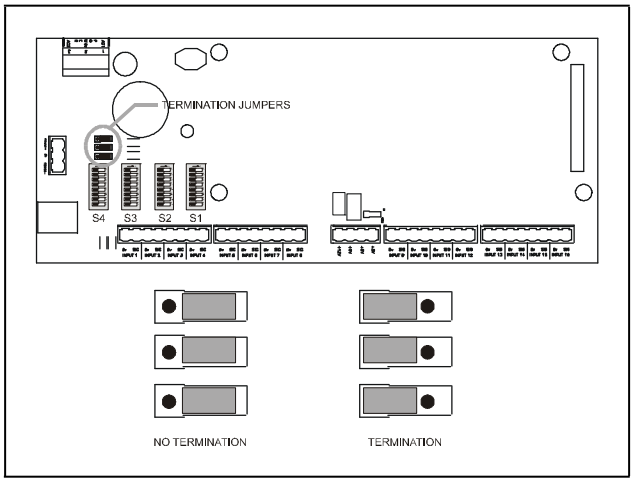



*Figure 3-3 - I/O Network Termination Jumper Settings*

# 4 RCB Input and Output Setup

## 4.1 The MultiFlex RCB Inputs

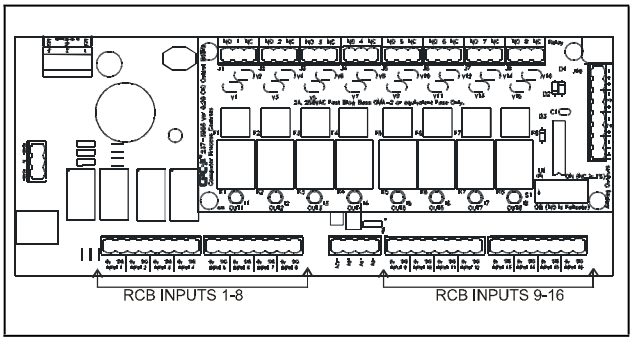



*Figure 4-1 - MultiFlex RCB Input Locations*

The MultiFlex RCB has 16 combination analog/digital outputs for connection to all analog and digital sensors, transducers, switches, and other input types typically used in a rooftop HVAC unit application. The input type and function for each point must be programmed in the RCB software by the installer.

**Figure 4-1** shows where the inputs are located on the MultiFlex board. **Table 4-1** describes the input types that may be programmed in the RCB.

**Table 4-1 - RCB Default Inputs**

| RCB Input Name | Type | Description |
|---|---|---|
| NOT USED | -- | Select this option to indicate no sensor is connected to the input point. |
| SpacTemp | TEMP or LM235-TEMP | Indoor air temperature sensor in the floor area |
| SuplTemp | TEMP or LM235-TEMP | Temperature probe mounted in the supply air flow |
| RtrnTemp | TEMP or LM235-TEMP | Temperature probe mounted in the return air flow |
| Mix Temp | TEMP or LM235-TEMP | Temperature probe mounted in the air flow where the return air is mixed with outside air from the damper |
| OAT | TEMP or LM235-TEMP | Outside air temperature sensor |
| StPt Adj | POT | Slide potentiometer for adjusting heat and cool setpoints |
| ID Hum | HUMIDITY | 0-5VDC Humidity Sensor mounted indoors |
| OD Hum | HUMIDITY | 0-5VDC Humidity Sensor mounted outdoors |
| *DuctPres<br>*Not available on RCB-P | INW | Pressure sensor measuring duct pressure (in inches of water) |
| *BldgPres<br>*Not available on RCB-P | INW | Pressure sensor measuring indoor air pressure (in inches of water) |
| Dewpoint | DEW POINT | Copeland Dewpoint Probe (*Copeland P/N 203-1902*) measuring dewpoint |
| Co2 Sens | CO2 | $CO_2$ indoor air sensor |
| KW Input | POWER-KW or PULSE-CNT | Watt-hour transducer with 0-5VDC output (POWER-KW) or pulse output (PULSE-CNT) |

Table 4-1 - RCB Default Inputs

| RCB Input Name | Type | Description |
|---|---|---|
| CL1 Prf - CL4 Prf | DIG-ON/OFF | Proof checking device for cool stages 1, 2, 3, or 4 |
| HT1 Prf - HT4 Prf | DIG-ON/OFF | Proof checking device for heat stages 1, 2, 3, or 4 |
| Air Prf | DIG-ON/OFF | Sail switch for blower fan proof checking |
| Cnd Prf | DIG-ON/OFF | Sail switch for condenser fan proof checking |
| Frz Stat | DIG-ON/OFF | Thermostat switch checking for freezing temperatures at the cool stage evaporator(s); when ON freeze alarm will be active. |
| Enth Swt | DIG-ON/OFF | Enthalpy switch used to enable or disable economization |
| BypSwtch | DIG-ON/OFF | Push button used for occupancy override. |
| Smoke In | DIG-ON/OFF | Smoke alarm input for system shutdown during fire. |

### 4.1.1 Wiring Sensors to the MultiFlex RCB

Wiring an input to the input points on a MultiFlex board requires three steps:

1. Connect the sensor's signal wires to the two terminals of an input point.
2. Set the input type dip switch that corresponds to the point being connected.
3. If necessary, connect the sensor to one of the 5V or 12V power terminals.

#### 4.1.1.1 Wiring

An input point on a MultiFlex board consists of two terminals, as shown in **Figure 4-2**. One of these terminals, labeled SIG, reads the signal from the sensor, while the other, labeled 0v is where the sensor's ground and/or cable shield wire is connected.

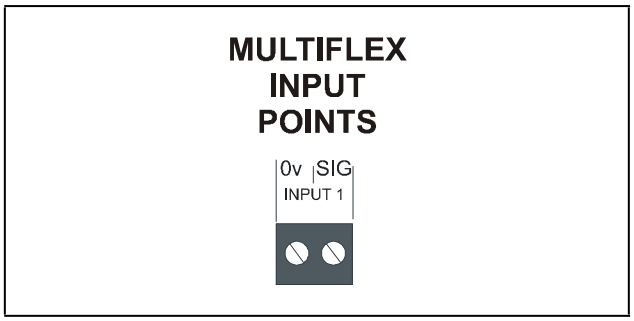



*Figure 4-2 - Input Board Points*

#### 4.1.1.2 Sensor Wiring Types

Specific wiring types are required for each type of sensor used with E2 or RMCC.

All Analog Temperature Sensors and Air Flow Sensors

Temperature and air flow sensors are to be wired with shielded, 2-conductor, at least 22 GA wire (Belden # 8761 or equivalent).

All Pressure Transducers, Humidity Sensors, and Refrigeration Transducers

Pressure and refrigeration transducers and humidity sensors are to be wired with shielded, 3-conductor, at least 22 GA wire (Belden #8771 or equivalent).

Dew Point and Light Level Sensors

These sensors are to be wired with shielded, 4-conductor at least 22 GA wire (Belden # 8729 or equivalent).

### 4.1.1.3 Input Type Dip Switches

Each MultiFlex input point has an input type dip switch that must be set. The input type dip switches for the RCB are on the switch bank labeled S1.

The input type dip switch tells the input board whether or not the sensor connected to the point is a resistive type sensor. Generally, if the sensor or transducer supplies its own voltage signal to the point, the dip switch should be set to the **LEFT (OFF)** position. If the sensor uses variable resistance and requires voltage to be supplied to it from the input point, set the dip switch to the **RIGHT (ON)** position. Dip switches for unused points should be set to the **RIGHT (ON)** position.

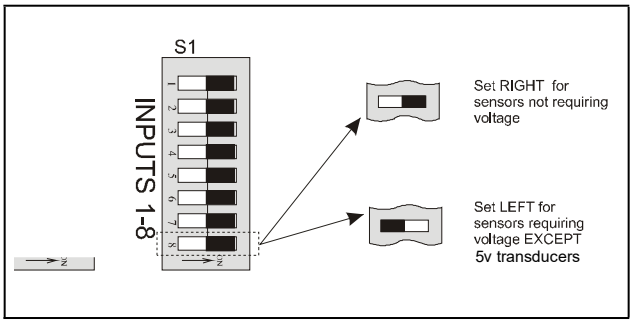



*Figure 4-3 - Input Type Dip Switches for RCB Board*

## 4.1.2 On-Board Power Connection

If power is needed to operate the sensor, four points are provided on the MultiFlex board that supply DC power: one +12VDC point, and three +5VDC points. See **Figure 4-4** for the location of these points.

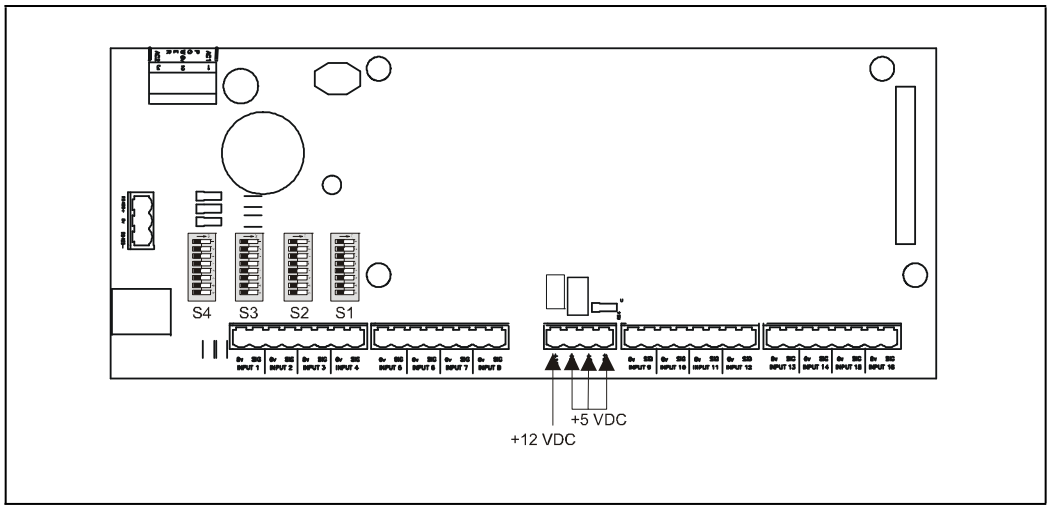



*Figure 4-4 - Input Board Power Sources*

To connect to one of the DC power sources, simply connect the sensor's power wire to one of the terminals.

### 4.1.2.1 Current Ratings for On-Board Power Sources

The maximum current that may be drawn from the +12VDC terminal is 100 milliamps. The maximum current that can be drawn from all three +5VDC terminals COMBINED is 50 milliamps.

### 4.1.2.2 Powering Sensors Requiring 24VAC Off the Power Transformer

Some sensors that require 24VAC can be powered off the MultiFlex's own 24VAC power connection. To connect to the 24VAC power source, connect the sensor's power wires to terminals AC1 and AC2.

This can only be done with sensors that keep the 24VAC signal isolated from its DC output signal (such as Copeland Dewpoint Probe, *P/N 203-1902*). If the output signal is not isolated from the 24VAC input, you must use a separate transformer.

## 4.2 The MultiFlex RCB Outputs

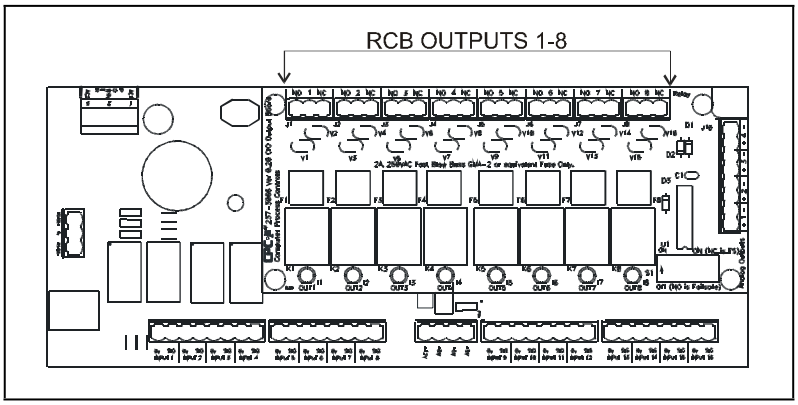



*Figure 4-5 - MultiFlex RCB Output Locations*

The MultiFlex RCB has eight relay outputs for connection to all outputs that are typically present for a rooftop unit. **Figure 4-5** shows the location of the RCB outputs, and **Table 4-2** describes the devices that can be assigned to these points. The relay output type and function for each point must be programmed in the RCB software by the installer.

**Table 4-2 - RCB Output Types**

| RCB Output Name | Description |
|---|---|
| Heat 1 - Heat 4 | Heat stages 1 through 4 |
| Cool 1 - Cool 4 | Cool stages 1 through 4 |
| Cnd Fan | Condenser fan for cool stages |
| SS Fan | Single-speed blower fan |
| *2S Fan Lo<br>*Not available on RCB-P | Low-speed stage of a two-speed blower fan |
| *2S Fan Hi<br>*Not available on RCB-P | High-speed stage of a two-speed blower fan |
| VsContact | Contactor for activating a variable-speed blower fan |
| Alarm | Dry contact that closes when an RCB alarm occurs |
| Rev Valve | Heat/Cool Reversing Valve |
| Mod Cool | Relay On when Mod Cool output is modulating |
| Mod Heat | Relay On when Mod Heat output is modulating |
| *Humidifr<br>*Not available on RCB-P | Humidifier |
| Dehumidifr | Dehumidification device (desiccant wheel) |
| Air Damper | Two-position outside air damper. |
| *Dmpr Open<br>*Not available on RCB-P | Motor that opens variable-position damper |
| *DmprClose<br>*Not available on RCB-P | Motor that closes variable-position damper |

### 4.2.1 Wiring Outputs to Points

The MultiFlex RCB has Form C relay contacts. **Figure 4-6** shows how to wire the three-terminal Form C contact.

One wire of the two-wire connection should always be connected to the middle terminal. The second wire must either be connected to the N.C. terminal (if you want the path to be closed when the relay is de-energized) or the N.O. terminal (if you want the path to be open during power failure).

The contacts you choose also affect what the board's fail-safe dip switch will need to be set to for proper operation. Refer to **Table 4-3** and **Table 4-4**.

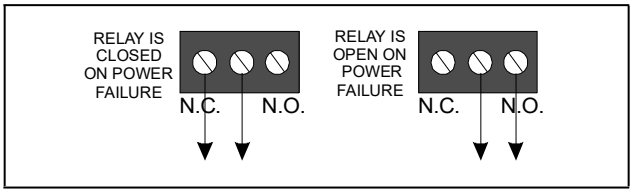



*Figure 4-6 - Form C Contact Wiring*

### 4.2.2 Output Fail-Safe Dip Switches

When a controller calls for a MultiFlex relay output to be ON, it sends a command to the MultiFlex to turn the output to the ON state (signified by the output LED being ON). The behavior of the relay when it is ON is determined by the position of the fail-safe switch. The fail-safe switches for the outputs are on a switch bank at the bottom right corner the plug-in output module. Each switch corresponds to an output on the board (switch #1 = output #1, etc.).

**Table 4-3** and **Table 4-4** show how the fail-safe switch and Form C contacts should be configured based on how you want the output to perform during both normal operation and during network/power loss.

***NOTE*** **There are not many cases where you would want a relay to be OPEN when called to be ON. For most applications, you will want to set the fail-safe switch to UP so that an ON command from the controller will close the relay.**

**Table 4-3 - Output Board Fail-Safe and Switch Settings when Contact is Wired Normally Closed (N.C.)**

| | State of Normally Closed (N.C.) Contacts on MultiFlex Relay Points | | | |
|---|---|---|---|---|
| Fail-safe Switch | Light is ON | Light is OFF | Loss of Communication | Loss of Power |
| Up (ON) | Closed | Open | Closed | Closed |
| Down (OFF) | Open | Closed | Closed | Closed |

**Table 4-4 - Output Board Fail-Safe and Switch Settings when Contact is Wired Normally Closed (N.O.)**

| | State of Normally Open (N.O.) Contacts on MultiFlex Relay Points | | | |
|---|---|---|---|---|
| Fail-safe Switch | Light is ON | Light is OFF | Loss of Communication | Loss of Power |
| Up (ON) | Open | Closed | Open | Open |
| Down (OFF) | Closed | Open | Open | Open |

### 4.2.3 Relay Output Ratings and Fuse Protection

Each relay output on the MultiFlex Combination I/O boards is rated for up to 240 VAC with a maximum current of 2A.

Each relay is fused with a 2A fast-blow 5mm x 20mm fuse, Bussman GMA-2 or equivalent.

## 4.3 Analog Outputs

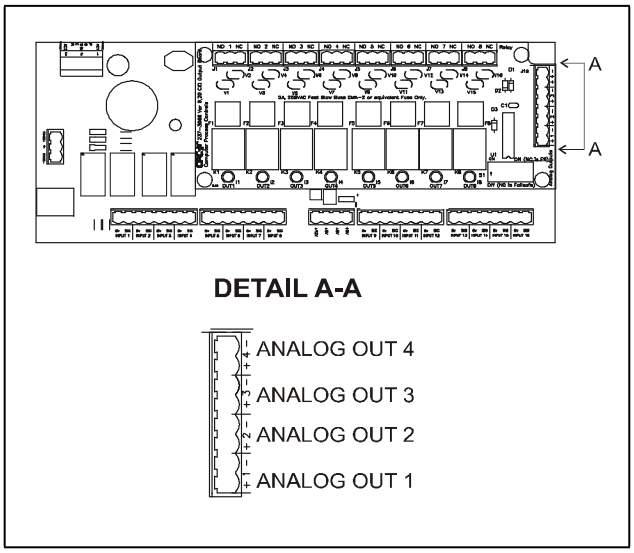



*Figure 4-7 - MultiFlex RCB Analog Output Locations*

The MultiFlex RCB analog outputs are 0-+10VDC points used for controlling variable-position economizers, mod heat and cool stages, and variable-speed fans. The maximum output current for each point is 10 milliamps. **Figure 4-7** shows the location of the analog outputs.

The function of each of the analog outputs must be configured in the RCB system software. **Table 4-5** lists the devices that may be assigned to the analog output points.

**Table 4-5 - RCB Output Types**

| RCB Output Name | Description |
|---|---|
| NDF | Not defined. Use this if the analog output will remain unused. |
| VS Fan | Inverter controlling a variable-speed fan |
| Mod Heat | Mod Heat output |
| Mod Cool | Mod Cool output |
| ∗Humidifr<br>∗Not available on RCB-P | Humidifier |
| Out Dmpr | Variable-position outside air damper |

### 4.3.1 Wiring the RCB Analog Output Points

The analog outputs have no hardware-based fail-safe settings (fail-safes are set in the board firmware by setting either fan speed on failure or economizer% on failure). All that is required to connect a device to an analog point is to connect the "+" terminal to the positive wire on the device and the "-" terminal to the negative (or ground) wire of the device.

# 5 Board Status LEDs

When a MultiFlex board is powered up, you will be able to determine the operating status of the board by observing its status LEDs. **Figure 5-1** shows the location of the MultiFlex's status LEDs.

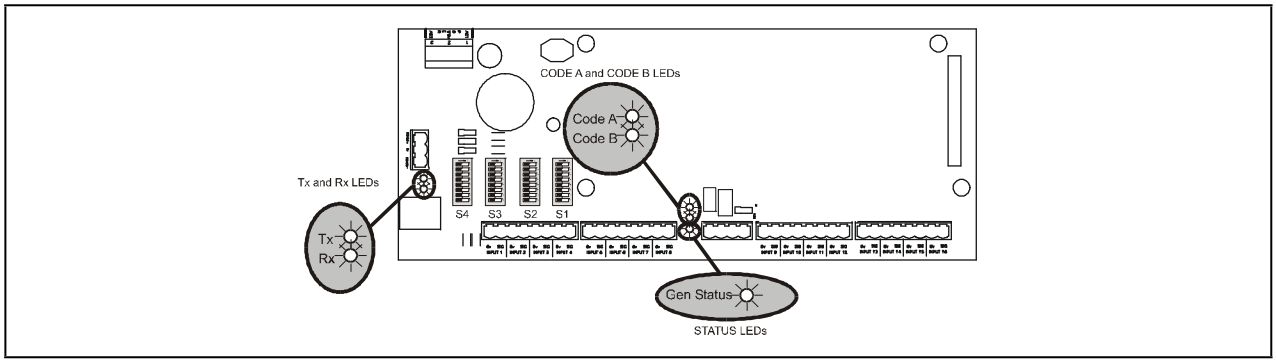



*Figure 5-1 - MultiFlex Status LED Locations*

## 5.1 Status LED

The Status LED blinks GREEN once per second to show that the board is powered and operational. If this light is dark, the board has likely lost power.

## 5.2 Tx and Rx LEDs

The Tx and Rx LEDs indicate when the MultiFlex is sending or receiving messages on the RS485 network.

The Tx LED blinks once every time the MultiFlex sends a response to the E2 or REFLECS. The Rx LED blinks once when the MultiFlex receives a message.

If the MultiFlex is connected to the network and set up to communicate with the controller, you should see these lights blinking regularly. If they do not, there may be a problem with the network.

## 5.3 The Code A LED

All MultiFlex I/O boards except the Multi-Flex 16 have two LEDs labeled Code A and Code B. These LEDs indicate failure conditions. When these LEDs are OFF, there are no failures active. When one or both of these LEDs are blinking, there are failure conditions. The rate of blinking indicates the type of failure:

### Code A Failure Conditions

- **Blinking fast (4 times/second)** - There is a problem with the flash memory or hardware clock on this board. This generally means the board is corrupted and must be replaced.
- **Blinking slowly (1 time/second)** - The board is not receiving any messages addressed to it. This means either the I/O network is down or it has not yet been commissioned.

## 5.4 The Code B LED

### Code B Failure Conditions

- **Blinking 2 times/second** - This indicates the board has lost its configuration. For the MultiFlex I/O boards, a board is considered "configured" if you have specified input type settings and analog output fail-safes. If Code B blinks at this rate on an operational board, it means the board must be reprogrammed. This light does not blink if the board is new or is using the unmodified default configuration.

## 5.5 Relay Output LEDs

Each relay output point on a MultiFlex has an indicator LED that shows the status of the output. This LED is lit to show the output is ON, and unlit to show the output is OFF.

The definition of ON and OFF in this case is determined by the position of the fail-safe dip switch (see **Table 4-3** and **Table 4-4**).

# 6 Software Overview

## 6.1 Introduction to Zone Control

Though RCBs may be used as stand-alone rooftop unit controllers, when used with Copeland E2 BX building controllers, they may be networked together in groups called zones. Zones are groups of rooftop boards and applications (ARTC, RCBs and/or AHU (air handling units) that share the same heating, cooling, and dehumidification setpoints, as well as other control parameters. The primary purpose of zone control is to maintain a specific temperature and humidity level throughout a wide area using multiple rooftop units or air handling unit applications.

Association between an RCB and a Zone application in the E2 BX is performed in the E2 user interface (refer to **Section 7.2, Associating an RCB with a Zone Application**). When an RCB is part of a Zone application, the parameters listed in **Table 6-1** are downloaded from the Zone application and used in place of the values programmed in the RCB board. Changes made to the Zone application parameters in the E2 will automatically be written to all RCBs in the zone.

**Table 6-1 - Zone Provided Parameters for the RCB**

| RCB Input Property | Zone Application Parameter | Description |
|---|---|---|
| OCCUPANCY | OCC STATE | The RCB will follow the zone's occupancy schedule to determine when to use occupied and unoccupied setpoints. |
| ZONE TEMP | ZONE TEMP OUT | The Zone combines space temperatures for all other rooftop controllers in its zone, and feeds this value back to the RCBs. |
| ECONOMIZE | ECON OK | The Zone will send an "OK" signal to all RCBs to indicate outside air is favorable for opening outside air dampers. |
| DEHUM | DEHUM ACTIVE | The Zone checks zone humidity and commands RCBs to activate dehumidification. |
| OCC HEAT | OCC HEAT OUT | The Zone application sends the values of all occupied and unoccupied heat and cool setpoints to all of its rooftop unit controllers. |
| OCC COOL | OCC COOL OUT | |
| UNOCC HEAT | UNOC HEAT OUT | |
| UNOCC COOL | UNOC COOL OUT | |
| SEASON | SUM WNTR MODE | The Zone application notifies the RCBs of the season mode to act in (either Summer or Winter). |
| OCC DEHUM | FB HUMID STPT | The Zone sends the humidity setpoint the RCB should use if communication with the controller is lost and the unit must operate in stand-alone mode (this assumes the RCB has a humidity sensor connected to the board). |

Zone control is covered in greater detail in the E2 controller's user manual (*P/Ns 026-1610 and 026-1614)* and in the E2 on-line help.

## 6.2 Temperature Control

In its most basic form, temperature control in an RCB reads a space temperature input value, compares it to the active heating or cooling setpoint, and activates or deactivates heating or cooling stages in an effort to satisfy the setpoint.

The majority of user setup that must be done in Temperature Control involves defining different setpoints in the RCB's parent zone for use in occupied, unoccupied, summer, and winter modes, and setting up the operating characteristics of the heating and cooling stages.

### 6.2.1 Setpoints

There are two active setpoints in an RCB: a cooling setpoint and a heating setpoint (both of which are supplied by the zone from the E2). In general, when the input rises above the cooling setpoint, cooling mode begins, and when the input falls below the heating setpoint, heating mode begins.

RCBs activate stages using PID Control, which controls the output as a percentage of total heating or cooling capacity, determined by the size of the difference between the space temperature and the setpoint, as well as the amount of time the temperature has been above setpoint.

The primary determiner of the PID percentage is the throttling range parameter for heating and cooling control. Throttling range is the number of degrees over which the PID will go from 0-100%.

The heating or cooling output percentage from PID control is used differently depending on whether the rooftop unit uses staged or modulated heating, and staged or modulated cooling.

#### 6.2.1.1 Staged Heating and Cooling

When heating or cooling is staged, the PID percentage is used to determine how many stages should be active. Multiple stages are always activated in a fixed sequence, beginning with stage 1, and continuing on to the next highest stage number until all stages are ON. Stages are deactivated in reverse order, beginning with the highest numbered stage and continuing backwards to stage 1.

As the PID percentage climbs from 0 to 100%, the RCB activates stages at even intervals determined by the total number of stages. For example, if the RCB is in heating mode and there are three heating stages, as the PID percentage climbs from 0 to 100% it will bring on stage 1 at 33%, stage 2 at 67%, and stage 3 at 100%.

When stages are ON, they are turned OFF only when the PID percentage falls below the next lowest PID interval. In the previous example, three heating stages are turned on at 33%, 67%, and 100%. When all three stages are ON, stage 3 will deactivate when the PID falls below 67%, stage 2 will deactivate below 33%, and stage 1 will deactivate when the PID falls to 0%.

**Table 6-2** gives a reference of PID ON and OFF percentages based on the number of heat or cool stages.

**Table 6-2 - PID ON and OFF Percentages for Staged Outputs**

| Max # of Stages | Stage # | PID ON% | PID OFF% |
|---|---|---|---|
| **1** | 1 | 100% | 0% |
| **2** | 1 | 50% | 0% |
| | 2 | 100% | 50% |
| **3** | 1 | 33% | 0% |
| | 2 | 67% | 33% |
| | 3 | 100% | 67% |
| **4** | 1 | 25% | 0% |
| | 2 | 50% | 25% |
| | 3 | 75% | 50% |
| | 4 | 100% | 75% |

Stage ON and OFF Delays

Heating and cooling stages may be also be set up with on and off delays. When a stage is called to be turned ON or OFF, if will wait until the ON or OFF delay has passed before turning it ON or OFF.

Each stage follows its own ON and OFF delay, separate from all other stages, and will observe them regardless of whether or not a stage is activated or deactivated out of the normal sequence (lowest numbered stages ON first, highest numbered stages OFF first).

MultiFlex RCB-P

The RCB-P (*P/N 810-3074)* and RCB standard use the same PID control algorithm to activate Heat and Cool stages.

When a Heat or Cool stage is Active, the Pulse algorithm can be applied to only one Heat or Cool stage (the highest number Active). The Pulse algorithm can turn an Active Heat or Cool stage ON and OFF outside of the PID control. During dehumidification the Pulse algorithm is disabled.

The Pulse algorithm uses simple Cut ON/Cut OFF control with Minimum ON and Minimum OFF times and has two possible modes of operation:

1. The Heat or Cool stage is turned ON and OFF using the Supply Temperature input and ON and OFF setpoints with Minimum ON and OFF times.
2. The Heat or Cool stage is turned ON and OFF using only the Minimum ON and OFF times.

In E2, each Heat and Cool stage has configurable setpoints for Supply Temperature ON, Supply Temperature OFF, Minimum ON time, and Minimum OFF time.

### 6.2.1.2 Modulating Heating and Cooling

When heating and cooling is modulating, the PID percentage is used to directly determine the output. As the PID percentage fluctuates from 0 to 100%, the Mod Heat or Mod Cool output will follow the PID level.

A user can configure a relay output to be a Mod Cool or Mod Heat. When the corresponding modulating cool or heat output is modulating, then this relay will be ON. Some equipment like the digital scroll needs to have a digital input to enable the modulating portion of the digital scroll compressor.

### 6.2.1.3 Modulating Plus Staged Heating and Cooling

810-3075 RCB controllers with 1.30F01 or higher firmware revision can be configured to use modulating and staged cooling and/or heating. The Heat Output Type and Cool Output Type parameters are used to select MOD+STAGED. In this mode, the modulating stage is the first stage to come on and the last stage to turn off.

You can only have one modulating output. If you also have 2 stages, then you effectively have three stages. With three cooling stages, the RCB then as the PID percentage climbs from 0 to 100%, the modulating output ramp up from 0 to 100% as the PID climbs to 33%. As soon as the modulating output goes above 0%, the Mod Cool relay (if configured) will be turned ON. At 33%, stage 1 will come on and the modulating output will drop to 0%. Then, if the PID continues to climb to 67%, the modulating output will ramp up from 0 to 100%. At 67%, stage 2 will come on and the modulating output will drop to 0%. If the PID continues to climb to 100%, the modulating output will again rise to 100%.

When PID falls below 100%, the modulating output will be ramped down. In the previous example of a modulating output and two stages, the 2nd stage will be turned off when the PID falls to 67%. The modulating output will then go back up to 100%. As the PID ramps down from 67% to 33%, the modulating stage will ramp down from 100% to 0%. At 33%, the first stage will be turned off and the modulating output will go back up to 100%. As the PID ramps down from 33% to 0%, the modulating output will ramp from 100% to 0%. When the PID gets back to zero, the Mod Col Relay output (if configured) will be turned OFF.

The following table shows what stages would be ON and the direction of the modulating output as the OUD ramps up and down.

**Table 6-3 - MOD Stages**

| Max # of Stages | Mod | Stages ON | PID % |
|---|---|---|---|
| 1 Mod 1 Stage | 0-100% | | 0-50% |
| | 0-100% | 1 | 50-100% |
| | 100-0% | 1 | 100-50% |
| | 100-0% | | 50-0% |
| 1 Mod 2 Stages | 0-100% | | 0-33% |
| | 0-100% | 1 | 33-67% |
| | 0-100% | 1, 2 | 67-100% |
| | 100-0% | 1, 2 | 100-67% |
| | 100-0% | 1 | 67-33% |
| | 100-0% | | 33-0% |
| 1 Mod 3 Stages | 0-100% | | 0-25% |
| | 0-100% | 1 | 25-50% |
| | 0-100% | 1, 2 | 50-75% |
| | 0-100% | 1, 2, 3 | 75-100% |
| | 100-0% | 1, 2, 3 | 100-75% |
| | 100-0% | 1, 2 | 75-50% |
| | 100-0% | 1 | 50-25% |
| | 100-0% | | 25-0% |

#### 6.2.1.4 Occupied/Unoccupied Setpoints and Summer/Winter Setpoints

The RCB itself may be programmed with different setpoints that are used during occupied and unoccupied building times.

The RCB has two ways of determining whether to use occupied or unoccupied setpoints. If the RCB is associated with a zone in an E2 or BCU, it will use whatever occupied state the zone says to operate in (i.e., the zone controls the schedule). If the RCB is not connected to a zone, or if the RCB loses communications with its parent controller, the RCB uses a fallback schedule that is saved in its own memory, which may be programmed with up to two start and end times for each of the seven days of the week for occupied and unoccupied building times.

The RCB board itself may not be programmed with separate sets of occupied and unoccupied setpoints for use during summer and winter. However, when associated with a Zone application, the Zone may be programmed with different summer vs. winter setpoints, and the Zone can determine the correct seasonal mode and pass the appropriate setpoints to the RCB when the season changes.

### 6.2.2 Low Supply Temp

If desired, to guard against the possibility of overcooling, you may enable a supply temperature minimum setpoint in the RCB. If the supply temperature falls below the minimum supply temperature for an amount of time equal to the programmed delay, the RCB will deactivate cool stages until the temperature rises above the setpoint.

## 6.3 Fan Control

The RCB boards support control of one single-speed fan stage, a low- and a high-speed fan stage (i.e., two-speed fan control), or a variable-speed fan. The fans may be controlled in one of three ways:

- **Continuous** - The fan is always on, even when the AHU Zone application is not in heating, cooling, or dehumidification mode. In two-speed or variable-speed fan control, when heating or cooling is not active, the fan will be ON at a fixed, user-defined default speed.
- **Auto** - The fan is only on when the AHU Zone application is in heating, cooling, or dehumidification mode.
- **Summer ON, Winter Auto** - This mode allows the fan to operate in Continuous mode during the summer months and in Auto mode during the winter months (based on the season passed to the RCB from the E2 controller).

If desired, activation and deactivation delays may be set up for the RCB application for both heating and cooling mode.

### 6.3.1 *Two-Speed Air Fan Strategy

*Not available in the RCB-P Version

If the RTU controlled by the RCB has a two-speed fan, the fan speed is determined by a parameter called the switch stage. The number specified in the switch stage parameter is the number of the stage that when activated or deactivated will switch the fan from low speed to high speed (or from high speed to low speed).

If the fan is inactive (or active in Continuous mode and no stages are ON), the fan will begin by operating at LOW speed until the stage number equal to the switch stage parameter value is activated. When this stage is activated, the fan will switch to HIGH speed, and remain at this speed until the switch stage is deactivated.

Delays may be set for fan activation and for speed changes.

### 6.3.2 Variable-Speed Fan Control

An RCB may control variable-speed fans using one of two different strategies: staged, which varies the fan speed based on individual fan speed setpoints for each heat and cool stage, or differential, which varies the fan speed to maintain a constant differential between the return air and supply air temperatures.

#### 6.3.2.1 Staged VS Fan Control

When the Staged VS fan control strategy is used, each heat and cool stage has its own individual VS fan speed setpoint. When one or more stages are active, the RCB will look at the setpoints of all active stages and operate the VS fan at the highest setpoint value.

*Example: An RCB is controlling two heat stages. Heat stage #1's VS fan setpoint is 50%, and Heat stage #2's VS fan setpoint is 100%. When heating mode first begins and the heat stage #1 becomes ACTIVE, the fan will increase speed from idle to 50%. When heat stage #2 is activated for more heating, the RCB looks at both heat stage #1 and #2's setpoints, determines that the highest setpoint belongs to stage #2 (100%), and increases the fan speed to 100%.*

Economization VS Fan Speed

Because cooling treats economization as a stage of cooling, the economization damper has its own fan speed setpoint. When economization is enabled during cooling but no other cooling stages are active, the VS fan will operate at the economization fan speed setpoint.

Idle VS Fan Speed

When using the Staged VS strategy with the "Continuous" fan mode (see **Section 6.3, Fan Control**), the RCB will use the Idle VS Fan Speed setpoint when no cooling or heating stages are active.

Dehumidification Offset

During dehumidification, typically you will want a lower VS fan speed. The RCB uses a dehumidification offset parameter to achieve this. When an offset greater that 0% is specified in the RCB, the offset is subtracted from the final VS fan speed when dehumidification is active.

For example, if the dehumidification offset is 5%, and cool stage 1's VS fan speed setpoint is 50%, when dehumidification is active with one cooling stage ON, the VS fan speed will be 45% (50% - 5%). If a second cool stage with a setpoint of 100% were to turn ON, the VS fan speed would increase to 95% (100% - 5%).

#### 6.3.2.2 Differential VS Fan Control

In Differential fan control, the VS fan speed is determined by the difference in temperatures between the air entering the RTU (mixed air, if economization is used, or return air if not used) and the air leaving the RTU (supply air). The RTU increases or decreases the fan speed to achieve a constant temperature differential between the supply and mixed or return air.

Sensors Used in Differential Calculation

Differential VS control requires the presence of a supply air temperature sensor. On the return side, the RCB will use one of the following sensors (listed in order of priority):

1. Mixed air temperature sensor.
2. Return air temperature sensor.
3. Space temperature sensor.
4. Zone temperature (sent to the RCB from its associated Zone application in E2).

Differential Control During Heating

When heating begins, the VS fan begins operating at the minimum VS speed (specified by a setpoint in the RCB). The RCB subtracts the value of the mixed or return air temperature from the value of the supply air temperature; the result is the heat differential. This differential is compared to the value of the heat differential setpoint.

If the differential is smaller than the setpoint, the VS Fan speed will increase. This will bring more air into the RTU, thus increasing the supply air temperature and increasing the value of the heat differential.

If the differential is larger than the setpoint, the VS Fan speed will decrease. This will bring less air into the RTU, thus decreasing the supply air temperature and decreasing the value of the heat differential.

Differential Control During Cooling

When cooling begins, the VS fan begins operating at the minimum VS speed (specified by a setpoint in the RCB). The RCB subtracts the value of the supply air temperature from the value of the mixed or return air temperature; the result is the cool differential. This differential is compared to the value of the cool differential setpoint.

If the differential is smaller than the setpoint, the VS Fan speed will increase. This will bring more air into the RTU, thus decreasing the supply air temperature and increasing the value of the cool differential.

If the differential is larger than the setpoint, the VS Fan speed will decrease. This will bring less air into the RTU, thus increasing the supply air temperature and decreasing the value of the cool differential.

Differential Control During Dehumidification

Differential fan control during dehumidification works identically to fan control during cooling, except the RCB will use an alternate differential setpoint when dehumidification is active. Typically this is used to specify a higher differential setpoint to decrease the fan speed, preventing overcooling and improving dehumidification performance.

Economization VS Fan Speed

When economization is enabled during cooling but no other cooling stages are active, the VS fan will operate at the economization fan speed setpoint.

Idle VS Fan Speed

When using the Differential VS strategy with the "Continuous" fan mode (see **Section 6.3, Fan Control**), the RCB will use the Idle VS Fan Speed setpoint when no cooling or heating is active.

## 6.4 Dehumidification and Humidification Control

Unlike Temperature Control, Dehumidification Control and Humidification Control is handled entirely by zones. A zone typically has a single humidity sensor, humidistat, or dewpoint probe input connected to the central building controller that measures relative humidity or dewpoint for the entire zone. If the zone determines that dehumidification or humidification is necessary, it notifies all RCBs in the zone to begin dehumidification.

### 6.4.1 Dehumidification Control

RCBs dehumidify by using cool stages and auxiliary outputs that are configured on the RCB as dehumidification devices. When dehumidification is needed, the RCB will generally turn on the dehumidification device first (if available) and then activate stages of cool up to a user-defined maximum number of cool stages to be used for dehumidification.

The specifics of how an RCB determines when to dehumidify depend on whether the RCB is operating as part of a zone, or stand-alone.

#### 6.4.1.1 Zone Dehumidification Control

When the RCB is part of an AHU Zone application in the E2, the Zone will determine if dehumidification is needed, and send a digital command to the RCB to tell it to begin dehumidifcation. The RCB will then cycle on its dehumidification device output (if available). After a programmed delay, if dehumidification is still necessary, a stage of cool will cycle ON. The RCBs will continue cycling cool stages ON in this manner until 100% of the cool stages designated for use in dehumidification are active (or until the setpoint is met). If the setpoint is met in the AHU Zone application, the Zone will command the RCB to stop dehumidifying, and the RCB will switch OFF the dehumidifier output and cycle OFF the cool stages.

#### 6.4.1.2 Stand-Alone Dehumidification

If the RCB is not operating as part of an AHU Zone, or if the RCB is part of a zone but you want the RCB to handle dehumidification by itself, it must be equipped with a humidity sensor. The RCB will follow its own programmed dehumidification setpoints, and operate dehumidification devices and/or cool stages as needed.

#### 6.4.1.3 Dehumidification Low Temp Lockout

To prevent overcooling when cool stages are being used for dehumidification, the RCB may be programmed with a dehumidification low temperature lockout setpoint. If the control temperature for the RCB falls below this setpoint, dehumidification will be shut down and locked out until the control temperature rises five (5) degrees above the setpoint.

### 6.4.2 *Humidification Control

*Not available in the RCB-P Version

RCBs humidify by activating and deactivating a humidifier output on the RCB. Unlike dehumidification, an AHU Zone cannot be used to control humidity — all humidity control is handled completely by the RCB, and requires a humidity sensor to be connected to one of the RCB's inputs.

The RCB uses cut-in and cut-out setpoints to control the humidity. When the measured humidity is below the cut-in setpoint, the RCB will activate the humidification device. The device will remain ON until the humidity rises above the cut-off setpoint.

## 6.5 Outside Air Control

The RCB may be programmed to control two-position or variable-position outside air dampers on a rooftop control unit. The position of the dampers may be determined by any or all of the following factors:

- Inside Air $CO_2$ Levels (dampers can be opened to allow fresh air when high $CO_2$ levels are present).
- Economization (under optimal conditions, using outside air during cooling).
- Smoke/Fire Alarm (shut dampers when smoke alarm occurs).

Variable-Position Damper Methods of Control

For variable-position outside air dampers, the RCB supports two different methods of control.

- **Analog (0-10VDC output)** - The position is controlled from an analog output point set up as "Out Dmpr" on the RCB that varies the voltage from 0-10VDC corresponding to the 0-100% PID output range.
- **Damper Open/Close motors** - The damper is controlled by two separate motors: one that opens the damper "DmprOpen," and another that closes the damper "DmprCls." Digital outputs activate the motors for measured lengths of time to achieve the proper damper position.

### 6.5.1 $CO_2$ Control

When a $CO_2$ sensor input is present on the RCB control board, the outside air damper may be used to bring fresh air into the building to reduce $CO_2$ levels. The $CO_2$ sensor's value is compared to the RCB's $CO_2$ setpoint. If the reading exceeds the setpoint:

- The damper will OPEN and remain open until the $CO_2$ value drops below the setpoint (for two-position dampers).
- The damper will open and modulate its position based on a PID comparison of the $CO_2$ sensor reading and the $CO_2$ setpoint (for variable-position dampers).

### 6.5.2 Economization

Economizer dampers on rooftop HVAC units are used to bring outside air into the building for use in cooling. The RCB supports control of two-position outside air dampers as well as variable-position (analog) dampers.

The RCB controls economization by first determining whether the outside air conditions are favorable for bringing in outside air (see **Section 6.5.2.3, Economization Enabling Strategy**). If the air is not favorable for economization, the RCB will close the dampers. If the air is favorable for economization, the RCB will use the dampers like a preliminary stage of cooling, opening them first when cooling

is first called for, and then activating more cool stages only if necessary to maintain the setpoint.

#### 6.5.2.1 *Operation of Two-Position Dampers During Economization

*Not available in the RCB-P Version

Two-position dampers are set to the OPEN position when economization is enabled and the RCB is in cooling mode. The damper will remain OPEN until cooling is not required, or until the RCB determines the outside air is not favorable for economization, at which time the dampers will be set to the CLOSED position.

#### 6.5.2.2 Operation of Variable-Position Dampers During Economization

When economization is enabled and the RCB is in cooling mode, the RCB controls the position of the damper using a PID algorithm, using a mixed air temperature sensor (mounted where the sensor may measure the mixture of outside air and supply air) and a mixed air temp setpoint.

The RCB opens and closes the damper incrementally to attempt to maintain the mixed air temp setpoint. The RCB will close the damper when the mixed air is below the setpoint to keep cooler air from entering, and open the damper when the mixed air is above setpoint and requires cooler air from outside.

If the RCB calls for cooling to be OFF, or the RCB determines outside air conditions are not favorable for economization, the RCB will close the damper to a user-defined minimum damper position.

#### 6.5.2.3 Economization Enabling Strategy

The RCB has a multi-level strategy for determining whether outside air conditions are favorable for economization. Each method of economization checking has a level of priority, and the RCB will always use the economization method that is the highest priority of all valid methods. If the RCB cannot use a particular method, either due to setup or sensor failure, it will attempt the next lowest priority method.

The methods, listed in the order of priority from highest to lowest, are:

1. **Enthalpy Switch** - The highest priority economization checking method. If an input is set up on the RCB as an "Enthalpy Switch", the RCB will read the value of this input, and enable economization when the switch is CLOSED and disable economization when the switch is OPEN. If no enthalpy switch is present on the RCB, the RCB will attempt the next lowest priority checking method.
2. **Outside Dewpoint vs. Setpoint** - If an input is set up on the RCB as a "Dewpoint" sensor, the value of this sensor will be compared to the outdoor air dewpoint setpoint. If the dewpoint is below the setpoint, economization will be enabled. If no dewpoint sensor is present on the RCB, or if the sensor has failed, it will attempt the next lowest priority checking method.
3. **Enthalpy Comparison** - If the RCB has inputs for outdoor humidity, indoor humidity, and outdoor air temperature, the RCB will calculate the enthalpy of the outdoor and indoor air, compare the two values, and if the outside air enthalpy is lower, economization will be enabled. If the RCB cannot calculate either outdoor or indoor enthalpy due to lack of the necessary inputs or by sensor failure, it will attempt the next lowest priority checking method.
4. **Dewpoint Failsafe** - If the RCB has no dewpoint probe, but it does have an input designated as an outdoor air temperature (OAT) sensor, it will use the OAT value as a fail-safe dewpoint, and compare the OAT value to the dewpoint setpoint. If the outside air temperature is lower than the dewpoint setpoint, economization will be enabled. If the outside air temperature or the dewpoint failsafe setpoint are not present, the RCB will attempt the next lowest priority checking method.
5. **Temp/Temp Comparison** - If the RCB has an input designated as an outdoor air temperature (OAT) and it cannot perform the dewpoint failsafe comparison, it will enable economization based on a straight comparison between the inside air temperature and the outside air temperature. If the outside air temperature is lower than the inside air temperature, economization will be enabled. If there is no outside air temperature sensor, or if the sensor has failed, the RCB will attempt the next lowest priority checking method.
6. **E2 Zone Enable** - If the RCB has none of the necessary inputs to perform economization checking methods 1 through 5 in the list above, but the RCB is part of an AHU Zone, the RCB will read the value of the ECONOMIZATION output from the AHU Zone and enable economization when the zone says to enable it. The Zone must be programmed with its own method of economization checking (refer to the E2 user manual and on-line help for AHU Zone application setup instructions).

   Note that the AHU Zone signal to economize is the LOWEST priority economization checking method. If an RCB has the capability of performing any of the higher-priority methods, it will use these methods and ignore the AHU Zone.
7. **No Economization** - If the RCB cannot perform any of the other six methods of economization, it will disable economization and leave all dampers in the CLOSED or minimum position.

### 6.5.3 Smoke Detection

The RCB may be programmed with a Smoke Detector input, which accepts a dry-contact digital signal from a smoke alarm or a building control network. When the smoke detector contact closes to indicate smoke has been

detected, all of the RCB's heating/cooling and fans will be overridden OFF and the outside air damper will be closed.

### 6.5.4 Priority When Economization, $CO_2$ Control, and Smoke Detection Are Used Together

When both $CO_2$ and Economization control are used together in the same RCB, it will control a two-position damper using OR logic (OPEN if one or both require it to be open, CLOSED if both do not require it to be open).

Variable-position dampers will be controlled based on which control calls for the highest percentage. In other words, if the damper needs to be set to 60% to satisfy $CO_2$ fresh air requirements and 40% to satisfy the mixed air temperature setpoint, the damper will be opened to 60%.

In any case, if a smoke detector input is present on the RCB, notification of a smoke alarm overrides the outside air dampers to the CLOSED position.

## 6.6 Reversing Valve Control

The RCB supports the control of a heat and cool reversing valve. These valves may be wired to any auxiliary output on an RCB designated as a reversing valve, or "Rev Valve."

The reversing valve output can be configured to activate during heating mode HtAct or cooling mode ClAct. If set for HtAct, the relay will energize only when heat is active, and is de-energized during cool or idle periods. Likewise, if set for ClAct, the relay will energize only when cool is active, and de-energize during heating mode or idle.

In order for the output to control the valve properly, heat reversing valves must be wired to the Normally Closed (N.C.) contacts, and cool reversing valves must be wired to the Normally Open (N.O.) contacts. This causes the heat valves to activate when heat stages are ON, and cool stages to activate when cool stages are ON.

## 6.7 Stand-Alone Operation

If for some reason an RCB board loses communications with its parent E2 unit for longer than five minutes, the board will go into Stand-Alone Mode.

In Stand-Alone Mode, the RCB will continue Temperature Control as normal using the space temperature as a control input. Since an RCB has its own stored fallback setpoints and a fallback occupancy schedule, the RCB will continue operating using its occupied or unoccupied heating and cooling setpoints.

Dehumidification and Economization will occur during stand-alone mode only if the board is equipped with the right sensors, as described below.

### 6.7.1 Dehumidification and Humidification Stand-Alone Operation

If the RCB board has an auxiliary input defined as a relative humidity sensor, dehumidification and humidification will continue as normal using the RH sensor as a control input.

### 6.7.2 $CO_2$ Control Stand-Alone Operation

The RCB requires the $CO_2$ sensor input to be attached to an RCB board input; therefore, control of the outside air dampers based on indoor $CO_2$ levels will be unaffected by a loss of communication with E2.

### 6.7.3 Economization Stand-Alone Operation

The RCB will continue economization as normal if it has the necessary inputs (enthalpy switch, OAT, etc.). Refer to **Section 6.5.2, Economization**, for more information about economization checking methods and priorities.

### 6.7.4 Summer/Winter Season and Occupied/Unoccupied Scheduling

The RCB itself does not recognize summer/winter seasonal changes; all shifting of setpoint during the summer and winter seasonal change is handled by the E2. The RCB will continue stand-alone operation using the last group of occupied and unoccupied heating and cooling setpoints sent to it by the E2, until communication is restored.

For occupied/unoccupied building time scheduling, the RCB uses a separate fallback schedule. The fallback schedule is a simple seven-day occupancy schedule with up to two usable ON/OFF schedule pairs per day. This schedule is separate from any time scheduling used by the E2 and must be programmed separately if you wish to use it.

If the fallback schedule is not programmed and the RCB loses communication with the E2, it will operate in occupied mode 24 hours a day.

### 6.7.5 Other Stand-Alone Operation

The RCB will continue operating the reversing valves (if present) as normal. Other control features that rely on communication with zones or other E2 applications, such as Demand Shed and Curtailment, Setpoint Reset and Optimum Start/Stop, will not be available.

## 6.8 Sensor Failures

In many cases, RCBs and AHU Zone applications can compensate for sensor failures by substituting other sensor values. This allows the RCB systems to continue operating as close to normal as possible until the failed sensors can be fixed or replaced.

### Space Temp Failure

If a space temperature sensor on an RCB fails, the RCB will substitute the value of the return air temperature sensor as the control value. If this fails or is not present, and the RCB is connected to a Zone application in an E2, the RCB will use the zone temperature value sent down from the E2 as a replacement value.

When the space temperature sensor fails, a failure alarm will be generated and sent to the Alarm Advisory Log.

### Outside Air Temp Failure

Failure of the outside air temperature sensor affects Economization only if "Temperature Comparison" is being used as the method of economization enabling. In this case, the RCB will attempt to find a different means of economization checking, and if it cannot find a valid one, economization will be disabled for stand-alone operation.

### Mixed Air Temperature Failure

If the RCB has variable-position dampers, it will use the mixed air temperature sensor as its control input for damper control. If the mixed air temperature sensor fails, it will substitute the supply air temperature sensor as its control value and continue economization. If neither the mixed air temperature or supply air temperature sensors are available, economization will be locked OFF and the damper will be closed until the sensor failures can be addressed.

### Humidity Failure

Under normal conditions, the RCB dehumidifies when the zone application sends a signal to dehumidify. As long as the RCB receives this signal from the zone application, any failure of an on-board humidity sensor will have no effect (since this sensor is not being used as the direct control value).

When communications with the zone application are lost, the only way an RCB may dehumidify without help from the zone application is if a humidity sensor is present on the board itself. If no sensor is present, or if the sensor has failed, dehumidification will not take place.

### Supply Temp Failure for RCB-P

If the supply temperature sensor on an RCB-P fails, and a heat or cool stage is active, the pulse algorithm can be operated in the fallback mode using only minimum ON and OFF times. If the PlsHTFailmode or PlsCLFailmode of the heat or cool stage is set to Use Min On/Off Time, otherwise the pulse algorithm will be disabled.

# 7 The MultiFlex RCB E2 Interface

The MultiFlex RCB is capable of communicating with an E2 version 2.10 or above.

Using MultiFlex RCB boards with a central E2 offers several benefits over simple stand-alone control, including:

- Reporting of RCB-related alarms in the Alarm Advisory Log.
- The ability to log RCB inputs in an E2 logging group.
- The ability to share outside air temperature values and control motor room temperature by sharing input values between the RCB and the E2.
- Remote access to RCB status and programming from the E2 front panel.
- The ability to remotely access RCBs from UltraSite32 or Site Manager, and to back up, restore, and offline program RCB configuration along with E2 site configuration.

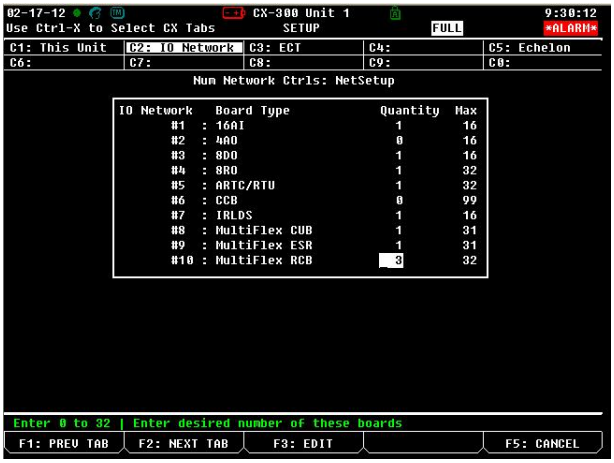
Communication between E2 and an RCB takes place over the RS485 I/O Network. Follow the instructions in **Section 3, The I/O Network**, to connect the RCBs to the E2 I/O Network. Then, follow the instructions in this chapter to set up the RCBs.

## 7.1 Adding/Deleting an RCB

### 7.1.1 Adding an RCB

Before an E2 will communicate with an RCB, it must be added as an I/O board. This task is performed in the Controller Setup screen. To access this screen:

| E2 |
|---|
| 1. Log in to the E2 controller.<br>2. Press the **Menu** Menu key.<br>3. Press &7 to navigate to the **System Configuration Menu**.<br>4. Press &7 to navigate to the **Network Status/Setup Menu**.<br>5. Press @2 - **Connected I/O Boards & Controllers**.<br>6. Enter the number of RCB boards that will be networked with this E2 in the RCB Controllers field. |




If you have properly set up all MultiFlex RCB boards on this E2's I/O Network, you can view the status of the I/O Network (press **F10** or the key to go back to the menu, then press - **Network Summary**). If E2 and the RCB boards are communicating, this screen will show the RCB boards as Online. If not, they will be shown as Offline.

### 7.1.2 Deleting an RCB

To remove an RCB from the E2:

| E2 |
|---|
| 1. Log in to E2.<br>2. Press the **Menu** Menu key.<br>3. Press &7 to navigate to the **System Configuration Menu**.<br>4. Press &7 to navigate to the **Network Setup Menu**.<br>5. Press @2 - **Connected I/O Boards & Controllers**.<br>6. Change the number of RCB boards in the RCB Controllers field to the correct number of boards. |

When RCBs are deleted in this way, E2 will always delete the highest numbered RCBs first. Therefore, if you have seven RCBs (numbered 1-7) and you change the number of RCBs to 5, the E2 will delete board #6 and #7, leaving boards #1 through #5.

## 7.2 Associating an RCB with a Zone Application

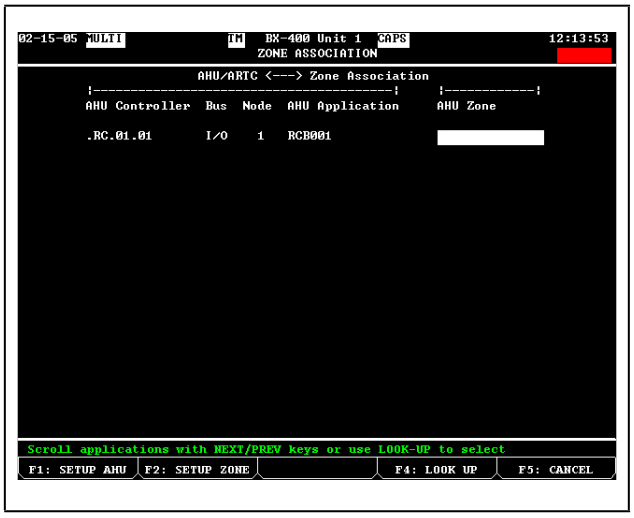



*Figure 7-1 - E2 Associations Screen*

After you have added all the RCBs to the E2 network and verified they are communicating properly, the next step is to associate them with an Zone application. Associating them with a zone is optional, but is the easiest way of grouping multiple RCBs so that they use the same setpoints, occupancy schedules, summer/winter seasonal schedules, etc. To associate one or more RCBs with Zone applications, you will first need to create Zone applications in the E2 BX if you have not already done so (press Menu - 6 for Add/Delete Application to add zones).

**E2**

1. Log in to the E2 (if not already logged in).
2. Press the **Menu** Menu key.
3. Press & 7 to navigate to the **System Configuration Menu**.
4. Press & 7 to navigate to the **Network Status/Setup Menu**.
5. Press % 5 - **Associations**.
6. This screen will list all RCBs, RTUs, and AHU applications in the E2 (see **Figure 7-1**). Each of these will have a field under the "**AHU Zone**" column where you may choose the Zone application the controller may be associated with.
7. Move the cursor to the **AHU Zone** field you wish to associate.
8. Press F4. Select the name of the Zone application you wish to use. Press Enter to confirm.

Refer to **Section 6.1, Introduction to Zone Control**, for a list of parameters that are automatically connected between the AHU Zone and the RCB when associated.

## 7.3 Viewing the RCB Status Screen

Once you have added an RCB to the E2, you will be able to see the status of the RCB board(s) from the front panel.

**E2**

1. From the Main Status Screen, press the **Menu** Menu key and select % 5 - Configured Applications.
2. Press @ 2 # 3 to select **MultiFlex RCB** from the Menu.
3. If multiple RCBs are associated with this E2, the RCB Summary Screen will be shown. To see a single RCB's status screen, use the arrow keys to highlight the RCB you wish to view, and press Enter.

The RCB Status screen for the RCB you selected will appear (**Figure 7-2**).


*Figure 7-2 - RCB Status Screen*

The RCB Status screen shows the current status of all heating, cooling, fans, dampers, and other outputs and controlled systems in the RCB. Though there is a large amount of information on an RCB Status screen, status information is grouped on this screen in several groups of related information in order to make the screen easier to read. Note that the MultiFlex RCB application must be configured to communicate with an RCB-P by setting the RCB Type parameter to Pulse under the Setup screen. The type of RCB will show on the Status screen in the upper right corner under RCB Type. If the RCB Type parameter is incorrectly set, Type Mismatch will be shown in the Network Summary screen for the device.

The Status screen groups are described below:

### 7.3.1 Temperatures, Inputs, and System Status

The large box on the left side of the RCB Status screen shows the current status of the RCB's most vital control inputs and setpoints. In bold at the top of this box are the most important of these: the CTRL TEMP (control temperature) and the currently active control setpoint, which is displayed in brackets next to the CTRL TEMP value. Also in bold at the top of this box are the occupancy state (OCC or UNOCC) and ZONE TEMP (if this RCB is a part of a Zone application). Other temperature inputs such as supply air, return air, and mixed air temperature are also displayed here.

At the bottom of this box, the HHT CONNECTION field shows whether a hand-held terminal is currently plugged into this RCB board. The RCB Status shows whether the board is currently communicating with the E2 (Online) or has lost communication (Offline).

### 7.3.2 Fan Status

The top box in the center column of the RCB Status Screen shows the status of all fans controlled by the RCB. This includes the ON/OFF status of a single-speed fan, the current speed of a two-speed blower fan (OFF/LOW/HIGH), and the speed percentage of a variable-speed blower fan.

### 7.3.3 Economization / Damper Status

In the top box of the right column in the RCB status screen, the economization state is displayed. Econ Status shows NOECON if economization checking shows the outside air is not favorable for economization, or ECON if economization is OK.

### 7.3.4 Dehum Status

The dehumidification status is shown in the middle box of the right column on the RCB Status screen. The Dehum Status is OFF if no dehumidification is active, or ON if dehumidification is active. An ON in this field will signify the dehumidification device is active if one is present, and it may also signify one or more cool stages are currently active to achieve dehumidification.

### 7.3.5 Heat and Cool Staged and Mod Status

The heating and cooling status for the RCB is shown in the two boxes at the bottom right of the RCB status screen. If using staged heating or cooling, the current ON/OFF status of the stages will be shown. If using modulated heating or cooling, the modulating percentage will be shown. If using Modulating and Staged you will see both on the Status screen ***Figure 7-5***.

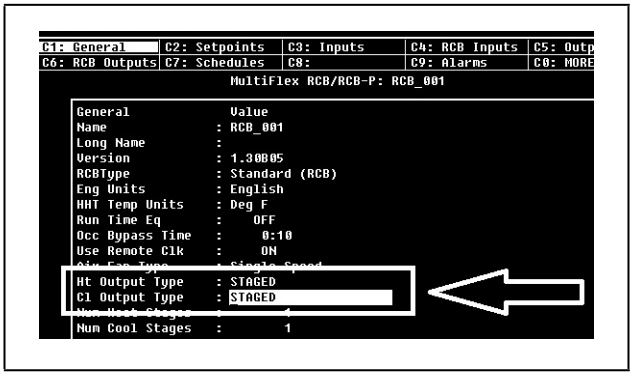



*Figure 7-3 - HI and CI Output Types*

The MOD + STAGED control type allows operation of a modulating Analog Output and staged Relay Outputs from the same control loop.

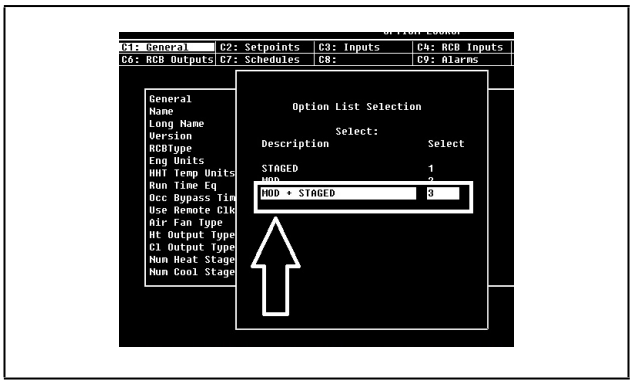



*Figure 7-4 - Choose Modulating + Staged Control Type*

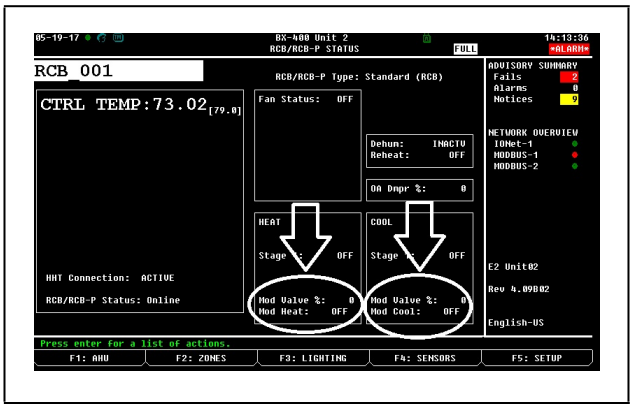



*Figure 7-5 - RCB Status Screen*

Pulse Heat or Pulse Cool is ON if one Heat or Cool stage is operated in Pulse Mode, and OFF if no stages are currently being operated in Pulse Mode.

### 7.3.6 Other Actions from the RCB Status Screen

#### 7.3.6.1 Detailed Status

A more detailed status screen can be displayed for this RCB by pressing the Enter key from anywhere on the RCB Status Screen to call up the Actions Menu, then selecting 6. Detailed Status. Detailed Status shows the current values of all inputs and outputs related to the RCB and the E2's RCB application.

#### 7.3.6.2 Setup

To set up the RCB, press F5 from the RCB Status Screen.

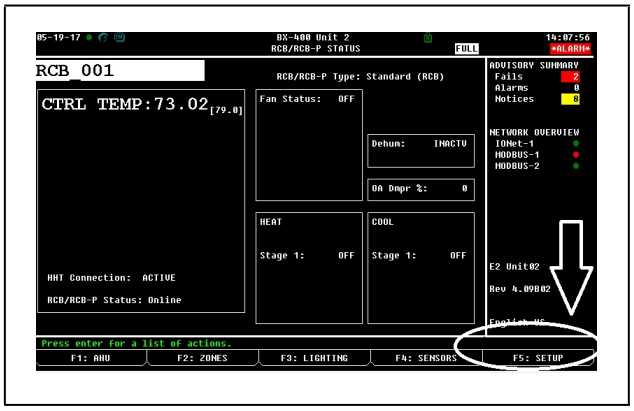



*Figure 7-6 - RCB Status Screen - Press F5 for Setup*

#### 7.3.6.3 Reset Runtimes

The RCB accumulates runtime statistics for its heat and cool stages, air fan, and condenser fan. These runtimes may be viewed from E2 in the Detailed Status screen (see **Section 7.3.6.1 Detailed Status**) under the Outputs tab. You may also view them with a HHT connected to the RCB.

You may reset one or all of the runtimes from the E2 front panel. From the RCB Status Screen:

1. Press Enter to call up the **Actions Menu.**
2. Select **10. Runtime Resets** from the Actions Menu. The RCB Runtime Resets screen will appear.

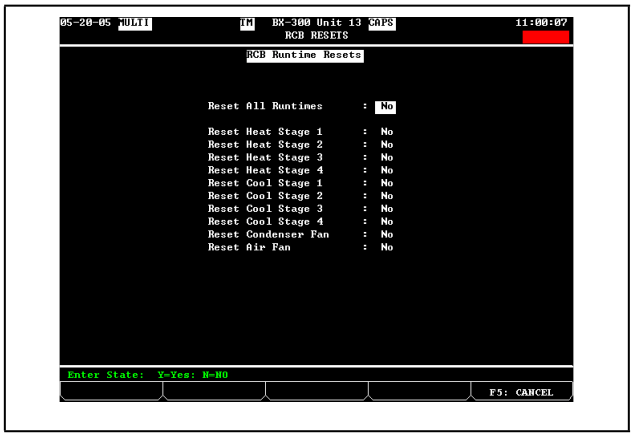



*Figure 7-7 - RCB Runtime Resets Screen*

To reset an individual runtime, move the cursor to highlight which runtime you wish to reset, press Next or Prev to change the value to **Yes**, and then press the **UP** or **DOWN** arrow key to execute the runtime reset. When the field changes back to **No**, the reset will be complete.

Reset All Runtimes, when executed, will reset all stage and fan runtimes at the same time.

## 7.4 RCB Setup Screens

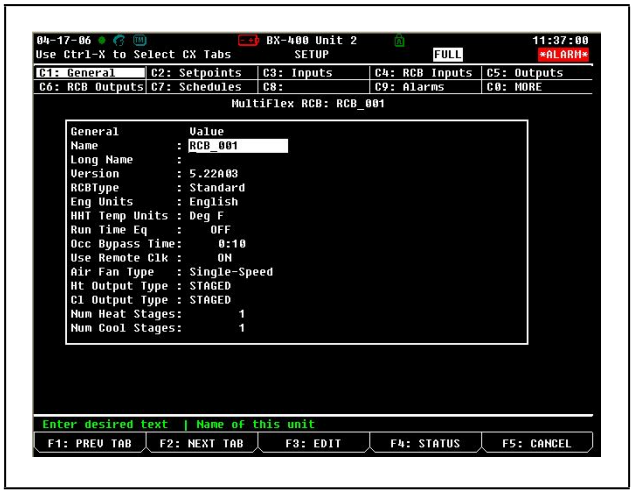



*Figure 7-8 - RCB Setup Screen*

Even when associating the RCB with a Zone application, there are many setup tasks that must be performed for each individual RCB using the RCB setup screens.

To access the RCB Setup Screens, navigate to the RCB's Status Screen, and press **F5: Setup**.

A complete description of each parameter in all of the RCB setup screens may be accessed by highlighting the parameter and pressing the **HELP** ? key. Use the F1 and F2 keys to scroll through the different screens.

To set up the MultiFlex RCB application to communicate with an RCB-P, set the RCB Type parameter to Pulse.

When setting up an RCB you should go through each screen to check the function of each parameter and determine if you will need to change the value to accommodate the way you want the RCB to operate. In general, here are some things most users will need to do in these screens to set up your RCB:

- Name your application. In **screen C1: General**, enter a name in the Name field that describes the RCB's basic function and location.
- Select **Fan** and **Heat/Cool** types. In screen **C1: General**, choose the type of fan to be controlled in the Air Fan Type field. Select whether your heat and cool will be **STAGED** or **MOD** (**modulated**) in the **Cl Output Type** and **Ht Output Type** fields.
- Enter setpoints. Scroll through all parameters in **C2: Setpoints** and set up your low supply temp setpoints, stage ON and OFF delays, and other desired settings.
- Set *humidity/dehum control setpoints and heat/cool setpoints. If the RCB is associated with a zone, the **C3: Inputs** screen will show the zone output connections that provide the RCB its heat/cool setpoints and occupied dehum setpoint. If this RCB will not be associated with a zone, you will need to enter these here.
  *Humidity control is not available on the RCB-P.
- Setup RCB Inputs. In **C4: RCB Inputs**, setup each RCB input point that has an input connected to it. Refer to the on-line help and also **Section 4.1, The MultiFlex RCB Inputs**, for more information.
- Setup RCB outputs. In **C6: RCB Outputs**, setup each RCB output point that has a device connected to it. Refer to the on-line help and also **Section 4.2, The MultiFlex RCB Outputs**, for more information.
- Set PID throttling ranges. In **C8: PID**, check the default throttling ranges for all PID-controlled RCB systems and verify they are the throttling ranges you wish to use. Simply put, throttling range is the number of engineering units between a PID output of 0% and a PID output of 100%. For example, in heating control, if your heating setpoint is 69°F and your throttling range is 3, the proportional mode of PID begins at 0% when the input is equal to the setpoint (69°F) and gradually climbs to 100% as the input falls to three degrees F below setpoint (66°F). The Throttling Range is the primary means of setting up PID control behavior. In general, larger values of the throttling range result in slower reactions to input changes.
- Define alarm/notice preferences. Scroll through the parameters in **C9: Alarms**, and set the preferences for alarm/notice delays, types, priorities, etc. Refer to the on-line help for the function of each setting.

## 7.4.1 RCB-P Pulse Control Setpoints Setup

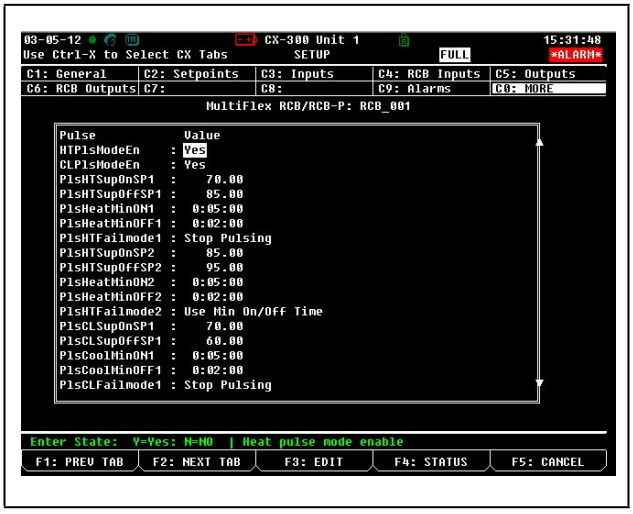



*Figure 7-9 - RCB-P Pulse Control Setup Screen*

### 7.4.1.1 Pulse Algorithm Description

The Pulse sequence is applied during heating or cooling. During dehumidification, the unit will not pulse the heating or cooling outputs. The algorithm supports up to four (4) heat and four (4) cool stages. The stages are turned on in a sequential manner. Stage1 is turned on first, then Stage2, Stage3, and finally Stage4.

**NOTE** **Note that only the highest number stage ON can be operated in Pulse mode.**

Pulse Heat Mode Algorithm

Heat pulsing mode is enabled if: **HTPlsModeEn** is set to **Yes**.

Each of the four (4) possible Heat stages has the following setpoints: PlsHTSupOnSP, PlsHTSupOffSP, PlsHeatMinON, PlsHeatMinOFF, and PlsHTFailmode.

If **HTPlsModeEn** is set to **Yes**, a Heat stage can be controlled in one of two pulse modes:

**Mode 1:** If PlsHTSupOnSP is less than its PlsHTSupOffSP and Supply Temp is in the valid range of 33.8°F to 194°F, the Pulse control will operate as follows:

If the Supply Temp is less than PlsHTSupOnSP, the *Pulse mode* Heat stage will turn ON if it has been OFF for more than the PlsHeatMinOFF time.

If the Supply Temp is more than PlsHTSupOffSP the *Pulse mode* Heat stage will turn OFF if it has been ON for more than the PlsHeatMinON time.

**Mode 2:** If PlsHTSupOnSP is greater than or equal to PlsHTSupOffSP or the Supply Temp is NOT in the valid range of 33.8°F to 194°F, and PlsHTFailmode is set to: Use Min On/Off Time, the Pulse control will operate as follows:

The *Pulse mode* Heat stage will be ON for PlsHeatMinON time, then turn OFF for PlsHeatMinOFF time. The cycle will repeat as long as HEAT ACTIVE is ON for the *Pulse mode* stage.

Pulse Cool Mode Algorithm

Cool Pulsing mode is enabled if: **CLPlsModeEn** is set to **Yes**.

Each of the 4 possible Cool stages has the following setpoints: PlsCLSupOnSP, PlsCLSupOffSP, PlsCoolMinON, PlsCoolMinOFF, PlsCLFailmode.

**⚠ CAUTION**

**The PlsCoolMinOFF time and PlsCoolMinON time have default values that will limit the maximum compressor cycles to approximately 8.5 cycles per hour during the Pulse algorithm. The PlsCoolMinOFF time and PlsCoolMinON time parameters are user-configurable. Use caution when changing these parameters, as reducing these values could have a negative impact on the compressor life.**

Compressor Cycles Per Hour Calculation

Cycle time in minutes = PlsCoolMinOFF time + PlsCoolMinON time.

Default settings are PlsCoolMinOFF = 2 minutes and PlsCoolMinON time = 5 minutes.

Default settings have a cycle time of 2 + 5 = 7 minutes per Cycle (7 minutes/Cycle)
(60 minutes/hour) / (7minutes/Cycle) = 8.57 Cycles/hour for the default settings during the Pulse algorithm.

If **CLPlsModeEn** is set to **Yes**, a Cool stage can be controlled in one of two Pulse modes:

**Mode 1:** If PlsCLSupOnSP is more than its PlsCLSupOffSP and Supply Temp is in the valid range of 33.8°F to 194°F, the Pulse control will operate as follows:

If the Supply Temp is more than PlsCLSupOnSP, the *Pulse mode* Cool stage will turn ON if it has been OFF for more than the PlsCoolMinOFF time.

If the Supply Temp is less than PlsCLSupOffSP the *Pulse mode* Cool stage will turn OFF if it has been ON for more than the PlsCoolMinON time.

***NOTE***

**During Mode 1 operation of the Pulse Cool Algorithm, the compressor cycles will usually be less than the Compressor Cycles Per Hour Calculation during the Pulse algorithm.**

**Mode 2:** If PlsCLSupOnSP is less than or equal to PlsCLSupOffSP or the Supply Temp is NOT in the valid range of 33.8°F to 194°F, and PlsCLFailmode is set to: Use Min On/Off Time, the Pulse control will operate as follows:

The *Pulse mode* Cool stage will be ON for PlsCoolMinON time then turn OFF for PlsCoolMinOFF time. The cycle will repeat as long as COOL ACTIVE is ON for the *Pulse mode* stage.

***NOTE***

**During Mode 2 operation (Use Min On/Off Time) of the Pulse Cool Algorithm, the compressors will always cycle at the Compressor Cycles Per Hour Calculation during the Pulse algorithm.**

# 8 The MultiFlex RCB Hand-Held Interface

The MultiFlex RCB Hand-Held Terminal interface allows you to view status of the rooftop HVAC systems and configure setpoints directly on the board. If you are using RCBs separate from a central E2 system, the Hand-Held Terminal will be the only programming interface you may use.

IMPORTANT! If the RCB boards are connected to a parent E2, do not use the Hand-Held Terminal to make permanent configuration changes. Changes made to an RCB via the Hand-Held Terminal are designed to be temporary for units connected to an E2. The parent controller does not recognize any configuration changes made by the HHT, and when the HHT is unplugged from the RCB, E2 will change all parameters changed with the HHT back to their original values.

## 8.1 RCB Hand-Held Terminal Status Screens

When an HHT is plugged into an RCB, users may access a series of screens that display input and output status information. Certain control parameters, such as offsets, setpoints, and deadbands, may also be changed in these screens. The HHT may also be used to initiate cooling, heating, fan, auxiliary, and economizer overrides.

The UP and DOWN keys on the HHT keypad are used to scroll through the screens. The DOWN key scrolls forward through the screens, and the UP key scrolls backward.

Some screens will have fields that may be changed using the HHT. To change the value in a field, press the RIGHT arrow key. A cursor will appear in the screen next to the first changeable field in the display. Use the UP and DOWN arrow keys to move the cursor to the desired field, and enter the desired value using the numeric keypad or select an option using the dash "—" key. When finished, use the UP and DOWN arrow keys to move the cursor off the screen.

At any screen, the F1 key may be used to call up a brief description of the screen's function. To exit the help screen, press any key on the keypad. The following sections show the HHT screens for the RCB.

## 8.2 RCB Opening Screens

| Road Map from RCB Main Screen | Menu | Description |
|---|---|---|
| N/A | MULTIFLEX RCB<br>TYPE:810-3075<br>VER: 1.10F01<br>( PRESS ) | This is the screen that first appears when the HHT is plugged into the RCB. It shows the controller type, Copeland part number, and version number. The last line of this screen will show any alarm conditions active for the RCB board. If no alarms are active, the last line will prompt the user to press the **DOWN ARROW** key to continue. *VER 5.xxxxx or greater indicates the RCB-P version. Revisions below VER 5.xxxxx indicate the RCB version.* |
| ↓ | DIP SETTINGS<br>Address: 1<br>Baud : 9600 | This screen shows the setting of the RCB board's network address and baud rate dip switches. You may use this screen to quickly double-check the network addresses of all your RCB boards during installation and troubleshooting. Each RCB should have a unique address number, and all boards should be set to **9600 baud**. Press the **DOWN ARROW** key again to go to the **Main Menu**. |

## 8.3 RCB Main Menu

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| N/A | MAIN MENU<br>1-STATUS MENU<br>2-CONTROL MENU<br>Select : 1 | The Main Menu has two options. To view the status of the RCB inputs, outputs, and other system functions, choose **1** - **STATUS MENU**. To program the RCB, or change setpoints, choose **2** - **CONTROL MENU**. |

## 8.4 Status Menu

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 1 (or press **F1** from any screen) | STATUS MENU<br>1-INPUT 2-OUTPUT<br>3-RUNTM 4-MISC<br>Select : 1 | The Status Menu allows you to view current input and output values, runtimes, and other status. Pressing **F1** on the HHT at any time will cause this screen to appear.<br>1. **INPUT** - Shows the values of the 16 RCB inputs.<br>2. **OUTPUT** - Shows the value of the 8 RCB outputs.<br>3. **RUNTM** - Shows the accumulated runtimes of the heat and cool stages, the air fan, and the condenser fan.<br>4. **MISC** - Shows the current control temp value, occupancy state, and number of stages available for dehumidification. |
| 1 - 1 | SpacTemp :73.0<br>SuplTemp :67.6<br>RtrnTemp :71.7<br>CL1 Prf :OFF | Choosing **1** - **INPUT** from the **Status Menu** displays a series of four screens that show the definition of each point on the RCB and its current value. The first screen shows the name and value of points 1 through 4. Press the **DOWN ARROW** key to view points 5-8, 9-12, and 13-16 on the next three screens. |
| 1 - 2 | Relay Output Status<br>Heat 1 :OFF<br>Heat 2 :OFF<br>Cool 1 :ON<br>Cool 2 :OFF<br><br>Analog Output Status<br>VS Fan :0.00<br>Out Dmpr :5.00<br>NDF :0.00<br>NDF :0.00 | Choosing **2** - **OUTPUT** from the **Status Menu** displays a series of screens that show the definition and state of the RCB relay outputs, and the definition and current value of the RCB analog outputs. The first screen shows the names and values of points 1 through 4. Press the **DOWN ARROW** key to view points 5-8, and analog points 1-4 on the next three screens. |
| 1 - ER 3 | Cool1: 0 Hrs<br>0.00 % of Time<br>Cool2: 0 Hrs<br>0.00 % of Time | Choosing **3** - **RUNTM** from the **Status Menu** displays a series of screens that show the number of hours the cool and heat stages, the air fan, and the condenser fan have been operating since the last runtime reset. Runtime stats for heat and cool stages 1 through 4 are shown, even if they are not defined or used for the RTU controlled by the RCB. Each runtime shows both the number of total runtime hours since last reset, but the percentage of time overall the stage or device has been ON since last reset.<br>Use the **DOWN ARROW** keys to scroll through the runtime screens. The order is:<br>1 - Cool Stages 1 and 2<br>2 - Cool Stages 3 and 4<br>3 - Heat Stages 1 and 2<br>4 - Heat Stages 3 and 4<br>5 - Air Fan and Condenser Fan |

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 1 - 2 | Relay Output Status<br>Heat 1 :OFF<br>Heat 2 :OFF<br>Cool 1 :ON<br>Cool 2 :OFF<br><br>Analog Output Status<br>VS Fan :0.00<br>Out Dmpr :5.00<br>NDF :0.00<br>NDF :0.00 | Choosing **2** - **OUTPUT** from the **Status Menu** displays a series of screens that show the definition and state of the RCB relay outputs, and the definition and current value of the RCB analog outputs. The first screen shows the names and values of points 1 through 4. Press the **DOWN ARROW** key to view points 5-8, and analog points 1-4 on the next three screens. |
| 1 - ER 3 | Cool1: 0 Hrs<br>0.00 % of Time<br>Cool2: 0 Hrs<br>0.00 % of Time | Choosing **3** - **RUNTM** from the **Status Menu** displays a series of screens that show the number of hours the cool and heat stages, the air fan, and the condenser fan have been operating since the last runtime reset. Runtime stats for heat and cool stages 1 through 4 are shown, even if they are not defined or used for the RTU controlled by the RCB. Each runtime shows both the number of total runtime hours since last reset, but the percentage of time overall the stage or device has been ON since last reset.<br>Use the **DOWN ARROW** keys to scroll through the runtime screens. The order is:<br>1 - Cool Stages 1 and 2<br>2 - Cool Stages 3 and 4<br>3 - Heat Stages 1 and 2<br>4 - Heat Stages 3 and 4<br>5 - Air Fan and Condenser Fan |

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 1 - 4 | Mode OCC HEAT<br>Ctrl Temp: 73.0<br>Active SP: 70.0<br>Dehum: InActive | Choosing **4 - MISC** shows three status items:<br>**Mode** - The first line shows the current operation modes. The first line will show OCC or UNOCC. If OCC, the RCB is using occupied setpoints; if UNOCC, the RCB is using unoccupied setpoints. This is determined by the schedule followed by the Zone to which this RCB is associated.<br>**HEAT or COOL** - Shows if the RCB is currently in Control Mode.<br>**Ctrl Temp** - The current temperature being used as the control temperature. This is typically the same value as the space temp input, unless the space temp sensor has failed or is unavailable, in which case it may be the supply temp or zone temp sent from the associated E2 Zone application.<br>**ACTIVE SP** - The active control setpoint.<br>**Dehum** - Inactive or Active is the current state of dehumidifcation. |
| 1 - 4 - ↓ | **Pulse Control Status Screen - RCB-P Only**<br>SuplTemp:106.3<br>Pulse Mode<br>Heat: ON Stg#2<br>Cool: OFF Stg#0 | **Pulse Control Status Screen**<br>**Supply Temp** - Used for Pulse Control.<br>**Heat** - Is the heat pulse mode ON/OFF and the stage number (Stg#) is the current pulsing stage.<br>**Cool** - Is the cool pulse mode ON/OFF and the stage number (Stg#) is the current pulsing stage. |
| 1 - 4 - ↓ | **Time/Date Status Screen**<br>MON 2/20/12<br>TIME :XX:XX:XX<br>FlashErase: 3<br>ShutdownInp: OFF | **Time/Date Status Screen**<br>**Date and Time** show the date and time.<br>**FlashErase** shows Flash erase: Flash erase is the number of times setpoints have been saved to flash. This number should not exceed 10,000.<br>**ShutdownInp** shows the Shutdown Input. The Shutdown input is ON when a global shutdown is received from E2. |

## 8.5 Control Menu

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 2 (or press **F2** from any screen) | CONTROL MENU<br>1-SETPTS 2-INPUT<br>3-OUTPUT 4-MORE<br>Select : 1<br><br>**More Options (press 4)**<br>5-SCHED 6-OVRRD<br>7-RESET 8-PID<br>9-MISC<br>Select : 5 | Selecting **2 - CONTROL** from the main menu takes you to the Control Menu, which is used to change input and output definitions, change setpoints, program or change schedules, and other system functions. Pressing **F2** at any time will cause this screen to appear.<br>1. **SETPTS** - Program and change control setpoints.<br>2. **INPUT** - View and/or change the assignment of RCB inputs 1 through 16.<br>3. **OUTPUT** - View and/or change the assignment of RCB relay outputs 1 through 8 and analog outputs 1 through 4.<br>4. **MORE** - Select this option to view the second part of the menu, to view or select options 5 through 9.<br>5. ***SCHED** - Program ON/OFF schedule times in the RCB's stand-alone schedule. **Schedules are not available for the RCB-P.*<br>6. **OVRRD** - Override RCB inputs, relays, and analog outputs.<br>7. **RESET** - Reset device runtime totals, alarms, or reset all setpoints to default.<br>8. **PID** - View and/or change heating, cooling, and other PID constants.<br>9. **MISC** - General functions, including changing time and date and other setpoints. |

### 8.5.1 Control Menu - Setpoints

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 2 - 1 | OCC UNO<br>HT: 71.0 65.0<br>CL: 75.0 79.0<br>MinSuplTmp: 0.0 | This screen shows the occupied and unoccupied heat and cool setpoints used by the RCB. These setpoints may be changed in this screen, but if the RCB is associated with a zone, the E2 will overwrite the setpoints back to their original values when the HHT is unplugged.<br>**MinSuplTmp** - If desired, you may specify a minimum supply temperature setpoint. If the supply temperature falls below this value, cool stages will be deactivated to prevent overcooling. |
| 2 - 1 - ↓ | Min ON/OFF Times<br>ON OFF<br>HT: 03:00 01:00<br>CL: 03:00 02:00 | This screen shows the minimum ON and OFF times for heat and cool mode activation. When heating or cooling mode first begins, the RCB will wait until the appropriate heating or cooling ON delay elapses before turning on the first stage. If heating or cooling mode is active, and the RCB determines heating or cooling mode should end, it will wait for the OFF delay before deactivating all stages.<br>*NOTE: These delays do NOT apply to interstage activations. In other words, the RCB does not apply the delay to EACH stage activation or deactivation (only the beginning and ending of heat or cool mode).* |
| 2 - 1 - ↓ 2 | OCC UNO<br>Dehum: 60 50<br>Cutoff: 50 %<br>DehumCoolStg: 1 | **Dehum OCC/UNO** - The dehumidification occupied and unoccupied setpoints are used in dehumidification control only if the RCB is not associated with a Zone application in E2 that controls dehum for all RCBs in the zone (or if the RCB is operating in stand-alone mode). The indoor humidity input value is compared to the active dehumidification setpoint to determine the dehumidification PID percentage.<br>**Cutoff** - If the RCB has a dehumidification device (an output defined as "Dehumidifr"), the Dehum CO parameter determines the PID percentage at which the output will turn ON and OFF. If the PID percentage climbs above the Dehum CO, the output will turn ON. If it falls below the Dehum CO, the output will turn OFF.<br>**DehumCoolStg** - This parameter defines how many cool stages for the rooftop unit may be activated during dehumidification. The RCB always uses the lowest numbered stages for dehumidification (for example, if the RTU has three cool stages and this parameter is set to 2, the RCB will only use cool stages 1 and 2 during dehumidification). |
| 2 - 1 - ↓ 3 | OCC UNO<br>Hum: 30 20 %<br>HumCutOff:30 %<br>RevVals: HtAct<br><br>*This screen is not available on the RCB-P version. | **Hum OCC/UNO** - The humidification occupied and unoccupied setpoints are used in humidity control. The indoor humidity input value is compared to the active humidification setpoint to determine the humidification PID percentage.<br>**HumCutOff** - The Hum CO parameter determines at what PID percentage the humidifier (an output defined as "Humidifr") will turn ON and OFF. If the PID percentage climbs above the Hum CO, the output will turn ON. If the PID percentage falls below the Hum CO, the output will turn OFF.<br>**RevVals** - If the RCB is controlling a reversing valve, this parameter determines when the reversing valve output will be active. If set to HtAct the RCB will energize the relay when heating mode is active. If set to ClAct the RCB will energize the relay when cooling mode is active. |

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 2 - 1 - ↓ 4 | Low Supply Temp<br>Enable: NO<br>SetPt: 59.0<br>Delay: 10 M<br><br>*This screen is not available on the RCB-P version. | **Low Supply Temp Enable** - If you wish to enable low supply temperature shutdown, set this field to YES.<br>**SetPt** - This is the minimum supply temp setpoint to be used in low supply temperature shutdown. If the supply temperature falls below this setpoint for an amount of time longer than the Delay, cool stages will be deactivated.<br>**Delay** - The Delay is the amount of time the supply temperature must be below the SetPt before cool stages will be deactivated. |
| 2 - 1 - ↓ 5 | Econ OCC UNO<br>Delta: 2.0 2.0<br>DewPtSP: 60.0<br>OATDlta: 10. | **Econ OCC/UNO Delta** - During economization, the mixed air temperature setpoint is determined by the active cooling setpoint MINUS the value of the Econ Delta parameter. For example, if the active occupied cooling setpoint is 72°F and the Econ OCC Delta is 5.4, the RCB will control the damper to attempt to maintain a mixed air temp of 66.6°F (72 - 5.4).<br>**DewPtSP** - The Dewpoint Setpoint is used when the "Outside Dewpoint vs. Setpoint" strategy of economization checking is used, in which case economization will be enabled when the outside dewpoint is lower than this setpoint.<br>**OATDelta** - The OATDelta is used in economization checking only when the "Temp Comparison" strategy is being used. This value is added to the indoor (space) temperature and compared to the outdoor air temperature; if the outdoor air temperature is lower than this value, economization will be enabled. |
| 2 - 1 - ↓ 6 | AirFan OCC UNO<br>Mode: AUTO AUTO<br>DHSpdDlta: 0%<br>DehumLoSP: 53.8 | **Air Fan Mode OCC/UNO** - The Air Fan Mode Occupied and Unoccupied fields determine the method of fan operation during occupied and unoccupied building times. AUTO mode activates the fan only when heating or cooling is active. CONT mode activates the fan continuously, even when there is no heating or cooling active. "SOWA" means the fan will be continuously ON in the summer season and AUTO mode in the winter season.<br>**DHSpdDlta** - the Dehum Speed Delta is the amount the VS Fan speed must change from its current position before the VS Fan will actually be commanded to operate at a different speed. For example, if the DHSpdDelta is set at 3% and the current VS Fan Speed is 50%, the fan will remain at 50% until the calculated fan speed exceeds 53% or falls below 47%. This feature will keep the fan from reacting to every small change in the calculated VS Fan percentage.<br>**DehumLoSP** - If the control temperature falls below this setpoint, dehumidification will be locked out to prevent overcooling. Dehumidification will remain locked out until the control temperature rises 5 degrees above this setpoint. |
| 2 - 1 - ↓ 7 | AirFan Delays<br>ON OFF<br>HT: 01:00 01:00<br>CL: 00:00 00:00 | **AirFan Delays** - The Air Fan ON/OFF delays are the amount of time the RCB will keep the air fan OFF after the first heat or cool stage turns ON, or ON after the first heat or cool stage turns OFF. This is typically used during heating mode to delay fan activation to prevent blowing cold air and to purge warm air from the plenum after heat stage deactivation. |

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 2 - 1 - ↓ 8 | Control Type<br>Fan: 1 Speed<br>Heat: Staged<br>Cool: Staged | Use this screen to specify what type of heat, cool, and fan devices will be controlled by this RCB.<br>**Fan** - Select "1 Speed," "*2 Speed," "Var Speed," or "No Fans." *2 Speed is not available for the RCB-P version.*<br>**Heat** - Select Staged if using staged heat, or Mod if using modulated heat.<br>**Cool** - Select Staged if using staged cool, or Mod if using modulated cool. |
| 2 - 1 - ↓ 9 | Low2Hi HT CL<br>Stg: 2 2<br>Mod: 50 50<br>SpinDwnDly:00:30<br><br>*This screen is not available on the RCB-P version. | **Low2Hi HT/CL Stg** - The two-speed fan cool and heat switch stage parameters are used only if a two-speed fan is present. The number represents the heat or cool stage number that, when activated, will switch the fan from LOW to HIGH speed, and when deactivated will switch the fan from HIGH to LOW speed. You may choose separate switch stages for both heat and cool modes.<br>**Mod HT/CL** - The SwMod parameters are used if modulated heating and cooling are used in conjunction with two-speed fans. This parameter represents the mod % at which the fan will transition from LOW to HIGH speed (if the PID is increasing) or from HIGH to LOW speed (if the PID is decreasing).<br>**SpinDwnDly** - The Spin Down Delay is the amount of time the RCB will wait before switching speeds. If the RCB calls for a transition from LOW to HIGH, or from HIGH to LOW, the RCB will wait for the delay to pass before switching speeds. |
| 2 - 1 - ↓ 10 | VS Fan Diff<br>HT CL<br>Min%: 30 30<br>Max%: 100 100 | **VS Fan Diff** - This screen allows you to set the minimum and maximum fan speeds for variable-speed fans during differential mode. When a VS fan is active during differential, it will begin operating at the minimum percentage when heat or cool mode first begins, and the VS fan will never operate at a speed below the minimum fan speed. The maximum percentage is the high limit for the VS fan speed during differential mode. You may specify separate minimum and maximum VS fan speeds for heating and cooling control. |
| 2 - 1 - ↓ 11 | Diff HT SP: 45.0<br>Diff CL SP: 20.0<br>Diff Dehum: 25.0<br>Mode: Staged | **Diff HT SP** - When Differential VS Fan Control is being used, the Differential Heat setpoint is the difference between the supply and return air temperatures the RCB will try to maintain during heating. The VS fan speed will increase or decrease to keep the heat differential equal to this setpoint.<br>**Diff CL SP** - When Differential VS Fan Control is being used, the Differential Cool setpoint is the difference between the return and supply air temperatures the RCB will try to maintain during cooling. The VS fan speed will increase or decrease to keep the cool differential equal to this setpoint.<br>**Diff Dehum** - When Differential VS Fan Control is being used, the Diff Dehum setpoint is the difference between the return and supply air temperatures the RCB will try to maintain during dehumidification. The VS fan speed will increase or decrease to keep the dehum differential equal to this setpoint. Typically, you will want to specify a higher differential setpoint than the Diff CL SP, so that the fan speed will be slower during dehumidification.<br>**Mode** - This field selects whether the fan will be controlled in Staged or Differential mode. Refer to **Section 6.3.2, Variable-Speed Fan Control**, for a description of these modes. |

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 2 - 1 - ↓ 12 | Econ%: 100<br>Idle%: 100<br>VS Fan Staged %<br>DehumOfset%: 0 | **Econ %** - When economization is active with no heating or cooling stages ON, the VS Fan will operate at the percentage specified in the Econ % field.<br>**Idle %** - When no heating or cooling stages are ON but the fan is operating in "Continuous" mode, the VS Fan will operate at the percentage specified in the Idle % field.<br>**VS Fan Staged Dehum Offset** - When using Staged fan control, the Dehum Offset will be subtracted from the total fan speed when dehumidification is active in the RCB. This slows the fan speed down for more effective dehumidification. |
| 2 - 1 - ↓ 13 | %HT1 HT2 HT3 HT4<br>100 100 100 100<br>%CL1 CL2 CL3 CL4<br>100 100 100 100 | The HT1-HT4 and CL1-CL4 parameters in this screen are the VS fan speed setpoints used when using Staged VS fan control. The RCB looks at the fan speed settings for all stages that are currently ACTIVE, and operates the fan at the highest setting. |
| 2 - 1 - ↓ 11 | Co2 SP: 1000.<br>DmprOccMin: 5 %<br>UnOccMin: 5 %<br>DigCutIn: 25 % | **$CO_2$ SP** - If using outside air dampers to control $CO_2$ levels, the $CO_2$ SP is the control setpoint that will be used. If the measured $CO_2$ level rises above this setpoint, the air dampers will be opened to lower the $CO_2$ level.<br>**DmprOccMin** - When the RCB is operating in Occupied mode, the DmprOccMin is the minimum percentage the damper will remain open even when economization is not being used. If the building you are controlling has air quality standards that require the damper be open to a minimum position, enter that position in this field.<br>**DmprUnoccMin** - When the RCB is operating in Unoccupied mode, the DmprUnoccMin is the minimum percentage the damper will remain open even when economization is not being used. If the building you are controlling has air quality standards that require the damper be open to a minimum position, enter that position in this field.<br>**DigCutIn** - Because PID Control is being used to determine economization damper position (even if the dampers are not variable-position), two-position (or digital) dampers are controlled by comparing the PID percentage to a cut-in setpoint. When the economization PID is above the DigCutIn setpoint, the dampers will be OPEN. When the economization PID is below the DigCutIn setpoint, the dampers will be CLOSED. |

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 2 - 1 - ↓ 11 | Co2 SP: 1000.<br>DmprOccMin: 5 %<br>UnOccMin: 5 %<br>DigCutIn: 25 % | **$CO_2$ SP** - If using outside air dampers to control $CO_2$ levels, the $CO_2$ SP is the control setpoint that will be used. If the measured $CO_2$ level rises above this setpoint, the air dampers will be opened to lower the $CO_2$ level.<br>**DmprOccMin** - When the RCB is operating in Occupied mode, the **DmprOccMin** is the minimum percentage the damper will remain open even when economization is not being used. If the building you are controlling has air quality standards that require the damper be open to a minimum position, enter that position in this field.<br>**DmprUnoccMin** - When the RCB is operating in Unoccupied mode, the DmprUnoccMin is the minimum percentage the damper will remain open even when economization is not being used. If the building you are controlling has air quality standards that require the damper be open to a minimum position, enter that position in this field.<br>**DigCutIn** - Because PID Control is being used to determine economization damper position (even if the dampers are not variable-position), two-position (or digital) dampers are controlled by comparing the PID percentage to a cut-in setpoint. When the economization PID is <u>above</u> the DigCutIn setpoint, the dampers will be OPEN. When the economization PID is <u>below</u> the DigCutIn setpoint, the dampers will be CLOSED. |
| 2 - 1 - ↓ 12 | DamperOpen: 90 S<br>Dmpr Close: 90 S<br>Dmpr Change: 0 %<br>DmprCalTm: 0:03<br><br>*This screen is not available on the RCB-P version. | **DmprOpen and DmprClose** - If the RCB is controlling a variable-position damper that uses separate motors for opening and closing the dampers, the Dmpr Open and Dmpr Close parameters specify how many seconds of operation it takes the motor to open or close the damper from 0% to 100% open. This informs the RCB how many seconds to operate the damper motors when a damper percentage change is called for.<br>**MinAirDelta** - The Minimum Air Delta is the minimum percentage the variable-position damper will remain OPEN at all times in order to meet outside air requirements for the site. The damper will never be closed to a position below the Minimum Air Delta value, even when called to be CLOSED.<br>**DmprCalTm**- Because the RCB has no way of directly verifying the correct damper opening percentage, once per day the RCB will calibrate the variable-position damper by fully closing the damper and re-opening it to the current position. The Damper Calibration Time parameter sets the time of day each day this calibration will occur. Enter the desired time in 24-hour format. |
| 2 - 1 - ↓ 13 | ProofDly ON OFF<br>HT : 00:30 00:30<br>CL : 00:30 00:30<br>Fan: 00:30 00:30 | This screen allows you to set the proof checking delays for heat, cool, and air fan proofing (if used). All delays are entered in MM:SS format. If a proof input reads a failure in a heat, cool, or fan for an amount of time longer than the read delay, it will attempt to reset the failure (or, if three resets have already been attempted and the failure still exists, the stage or fan will be disabled). Different delays may be set for reading the ON and OFF states.<br>**HT** - Refers to proof inputs for all heat stages.<br>**CL** - Refers to proof inputs for all cool stages.<br>**Fan** - Refers to the fan proof input.<br><br>*For the RCB-P, Proofing is disabled for the heat or cool stage that is currently being operated in the Pulse mode. |

## 8.6 Inputs

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 2 - 2 (press UP ARROW and DOWN ARROW keys to cycle through input screens 1-16) | Terminal NO: 1<br>Name: SpacTemp<br>Type: TEMP<br>Offset: 0.00 | The 16 screens under the "Inputs" menu selection are where you must specify the function of the 16 input points on the RCB board.<br>**Terminal No** - This read-only field shows the number of the point referred to in this screen.<br>**Name** - The Name field is where you must select the function of the input. Refer to **Table 4-1** *on page 8* for a full list of inputs.<br>**Type** - The Type field is largely set automatically by the default sensor type that matches the input type you select in the Name field. For example, if an input is set as a proof input, the Type will automatically be set to DIG-ON/OFF. Most selections in the Name field only have one valid setting for the Type field, but there are some exceptions:<br>**TEMP SENSORS** - Any temperature sensor (SpacTmp, Mix Tmp, etc.) defaults to a type value of TEMP, indicating the sensor is a Copeland temperature sensor. However, if using LM235-based temp sensors, this field may be changed to LM-235 TMP.<br>**KW INPUT** - The KW Input input type may be set to either **POWER-KW** (analog 0-5VDC watt transducer) or **PULSE-CNT** (pulse accumulation type KWH input).<br>**Offset** - The Offset is added to the raw value of this sensor to correct known errors in the reading. |

## 8.7 Outputs

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 2 - 3 (press **UP ARROW** and **DOWN ARROW** keys to cycle through relay output screens 1-2 and analog output screens 1-4) | Out#1: Heat 1<br>Out#2: Heat 2<br>Out#3: Cool 1<br>Out#4: Cool 2<br><br>Analog Out #1<br>Name: VS Fan<br>MinV: 0.00 0.00%<br>MaxV: 10.0 | The six screens under the OUTPUTS menu selection are where the functions of the eight relays and the four analog outputs on the RCB are specified.<br>**Out#1-8** - The Out#1 through Out#8 fields specify the functions of outputs 1 through 8. Refer to **Table 4-2** *on page 11* for a list of output types and their functions.<br>**Analog Out #1, #2, #3, and #4** - The Analog Out #1-#4 screens are where the analog output types are chosen and the min/max voltage parameters are specified. Refer to **Table 4-5** *on page 13* for a list of output types and their functions. The MinV and MaxV parameters set the minimum and maximum voltages for this analog output when the percentage values are 0% and 100% respectively. The output scales its voltage based on the values of these two parameters, so that it begins on the MinV at 0% and increases linearly to MaxV as it goes to 100%.The % value by MinV affects the hand-held display, and scales the percentage displayed on the HHT. When the voltage is at MinV, the percentage in this field is displayed in the hand-held. This increases to 100% as the analog output value increases to MaxV. |

## 8.8 Scheduling

**This screen is not available on the RCB-P version.*

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 2-4-5 | Sunday<br>OCC UNO<br>SP1: 0:00 0:00<br>SP2: 0:00 0:00 | The seven screens under the SCHED menu option in the Control Menu are where you set the occupancy scheduling events for RCB when it operates in stand-alone mode. This schedule will only be followed when the RCB is in stand-alone mode; if connected to a Zone application in E2, the RCB will always use the occupancy schedule followed by the Zone application. Each day of the week may have up to two OCC/UNO event pairs. Enter the time occupancy mode will start in the OCC column, and the time occupancy mode will end in the UNO column. Use the DOWN ARROW key to scroll through the screens to program events for different days (Sunday - Saturday). |

## 8.9 Overrides

***Table 8-1***

| | | |
|---|---|---|
| 2-4-6 | DigOut1: NOR<br>DigOut2: NOR<br>DigOut3: NOR<br>DigOut4: NOR<br><br>Analog Override<br>Ovr Pct<br>AOut1: NOR 0.00%<br>AOut2: NOR 0.00% | There are four screens under the **OVRRD** menu option in the Control Menu. These screens may be used to override any of the relay output and analog output points on the RCB board.<br><br>To override a digital (relay) output, locate the **DigOut** field whose number corresponds to the number of the relay you wish to override. Press the **RIGHT ARROW** key and move the arrow to the field, then use the **"."** or **"-"** keys to select the state you wish to override the relay to (**ON** or **OFF**). Then, use the **UP/DOWN** arrow keys to move the cursor off the field to begin the override. The override will continue until the HHT is unplugged from the board or the DigOut override field is changed back to **NOR** (**no override**).<br><br>To override an analog output, locate the **AOut** field whose number corresponds to the number of the analog output you wish to override. Press the **RIGHT ARROW** key and use the **UP/DOWN** arrow keys to point the arrow to the field in the Ovr column of the output you wish to override. Press the **"-"** key to change the **Ovr** field to **YES**, then press the **RIGHT ARROW** key to move the cursor to the Pct column. Enter the percentage (from 0-100) you wish to override the output to. The override will continue until the HHT is unplugged from the board or the AOut's Ovr field is changed back to **NO**. |
| | Input Override: 1<br>Space Temp: NO<br>Ovrd Value: 77 | The user can also override the inputs that are configured. Scroll through the inputs to the desired input. Arrow to the NO field and use **"."** to **"-"** to toggle to **YES**. Advance to override value and enter the desired value. To cancel the override, arrow to the **YES** field and toggle to **NO**. |

## 8.10 Resets

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 2-4-7 | RunTime Reset<br>CL1 CL2 CL3 CL4<br>.. .. .. ..<br><br>HT1 HT2 HT3 HT4<br>.. .. .. ..<br>AirFan CndFan<br>.. ..<br><br>Reset Alms: ..<br>Reset SPs: ... | The three screens under the **RESETS** option in the control menu are used to reset runtimes for the cool and heat stages, the air fan, and the condenser fan, and also to reset alarms or return the RCB back to factory default setpoints.<br><br>To reset any runtimes, alarms, or setpoints on these screens, press the **RIGHT ARROW** key, and use the arrow keys to highlight the field you wish to reset. Press the **"-"** key to change the field from **".."** to **Yes**. The reset will take place as soon as you move the cursor off the field.<br><br>**CL1**-**CL4** - These are used to reset the runtime logs for cool stages 1-4.<br>**HT1** - **HT4** - These are used to reset the runtime logs for heat stages 1-4.<br>**AirFan** - This is used to reset the blower fan runtime log.<br>**CndFan** - This is used to reset the condenser fan runtime log.<br>**Reset Alms** - Resetting this field will reset any alarm condition that currently has RCB running in a safe mode. This includes proof failures and smoke alarm shutdowns.<br>**Reset SPs** - Resetting this field will restore all RCB setpoints back to the original factory defaults. All inputs, outputs, and setpoint configuration done in this RCB will be lost.<br>*NOTE - If this RCB is associated with a Zone, the reset will only last as long as the HHT is plugged into the RCB. When the HHT is removed, the E2 will rewrite its stored configuration to this RCB. Resetting setpoints from the HHT does NOT affect this RCB's configuration in the E2.* |

## 8.11 PID

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 2-4-8 | Heating<br>I: 0.3 TR: 3.0<br>Cooling<br>I: 0.3 TR: 3.0<br>(5 screens total) | Most of the important systems in the RCB use PID control. PID is short for "Proportional-Integral-Derivative," a control strategy that takes into account not only the difference between a control input and a control setpoint, but the amount of time the two have been different and the rate at which it is changing. The result is a 0-100% output that is used to control an output that is used to bring the input closer to the setpoint. There are nine systems that use PID control in the RCB: Heating, Cooling, *Humidification, Dehumidification, Economization, *Low Supply Temp, and $CO_2$. Variable Speed - Fan Heat Differential. Variable Speed - Fan Cool Differential. Each system uses a modified version of PID called "P+I," which uses three constants that determine how the RCB will react to changes in input value. *Not available on the RCB-P version.<br><br>The values chosen by default for the PID constants are the recommended settings for use in HVAC control. It is not recommended you alter these values without assistance from Copeland.<br>**I**: The I field is the PID's integral gain. This is a multiplier that affects the amount the integral mode of PID will change the PID output based on the amount of time the input has been higher or lower than the setpoint. Integral mode seeks to increase or decrease PID output when proportional mode alone isn't successful in bringing the input equal to the setpoint. By default, it is only used in heating and cooling control, and it is recommended to remain at 0.00 for all other systems that are not related to heating and cooling. I Gain should only be changed in small amounts (tenths or hundredths) to increase or decrease the system's reaction time to input changes.<br>**TR**: Simply put, throttling range is the number of engineering units between a PID output of 0% and a PID output of 100%. For example, in heating control, if your heating setpoint is 69°F and your throttling range is 3, the proportional mode of PID begins at 0% when the input is equal to the setpoint (69°) and gradually climbs to 100% as the input falls to three degrees F below setpoint (66°). The Throttling Range is the primary means of setting up PID control behavior. In general, larger values of the throttling range result in slower reactions to input changes.<br>**P**: * "P" is the PID's proportional gain. This is a multiplier that affects the amount the proportional mode of PID will change the output percentage when reacting to a control input value change. The Throttling Range also affects proportional mode, and it is recommended you change the throttling range if you require a big alteration to the way the PID output works. *The P Gain of the RCB is hidden and fixed to a value of 1.0 |

## 8.12 Miscellaneous

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 2-4-9 | Date: 01/01/03<br>Time: 12:00:00<br>OccOvrd: 10M | **Date** - The current date kept by the RCB. It is not necessary to set this with the HHT if the RCB is part of an E2 Zone application, since the E2 will keep the date in synchronization with its own date/time information. If operating the RCB in stand-alone mode, you may want to change this date to the current date. Enter the desired date in MM/DD/YY format.<br>**Time** - The current time kept by the RCB. It is not necessary to set this with the HHT if the RCB is part of an E2 Zone application, since the E2 will keep the time in synchronization with its own date/time information. If operating the RCB in stand-alone mode, you may want to change this date to the current date. Enter the desired time in 24-hour HH:MM:SS format.<br>**OccOvrd** - If the RCB will be using space temperature sensors with built-in occupancy override buttons, the OccOvrd field is the amount of time a user-initiated occupancy override will last. Enter the desired amount of time in minutes. |
| 2-4-9-↓ | EngUnit: English<br>TempUnit: Deg F<br>KWPerPulse: 0.1 | **EngUnit** - The EngUnit field determines how pressure values are displayed in the HHT. Select English for bars or Metric for pascals.<br>**TempUnit** - The TempUnit field determines how temperature values are displayed in the HHT. Select Deg F for Fahrenheit or Deg C for Celsius.<br>**KWPerPulse** - If using a pulse accumulator style KW transducer, this parameter sets the number of KW represented by each pulse. Refer to your transducer's specifications for the correct value, and enter it in this field. |

| Road Map from RCB Main Menu | Menu | Description |
|---|---|---|
| 2-4-9-↓2 | Analog KW Setup<br>Volt KW<br>Min: 0.00 0.00<br>Max: 5.00 100.0 | **Analog KW Setup** - The fields in this screen set the minimum and maximum input voltages coming from the KW transducer's analog input, and scales it to the minimum and maximum KW represented by the input voltages. In the Min fields, enter the minimum voltage of the KW transducer input, and the number of KW that voltage represents (usually zero).In the Max fields, enter the maximum voltage of the KW transducer input, and the number of KW that voltage represents. Refer to the transducer's user documentation to determine this value. |
| 2-4-9-↓3 | RTequalize: OFF<br>OccOvrd: NOR<br>PrfWtDly: 05:00 | *__RTequalize__ - The RCB has the capability of equalizing heating and cooling stage runtimes. When this field is set to ON, it will activate and deactivate heating and cooling stages based on the number of hours runtime the stages have been operating. When this field is set to OFF, it will sequence the heating and cooling stages in order, always beginning and ending with stage 1. *_Not available on the RCB-P version._<br>**OccOvrd** - You may use this field to manually override the RCB occupancy state. Select ON to override the state to occupied, or OFF to override it to unoccupied. If you wish to cancel this override, unplug the HHT or manually set this field to NOR.<br>**PrfWtDly** - The Proof Wait Delay is the amount of time the RCB will wait after a proof failure before attempting to reset the proof failure by reactivating the device. Enter the desired time in MM:SS. |
| 2-4-9-↓4 | Daylight Savings<br>APR 1stWeek SUN<br>DLT Savings End<br>OCT 5thWeek SUN | ***The Daylight Savings Time screen** allows you to customize when you want daylight savings time to begin and end for this RCB. The defaults, used by the United States, are the 1st Sunday of April and the last (5th) Sunday of October. If you wish to choose different start months, weeks, or days, enter them on this screen.<br><br>*This screen is not available on the RCB-P version. |

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