



FOCUS GUIDE

AIR MAKE-UP CONTROLLER

Configuration Guide for Prolon Focus Software

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1 - Prolon Air Make-Up Controller

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

The Prolon series *Make Up Air Controller* is designed to control a variety of different make-up air units and systems. 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 M2000 MUA uses PI (Proportional-Integral) control loops to optimize HVAC management and offers a variety of functions such as outdoor reset for the discharge air temperature, building pressure control, CO₂ control, safety limits, Lockout mode and more.

The Prolon series *Make Up Air Controller* is in essence a collection of highly effective MUA 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 *Make Up Air Controller* is only offered on the M2000 hardware platform. Please see the **HARDWARE GUIDE** for more information on the I/O and wiring:

M2000 → 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 *Make Up Air Controller* is **ONLY** available as a Master device. Furthermore, it is only expecting to find a single T1100 Digital Thermostat as a Follower device. If others are found on its network, the average demand of these T1100s will be used.

Please note that the *Make Up Air Controller* does not require a T1100 Digital Thermostat to operate: it can operate based on Outside Temperature reset scales, or with an attached analog room sensor or thermistor.

The Prolon *Make Up Air 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

The Prolon *Make Up Air Controller* will automatically detect and start sharing information with the Follower controllers that it finds. The information that is shared includes the occupancy status, outside air temperature and zone demand. Data is exchanged approximately every three seconds.

The Prolon *Make Up Air 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 *Make Up Air 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 there is already an outside temperature sensor physically connected to the input on the *Make Up Air 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.



3 - Adding an Air Make-Up to a Focus Project

Prolon Focus is a free Home and configuration software for all Prolon controllers. Once the *Make Up Air 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 ***Make Up Air Controller's*** address can be assigned using the physical dipswitch found on the controller directly. The address will be encoded in binary. Please see the **HARDWARE GUIDE** for more information.

3.1.1 - Address Locking

Although the controller has physical dipswitches for addressing, 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. A Prolon ***Make Up Air Controller*** can be simply added onto the screen by clicking on the "New Make Up Air" button, found in the **Devices Drag and Drop** list on the left side of the Focus screen (System View only):



Figure 1 - New Make Up Air Button

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



4 - Air Make-Up Controller Icon

Each *Make Up Air Controller* added to your system has its own icon. Each icon displays data about the *Make Up Air Controller* it represents, and this data is updated regularly. You can open the configuration screen for a *Make Up Air 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).

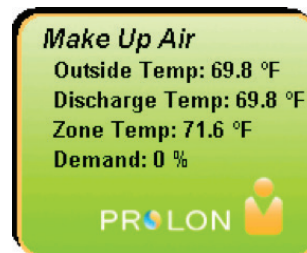


Figure 2 - Make Up Air Icon

4.1 - Icon Data

- **Name:** The name of the *Make Up Air Controller*. You can change it by right clicking the icon and choosing “Rename”. By default, it is set to “Make Up Air”.
- **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.
- **Discharge Temp:** The current air temperature discharging from the unit. Will display “N/A” (not applicable) if no sensor is attached.
- **Zone Temp:** The current zone air temperature. Will display “N/A” if there is no physical temperature sensor is attached or if offline.
- **Demand:** The *Make Up Air 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.
- **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 *Make Up Air Controller* is in occupied mode. If the icon is grey, the *Make Up Air Controller* is in unoccupied mode. The icon will be grey when working offline.



4.2 - Icon Colors

The Make Up Air icon changes color depending on the status and current actions being taken by the controller.

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



Figure 3 - Grey Icon

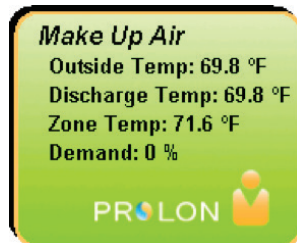


Figure 4 - Green Icon

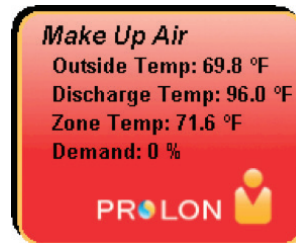


Figure 5 - Red Icon



Figure 6 - Blue Icon

4.3 - Icon Right-Click

At any time, you can right-click the Make Up Air icon to access a list of useful functions.

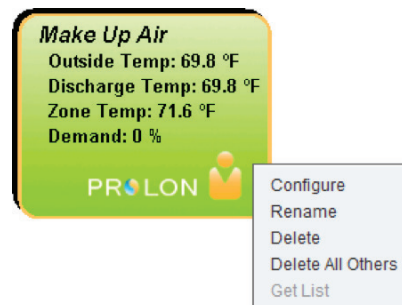


Figure 7 - Icon Right-Click for Air Make-Up

- **Configure:** This opens the configuration screen for the *Make Up Air Controller* (same as double-clicking the icon).
- **Rename:** Lets you rename the *Make Up Air Controller*. Names are limited to 16 characters.
- **Delete:** Removes the *Make Up Air 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 *Make Up Air 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.



5 - Configuration of a Air Make-Up Controller

To view the configuration of a *Make Up Air 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 *Make Up Air Controller* Home screen to transfer you to its corresponding configuration page. ([See Icon Quick Jumps for more details, p.14](#)).

5.1 - Air Make-Up Controller Home Screen

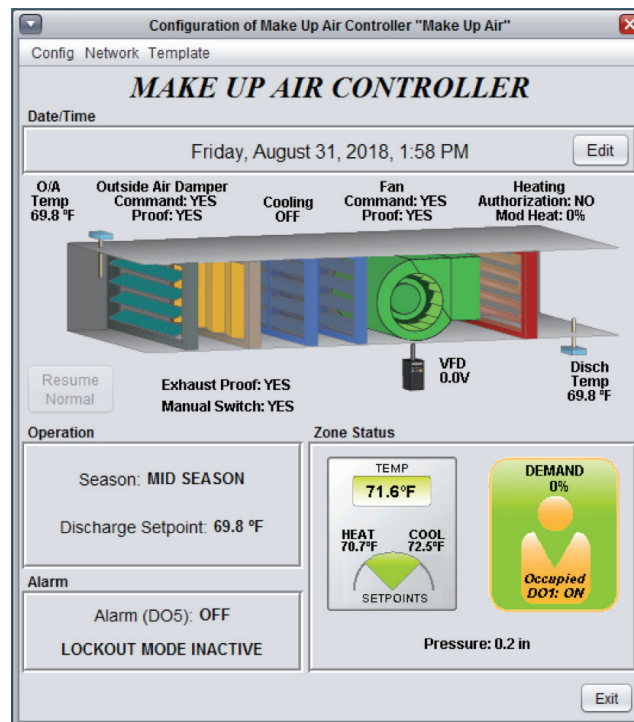


Figure 8 - Make Up Air Home Screens

This screen shows the status of all inputs and outputs of the Prolon *Make Up Air Controller*, as well as the active set-points. All values will be "N/A" (Not Applicable) if offline.

Note that this screen will vary 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 **Make Up Air Controller**. This can be edited with the Edit button.
- **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.
- **Disch Temp:** The current discharge air temperature. Will display "N/A" if no discharge air temperature sensor is attached.
- **Exhaust 1 Proof / Digital Input:** Status of the digital input that initiates the Make Up Air activation sequence. The **Make Up Air Controller** will not begin operating until either this input or the "Exhaust 2 Proof / Manual Switch" input below detects a closed contact. This input is usually attributed to a proof of exhaust fan, but in the case where there is no exhaust fan is selected ([see 5.2.2 – Exhaust Fan / Occupancy \(D01\)](#)), it is simply displayed as a "Digital Input".
- **Manual Switch / Exhaust 2 Proof:** Status of the digital input that typically acts as a manual start switch for the Make Up Air activation sequence. The **Make Up Air Controller** will not begin operating until either this input or the "Exhaust 1 Proof / Digital Input" input above detects a closed contact. This input is usually attributed to a Manual Switch, but in the Dual Volume sequence ([see 5.2.1 – Sequence](#)), it can be displayed as a "Exhaust 2 Proof" or even "Digital Input 2 (HI)".
- **Zone Temp & Setpoints:** The current zone air temperature, accompanied by the active heating and cooling setpoints. This information is only provided if there is an analog wall temperature sensor physically connected to the controller. In the event a T1100 digital thermostat is used as a follower device, the zone temp and setpoints will only be displayed in the Home page of that T1100 thermostat and will be displayed as "N/A" here.
- **Demand:** The **Make Up Air 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. Note that in the event a T1100 digital thermostat is used as a follower device, it is the T1100 who is the source of this calculation.
- **Occupancy:** The occupancy status of the **Make Up Air Controller**. Occupancy is first determined by the real time clock onboard the **Make Up Air Controller** along with the programmed schedule. However, an occupancy status received from a Proton Network Controller takes precedence over the internal occupancy calculated by the **Make Up Air Controller**.
- **Pressure:** The current pressure reading in the building. Will only be displayed in a Variable Volume sequence, when the VFD control mode is set to Pressure.
- **CO₂:** The current CO₂ reading in the building. Will only be displayed in a Variable Volume sequence, when the VFD control mode is set to CO₂.



5.1.2 - Displayed Information (Outputs)

- **Outside Air Damper:** The statuses of both the command and proof for the Outside Air Damper. These are displayed above an icon for the damper. The damper icon will only display as open when both the command is ON and there is proof.
- **Cooling:** The status of the mechanical cooling is displayed above an icon representing compressor coils. Each coil represents a stage of cooling. If there are 2 stages, then the first stage of cooling is the coil on the right and the second stage is the one on the left. A cooling stage is on when it is colored blue and off when it is grey. The text only displays the highest active stage.
- **Fan:** The statuses of both the command and proof for the Fan. These are displayed above a green fan icon. When the fan is on and there is a proof of fan signal, the icon animates by rotating the fan blades. When the fan is off or when proof of fan is missing, the fan blades are stopped.
- **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. Displayed above the icon is the state of the heating authorization, as well as the value of the modulating heat output.
- **VFD:** The current voltage applied to the variable frequency drive. Will only be displayed if Hardware sequence is set the "Dual Volume" or "Variable Volume" ([see 5.2.1 – Sequence](#)).
- **DO1:** The status of Digital Output 1, which strictly follows the occupancy status of the **Make Up Air Controller** (On during Occupied, Off during unoccupied), even in Lockout mode.
- **Season:** The Make Up Air operating season, as determined by the outside air temperature and the settings in the Winter and Summer configuration screens. When the outside air temperature is in between these settings, the season will be displayed as "Mid-Season". Only the Outside Air Damper and the Fan are operational during Mid-Season.
- **Discharge Setpoint:** The calculated discharge setpoint used exclusively during the Winter season. In any other season, displayed as "N/A".
- **Alarm:** The status of the Digital Output 5, which is used to indicate that Lockout Mode is active in the **Make Up Air Controller**. Lockout Mode can be triggered for a number of reasons, and a short description of the reason is displayed below the Alarm Output status text and is highlighted by some blinking text. Lockout Mode can be cancelled by closing a contact on analog input 5, or by right-clicking the blinking text and selecting the "Cancel Lockout Mode" button. [See 5.7.3 – Lockout Mode for more information.](#)



5.1.3 - Date/Time

The Proton **Make Up Air Controller** has an internal real time clock. The current date and time are displayed at the top of the Home screen. To edit the time, click on the "Edit" button.

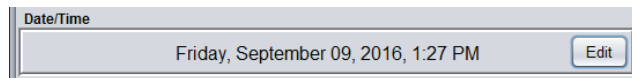


Figure 9 - Edit Time Button

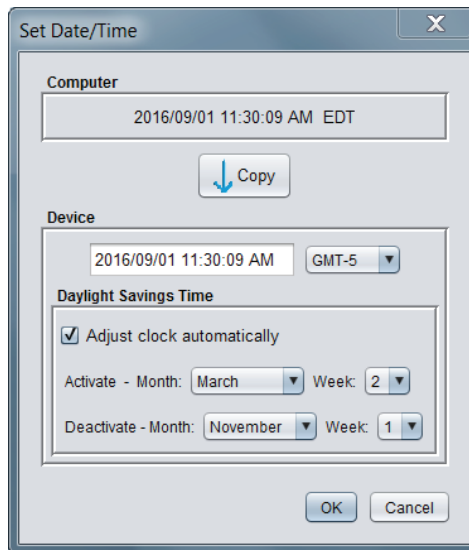


Figure 10 - Edit Time Dialog Box

5.1.4 - Icon Quick Jumps

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

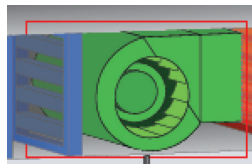


Figure 11 - Icon Quick Jump Example

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



OBJECT	QUICK JUMP
Outside Air Damper	Hardware Configuration
Cooling Compressors	Summer Configuration
Fan	Hardware Configuration
Heating Coils	Winter Configuration
VFD	Hardware Configuration
Discharge Sensor	Limits Configuration
Lockout Mode Status	Limits Configuration
Zone Thermostat	Temperature Configuration
Occupancy Status	Weekly Schedule
Pressure / CO2 Reading	Pressure / CO2 Configuration

Please note that in Standard Access mode, only the Weekly Schedules and Temperature Configurations will be accessible. Please view the Proton Focus User Guide for more information about Access levels.

5.1.5 - Icon Manual Override

Certain components of the **Make Up Air 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:

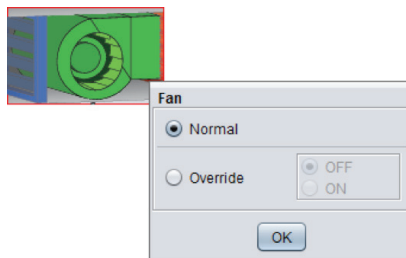


Figure 12 - Icon Manual Override

- **Normal:** Selecting the “Normal” button will revert the selected item to its normal behavior. 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.

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 13 - Override Example for the Fan

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

Outside Air Damper	Modulating Heat
Fan	VFD
Cooling Stages	Occupancy
Heat Authorization	Lockout Mode

Please note that if you are in Standard access mode, or if you are offline, you will not be able to override any objects. All overrides are cancelled when the **Make Up Air Controller** is reset or loses power.



5.1.6 - "Resume Normal" Button

This button allows the **Make Up Air Controller** to return to its fully automated behavior. All overrides previously applied to the device will be disabled. However, before any action is taken, a dialog box will appear to confirm your choice.

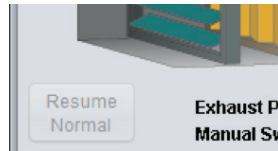


Figure 14 - "Resume Normal" Button

5.2 - Hardware Configuration

This screen is used to setup the sequences in the **Make Up Air Controller** that affect the nature of the inputs and outputs.

5.2.1 - Sequence

This section selects the air volume sequence used by the **Make Up Air Controller**. There are three choices.

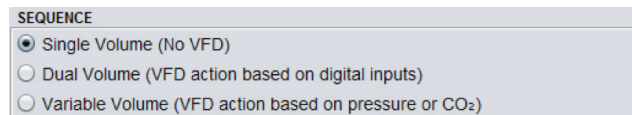


Figure 15 - Air Volume Sequence

Single Volume

This sequence is the most basic. The sequence begins when either Digital Input 1 (proof of exhaust fan) or the Manual Switch inputs detect a closed contact (only one is required). The outside air damper then opens. When proof of damper opening is obtained, the fan is activated. Finally, when proof of fan is obtained, heating or cooling actions are authorized. See the Winter and Summer configuration screens to see how heating or cooling calls are respectively generated. There is no fan speed control in the Single Volume sequence.

Dual Volume

This sequence differs from single volume simply by adding fan speed control. The fan speed is determined by the status of digital inputs 1 & 2, which are typically associated with two separate exhaust fan proofs. The VFD outputs 0V when neither input detect a closed contact. When a single contact is closed (regardless of which), the minimum voltage is applied ([see 5.2.5 – Variable Frequency Drive \(AO3\)](#)). When both contacts are closed, the maximum voltage is applied.

Variable Volume

This sequence differs from single volume by adding fan speed control based on either building pressure or CO₂. The VFD output will the scale between the minimum and maximum voltages defined in [5.2.5 – Variable Frequency Drive \(AO3\)](#) and will modulate based on the settings from the [5.6 – Pressure/CO₂ Configuration screens](#).



5.2.2 - Exhaust Fan / Occupancy (DO1)

This section defines the display options of Digital Inputs 1 & 2, as well as Digital Output 1, but it does not affect their functions.

EXHAUST FAN / OCCUPANCY (DO1)

With Exhaust Fan

Show DO1 demand

Figure 16 - Exhaust Fan / Occupancy (DO1)

When the “**With Exhaust Fan**” option is selected, the Digital Inputs will be displayed as Proof of Exhaust (where applicable). The demand of Digital Output 1 (Occupancy based) must be displayed in this mode since it usually represents the command for the exhaust fans.

If “**With Exhaust Fan**” is not selected, the Digital Inputs will simply be displayed as Digital Inputs, and you may choose whether or not it is relevant to show the demand of DO1, since you may not actually be using it for anything.

5.2.3 - Modulating Heat

This section simply defines the voltage output range for the Modulating Heat output (AO1), as well as if it should operate in Reverse Acting mode.

MODULATING HEAT (AO1)

Output Range: 0-10 VDC

Reverse Acting

Figure 17 - Modulating Heat (AO1)

The actual sequence governing the heating outputs is defined in the Winter Sequence configuration screen.



5.2.4 - Mechanical Cool

This section defines the mechanical cooling method, as well as the minimum ON and OFF times for staged cooling and output range for analog cooling. If there is no mechanical cooling for the **Make Up Air Controller**, it can be deactivated here.

MECHANICAL COOLING (AO2)

Mode: ANALOG

Range: 0-10 VDC Reverse Acting

Figure 18A - Analog Mechanical Cooling (AO2)

MECHANICAL COOLING (AO2)

Mode: STAGED

Number of stages: 2 Min ON: 2 min Min OFF: 5 min

Figure 18B - Staged Mechanical Cooling (AO2)

The actual sequence governing the mechanical cooling is defined in the Summer Sequence configuration page.

Important note: If the mechanical cooling is STAGED, a single analog output (AO2) is used to drive the cooling stages the voltage will be 0VDC when the stage is OFF, and 10 VDC when the stage is ON. If there are two cooling stages, the voltage will be 0VDC (both stages OFF), 5VDC (1 stage ON), or 10 VDC (both stages ON). In most cases, a DC relay will be required to convert the DC signal into 24VAC outputs. This relay is not provided by Proton and must be accounted for when designing a project.

5.2.5 - Variable Frequency Drive

This section defines the electrical parameters of the Variable Frequency Drive output (AO3). It is only visible in Dual Volume or Variable Volume air sequences.

VARIABLE FREQUENCY DRIVE (AO3)

Output Range: 0-10 VDC Minimum: 3.0 V

Invert Signal Maximum: 10.0 V

Figure 19 - Variable Frequency Drive (AO3)

In the **Dual Volume** sequence, the fan speed is determined by the status of digital inputs 1 & 2, which are typically associated with two separate exhaust fan proofs. The VFD outputs 0V when neither input detect a closed contact. When a single contact is closed (regardless of which), the minimum voltage is applied. When both contacts are closed, the maximum voltage is applied.

In the **Variable Volume** sequence, the VFD modulates according to the selected sequence defined in the [5.6 – Pressure/CO₂ Configuration page](#), while respecting the minimum and maximum voltages laid out here.



5.3 - Temperature Configuration

If an analog zone temperature sensor is connected to the **Make Up Air Controller**, a demand will be calculated for that 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. This page only applies when an analog sensor is connected. *If a T1100 Digital Thermostat is used as a follower device, this screen is then ignored, since these calculations will instead occur in the T1100.*

5.3.1 - PI Controller

In PI loop control, the demand is calculated by adding the proportional component of the demand to the integral component.

PI Controller	
Proportional: 5.4 °F	Cooling Integral: 15 min
Heating Integral: 15 min	Integral Dropoff Speed: 4 (Default) ▼

Figure 20 - PI Controller

These components are determined as follows:

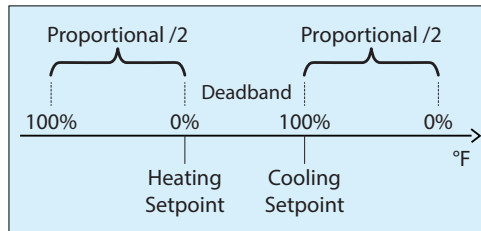


Figure 21 - PI Loop Proportional Band

- **Proportional:** Defines the proportional band used by the **Make Up Air 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.
- **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.
- **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.
- **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.



5.3.2 - Setpoints

This section defines how the active zone setpoints are calculated.

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 Override Time:	120 min		

Figure 22 - Zone Setpoints

- **Default Heating Setpoint:** When there is no external source of heating setpoint, such as a connected analog wall sensor, then this is the value that will be used as the heating setpoint. Otherwise it is ignored.
- **Min Deadband:** The deadband between the occupied heating setpoint and the occupied cooling setpoint. The cooling setpoint is determined simply by adding this deadband to the heating setpoint.
- **Setpoint Limits:** These limits are applied to the raw setpoints determined above (either from an analog wall sensor or just from the default heating setpoint) to effectively limit the range of setpoints available for this zone. This will result in the 'active' heating and cooling setpoints for occupied mode.
- **Unoccupied 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 (applies to analog wall sensor only).

5.4 - Winter Configuration

The Winter sequence is activated when the outside temperature is below a configurable setpoint. In this sequence, the heating authorization output is always activated, and modulating heat will maintain the calculated discharge air setpoint. Outside this sequence, heating authorization is off.



5.4.1 - Winter Sequence Enable

This is the setpoint below which the winter season is activated:

WINTER CONFIGURATION

WINTER SEQUENCE

Enable Winter Sequence when outside temp is below: 64.4 °F

Figure 23 - Winter Sequence Enable

The discharge air setpoint will then be calculated based on zone demand or outside air temperature.

5.4.2 - Discharge Air Based on Zone Demand

When this option is selected, the zone demand determines the discharge air setpoint based on the following reset scale:

Discharge Air Temperature Scale

Calculate Discharge Air Setpoint using: Zone Demand Outside Temp

Zone Demand	Discharge Air Setpoint
-100 %	Min: 55.4 °F
0 %	Default: 69.8 °F
100 %	Max: 69.8 °F

Figure 24 - Discharge Air based on Zone Demand (Winter mode)

The zone demand is either provided over the network by a T1100 digital thermostat, or locally calculated based on an attached zone temperature sensor. If neither are available, the discharge air temperature can instead be determined based on outside temperature.



5.4.3 - Discharge Air Based on Outside Temp

When this option is selected, the current outside temperature determines the discharge air setpoint based on the following configurable reset scale:

Discharge Air Temperature Scale	
Calculate Discharge Air Setpoint using:	
<input type="radio"/> Zone Demand	
<input checked="" type="radio"/> Outside Temp	
Outside Temp	Discharge Air Setpoint
64.4 °F	Default: 69.8 °F
53.6 °F	Max: 85.0 °F

Figure 25 - Discharge Air based on Outside Temp (Winter mode)

The outside air temperature is either provided over the network by a Network Controller, or locally from an attached temperature sensor.

5.4.4 - Discharge Air PI Loop

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

Proportional: 36.0 °F	Integral: 5 min
-----------------------	-----------------

Figure 26 - Discharge Air PI Loop

The Proportional component is represented as follows:

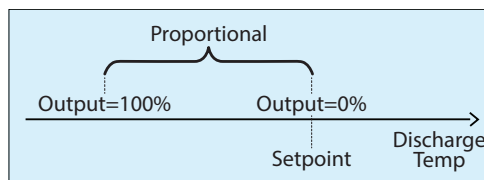


Figure 27 - Discharge Air Proportional Band

As the discharge air drifts below the setpoint, the Proportional component ramps up the heating output to compensate.

The **Integral** component is defined as the amount of time required to gradually increase the heating output by 100% due to a constant error of 1.8 °F. Its purpose is to correct small errors over time.

The **Proportional** component is then added to the **Integral** component to calculate the final heating output. When properly tuned, the PI loop will efficiently maintain the discharge air setpoint.



5.5 - Summer Configuration

The Summer sequence is activated when the outside temperature is above a configurable setpoint. Cooling is only authorized in this sequence. When in between the Winter and Summer sequences, only the outside air damper and fan are allowed to operate.

5.5.1 - Summer Sequence Enable

This is the setpoint above which the summer season is activated:

SUMMER SEQUENCE	
Enable Summer Sequence when outside temp is above:	73.4 °F

Figure 28 - Summer Sequence Enable

The cooling activity will then be determined by either the zone demand or the outside air temperature.

5.5.2 - Staged Cooling

5.5.2.1 - Cooling based on Zone Demand

When this option is selected, the zone demand determines when the cooling stages will activate by using the **Setpoint** and **Differential** band for each stage.

Cooling Based on Demand		
<input checked="" type="checkbox"/> Control mechanical cooling stages based on Zone Demand		
	Setpoint	Differential
Stage 1	30 %	40 %
Stage 2	75 %	40 %
Enable Stage 1 when outside temp is above: 73.4 °F		
Enable Stage 2 when outside temp is above: 77.0 °F		

Figure 29 - Cooling based on Zone Demand

Each stage of mechanical cooling has an activation and a 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 diagram:

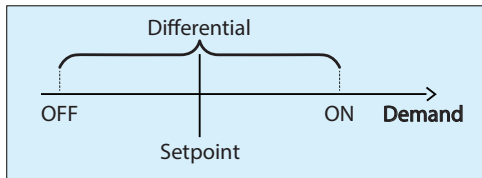


Figure 30 - Staged Cooling based on Demand

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 5.2.4 – Mechanical Cool](#)).

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.

Finally, the cooling stages can also be interlocked with the outside air temperature, even when they are driven by the demand.

The zone demand is either provided over the network by a T1100 digital thermostat, or locally calculated based on an attached zone temperature sensor. If neither are available, the cooling can instead be activated solely based on outside air temperature.

5.5.2.2 - Cooling Based on Outside Temp

When this option is selected, the current outside air temperature exclusively determines the activity of the cooling stages:

	Setpoint	Differential
Stage 1	30 %	40 %
Stage 2	75 %	40 %

Activate Stage 1 when outside temp is above: 73.4 °F

Activate Stage 2 when outside temp is above: 77.0 °F

Figure 31 - Cooling based on Outside Temp



5.5.3 - Analog Cooling

5.5.3.1 - Cooling based on Zone Demand

When this option is selected, the zone demand determines the discharge air setpoint based on the following reset scale:

The screenshot shows a configuration window titled "Discharge Air Temperature Scale". At the top, it says "Calculate Discharge Air Setpoint using:" with two radio buttons: "Zone Demand" (which is selected) and "Outside Temp". Below this, there are two columns of input fields. The left column is labeled "Zone Demand" and contains three input boxes with the values "-100 %", "0 %", and "100 %". The right column is labeled "Discharge Air Setpoint" and contains three input boxes with the values "Min: 55.4 °F", "Default: 64.4 °F", and "Max: 69.8 °F".

Figure 32 - Discharge Air based on Zone Demand (Summer mode)

The zone demand is either provided over the network by a T1100 digital thermostat, or locally calculated based on an attached zone temperature sensor. If neither are available, the discharge air temperature can instead be determined based on outside temperature.

5.5.3.2 - Cooling based on Outside Temp

When this option is selected, the current outside temperature determines the discharge air setpoint based on the following configurable reset scale:

The screenshot shows a configuration window titled "Discharge Air Temperature Scale". At the top, it says "Calculate Discharge Air Setpoint using:" with two radio buttons: "Zone Demand" and "Outside Temp" (which is selected). Below this, there are two columns of input fields. The left column is labeled "Outside Temp" and contains two input boxes with the values "82.4 °F" and "73.4 °F". The right column is labeled "Discharge Air Setpoint" and contains two input boxes with the values "Min: 55.4 °F" and "Default: 64.4 °F".

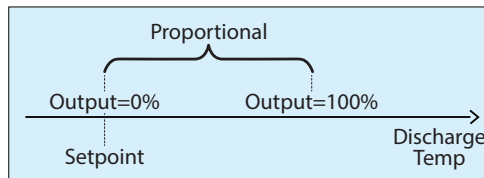
Figure 33 - Discharge Air based on Outside Temp (Summer mode)

The outside air temperature is either provided over the network by a Network Controller, or locally from an attached temperature sensor.



5.5.3.3 - Discharge Air PI Loop

Depending on the type of mechanical cooling chosen, additional settings are available to ensure proper operation. The Proportional component is represented as follows:



As the discharge air drifts above the setpoint, the Proportional component ramps up the cooling output to compensate.

The **Integral** component is defined as the amount of time required to gradually increase the cooling output by 100% due to a constant error of 1.8 °F. Its purpose is to correct small errors over time.

The **Proportional** component is then added to the **Integral** component to calculate the final cooling output. When properly tuned, the PI loop will efficiently maintain the discharge air setpoint.

5.6 - Pressure / CO₂ Configuration

This screen is used to setup the VFD activity, but only when the **Variable Volume** sequence is selected ([see 5.2.1 – Sequence](#)).

5.6.1 - Sequence Selection

The **Make Up Air Controller** can modulate the VFD based either on building pressure or on CO₂.



Figure 34 - Pressure / CO₂ Sequence Selection



5.6.2 - Pressure Control

When pressure control is selected, the **Make Up Air Controller** uses a PI loop to accurately maintain the building pressure setpoint.

Figure 35 shows the configuration for the Pressure control loop. The interface includes the following parameters:

- Setpoint: 0.0 in
- Proportional: 0.08 in
- Integral: 15 min
- Input Range (pressure): -0.1 / +0.1 in
- Input Range (voltage): 0-5 VDC

Figure 35 - Pressure Setup

The **Proportional** component is represented as follows:

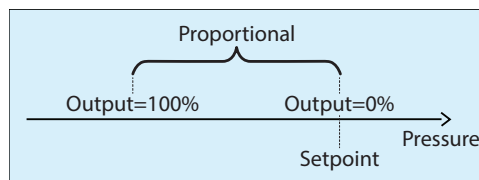


Figure 36 - Pressure Proportional Band

As the building pressure drifts below the setpoint, the **Proportional** component ramps up the VFD to compensate.

The **Integral** component is defined as the amount of time required to gradually increase the VFD output by 100% due to a constant error of 1 Pa (0.004 inches H₂O). Its purpose is to correct small errors over time.

The **Proportional** component is then added to the **Integral** component to calculate the final VFD output. When properly tuned, the PI loop will efficiently maintain the building pressure setpoint.

Finally, you can select the input settings that match your pressure transducer.

5.6.3 - CO₂ Control

When CO₂ control is selected, the **Make Up Air Controller** uses a simple Proportional loop to maintain the CO₂ setpoint.

Figure 37 shows the configuration for the CO₂ control loop. The interface includes the following parameters:

- Setpoint: 800 ppm
- Proportional: 200 ppm

Figure 37 - CO₂ Setup



The **Proportional** component is represented as follows:

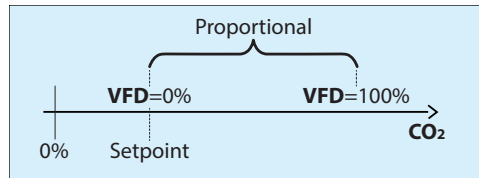


Figure 38 - CO₂ Proportional Band

As the CO₂ drifts above the setpoint, the **Proportional** component ramps up the VFD to compensate.

5.7 - Limits Configuration

This screen sets up various safety limits and defines the conditions that activate Lockout mode.

5.7.1 - Discharge Air Low Limit

For Make Up Air units, it is very important to monitor the discharge air temperature and to react when it gets too cold. This could signal that there is a problem with the heating equipment.

LIMITS CONFIGURATION	
DISCHARGE AIR LOW LIMIT	
-Close Fresh Air Damper when discharge air is below:	39.2 °F
-Open again when above:	53.6 °F
-Ignore this limit for the first:	15 min after startup

Figure 39 - Discharge Air Low Limit

The **Make Up Air Controller** has user configurable setpoints that will close the fresh air damper in case it gets too cold. When the fresh air damper closes, the fan must stop, as well as any heating or cooling actions taking place. The system will automatically start up again when the discharge temperature rises. Note that if this limit is tripped three times in succession, the unit will go into lockout mode ([see 5.7.3 – Lockout Mode](#)).

This limit can be ignored temporarily at startup to take into account the longer delay to get the heating up and running.



5.7.2 - Discharge Air High Limit

There is also a high discharge limit to protect against excessive heating.

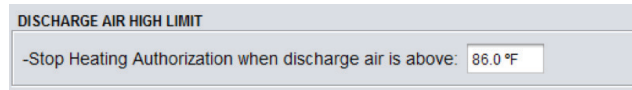


Figure 40 - Discharge Air High Limit

When this limit is tripped, the heating authorization and the modulating heating outputs are deactivated until the temperature returns to acceptable levels below the limit.

5.7.3 - Lockout Mode

Lockout mode is a safety feature that is used to protect the system by immediately:

- closing the fresh air damper
- stopping the fan
- deactivating heating authorization and modulating heating outputs
- deactivating all cooling stages

There are four reasons that can cause Lockout mode:

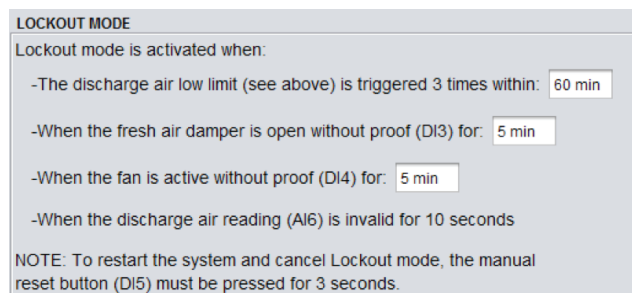


Figure 41 - Lockout Mode

When Lockout mode does occur, the specific reason can be determined in the Home screen of the **Make Up Air Controller** when using Proton Focus software ([see 5.1.2 – Displayed Information \(Outputs\)](#)).

Canceling Lockout mode and restarting the system requires a manual intervention on the part of the user. This is to underline that there is something wrong in the system and it requires investigation.

There are two ways to restart the system and cancel Lockout mode:

- The manual reset contact at Digital Input 5 must be closed for 3 seconds
- From the Home page, right-click the blinking Lockout message and press the “Cancel Lockout Mode” button that pops up

Please note that even during Lockout mode, Digital Output 1 continues to follow the occupancy status.



5.8 - Calibration Configuration

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.

The screenshot shows a software window titled "Configuration of Make Up Air Controller 'Air Make Up'". The window has a menu bar with "Config", "Network", and "Template" options, and a "Home" button. The main content area is titled "CALIBRATION" and is divided into two sections: "Temperature" and "Other".

Temperature

- Supply Temperature Calibration :
- Outside Temperature Calibration :
- Zone Temperature Calibration :

Other

- Pressure Offset :
- CO₂ Calibration :

At the bottom right of the window, there are three buttons: "Refresh", "Apply", and "Exit".

Figure 42 - Calibration Screen



5.9 - Device Properties

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.



Figure 43 - Device Properties Screen

- **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 Button:** 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 Button:** 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

6.1 - Device List

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

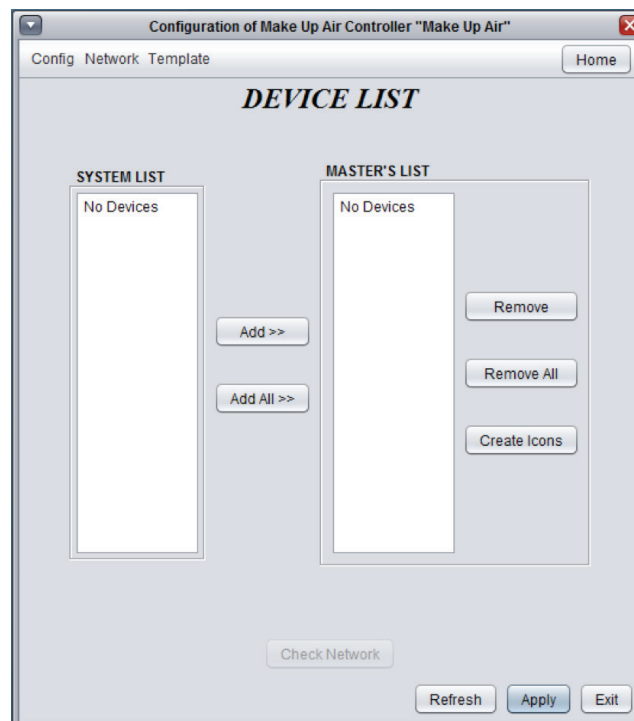


Figure 44 - Device List Screen

- **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, Proton 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.



6.2 - COM Port Settings

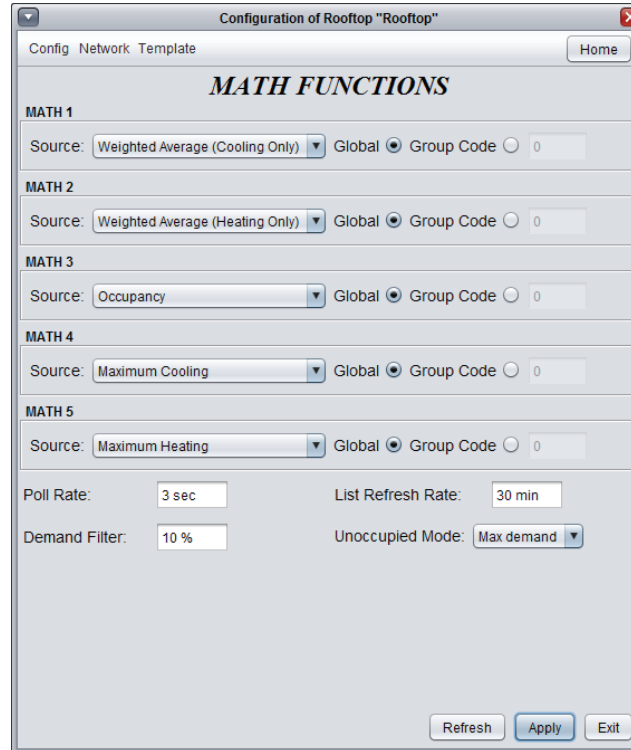


Figure 45 - COM Port Configuration Screen

Changes to the settings in this section will only take effect once the **Make Up Air Controller** is reset or has power cycled. Each port on the **Make Up Air 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 **Make Up Air Controller** is 57600bps but may be set to any of these standard values:
 - ▷ 9600 bps
 - ▷ 19200 bps
 - ▷ 38400 bps
 - ▷ 57600 bps
 - ▷ 76800 bps
 - ▷ 15200 bps
- **Parity:** This sets the parity for communication on the COM port. The default parity used by a **Make Up Air 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.



6.3 - Weekly Routines

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 46 - Weekly Routines Screen

- **Weekly Schedule Grid:** The Weekly Schedule Grid defines the weekly occupancy routine of the **Make Up Air 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 **Make Up Air Controller**, the schedule sent by the Network Scheduler will take precedence over the one set here.



6.4 - 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.

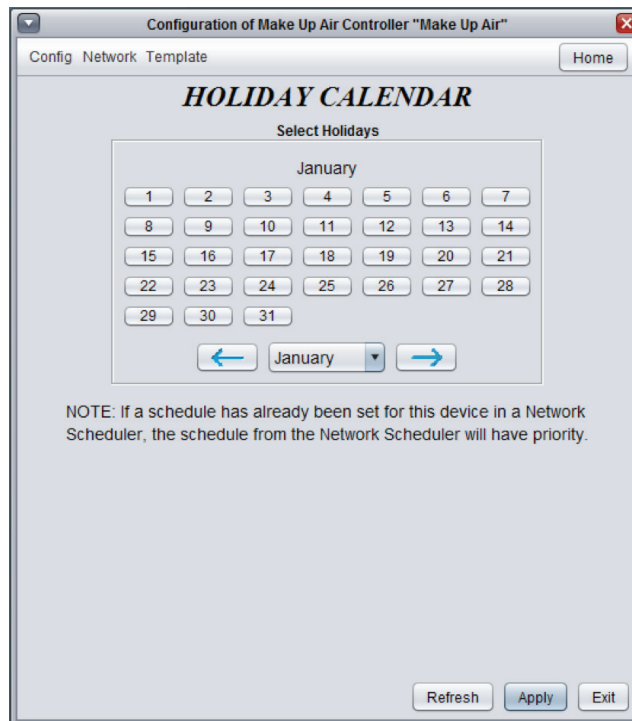


Figure 47 - Holiday Calendar Screen

- **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.



7 - Template Menu

7.1 - Save as Template

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

7.2 - Load Template

After saving a **Make Up Air Controller** configuration in a template, you can load this template into another **Make Up Air Controller** by selecting this menu item in the configuration screen of the **Make Up Air 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 **Make Up Air 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.

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