PR⬤LON

FOCUS GUIDE

CHILLER CONTROLLER

Configuration Guide for Prolon Focus Software

Table of Contents

Table of Contents

Table of Figures

1 - Prolon Chiller Controller

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

The Prolon *Chiller controller* **monitors dedicated inputs and uses pre-established control sequences that drive dedicated outputs to control standard chiller equipment. The main goal of this controller is to target chilled water temperature supply by cooling it down when necessary. Numerous configurable parameters and sequences allow for the fine tuning of the pumps, chiller stages, target supply temperature, water pressure and a whole range of safeguards. The various programming options allow the user to incorporate lead-lag sequences into the pumps and chiller stages, specify conditions for pump activity as well as apply schedules and limits.**

The Prolon series *Chiller Controller* **is in essence a collection of highly effective chiller 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 **Chiller Controller** is in essence a collection of highly effective chiller 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 **Chiller Controller** has been offered on the following hardware platforms. Please see each platform's HARDWARE GUIDE for more information:

M2000 → 99 Analog Inputs / 5 Digital Outputs / 3 Analog Outputs.
The M2000 controls up to four chiller stages and includes Water Pressure control.

C1000 → 3 Analog Inputs / 1 Binary Input / 4 Digital Outputs / 1 Analog Output.
The C1000 controls up to three chiller stages.

2 - Networking

Prolon's *Chiller Controllers* can operate completely independent, but can also be integrated into a network with other types of Prolon 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

When a **Chiller Controller** is networked with a Prolon Master Controller (such as a Rooftop controller), it will automatically be detected and start sharing information. Here is the list of current Prolon Master Controllers:

▷ Rooftop Controller (RTU)

▷ Heatpump Controller (HP)

▷ Make Up Air Controller (MUA)

▷ Hydronics Controller (HYD)

The Prolon Network Controller is a special case, as it acts as a link between all Master Controllers, so it will be treated in a class on its own.

The following table summarizes the information shared between **Chiller Controllers**, Prolon Master Controllers, and the Prolon Network Controller. This information is exchanged approximately every three seconds for Master Controllers, and every ten to thirty seconds for the Network Controller. If the information stops being received, it will be declared invalid after 720 seconds.

	Automatically received from Master	Can be received from NC (Configurable)	Can send to NC (Configurable)
Outside Temperature	X	X	X
Occupancy	X	X	
Results of Math Functions	X		

Figure 1 - Shared Information

Note that this table applies to the most recent firmware revision of Prolon controllers and may not accurately represent all older firmware revisions.

Description

- **Outside Air Temperature**: The outside air temperature will automatically be shared from the Master Controller to the **Chiller Controller**. A Network Controller can also be configured to share the outside temperature with a **Chiller Controller** should a Master Controller not be present. In the case where both are present, the last received outside temperature value will be used. The outside temperature can be used to reset the supply setpoint and activate/deactivate pump(s).

- **Occupancy**: The occupancy status will automatically be shared from the Master Controller to the Chiller Controllers. A Network Controller can also be configured to share the occupancy status with the **Chiller**

Controller should a Master Controller not be present. In the case where both are present, the occupancy status received from the Network Controller will take priority. The Occupancy status can be used to activate the pumps.

- **Results of Math Functions**: A Master Controller is continuously calculating the overall demand of the building using configurable mathematical operations, in a process called Flexi-Zone. The results of these functions can then be sent to the Chiller Controllers to calculate the chilled water supply setpoint.

3 - Adding a Chiller Controller to a Focus Project

Prolon Focus is a free visualization and configuration software for all Prolon controllers. Once the *Chiller 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 *Chiller 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 such as the chiller, 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 can protect against users mistakenly changing the addresses by playing with the wrong dipswitches, but it 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- Master Get List

If the *Chiller 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":
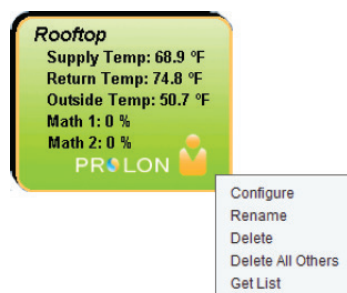
Figure 2 - Master Get List

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

3.2.2 - New Chiller Controller Button

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

Figure 3 - "New Chiller" Button

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

4 - Chiller Controller Icon

Each *Chiller Controller* added to your system has its own icon. Each icon displays data about the *Chiller Controller* device it represents, and this data is updated regularly. You can open the configuration screen for a *Chiller Controller* by double-clicking on its icon. If the *Chiller Controller* is offline, all data values will show "N/A" (Not Applicable).
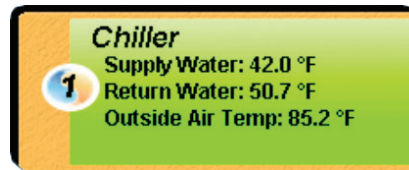
Figure 4 - Typical Chiller Controller Icon

4.1 - Icon Data

- **Title**: The name of the **Chiller Controller**. You can change it by right clicking the icon and choosing Rename. By default, it is set to "Chiller".

- **Address number**: This can be seen in the blue and orange circle (yin/yang) at the left side of the icon.

- **Supply Water**: The current water temperature supplied by the chiller. Will display "N/A" if there is no supply temperature sensor attached, or if the controller is offline.

- **Return Water**: The current water temperature returning to the chiller. Will display "N/A" if there is no sensor attached, or if the controller is offline.

- **Outside Temperature**: The current outside air temperature. Will display "N/A" if there is no outside temperature sensor attached AND the controller is not receiving this value over the network or if the controller is offline.

4.2 - Icon Colors

The icons also change color depending on the chiller state.

- **Grey**: The icon is grey when working offline or if the communication with that **Chiller Controller** is lost. All data will be seen as "N/A".

- **Green**: The icon is green when the controller is communicating, but all chiller stages are currently off.

- **Blue**: The icon is blue when at least one chiller stage is activated.
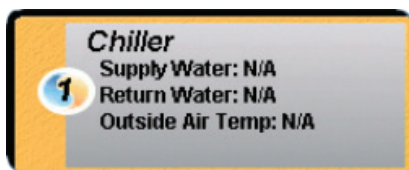
Figure 5 - Grey Icon
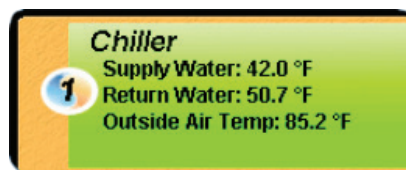
Figure 6 - Green Icon
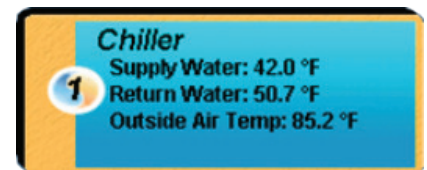
Figure 7 - Blue Icon

4.3 - Icon Right-Click
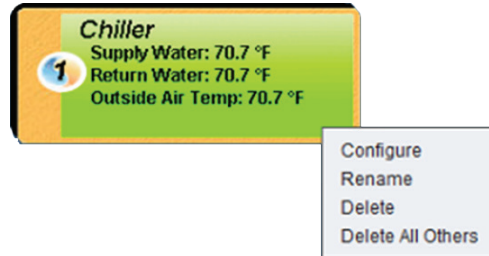
Figure 8 - Icon Right-Click for Chiller

- **Configure**: Opens the configuration screen for this *Chiller Controller*.

- **Rename**: Allows you to rename this *Chiller Controller.* Names are limited to 16 characters.

- **Delete**: Removes this *Chiller 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 Chiller Controller

To view the configuration of a *Chiller 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 *Chiller Controller* Home Screen to transfer you to its corresponding page. *(For more details, see Section 5.1.4 - Icon Quick Jumps)*

5.1 - Chiller Controller Home Screen
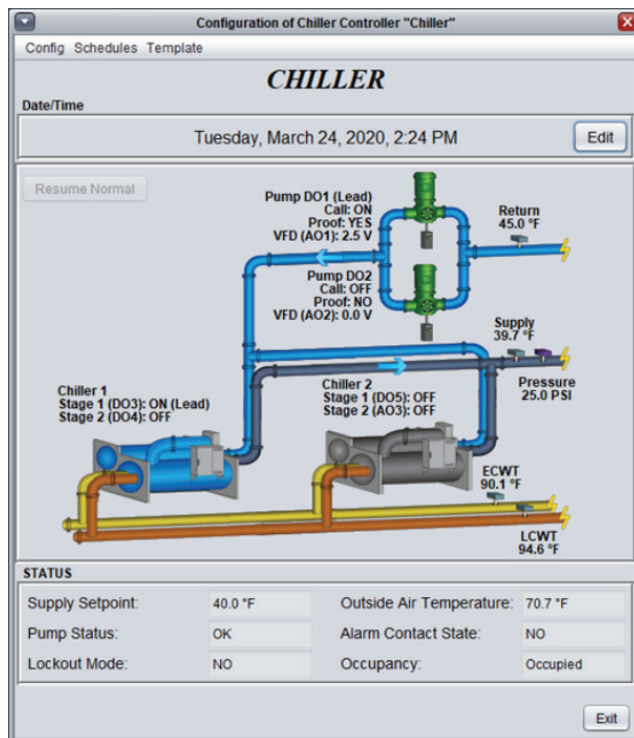
Figure 9A - Chiller Controller Home Screen - Water Cooled
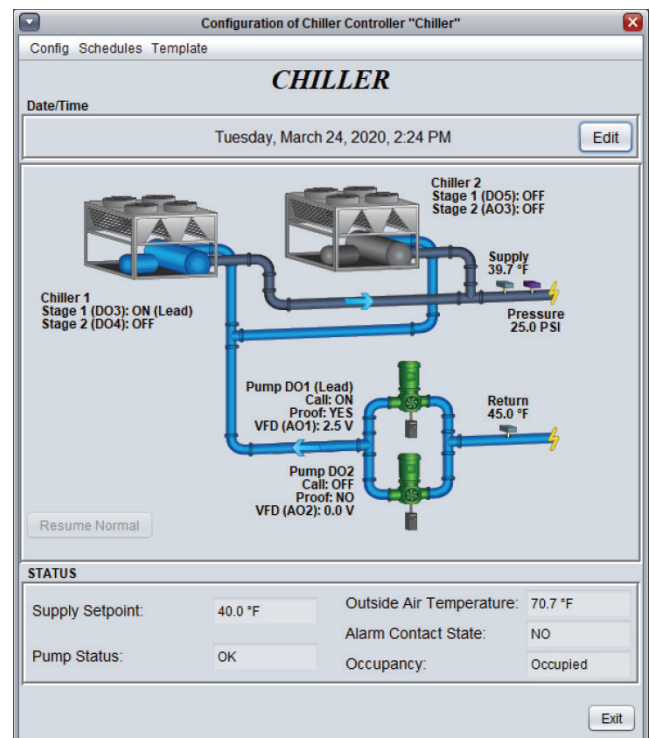
Figure 9B - Chiller Controller Home Screen - Air Cooled

This screen shows the status of all inputs and outputs of the **Chiller Controller**, as well as the active setpoint. All values will be "N/A" (Not Applicable) when 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 the real time clock included in the Prolon **Chiller Controller**. This can be edited with the Edit button. (Unavailable for the C1000 hardware platform). The time can be displayed in either 12h or 24h format by changing the setting in 'Time Format', under the User Profile (top right portion of the screen).

- **Return**: The current return water temperature. Will display "N/A" if no sensor is attached. Will not be visible if Return Water Sensor is not enabled *(see section 5.2 - Display Configuration)*.

- **Supply**: The current supply water temperature. Will be "N/A" if no sensor is attached. *NOTE*: A Supply Sensor is required for the chiller sequence to run.

- **Pressure**: The current water pressure reading. Will not be visible if the Water Pressure Control Sequence is disabled *(see section 5.6 - Pressure Configuration)*.

- **ECWT**: The current Entering Condenser Water Temperature reading. Will display "N/A" if no sensor is attached. Will not be visible if ECWT Sensor is not enabled. Available only for water cooled chiller configuration. *(see section 5.2 - Display Configuration)*.

- **LCWT**: The current Leaving Condenser Water Temperature reading. Will display "N/A" if no sensor is attached. Will not be visible on the C1000 Hardware platform or if LCWT Sensor is not enabled. Available only for water cooled chiller configuration. *(see section 5.2 - Display Configuration)*.

- **Supply Setpoint**: Displays the current target supply temperature. This setpoint is determined in the Setpoint Configuration screen *(see section 5.5 - Setpoint Configuration)*.

- **Outside Air Temperature**: 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. Will not be visible if Outside Air Reading is not enabled *(see section 5.2 - Display Configuration)*.

- **Pump Status**: Display the current status of the Pump Backup Sequence (only visible when Backup Pump Sequence enabled).
  - ▷ **OK**: Displayed when the Lead Pump is operating and has proof. Also displayed if both pumps are purposefully inactive.

  - ▷ **LEAD FAIL**: Indicates that the Lead Pump was activated but failed to prove after a configurable delay. In this state, the Lead Pump shuts off and the Backup Pump is running.
  - ▷ **BOTH FAIL**: Indicates that the Backup Pump has also failed to prove after operating for the configured delay. The Backup will continue to operate in this state, while the Lead Pump can be configured to either run simultaneously in an attempt to achieve some kind of minimum flow, or simply remain off.

- **Alarm Contact State**: Indicates the state of the Alarm Contact Input (Analog Input 9) on the M2000. (Not visible on the C1000 Hardware platform).

- **Lockout Mode**: Indicates if the **Chiller Controller** has entered Lockout Mode. Lockout Mode is activated upon the detection of multiple sequential faults *(see section 5.4.4 - Limits)* for more details on Lockout Mode).

- **Occupancy**: The occupancy status of the Chiller Controller. The occupancy state can be determined by a number of factors. They are listed here in order of priority:
  - ▷ The occupancy status received from a Prolon Network Controller takes first priority.
  - ▷ The occupancy status received from a Prolon Master Controller, such as a Rooftop or Heatpump is then used.
  - ▷ Finally, the occupancy status determined by the real time clock onboard the **Chiller Controller,** combined with a programmed schedule will be used (only available on M2000). For the C1000 hardware platform, which does not have an onboard real time clock, it will simply default to occupied mode unless indicated otherwise from the network.

5.1.2 - Displayed Information *(Outputs)*

Pumps

Pump activity is represented by green pump icons displayed on the Home Screen. Based on the chosen configuration *(see section 5.3 - Pump Configuration)*, a single pump, a pair of pumps or no pumps will be displayed. Each pump icon will display the call for pump from the controller, as well as the proof of pump operation. When call and proof are both confirmed, the pump icon will animate: Pump blades will rotate and arrows will appear indicating water flow direction. For dual pump configurations, the identity of the lead pump and the lag pump will be displayed.

The identification of the output responsible for each pump will also be displayed (i.e. DO1/DO2). This is to help simplify physical setup and troubleshooting.

Finally, if you hover the mouse over any pump icon while online, the Focus software will display the total run time of the associated pump. Also, if the pump is currently ON, it will display how long the pump has been running. These values are stored in the controller and can be cleared in the Device Properties configuration page *(see section 5.9 - Device Configuration)*.

Figure 10 - Pump Display

Note: The C1000 hardware platform only has one input dedicated to the proof of pump, so for dual pumps set in a Backup Pump configuration, the lone proof input will be displayed adjacent to both pumps.

Chiller

Chiller activity is represented by chiller icons displayed on the Home Screen. A variety of chiller setups options are possible *(see section 5.4 - Chiller Configuration)*, with up to two individual chiller icons displayed at a time. Depending on the setup, a single chiller icon can also have multiple stages. Each individual chiller icon will display the call for chiller stages from the controller, and the active chiller icons will turn blue.

For configurations with multiple chillers using lead-lag control the identity of the lead chiller stage will be also displayed.

The identification of the output responsible for each chiller will also be displayed (i.e. DO3, DO4, etc.); this is to help simplify physical setup and troubleshooting.

Finally, if you hover the mouse over any chiller icon while online, the Focus software will display the total run time of the associated chiller. Also, if the chiller is currently ON and it is the lead stage, it will display how long the chiller has been running. These values are stored in the controller and can be cleared in the Device Properties configuration page *(see section 5.9 - Device Configuration)*.
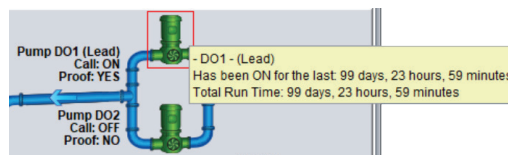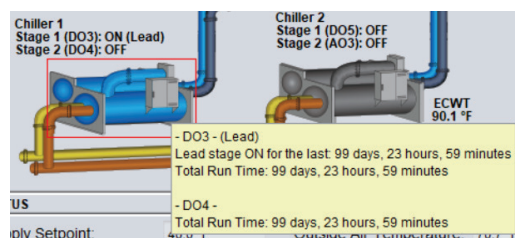

Figure 11 - Chiller Display

VFD

For M2000 Chiller setups controlling the water pressure, the VFD status will be displayed adjacent to the pump icon it is associated with. The VFD output voltage is shown, along with an identifier of the physical output being used (i.e. AO1 or AO2). The VFD voltage typically increases increases or decreases to maintain a constant pressure setpoint.
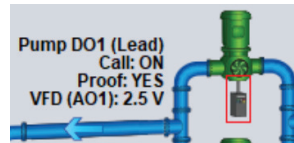
Figure 12 - VFD Display

5.1.3 - Date/Time

The Prolon *Chiller Controller* has an internal real time clock (unavailable on the C1000 hardware platform). The current date and time are displayed at the top of the Home Screen. To edit the time, click on the "Edit" button.
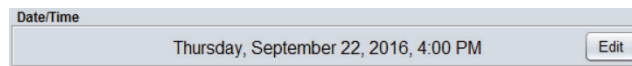
Figure 13 - Edit Time Button

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 *Chiller 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 saving 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 Jumps

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

Figure 15 - Icon Quick Jump Example (Pump)

The following is a list of the featured items and their corresponding destination:

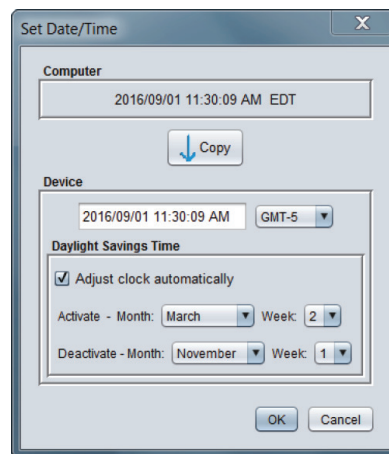| ITEMS	QUICK JUMP
Chillers	Chiller Configuration
Pumps	Pumps Configuration
VFD	Pressure Configuration
Supply Setpoint	Setpoint Configuration
Lockout Mode	Chiller Configuration
Outside Air Sensor	Calibration Configuration
Return Water Sensor	Calibration Configuration
Supply Water Sensor	Calibration Configuration
Occupancy	Weekly Routines (M2000 only)
ECWT Sensor	Chiller Configuration
LCWT Sensor	Chiller Configuration (M2000 only)
Pressure Sensor	Pressure Configuration

Please note that if the advanced password is enabled, you will not be able to double-click on any objects.

5.1.5 - Icon Manual Override

Certain components of the **Chiller Controller** can be overridden. To use this feature, right-click on the item of the component you wish to override. A pop-up menu will appear if this feature is available. Note: Overrides are unavailable in Offline mode.
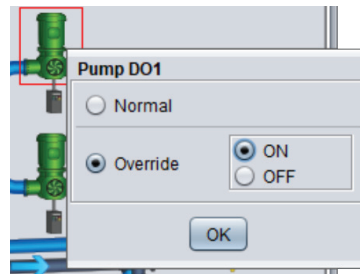

Figure 16 - Manual Override of the Pump

• **Override**: Selecting the "Override" button will allow the user to manually override the selected object until the normal mode is resumed. The following is a list of all items that can be overridden:

Chillers
Pumps
VFD
Occupancy

When an override is applied to an object, a yellow highlight appears around its icon and any associated text starts to flash. For example, in the figure below, the chiller has been overridden.
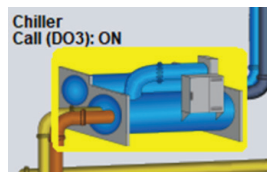
Figure 17 - Override Example, Chiller

Please note that if the advanced password is enabled, or if you are offline, you will not be able to override any objects (please review the Prolon Focus User Guide for more information about passwords).

All overrides are cancelled when the **Chiller Controller** is reset or loses power.

• **Normal**: Selecting the "Normal" button will revert the selected item back to its normal automatic behavior. Any override applied to this object will be disabled.

5.1.6 - "Resume Normal" Button

This button allows the **Chiller Controller** to return to its fully automated behavior. All overrides previously applied to the **Chiller Controller** will be disabled. However, before any action is taken, a dialog box will appear to confirm your choice.
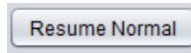
Figure 18 - "Resume Normal" Button

5.2 - Display Configuration

This section is simply used to customize the graphics and icons of the Home page but has no effect on the sequences running in the controller.

Figure 19 - Display Configuration

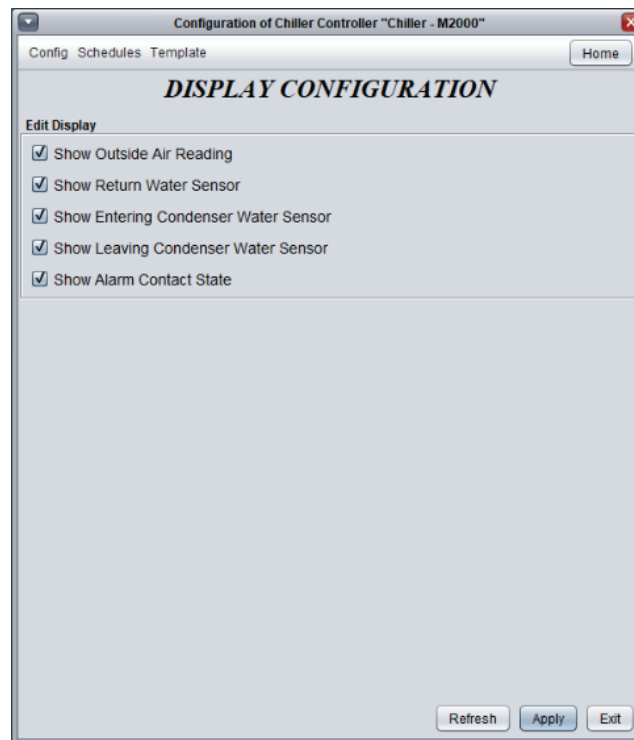For the C1000 Hardware platform, the options for the 'Leaving Condenser Water Sensor' and 'Alarm Contact' are not available since that hardware platform does not have inputs for those values.

5.3 - Pump Configuration

This screen is used to select and configure the pump sequence. The Pump Sequence is the first setting on this screen and will influence the remaining sections.
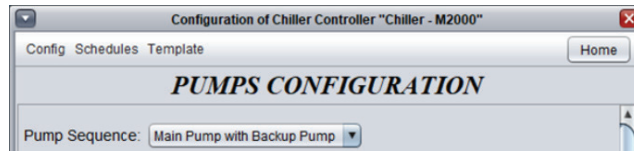

Figure 20 - Pumps Configuration Screen

There are three Pump Sequences available:

- **None**: The sequence deactivates the pumps, hides them from the Home page graphics, and enables the chiller stages to run without requiring pump action or proof. Use this if your pumps are being handled externally from the Prolon *Chiller Controller*.

- **Single Pump**: The single pump sequence simply activates a pump based on the Activation conditions below. Its purpose is to circulate water through the chillers, but not necessarily through the building itself (which can be done by another pump or loop). In this sequence, proof of operation of the pump is required before any chiller stages can activate. Figure 20 - Pumps Configuration Screen

- **Main Pump with Backup Pump**: The purpose of this sequence is to activate a backup pump when the main pump does not have proof of operation for a configurable amount of time. The main pump activates based on the Activation conditions below. These pumps should be installed in parallel, and their purpose is to circulate water through the chillers, but not necessarily through the building itself (which can be done by another pump or loop). In this sequence, proof of operation of either pump is required before any chiller stages can activate.

  If desired, these two pumps can operate in a lead-lag sequence, evenly distributing the workload between both pumps (see below).

5.3.1 - Activation Sequence

This section defines the conditions that will activate the pumps. Pump activation is required before a chiller stage can activate.
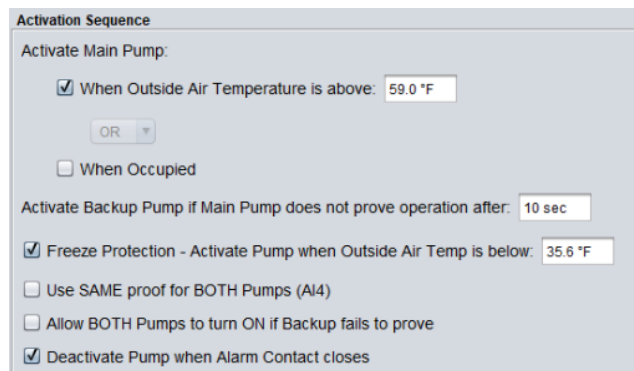

Figure 21 - Pump Activation Setup

Pump activity can be enabled based on the outside air temperature, on occupancy, or on a combination of these two conditions. **Note**: If the outside temperature reading becomes invalid, then that condition is automatically assumed to be met.

- **Activate Backup Pump if**: This defines the amount of time that the Main Pump will attempt to run without proof before the Backup Pump will be activated. The Main Pump will deactivate when this transition occurs.

- **Freeze Protection**: This function is used to force the pump to activate even when it is not required to do so according to the pre-established activation sequence. The goal is to keep the water circulating to prevent freezing in the pipes.

- **Use SAME proof for BOTH Pumps**: Select this option if both lead pump and backup pump use a common proof (1 proof for both pumps). You only need to connect the sensor to Analog Input 4, and the controller will relate any proving signal to whichever pump is currently active. (This setting is automatically used on the C1000 Hardware platform since there is only a single input for proof of pump.)

- **Allow BOTH Pumps to turn ON if Backup fails to prove**: When the Backup Pump attempts to run but does not obtain proof within the delay, the pumps enter the 'BOTH FAIL' status. In this status, the Backup Pump continues to run, but the Main Pump's activity will depend on this setting. When selected, the Main Pump will also activate under the 'BOTH FAIL' status in an attempt to provide flow to the system.

- **Deactivate Pump when Alarm Contact closes**: On the M2000 Hardware platform, there is an input dedicated to an Alarm Status contact. When this setting is selected, closing the contact on that Alarm input will deactivate and prevent the pumps from running. (This option is not available on the C1000 Hardware platform). Otherwise, this contact will be used for display purposes only.

5.3.2 - Pump Lead-Lag

The pump lead-lag sequence is only available when the backup pump sequence is selected. The purpose of a lead-lag sequence is to spread the workload evenly between the two available pumps.

One pump is initially designated as the "lead pump"; it will be the first to activate on a call for pump. The lag pump is the backup pump and will activate if no proof of the lead pump is obtained. As the lead-lag sequence progresses, the role of "lead pump" will be exchanged between the pumps, allowing for a more even distribution of work and wear to the pumps.

This section defines the conditions that will rotate which pump is the lead pump. Pump activation and pump proof are required before the chiller stage can activate.
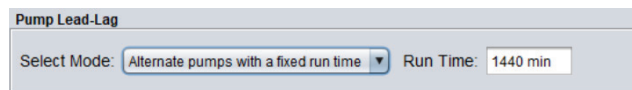

Figure 22 - Pump Lead-Lag Setup

There are four available lead-lag sequences:

- **Alternate pumps after each call**: The role of "lead pump" alternates every time the pumps stop operating. The pumps do not exchange roles while a pump is still operating.

- **Alternate pumps with a fixed run time**: The role of "lead pump" alternates automatically based on a configurable interval of uninterrupted time spent in the ON state. When the interval expires, the lead pump will stop and the lag pump will immediately take over, becoming the new lead pump. This sequence is best when the pumps operate for long stretches of time without stopping, for example, when it is based exclusively on outside air temperature.

- **Equal run time**: Every time the pumps stop operating, the role of "lead pump" is re-evaluated, based on the total run time of each pump. The pump with the lowest run time becomes the lead pump. The pumps do not exchange roles while a pump is operating.

- **No lead-lag**: The role of "lead pump" does not alternate under any circumstance, hence one pump (DO1) will always be designated the "lead pump", and the other pump (DO2) will always be designated the "backup pump".

5.3.3 - Pump Setup

This section defines different operational run times and delays for the pump operation.

Figure 23 - Pump Setup

- **Min ON Time**: Once a pump is activated, this is the minimum amount of time it must remain ON, even if the pump is no longer needed to operate. This is used to prevent short-cycling the pump.

- **Min OFF Time**: Once a pump is deactivated, this is the minimum amount of time it must remain OFF, even if the pump is suddenly required again. This is used to prevent short-cycling the pump.

- **Pump Run Time after Chiller Shutdown**: This delay is used to keep the pumps running after the last remaining chiller stage is turned off. The goal is to purge the cold water out of the chiller and into the system or allow for a chiller pump down cycle.

- **Exercise Pumps**: This function is used to turn on the pump periodically to prevent pump seizure during winter periods due to extended idle periods.

5.4 - Chiller Configuration

This screen is used to configure the chiller sequence of the Prolon **Chiller Controller**. There are two types of chiller sequences available: Water Cooled and Air Cooled.

Figure 24 - Chiller Sequence Configuration

Both sequences are largely identical, except the Water Cooled sequence has additional temperature safeguards to de-activate the chiller based on ECWT or LCWT *(see section 5.4.4 - Limits)*. Each sequence has its own distinct background image on the Home page. In both sequences, proof of operation of a pump (unless pump configuration is set to "none"), as well as a valid supply water temperature reading is required before any chiller stages can activate.

Figure 25 - Chiller Stage Configuration

The Prolon M2000 Chiller Controller can support up to four chiller stages, and the C1000 can support up to three. For visualization purposes, the Home page can display this as:

- A single chiller with up to four stages
- Two individual chillers with up to two stages each

Each chiller stage will respect the minimum ON and OFF times, as well as the interstage delay

- **Min ON Time**: Once a chiller stage is activated, this is the minimum amount of time it must remain ON, even if the chiller is no longer needed to operate. This is used to prevent short-cycling. Note: if proof of pump is lost, all chiller stages will deactivate immediately, regardless of minimum on time.

- **Min OFF Time**: Once a chiller stage is deactivated, this is the minimum amount of time it must remain OFF, even if the chiller stage is suddenly required again. This is used to prevent short-cycling.

- **Interstage Activation Delay**: Once a chiller stage is activated, this is the minimum amount of time that must expire before an additional stage can be turned on.

- **Interstage Deactivation Delay**: Once a chiller stage is deactivated, this is the minimum amount of time that must expire before the next chiller stage can be turned off. Note: if proof of pump is lost, all chiller stages will deactivate immediately, regardless of interstage deactivation delay.

5.4.1 - Activation Sequence

Chiller stages are enabled based on a call for cooling. A call for cooling occurs when the supply temperature rises above the activation point. Alternatively, if the supply temperature drops below a deactivation point, the call for cooling is cancelled. These activation and deactivation points are determined by a differential band, centered on the current water supply setpoint:
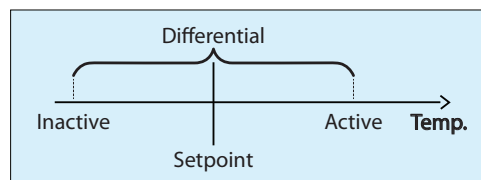

Figure 26 - Staged Chiller Operation Based on Supply Differential

See Section 5.5 - Setpoint Configuration for the configuration of the Supply Setpoint and Differential bands.

Once a call for cooling has been established and proof of pump is obtained, the first chiller stage will be activated. If the supply temperature remains above the activation point, subsequent chiller stages (if applicable) will turn on once the interstage activation delay is satisfied for each stage.

If the supply temperature then drops below the deactivation point, the highest chiller stage deactivates (provided the minimum ON time has expired). If the supply temperature continues to remain below the deactivation point, subsequent chiller stages will turn off once the interstage deactivation delay is satisfied for each stage.

Should the water supply temperature remain in the zone between the activation and deactivation points, no additional chiller stages will be activated or deactivated (equilibrium).

5.4.2 - Chiller Lead-Lag

The purpose of a lead-lag sequence is to spread the workload more evenly between the available chiller stages.

One stage is initially designated as the "lead stage": it will be the first to activate on a call for cooling. As the lead-lag sequence progresses, the role of "lead stage" will be exchanged, allowing for a more even distribution of work and wear to the chillers.
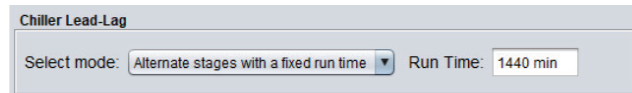

Figure 27 - Chiller Lead-Lag Configuration

There are four available lead-lag sequences:

- **Alternate stages after each call**: The role of "lead stage" alternates every time the chillers stop operating. The chillers do not exchange roles while a stage is still operating.

- **Alternate stages with a fixed run time**: The role of "lead stage" alternates automatically based on a configurable interval of total time spent in the ON state. This may imply that stages will suddenly turn on or off to satisfy the conditions of their new roles.

- **Equal Run Time**: Every time the chillers stop operating, the role of "lead stage" is re-evaluated, based on the total run time of each stage. The stage with the lowest run time becomes the lead stage. The chillers do not exchange roles while a stage is still operating.

- **No lead-lag**: The role of "lead stage" does not alternate under any circumstance.

IMPORTANT: Regardless of the chosen lead lag-sequence or chiller setup, chiller stages always operate in a FILO (First In, Last Out) sequence. The lead stage is always the first one to turn on in response to a call for cooling, and the last on to turn off once the call for cooling is satisfied.

5.4.3 - Freeze Protection

As explained in *Section 5.3.1 - Pump Activation Sequence*, the Prolon Chiller Controller has a Freeze Protection Sequence built into the Pump configuration. That sequence is used to activate the pumps under cold weather to ensure the pipes don't freeze. The chiller configuration page allows for additional customization to this sequence:

Figure 28 - Chiller Freeze Protection

This setting prevents the chiller stages from activating whenever the pumps are ON due to Freeze Protection conditions.

5.4.4 - Limits

The Limit section is used to establish temperature safeguards that can either stage down any active chiller stages or shut them all down immediately.

Figure 29 - Limits Configuration

Note: This section is not available for the Air Cooled chiller sequence since the limits are entirely based off temperature readings that are only applicable to the Water Cooled sequence (ECWT and LCWT). Also, the C1000 Hardware platform does not have any inputs for the LCWT, so those limits are also absent on the C1000.

Lockout Mode
Lockout Mode can be activated when any of the Immediate Shut Down Limits above are triggered three times within the configurable delay. (This does not include the Chiller Stage-Down Limit based on LCWT). When Lockout Mode is activated, the chillers remain disabled until a user intervention occurs. The user can reset the Lockout mode using one of the following methods:

- Cycle power or Reset the Prolon *Chiller Controller*
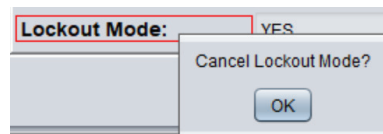- Cancel Lockout Mode from the Home Screen by right clicking on the blinking Lockout text

Figure 30 - Limits Configuration

Please note that Lockout Mode does not affect the pumps in any way.

5.5 - Setpoint Configuration

In the Prolon **Chiller Controller**, the chilled water supply setpoint can be determined in two different ways: Fixed Setpoint, or based on a Reset Scale:

Figure 31 - Supply Setpoint Based on Reset Scale

The Reset Scale can be based on the return water temperature, the outside air temperature, or a network supplied Math value.

5.5.1 - Return Temperature

When the reset scale is based on the return water temperature, the supply setpoint decreases as the return temperature increases.
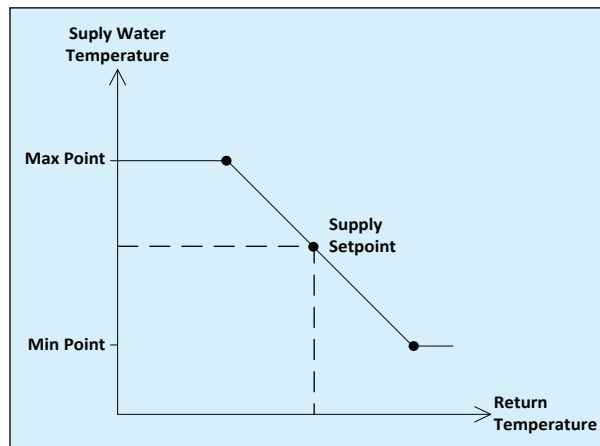

Figure 32 - Return Temperature Reset Scale

If the return temperature becomes invalid, the minimum supply setpoint is used.

5.5.2 - Outside Temperature

When the reset scale is based on the outside air temperature, the supply setpoint decreases as the outside temperature increases.
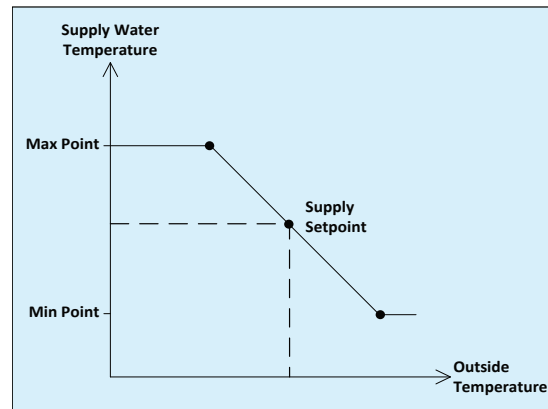

Figure 33 - Outside Temperature Reset Scale

If the outside temperature becomes invalid, the minimum supply setpoint is used.

5.5.3 - Math Values

The Math Values are supplied by a Network Master and usually represent an average cooling or heating demand coming from the zone controllers in the building. A Math Value ranges from -100% to +100%, where a negative number represents a call for cooling and a positive number, a call for heating. A decreasing Math Value represents a stronger call for cooling, so the supply setpoint decreases as well.
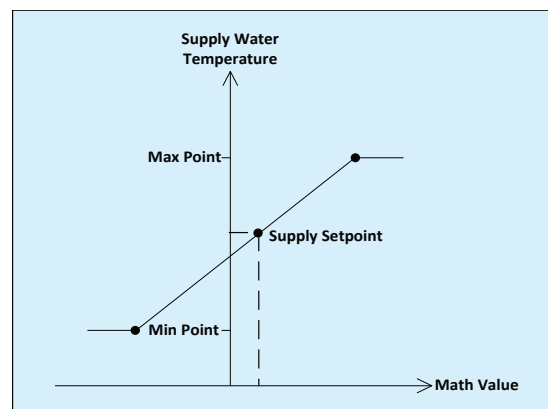

Figure 34 - Math Values Scale

If there are no Math Values being provided by the network, the minimum supply setpoint is used. Note that Math Values can be configured for a wide range of functions and may not simply represent the average cooling demand of the zone controllers. Please refer to the Focus Guide of a Network Master for more details.

5.6 - Pressure Configuration

The Pressure Configuration page is for setup of the outputs used to control Variable Frequency Drives (VFD) used to maintain water pressure in the system. Please note that the C1000 Hardware Platform does not support the Water Pressure Control sequence. There is one VFD output for each Pump output and they are associated as follows:

- VFD 1 speed command (Analog Output 1) is associated with Pump 1 run command (Digital Output 1)
- VFD 2 speed command (Analog Output 2) is associated with Pump 2 run command (Digital Output 2)

Each VFD output will only be active when its respective pump output is active. The output value is calculated based on the input reading and control loop settings below.

Figure 35 - Pressure Configuration Screen

5.6.1 - Sensor Type

The Prolon **Chiller Controller** is compatible with many water pressure transmitters. The ouput signal can be among any of the following standard ranges:

- 0-5 VDC
- 1-5 VDC
- 0.5-4.5 VDC
- 0-20mA
- 4-20mA

The transmitter pressure range is entirely configurable from anywhere between -500 to +500 PSI.

5.6.2 - Control Loop

This section is where the fixed pressure setpoint is defined, as well as the PI Loop parameters used to tune the pressure control sequence.

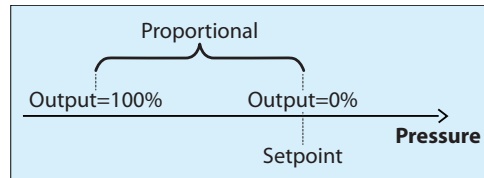The Proportional component of the PI Loop is defined as follows:

Figure 36 - VFD Proportional Band

As the water pressure drifts below the setpoint, the Proportional component ramps up to compensate.

The Integral component is defined as the amount of time required to increase the VFD's output by 100% due to a constant error of 1 PSI. Its purpose is to correct small errors over time.

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

5.6.3 - Output Signal

The VFD Output signal is highly customizable, and can produce voltages in these standard ranges:

- 0-10 VDC
- 2-10 VDC
- 0-5 VDC

On top of these ranges, a minimum and maximum voltage can be specified. The signal can also be configured for Reverse Acting.

5.7 - Calibration Configuration

This page is used to offset the various input readings provided to the controller by the attached sensors.

Figure 37 - Calibration Configuration

Note that for the C1000 Hardware platform, the outside temperature, LCWT and pressure calibration values are missing since the C1000 platform does not have inputs available for those sensors.
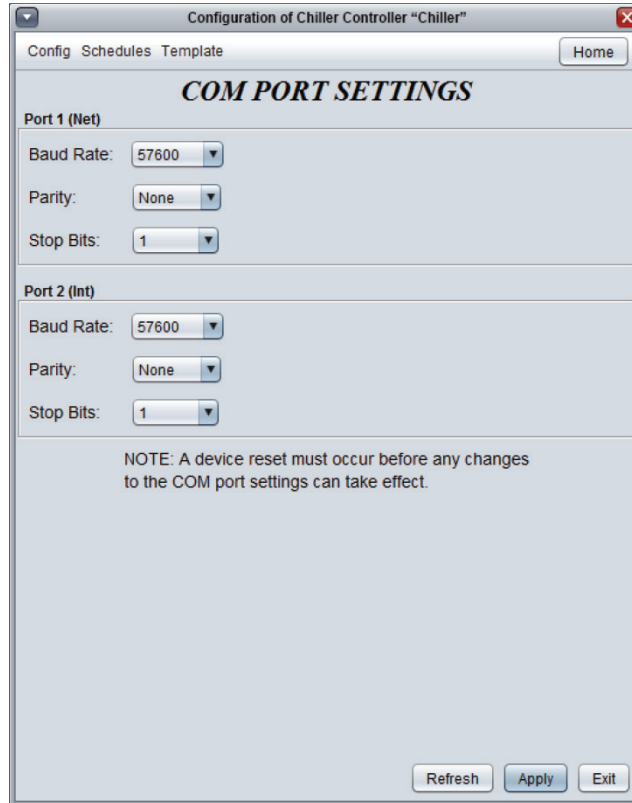
5.8 - COM Port Settings

Figure 38 - COM Port Configuration Screen

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

Note: It is strongly recommended that you do not change any of these settings away from their defaults unless you have specific knowledge of how these settings work or have been directed to by Prolon Technical Support. Changing these settings can cause loss of communication with this controller and may disrupt communication on the network if not done properly.

- **Baud Rate**: This sets the baud rate value for the COM port. The default baud rate used by the **Chiller Controller** is 57600bps but may be set to any of these standard values:
  ▷ 9600
  ▷ 19200
  ▷ 38400
  ▷ 57600
  ▷ 76800
  ▷ 115200

- **Parity**: This sets the parity for communication on the COM port. The default parity used by the **Chiller Controller** is "None" but may be set to any of these standard values:
  ▷ Aucune
  ▷ Impaire
  ▷ Paire

- **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.

5.9 - Device Properties

Figure 39 - 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 nature 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 configured 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 right-click on the icon and select the rename option.

- **Reset Device**: Causes the device to reset as if it had been powered off and back on. 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 anyway.

- **Clear Timers**: This function is used to clear and restart the various run time counters for the pumps and chiller stages. Any single timer can be cleared without affecting the others.
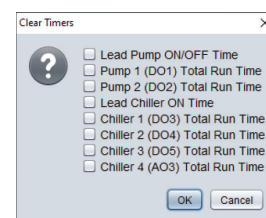

Figure 40 - Clear Timers Pop Up

5.10 - Weekly Schedule

This screen is used to configure weekly occupancy schedules (M2000 hardware platform only).

Figure 41 - Weekly Routines Screen

- **Weekly Schedule Grid**: The Weekly Schedule Grid defines the weekly occupancy routine of the controller. Double-click a cell on the grid to edit it.

  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).

  The time can be displayed in either 12h or 24h format by changing the setting in the 'Options' menu, under 'Units', then 'Time Format'.

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

- **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.

5.11 - Holiday Calendar

This screen is used to define which dates are holidays so that the normal daily schedule can be replaced by an alternate holiday schedule. The calendar has no pre-defined holidays marked, allowing for complete customization of the holiday calendar upon initial configuration. The holiday calendar does not recognize floating holidays (Labor Day, Memorial Day, etc.) and thus must be adjusted annually.
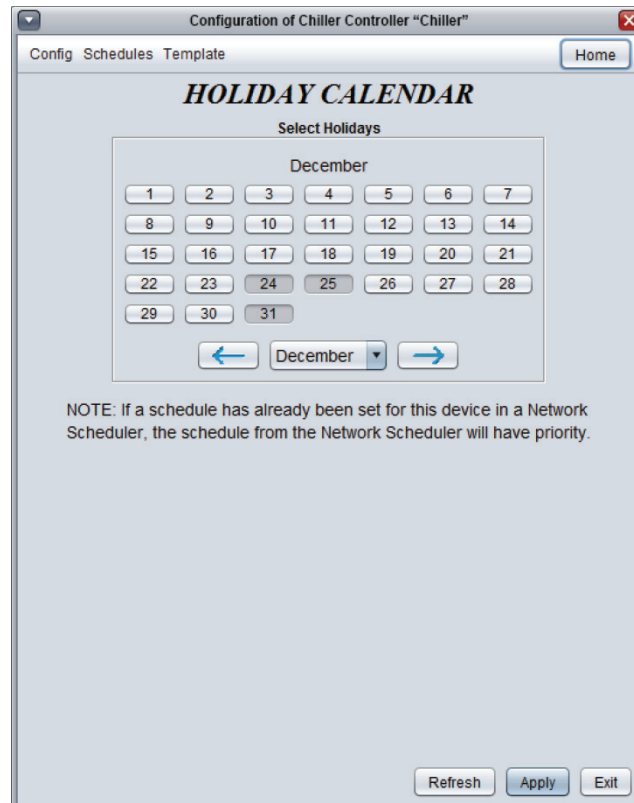

Figure 42 - Holiday Calendar Screen

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 change months by clicking on the arrows at the bottom or by simply choosing the desired month from the drop down list of months.

5.12 - Template Menu

5.12.1 - Save as Template

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

5.12.2 - Load Template...

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