



# FOCUS GUIDE

## ROOFTOP CONTROLLER

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Configuration Guide for Prolon Focus Software

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[www.proloncontrols.com](http://www.proloncontrols.com) | [info@proloncontrols.com](mailto:info@proloncontrols.com)  
17 510, rue Charles, Suite 100, Mirabel, QC, J7J 1X9



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REV. 7.4.1

PL-FOC-RTU-C/F-EN

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# 1 - Prolon Rooftop Controller

This guide will describe in detail the operating sequences and configuration variables used by the Prolon series *Rooftop Controllers*.

The Prolon series *Rooftop Controller* is designed to control a variety of different rooftop units or HVAC air handling equipment. The on-board microcontroller offers precise digital control to maximize performance. The available control sequences are fully configurable, either locally or remotely, using free software. The controller uses PI (Proportional-Integral) control loops to optimize HVAC management and offers a variety of sequences to control the fan, cooling compressors, heating equipment and much more. It can also act as a Master controller when connected to a Prolon network.

The Prolon series *Rooftop Controller* is in essence a collection of highly effective RTU control sequences designed by Prolon, based on the feedback of our trusted clients and contractors with years of field experience. The sequences offered are highly configurable, allowing for a greater flexibility in the final operation of the controller, but they are not programmable.

## 1.1 - Hardware Variations

The Prolon series *Rooftop Controller* is in essence a collection of highly effective RTU control sequences designed by Prolon, based on the feedback of our trusted clients and contractors with years of field experience. These sequences are then programmed into various hardware models, offering the user the choice of expanded functionality versus targeted pricing.

The sequences are identical between the various hardware platforms, and are only differentiated by the physical constraints of the chosen hardware. This guide will underline these differences whenever they apply.

The Prolon *Rooftop Controller* has been offered on the following hardware platforms. Please see each platform's **HARDWARE GUIDE** for more information:

**M2000** → 9 Analog Inputs / 5 Digital Outputs / 3 Analog Outputs

**C1000 (VC1000F)** → 3 Analog Inputs / 1 Binary Input / 4 Digital Output / 1 Analog Output  
The following sequences are unavailable for the C1000: Exhaust Fan, Static Pressure, Economizer, CO<sub>2</sub>

**M1000 (Discontinued)** → 9 Analog Inputs / 5 Digital Outputs / 3 Analog Outputs





## 2 - Networking

Prolon networks are divided into Master and Follower devices. Master devices are in charge of sharing information with Follower devices. The Prolon *Rooftop Controller* is available as either a Master or a Follower, regardless of the hardware platform:

- The *Zoning Rooftop* sequence (master) is best suited for rooftops that are serving multiple zones, and whose decisions are based on the collective demand of these zones
- The *Single-Zone* sequence (follower) is only suitable for rooftops that are entirely driven by a single temperature sensor

Regardless of the chosen sequence, the Prolon *Rooftop Controller* can be integrated into a Prolon network with other controllers, where they will share and exchange information for a more effective overall system. Prolon's default method of network communication is Modbus RTU over RS485.

### 2.1 - Shared Information (*Zoning Rooftop Controller*)

The Prolon *Zoning Rooftop Controller* will automatically detect and start sharing information with the Follower controllers that it finds. Typical examples of shared information include the occupancy status, supply air temperature, zone demand, and more.

Please refer to the Focus Guide of each respective controller for a detailed list of the information that a Prolon *Zoning Rooftop Controller* will exchange, as each controller requests and provides different kinds of information. Data is exchanged approximately every three seconds.

The Prolon *Zoning Rooftop Controller* can also receive the following information from the Prolon Network Controller:

- **Occupancy Status:** The occupancy status received from the Network Controller will take priority over the occupancy state calculated by the *Zoning Rooftop Controller's* own internal schedule.
- **Outside Air Temperature:** The Network Controller can collect and distribute the outside air temperature to any controller on a Prolon network.

If a physical input on the *Zoning Rooftop Controller* is assigned to occupancy or occupancy override, this physical input's status will take priority over information received from the network.

If there is already an outside temperature sensor physically connected to the input on the *Zoning Rooftop Controller*, then the physical input will take priority over the one received over the network.

**Note** that this data will only be shared if the Network Controller is configured to do so. Data is exchanged with a Prolon Network Controller every ten to thirty seconds. If the information stops being received, it will be declared invalid after 720 seconds.



## 2.2 - Shared Information (*Single-Zone Rooftop Controller*)

When integrated into a system with a Proton Master Controller, the Proton ***Single-Zone Rooftop Controller*** will automatically be detected and start sharing information. A Proton Network Controller can also be configured to share information. Here is a list of all currently exchanged information:

- **Occupancy Status:** The occupancy status can only be received from the Network Controller, and it will take priority over the occupancy state calculated by the ***Single-Zone Rooftop Controller***'s own internal schedule.  
  
If a physical input on the ***Single-Zone Rooftop Controller*** is assigned to occupancy or occupancy override, this physical input's status will take priority over information received from the network.
- **Outside Air Temperature:** The outside air temperature will automatically be shared from a Master Controller to the ***Single-Zone Rooftop Controller***. A Network Controller can also be configured to share the outside temperature should a Master Controller not be present. In the case where both are present, the last received outside temperature value will be used. If there is already an outside temperature sensor physically connected to the input on the ***Single-Zone Rooftop Controller***, then the physical input will take priority over the one received over the network.

This information is exchanged approximately every three seconds for Master Controllers, and every 10 to 30 seconds for the Network Controller. If the information stops being received, it will be declared invalid after 720 seconds.

The ***Single-Zone Rooftop Controller*** does not have any information of its own to contribute to a Master Controller.



## 3 - Adding a Rooftop Controller to a Focus Project

**Prolon Focus is a free visualization and configuration software for all Prolon controllers. Once the *Rooftop Controller* has been physically wired to a Prolon network, it's time to add this controller to your Focus project.**

### 3.1 - Assigning Addresses

The Prolon ***Rooftop Controller***'s address can be assigned using the physical dipswitch found on the controller directly. The address will be encoded in binary. Please see each platform's **HARDWARE GUIDE** for more information.

#### 3.1.1 - Address Locking

For hardware platforms with physical addressing dipswitches, be aware that Prolon Focus offers a feature that allows a user to lock the address of a controller to a specific value, regardless of what is present on the addressing dipswitch. This allows for protection against unwitting users from changing the addresses by playing with the dipswitches, but can also lead to confusion. Please see **Address Management** in the Prolon Focus User Guide for more information.

### 3.2 - Adding the Controller to the Screen

Once the controller has been physically wired to a Prolon network and it has an assigned address, it is time to add it to your Prolon Focus project screen.

#### 3.2.1 - Zoning Rooftop Controller

A Prolon ***Zoning Rooftop Controller*** can be simply added onto the screen by clicking on the "New Rooftop" button, found in the **Devices Drag and Drop** list on the left side of the Focus screen (System View only):



**Figure 1 - New Zoning Rooftop Button**

Focus will ask for the address of the controller, attempt to locate it, and add it on the screen if successful.



## 3.2.2 - Single-Zone Rooftop

There are two methods to add a **Single-Zone Rooftop Controller** to a project, and the appropriate method is determined by the presence of a Prolon Master Controller in the network.

### 3.2.2.1 - Master Get List

If the **Single-Zone Rooftop Controller** is placed under a Master Controller in the network hierarchy, it can be added to your screen simply by performing a GET LIST on the Master. The Master Controller will take charge and scan its network for controllers, and all those that are found will automatically be added to the screen. To perform a GET LIST, right-click on your Master icon and select "Get List":

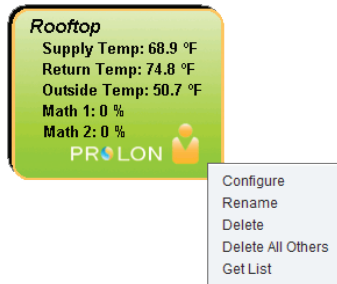


Figure 2 - Master "Get List"

**Note** that this step is **crucial**, as no communication will reach your **Single-Zone Rooftop Controller** if it has not been added the Master's List. If no Master controller is assigned to the **Single-Zone Rooftop Controller**, then this step can be ignored, and the new **Single-Zone Rooftop Controller** button can be used instead (see below).

### 3.2.2.2 - New Single-Zone Rooftop Button

In the event where there is no Master Controller assigned to the **Single-Zone Rooftop Controller** in the network hierarchy, then a **Single-Zone Rooftop Controller** can simply be added onto the screen by clicking on the "New Single-Zone Rooftop" button, found in the Devices Drag and Drop list on the left side of the Focus screen (System View only):

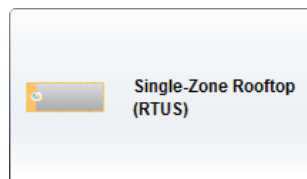


Figure 3 - New Single-Zone Rooftop Button

Focus will ask for the address of the controller, attempt to locate it, and add it on the screen if successful.

Alternatively, you can add multiple **Single-Zone Rooftop Controllers** in sequence by right clicking the button and selecting the "Create Multiple" option. This option will facilitate the creation of multiple **Single-Zone Rooftop Controllers** in sequential order.



## 4 - Rooftop Controller Icon

Each *Rooftop Controller* added to your system has its own icon. Each icon displays data about the *Rooftop Controller* it represents, and this data is updated regularly. You can open the configuration screen for a *Rooftop Controller* by double-clicking on its icon or right-clicking it and choosing the “Configure” option. If the Controller is offline, all data will be displayed as “N/A” (not applicable).

### 4.1 - Zoning Rooftop Controller Icon

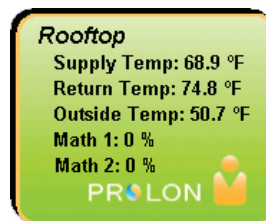


Figure 4 - Zoning Rooftop Icon

#### 4.1.1 - Icon Data

- **Name:** The name of the *Zoning Rooftop Controller*. You can change it by right clicking the icon and choosing “Rename”. By default it is set to “Rooftop”.
- **Supply Temp:** The current air temperature in the supply duct. Will display “N/A” (not applicable) if no supply temperature sensor is attached or if the network does not supply a reading.
- **Return Temp:** The current temperature of the return air. Will display “N/A” if no return air temperature sensor is attached.
- **Outside Temp:** The current outside air temperature. Will display “N/A” if no outside air temperature sensor is attached or if the network does not supply a reading.
- **Math Values:** The values of the selected math functions. The displayed math functions can be changed and even renamed in the Display Configuration page ([p.24](#)). Only the first two selected functions will be displayed.
- **Status Icon:** A person-shaped icon is always visible next to the Prolon logo, indicating if the controller is currently occupied or unoccupied. If the icon is orange, then the *Zoning Rooftop Controller* is in occupied mode. If the icon is grey, the *Zoning Rooftop Controller* is in unoccupied mode. The icon will be grey when working offline.

### 4.2 - Single-Zone Rooftop Controller Icon

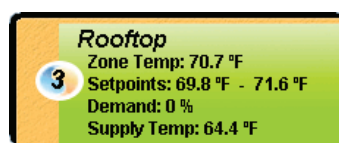


Figure 5 - Single-Zone Rooftop Icon



## 4.2.1 - Icon Data

- **Name:** The name of the **Single-Zone Rooftop Controller**. You can change it by right clicking the icon and choosing "Rename". By default it is set to "Rooftop".
- **Address Number:** This can be seen in the blue and orange circle (yin/yang) at the left side of the icon.
- **Temperature:** The current zone air temperature. Will display "N/A" if there is no temperature sensor attached or if offline.
- **Setpoints:** The active heating and cooling setpoints, respectively. Will display "N/A" if the **Single-Zone Rooftop Controller** is offline.
- **Demand:** The **Single-Zone Rooftop** continuously calculates the demand for its zone. This demand takes the form of a number varying from -100% to +100%, where a negative percentage indicates a cooling demand, and a positive number indicates a heating demand. A demand of zero indicates that the controller is within its zone temperature setpoints and is satisfied. Will display "N/A" if the **Rooftop Controller** is offline.
- **Supply Temp:** The actual air temperature in the supply duct. Will display "N/A" (not applicable) if no supply temperature sensor is attached or if the network does not provide a reading.

## 4.3 - Icon Colors

The Rooftop icon changes color depending on the status and current actions being taken by the controller. Although the **Zoning Rooftop Controller** icons are shown below, this information equally applies to the **Single-Zone Rooftop Controller** as well.

- **Grey:** The Rooftop icon is grey when offline or if data is not being received.
- **Green:** The Rooftop icon is green when no heating or cooling actions are being taken.
- **Red:** The Rooftop icon is red when heating actions are being taken.
- **Blue:** The Rooftop icon is blue when cooling actions are being taken.

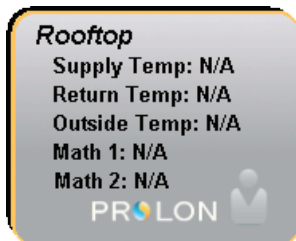


Figure 6 - Grey Icon

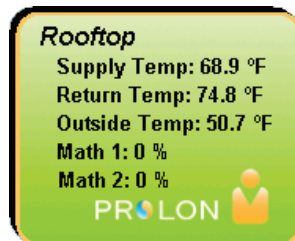


Figure 7 - Green Icon

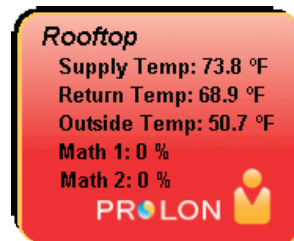


Figure 8 - Red Icon

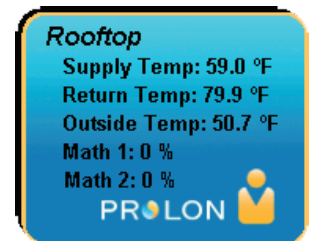


Figure 9 - Blue Icon

## 4.4 - Icon Right-Click

At any time you can right-click the Rooftop icon to access a list of useful functions.



## 4.4.1 - Zoning Rooftop Controller

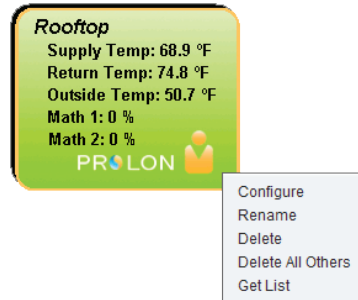


Figure 10 - Icon Right-Click for Zoning Rooftop Controller

- **Configure:** This opens the configuration screen for the **Zoning Rooftop Controller** (same as double-clicking the icon).
- **Rename:** Lets you rename the **Zoning Rooftop Controller**. Names are limited to 16 characters.
- **Delete:** Removes the **Zoning Rooftop Controller** from your network.
- **Delete All Others:** Removes all other Icons from the current system. This is useful for debugging purposes, for example when trying to exclusively establish communication with this controller, and the presence of the other controllers in your project is causing communications to slow down.
- **Get List:** Causes the **Zoning Rooftop Controller** to automatically retrieve the list of controllers connected to its system. A new icon is created for all controllers that are found. This function is unavailable offline.

## 4.4.2 - Single-Zone Rooftop Controller

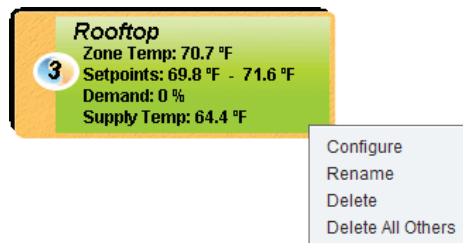


Figure 11 - Icon Right-Click for Single-Zone Rooftop

- **Configure:** Opens the configuration screen for this **Single-Zone Rooftop Controller**.
- **Rename:** Allows you to rename this **Single-Zone Rooftop Controller**. Names are limited to 16 characters.
- **Delete:** Removes this **Single-Zone Rooftop Controller** from your Focus Project.
- **Delete All Others:** Removes all other icons from the current system. This is useful for debugging purposes, for example when trying to exclusively establish communication with this controller, and the presence of the other controllers in your project is causing communications to slow down.



## 5 - Configuration of a Rooftop Controller

To view the configuration of a *Rooftop Controller* in detail, double-click on its icon to see its configuration screen. Use the menus in the top left corner to navigate between the different sections, or simply double-click any item in the *Rooftop Controller* Home screen to transfer you to its corresponding configuration page. ([See Icon Quick Jumps for more details, p.20](#)).

### 5.1 - Rooftop Controller Home Screen

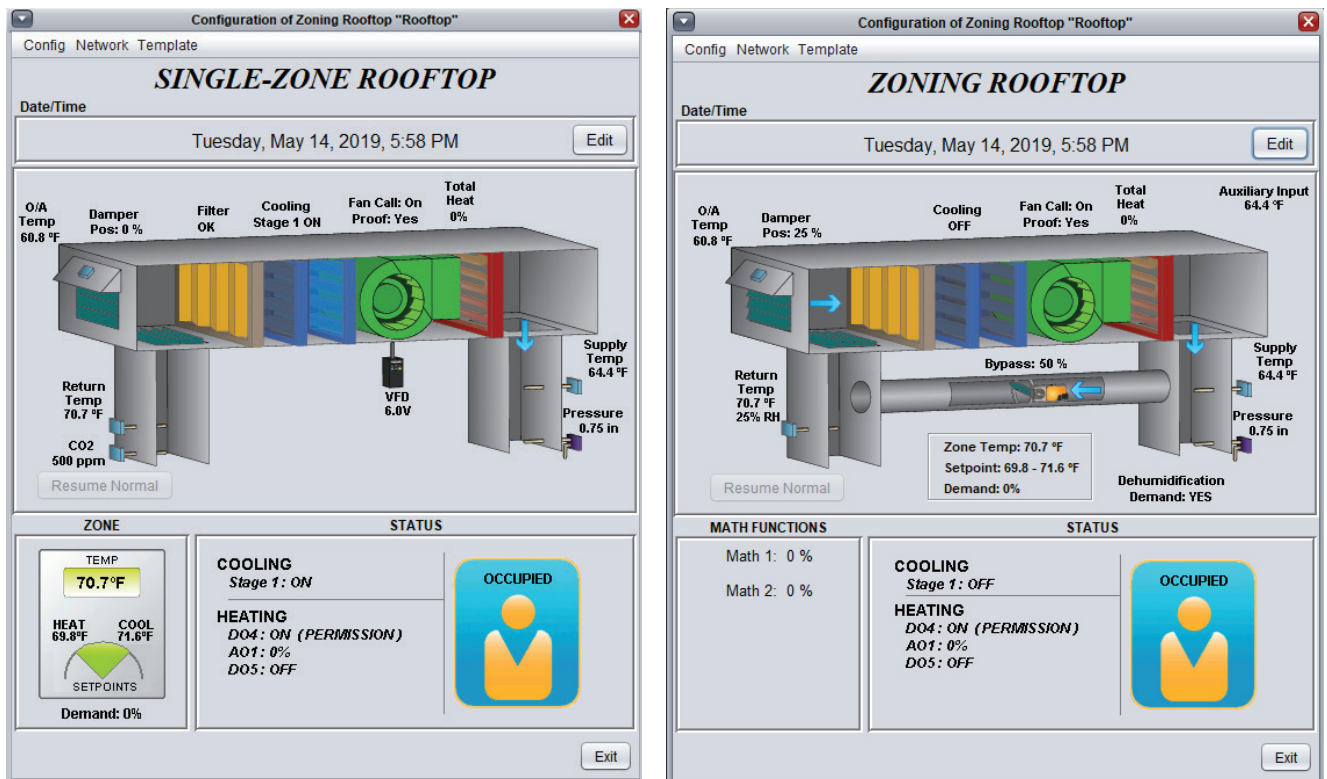


Figure 12 - Rooftop Controller Home Screens

This screen shows the status of all inputs and outputs of the Proton *Rooftop Controller*, as well as the active setpoints. All values will be "N/A" (Not Applicable) if offline.

**Note** that this screen will vary **greatly** depending on the sequences and display choices that are selected. The following section lists all possible parameters that can be displayed on the screen, but some are mutually exclusive of others due to hardware constraints or sequence logic. The list below outlines the requirements for each element.





## 5.1.1 - Displayed Information (Inputs)

- **Date/Time:** The current date and time from real time clock included in the Proton **Rooftop Controller**. This can be edited with the Edit button. (Unavailable for the C1000 hardware platform).
  - **O/A Temp:** The current outside air temperature. Will display “N/A” if no outside air temperature sensor is attached, or if none is provided from the network.
  - **Return Temp:** The current return air temperature. Will display “N/A” if no return air temperature sensor is attached.
  - **Return Air Relative Humidity:** The relative humidity reading in the return air. This reading will only be available if:
    - ▷ A Proton Humidity Controller is added to the Focus project in this system;
    - ▷ The **Rooftop Controller** is a **Master** Controller.
  - **Supply Temp:** The current supply air temperature. Will display “N/A” if no supply temperature sensor is attached or if none is provided from the network.
  - **Supply Air Relative Humidity:** The relative humidity reading in the return air. This reading will only be available if:
    - ▷ A Proton Humidity Controller is added to the Focus project in this system;
    - ▷ The Proton Humidity Controller is configured to use a relative humidity sensor in the supply;
    - ▷ The **Rooftop Controller** is a **Master** Controller.
  - **Mix Temp:** The current mixed air temperature (not shown in images above). Will display “N/A” if no mixed air temperature sensor is attached. Will only be displayed if Input 4 Mode is set to “Mix Sensor” ([see p.24](#)). Unavailable for the C1000 hardware platform.
  - **Filter:** The current status of the filter (OK / Dirty). Will only be displayed if Input 4 Mode is set to “Filter Sensor” ([see p.24](#)). Unavailable for the C1000 hardware platform.
  - **Pressure:** The current static air pressure in the supply duct, measured in inches of water. Unavailable for the C1000 hardware platform.
  - **Dehumidification Demand:** Displays the status of the dehumidification demand coming from a Proton Humidity Controller. Depending on the configuration, this may not necessarily translate to any Dehumidification action being shown directly on screen, such as when zone dampers are being commanded to open. Unavailable for the **Single-Zone Rooftop Controller**.
  - **Zone Temp, Setpoints & Demand:** The current zone air temperature, accompanied by the active heating and cooling setpoints, and the resulting zone demand. This information will be displayed differently for **Zoning** or **Single-Zone Rooftop Controllers**:
    - ▷ For **Zoning Rooftop Controllers**, it is displayed in the center of the screen, and can only be provided by an analog wall temperature sensor that is physically connected to the controller (unavailable for the C1000 hardware platform).
    - ▷ For **Single-Zone Rooftop Controllers**, it is displayed in the Zone section on the bottom left of the screen, as part of a larger, wall sensor design. This information can be provided by a digital communicating wall sensor or by an analog wall sensor that is physically connected to the controller (unavailable for the C1000 hardware platform). In the case where analog and digital wall sensors are connected at the same time, the analog sensor will take priority.
- The **Rooftop Controller** continuously calculates the demand for its zone. This demand takes the form of a number varying from -100% to +100%, where a negative percentage indicates a cooling demand, and a positive number indicates a heating demand. A demand of zero indicates that the controller is within its zone temperature setpoints and is satisfied.
- For **Zoning Rooftop Controllers**, this demand (if available) will then be integrated into the overall building demand in a process called Flexi-Zone. The result of this process allows the **Zoning Rooftop Controller** unit to activate heating or cooling equipment based on an average demand of the entire building, instead of being driven by a single wall sensor.
- **CO<sub>2</sub>:** The carbon dioxide levels read by the CO<sub>2</sub> sensor, displayed in PPM (parts per million). Unavailable for the C1000 hardware platform.



- **Auxiliary Temp:** This is a special, auxiliary temperature reading that the controller can display. It has no bearing on the sequences performed by the controller, and is only used to show a temperature reading for display purposes only. It can be renamed as desired, with up to sixteen characters maximum. Unavailable for the C1000 hardware platform.
- **Occupancy:** The occupancy status of the **Rooftop Controller**. The occupancy state can be determined by a number of factors. They are listed here in order of ascending priority:
  - ▷ Occupancy is first determined by the real time clock onboard the **Rooftop Controller** along with the programmed schedule (M2000 only).
  - ▷ An occupancy status received from the Proton Network Controller then takes precedence over the internal real time clock of the **Rooftop Controller**.
  - ▷ Finally, if there is a physical occupancy input (C1000 only), or a physical occupancy override input (M2000 only), closing this contact will take definite control over the desired occupancy state of the Rooftop.

**Note** that during unoccupied mode, the **Zoning Rooftop Controller** may display as occupied if one of its zones has been locally overridden back to occupied mode. This does not mean it is sending a command for occupancy to the rest of the zones.



## 5.1.2 - Displayed Information (Outputs)

- **Damper:** The position of the outside air damper, in percentage. The icon will animate to approximate the relative opening of the damper. (Unavailable for the C1000 hardware platform). Will also display the target supply air setpoint when the economizer supply air sequence is enabled.
- **Fan:** The status of the call for fan is displayed above a green fan icon in the middle of the screen. Accompanied by a proof of fan status (can be hidden for the C1000 hardware platform). When the fan is on and there is a proof of fan signal, the icon animates by rotating the fan blades, and arrows appear indicating airflow. When the fan is off or when proof of fan is missing, the fan blades are stopped and there are no more airflow arrows.
- **Cooling:** The status of the mechanical cooling is displayed above an icon in the center of the page, representing compressor coils. For ON/OFF cooling, the highest active stage will be displayed. For analog cooling, the percentage of the output is displayed. This information can also be seen in the status box at the bottom of the screen.

If the constant cooling sequence is active, the target supply air setpoint will also be displayed.

Each coil represents a stage of cooling. The first stage of cooling is the coil on the right and the second stage is the coil on the left. A cooling stage is on when it is coloured blue and off when it is grey. Although the Proton **Rooftop Controller** can control up to four stages of cooling, only two compressor coils can be shown on the screen at a time. Please rely on the text information in the Status section (bottom center of the Home Page) for complete information on your compressor stages.
- **Heating:** The overall status of the heating outputs is displayed above an icon on the right side of the screen, representing a heating coil. The icon's color represents the intensity of the heating action being taken. The value displayed above the icon is the total heat. The total heat is calculated using an average of all outputs currently attributed to heating.

The state of each individual heating output is displayed below in the Status section.
- **Bypass:** The current position of the bypass damper, in percentage (unavailable for the C1000 hardware platform). The icon will animate to approximate the relative opening of the damper, taking into account the chosen opening direction. Will only be displayed if the Pressure Control Mode is set "Bypass Damper" ([see p.25](#)).
- **VFD:** The current voltage applied to the variable frequency drive (unavailable for the C1000 hardware platform). Will only be displayed if Pressure Control Mode is set to "Variable Frequency Drive" ([see p.25](#)).
- **Exhaust Fan:** The state of the exhaust fan output (unavailable for the C1000 hardware platform). There is no icon associated with this information. This will only be visible if Digital Output 5 is set to control the exhaust fan ([see p.28](#)).
- **Math Functions:** Display the current calculated values of each math function, as defined in the Math Function screen ([see p.64](#)). A **Zoning Rooftop Controller** is continuously calculating the results of the five math functions which commonly represent the overall cooling or heating demand of the building, in a process called Flexi-Zone.



### 5.1.3 - Date/Time

The Proton **Rooftop Controller** has an internal real time clock (unavailable on the C1000 hardware platform). The current date and time is displayed at the top of the Home screen. To edit the time, click on the “Edit” button.

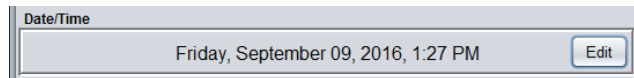


Figure 13 - Edit Time Button

A window appears allowing you to edit the time. Your computer’s time is shown at the top of the window. You can copy your computer’s time directly into the time of the **Rooftop Controller** using the “Copy” button, or simply edit the time yourself by directly typing it in the corresponding text box. A drop down list of time zones is also made available.

The use of daylight savings time can also be configured here. When set to automatic control, daylight savings will be enabled and disabled on Sunday at 2AM on the specified weeks.

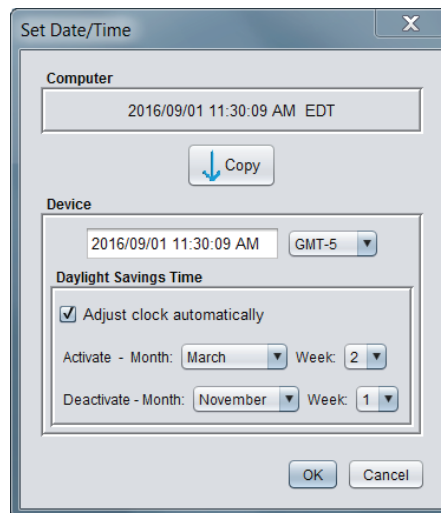


Figure 14 - Edit Time Dialog Box

### 5.1.4 - Icon Quick Jump

Certain items in the Home screen will direct you to its corresponding configuration screen when they are double-clicked. A yellow contour will surround the object if this option is available.

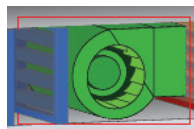


Figure 15 - Icon Quick Jump Example for the Fan

The following is a list of the clickable objects and their corresponding destination:



ITEMS	QUICK JUMP
Outside Temp Sensor	Limits
Return Temp Sensor	Limits
Supply Temp Sensor	Limits
CO2 Sensor	CO2 Configuration
Static Pressure Sensor	Pressure Configuration
Zone Temp and Setpoints	Temperature Configuration
Outside Air Damper	Economizer Configuration
Bypass Damper	Pressure Configuration
VFD	Pressure Configuration
Cooling Compressors	Cooling Configuration
Fan	Fan Configuration
Heating Coil	Heating Configuration
Math Functions	Math Functions
Occupancy Status	Weekly Routines <i>(unavailable for C1000)</i>
Dehumidification demand	Dehumidification Config
Exhaust Fan	Fan Configuration

Please note that if the advanced password is enabled, only the Weekly Schedules and Temperature Configuration will be accessible. Please view the Prolon Focus User Guide for more information about passwords.



## 5.1.5 - Icon Manual Override

Certain components of the **Rooftop Controller** can be overridden. To perform an override, right-click the icon of the component you wish to override. A pop-up menu will appear if this feature is available:

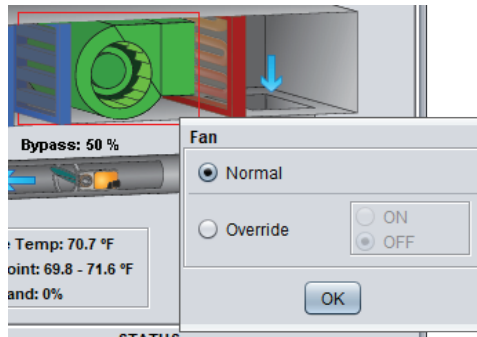


Figure 16 - Manual Override Example

- **Normal:** Selecting the “Normal” button will revert the selected item to its normal behaviour. Any override still applied to this object will be disabled.
- **Override:** Selecting the “Override” button will allow the user to manually override the selected object until Normal mode is resumed.

The following is a list of all items that can be overridden:

All Cooling Stages
All Heating Stages
Fan
Outside Air Damper
Bypass Damper
VFD
Exhaust Fan
Occupancy

Please note that all overrides still respect the temperature limits, minimum time delays and fan activity. There is an option to allow for absolute control over the overrides, and in essence to ignore these limits. [See Enable Absolute Overrides on p.25 for more details.](#) Fan and Occupancy can be overridden at all times.

When an override is applied to an object, a yellow contour appears around its icon and any associated text starts to flash. For example, in the adjacent picture, the fan is overridden.

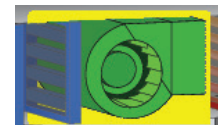


Figure 17 - Override example for the fan

Please note that if the advanced password is enabled, or if you are offline, you will not be able to override any objects. All overrides are **cancelled** when the **Rooftop Controller** is reset or loses power.



## 5.1.6 - "Resume Normal" Button

This button allows the **Rooftop Controller** to return to its fully automated behaviour. All overrides previously applied to the device will be disabled. Absolute overrides, if applicable, will also be deactivated ([see p.25](#)). However, before any action is taken, a dialog box will appear to confirm your choice.

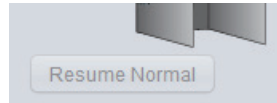


Figure 18 - "Resume Normal" Button

## 5.1.7 - Mode Set Button

This button allows you to manually override the operating mode of the **Rooftop Controller**. A popup will appear with the available options.

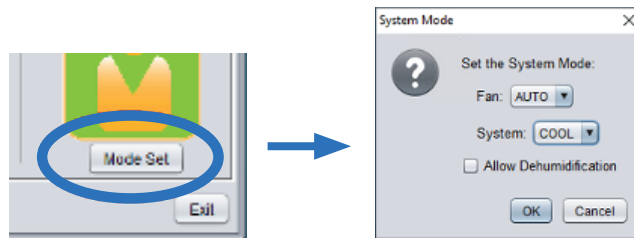


Figure 19 - RTU System Mode Override

When the System Mode is set, the button will blink yellow continuously.

- **Fan**
  - ▷ **AUTO**: The fan will run as per defined in the Fan Configuration Menu
  - ▷ **ON**: Override the fan to ON
  - ▷ **OFF**: Override the fan to OFF
- **System\***:
  - ▷ **AUTO**: The unit will respond to both heating and cooling calls
  - ▷ **HEAT**: The unit will respond to heating calls only
  - ▷ **COOL**: The unit will respond to cooling calls only
  - ▷ **OFF**: The unit will not respond to either heating or cooling calls
  - ▷ **Allow Dehumidification**: The unit will respond to dehumidification calls (may be combined with HEAT or COOL modes)

*\*NOTE: the System Mode (AUTO, HEAT, COOL, OFF) does not affect the fan operation.*

Unlike most overrides, the System Mode is stored in memory and will be restored after a power loss or reset.



## 5.2 - Display Configuration

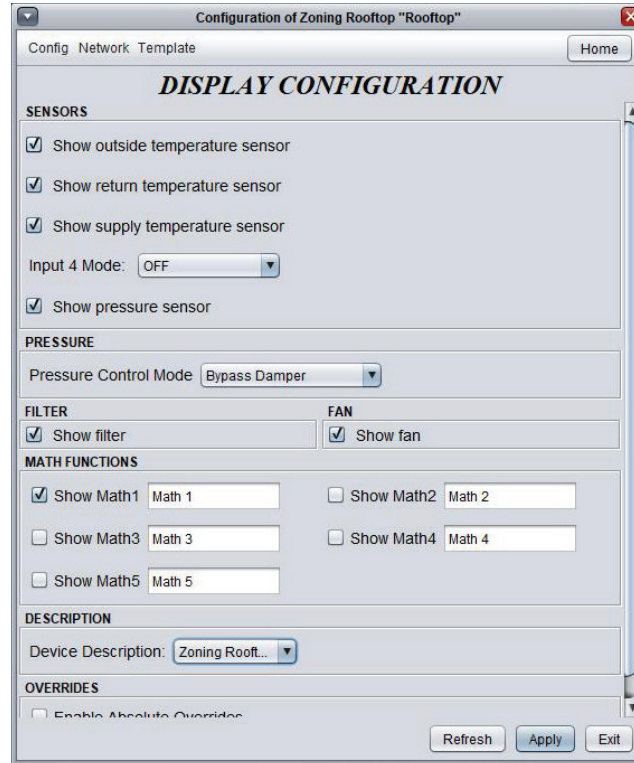


Figure 20 - Display Configuration Screen

This screen lets you customize the graphical display of the home screen. Only a few settings here can actually affect the operation of the controller: they will be detailed below.

- **Sensors:** This section allows you to select which sensors are displayed in the Home Screen. **Note** that just because a sensor is chosen not to be displayed, its readings will still be taken into account for safety limits or other sequences. So if the intention is to truly ignore a sensor reading, the sensor must be physically disconnected from the controller.
- **Input 4 Mode (M2000 Only):** You can also select the mode of operation for the general purpose analog input #4. Depending on the chosen mode, this particular setting can in fact influence the sequence of operation of the controller:
  - ▷ **Mix Sensor:** When mix sensor mode is selected, a mixed air sensor icon will appear in the Home Screen along with the current reading. This reading can then be used in the economizer sequences ([see p.46 for more details](#)).
  - ▷ **Filter Sensor:** In this mode, a message indicating if the filter is clean or dirty will appear above the filter icon. This setting does not affect the sequence of operation of the controller.
  - ▷ **Schedule Override:** When set as a Schedule Override input, the controller will return to occupied mode for the duration that the contact is closed. This takes priority over the schedule determined by the internal real time clock or even the schedule received from the Network Controller. It also immediately activates the exhaust fan (if applicable) if the exhaust fan is set for occupancy mode. This input has no effect if the controller was already occupied.
  - ▷ **Aux Temp Input:** The input is used to display an auxiliary temperature input on the Home Screen. It has no effect on the sequence of operation of the controller. It can be renamed as desired (16 characters max).





- **Digital Input Mode (C1000 Only):** You can select the mode of operation for the general purpose digital input (C1000 Only). This setting influences the sequence of operation of the controller
  - ▷ **Occupancy:** In this mode, an open contact signifies that the controller should be occupied, unless indicated otherwise from a Network Controller or other device. A closed contact signifies that the controller should instead be unoccupied, but in this case it will actually ignore the status sent by the Network Controller.
  - ▷ **Fan Proof:** In this mode, a closed contact indicates proof of fan operation.
- **Filter:** This option shows or hides the yellow air filter icon on the Home Screen, and any associated text. This setting does not affect the sequence of operation of the controller.
- **Pressure Control Mode:** This option lets you display either a bypass damper or a variable speed drive to control the **static** pressure. If no pressure control system is in place, it can be set "None".
- **Fan:** This option shows or hides the green fan icon on the Home Screen, and associated text. This setting does not affect the sequence of operation of the controller.
- **Math Functions:** This section selects the Math Functions that are to be displayed on the Home Screen AND ON THE ZONING ROOFTOP CONTROLLER ICON of the controller. Math functions can represent the calculated average demand of the entire building ([see p.64 for more details](#)). Each Math function's name can be customized (up to 16 characters long). These settings do not affect the sequence of operation of the controller.
- **Device Description:** This feature simply allows you to change the description of the controller that appears on the Vis page and at the top of the configuration page window. This feature is for display purposes only and does not affect controller operation.
- **Enable Absolute Overrides:** This option activates absolute override mode. By default, manual overrides are blocked if the safety of the system is at risk, for example, by cancelling a manual cooling override if the fan stops or if it is too cold in the supply. Absolute overrides bypass all limits and restrictions and therefore should only be used for testing. This setting will be lost if the controller should lose power or is reset. **PROCEED AT YOUR OWN RISK.**



## 5.3 - Fan Configuration

	OCCUPIED MODE	UNOCCUPIED MODE	OVERRIDE MODE
Fan OFF	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fan AUTOMATIC	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Fan ON	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

**AUTOMATIC**

Demand Source

Fan ON if heating demand is greater than: 10 % Math 2

Fan ON if cooling demand is greater than: 10 % Math 1

Minimum fan cycle time: 15 min

**EXHAUST FAN**

Use Digital Output 5 to control the Exhaust Fan

Control Mode: Occupancy

Morning Delay: 90 min

Power Exhaust

Setpoint: 35 %

Differential: 10 %

Refresh Apply Exit

**Figure 21 - Fan Configuration Screen**

This screen is used for the setup of the main supply fan, as well as for optional Exhaust Fan configuration. Proof of operation of the main supply fan is required before any cooling or heating actions can take place.

The fan operation is primarily occupancy based, but can also activate:

- On demand from the zones.
- Due to very high or very low outside temperature.
- Due to humidification or dehumidification request.
- Due to high CO<sub>2</sub> levels.



### 5.3.1 - Occupancy Based Operation

Main supply fan operation is first determined by the occupancy status:

- **Occupied mode:** The **Rooftop Controller** will perform the selected action when it is occupied, as determined by its own internal schedule or from the one received from the network controller. This includes the physical inputs configured for occupancy (C1000) or occupancy override (M2000 – A14).
- **Unoccupied mode:** The **Rooftop Controller** will perform the selected action when it is unoccupied, as determined by its own internal schedule or from the one received from the network controller. This includes the physical inputs configured for occupancy (C1000).
- **Override mode:** The **Rooftop Controller** will perform the selected action when it is in Override mode. The **Rooftop controller** will enter Override mode when the local Override button is pushed on the wall thermostat of any of its Follower Controllers, or its own. The Override button will cause the Controller to remain in this mode for a configurable delay, or until it returns to normal Occupied mode.

Once the occupancy status has been determined, the fan will simply go ON or OFF as selected. If Automatic mode is chosen, then additional demand-based information will be required (see below).

### 5.3.2 - Automatic

The actions taken in this mode are based on demand.

- **Fan ON if heating demand is greater than:** Select this if you want the fan to turn on based on a heating demand. For **Zoning Rooftop Controllers**, a math function representing the collective heating demand of the zones in the system will be used for this purpose ([see Math Functions p.64](#)). The fan will be ON when the heating demand is greater than the configured setpoint.
- **Fan ON if cooling demand is greater than:** Select this if you want the fan to turn on based on a cooling demand. For **Zoning Rooftop Controllers**, a math function representing the collective cooling demand of the zones in the system will be used for this purpose ([see Math Functions p.64](#)). The fan will be ON when the cooling demand is greater than the configured setpoint.

Default	10 %
---------	------

Default	10%
---------	-----

- **Minimum fan cycle time:** This is the minimum amount of time that the fan will stay ON once activated. Even if the demand drops below the setpoint, the fan remains ON until the time delay is met. After this time, the fan will turn OFF as soon as the demand drops under the setpoint.

Default	15 mins
---------	---------



### 5.3.3 - Exhaust fan

- **Use Digital Output 5 to control the exhaust fan:** This option assigns Digital Output 5 to controlling an exhaust fan. Choosing this option will disable Digital Output 5 as a heating output. (Unavailable for C1000 hardware platform).
- **Control Mode:** The exhaust fan can be controlled either by Occupancy or by the Power Exhaust sequences.
  - ▷ **Occupancy:** The exhaust fan is active whenever the **Rooftop Controller** is in occupied mode, with the exception of the first few minutes spent in the occupied state, as described by Morning Delay below.
  - ▷ **Power Exhaust:** The exhaust fan will be active depending on the current position of the outside air damper, using the setpoint and differential.

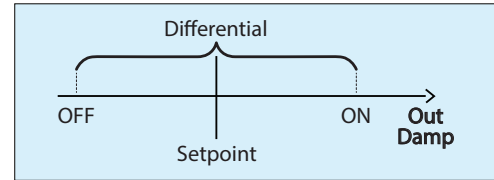


Figure 22 - Power Exhaust Sequence

- **Morning Delay:** When the Exhaust Fan's control mode is set to "Occupancy" (see above), this is the amount of time after the **Rooftop Controller** switches from unoccupied mode back to occupied mode that the exhaust fan output will remain deactivated.

## 5.4 - Cooling Configuration

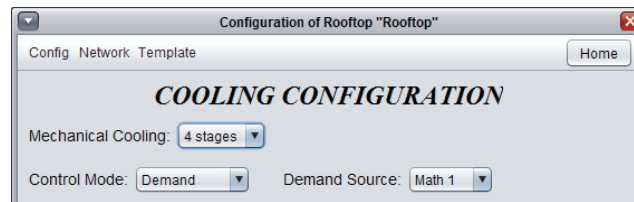


Figure 23 - Cooling Configuration

This screen is used for the setup of the mechanical cooling. Fan activity must be confirmed before any mechanical cooling will take place. Temperature limits and other time delays can also affect the activation of the mechanical cooling. [Please see the Limits Configuration \(p.56\) for more details.](#)

- **Mechanical Cooling:** Selects the type of mechanical cooling to be used by the **Rooftop Controller**. Be aware that selecting certain modes (as detailed below) will require auxiliary hardware modules to be attached to the controller, in order to obtain sufficient digital or analog outputs.
  - ▷ **When 3 or 4 stages are selected,** the DMUX-4J relay interface from ACI must be connected to Digital Output 2 of the **Rooftop Controller**. The DMUX-4J must be set to "Sequenced Relay Control" with a one-second pulse resolution. Digital Output 3 on the controller will remain inactive.
  - ▷ **When Analog Cooling is selected,** a PTA2 interface (v1) from ACI must be connected to Digital Output 2 of the **Rooftop Controller**. The PTA2 input pulse range must be set to 0.1-10 sec. Digital Output 3 on the controller will remain inactive.



- **Control Mode:** This setting will determine how cooling will be driven for this **Rooftop Controller**. Cooling can be demand-based, or be driven by a target supply temperature. Each method requires various settings which will be detailed below.

## 5.4.1 - Control Mode (Demand)

In this mode, cooling equipment will be activated based on the demand for cooling. In the case of a **Zoning Rooftop Controller**, a math function representing the collective cooling demand of the zones in the system will be used for this purpose ([see Math Functions p.64](#)). Once the demand is satisfied, cooling will stop.

### 5.4.1.1 - Staged Cooling

Staged cooling that uses the **Demand** control method is defined by the **Setpoint** and **Differential** band for each individual stage:

Control Mode:	Demand	Demand Source:	Math 1
<b>SETPOINT</b>			
	Setpoint	Differential	
Stage 1 :	35 %	20 %	
Stage 2 :	50 %	20 %	
Stage 3 :	80 %	20 %	NOTE: When 3 or 4 stages of cooling are selected, Digital Output 2 will pulse, requiring a DMUX-4J to transform the pulses into ON/OFF stages.
Stage 4 :	90 %	19 %	

Figure 24 - Staged Cooling Setup Based on Demand

Each stage of mechanical cooling has an activation and deactivation point. These points are centered on the **Setpoint** of the stage, and separated by the **Differential** of the stage, as shown in the following graph:

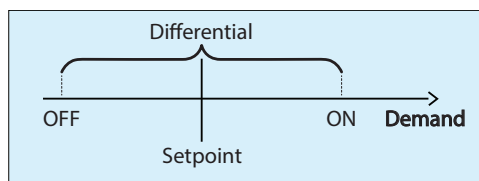


Figure 25 - Staged Cooling Control based on Demand

The Differential band ensures that the activation and deactivation points are sufficiently spread apart, so as to avoid short-cycling the equipment. Configurable minimum run times also protect the equipment in this manner ([see Staged Cooling Operation below, p.32](#)).



As the cooling demand ramps up, it will pass through the activation points of the various stages, turning them on sequentially. A stage cannot start until its preceding stage has been activated, and the Proton Focus software ensures that the settings respect this.

Then, as the cooling demand drops back down, it will pass back through the deactivation points and turn off the equipment, in the opposite order they were activated in (First In Last Out). There is no lead-lag sequence to alternate the order of activation.

### 5.4.1.2 - Analog Cooling

Analog cooling that uses the **Demand** control method is defined by its **Setpoint** and **Proportional** band:

ANALOG OUTPUT	
Setpoint:	35 %
Proportional:	20 %

Figure 26 - Analog Cooling Setup Based on Demand

As long as the cooling demand stays below the **Setpoint**, the analog output remains off. Once the demand ramps up past the **Setpoint**, the analog output's value will also increase proportionally. Once the demand hits the sum of the **Setpoint** and **Proportional** band, the output will be at its maximum:

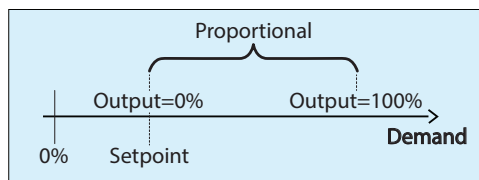


Figure 27 - Analog Cooling Control Based on Demand

### 5.4.2 - Control Mode (Supply Temp)

In this mode, cooling equipment is activated so as to maintain a target supply air temperature setpoint. Heating will only ever come on to maintain a low supply limit during very cold outside weather or during morning warm up sequences. If an economizer is available, it will use the same target supply setpoint determined here.

The supply air temperature setpoint can be fixed, or may be reset based on various factors such as outside temperature, return air temperature or even demand, as detailed below:

#### **Demand**

In this configuration, the target supply temperature setpoint will vary along with the cooling demand according to the scale below. For a **Zoning Rooftop Controller**, a math function representing the collective cooling demand of the zones in the system will be used for this purpose ([see Math Functions p.64](#)).

The target supply temperature will not continue to climb or drop beyond the limits imposed in the scale. In other words, the **Rooftop Controller** will always maintain the maximum supply setpoint, even if there is no cooling demand present. Inversely, it will never target lower than the minimum supply setpoint, even if there is a 100% call for cooling.



SETPOINT

Calculate Supply Setpoint using: Demand based on: Math 1

Demand	Supply Setpoint
20 %	Max: 64.4 °F
30 %	Min: 59.0 °F

Figure 28 - Supply Setpoint Based on Demand

**Fixed**

In this configuration, the target supply setpoint will never vary, and will remain at the configured fixed setpoint.

SETPOINT

Calculate Supply Setpoint using: Fixed at: 55.0 °F

Figure 29 - Fixed Supply Setpoint

**Outside Temp**

In this configuration, the target supply setpoint will vary along with the outside air temperature, according to the scale below. The target supply temperature will not continue to climb or drop beyond the limits imposed in this scale.

SETPOINT

Calculate Supply Setpoint using: Outside Temp

Outside Temp	Supply Setpoint
55.0 °F	Max: 65.0 °F
70.0 °F	Min: 55.0 °F

Figure 30 - Supply Setpoint Based on Outside Temperature

**Return Temp**

In this configuration, the target supply setpoint will vary along with the return air temperature, according to the scale below. The target supply temperature will not continue to climb or drop beyond the limits imposed in this scale.

SETPOINT

Calculate Supply Setpoint using: Return Temp

Return Temp	Supply Setpoint
70.0 °F	Max: 65.0 °F
80.0 °F	Min: 55.0 °F

Figure 31 - Supply Setpoint Based on Return Temperature



### 5.4.2.1 - Staged Cooling

Staged cooling that uses the **Supply Temp** control method will have its operation defined by the **Differential** band:

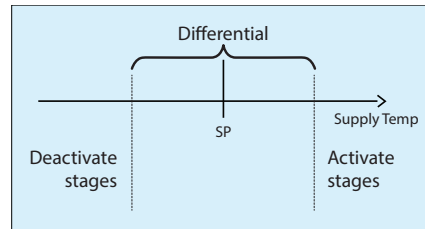


Figure 32 - Staged Cooling Control Based on Supply Temp

Centered on the current calculated Supply Setpoint, the Differential defines a band in which the Rooftop Controller is satisfied with the current supply temperature and will not activate or deactivate any currently running stages.

If the supply temperature goes below this band, it has effectively become too cold in the supply, and the **Rooftop Controller** will continue to turn off cooling stages as long as it remains below this band. Cooling stages will turn off while respecting the Interstage Deactivation Delay as well as the Minimum On Time (see below).

If the supply temperature goes above this band, it has effectively become too hot in the supply, and the **Rooftop Controller** will continue to turn on cooling stages as long as it remains above this band. Cooling stages will turn on while respecting the Interstage Activation Delay as well as the Minimum Off Time (see below).

### 5.4.2.2 - Analog Cooling

Analog cooling that uses the **Supply Temp** control method uses a PI loop to maintain an accurate supply setpoint, and is defined by its **Proportional** and **Integral** components:

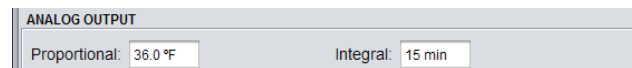


Figure 33 - Analog Cooling PI Loop Setup

- **Proportional:** The Proportional component of the PI loop is used to ramp up the output based on the offset from the current setpoint, as displayed in the image below:
- **Integral:** The integral component of the PI loop periodically adds to the output with small increments over time, correcting small offsets that are not picked up by the Proportional component. It is defined as the amount of time required to adjust the output by 100% for an error of 1.8°F (1 °C).

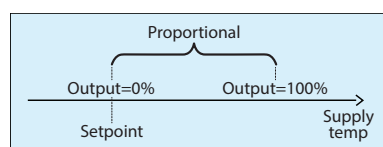


Figure 34 - Proportional Component of Analog Cooling PI Loop





### 5.4.3 - Operation

Depending on the type of mechanical cooling chosen, additional settings are available to ensure proper operation.

#### 5.4.3.1 - Staged Cooling

OPERATION	
Min ON Time: <input type="text" value="2 min"/>	Min OFF Time: <input type="text" value="5 min"/>
Interstage Activ. Delay: <input type="text" value="3 min"/>	Interstage Deactiv. Delay: <input type="text" value="2 min"/>

Figure 35 - Staged Cooling Operation

- **Min On Time:** Once a stage of cooling is activated, this is the minimum amount of time it must remain ON, even if cooling is no longer required. (This setting can be ignored if a low temperature limit is triggered or if proof of fan is lost, allowing the stages to turn off immediately).
- **Min Off Time:** Once a stage of cooling is deactivated, this is the minimum amount of time it must remain OFF, even if cooling is required. This delay is automatically activated when power is applied to the **Rooftop Controller**.
- **Interstage Activation Delay:** The amount of time that must elapse after a cooling stage is activated before another stage can be turned ON. (Unavailable if only one cooling stage selected).
- **Interstage Deactivation Delay:** The amount of time that must elapse after a cooling stage is deactivated before another stage can be turned OFF. (This setting can be ignored if a low temperature limit is triggered or if proof of fan is lost, allowing the stages to turn off immediately).

#### 5.4.3.2 - Analog Cooling

Range: <input type="text" value="0-10V"/>	<input type="checkbox"/> Reverse Acting
NOTE: When analog cooling is active, Digital Output 2 will be a pulsing output. A digital to analog converter (PTA2) is therefore required.	

Figure 36 - Analog Cooling Operation

- **Range:** The analog cooling output can work over 2 different voltage ranges:
  - ▷ 0-10 VDC
  - ▷ 2-10 VDC
- **Reverse Acting:** When this is selected, the output voltage will be inversely proportional to the calculated output value.



## 5.5 - Heating Configuration

This screen is used to setup the heating configuration of the **Rooftop Controller**. Fan activity must be confirmed before any heating will take place. Temperature limits and other time delays can also affect heating activation. [Please see the Limits Configuration \(p.56\) for more details.](#)

The layout and configuration properties available on this screen will vary based on the **cooling** mode selected ([see p.28](#)). If cooling is demand-based, heating will also be demand-based. If cooling is instead based on a target supply air temperature, then heating will be activated under another set of conditions, as detailed below.

### 5.5.1 - Demand Mode

In this mode, the heating equipment will be activated based on a demand for heating. In the case of a **Zoning Rooftop Controller**, a math function representing the collective heating demand of the zones in the system will be used for this purpose ([see Math Functions p.64](#)). Once the demand is satisfied, heating will stop. Note that heating will be demand-based when **cooling** is first configured to be demand-based ([see p.30](#)).

#### 5.5.1.1 - Digital Output 4

DIGITAL OUTPUT 4  
Function: Preheat Permission  
Setpoint: 55 % Differential: 20 %  
Min OFF Time: 2 min

Figure 37 - Setup of Digital Output 4

(Output 4 for C1000 hardware platform)

The function of Digital Output 4 on the **Rooftop Controller** can be selected via the dropdown box in this section:

- **OFF:** The output will remain OFF
- **Preheat Permission:** Preheat Permission is granted when the fan activity is confirmed and when there is no active cooling for a specified time period ([see Delay between Heating and Cooling, p.59](#)), and when the outside air limit is met ([see p.56](#)). This is the default setting.
- **Heating Stage:** The output is used as an ON/OFF heating stage, with activation and deactivation points based on the heating demand. These points are centered

on the **Setpoint**, and separated by the **Differential** of the stage, as shown in the following graph:

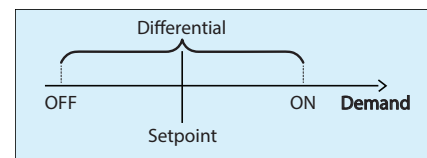


Figure 38 - Differential Heating Control Based on Demand



The Differential band ensures that the activation and deactivation points are sufficiently spread apart, so as to avoid short-cycling the equipment. Configurable minimum run times also protect the equipment in this manner.

- **Hot Gas Reheat:** This function activates the output whenever there is a dehumidification call for staged mechanical cooling. The output turns on at the same time as mechanical cooling to indicate to the equipment that there is a call for dehumidification.

- **Min OFF Time:** Regardless of the selected function selected above, this is the amount of time that must elapse after the output turns off before it can turn back on again.

### 5.5.1.2 - Digital Output 5

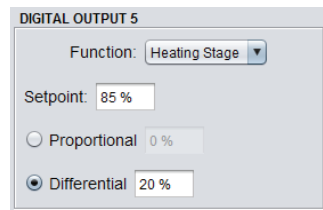


Figure 39 - Setup of Digital Output 5

Digital Output 5 is a multipurpose output on the **Rooftop Controller** (but not available on the C1000 hardware platform). Its function can be set via the dropdown box in this section. Note that this section will be unavailable if Digital Output 5 is already assigned to control an exhaust fan ([see p.28](#)).

- **OFF:** The output will remain OFF
- **Heating Stage (Differential):** The output is used as an ON/OFF heating stage, with activation and deactivation points based on the heating demand. These points are centered on the **Setpoint**, and separated by the **Differential** of the stage, as shown in the following graph:

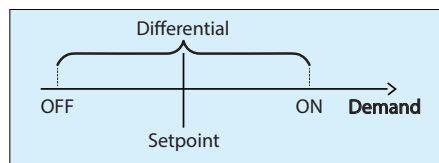


Figure 40 - Differential Heating Control Based on Demand

The Differential band helps ensures that the activation and deactivation points are sufficiently spread apart, so as to avoid short-cycling the equipment.

**Note:** When Digital Output 4 is also set as a heating stage and it has a lower setpoint, then Digital Output

5 will officially act as a second heating stage: it will only activate so long as Digital Output 4 is also active.

- **Heating Stage (Proportional):** The output is a heating stage that uses pulse width modulation, where the pulse width changes proportionally with the demand. The total pulse width period is one second. The pulse width depends on the **Setpoint** and **Proportional** band, as shown in the following graph:

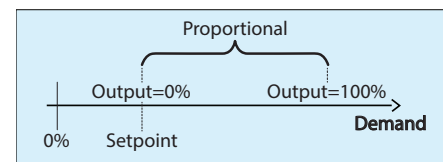


Figure 41 - Proportional Heating Control Based on Demand

The output is at 0% when the demand is below the setpoint, and increases proportionally with the demand until it finally reaches 100% when the demand reaches the sum of the setpoint + proportional band. The sum of the setpoint and the demand cannot be greater



than 100%. Here is an example:

Given the:

- ▷ Setpoint = 25%
- ▷ Proportional band = 50%
- ▷ Demand (Math 1) = 45% heating

Then the calculated output value is:

- ▷  $(45-25) / 50 = 40\%$

For example, a 25% output percentage will result in the output being ON for 0.25 seconds, and then OFF for the remaining 0.75 seconds. These pulses will simply repeat over and over.

- **Baseboard:** When configured as a baseboard output, the output will not be restricted by fan activity or by any limits or timing elements. Otherwise it operates like a Heating Stage as described above.

### 5.5.1.3 - Analog Output 1

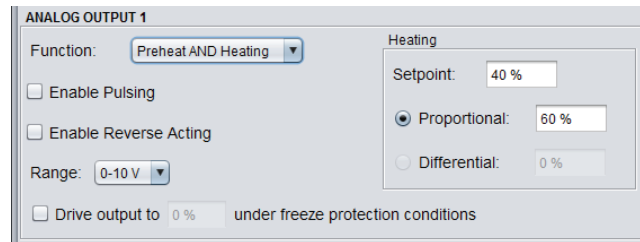


Figure 42 - Setup of Analog Output 1

(Output 5 for C1000 hardware platform)

The function of Analog Output 1 on the **Rooftop Controller** can be selected via the dropdown box in this section. It can be used for standard Heating, **Preheating** or both. In the case that both are selected, the highest value will be used.

The sequence behind preheating is described in the **Preheating** section below [\(p.38\)](#).

The standard heating sequence for this output can either be ON/OFF or modulating:

- **Heating Stage (Differential):** The output is used as an ON/OFF heating stage, with activation and deactivation points based on the heating demand. These points are centered on the **Setpoint**, and separated by the **Differential** of the stage, as shown in the following graph:

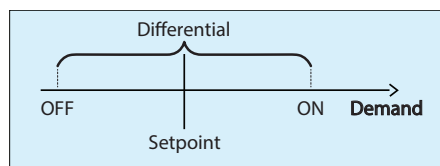


Figure 43 - Differential Heating Control Based on Demand

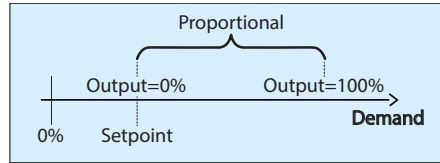
The Differential band helps ensure that the activation and deactivation points are sufficiently spread apart, so as to avoid short-cycling the equipment.

**Note:** This option is not available if the function of Analog Output 1 is Preheat AND Heating, due to the fact that Preheating is inherently modulating.

- **Heating Stage (Proportional):** The output is a modulated heating stage whose action changes proportionally with the demand. You can select if the output will use pulse width modulation, or simply ramp the voltage up and down using voltage modulation.



The output's value, on a scale of 0-100%, is calculated as follows:



**Figure 44 - Proportional Heating Control Based on Demand**

The output is at 0% when the demand is below the setpoint, and increases proportionally with the demand until it finally reaches 100% when the demand reaches the sum of setpoint + proportional band. The sum of the setpoint and the demand cannot be greater than 100%. Here is an example:

Given the:

- ▷ Setpoint = 25%
- ▷ Proportional band =50%
- ▷ Demand (Math 1) = 45% heating

Then the calculated output value is:

- ▷  $(45-25) / 50 = 40\%$

This output percentage is then converted into a pulse width or into a modulating voltage depending on whether or not the **Enable Pulsing** checkbox is selected. Pulse width modulation is designed for solid-state relay-equipped electric duct heaters. For example, a 25% output percentage for a pulsing output will result in the output being ON for 0.25 seconds, and then OFF for the remaining 0.75 seconds. These pulses will simply repeat over and over. For modulating 0-10VDC outputs, a 25% output will provide 2.5VDC at the output terminals.

- **Hot Gas Reheat:** This function activates the output whenever there is a dehumidification call for staged mechanical cooling. The output turns on at the same time as mechanical cooling to indicate to the equipment that there is a call for dehumidification.
- **Enable Reverse Acting:** The output voltage will be inversely proportional to the calculated output value. For example, in a range of 0-10VDC, if the modulating output is calculated to be at 30%, it will output 7 volts at the terminals.

- **Range:** This option selects the voltage range provided by the **Rooftop Controller** at the terminals of Analog Output 1. The range always corresponds to a full 0-100% output scale. For example, in the 2-10V range, a 0% output corresponds to 2V, and a 50% output corresponds to 6V.

- **Drive Output under freeze protection conditions:** This option is specifically designed for hot water valves for which the failsafe position should NOT be 0%. This is useful to protect the system when very cold air is detected in the supply and the fan is not running. The user can specify a desired default position to drive the output when **ALL** the following conditions are met:

- ▷ The supply air temperature or mix air temperature\* drops below the fan cutoff limit
- ▷ There is no call OR proof of fan
- ▷ The outside temperature is below the preheat enable setpoint

\* If a Mix Air Temperature has been selected for Analog Input 4 ([See Section 5.2 Display Configuration for more information](#)), the fan cut off limit condition applies to the Mix Air Temperature sensor.

If a Mix Air Temperature has NOT been selected for Analog Input 4, the fan cut off limit condition applies to the Supply Air Temperature sensor

If there is no valid temperature reading for the Supply Air, Mix Air or Outside Air Temperature sensors, the controller will assume the temperature limits have been tripped for its specific condition. For example:

- ▷ If the Mix Air Temperature reading is invalid, the controller will assume it has dropped below the fan cutoff limit
- ▷ If the Outside Air Temperature is invalid, the controller will assume it has dropped below the preheat enable setpoint.



## 5.5.1.4 - Preheating

PREHEATING			
Setpoint :	70.7 °F	Low Limit:	55.4 °F
Proportional :	36.0 °F	Integral :	15 min

Figure 45 - Preheating Setup

The goal of Preheating is to maintain the desired supply air temperature **Setpoint**.

Preheating with the Analog Output is enabled when:

- ▷ The Analog Output is set to **Preheating** (see p.36)
- ▷ The outside temperature is below the **Enable Preheat Setpoint** (see p. 56), or if the outside air temperature is invalid
- ▷ The demand for cooling is less than 10% and all cooling equipment is deactivated. If preheating is deactivated due to a cooling demand of 10%, then the cooling demand must return to 0% before preheating will be enabled again.
- ▷ There is a valid supply air temperature reading

The value of the Analog Output for the Preheating sequence is calculated based on a PI (**Proportional / Integral**) control loop. The **Proportional** component of the loop is determined as follows: As the supply temperature drifts below the setpoint, the **Proportional** component ramps up to compensate.

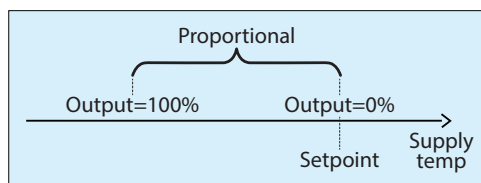


Figure 46 - Preheat Proportional Band

The **Integral** component is defined as the amount of time required to add 100% to the Preheat output due to a constant error of 1.8 °F (1 °C). Its purpose is to correct small errors over time.

The **Proportional** component is then added to the **Integral** component to calculate the final Preheat output. When properly tuned, this PI loop will maintain a constant supply air **Setpoint** in the duct.

- **Low Limit:** The Low Limit is a lower, alternate preheating setpoint which is used to maintain a safe air temperature in the supply duct during very cold winter periods. Unlike the normal preheat setpoint, it is authorized to be used even if there is a strong cooling demand, however cooling equipment must still be deactivated first.

Essentially, it is used during winter periods where a cooling demand is present (due to strong sunlight or other reasons), and there is an outside air damper in the system. When the supply air temperature gets too low, the outside air damper will naturally close to its minimum position, but sometimes this is not sufficient to maintain safe temperatures in the supply. This is where this alternate preheat low limit comes into play to protect the building.



## 5.5.2 - Supply Control Mode

This heating mode is meant to compliment the constant cooling supply air control sequence as defined in [section 5.4.2 : Control Mode - Supply Temp.](#)

In this sequence, heating demands are generally handled locally at each zone by peripheral heating, while heating performed by the **Rooftop Controller** itself only occurs under a very particular set of conditions, as detailed below.

This mode is automatically enforced when cooling is configured to be supply temperature based ([see p.28](#)).

### 5.5.2.1 - Morning Warm-up

The first situation in which the **Rooftop Controller** can perform heating actions directly is during the Morning Warm-Up sequence. This sequence is usually intended for gas powered units and occurs on a transition from unoccupied to occupied mode during cold winter periods.

The goal here is to save money by reheating the building using less expensive gas heating, instead of relying on the electrical peripheral heating from all zones.

The screenshot shows a configuration window titled "MORNING WARM-UP". It contains several settings, all of which are checked:

- Enable Morning Warm-Up Sequence
  - When Outside Temp is below: 55.4 °F
  - For an interval of: 30 min
- Activate DO4 when return is below: 67.1 °F
- Activate DO5 when return is below: 62.6 °F
- Activate AO1 (ON/OFF) when return is below: 55.4 °F
- Zone Damper Override: 50 % Position ▾

Figure 47 - Morning Warm-Up Setup

The sequence can be interlocked with outside temperature, and will only be active for a fixed interval of time, during which the constant cooling sequence will put on standby and all cooling equipment remains deactivated.

The activity of the selected heating outputs is also dependent on the return temperature. Once the **Rooftop Controller** transitions to occupied mode, these outputs activate and stay on as long as the return temperature remains below each respective setpoint. The outputs are ON/OFF only, and do not modulate in any way.

The **Rooftop Controller** also commands all zones to override their dampers to the indicated position (or to the indicated flow) so as to ensure that the warm supply air is distributed evenly throughout the building.

Finally, once the return temperature is satisfied for all outputs, or if the interval time expires, the Morning Warm-Up sequence finishes. Zone dampers return to automatic control and cooling can resume.



## 5.5.2.2 - Low Supply Limit

The only other situation during which the **Rooftop Controller** can perform heating actions directly is during the Low Supply Limit sequence. This sequence is used to maintain a safe air temperature in the supply duct during very cold winter periods, even when there is an outside air damper in the system.

When the supply air temperature gets too low, the outside air damper will naturally close to its minimum position, but sometimes this is not sufficient to maintain safe temperatures in the supply. This is where the Low Supply Limit sequence comes into play to protect the building.

The Low Supply Limit can be maintained by using either digital ON/OFF stages, or by using the analog output, as detailed below:

### Digital Outputs

When the digital outputs are being used to maintain the low supply limit, they will activate and deactivate so as to keep the supply air within a reasonable temperature range.

The screenshot shows a configuration window titled "LOW SUPPLY LIMIT". It contains the following settings:

- Use **DO4/DO5** to maintain Low Supply Limit.
- Activate DO4 when supply is below: **50.0 °F**
- Activate DO5 when supply is below: **46.4 °F**
- Differential: **3.6 °F**

Figure 48 - Low Supply Limit - Digital Output Control

Each digital output will activate at the specific supply air temperature **Setpoint**, and deactivate at a higher point determined by the **Differential**:

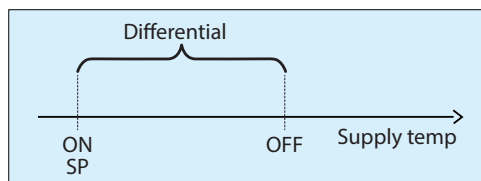


Figure 49 - Low Supply Limit Differential

The Differential band helps ensure that the activation and deactivation points are sufficiently spread apart, so as to avoid short-cycling the equipment.

### Analog Output

When the analog output is used to maintain the low supply limit, it will modulate so as to prevent the supply air temperature from dropping below the indicated low limit. A checkbox is also available to specify that Digital Output 4 is required as permission for the heating equipment to activate.

The screenshot shows a configuration window titled "LOW SUPPLY LIMIT". It contains the following settings:

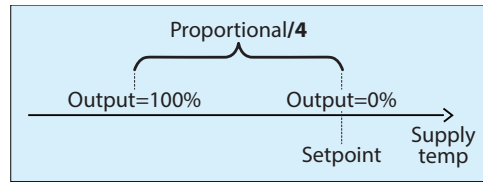
- Use **AO1** to maintain Low Supply Limit: **55.4 °F**
- Proportional: **36.0 °F**
- Integral: **15 min**
- Use DO4 as Permission

Figure 50 - Low Supply Limit - Analog Output Control





The value of the Analog Output for the Low Limit sequence is calculated based on a PI (**Proportional /Integral**) control loop. The **Proportional** component of the loop is determined as follows:



**Figure 51 - Low Supply Limit - Analog Proportional Band**

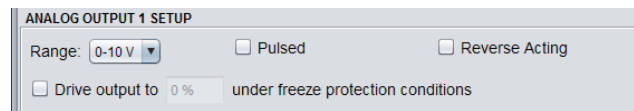
As the supply temperature drifts below the setpoint, the **Proportional** component ramps up to compensate.

The **Integral** component is defined as the amount of time required to add 100% to the Preheat output due to a constant error of 0.45°F (0.25 °C). Its purpose is to correct small errors over time.

The **Proportional** component is then added to the **Integral** component to calculate the final Preheat output. When properly tuned, this PI loop will maintain a constant supply air **Setpoint** in the duct.

### 5.5.2.3 - Analog Output 1 Setup

Whenever the analog output is enabled in either heating sequence above (Morning Warm-Up or Low Supply Limit), the section allows for fine tuning of the output's behaviour.



**Figure 52 - Supply Temp Control - Analog Output Setup**

- **Range:** This option selects the voltage range provided by the **Rooftop Controller** at the terminals of Analog Output 1. The range always corresponds to a full 0-100% output scale. For example, in the 2-10V range, a 0% output corresponds to 2V, and a 50% output corresponds to 6V.
- **Pulsed:** When pulsed, the analog output percentage is used for pulse width modulation instead of a voltage modulation. Pulse width modulation is designed for solid-state relay-equipped electric duct heaters.
- **Reverse Acting:** The output voltage will be inversely proportional to the calculated output value. For example, in a range of 0-10VDC, if the modulating output is calculated to be at 30%, it will output 7 volts at the terminals.
- **Drive Output under freeze protection conditions:** This option is specifically designed for hot water valves for which the fail safe position should NOT be 0%. This is useful to protect the system when very cold air is detected in the supply and the fan is not running. The user can specify a desired default position to drive the output when **ALL** the following conditions are met:

For example, a 25% output percentage for a pulsing output will result in the output being ON for 0.25 seconds, and then OFF for the remaining 0.75 seconds. These pulses will simply repeat over and over. For modulating 0-10VDC outputs, a 25% output will provide 2.5 VDC at the output terminals.

- ▷ The supply air temperature drops below the fan cutoff limit
- ▷ There is no call OR proof of fan
- ▷ The outside temperature is below the preheat enable setpoint



## 5.6 - Zone Temperature Configuration

If a zone temperature sensor is connected to the **Rooftop Controller**, it will calculate a demand for the attached zone. This demand takes the form of a number varying from -100% to +100%, where a negative percentage indicates a cooling demand, and a positive number indicates a heating demand. A demand of zero indicates that the controller is within its zone temperature setpoints and is satisfied.

The screenshot shows a software window titled "Configuration of Zoning Rooftop 'Rooftop'". The window contains the following sections and settings:

- PI Controller**
  - Proportional: 5.4 °F
  - Cooling Integral: 15 min
  - Heating Integral: 15 min
  - Integral Dropoff Speed: 4 (Default)
- Setpoints**
  - Default Heating Setpoint: 70.7 °F
  - Min Deadband: 1.8 °F
- Setpoint Limits**

	Min	Max
Heating:	66.2 °F	77.0 °F
Cooling:	68.0 °F	78.8 °F
- Unoccupied Mode**

	Heat	Cool
Offsets:	-5.4 °F	9.0 °F
Setpoint Limits:	59.0 °F	86.0 °F
- Thermostat**

	Min	Max
Scale Limits:	59.0 °F	86.0 °F

Override Time: 120 min
- Source the Zone Temperature from the Return Temperature

Buttons at the bottom: Refresh, Apply, Exit.

Figure 53 - Zone Temperature Configuration Screen

**Source the Zone Temperature from the Return Temperature:** Activating this function will replace any zone temperature reading with the current return temperature reading. This can be used to drive the zone demand from the return temperature when there is no temperature sensor in the space. Note that the return temperature reading still continues to serve as the return temperature and can still trigger any associated limits or safeties.



## 5.6.1 - PI Controller

In PI loop control, the demand is calculated by adding the proportional component of the demand to the integral component. These components are determined as follows:

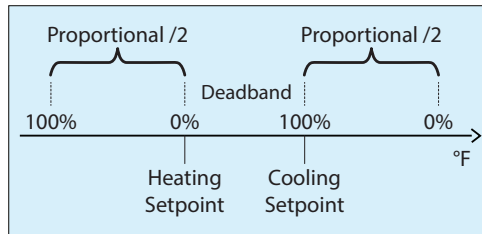


Figure 54 - PI Loop Proportional Band

- **Proportional:** Defines the proportional band used by the **Rooftop Controller** to calculate the proportional component of the demand. Please refer to the image above. Setting this value to zero removes proportional control, and consequentially, integral control. Demand will always be zero.
- **Heating Integral:** Defines the amount of time required for the heating integral component of the demand to equalize the proportional component. Setting this value to zero removes the heating integral component of the demand.

Default 5.4 °F / 3 °C

Default 15 mins

- **Cooling Integral:** Defines the amount of time required for the cooling integral component of the demand to equalize the proportional component. Setting this value to zero removes the cooling integral component of the demand.
- **Integral Dropoff Speed:** This setting defines how quickly the accumulated heating or cooling integral component of the PI calculation will be eliminated once the zone temperature returns within the setpoint deadband. The setting is provided on a scale of 1 to 5, with 1 being the slowest. Slowing down this setting can be useful in zones which have a strong constant heating or cooling load, which may make it advantageous to keep the zone demand ON even though the setpoints have been met.

Default 15 mins

Default 4

## 5.6.2 - Setpoints

- **Default Heating Setpoint:** When there is no external source of heating setpoint, such as a connected digital or analog wall sensor, this is the value that will be used as the heating setpoint. Otherwise it is ignored.
- **Occupied Deadband:** The deadband between the occupied heating setpoint and the occupied cooling setpoint. The cooling setpoint is calculated by adding this deadband to the heating setpoint.

Default 70.7 °F / 21.5 °C

Default 1.8 °F / 1 °C



- **Setpoints Limits:** These are the limits that are applied to the raw setpoints determined above (received for example, from the digital or analog wall sensor) to effectively limit the range of setpoints available for this zone. This will result in the 'active' heating and cooling setpoints for occupied mode.

- ▷ Minimum Heating Setpoint

Default	66.2 °F / 19 °C
---------	-----------------

- ▷ Maximum Heating Setpoint

Default	77 °F / 25 °C
---------	---------------

- ▷ Minimum Cooling Setpoints

Default	68 °F / 20 °C
---------	---------------

- ▷ Maximum Cooling Setpoints

Default	78.8 °F / 26 °C
---------	-----------------

### 5.6.3 - Unoccupied Mode

- **Offsets:** The setpoints calculated for occupied mode (after applying the setpoint limits) are offset by these amounts during unoccupied mode.

- ▷ Heating

Default	-5.4 °F / -3 °C
---------	-----------------

- ▷ Cooling

Default	9 °F / 5 °C
---------	-------------

- **Setpoint Limits:** Once the unoccupied setpoints are calculated, they are then limited by the following values:

- ▷ Heating

Default	59 °F / 15 °C
---------	---------------

- ▷ Cooling

Default	86 °F / 30 °C
---------	---------------

### 5.6.4 - Thermostat

- **Scale Limits:** These are the minimum and maximum values of the scales on the wall sensor connected to this controller. This only applies to wall sensors with scale markings, such as the T200 or PL-RS wall sensors. Change this only to match the scale of the given wall sensor.

- ▷ Minimum

Default	59 °F / 15 °C
---------	---------------

- ▷ Maximum

Default	86 °F / 30 °C
---------	---------------

- **Override Time:** This is the amount of time spent in occupied mode once the device is overridden from unoccupied mode using the override button on the thermostat.

Default	120 mins
---------	----------



## 5.7 - Pressure Configuration

This screen is used to setup and control the static pressure of the system. The **Rooftop Controller** can either control a bypass damper or a variable frequency drive to maintain static pressure. Note that this screen is unavailable on the C1000 hardware platform.

The screenshot shows a 'Static Pressure' configuration window with the following fields:

- Setpoint: 0.75 in
- Differential: 0.15 in
- Input Range (pressure): 0 - 1 in. H2O
- Input Range (voltage): 0 - 5 VDC

Figure 55 - Static Pressure Setup

The **Rooftop Controller** has an analog output dedicated to pressure control and will slowly make adjustments to the output voltage so as to obtain the static pressure **Setpoint**.

In an effort to preserve the lifespan of the equipment, a **Differential** band is used to define a range, centered on the setpoint, in which the static pressure is acceptable. The pressure must deviate from the setpoint by half the differential before the controller will attempt to compensate for the change.

This section also defines the parameters of the static pressure sensor:

- **Input Range (pressure):** These are the available static pressure sensor ranges that the **Rooftop Controller** can work with. Options range from 1 to 2.5 inches of water.
- **Input Range (voltage):** These are the available sensor voltage ranges that the **Rooftop Controller** can work with. The two options are 0-5VDC and 1-5 VDC.

### 5.7.1 - Bypass Damper Settings

When the **Pressure Control Mode** in the Display Configuration menu ([see p.25](#)) is set to **Bypass Damper**, this section is used to setup its operation.

The screenshot shows a 'Damper Settings' configuration window with the following fields:

- Damper Opening Direction: Counter-clockwise
- Damper Opening Delay: 95 sec
- Action Speed: 3
- Output Range: 2-10 V

Figure 56 - Bypass Damper Setup

- **Damper Opening Direction:** Sets the direction in which the damper opens (clockwise or counter clockwise)
- **Damper Opening Delay:** This is the amount of time that it takes for the actuator to fully open the damper, starting from a closed position. The actuator's manufacturer specifies this value. Note that this setting is only useful so as to accurately represent the damper's



current position on screen, but is not used in the control sequence.

Default	95 sec
---------	--------

- **Damper Speed:** The speed at which the output voltage will change to reach the desired pressure setting. Slow this down for increased stability: 1 is slow, 5 is fast. (3 is the default).
- **Output Range:** The **Rooftop Controller's** analog output can work over 3 different voltage ranges:
  - ▷ 0-10V
  - ▷ 2-10V
  - ▷ 2.4-7.5V

## 5.7.2 - Variable Frequency Drive Settings

When the **Pressure Control Mode** in the Display Configuration menu ([see p.25](#)) is set to **Variable Frequency Drive**, this section is used to setup its operation.

Drive Settings

Action Speed: 3

Output Range: 2-10 V

Voltage

Minimum: 3.0 V Maximum: 10.0 V

Hertz

Display in Hertz Min: 20 Hz Max: 60 Hz

Figure 57 - Variable Frequency Drive Setup

- **Action Speed:** The speed at which the controller will react to reach the desired pressure. Slow this down for increased stability: 1 is slow, 5 is fast. (3 is the default).
- **Output Range:** The variable frequency drive output can work over 3 different voltage ranges.
  - ▷ 0-10V
  - ▷ 2-10V
  - ▷ 2.4-7.5V
- **Minimum:** Minimum voltage maintained at all times by the **Rooftop Controller** for the Variable Frequency Drive output.
- **Maximum:** Maximum voltage allowed at the terminals of the Variable Frequency Drive on the **Rooftop Controller**.
- **Display in Hertz:** This feature allows you to display the VFD action occurring on the Visualisation page in Hertz instead of in Volts. Hertz units will also be used when applying overrides to the VFD. The minimum and maximum Hertz settings correspond directly to the minimum and maximum voltage. This feature is for display purposes only and does not affect controller operation.

## 5.8 - Economizer Configuration

This screen is used to setup and control the economizer sequence. When the **Use Economizer** checkbox is checked, the **Rooftop Controller** will use a dedicated analog output to drive an outside air damper for free-cooling purposes.

In the case where CO<sub>2</sub> control is enabled ([see p.51](#)), the widest opening position requested from either sequence will be used to drive the outside air damper. If the **Use Economizer** checkbox is not checked, the outside air damper can still be used for CO<sub>2</sub> control if required.

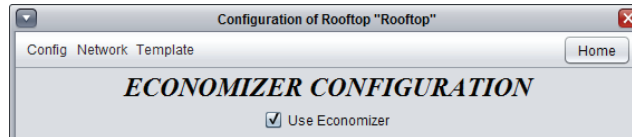


Figure 58 - Economizer Configuration Screen

**Note** that if no proof of operation of the main supply fan is obtained, the damper fully closes. This screen is unavailable for the C1000 hardware platform.

## 5.8.1 - Outdoor Temp Change Over

The economizer's operation is enabled based on the outside air temperature.

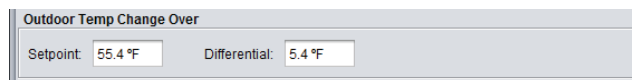


Figure 59 - Economizer Outdoor Change Over Setup

The activation and deactivation of the economizer is determined by a **Setpoint**, with a **Differential** band centered around the setpoint, as follows:

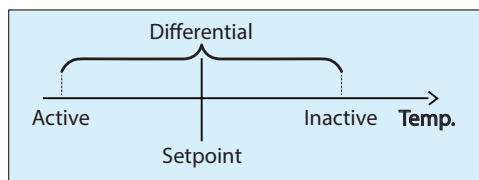


Figure 60 - Economizer Change Over Differential

Below the activation point, the economizer sequence is the first to respond to demands for cooling, taking advantage of the cold outside air. Mechanical cooling can be completely prohibited in this mode, or simply have its activation points pushed back, as determined in the section below ([see section 5.8.5 for more information](#)).

Above the deactivation point, it is too warm to use the economizer sequence, so the damper will remain at its minimum position, unless there is a call for fresh air due to the CO<sub>2</sub> sequence.

If there is no valid outside air temperature reading, only mechanical cooling will be used, and the economizer will remain at its minimum position.

## 5.8.2 - Economizer Control

This section determines the operation behind the economizer sequence. If the Cooling Control Mode is set to Supply Temperature ([see Cooling Configuration p.28](#)), then this section will be **unavailable**, since the economizer will simply use the same target supply temperature determined in the Cooling Configuration ([see p.30](#)). Otherwise, the economizer's operation can either be based on damper position, supply temperature or mixed air temperature.



### 5.8.2.1 - Damper Position

When the economizer control is set to Damper Position, the controller will drive the outside air damper based on the cooling demand [\(for Zoning Rooftop Controllers, this is selected in the Cooling Configuration, see p.28\)](#).

The screenshot shows the 'Econo Control' window with the following settings:  
Control using: Damper Position (dropdown)  
Setpoint: 20 %  
Proportional: 30 %  
Minimum: supply (dropdown) temperature: 59.0 °F

Figure 61 - Economizer Damper Position Setup

Below the **Setpoint**, the damper will remain at its minimum position. As the cooling demand increases past the setpoint, the Damper will open proportionally, until the point where the cooling demand reaches the (**Setpoint + Proportional**), at which point it will be fully open:

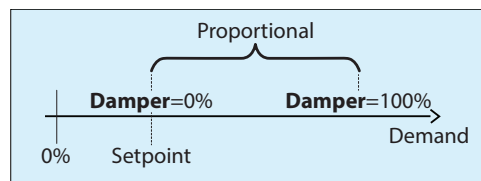


Figure 62 - Economizer Damper Proportional Band

At any point during the operation of the economizer sequence, if the supply or mixed air temperature should drop below the prescribed low limit, the damper will move in an attempt to maintain this limit. However, it will not close beyond its minimum position.

**Note** that if the temperature reading becomes invalid, for safety reasons the controller must assume that it is too cold and will close to its minimum, letting mechanical cooling take over.

### 5.8.2.2 - Supply Temp

When the economizer control mode is set to Supply Temp, the controller will modulate the outside air damper so as to target a specific supply air temperature setpoint. This target supply air setpoint is determined by the overall cooling demand [\(for Zoning Rooftop Controllers, this is selected in the Cooling Configuration, see p.30\)](#).

The screenshot shows the 'Econo Control' window with the following settings:  
Control using: Supply Temp (dropdown)  
Math Demand: 20 %  
30 %  
Target Temp: Max: 65.0 °F, Min: 55.0 °F

Figure 63 - Economizer Supply Temp Setup

When the cooling demand is below the lowest point on the demand scale (20% in the image above), the economizer sequence is disabled and the damper maintains its minimum position.





As the cooling demand increases into the demand scale's range, the economizer sequence becomes enabled. The target supply temperature will drop proportionally as the cooling demand increases, until it hits the lowest point in the scale, at which point the target supply temperature will stop decreasing.

If the supply air temperature reading becomes invalid, the economizer sequence is disabled and the damper will remain at its minimum.

### 5.8.2.3 - Mix Temp

When the economizer control mode is set to Mix Temp, the controller will modulate the outside air damper so as to target a specific mixed air temperature setpoint. This target mixed air setpoint is determined by the overall cooling demand [\(for Zoning Rooftop Controllers, this is selected in the Cooling Configuration, see p.30\)](#).

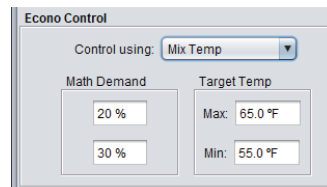


Figure 64 - Economizer Mix Temp Setup

When the cooling demand is below the lowest point on the demand scale (20% in the image above), the economizer sequence is disabled and the damper maintains its minimum position.

As the cooling demand increases into the demand scale's range, the economizer sequence becomes enabled. The target mix temperature will drop proportionally as the cooling demand increases, until it hits the lowest point in the scale, at which point the target mix temperature will stop decreasing.

If the mixed air temperature reading becomes invalid, the economizer sequence is disabled and the damper will remain at its minimum.

### 5.8.3 - Damper Setup

The Damper Setup section describes certain basic behaviours of the damper that applies to all economizer sequences.

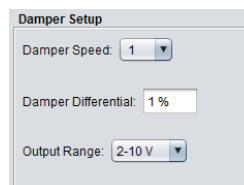


Figure 65 - Economizer Damper Setup

- **Damper Speed:** The speed at which the output voltage will change to reach the desired temperature setpoint (where applicable). Slow this down for increased stability: 1 is slow, 5 is fast. (1 is the default).
- **Damper Differential:** The minimum increment by which the outside air damper can move. Increasing this value can reduce wear and tear on the actuator, but in turn decreases the controller's ability to maintain an accurate temperature setpoint.
- **Output range:** The voltage range that the economizer output will use, which can be either:
  - ▷ 0-10 VDC
  - ▷ 2-10 VDC



## 5.8.4 - Limits

This section defines the minimum outside air damper position, and when it is to be used.

Limits	
Min Damp Position:	0 %
<input checked="" type="checkbox"/> Enable Morning Ventilation Period:	90 min

Figure 66 - Limits Setup

The minimum damper position is applied at all times, except in any of the following situations:

- ▷ When there is no call for fan
- ▷ When there is no proof of fan
- ▷ When the system is in unoccupied mode
- ▷ When the Morning Ventilation Period is active

If there is no call or proof of fan, the damper closes completely, regardless of the minimum.

In unoccupied mode, the damper minimum becomes zero, but can still open on a call for cooling or for CO<sub>2</sub> reduction.

The **Morning Ventilation Period** is activated upon a transition from unoccupied mode back to occupied mode. During this fixed period of time, the economizer's minimum position becomes zero. The purpose of this function is to make it easier to heat up the building in the morning, and any concerns about air quality should be at a minimum since the building has just been unoccupied. Note that this function only sets the damper minimum position to zero, but will still open as necessary on a call for cooling or for CO<sub>2</sub> reduction.

## 5.8.5 - Mechanical Cooling Setup

This section describes if and how mechanical cooling will be used when the economizer sequence is active.

Mechanical Cooling Setup	
<input checked="" type="checkbox"/> Permit Mechanical Cooling with Economizer	
Alternative Setpoint of Mechanical Cooling (Stage 1) when Economizer enabled:	75 %
Alternative Proportional:	20 %

Figure 67 - Mechanical Cooling Setup

The option to **Permit Mechanical Cooling with Economizer** authorizes the first (and ONLY the first) mechanical cooling stage to function, even when the economizer is active. When this occurs, the mechanical cooling stage will use the alternate setpoint and differential from this section, and not those indicated in the cooling configuration screen ([see p.28](#)). If this option is NOT selected, then mechanical cooling will not be permitted when the economizer is enabled.

**Note** that if the Cooling Control Mode is set to Supply Temperature ([see Cooling Configuration p.28](#)), the alternative setpoint and differential discussed above will be unavailable, and mechanical cooling will activate according to the normal sequences defined in the Cooling configuration page.



## 5.9 - CO<sub>2</sub> Control Configuration

This screen is used to control the CO<sub>2</sub> sequence. When the **Enable CO<sub>2</sub> Control** checkbox is checked, the Rooftop Controller will use a dedicated analog output to drive an outside air damper for air quality purposes (the same dedicated analog output used in the economizer sequence).

In the case where Economizer control is enabled ([see p.46](#)), the widest opening position requested from either sequence will be used to drive the outside air damper. If the **Use Economizer** checkbox is not checked, the outside air damper can still be used for CO<sub>2</sub> control if required.



Figure 68 - CO<sub>2</sub> Configuration Screen

**Note** that this screen is unavailable for the C1000 hardware platform.

### 5.9.1 - Setup

The **Rooftop controller** will drive the outside air damper based on the detected levels of CO<sub>2</sub>:

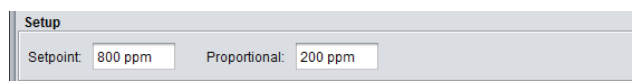


Figure 69 - CO<sub>2</sub> Setup

Below the Setpoint, the damper will remain at its minimum position, as defined in the Economizer configuration ([p.47](#)). If no economizer sequence is used, the minimum is then zero. As the CO<sub>2</sub> level increases past the setpoint, the Damper will open proportionally, until the point where the CO<sub>2</sub> reaches the (Setpoint + Proportional), at which point it will be fully open:

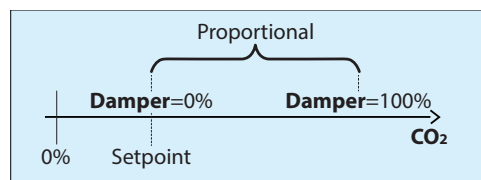


Figure 70 - CO<sub>2</sub> Proportional Band

If the main supply fan is off when the CO<sub>2</sub> level increases past the setpoint, the controller will call for the main supply fan to turn on before opening the damper.



## 5.9.2 - Limits

There are two sequences that can limit the opening of the damper position during a call for more fresh air.

Limits	
Max Damper Opening:	50 %
<input checked="" type="radio"/> Min Supply Temp	53.6 °F
<input type="radio"/> Min Mix Temp:	

Figure 71 - CO<sub>2</sub> Limits Setup

The **Maximum Damper Opening** position blocks the damper from opening past that point, even when there is a strong CO<sub>2</sub> concentration. It is used to avoid artificially creating a heating demand in the building, with the tradeoff being a slower response time for air quality. It is important to note that this maximum does not affect the economizer sequence, only the CO<sub>2</sub> control sequence.

The outside air damper position can also be limited by **temperature**. You can choose to limit the opening either by the supply temperature or the mixed air temperature. When the selected temperature goes below the limit, the outside air damper will begin to close until the limit is satisfied. If there is no valid temperature reading, the damper will remain at the minimum position for system safety concerns.

Both limiting sequences are both applicable at all times. In other words, if the max damper position has been attained and then the supply/mixed air gets too cold, the damper will then close until the limit is satisfied.

## 5.10 - Dehumidification

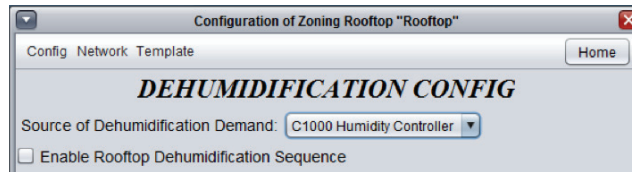
The Proton **Zoning Rooftop Controller** and **Single-Zone Rooftop Controller** have a built-in dehumidification sequence. It can activate compressor stages or open the outside air damper, while also reheating the incoming air.

The relative humidity percentage can be provided to the **Rooftop Controller** with any of the following methods:

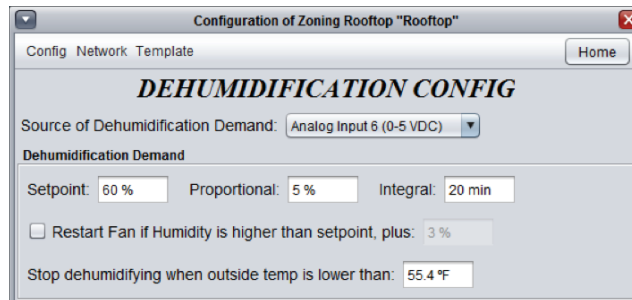
- **Zoning Rooftop Controller:**
  - ▷ RH% provided by Proton Humidity controller (PL-C1000-HU)
  - ▷ 0-5Vdc signal to PL-M2000-RTU Analog Input #6 (See Hardware Guide)
- **Single-Zone Rooftop Controller:**
  - ▷ 0-5Vdc signal to PL-M2000-RTUS Analog Input #6 (see Hardware Guide)

The Proton Humidity controller (PL-C1000-HU) or 0-5vdc humidity transducer provide a request for dehumidification to the Rooftop. This request can vary in intensity and appears in the form of a number ranging from 0 to 100%.

The dehumidification sequence is enabled with a checkbox at the top of the screen. Note that even if this checkbox is not checked, there is still an option available at the bottom of the screen to command all zone dampers to a certain minimum opening position during dehumidification requests. This is useful for cases where dehumidification is being handled externally from the **Rooftop Controller**, yet we still want zone dampers to open to make use of this dehumidified air.



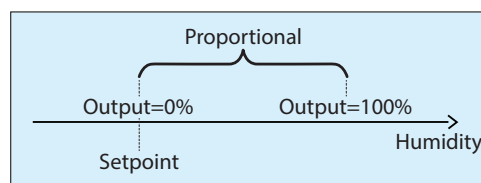
**Figure 72 - Dehumidification Configuration Screen (using PL-C1000-HU Controller)**



**Figure 73 - Dehumidification Configuration Screen (using Analog Input 6, 0-5 VDC Humidity Transducer)**

### 5.10.1 - Dehumidification Demand (*Analog Input 6 method only*)

The dehumidification demand is determined by a PI (Proportional / Integral) loop and is a number ranging from 0 to 100%. The higher the number, the more it is requesting dehumidification. The Proportional component of the PI loop is determined as follows:



As the relative humidity rises above below the setpoint, the Proportional component ramps up to compensate. The Integral component is defined as the amount of time required to increase the output's value by 100% to compensate for an error of 1%RH. Its purpose is to correct small errors over time. The Proportional component is then added to the Integral component to calculate the final output value. When properly tuned, this PI loop will efficiently maintain the Dehumidification Setpoint.

- **Fan Restart:** In most cases, a Proton **Rooftop Controller (Zoning and Single-Zone)** is configured to stop the main fan in unoccupied mode for energy savings purposes. However, even in unoccupied mode, the controller continues to monitor the humidity levels. Should the humidity levels get too high, the **Rooftop Controller** can restart the fan. A fan request is sent based on a configurable offset from the normal dehumidification setpoint.
- **Outside Air Temperature:** The Proton **Rooftop Controller (Zoning and Single-Zone)** will also limit dehumidification actions based on outside air temperature. If the outside air reading is invalid and not provided over the network, then this limit is ignored.



## 5.10.2 - Cooling

The Proton **Rooftop Controller (Zoning and Single-Zone)** can activate cooling equipment upon a request for dehumidification. The equipment used will vary depending on the conditions highlighted below.

Please note that dehumidification will only take place when there is no active call for cooling or heating equipment.

### 5.10.2.1 - Compressor Stages

The Proton **Rooftop Controller (Zoning and Single-Zone)** can activate up to two compressor stages for dehumidification purposes.

Cooling		
Authorize cooling with the following adjusted setpoints:		
Compressor Stage 1		
Setpoint: 50 %	Differential: 20 %	(% dehum demand)
Compressor Stage 2		
Setpoint: 80 %	Differential: 20 %	(% dehum demand)

Figure 74 - Setup of Dehumidification with Compressors Stages

Each stage of mechanical cooling has an activation and deactivation point based on the request for dehumidification provided by a remote Proton Humidity controller or a RH% transducer. These points are centered on the **Setpoint** of the stage, and separated by the **Differential** of the stage, as shown in the following graph:

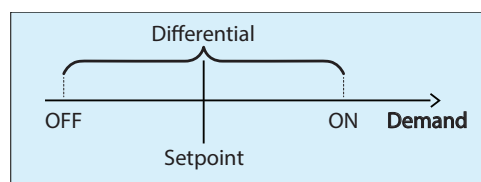


Figure 75 - Staged Dehumidification Based on Demand

The Differential band ensures that the activation and deactivation points are sufficiently spread apart, so as to avoid short-cycling the equipment. Configurable minimum run times also protect the equipment in this manner ([see Staged Cooling Operation, p.29](#)).

As the dehumidification demand ramps up, it will pass through the activation points of the stages, turning them on sequentially. A stage cannot start until its preceding stage has been activated.

As the dehumidification demand drops back down, it will pass back through the deactivation points and turn off the equipment, in the opposite order they were activated in (First In Last Out). There is no lead-lag sequence to alternate the order of activation.



### 5.10.2.2 - Analog Cooling

The Proton **Rooftop Controller (Zoning and Single-Zone)** can use analog cooling for dehumidification purposes. Its actions are based on the request for dehumidification provided by a remote Proton Humidity controller or a RH% transducer.

Cooling  
Authorize cooling with the following adjusted setpoints:  
Analog Cooling  
Setpoint: 50 % Proportional: 20 % (% dehum demand)

Figure 76 - Setup of Dehumidification with Analog Cooling

As long as the dehumidification demand stays below the **Setpoint**, the analog output remains off. Once the demand ramps up past the **Setpoint**, the analog output's value will also increase proportionally. Once the demand hits the sum of the **Setpoint** and **Proportional** band, the output will be at its maximum:

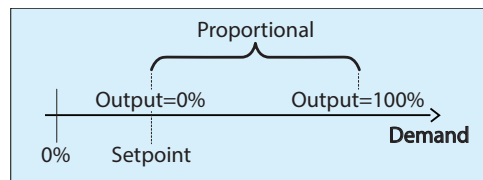


Figure 77 - Analog Dehumidification Based on Demand

### 5.10.2.3 - Economizer

The Proton **Rooftop Controller (Zoning and Single-Zone)** can use the economizer for dehumidification purposes. Its actions are based on the request for dehumidification provided by a remote Proton Humidity controller or a RH% transducer.

Economizer  
Setpoint: 50 % Proportional: 50 % (% dehum demand)  
Alternate Outside Changeover Temperature: 55.4 °F

Figure 78 - Setup of Dehumidification with Economizer

As long as the dehumidification demand stays below the **Setpoint**, the economizer remains at its minimum position. Once the demand ramps up past the **Setpoint**, the economizer's value will also increase proportionally.

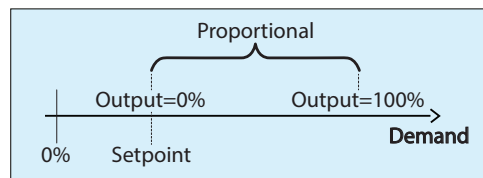


Figure 79 - Economizer Dehumidification Based on Demand



Once the demand hits the sum of the **Setpoint** and **Proportional** band, the economizer will be fully open: Even when dehumidifying, the low supply limits defined in the economizer configuration ([see p.47](#)) still apply, and the damper will close if it gets too cold.

The Proton **Zoning Rooftop Controller** also provides an **Alternate Outside Changeover Temperature** at which the economizer can be used for dehumidification. Below this temperature, the economizer is used for dehumidification, otherwise mechanical cooling will be used.

### 5.10.3 - Preheating

When the Proton **Zoning Rooftop Controller** is actively dehumidifying using cooling equipment, it can also simultaneously reheat the incoming supply air so as to avoid artificially creating a heating demand in the building.

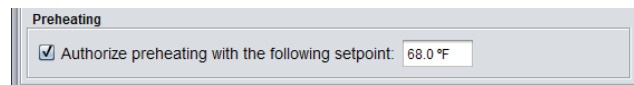


Figure 80 - Preheat Authorization During Dehumidification

The **Zoning Rooftop Controller** will use the same PI control loop defined in the Heating configuration ([see p.37](#)) to attain the target setpoint. Please note this option will not be available if the analog heating is disabled.

### 5.10.4 - Zone Dampers

The Proton **Zoning Rooftop Controller** can command all zone dampers to use a certain minimum position when dehumidification is active:

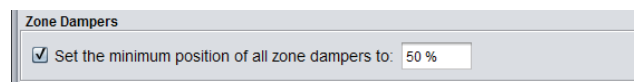


Figure 81 - Dehumidification Zone Damper Min

This option can be used regardless of whether or not the **Rooftop Controller** actually has its dehumidification sequence enabled: often the equipment itself has an alternate input for this sequence, which can be controlled directly with a Proton Humidity Controller. However even in this case, we still want zone dampers to open to make use of this dehumidified air.

## 5.11 - Limits Configuration

The Proton **Zoning Rooftop Controller** can regulate or subdue the action of many sequences based on various temperature limits.





## 5.11.1 - Return Air Temperature

Both Cooling and Heating can be limited by the return air temperature:

LIMITS		
RETURN AIR TEMPERATURE		
Stop Cooling when lower than:	57.2 °F (1st Stage)	68.0 °F (2nd Stage)
Stop Heating when higher than:	95.0 °F	
Enable Preheating if lower than:	53.6 °F	

Figure 82 - Return Air Temperature Limits

These limits have a built-in differential bands to prevent short cycling of the equipment should the return temperature fluctuate closely around these limits.

- When the **cooling** limits are tripped, the return temperature must rise back above the limit, plus an additional 3.6°F (2°C) before cooling will be enabled again.
- When the **heating** limits are tripped, the return temperature must drop back below the limit, minus an additional 9°F (5°C) before heating will be enabled again.

**Note** that the **Return Limit for the First Stage of Cooling** also applies to the Economizer sequence, causing the outside air damper to return to its minimum position when tripped.

If the Return Air Temperature reading is *Invalid*, it is assumed that these limits are *Satisfied*.

## 5.11.2 - Outside Air Temperature

Both Cooling and Heating can be limited by the outside air temperature. The Preheating sequence is also enabled based on outside temperature:

OUTSIDE AIR TEMPERATURE		
Stop Cooling when lower than:	-40.0 °F (1st Stage)	53.6 °F (2nd Stage)
Stop Heating when higher than:	86.0 °F	
Enable Preheating if lower than:	53.6 °F	
Restart Fan when lower than:	-40.0 °F	or higher than: 104.0 °F

Figure 83 - Outside Air Temperature Limits

These limits have a built-in differential bands to prevent short cycling of the equipment should the outside temperature fluctuate closely around these limits.



- When the cooling limits are tripped, the outside temperature must rise back above the limit, plus an additional 3.6°F (2°C) before cooling will be enabled again.
- When the heating limits are tripped, the outside temperature must drop back below the limit, minus an additional 3.6°F (2°C) before heating will be enabled again.
- When preheating is enabled, the outside temperature must rise back above the limit, plus an additional 3.6°F (2°C) before preheating will be disabled.
- The **Fan Restart Sequence** does not have any associated differential band due the fact that the Fan sequence has a built in minimum run time to prevent short cycling.

If the Outside Air Temperature reading is **Invalid**, it is assumed that these limits are **Satisfied**. Preheating is also permitted when the reading is invalid.

### 5.11.3 - Supply Air Temperature

Both Cooling and Heating can be limited by the supply air temperature:

The screenshot shows a control panel titled "SUPPLY AIR TEMPERATURE" with the following settings:

- Stop Cooling stages in succession when lower than: 48.2 °F
- Modulating Heat Limit of Analog Output 1: 104.0 °F (if modulating)
- Stop Heating when higher than: 122.0 °F
- Stop Fan when lower than: 39.2 °F
- Restart at: 53.6 °F

Figure 84 - Supply Air Temperature Limits

These limits have a built-in differential bands to prevent short cycling of the equipment should the supply air temperature fluctuate closely around these limits.

- When the cooling limit is tripped, the supply temperature must rise back above the limit, plus an additional 5.4°F (3°C) before cooling will be enabled again. Cooling stages will turn off while still respecting the Interstage Deactivation Delay ([see p.34](#)). In the case of Analog Cooling, the output will modulate to maintain at least this temperature (the differential does not apply here).
- For the non-modulating heating limit, the supply temperature must drop back below the limit, minus an additional 9°F (5°C) before any heating will be enabled again.

The **Fan Stop Limit** prevents the fan from supplying very cold air into the building, for example if the outside air damper is stuck open and heating is not working. Note that this limit will be ignored for a short period of time following a normal activation of the fan. This is simply to give a chance to the heating equipment to heat up the air first.

The amount of time that the Fan Stop Limit is ignored upon the activation of the fan is equal to the minimum OFF time of the DO4 heating output ([see p.35](#)) plus 1 minute, or 5 minutes in total, whichever is more.

This limit will not be ignored a second time if it is the very reason the fan stopped in the first place.



## 5.12 - Priority Configuration

The priority configuration page is used to determine how the **Zoning Rooftop Controller** will react when it has equally strong cooling and heating demands coming from its zone controllers.

Please note that since the **Single-Zone Rooftop Controller** cannot communicate with any zone controllers, it will never have conflicting demands, and this screen is therefore unnecessary and unavailable.

Configuration of Rooftop "Rooftop"

Config Network Template Home

**PRIORITY**

Deadband Between Heating and Cooling: 20 %

Delay Between Heating and Cooling : 5 min

**PRIORITY MODE**

Auto

Outside Temp. : 46.4 °F Differential : 7.2 °F

Manual

Cooling  Heating

Refresh Apply Exit

Figure 85 - Priority Configuration Screen

First, there are two parameters used to keep heating and cooling actions sufficiently spaced apart in the first place:

- **Deadband between Heating and Cooling:** This specifies a deadband, centered on 0%, in which no heating and no cooling actions will be taken, regardless of the setpoints used in the cooling or heating configuration pages. This value is applied to each math function.
- **Delay between Heating and Cooling:** This is the minimum amount of time that must pass after the end of any heating action before any cooling action can begin, and vice-versa.



## 5.12.1 - Priority Mode

A **Zoning Rooftop Controller** activates heating or cooling based on the collective demands coming from its zones. The calculation method can actually differ for heating versus cooling ([see Math Configuration p.64](#)), possibly resulting in simultaneous demands strong enough to activate the equipment in both modes. A decision must then be made by the **Zoning Rooftop controller** about which to activate.

The decision in this case can either be determined manually, or based on the outside air temperature. When based on the outside temperature, a differential band centered on the outside temperature setpoint is used to avoid alternating back and forth too quickly between priority modes.

**Note** that these Priority rules only come into play when there is conflicting heating and cooling demands. If only cooling is calling for action, then the **Zoning Rooftop Controller** will cool without hindrance, even when the priority is set to heating. It will, however, stop cooling should the heating demand become strong enough to activate the heating equipment.

Again, this section is only relevant when heating and cooling are being controlled by the different math functions; otherwise the priority has no importance since a math function cannot produce a heating and cooling demand at the same time.

If the Cooling Mode is set to Supply Temp ([section 5.4.2](#)), then the Priority Mode settings become unused. However the Deadband and Delay parameters seen above remain in effect.

## 5.13 - Calibration

This screen allows the user to adjust the controller's various input readings, in case a noticeable offset is observed. Positive or negative values can be entered.

Category	Parameter	Value
Temperature	Supply Temperature Calibration	0.0 °F
	Return Temperature Calibration	0.0 °F
	Outside Temperature Calibration	0.0 °F
	Zone Temperature Calibration	0.0 °F
	Zone Setpoint Calibration	0.0 °F
	Mix Temperature Calibration	0.0 °F
Other	Pressure Offset	0.0 in
	CO <sub>2</sub> Calibration	0 ppm

Figure 86 - Calibration Screen

The Zone Setpoint value will be added to the setpoint reading received from a wall sensor to calculate the actual heat setpoint. It only applies to sensors with physical scales, such as the T200 or PL-RS wall sensors.



## 5.14 - Device Properties



Figure 87 - Device Properties Screen

This screen shows all the intrinsic properties of the device you are configuring. This helps you determine its capabilities without having to visually inspect the device.

- **Device Type:** The type of controller you are configuring.
- **Software version:** The current software in the controller. The greater the software version, the more advanced the device is. Devices can be upgraded by reprogramming them (see “Reprogram” below).
- **Hardware version:** This is the physical hardware platform of the controller. Different hardware has different features. The hardware can only be changed by replacing it physically.
- **Device Number:** The network address of the controller, which is set manually using the dipswitches or through software.
- **Device Name:** This field indicates the current name of the controller, which you can modify. Alternatively, you can just right-click on the icon and select the ‘Rename’ option.
- **Reset Device:** Causes the device to perform a reset. All configuration properties REMAIN SAVED. However, resetting the controller removes all active overrides. This function is useful for debugging purposes.
- **Reprogram:** This function is used to upgrade the controller to a new software version. Focus will begin by asking you for the HEX file that contains the software update. Software update HEX files can only be provided by Prolon. At the end of the procedure, Focus will automatically reapply all the parameters you have previously configured into the device.

Should there be any interruption during the programming procedure (due to intermittent communication or other), the procedure is halted to allow time for the problem to be fixed. When ready, the whole upgrade procedure can be resumed at any time by pressing this button again. It is normal for the icon to turn grey and become unresponsive during this period. Simply continue with the procedure anyways.



## 6 - Network Menu

A Prolon *Master* Controller such as a Zoning Rooftop or Zoning Heatpump Controller manages the Prolon *Follower* controllers (VAV Controller, Thermostat, etc.) in its system. It exchanges data with them and this data can be used to calculate math functions, control the occupancy, activate morning warm up functions, and much more. Therefore a proper network configuration is an important element in any zoning system.

### 6.1 - Device List

This screen displays two different lists of known controllers in the current system, and is mainly used for debugging purposes.

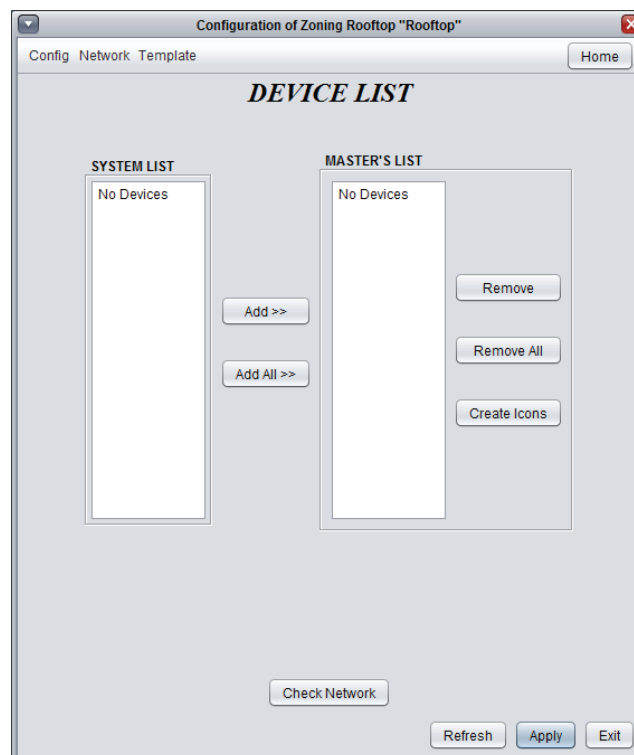


Figure 88 - Device List Configuration Screen

- **System List:** This is simply the list of icons that have been added to the current system in your Focus project. It does not imply that the controllers in this list are functional and communicating. Icons that are currently non-responsive (grey color) will still appear in this list, as long as they appear somewhere on the project screen.
- **Master's List:** This is the list of follower controllers that the master controller is currently aware of. The master builds this list after a **Get List** procedure, which occurs periodically or upon user command.

This list can be useful during a job start-up or during troubleshooting, letting you know what controllers the master can detect, highlighting possible sources of problems.

An **important** note here is that if a follower is not currently on the master's follower list, the master will NOT attempt to communicate with it. This means



that the demand of this follower will not be included in any math function calculation, and the follower will not receive the system-shared supply air temperature or occupancy status. In addition, Prolon Focus will NOT be able to communicate with the follower (its icon becomes grey). This is because the master assumes that the follower does not exist and therefore blocks any related network traffic.

When online, **updating** the master's follower list can be done quickly by simply pressing the "Check Network" button, by right-clicking the master icon and choosing "Get List", or by resetting the master controller.

Under normal circumstances, both lists should match.

## 6.1.1 - Buttons

- **Add>>**: Add the selected followers from the system's follower list to the master's follower list. To select a follower, simply click on its name in the list. To select multiple followers, hold CTRL while clicking on their names.
- **Add All>>**: Add all the followers from the system's follower list to the master's follower list.
- **Remove**: Remove the selected followers from the master's follower list. To select a follower to remove, simply click on its name in the list. To select multiple followers, hold CTRL while clicking on their names.
- **Remove All**: Remove all the followers from the master's follower list.
- **Create Icons**: Create Focus icons for each follower in the master's follower list, unless the icon already exists.
- **Check Network**: Causes the master to automatically retrieve the list of followers attached to it. All followers found will be displayed in the "Master's List" box. This function is unavailable offline.



## 6.2 - Math Functions

This screen is used to configure a Proton Master's math functions.

Configuration of Rooftop "Rooftop"

Config Network Template Home

### MATH FUNCTIONS

**MATH 1**  
Source: Weighted Average (Cooling Only) Global  Group Code

**MATH 2**  
Source: Weighted Average (Heating Only) Global  Group Code

**MATH 3**  
Source: Occupancy Global  Group Code

**MATH 4**  
Source: Maximum Cooling Global  Group Code

**MATH 5**  
Source: Maximum Heating Global  Group Code

Poll Rate:  List Refresh Rate:

Demand Filter:  Unoccupied Mode:

Refresh Apply Exit

Figure 89 - Math Functions Configuration Screen

Besides calculating its own demand, a Proton Master will detect and analyze the demand and group codes of all the zone controllers on its network. With the various demands on hand, it calculates the math functions as specified below.

The results of these math functions are then applied to the cooling, heating and other functions of the master controller, as defined by the user.

**Note** that if the Master Controller has its own attached zone temperature sensor, it essentially counts as a individual Zone Controller as well, and will include its own readings in the calculations below.

There are five available math functions to configure. For each function, you have the following options:





- **Source:** Each math function can be calculated in one of the following ways:
  - ▷ **Weighted Average:** The weighted average of all the Zone Controllers included in the calculation. The weighted average is calculated by multiplying the demand of each Zone Controller by its respective weight and adding them together. The result is then divided by the total weight in the calculation. This provides a math function whose final result is more influenced by the zones with greater weight.
  - ▷ **Max Heating:** This returns the highest demand of heating of all the Zone Controllers included in the calculation.
  - ▷ **Max Cooling:** This returns the highest demand of cooling of all the Zone Controllers included in the calculation.
  - ▷ **Weighted Average (heating only):** This is the same as “Weighted Average”, except only zones with a heating demand are included in the calculation. Zones in cooling are worth 0%.
  - ▷ **Weighted Average (cooling only):** This is the same as “Weighted Average”, except only zones with a cooling demand are included in the calculation. Zones in heating are worth 0%.
  - ▷ **Occupancy:** If there is at least one Zone Controller found in this calculation that is occupied (or overridden to be occupied), this math function will return 100%, otherwise it will be 0%.
  - ▷ **Override:** If there is at least one Zone Controller found in this calculation that is overridden from unoccupied to occupied mode, this math function will return 100%, otherwise it will be 0%.
  - ▷ **Radiant Request:** As soon as the radiant cycle percentage of any single one of the participating zones in the math function becomes greater than 0%, the math value goes to 100%. Otherwise it remains at 0%.
- **Global:** When this is selected, ALL Zone Controllers found in the system are included in the calculation. If “Weighted Average” is selected, then the weight used will be specified in the Group Codes configuration screen, in the Global field of each Zone Controller.
- **Group Code:** When this is selected, ONLY the Zone Controllers belonging to this group are included in the calculation. There are 250 groups available, numbered 1 through 250. If weighted average is selected, then the weight will be specified in the Group Codes configuration screen of each Zone Controller. When group codes are not being used, it is automatically set to zero.
- **Poll Rate:** The interval at which this device will retrieve new data from the Zone Controllers on the network. Increase this value to alleviate network traffic.
- **List Refresh Rate:** The interval at which this device will attempt to detect any Zone Controllers on the network. Setting this to zero will disable list refreshing.
- **Demand Filter:** The demand filter is used to limit the rate of change of the math functions. When a math value changes, it is first compared to its previous value. The difference between the two is multiplied by the demand filter and added to the previous value.

Example:

  - ▷ Demand Filter = 30%
  - ▷ Previous math value = 50%
  - ▷ Desired math value = 75%
  - ▷ Final math value =  $(75-50) \times 30\% + 50 = 57.5\%$

Therefore, instead of the math value suddenly jumping from 50% to 75% in the span of 1 second, it will instead jump to 57.5 % and gradually reach the 75% mark. Note that the demand filter is not applied if the difference between the previous math value and the desired math value is equal or less than 3%.
- **Unoccupied Mode:** This option can modify the math calculation strategies during unoccupied mode.
  - ▷ **Max demand:** During unoccupied mode, “Averaging” type math functions will be replaced by “Max demand” type functions:
    - ▷ “Weighted Average” is replaced by “Max Demand”. In the case where there are conflicting demands between different followers (cooling and heating), priority is used to decide between them ([p.59](#)).
    - ▷ “Weighted Average (Cooling Only)” is replaced by “Maximum Cooling”
    - ▷ “Weighted Average (Heating Only)” is replaced by “Maximum Heating”
- **Normal:** Math functions will be calculated the same way, regardless of occupancy.



## 6.3 - Group Codes

Group #	Weight
0	0
0	0
0	0
Global	1

Figure 90 - Group Codes Screen

This screen lets you configure which math groups the **Zoning Rooftop Controller** should belong to, as well as the voting weight it should have in each group. This information is used as part of Proton's Flexi-Zone math calculation system. A **Zoning Rooftop Controller** can belong to three different groups at a time, as well as the global group.

- **Group #:** A group that the **Zoning Rooftop Controller** belongs to. When this is set to zero, the **Zoning Rooftop Controller** does not participate in a group.
- **Weight:** The weight of the **Zoning Rooftop Controller** in the selected group. Used in weighted average calculations. Setting this to zero removes it from the group.
- **Global Weight:** The weight of the **Zoning Rooftop Controller** in the global group. Used in weighted average calculations. Setting this to zero removes it from the global group.



## 6.4 - COM Port Settings

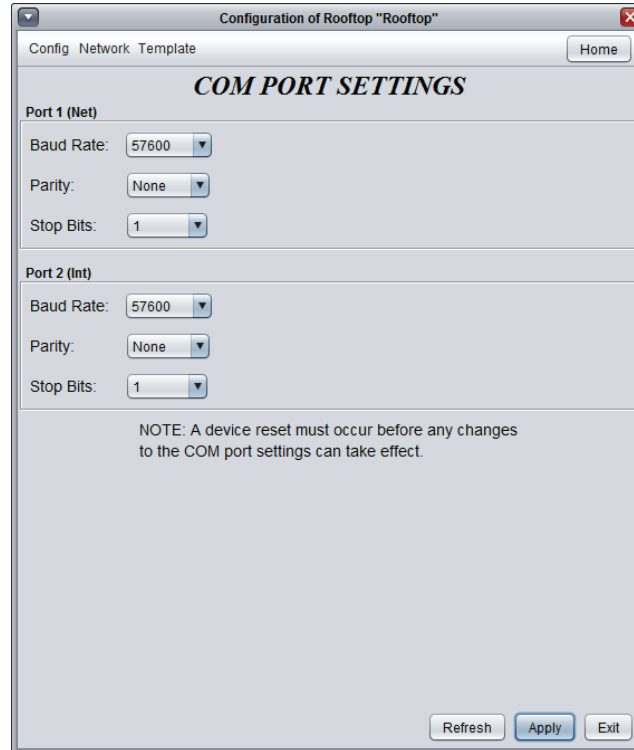


Figure 91 - COM Port Configuration Screen

Changes to the settings in this section will only take effect once the **Rooftop Controller** is reset or has power cycled. Each port on the **Rooftop Controller** has the same options. Please refer to each platform's hardware guide for more details on the COM ports.

- **Baud Rate:** This sets the baud rate value for the COM port. The default baud rate used by a **Rooftop Controller** is 57600bps but may be set to any of these standard values:
  - ▷ 9600 bps
  - ▷ 19200 bps
  - ▷ 38400 bps
  - ▷ 57600 bps
  - ▷ 76800 bps
  - ▷ 115200 bps
- **Parity:** This sets the parity for communication on the COM port. The default parity used by a **Rooftop Controller** is "None" but may be set to any of these standard values:
  - ▷ None
  - ▷ Odd
  - ▷ Even
- **Stop Bits:** Sets the number of stop bits used by the COM port. By default, it is set to 1, but can also be set to 2.



## 6.5 - Weekly Schedule

This screen is used to configure weekly occupancy schedules.

	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Holiday
ON	-	7:00 AM	7:00 AM	7:00 AM	7:00 AM	7:00 AM	-	-
OFF	-	-	-	-	-	-	-	12:00 AM
ON	-	-	-	-	-	-	-	-
OFF	-	-	-	-	-	-	-	-
ON	-	-	-	-	-	-	-	-
OFF	-	-	-	-	-	-	-	-
ON	-	-	-	-	-	-	-	-
OFF	-	6:00 PM	6:00 PM	6:00 PM	6:00 PM	6:00 PM	-	-

Copy/Paste

Copy from: Choose a day to copy...

--- Paste To ---

Sunday  Monday  Tuesday  Wednesday

Thursday  Friday  Saturday  Holiday

Paste

NOTE: If a schedule has already been set for this device in a Network Scheduler, the schedule from the Network Scheduler will have priority.

Refresh Apply Exit

Figure 92 - Weekly Routines Screen

- **Weekly Schedule Grid:** The Weekly Schedule Grid defines the weekly occupancy routine of the **Rooftop Controller**.
- **Copy/Paste:** The Copy/Paste function makes it easy to copy a particular day's schedule and apply it to other days of the week. Simply choose a day to copy from the drop down list, select one or more days to paste to, then click the "Paste" button.

The occupancy status only changes when a valid time is encountered on the weekly schedule grid. For example in the routine above, on Monday the device will be set to "Occupied" at 7:00 AM. At 6:00 PM, the device will be set to "Unoccupied" and **remain so** until the next valid time is encountered (7:00 AM the next day), where it becomes occupied again. The "Holiday" column will replace a normal weekday anytime the current date has been set as a holiday (see the next section).

**Note** that if a Network Controller is present on the network and it has been configured to send a schedule to this **Rooftop Controller**, the schedule sent by the Network Scheduler will take precedence over the one set here.



## 6.6 - Holiday Calendar

This screen is used to define which dates count as holidays, so that the normal daily schedule can be replaced by an alternate, special holiday schedule. The holiday calendar does not automatically recognize floating holidays (Labor Day, Memorial Day, etc.) and thus must be adjusted annually.

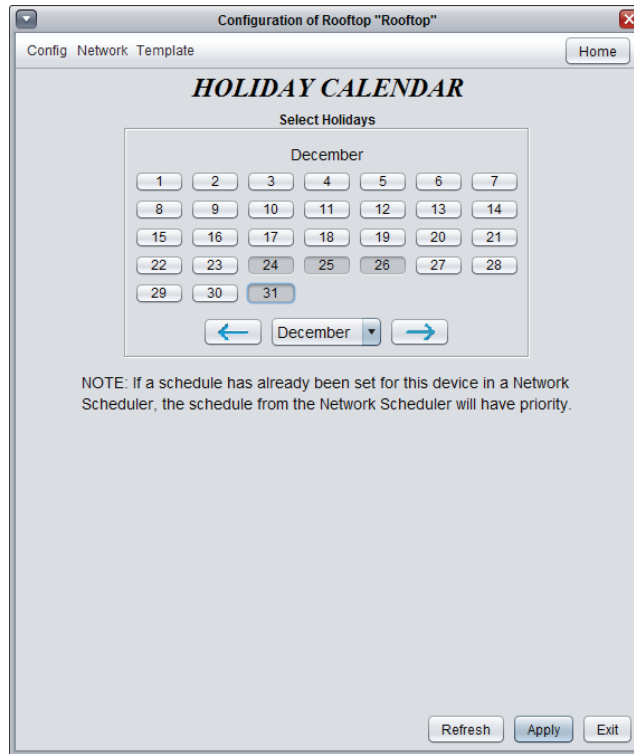


Figure 93 - Holiday Calendar Screen

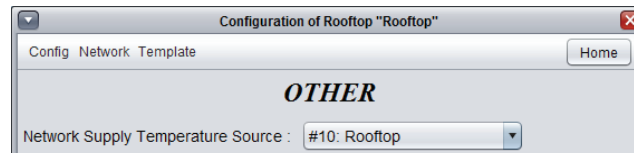
- **Calendar Dates:** On the selected days, the holiday occupancy routine defined in the Weekly Routines screen will replace the normal occupancy schedule of that day. After the day is over, the next day follows the standard schedule again.

To select or unselect a date, simply click on it. You can flip through the different months by clicking on the arrows at the bottom or by simply choosing the desired month from the drop down list of months.



## 6.7 - Other

This screen contains various settings and sequences that require the participation of zone controllers in the system.



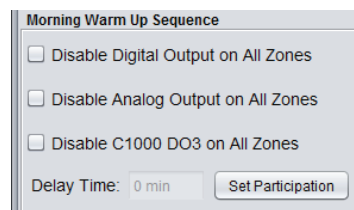
**Figure 94 - Network Supply Temperature Source**

- **Network Supply Temperature Source:** This option is used to define which controller is the source of the supply air temperature reading for the system. The Master retrieves this reading from the device and distributes it to all other controllers.

Any controller that already has its own supply temperature sensor will use the reading from its own attached sensor and ignore the one received from the Master. By default, this is set to distribute the Master's supply air temperature reading.

### 6.7.1 - Morning Warm Up Sequence

The Morning Warm Up Sequence is used to temporarily disable the outputs on selected zone controllers upon a transition to Occupied Mode. This is an interesting way to obtain considerable energy savings by relegating morning heating demands to the Master Controller, instead of using terminal heating on top of the Master's own heating.



**Figure 95 - Morning Warm Up Sequence**

Upon a transition from unoccupied to occupied (but not including those which occur due to manual overrides), the Master Controller commands all participating zones controllers to disable the selected outputs for the amount of time specified.

For C1000 VAV Controllers, the Digital output corresponds to Output 4, and the Analog Output corresponds to Output 5.



## 6.7.2 - Cooling Priority Zones

When a zone is specified as a cooling priority zone, the Master will use the cooling demand of that zone to drive the cooling sequence, as long as the demand of that zone is greater than the math output normally assigned to cooling.

Cooling Priority Zones

Zone 1: #3: Zone

Zone 2: None

Zone 3: None

Allow Second Compressor Stage

Figure 96 - Cooling Priority Zones

A maximum of three high-priority cooling zones may be selected. This feature can be very useful for conference rooms, which under most circumstances are empty and without cooling demand. But once that room fills with occupants, it can effectively drive the cooling in the Master controller.

**Note** that this sequence takes priority over heating, even if heating normally has priority ([see p.60](#)).

This feature can be further customized by specifying if the second cooling compressor stage is allowed to run (if applicable), or if only the first stage is authorized. This can ensure that a single zone does not overcool an entire system.

**WARNING:** This sequence should only be used by experienced building automation specialists.

## 6.7.3 - Outside Temperature Override

This function commands the selected zone controllers to set their outputs to a minimum specified value under certain outside temperature conditions. These overrides can be activated when the outside temperature is either greater or less than a given setpoint:

Outside Temperature Overrides

If temp is less than -4.0 °F

If temp is greater than 80.0 °F

set Digital Output to 40 % (minim)

set Digital Output to 0 % (minim)

set Analog Output to 0 % (minim)

set Analog Output to 0 % (minim)

set C1000 DO3 to 0 % (minim)

set C1000 DO3 to 0 % (minim)

Set Participation

Set Participation

Figure 97 - Outside Temperature Override

This can be useful to force particular zone controllers to activate their heating outputs in anticipation of a strong heating demand due to cold outside temperatures, for example, during unoccupied mode.

For modulating or pulsing outputs, the override only acts as a minimum in this case: the overridden output can still increase its action if called to.

For ON/OFF differential outputs, only an override of 100% will activate that output. Otherwise it will remain off.

Alternatively, in the special case where the **override is set to zero**, the output will instead remain deactivated for the duration of the override. This can be useful to ensure that heating outputs stay off during warmer seasons.

For C1000 VAV Controllers, the Digital output corresponds to Output 4, and the Analog Output corresponds to Output 5.



## 6.7.4 - Zone Damper Override

This function commands all VAV zone dampers to the desired position.

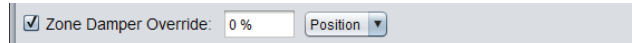


Figure 98 - Zone Damper Override

This function is useful during air balancing procedures. The available modes are:

- **Position:** Dampers simply go to the desired position.
- **Flow:** For pressure independent zone controllers, the damper will move to target a flow reading determined by the override percentage, using its minimum and maximum air flow setpoints as a scale.
- **Min:** Dampers go to their minimum position if pressure dependent, or their minimum flow setpoint if pressure independent. The override value is not used.
- **Max:** Dampers go to their maximum position if pressure dependant, or their maximum flow setpoint if pressure independent. The override value is not used.

For example, if the minimum flow setpoint for a VAV Zone Controller is 100 CFM, and the maximum flow setpoint is 200 CFM, and the override is set to 75%, then the VAV controller will target 175 CFM.

This parameter will be lost if the master loses power or is reset.

## 6.8 - Template Menu

### 6.8.1 - Save as Template

The template function gives you the ability to save the configuration of a particular **Rooftop Controller** for future use, which can then be applied to any other **Rooftop Controller**, regardless of hardware platform. Each configurable property of the **Rooftop Controller** is saved into this template file, except for its name. This function is very useful if you have many **Rooftop Controllers** with the same or very similar configurations. You will be able to quickly copy and paste the configuration from **Rooftop Controller** to **Rooftop Controller**.

### 6.8.2 - Load Template...

After saving a **Rooftop Controller** configuration in a template, you can load this template into another **Rooftop Controller** by selecting this menu item in the configuration screen of the **Rooftop Controller** you wish to change. All configuration properties found in the template are then copied into the configuration screen for your viewing or possible modification. Once you are satisfied with the set of properties, click the "Apply" button.

**Note:** The template configuration will not be applied to the **Rooftop Controller** until you click on the "Apply" button. If you do not wish to use the configuration properties of a loaded template, click on the "Refresh" or "Exit" buttons.