THERMOTRON®

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8800 Display Module Instruction Manual

Revision 19: August 14, 2019

This generic manual is intended for reference purposes only and is not intended to be used to operate your equipment. For operating instructions and a description of the features used on your specific control system, see the manual set supplied with your Thermotron product.

This manual provides the most current generic operating instructions for this controller at the time of its revision date. Therefore this manual may not include some recent software changes. This manual also may cover features that are not available on your current controller. Examples within this manual are for typical configurations that may not apply to the configuration of your control system.

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Section 1: Setup

Introduction to the 8800 display module

NOTE: For information on the CM2 control module, refer to the *CM2 Control Module Technical Manual*.

The 8800 display module uses a CM2 control module, an SBC unit running Windows, and a touch screen monitor to control an environmental test chamber. The display module uses a software application written for a Windows environment. The application allows you to operate an environmental test chamber using the 8800 display module (touch screen) and the CM2 control module. **NOTE**: The 8800 will always power up and auto-run the 8800 application. Any attempt to circumvent this operation and enter the Windows operating system without specific Thermotron guidance will void the warranty of the control system.

Using the touch screen

The touch screen monitor is the only user input device. To push a button or make a selection, touch the appropriate area of the screen with the supplied stylus. **NOTE**: To calibrate the touch screen from any screen, hold the stylus against the touch screen for 10 seconds and follow the instructions on the screen.

When you touch a specific area of the screen one of several things could happen:

- ***The button will remain "in" and perform the desired function.*** For example, touching the **Manual** button will switch the display to the manual mode screen.
- ***A radio button, check box, or line will be selected.*** Touching the item a second time will deselect it.
- ***A drop-down menu will appear***, enabling you to make a selection from a list.
- ***The alphanumeric keypad will appear.*** Use the keypad to enter an alphanumeric value into the field. The 8800 will highlight the last key pressed. Press **Enter** to accept the new value, or press **Cancel** to close the keypad without entering a new value.

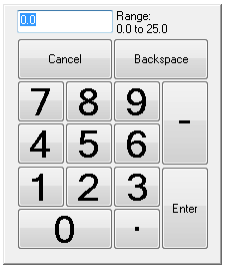
  For example, when you touch a channel name field on the **Chan/Aux Names** panel, the keypad will appear, indicating that you can enter an alphanumeric value.

  The alphanumeric keypad defaults to lowercase letters. To enter uppercase letters or the symbols on the number keys, press **Shift** and then the desired letter keys. To return the keypad to lowercase letters, press **Shift** again.

  The **Backspace** key deletes the character to the left of the cursor. The left and right arrow keys, located on either side of the **Space** key, move the cursor to the left and right in the display field at the top of the keypad.

- ***The numeric keypad will appear.*** At the top of the keypad is a small display field as well as an indication of the allowable range of the selected field. Use the keypad to enter a numeric value into the field. Press **Enter** to accept the new value, or press **Cancel** to close the keypad without entering a new value into the field.

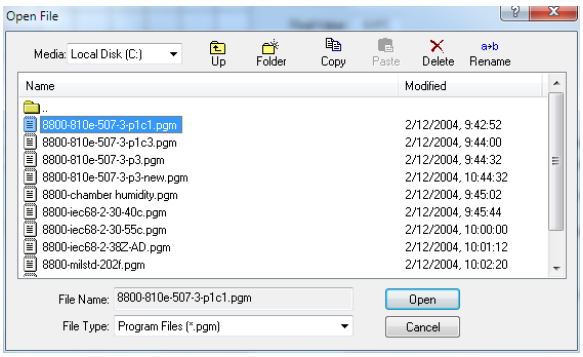
  For example, when you touch the **Deviation** field on the program screen, the numeric keypad will appear, indicating you need to enter a value between 0.0 and 25.0 into the field.

File functions

The 8800 uses standard Windows dialog boxes for opening and saving files (such as program files or graph settings files). The buttons at the top of the dialog boxes also allow you to copy, paste, delete, and rename files.

Files may be loaded from and saved to the internal hard drive, a network drive, or an external USB drive.



8800 file types

The following table describes the types of files used by the 8800:

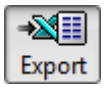
File type	*Extension*	*Access screen*	*8800 functions*	*Description*
Chamber configuration	.pck/.pkx	Main	Save and open	Allows the user to back up and restore the chamber configuration. **NOTE**: The *.pkx extension is for export-limited 8800s.
7800 configuration	.cfg	Main	Open	Allows the user to load a 7800 programmer/controller configuration into the 8800. **CAUTION**: This function should be used only with Thermotron Product Support guidance.
Chamber data	.csv	Graph	Save	Comma-delimited data that can be opened in standard spreadsheet programs.
Graph picture	.bmp	Graph	Save	A bitmap of the current graph that can be opened in standard graphics programs.
Graph view settings	.gvs	Graph	Save and open	Allows the user to back up and restore customized graph view settings.
Program	.pgm	Program	Save and open	Allows the user to back up and restore an 8800 program.
7800 program	.prg	Program	Open	Allows the user to load into the 8800 a program written for a 7800 programmer/controller.
Control parameters	.prm	Setup/ Control Parameters	Save and open	Allows the user to back up and restore control parameter settings.
DAQ configuration	.daq	DAQ	Save and open	For more information on the DAQ option, refer to the *8800 DAQ Instruction Manual*.

The 8800 has a virtually unlimited amount of storage space for settings and data. The only limit on the 8800 storage capacity is the available space on the internal hard drive. **NOTE**: Once the drive is full, the oldest data is automatically deleted to make space for new data.

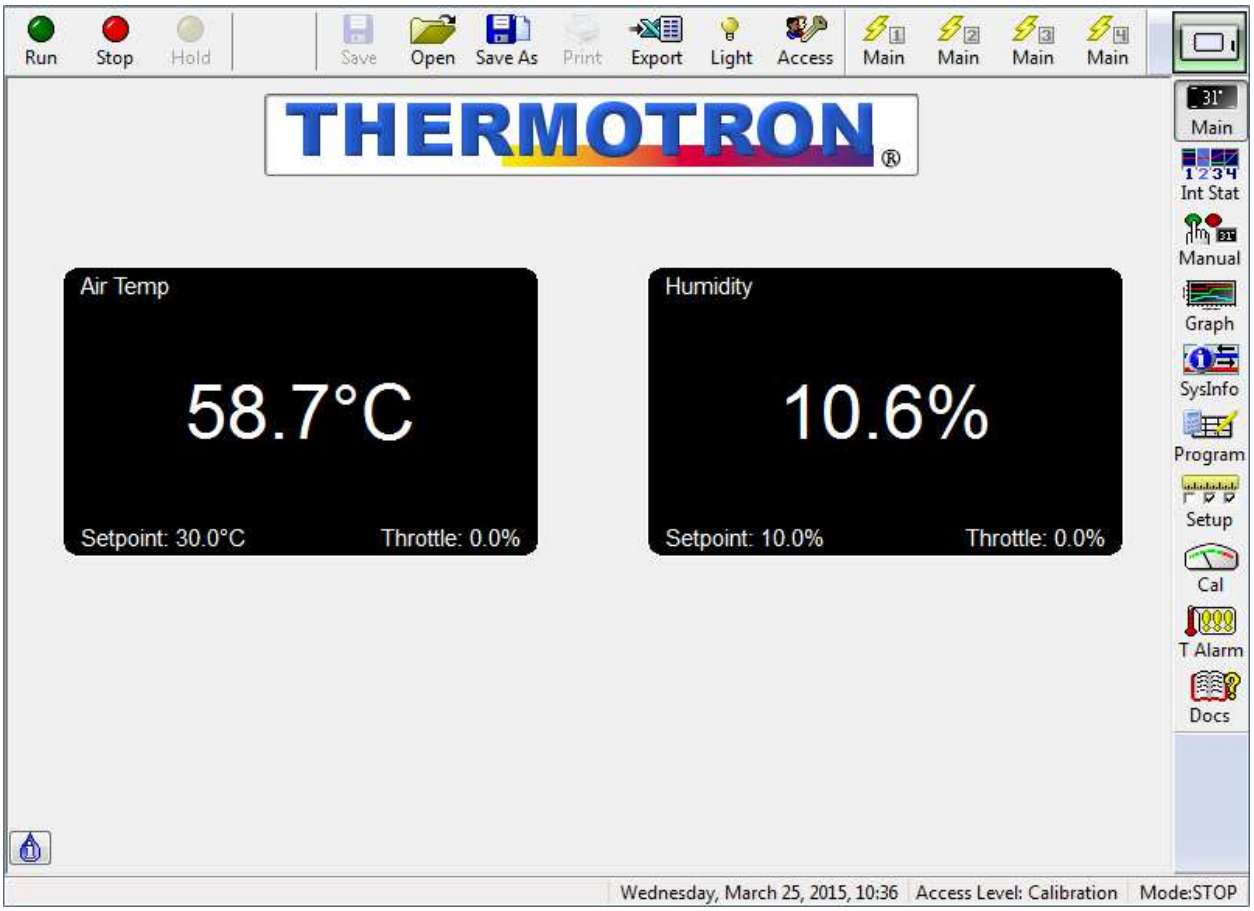
NOTE: The 8800 Backup Wizard helps you create a backup of your programs, settings, and data files so you can prevent data loss and damage caused by disc failures, power outages, virus infections, and other potentially damaging events. The 8800 Restore Wizard helps you restore your previously backed-up data in the event of a hardware failure, accidental erasure, or other data loss or damage. For more information, see “Backup/Restore panel” later in this section.

Exporting 8800 data

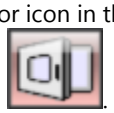
Press the **Export** button from any screen to start the Export Data Wizard. This wizard provides step-by-step instructions for exporting data log files from the 8800.



8800 display controls



The 8800 display is made up of the following parts:

- The selected screen or panel in the center of the touch screen. The above illustration shows the main screen, which displays the channel name, current process variable, set point, and throttle for each active channel.
- The action buttons, which are always available at the top of the touch screen. For more information, see "Action buttons" later in this section.
- The function buttons, which are always available along the right side of the touch screen. Function buttons are used to select the various 8800 screens and panels. For more information, see "Function buttons" later in this section.
- The current date, time, access level, and mode of the 8800 display module, which are always displayed at the bottom of the touch screen.
- In temperature-humidity mode the humidity information button will be displayed in the lower left corner. Pressing the button will bring up the Humidity Info dialog box. For more information see "Running in manual mode" in Section 2.
- On SE-Series chambers, as well as on custom chambers with an optional door switch, a door icon in the upper right corner of the display indicates whether the chamber door is closed or open  . For information on the door options, see "Actions to take when door is opened" later in this section.

Action buttons

The action buttons are always available at the top of the touch screen. The following paragraphs list the action buttons and briefly describe their functions.

Run In manual mode pressing the **Run** button starts running a manual mode test. In program mode pressing the **Run** button brings up the Run Options dialog box. When a test is running, the green indicator is lit. When a scheduled program is pending, the blue indicator is lit.

Stop When a test is running, pressing the **Stop** button brings up the Stop Confirmation dialog box.

- To stop the test press **Yes**. When a test is stopped, the red stop indicator is lit.
- To cancel the stop request and continue running the test, press **No**.
- To disable stop confirmation, check **Do not ask this again**, or uncheck **Confirm Stop Key Press** on the System Setup panel of the setup screen.

Hold Pauses a test and lights the yellow hold indicator. To resume the test at the same point it was paused, press **Run**.

Save Saves a new or modified file.

Open Loads a saved file.

Save As Saves a file under a new name or in a new location.

Print Prints the currently selected program or graph, or individual days of the activity log.

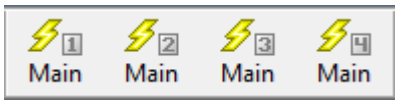
Export Starts the Export Data Wizard. This wizard provides step-by-step instructions for exporting data log files from the 8800.

Light Turns the chamber light on and off. When the chamber light is on, the button's yellow light indicator is lit.

Access Brings up the Change Access Level dialog box, allowing you to change the access level and password of the 8800 display module. For more information, see "Changing access levels and passwords" later in this section.

Quick navigation buttons

The user-defined quick navigation buttons allow you to switch quickly between frequently used screens and panels. To assign a quick navigation button:



1. Go to the screen or panel you want to access with a quick navigation button.
2. Press and hold one of the quick navigation buttons.
3. The button name will change to the name of the selected screen or panel.

For example, press the **Setup** button and then select the System Setup panel. Press and hold the second quick navigation button. The button name will change to **SysSet**. The button now can be used to take you directly to the System Setup panel.

Function buttons

The function buttons are always available on the right side of the touch screen. The following paragraphs list the function buttons and briefly describe their functions.

Main Returns to the main screen.

Int Stat Accesses the interval status screen. This screen allows you to view the status and options for the currently loaded program.

Manual Accesses the manual mode screen. This screen allows you to select the values and options for manual mode operation.

Graph Accesses the graph screen. This screen allows you to view the logged data as a graph as well as select what data will be graphed and how that data will be displayed.

SysInfo Accesses the chamber status panels. These panels provide status and diagnostic information.

Program Accesses the program screen. This screen allows you to create, save, load, and modify programs.

Setup Accesses the setup panels. These panels allow you to modify system and control parameters, computer interface/network settings, and channel/auxiliary names.

Cal Accesses the calibration panels. The **Cal** button appears only if the 8800 access level is Calibration. For more information, refer to Section 5 of this manual.

T Alarm Accesses the Therm-Alarm panels. These panels allow you to view and change the Therm-Alarm settings and calibrate the Therm-Alarm. The **T Alarm** button appears only if your chamber is equipped with one or more Therm-Alarms.

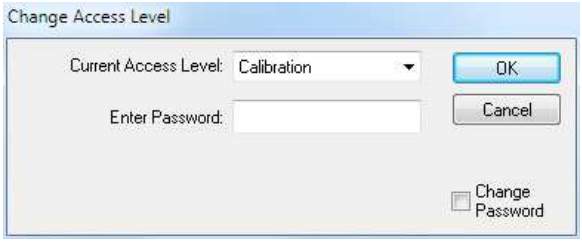
Docs Accesses the online Help system. Allows you to get help on any topic relating to the 8800 control system.

Changing access levels and passwords

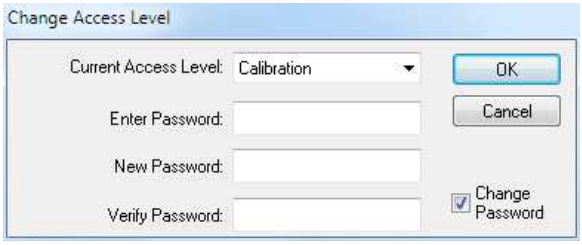
The access level function allows you to select from six different levels of access to the 8800 functions. The following table provides a general overview of which functions are available at each access level.

Name	*Functions available*
Locked	All functions are locked out. Most information may be viewed but not modified.
Level One	Program run, stop, and hold modes are enabled.
Level Two	Manual mode operation is enabled.
Programmer	Program creation/editing/graphing and clock setting are enabled.
Lab Manager	System parameters and process alarms can be set.
Calibration	Calibration and other advanced functions are enabled.

Authorized users can set a password for each access level. Once the current password is entered, the authorized user can also select a new password.



1. Press the **Access** button at the top of the screen. The Change Access Level dialog box will appear.
2. To change the access level:
   a. Select the desired access level from the Current Access Level drop-down menu.
   b. If no password has been set, press **OK**.
   c. If a password has been set, select the Enter Password field, use the alphanumeric keypad to enter the password, then press **OK**.

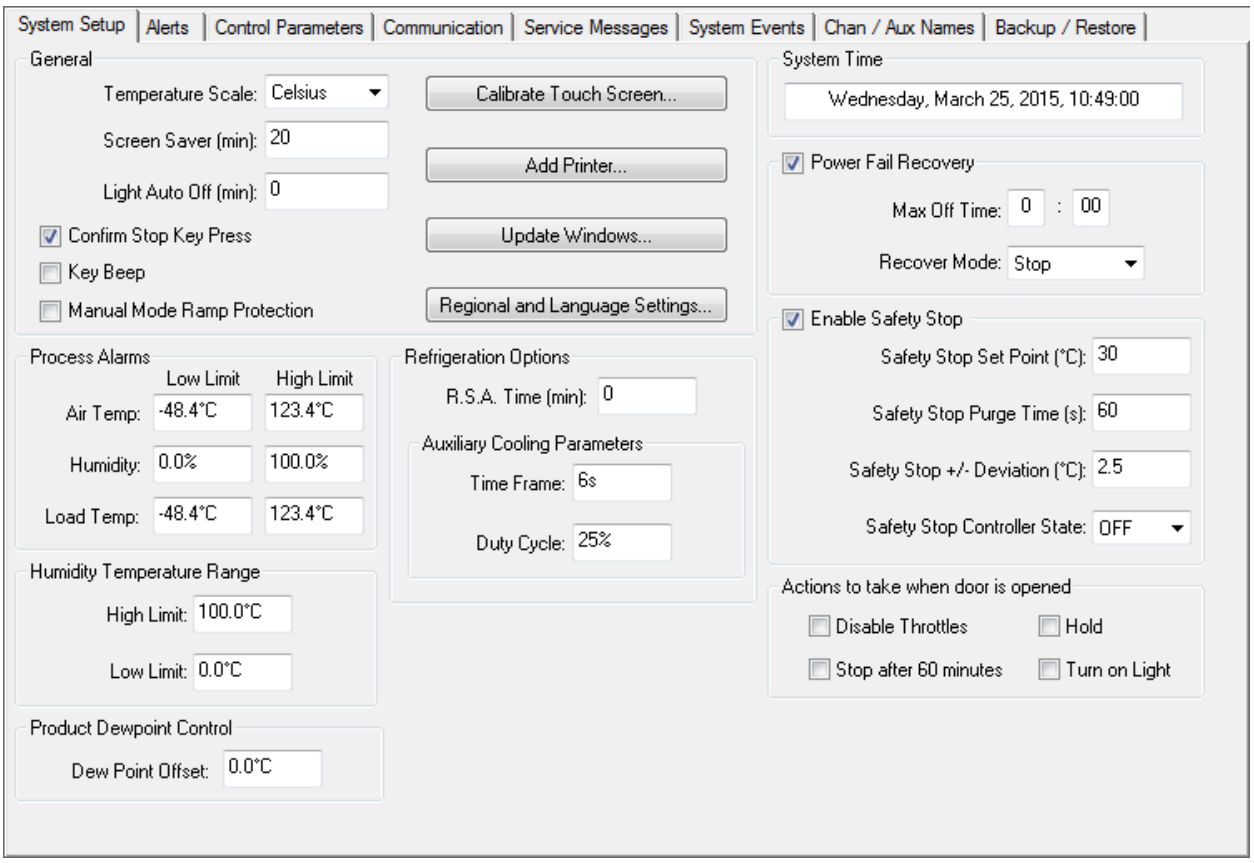


3. To change the password:
   a. Select the Change Password check box. The New Password and Verify Password fields will appear.
   b. If no password has been set, go to step 3.d.
   c. If a password has been set, select the Enter Password field and use the alphanumeric keypad to enter the password.
   d. Select the New Password field and use the alphanumeric keypad to enter the new password. Passwords may consist of up to 20 keystrokes using any keys except **Enter** and **Cancel**.
   e. Select the Verify Password field and enter the new password again.
   f. To accept the new password press **OK**. To exit without changing the current password, press **Cancel**.
   g. If you did not enter the new password correctly, this error message will appear:
   h. Press **OK** and repeat step c.

Using the setup panels

Press **Setup** to access the setup panels. These panels allow you to configure the 8800 display module to meet your specific testing needs. This section describes the setup panels and how to use them. To return to the main screen from any setup panel, press **Main**.

System Setup panel



NOTE: To change most settings on the System Setup panel, the 8800 access level must be Lab Manager or higher.

General settings

1. From any screen press **Setup**, then select the System Setup panel.
2. Under General select a field and enter or modify the setting. For numeric values the keypad will display the allowable range of the selected field. The following describes each field:
   - Select the **Temperature Scale** (Celsius or Fahrenheit) the 8800 will use to display temperature values.
   - The **Screen Saver** field allows you to enter the number of minutes of idle time before the screen saver is displayed. A value of 0 disables the screen saver function.
   - The **Light Auto Off** field allows you to enter the number of minutes of idle time before the chamber light is automatically shut off. A value of 0 disables the automatic light shut-off function.
   - To disable stop key confirmation, uncheck **Confirm Stop Key Press**. This will prevent the **Stop Confirmation** dialog box from appearing whenever the **Stop** button is pressed.
   - To toggle on or off an audible key beep each time a key is pressed, check or uncheck **Key Beep**.
   - If **Manual Mode Ramp Protection** is unchecked, when you press the **Run** key in manual mode the 8800 will begin ramping at the entered **Ramp Rate** from the *current set point value* toward the **New Set Point** value.

If **Manual Mode Ramp Protection** is checked, when you press the **Run** key in manual mode the 8800 set point(s) will automatically go to the *current process variable*, then begin ramping at the entered **Ramp Rate** toward the **New Set Point**.

- To calibrate the touch screen, press **Calibrate Touch Screen** and follow the instructions on the screen.
- To add a printer, press **Add Printer** and follow the instructions on the screen.
- To update the Windows operating system, press **Update Windows**. This will launch a browser and attempt to connect to the Windows Update server on the Internet. If your company uses a proxy server you will need to supply that information.
- If you want to change the language you use to view and enter text, or how the 8800 formats numbers, time, and dates, press **Regional and Language Settings** and adjust the language or regional formatting settings.

Setting process alarms

CAUTION: It is *your* responsibility to set process alarm limits appropriate for your product. Process alarms will not guarantee the safety of your product. To protect your product from temperature extremes, you must properly configure and use a product protection device such as a Therm-Alarm. If you are testing expensive products, you should have an additional back-up product protection device.

Each channel of the 8800 can be set up to activate an alarm if the temperature, humidity, or other process variable exceeds high or low limits you select. If the variable exceeds the high or low limit, the 8800 enters stop mode. Factory-specified limits are programmed into the 8800.

1. From any screen press **Setup**, then select the System Setup panel.
2. Under Process Alarms select a low or high limit field.
3. The numeric keypad will appear. The allowable range of the selected field appears beside the small display field at the top of the keypad.
4. Enter the desired limit for the channel, then press **Enter**.

Setting the humidity temperature range

NOTE: For your chamber's humidity temperature range, refer to the specifications listed in your chamber manual.

1. From any screen press **Setup**, then select the System Setup panel.
2. Under Humidity Temperature Range select the high or low limit field.
3. The numeric keypad will appear. The allowable range of the selected field appears beside the small display field at the top of the keypad.
4. Enter the temperature limit, then press **Enter**.

Setting the product dew point control dew point offset

The 8800 product dew point control (PDC) option operates the chamber temperature and humidity systems in such a way that the chamber dew point is limited to a temperature that is lower (by a user-specified offset) than the temperature of the product or products being monitored in the chamber. For more information on product dew point control, see Appendix B of this manual.

To specify the PDC offset, follow these steps:

1. From any screen press **Setup**, then select the System Setup panel.
2. Under Product Dew Point Control select the **Dew Point Offset** field.
3. The numeric keypad will appear. The allowable range of the selected field appears beside the small display field at the top of the keypad.
4. Enter the desired dew point offset. When enabled in manual mode or by interval in program mode, the 8800 will limit the dew point of the chamber to the monitored product temperatures minus this offset.

Refrigeration options

When running a program the refrigeration system anticipator time (**R.S.A. Time**) is the number of minutes the 8800 will pre-cool the mechanical refrigeration system before entering a zero-time cooling interval (normally a guaranteed soak). RSA time identifies a cooling interval when the final value is less than the current interval's final value and the interval time is 0:00:00. This reduces the lag time caused by cooling the refrigeration hardware.

1. From any screen press **Setup**, then select the System Setup panel.
2. Under Refrigeration Options select the **R.S.A. Time** field and enter or modify the setting. The keypad will display the allowable range.

Auxiliary cooling parameters

Some chambers are equipped with optional liquid nitrogen (LN_2) or carbon dioxide (CO_2) auxiliary cooling systems. When the refrigeration system is operating at full cooling throttle, the auxiliary cooling system can be operated for a programmed percentage (duty cycle) of a selected time frame.

For example, if you set the auxiliary cooling time frame to five seconds and the duty cycle to 30%, the auxiliary cooling system comes on for 1.5 seconds (30% of five seconds) and then goes off for the remaining 3.5 seconds of the five-second interval. If you set the duty cycle to 100, the auxiliary cooling system comes on and stays on for as long as the refrigeration system is operating at full cooling throttle.

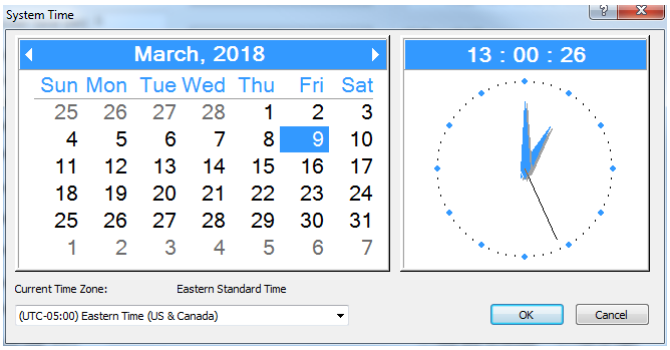
1. From any screen press **Setup**, then select the System Setup panel.
2. Under Refrigeration Options / Auxiliary Cooling Parameters select a field and enter or modify the setting.
3. Enter the length of the **Time Frame** in seconds. The keypad will display the allowable range.
4. Enter the percentage of the **Duty Cycle**.

System time

The real time clock keeps track of the time and date, which the 8800 uses for reference, delayed program start, and the time stamp for the graph and data logging functions.

1. From any screen press **Setup** and select the System Setup panel.
2. Selecting the System Time field will bring up the System Time dialog box.
3. Adjust the date, time zone, and/or time as required, then press **OK**.

NOTE: After changing the **Current Time Zone**, there may be a delay of up to 24 hours before all 8800 screens and graphs are updated.



Power failure recovery

If the 8800 is in run or hold mode and a power failure occurs that is longer than the **Max Off Time** setting, the 8800 will automatically power up in the mode selected under **Recover Mode**.

1. From any screen press **Setup**, then select the System Setup panel.
2. To enable or disable power fail recovery, check or uncheck the **Power Fail Recovery** check box.
3. For **Max Off Time** select the number of hours and minutes power must be lost before the 8800 enters power failure recovery mode. The keypad will display the allowable range of each field.
4. From the **Recover Mode** drop-down menu select a mode to power up in following any power failure that exceeds the **Max Off Time** setting. The available settings are:
   - **Stop**: The 8800 will stop the test that was running when power failed.

- **Hold**: The 8800 will hold the test at the point reached when power failed.
- **Run**: The 8800 will return to the mode it was in when power failed.
- **Restart**: The 8800 will start running the test again from interval 1.

Enabling safety stop

As an additional safety measure, you may enable safety stop. When enabled, whenever the chamber goes into stop it will go to a special "safety stop mode" and the channel 1 set point will go to the safety stop set point. It will control to the set point if the safety stop controller state is set to ON, or it will drift to the set point if the safety stop controller state is set to OFF. Once channel 1 is within +/- the safety stop deviation of the safety stop set point, the purge output will be forced on for the safety stop purge time. After all of this is done the chamber will shut off. If the chamber is equipped with door locks they will remain active until the safety stop sequence has been satisfied.

1. From any screen press **Setup**, then select the System Setup panel.
2. To enable or disable safety stop, check or uncheck the **Enable Safety Stop** check box.
   - **Safety Stop Set Point**: Upon stopping, the chamber will control or drift to this set point.
   - **Safety Stop Purge Time**: After getting within +/- the safety stop deviation of the set point, the purge will be enabled for the specified time (in seconds), then the chamber will stop. A setting of zero will disable purge.
   - **Safety Stop +/- Deviation**: This is the deviation from the safety stop set point that the chamber must reach before the purge output is forced on.
   - **Safety Stop Controller State**: Turn this setting ON if you want to control to the safety stop set point. Turn this setting OFF if you want to drift to the safety stop set point.

NOTE: The chamber will not allow **Run**, **Stop**, or **Hold** to be pressed when safety stop is active. Channel 1 will display a "Safety Stop Active…" message while the chamber waits for the safety stop to complete. An active safety stop will be cancelled if the 8800 is power-cycled or reset.

Actions to take when door is opened

A green door icon in the upper right corner of the 8800 display indicates the chamber door is closed.
A pink door icon in the upper right corner of the 8800 display indicates the chamber door is open.
NOTE: The door icon and options are available on SE-Series chambers, as well as on custom chambers with an optional door switch.

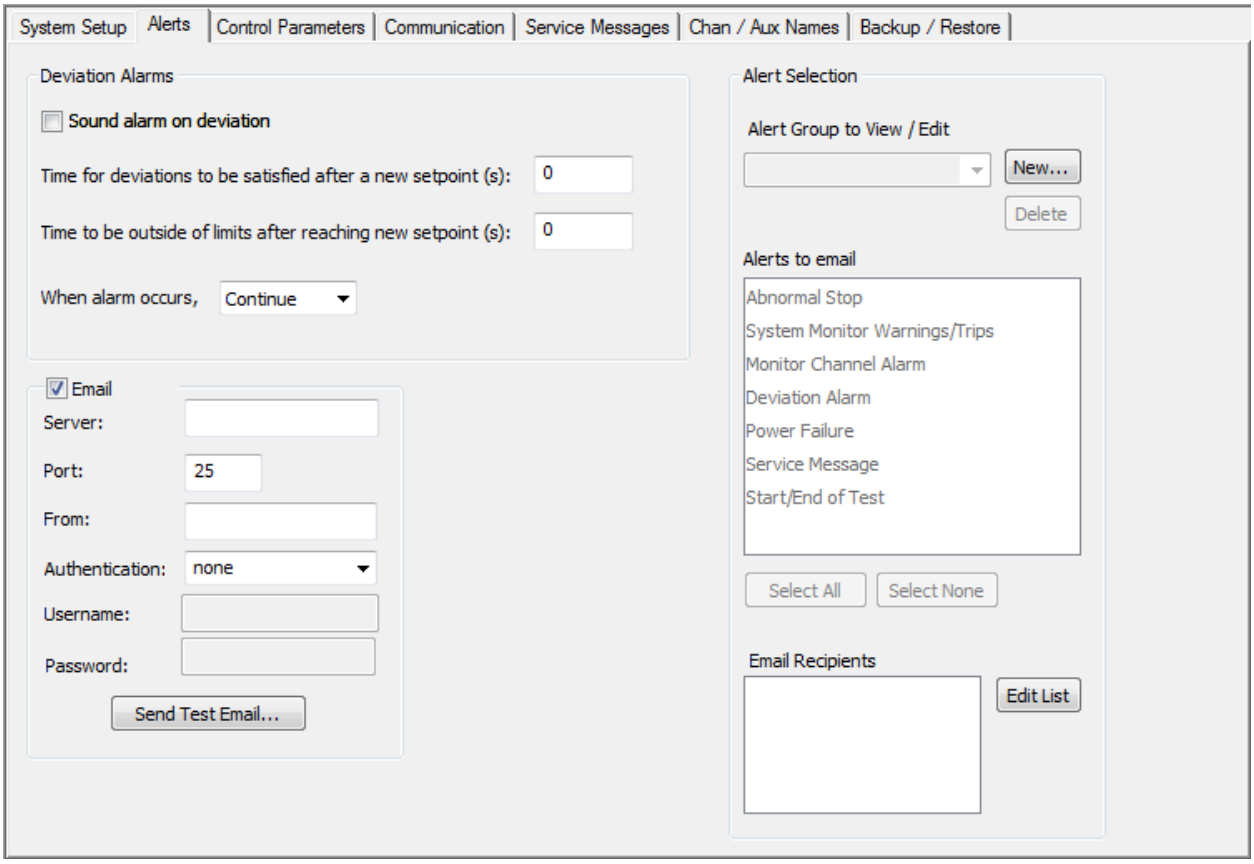
By default, the following actions occur when the chamber door is open:

- The flow of all inert gases, such as liquid nitrogen (LN_2), gaseous nitrogen (GN_2), or carbon dioxide (CO_2), is automatically stopped. This function cannot be overridden by the user.
- The 8800 activity log will display a *Chamber door OPENED* message (with date/time stamp) when the door is opened. The activity log will display a *Chamber door CLOSED* message when the door is closed.

Along with the default actions, a number of optional actions can be set up by the user.

1. From any screen press **Setup**, then select the System Setup panel.
2. Under **Actions to take when door is opened**, enable or disable the following options:
   - **Disable Throttles**: All active throttles will go to 0% when the door is opened. This setting cannot be overridden by the user.
   - **Stop after 60 minutes**: The 8800 will enter stop mode if the door is continuously open for 60 minutes. This option protects against excessive moisture building up on the evaporator coil.
   - **Hold**: The 8800 will enter hold mode when the door is opened, and will automatically resume when the door is closed. **NOTE**: When the door is open, the user can override the hold mode by pressing the **Run** button.
   - **Turn on Light**: The chamber light will turn on when the door is opened, and will turn off when the door is closed. This setting can be overridden by the user while the door is open.

Alerts panel



Deviation alarms

In manual or program mode, deviation settings control how far you will allow the temperature or other process variable to be from setpoint. The deviation is monitored and the deviation alarm is activated if the value is exceeded. This part of the Alerts panel allows you to specify how the 8800 will respond to a deviation alarm.

1. To set up the deviation alarm response, press **Setup**, then select the Alerts panel.
2. To cause an alarm to sound when a deviation value is exceeded, select the **Sound alarm on deviation** check box. **NOTE**: The deviation setting has to be non-zero for it to be relevant.
   - The **CM** and **Output** controls can be used to specify a physical output that will be activated whenever an alert occurs. This can be used to activate an external audible alarm, light, etc., when an alert is active.
   - To define how long the system will wait after a setpoint change before it starts monitoring the deviation, enter a value in the **Allow *n* seconds for deviations to be satisfied after a new setpoint** field.
   - To prevent nuisance alarms, enter a value in the **Must be out of limits for *n* seconds if setpoint had been reached** field. For example, if the value is set to 60 and the process variable is out of the deviation band for five seconds, no alarm will sound.
3. The **Continue/Stop/Hold** option allows you to select the action the 8800 will take when a deviation occurs.
   - **Continue** will generate an alarm notification and allow the test to continue.
   - **Stop** will stop the test.
   - **Hold** will put the 8800 into hold mode.

4. If either of the timer options is non-zero, the following will happen when a deviation occurs:
   - A warning message will appear.
   - The deviation alarm will be recorded in the activity log.

Email alerts

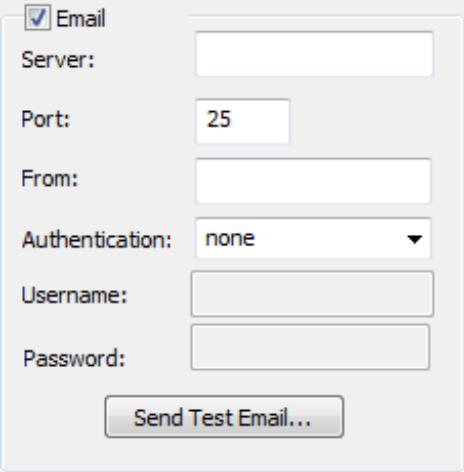
Beginning with software version V5.13, the 8800 can automatically report various chamber alerts by sending an email or text message to selected recipients. **NOTE**: To use this feature the 8800 must be on a local network that is running an email server. You must be in Lab Manager (or higher) access level to edit email and alert settings.

Alert activity is recorded in the 8800's activity log. Email setup and alert information can be backed up as part of the **Setup Data (User setup & Configuration)** selection of the Backup Wizard. As with all setup and configuration data, if this information is restored to a different 8800 it overwrites all current settings.

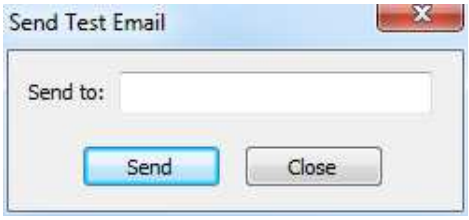
Setting up access to your local network's email server

1. Press **Setup**, then select the Alerts panel.
2. Select the **Email** checkbox.
3. Enter the required email settings to access the email server on your network.
   - Contact your IT department for assistance if necessary.
   - The **From:** field can contain any text as long as it includes the @ symbol. This text will be displayed in the From field whenever an email or text is received by a recipient.

     NOTE: Depending on the text you choose for this field, it may be necessary for email recipients to adjust their incoming email settings so that emails from this address are not blocked or routed to junk or spam folders.

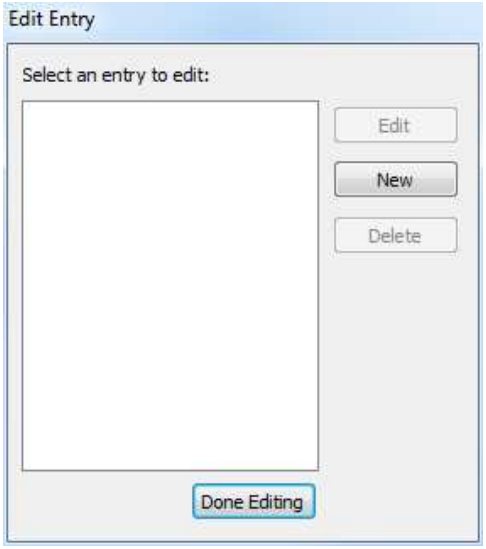


4. When all settings have been entered, press the 8800 **Save** button.
5. To send a test message to verify that the email settings have been entered properly, press the **Send Test Email...** button, enter a valid email address, then press **Send**.

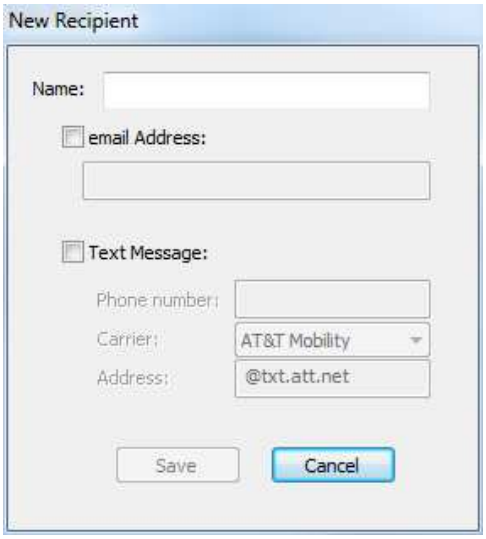


Creating/editing email recipients

1. Press **Setup**, then select the Alerts panel.
2. Press **Edit List**. The **Edit Entry** dialog box will appear:



3. Press **New**. The **New Recipient** dialog box will appear:

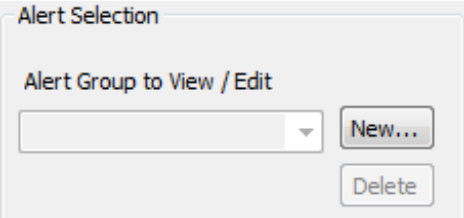


4. Enter a meaningful **Name** for this recipient.
5. A recipient can receive alerts via email, text message, or both.
   - To send email alerts to a recipient, select **email Address** and enter the recipient's email address.
   - To send text message alerts to a recipient, select **Text Message** and enter the recipient's cell phone number and select their carrier. If the carrier is not listed in the **Carrier** drop-down menu, select **Other** and enter the desired address for this carrier. You might need to contact your cell phone carrier for this information.
6. To save the recipient information, press **Save**.
7. To add more recipients to the list, press **New** again and repeat the above steps.
8. To edit a recipient's information, highlight the desired recipient in the list, then press **Edit**.
9. To delete a recipient, highlight the desired recipient in the list, then press **Delete**.
10. When all recipients have been added, press **Done Editing**.

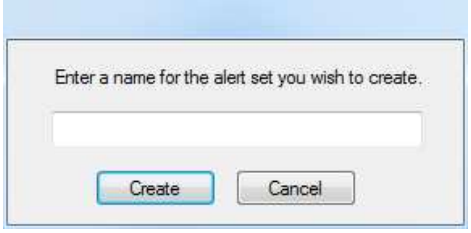
Creating/editing alert groups

NOTE: Before creating an alert group you should create one or more email recipients.

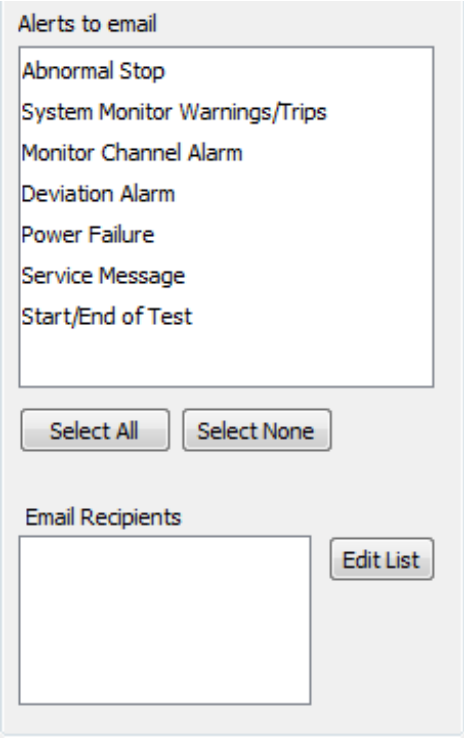
1. Press **Setup**, then select the Alerts panel.
2. Under **Alert Group to View / Edit**, press **New**.



3. Enter a meaningful name for the alert group, then press **Create**.
   NOTE: Once an alert group is created it is always active as long as email functionality is enabled.



4. In the **Alerts to email** list, highlight the desired categories of alerts you want the 8800 to monitor for sending email and/or text message alerts. A detailed description of the alert categories can be found in the "Alert categories, names, message examples" table below.
5. Select the recipient(s) you wish to receive notification of the selected alerts.
6. Press the 8800 **Save** button.
7. To create more alert groups with different combinations of alert categories and recipients, repeat the above steps.
8. To edit an alert group, select the group to edit, make the desired changes in the **Alerts to email** and/or **Email Recipients** list, and press **Save**.
9. To delete an alert group, select the group to delete, press **Delete**, then press **Yes**.



Format of recipient email/text

From: Text entered in the Alerts panel **From:** field.

Subject: Text entered in the **Chamber Description:** field in the Communication panel, followed by the applicable category in the **Alerts to email** list in the Alerts panel.

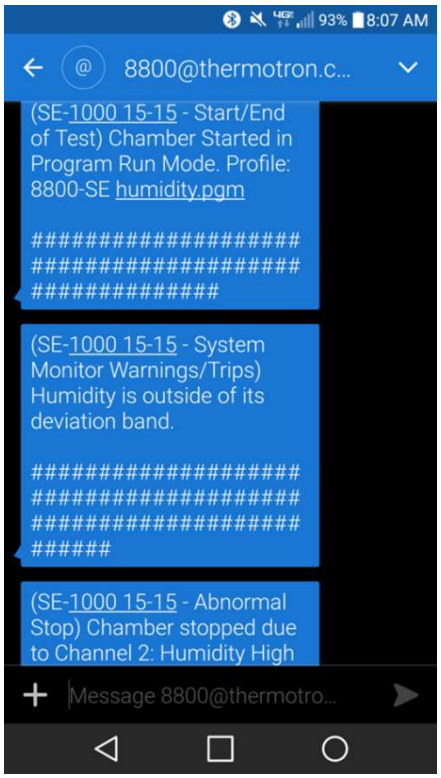
For sample body text, see the examples in the "Alert categories, names, message examples" table below.

Alert categories, names, message examples

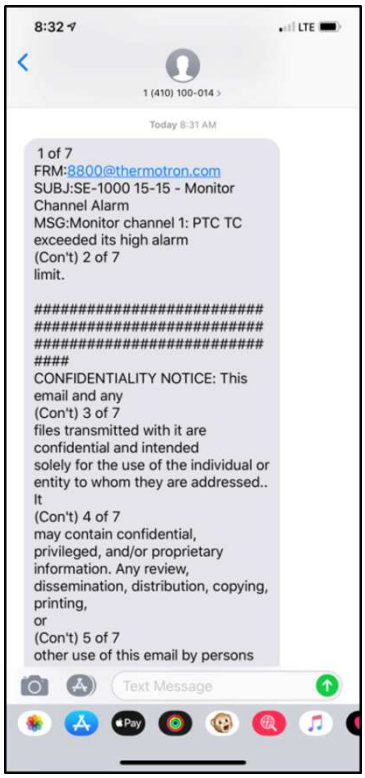
Alert category	*Alert name*	*Message examples*
Abnormal Stop	Open Input	Chamber stopped due to Channel 'n' : <channel name> Open Input.
	Low Process Alarm	Chamber stopped due to Channel 'n' : <channel name> Low Process Alarm.
	High Process Alarm	Chamber stopped due to Channel 'n' : <channel name> High Process Alarm.
	Therm-Alarm Trip	Chamber stopped due to a Therm-Alarm trip.
	Refrigeration Trip	High Stage compressor, Oil Pressure/Other Trip.
		Low Stage compressor, Oil Pressure/Other Trip.
		Sys A: High Stage Compressor, Low Pressure Trip.
		Sys A: High Stage Compressor, High Pressure Trip
		Sys A: High Stage Compressor, Discharge Temperature Trip.
		Sys A: Low Stage Compressor, Low Pressure Trip.
		Sys A: Low Stage Compressor, High Pressure Trip.
		Sys A: Low Stage Compressor, Discharge Temperature Trip.
		Sys A: High Stage Compressor Fault.
		Sys A: Low Stage Compressor Fault.
	Power Failure Stop	Chamber stopped due to a power failure on: <date/time> that exceeded the Power Failure Recovery time limit.
	External Input	Chamber stopped due to an external Stop input.
	Door Open	Chamber stopped due to a door open condition for 60 minutes.
	Dual Humidity Trip	Chamber stopped due to Dual Humidity sensor drift or failure.
	Deviation Alarm Alert	Chamber stopped due to a Deviation Alarm Alert.
	Incompatible Hardware	Chamber stopped due to incompatible hardware - Contact Thermotron.
System Warnings/Trips	Refrigeration Warning	Sys A: High Stage Compressor, Low Pressure Warning.
		Sys A: High Stage Compressor, High Pressure Warning.
		Sys A: High Stage Compressor, Discharge Temperature Warning.
		Sys A: Low Stage Compressor, Low Pressure Warning.
		Sys A: Low Stage Compressor, High Pressure Warning.
		Sys A: Low Stage Compressor, Discharge Temperature Warning.
	Circulator Trip	Sys A: Circulator is off! Check: circulator switch, Therm-Alarm, high heat limit switch, etc.
	Control Module(s) Missing	The number of Control Modules found is less than the number configured.
	Therm-Alarm(s) Missing	The number of Therm-Alarms found is less than the number configured.
	Dual Humidity Warning	The dual humidity redundant sensors are drifting apart or failing.
	Generator Tank Low	Low water in the humidity steam generator tank.
	Water Reservoir Low	Low water in humidity reservoir tank.
	Therm-Alarm	Attention: A Therm-Alarm has tripped.
Monitor Channel Alarm	Monitor Channel Alarm	Monitor channel 'n': <channel name> exceeded its high alarm limit.
		Monitor channel 'n': <channel name> exceeded its low alarm limit.
Deviation Alarm	Deviation Alarm	Channel 1: Air Temp is outside of its deviation band.
Power Failure	Power Failure	A Power Failure occurred on Wednesday February 6, 2019 at 9:27
Service Message	Service Message	<Service Message Text>
Start / End of Test	Test Started	Chamber Started in Program Run Mode. Profile:<name of test>

Alerts sent to cell phones

Actual alert information from the controller will always be 160 characters or less. Alerts that are destined for a cell phone must first pass through a company's email server, which typically appends more information to the original alert message. If the resulting message is greater than 160 characters, the various cell phone carriers will handle the message differently.



Example 1

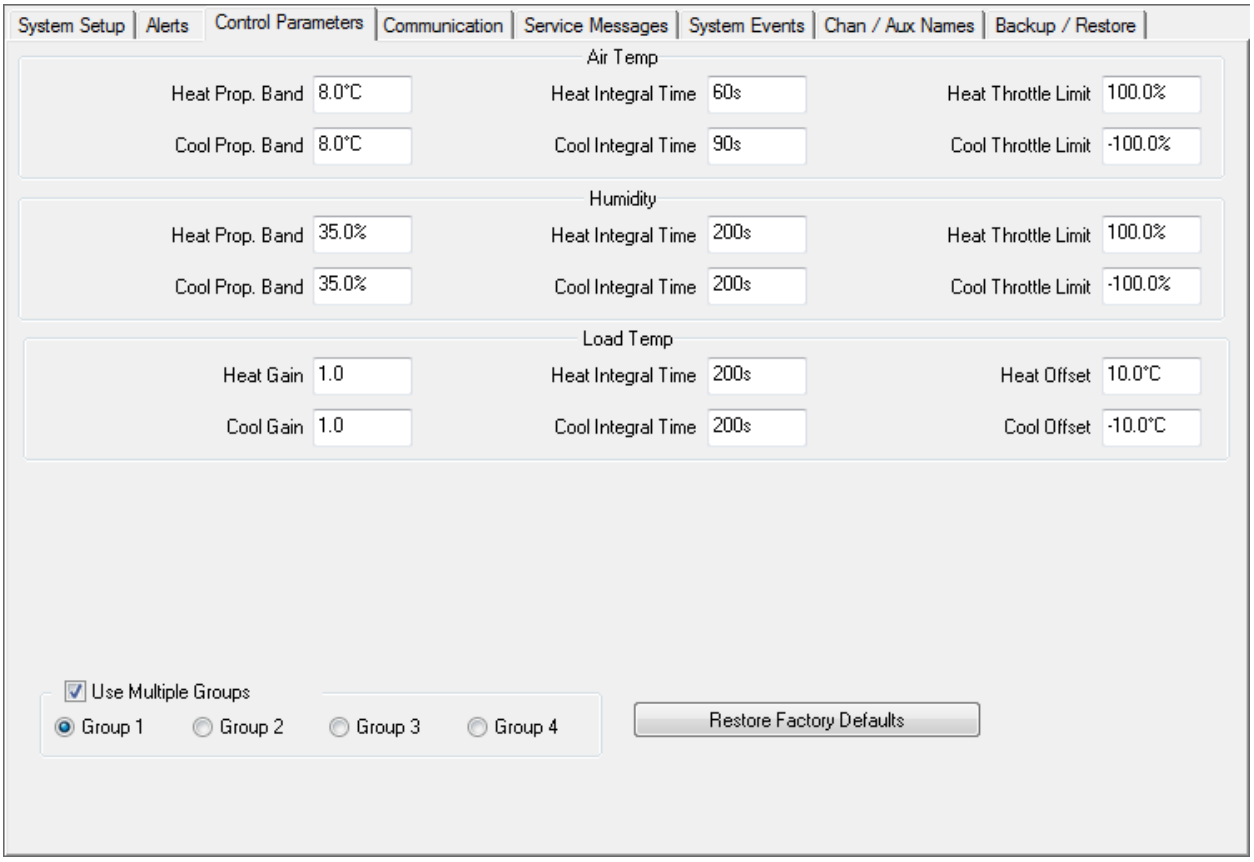


Example 2

- In **Example 1**, an alert message greater than 160 characters is received by one of the major carriers. It receives the first 160 characters and then terminates. This is sufficient for the 8800 alert feature since all alert information will be contained in the first 160 characters. The rest of the (truncated) data is often boilerplate security warning information appended to the original message by the company's email server.
- In **Example 2**, a similarly lengthy alert message is received by another major carrier. It receives the entirety of the alert information as seven consecutive text messages. The actual 8800 alert information is contained in the first text message. The rest of the message is boilerplate security information appended by the company's email server.

NOTE: If receiving several texts for a single alert is a concern (or an annoyance), you should consult your company's IT department and see if they can exclude the company appended text for specific recipients.

Control Parameters panel



CAUTION: The 8800 programmer/controller was factory-tuned and should not need to be re-tuned unless the product requirements change enough to affect the performance of the chamber. Incorrect values could damage your equipment and/or product. For information on tuning control parameters, see Appendix C. For information on tuning the product temperature control (PTC) control parameters, see Appendix D.

Control parameters adjust the performance of the chamber around the set point. As the chamber nears the set point, the 8800 adjusts the chamber throttles to provide a smooth ramp to the set point. To prevent overshooting and oscillation around the final set point, the refrigeration, heating, and other systems must be damped as they approach the set point. To maximize chamber performance, you must also compensate for lag times.

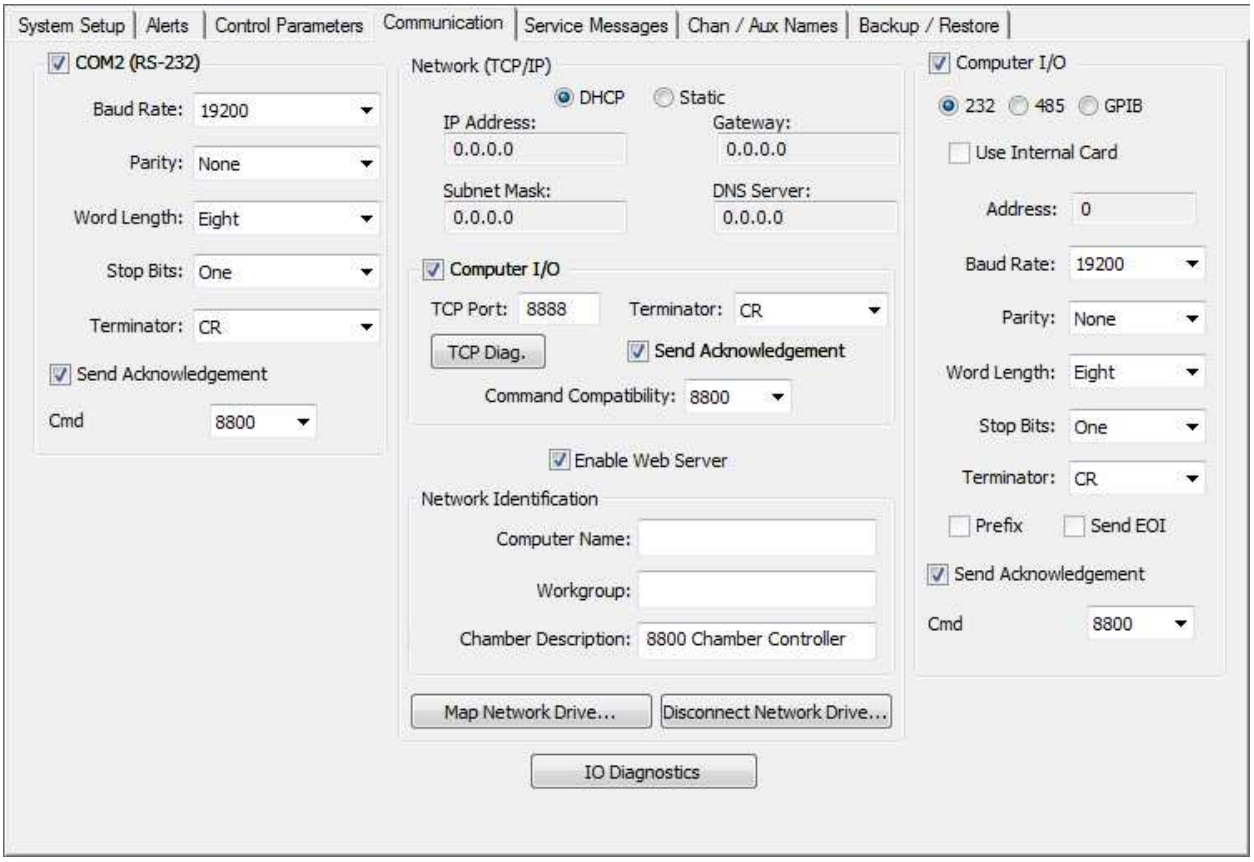
Up to four groups of chamber parameters can be entered into the 8800 for each control channel. This allows you to select chamber performance appropriate for the type of interval or program you are running. For example, in one interval you may want less control during a ramp between two extreme temperatures, but in the next interval you may want more control to maintain a constant temperature. To achieve the two levels of control, two groups of parameters can be programmed. To enable multiple groups of control parameters, select the **Use Multiple Groups** check box. To restore the control parameters that were set at the factory, press the **Restore Factory Defaults** button.

Control parameter files

You may also save and load control parameters to and from a file using the **Save As** and **Open** buttons. This provides the ability to save sets of custom control parameters in addition to the four groups already available.

Control parameters files can also be associated with a program such that every time a program runs it will use the control parameters in a file instead of the currently loaded parameters. To do so you must save a control parameter file with the same name as the program you wish to associate the parameters with. For example, if you have a program named *Simple Test.prg*, and you save a set of control parameters in a file named *Simple Test.prm*, every time you run Simple Test it will automatically use the parameters in the *Simple Test.prm* file.

Communication panel



NOTE: To change any computer interface setting, the 8800 access level must be Lab Manager or higher. For more information on computer interface settings, refer to Section 4 of this manual.

Each 8800 display module is equipped with three independent computer interface ports. The 8800 can communicate through all three ports at the same time:

- **COM2 (RS-232)**: Communication through the 8800 display module's serial port. This port enables the 8800 display module to communicate with a personal computer using Thermotron's serial communications protocol. Any off-the-shelf RS-232 cable will work with this port. **NOTE**: This port is for RS-232 communications only.
- **Network (TCP/IP)**: Communication through the 8800 display module's Ethernet connector. This connector is a standard eight-pin RJ45 connector. It is intended to enable a personal computer to communicate with an 8800 display module over a standard Ethernet network.
- **Computer I/O**: Communication through the control module's optional computer I/O module. Available protocols are RS-232, RS-485, or GPIB (IEEE-488). For more information, refer to the *CM2 Control Module Technical Manual*.

The following paragraphs discuss how to properly configure the 8800 to use the various communications protocols.

COM2 (RS-232)

1. From any screen press **Setup**, then select the Communication panel.
2. Under COM2 (RS-232) select each field to modify its setting.
3. From the **Baud Rate** drop-down menu select the highest baud rate the host computer's interface card will be using.
4. Select the desired **Parity**. To disable parity checking, select **None**.

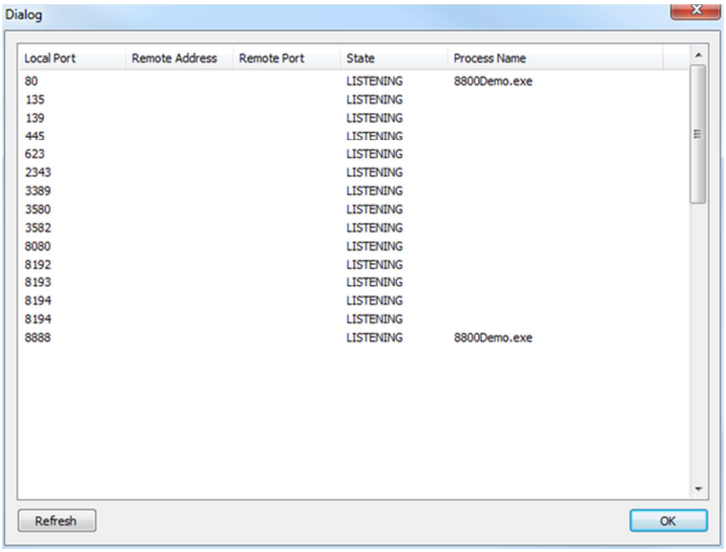
5. Select the desired **Word Length**. For most applications, select **Eight**.
6. Select the desired **Stop Bits**. For most applications, select **One**.
7. Select the desired **Terminator**.
8. The 8800 uses the **Send Acknowledgement** function to provide feedback to the computer when the 8800 is ready for the next command. The 8800 will only send an acknowledgement back to the host computer for non-query commands.

   When the error code is received by the host computer it knows that the 8800 has finished processing the command. If a response has not been received within two seconds, the command should be re-sent.

   A non-zero error code response could indicate that the 8800 did not process the command properly and it should be re-sent, or it could indicate that the 8800 processed the command properly but it was invalid for some reason and needs to corrected before it is re-sent. For more information see "Error codes" in Section 4 of this manual.
9. Select the desired **Cmd** compatibility. Command compatibility allows the 8800 to emulate a legacy instrument's command set. For more information see "Legacy instrumentation command compatibility" later in this section.

Network (TCP/IP)

1. From any screen press **Setup**, then select the Communication panel.
2. Under Network (TCP/IP) select each field to modify its setting.
3. Network address settings:
   - Select the type of TCP/IP addressing (either **DHCP** or **Static**). **NOTE**: The following need to be set only if Static is selected. If DHCP is selected they are grayed out and filled in automatically.
   - Enter a valid **IP Address**.
   - Enter a valid **Subnet Mask**.
   - Enter a valid **Gateway** address.
   - Enter a valid **DNS Server** address.
4. Computer I/O settings:
   - Enter a valid **TCP Port** address.
   - Select the desired **Terminator**.
   - To determine which TCP ports are being used by software running on the SBC, press the **TCP Diag.** button. The TCP diagnostics dialog will appear.



- The 8800 uses the **Send Acknowledgement** function to provide feedback to the computer when the 8800 is ready for the next command. The 8800 will only send an acknowledgement back to the host computer for non-query commands.

  When the error code is received by the host computer it knows that the 8800 has finished processing the command. If a response has not been received within two seconds, the command should be re-sent.

  A non-zero error code response could indicate that the 8800 did not process the command properly and it should be re-sent, or it could indicate that the 8800 processed the command properly but it was invalid for some reason and needs to corrected before it is re-sent. For more information see "Error codes" in Section 4 of this manual.

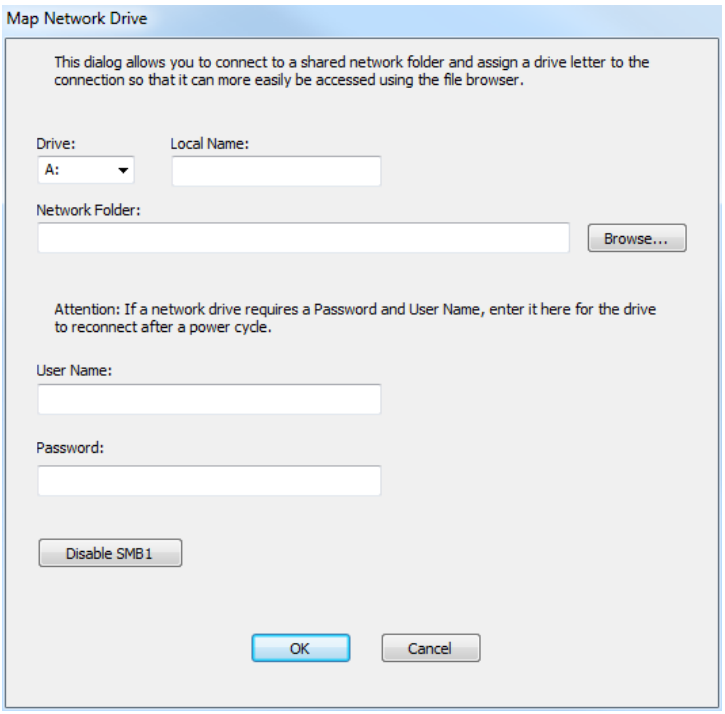
- Select the desired **Command Compatibility**. Command compatibility allows the 8800 to emulate a legacy instrument's command set. For details see "Legacy instrumentation command compatibility" later in this section.

5. Selecting **Enable Web Server** allows you to view the 8800 controller status from any computer on the network by entering the 8800's **IP Address** in a web browser. **NOTE**: This function is enabled by default.
6. Under Network Identification, enter a valid **Computer Name**, the name of the **Workgroup** this 8800 should use, and, if desired, a **Chamber Description**.
7. To map a remote folder on your network to a local drive letter, press the **Map Network Drive...** button, select the local **Drive** letter, choose a **Local Name**, and select the remote **Network Folder**.
8. To remove a mapped drive association, press the **Disconnect Network Drive...** button and select the **Network Drive** letter.

Disabling/enabling SMB1

SMB1 is a network file sharing protocol. To disable or enable the SMB1 file protocol, follow these steps:

1. Make sure the 8800 is in stop mode.
2. From any screen press **Setup**, then select the Communication panel.
3. Press the **Map Network Drive...** button.
4. Press the **Disable SMB1** button.
5. If the controller is ***not*** in stop mode, the user will be told that the controller must be in stop mode to disable or enable SMB1.
6. If the controller is in stop mode, the user will be asked if they want to disable or enable SMB1 (depending on whether SMB1 is already enabled or disabled).
   a. If the user answers **Yes**, the controller will automatically restart after disabling or enabling SMB1.
   b. If the user answers **No**, no change will be applied.



Computer I/O

The 8800 display module allows you to configure and use the computer interface capabilities of its control module. For more information, refer to the *CM2 Control Module Technical Manual*.

1. From any screen press **Setup**, then select the Communication panel.
2. Under Computer I/O select each field to modify its setting.
3. Select the desired interface (RS-**232**, RS-**485**, or **GPIB**). **NOTE**: If the 8800 has a CM2 control module with a serial I/O converter, you can use an off-the-shelf straight-through cable.
4. Select **Use Internal Card** to use an internal GPIB card.
5. If applicable:
   - Enter a valid multidrop **Address**.
   - From the **Baud Rate** menu select the highest baud rate the host computer's interface card can handle.
   - Select the desired **Parity**. To disable parity checking, select None.
   - Select the desired **Word Length**. For most applications, select Eight.
   - Select the desired **Stop Bits**. For most applications, select One.
   - Select the desired **Terminator**.
   - If needed for multidrop communication, select **Prefix** or **Send EOI**.
   - The 8800 uses the **Send Acknowledgement** function to provide feedback to the computer when it has finished processing a non-query command. When enabled, the 8800 will echo back the error code to the host computer when the non-query command has been processed. This serves two functions:

     When the error code is received by the host computer it knows that the 8800 has finished processing the command. If a response has not been received within two seconds, the command should be re-sent.

     A non-zero error code response could indicate that the 8800 did not process the command properly and it should be re-sent, or it could indicate that the 8800 processed the command properly but it was invalid for some reason and needs to corrected before it is re-sent. For more information see "Error codes" in Section 4 of this manual.
   - Select the desired **Cmd** compatibility. Command compatibility allows the 8800 to emulate a legacy instrument's command set. For details see "Legacy instrumentation command compatibility" below.

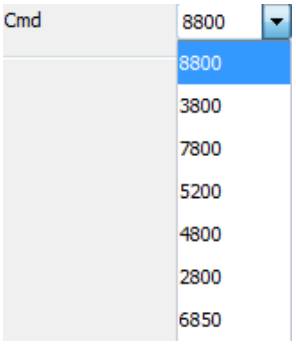
I/O diagnostics

Pressing the **IO Diagnostics** button will take you to the computer interface diagnostic panel. This panel allows you to examine the current computer I/O communications as well as the last 25 computer I/O errors that have occurred. For more information, refer to "Computer interface diagnostic panel" in Section 3 of this manual.

Legacy instrumentation command compatibility

The 8800 computer interface is fully compatible with the following legacy instrumentation's command sets:

- 3800
- 7800
- 5200
- 4800
- 2800
- 6850



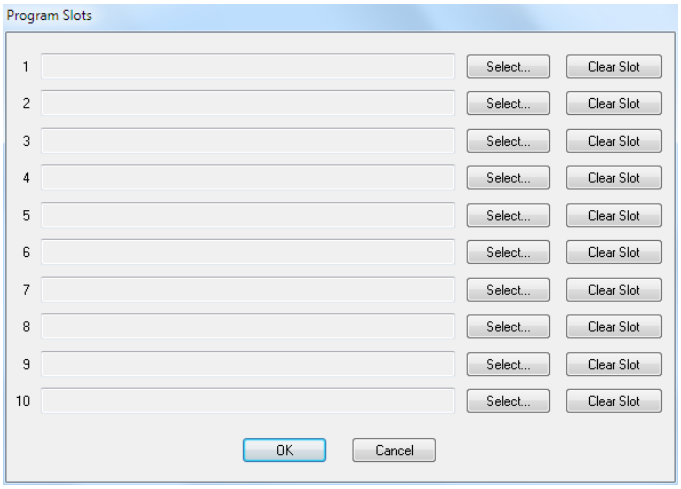
If you have a program written to control a legacy instrument it will work seamlessly with an 8800 without any changes. The 8800 can be set up to use any of the legacy command sets per interface (COM2, network, computer I/O), providing you with extra flexibility. For example, you could use your legacy software to communicate with the 8800 using GPIB, and at the same time use ThermoTrak II to communicate with the 8800 over your network.

To select which instrument's command set to use for each interface, use the **Cmd** compatibility drop-down menu. Any selection other than 8800 will cause the **Cmd Compat Program Slots...** button to appear.

Legacy program slots

In addition to selecting the desired command set, you may also set up which 8800 programs occupy the legacy instrument's 10 program slots.

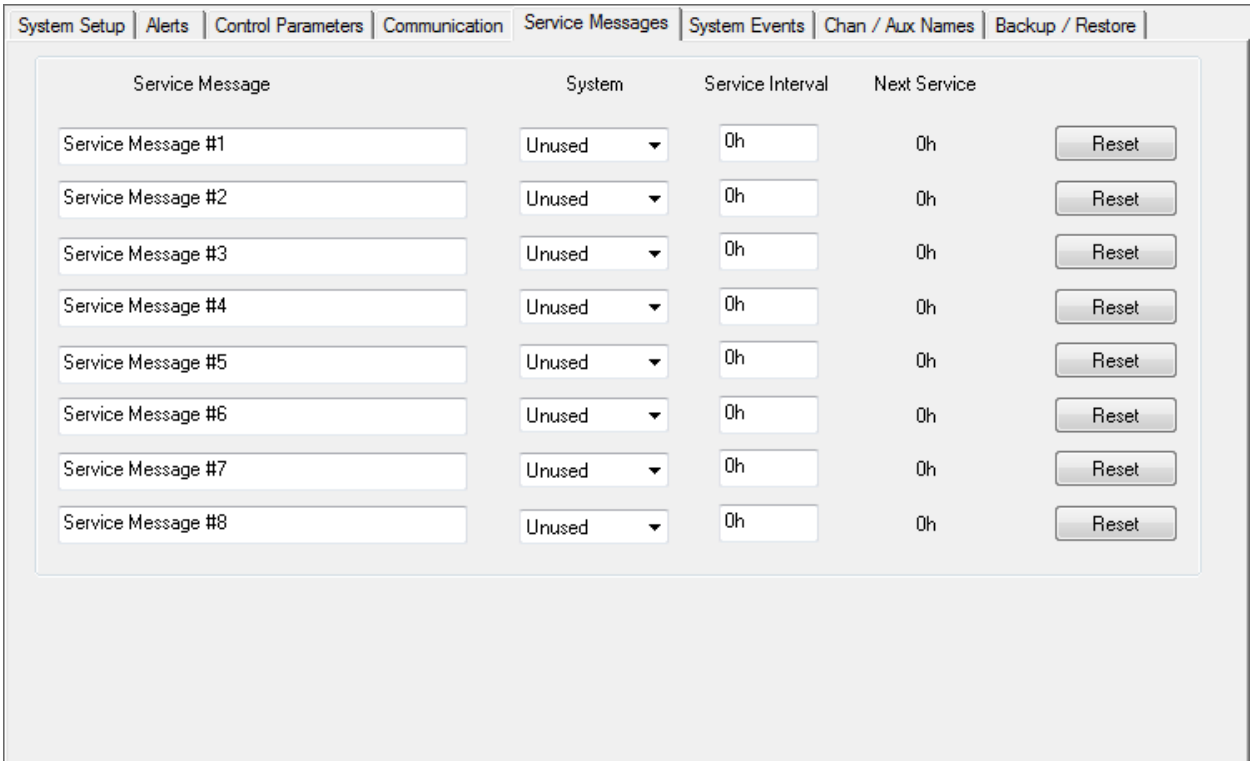
1. To view the program slot information, press the **Cmd Compat Program Slots...** button. The Program Slots dialog box will appear.
2. To assign a program to a slot, press the slot's **Select...** button, navigate to the desired program, and press **Select**.
3. To clear a program from a slot, press the slot's **Clear Slot** button.
4. To accept your selections, press **OK**. To close the Program Slots dialog box without making any selections, press **Cancel**.



Computer interface diagnostics

Pressing the **IO Diagnostics** button will take you to the computer interface diagnostic panel. This panel allows you to examine the current computer I/O communications as well as the last 25 computer I/O errors that have occurred. For more information, refer to "Computer interface diagnostic panel" in Section 3 of this manual.

Service Messages panel



NOTE: To modify service messages, the 8800 access level must be Lab Manager or higher.

The Service Messages panel allows the user to create up to eight different messages that can be displayed when certain events take place. Service messages can be based off of four types of events:

- ***System run times***: These services messages will be displayed after the selected chamber system has run for the specified service interval.
- ***Calendar dates***: These service messages will be displayed at noon on the selected date.
- ***Digital input***: These service messages will be displayed when the specified digital input (service interval) goes active. **NOTE**: An 8800 display module may be equipped with up to four CM2 control modules. Each control module has six digital inputs. The valid range for selecting a digital input service message is 1-24, where:

  1-6 refers to the six digital inputs of CM2 control module 0

  7-12 refers to the six digital inputs of CM2 control module 1

  13-18 refers to the six digital inputs of CM2 control module 2

  19-24 refers to the six digital inputs of CM2 control module 3

  To see how many control modules your 8800 display module has, refer to the instrument wiring schematic(s). For the location of the control module's digital inputs, refer to the *CM2 Control Module Technical Manual*.
- ***Digital output***: These service messages will be displayed when the specified digital output (service interval) goes active. **NOTE**: An 8800 display module may be equipped with up to four CM2 control modules. Each control module has 40 digital outputs. The valid range for selecting a digital output service message is 1-340, where:

  1-40 refers to the 40 digital outputs of CM2 control module 0

  101-140 refers to the 40 digital outputs of CM2 control module 1

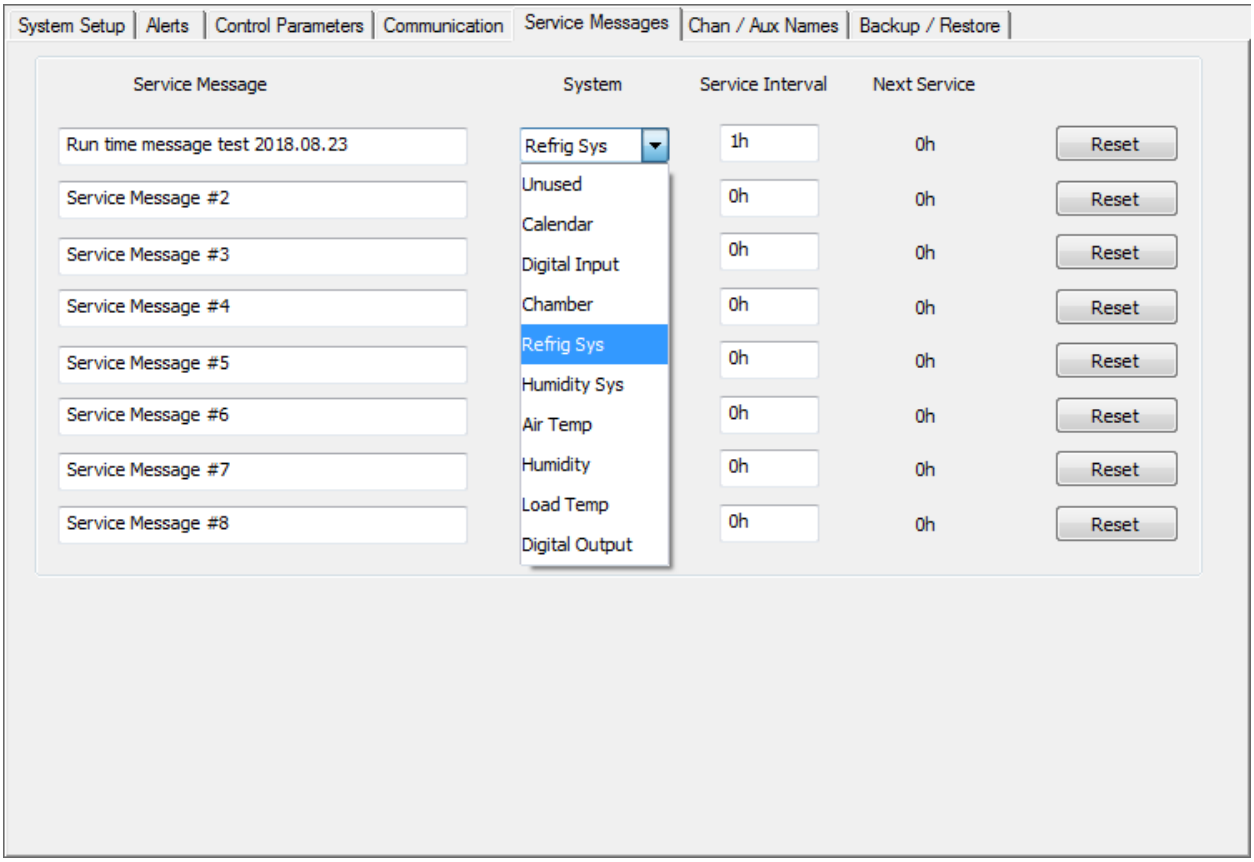
  201-240 refers to the 40 digital outputs of CM2 control module 2

  301-340 refers to the 40 digital outputs of CM2 control module 3

To see how many control modules your 8800 display module has, refer to the instrument wiring schematic(s). For the location of the control module's digital outputs, refer to the *CM2 Control Module Technical Manual*.

To modify service messages, follow these steps:

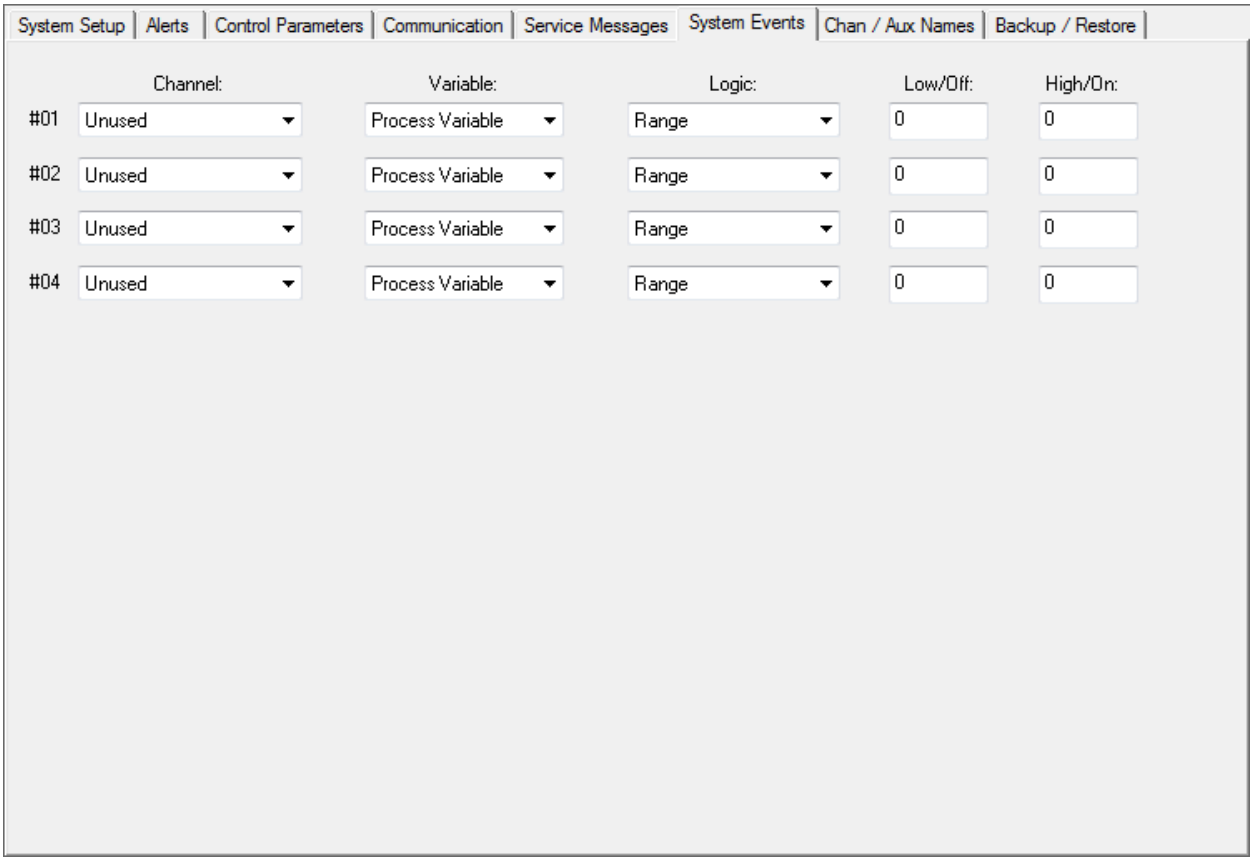
1. Select a **Service Message** field and use the alphanumeric keypad to enter the text of the message. Messages can be up to 40 characters long.
2. From the **System** drop-down menu select a system to associate with the selected service message.



3. For run time messages, select the **Service Interval** field and use the numeric keypad to enter the desired length of the interval in hours.
4. For calendar messages, select the date control and use the calendar to select the desired date.
5. For digital input and output messages, select the **Service Interval** field and use the numeric keypad to enter the desired digital input or output.
6. The **Next Service** column displays the number of hours left in each service interval before its service message is displayed.

Once the service is completed, return to the Service Messages panel and reset the message's service interval timer. To reset a service message interval timer, press **Reset**.

System Events panel



NOTE: If you do not see a System Events tab, it means your 8800 is not set up to support system events.

System events monitor variables, such as temperature or throttle, and turn digital outputs on or off based on the state of the monitored variables. **NOTE**: To configure a system event, the 8800 access level must be Lab Manager or higher. The number of system events available for your use depends on your 8800's factory configuration.

Each system event must be configured with some or all of the parameters listed in this section. These parameters specify the control points for the selected logic. The following table explains the meaning of each of these relative to the logic type selected.

Logic type	***Low/Off***	***High/On***
Range	The low value of the active range.	The high value of the active range.
Point	The off point, which may provide hysteresis.	The on point.
Duty cycle output	The time period. The total time from one on cycle to the next.	The duty cycle. The percent of the period during which the system event will be activated.
Repeat cycle timer	The off time. The amount of time the system event will be deactivated.	The on time. The amount of time the system event will be activated.

NOTE: The low/off and high/on parameters are unitless. They assume the units of the variable selected, or minutes in the case of the timers.

System event parameters defined

1. **Channel** identifies the channel associated with the system event. Any configured control or monitor channel can be used to trigger system events. Selecting **Unused** indicates that the system event is not used. For control channels the system event logic will be active only when the channel associated with it is selected and running.
2. **Variable** indicates which variable the 8800 will monitor for the selected channel. The available variable types are:
   - **Process Variable**: The system event uses the selected channel's process variable to trigger the event. Any value within the range of the selected control channel can be used.
   - **Setpoint**: The system event uses the selected channel's set point to trigger the event. Any value within the range of the selected control channel can be used.
   - **Throttle**: The system event uses the selected channel's throttle to trigger the event. The range is -100% throttle to +100% throttle.
   - **Deviation**: This variable is the process variable minus the set point. This variable uses the same unit of measurement as the process variable and set point.
3. **Logic** indicates the type of system event. This parameter determines when the 8800 will activate and deactivate the system event. The available logic types are:
   - **Range**: The system event output will be activated when the variable is within the selected range (between the low and high parameters, inclusive).
   - **Point**: The system event output will be activated when the variable is at the on point, and deactivated when the variable is at the off point. This provides some switching hysteresis when required. The relative values of the on point and the off point determine the logic as follows:

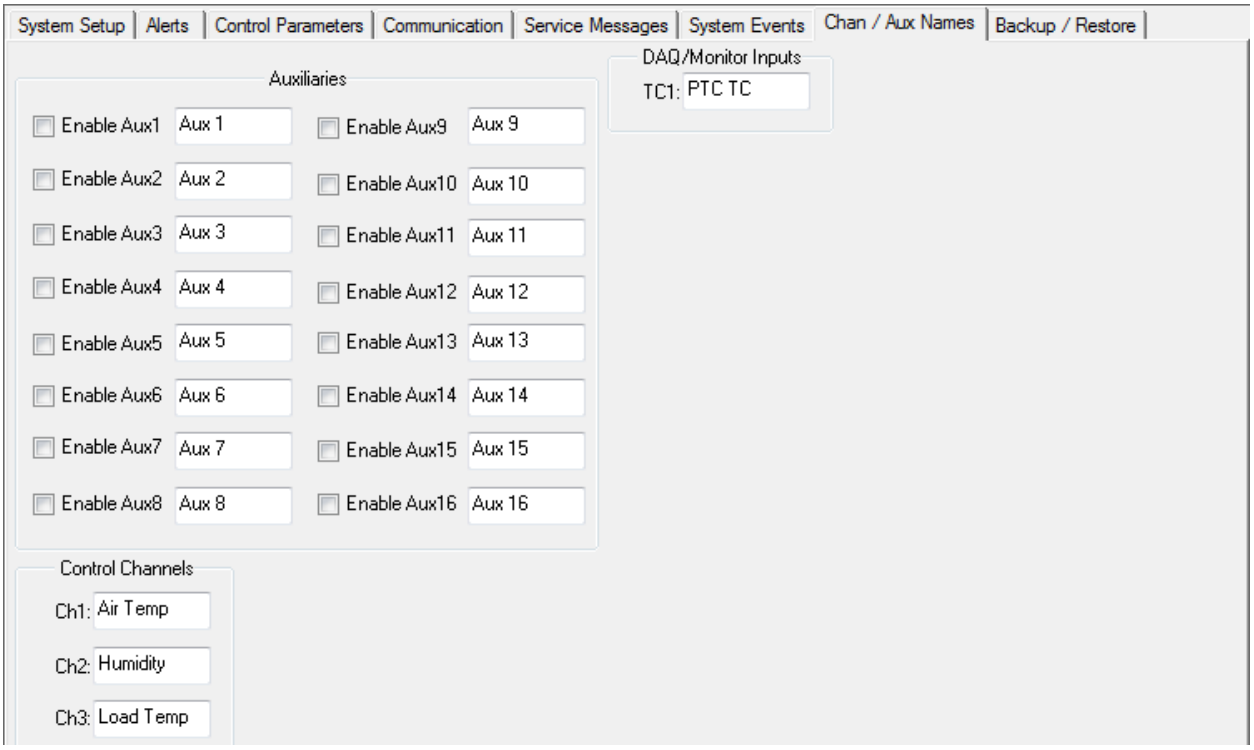
On point ≥ Off point		
Var ≤ Off	Off < Var < On	Var ≥ On
Deactivate	No Change	Activate
On point < Off point		
Var ≤ On	On < Var < Off	Var ≥ Off
Activate	No Change	Deactivate

   - **Duty Cycle**: This type of system event will provide a pulse output based on the low and high settings. The low/off setting specifies the output's period in minutes, and the high/on setting specifies the output's duty cycle (percentage on). For example, a low/off setting of 1.0 with a high/on setting of 50.0 will provide a 50% duty cycle pulse with a period of one minute (the output will be activated for 30 seconds and deactivated for 30 seconds).
   - **Repeat Cycle**: This type of system event will provide a variable pulse with an adjustable on/off time setting. This type of system event is very similar to the duty cycle type, except that the parameters are set differently. The low/off setting specifies the off time in minutes, and the high/on setting specifies the on time in minutes.
4. **Low/Off**: Low or off point
5. **High/On**: High or on point

Setting up system events

1. From the main screen press **Setup**, then select the System Events panel.
2. Before you change any system event parameters, you should record the original settings.
3. Select each field to modify its setting.
4. Record the new system event settings on the 8800 worksheets in Appendix E. Keep these settings with the 8800 manual.

Chan/Aux Names panel



NOTE: To modify any of these settings, the 8800 access level must be Lab Manager or higher. To help reduce clutter in the program and manual mode screens, enable only the auxiliary relays of interest.

The Chan/Aux Names panel allows you to assign descriptive names to auxiliaries, control channels, and DAQ/monitor inputs for display in all screens and data logging. This panel also lets you enable or disable the displaying of auxiliary relay names. **NOTE**: Disabling the displaying of an auxiliary relay name does not disable the actual auxiliary relay.

Modifying auxiliary relay settings

1. From any screen press **Setup**, then select the Chan/Aux Names panel.
2. To enable an auxiliary relay to be displayed in the program or manual mode screens, etc., select the auxiliary's **Enable** check box.
3. To rename an auxiliary relay, select the field of the auxiliary relay you want to rename. When the alphanumeric keypad appears, enter the desired name of the auxiliary relay.

Changing a control channel name

1. From any screen press **Setup**, then select the Chan/Aux Names panel.
2. Select the field of the control channel name you want to modify.
3. When the alphanumeric keypad appears, enter the desired name of the channel.

Changing a DAQ/monitor input name

1. From any screen press **Setup**, then select the Chan/Aux Names panel.
2. Select the field of the DAQ/monitor input name you want to modify.
3. When the alphanumeric keypad appears, enter the desired name of the input.

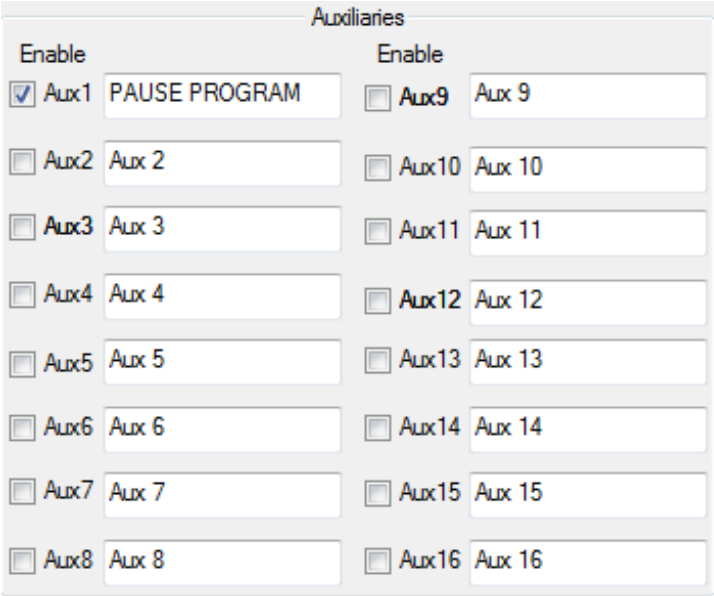
PAUSE PROGRAM auxiliary

Beginning with 8800 software version V4.110, the PAUSE PROGRAM auxiliary function allows a user to pause a program at the start of any interval by enabling a specially named auxiliary output. Once the program has been paused using the PAUSE PROGRAM auxiliary, it can be resumed by pressing the **Run** button, triggering an external **Run** digital input, or issuing the **RESM** computer I/O command.

- Only one auxiliary can be named PAUSE PROGRAM. If more than one auxiliary has the name PAUSE PROGRAM, only the first one (the one assigned to the lowest auxiliary number) will have the PAUSE PROGRAM logic.
- The PAUSE PROGRAM logic is available only when running a program. When the PAUSE PROGRAM auxiliary is enabled during any interval of a running program, in addition to the PAUSE PROGRAM logic it will also turn on any outputs configured for this auxiliary number in the same way as a normal auxiliary. In manual mode an auxiliary named PAUSE PROGRAM will behave the same as any other auxiliary.

Setup

1. From any screen press **Setup**, then select the Chan/Aux Names panel.
2. Enable one of the auxiliaries and change its name to PAUSE PROGRAM. **NOTE**: The name ***must*** be in all capital letters. You should name only one auxiliary PAUSE PROGRAM.

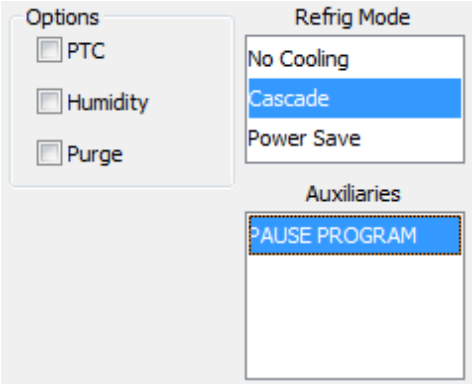


Programming and operation

When creating a program, select the PAUSE PROGRAM auxiliary in any interval that you would like the 8800 to pause (enter hold mode) when the controller reaches that interval at run time.

During the running of any program, whenever an interval is reached that has a PAUSE PROGRAM auxiliary enabled, the program will immediately enter hold mode at the start of the interval. The program will remain in hold mode until one of the following occurs:

- The **Run** button is pressed, or
- An external **Run** input is triggered, or
- The **RESM** computer I/O command is issued, or
- The program enters stop mode for any reason.

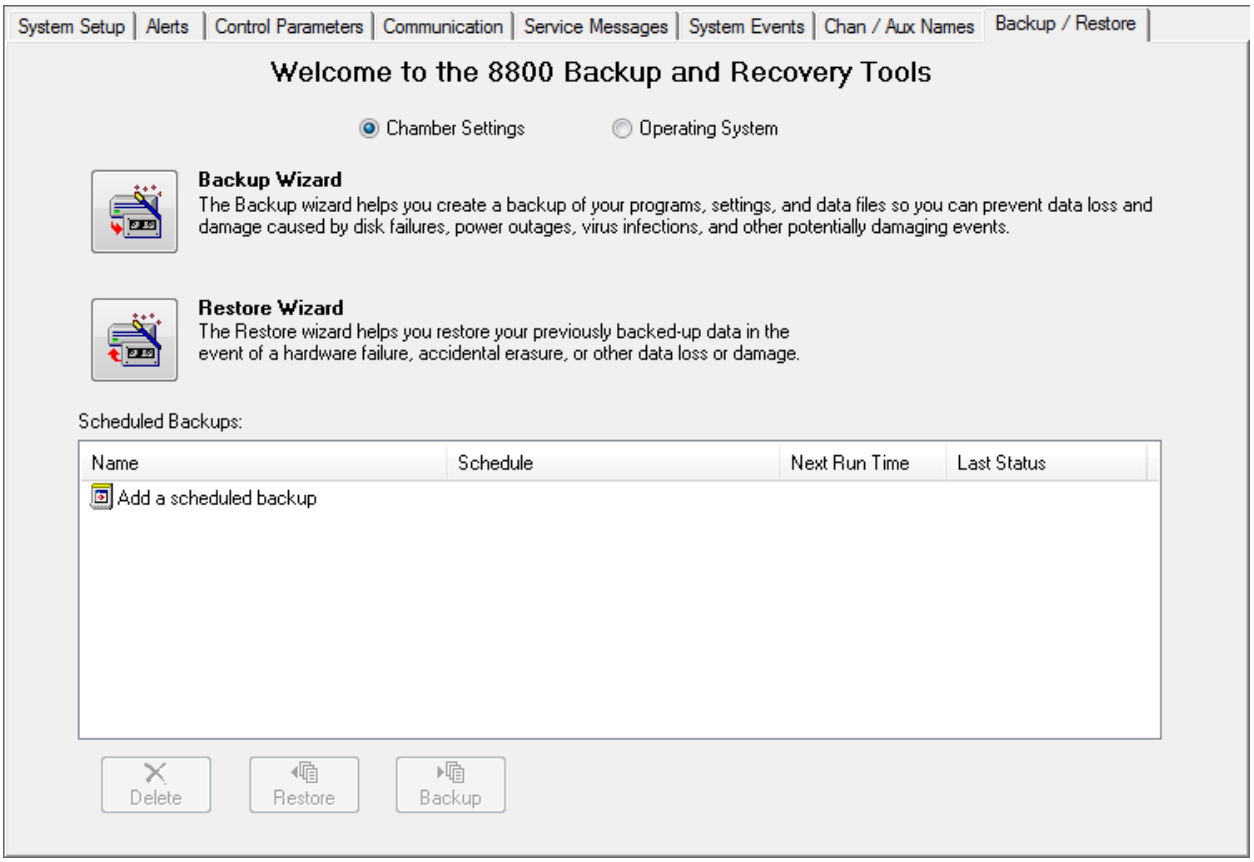


Backup/Restore panel

The 8800 has two types of built-in backup and restore functions:

- **Chamber Settings**: This feature lets you back up and restore your chamber's information, including its setup information, programs, data log, and activity log.
- **Operating System**: This feature lets you set system-wide restore points, which can be used to restore your system to a previously known state if anything unexpected happens.

Backup and recovery tools: Chamber settings



The **Backup Wizard** helps you create immediate or scheduled backups of your programs, settings, and data files so you can prevent data loss and damage caused by disc failures, power outages, virus infections, and other potentially damaging events.

To back up your programs, settings, activity log, and data files, follow these steps:

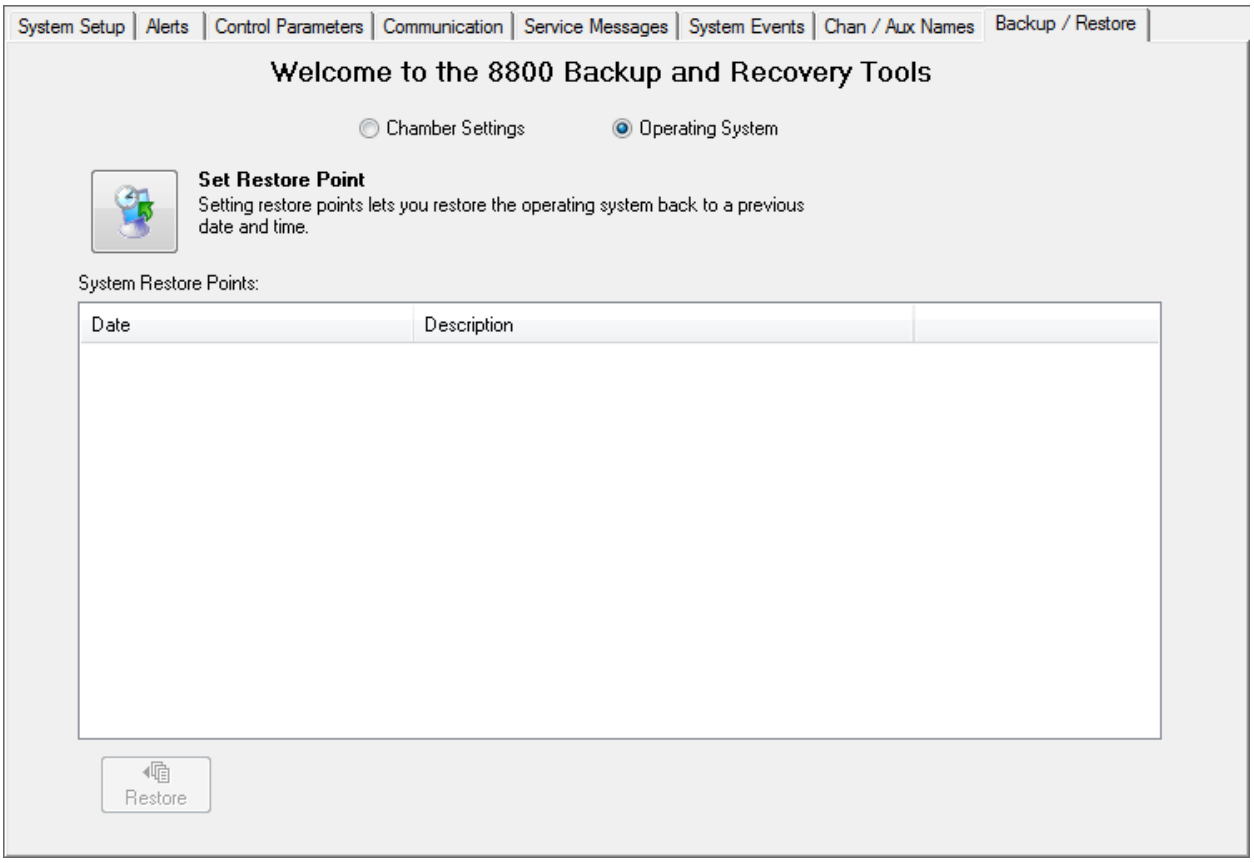
1. From any screen press **Setup**, then select the Backup/Restore panel.
2. Press **Backup Wizard** and follow the instructions on the screen.
3. To delete a scheduled backup, select the item in the **Scheduled Backups** field, then press **Delete**.

The **Restore Wizard** helps you restore your previously backed-up data in the event of a hardware failure, accidental erasure, or other data loss or damage.

To restore previously backed-up data, perform one of the following:

- Press **Restore Wizard** and follow the instructions on the screen.
- Select the item in the **Scheduled Backups** field, then press **Restore**.

Backup and recovery tools: Operating system



Restore Points let you restore the entire operating system (not including data) to a previously known state. If your system is free of problems, such as viruses, you may wish to set a restore point. Then at any time in the future if problems arise you could restore the operating system back to exactly the way it was when you created the restore point.

To set a restore point, follow these steps:

1. From any screen press **Setup**, then select the Backup/Restore panel.
2. Press the **Operating System** radio button.
3. Press the **Set Restore Point** button and follow the instructions on the screen.

To restore the system to a previous point, follow these steps:

1. From any screen press **Setup**, then select the Backup/Restore panel.
2. Press the **Operating System** radio button.
3. Choose a restore point from the list and press **Restore**.

Specific backup example

To create a backup file for a specific range of dates, follow these steps:

1. Insert your flash drive into one of the USB ports on the 8800 SBC unit. For more information on the USB ports, refer to Section 6 of this manual.
2. Press the **Setup** icon on the right-hand side of the 8800 screen.
3. Select the **Backup/Restore** tab.
4. Make sure the **Chamber Settings** radio button is selected.
5. Select the **Backup Wizard** button and press **Next** to continue.
6. Select all four of the check boxes and press **Next** to continue.
7. Select the **Now** radio button and press **Next** to continue.
8. Select the **Custom** radio button.
    a. Select the **Start Box** and select the start date from the calendar.
    b. Select the **End Box** and select the end date from the calendar.
    c. Press **Next** to continue.
9. Press the **Browse** button and a dialog box will open.
    a. Select your flash drive from the **Media** drop-down menu.
    b. Select the file name text box and enter the chamber serial number (for example, 45123).
    c. Press **Save** to continue.
10. Press **Next** to continue.
11. Press **Finish** to save the backup file to the flash drive.
12. Remove the flash drive from the 8800.

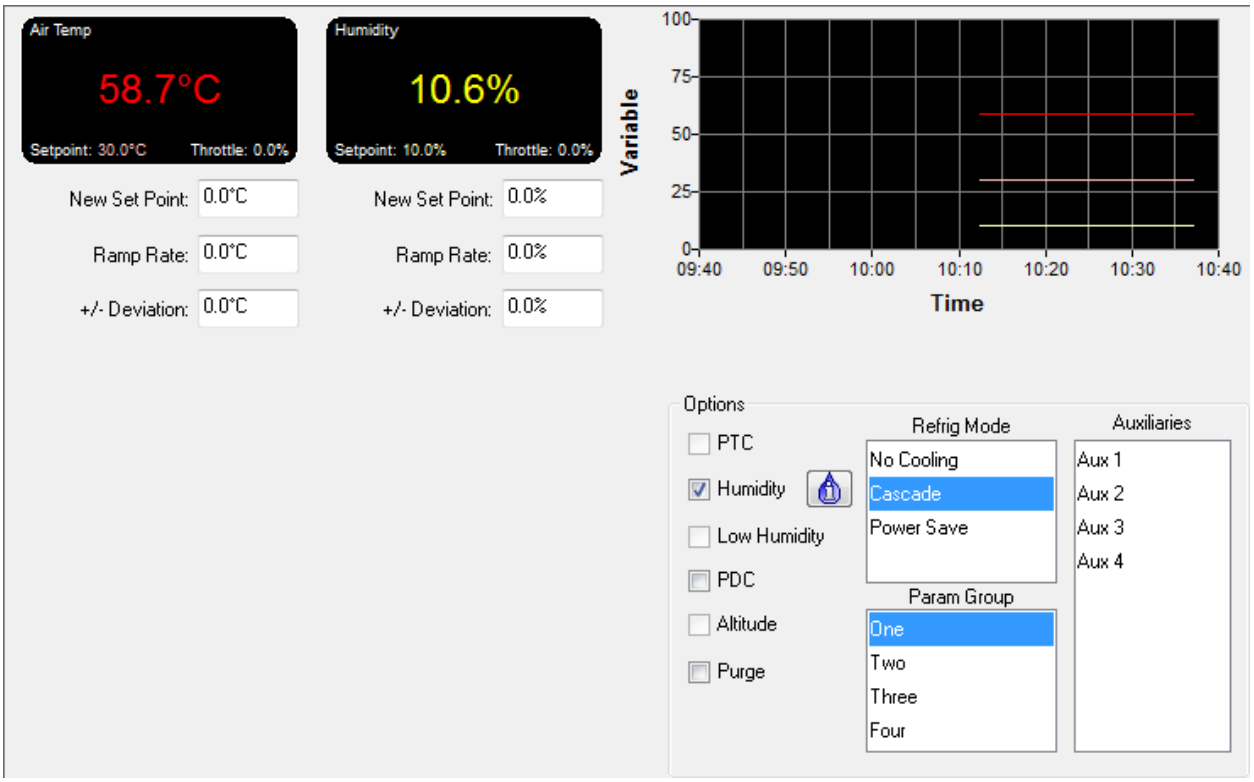
Section 2: Operation

Manual mode operates the 8800 using set point and rate of change (ramp rate) settings. You can enter manual mode when the system is in stop mode. For instructions see "Running in manual mode" below. **NOTE**: You also can enter manual mode from hold program mode if, while running a program, you want to perform a special operation in manual mode and then continue with the program. See Step 7 of "Running a program" later in this section.

Program mode operates the 8800 using programs. Each program consists of a group of intervals, up to a maximum of 300 intervals per program. In each interval the controller cycles the chamber toward a final temperature and/or other process variable in a specified amount of time. Once the interval is completed, the 8800 either transitions to the next interval or loops back to an earlier interval. Once a program is entered into memory it can be run immediately, or it can be set up for a delayed start. For instructions see "Program mode operation" later in this section.

Running in manual mode

1. Press **Manual**. The manual mode screen will appear.

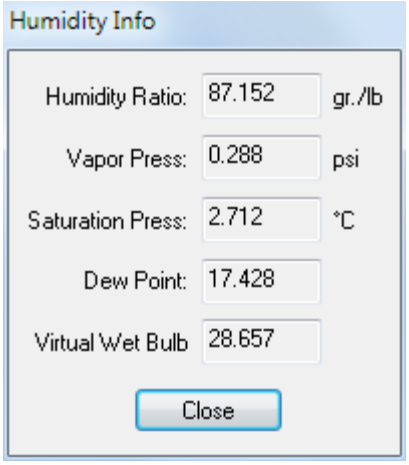


2. Select and change the settings for the manual mode test. The following list describes the manual mode values and options displayed:

   - **New Set Point**: Enter the desired value for each active channel. When the ramp rate is not zero, the set point will change toward this new value at the selected rate.
   - **Ramp Rate**: Enter the desired number of degrees or other units per minute. If you enter a setting other than zero, the controller ramps to the new set point, changing the set point in a timed ramp. If you enter a zero, the controller performs a step change. During a step change, the 8800 outputs a full demand (±100% throttle) until it enters the set point's proportional band. **NOTE**: Each active channel can have its own unique ramp rate that runs simultaneously.

- **+/- Deviation**: Enter the value for how far you will allow the temperature or other process variable to be from set point. The deviation setting will be monitored and the deviation alarm will be activated if the value is exceeded. Enter a positive number only; the 8800 will monitor both positive and negative deviations. **NOTE**: The **+/- Deviation** field appears only if the 8800 was factory-configured with at least one alarm output.
- **PTC**: Enables product temperature control — an optional heating and cooling process that controls the process variable from the product temperature rather than the test space air temperature. **NOTE**: Product temperature control is disabled if humidity is enabled.
- **Humidity**: Enables the optional humidity system. **NOTE**: Humidity is disabled if product temperature control (**PTC**) or altitude is enabled.

  For humidity information press the humidity information button next to the **Humidity** field. The Humidity Info dialog box will appear.



- **Low Humidity**: Enables the optional low humidity system. **NOTE**: Low humidity is disabled if product temperature control (**PTC**) or altitude is enabled.
- **PDC**: Enables product dew point control. The 8800 will control the temperature and humidity outputs in order to maintain the dew point at a value less than or equal to the monitored load temperature minus the dew point offset. The PDC option must be enabled before or at the same time as a temperature or humidity transition. Turning the PDC option on during a transition will not allow the function to operate, since the set points will have already changed. **NOTE**: The PDC option can be enabled only when the **Humidity** option is enabled. For more information on product dew point control, see Appendix B of this manual.
- **Altitude**: Enables the altitude option (if applicable). **NOTE**: Altitude is disabled if humidity is enabled.
- **Purge**: Enables the purge option (if applicable).
- **Thermotrimmer**: Enables the thermotrimmer option (if applicable).
- **Refrig Mode**: Select the desired refrigeration mode for this manual mode test. **NOTE**: Power Save is available on SE-Series chambers only.
- **Param Group**: Select the desired parameter group for this manual mode test. For more information, see "Control Parameters panel" in Section 1 of this manual.
- **Auxiliaries**: Select the auxiliary relays you want to activate. For information on enabling/disabling the display of auxiliary relay names, see "Chan/Aux Names panel" in Section 1 of this manual. **NOTE**: Standard auxiliaries are active only when the 8800 is in run mode. Live auxiliaries can be enabled without the 8800 being in run mode. For more information on your live auxiliaries, refer to your chamber manual.

3. To start running in manual mode using the settings entered above, press **Run**.
4. To suspend the test at its current settings, press **Hold**. The 8800 will enter hold manual mode.
5. To resume running a suspended test, press **Run**.
6. To stop manual mode operation, press **Stop**.

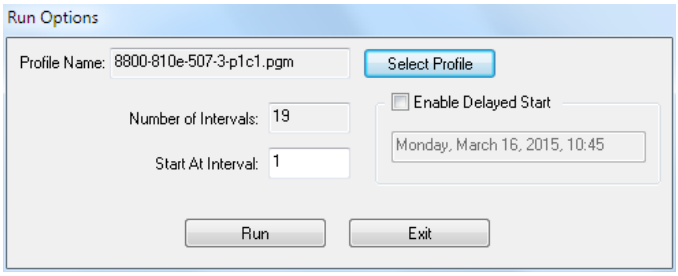
Program mode operation

The programmer function operates the 8800 using programs. Each program consists of a group of intervals. In each interval the controller cycles the chamber toward a final temperature and/or other process variable in a specified amount of time. Once the interval is completed, the 8800 either transitions to the next interval or loops back to an earlier interval. Once a program is entered into memory it can be run immediately, or it can be set up for a delayed start.

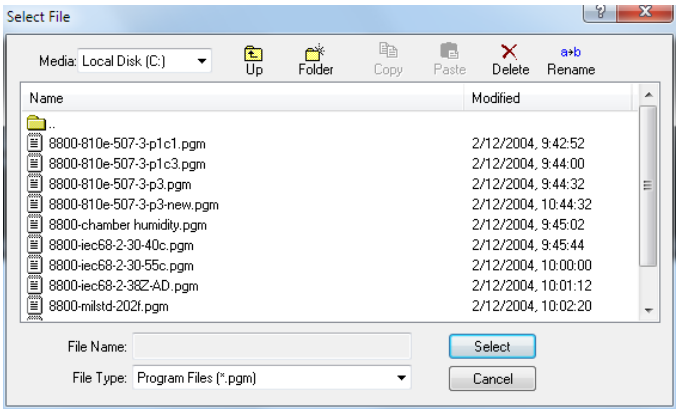
To run an existing program, see “Running a program” below. To resume a test that was previously stopped, see “Resuming a test” later in this section. To create or modify a program, see “Programmed cycling” later in this section.

Running a program

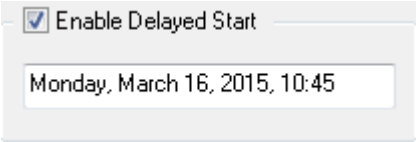
1. With the 8800 in stop mode, press **Run** from any screen other than the manual mode screen. The Run Options dialog box will appear.



2. The name of the currently loaded profile appears in the **Profile Name** field. To load a different profile:
   a. Press the **Select Profile** button. The Select File dialog box will appear.
   b. Select the profile you want to load.
   c. Press **Select**.

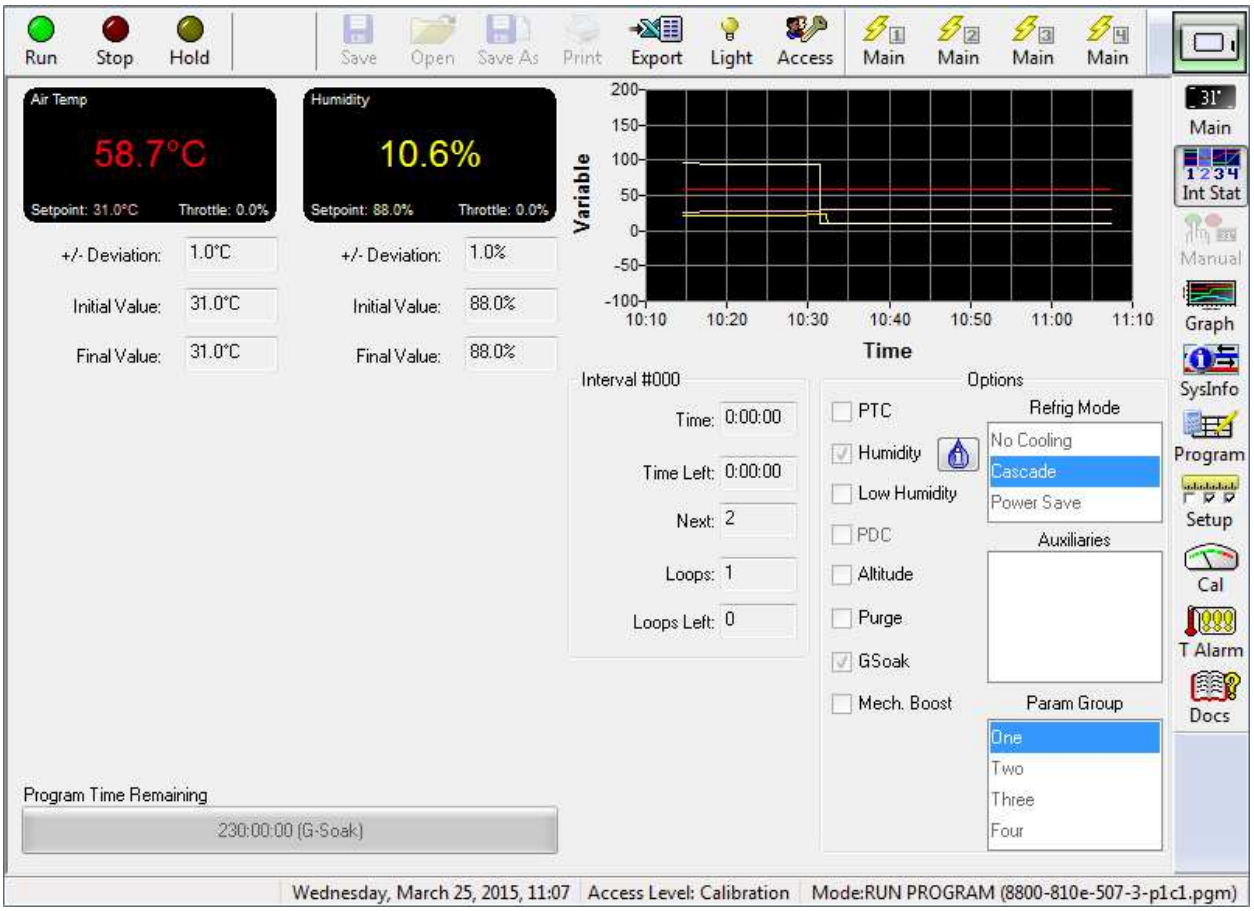


3. The **Number of Intervals** field displays the total number of intervals in the loaded profile. The **Start At Interval** field shows the starting interval (the default value is 1). To start the loaded profile at an interval other than 1, select the **Start At Interval** field and use the numeric keypad to enter the desired starting interval.
4. To schedule the selected profile to start at a preset time in the future:
   a. Select **Enable Delayed Start**.
   b. Select the adjacent date and time field to choose when to start running the program.



   c. Press **Start Delay**. The 8800 will enter delayed start mode and the **Run** indicator will turn blue.

   NOTE: You cannot run another program or enter manual mode while a delayed start is pending. To cancel a delayed start, press **Run**, then press **Cancel Delay**.
5. To start the program immediately, press **Run**. The 8800 will enter run program mode, the **Run** indicator will turn green, and the interval status screen will appear. A progress bar in the bottom left corner will display the **Program Time Remaining**.



6. For humidity information press the humidity information button next to the **Humidity** field. The Humidity Info dialog box will appear.

7. To suspend the interval at its current settings, press **Hold**. The 8800 will enter hold program mode and the edit button will appear in the lower left corner of the screen. **NOTE**: In hold program mode the 8800 will maintain the chamber test space at the last set point.

   a. To enter temporary values into the current interval, go to step 8.

   b. To resume running a suspended test, press **Run** and go to step 9.

8. To enter temporary values into the current interval:

   a. Press the **Edit** button.

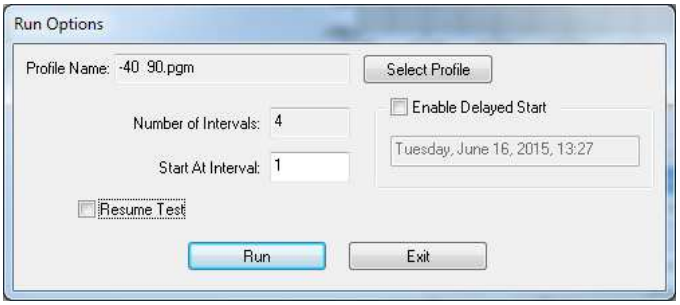
   b. Select and enter the temporary values and options as desired. **NOTE**: If you want to permanently save these changes to the current program, press the **Save** button. If you want to permanently save these changes to a program with a new name, press the **Save As** button. Otherwise, once the interval is completed, the temporary values will be discarded and the next time the interval is run the original programmed values will apply.

   c. Press the **Edit** button again, then press **Run**. The 8800 will enter run program mode again using the new values for the remainder of the current interval.

9. To stop a running test, press **Stop**.

Resuming a test

If the last test that was run stopped for any reason before it completed, the next time the Run Options dialog box is displayed a **Resume Test** checkbox will be available. To resume the test from the point it was previously stopped, check this selection and press **Run**.



Programmed cycling

The 8800 provides programmed control of the temperature and other process variable cycling operations for your chamber. This section provides a general description of programmed cycling and programming options, followed by step-by-step programming procedures.

The basic purpose of a chamber is to cycle products through a wide range of environmental conditions.

- During temperature or quality testing, temperatures and other process variables are changed at a specified rate to verify product performance.
- During stress screening, process variables are changed as quickly as possible to force any early life failures on each product.

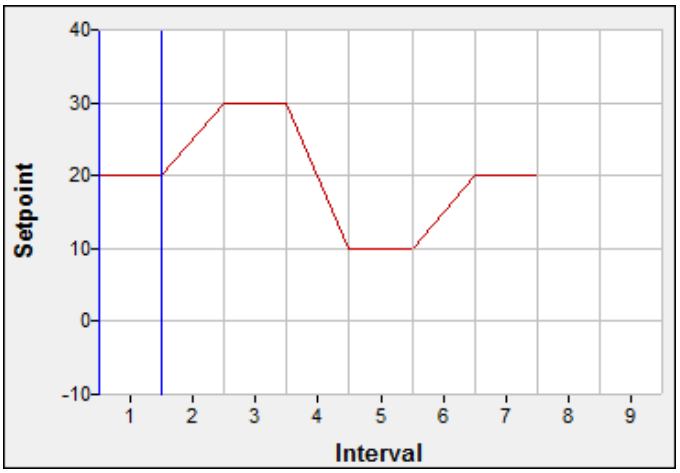
To perform process variable cycling, programs are written to control the chamber. Each program is made up of intervals, up to a maximum of 300 intervals per program. Each interval runs the chamber from an initial value to a final value in a specified amount of time. An interval's time can vary up to 99 hours, 59 minutes, 59 seconds, and is limited only by the speed a chamber can reach a given parameter. Refer to your chamber manual's performance specifications to determine change rates.

Each basic interval is programmed with the following entries:

- **Initial Value** is the starting value of the set point for this program. Initial values can be edited only in interval 1. After the first interval, the initial value is always the final value of the previous interval.
- **Final Value** is the ending value of the set point for this interval.
- **Deviation** controls how far you will allow the temperature or other process variable to be from set point. The deviation will be monitored and the deviation alarm will activate if the value is exceeded. **NOTE**: In an interval with guaranteed soak (**G-Soak**) enabled, the 8800 will immediately set the set point equal to the interval's final value and then wait until the process variable is within the deviation band of the final value. Once the process variable is within the deviation band, the interval time will begin counting down. For multiple-channel programs, all non-zero deviation bands must be satisfied before the interval time will begin counting down.
- **Ramp Rate** controls the speed (in degrees or other units per minute) at which the 8800 cycles a process variable to a new set point. **NOTE**: Each active channel can have its own unique ramp rate that runs simultaneously.
- **PTC** enables product temperature control, an optional heating and cooling process that controls the process variable from the product temperature rather than the test space air temperature. PTC uses the load temperature to control the channel 1 air set point for faster load stabilization. **NOTE**: Product temperature control is disabled if humidity is enabled.
- **Humidity** enables the optional humidity system. The humidity system should be enabled only in the temperature range selected under Humidity Temperature Range on the System Setup panel. For more information, see "System Setup panel" in Section 1 of this manual. **NOTE**: Humidity is disabled if product temperature control (PTC) or altitude is enabled.

- **Low Humidity** enables the optional low humidity system. **NOTE**: Low humidity is disabled if product temperature control (PTC) or altitude is enabled.
- **PDC** enables product dew point control, an optional humidity control process. The 8800 will control the temperature and humidity outputs in order to maintain the dew point at a value less than or equal to the monitored load temperature minus the dew point offset. The PDC option must be enabled before or at the same time as a temperature or humidity transition. Enabling the PDC option during a transition will not allow the function to operate, since the set points will have already changed. **NOTE**: The PDC option can be enabled only when the **Humidity** option is enabled. For more information on product dew point control, see Appendix B of this manual.
- **Altitude** enables the altitude option (if applicable). **NOTE**: Altitude is disabled if humidity is enabled.
- **Purge** enables the purge option (if applicable).
- **Thermotrimmer**: Enables the thermotrimmer option (if applicable).
- **Refrig Mode** allows you to select the refrigeration mode for each interval. **NOTE**: Available on SE chambers only.
- **Auxiliaries** (auxiliary relays) may be enabled or disabled for each interval. For information on enabling/disabling auxiliary relays, see "Chan/Aux Names panel" in Section 1 of this manual. **NOTE**: Standard auxiliaries are active only when the 8800 is in run mode. Live auxiliaries can be enabled without the 8800 being in run mode.
- **Time** is the duration of the interval. This value controls how fast the set point is to be cycled from initial value to final value.

  The image to the right illustrates a sample temperature program with seven intervals. Each interval represents an action or condition inside the chamber. The first interval ensures the chamber reaches a given starting temperature, in this case 20°C. The second interval increases ("ramps") to the next required temperature of 30°C. The third interval maintains that temperature for five minutes. The fourth interval lowers the temperature to 10°C. The fifth interval holds the temperature for five minutes. The sixth interval raises the temperature to 20°C, with the seventh interval holding that temperature for five minutes.



  Along with raising, lowering, and holding the chamber temperature, each interval lasts a specified length of time. The interval time has two methods of control:

  a. If you enter a **Time** greater than zero, the 8800 performs a temperature ramp. This cycles the temperature evenly to the final temperature within the programmed time. If too short a time is programmed, the 8800 will transition to the next interval when the time runs out anyway.

  b. If you enable guaranteed soak (**G-Soak**) and set one or more **Deviations**, the 8800 will immediately set the set point equal to the interval's final value and then wait until the process variable is within the deviation band of the final value. Once the process variable is within the deviation band, the interval time will begin counting down. For multiple-channel programs, all non-zero deviation bands must be satisfied before the interval time will begin counting down.

- Sequential programming is selected by allowing the 8800 to increment to the next sequential interval (the default value in the **Next Int** field). Programmed looping is selected by using the **Next Int** and **# Loops** values. **Next Int** indicates the interval to transition to after completion of the current interval; **# Loops** is the total number of times the programmed loop will be executed.

For programmed looping, the **Next Int** value is valid only if it is less than or equal to the number of the current interval, and if the **# Loops** value is greater than 1. The interval will actually loop back to the target interval the **# Loops** value minus 1. The following rules apply to looping:

- The target interval may be the target of another loop, but must not cross into another loop. (When a loop is crossed, the target interval is between the beginning interval and the ending interval of the loop).
- Nested looping is legal. In nested looping, one loop starts and finishes inside another loop. Both loops can have the same target interval.
- The final value of the looping interval should be the same as the initial value of the target interval.
- The maximum number of separate loop patterns per program is 300.

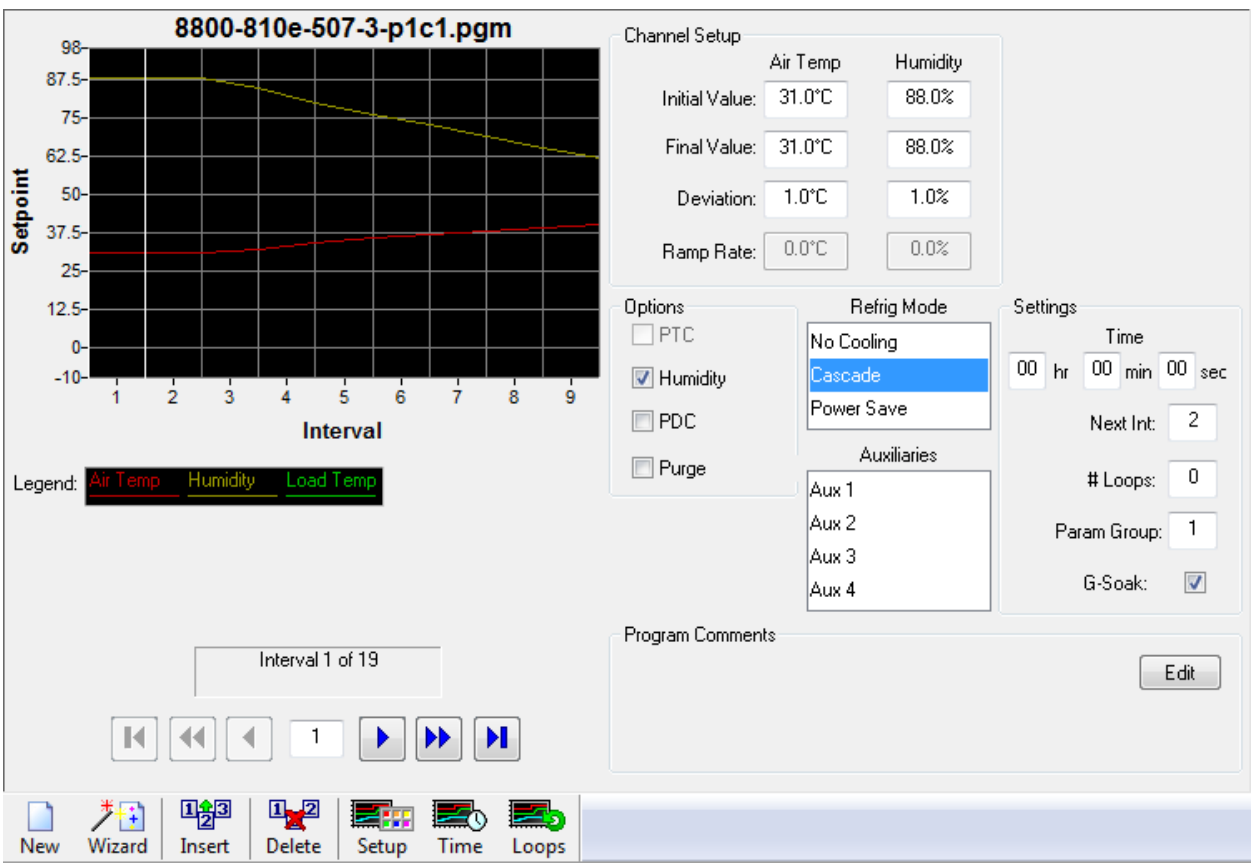
- **Param Group** allows you to select the desired parameter group for each interval. For more information, see "Control Parameters panel" in Section 1 of this manual.

Using the above program entry steps, a relatively complex program can be written. Repetitive tests can be looped and repeated rather than rewritten. Fast temperature cycles can be programmed using the guaranteed soak (**G-Soak**) method. Controlled temperature cycles can be programmed using the ramp method.

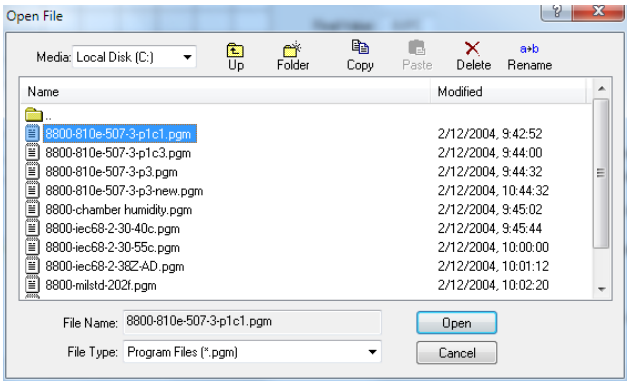
During two-channel (such as temperature/humidity) operations, the program becomes more complex. Each channel's variable is programmed with an initial value and final value. During guaranteed soaks both channels can be programmed with a deviation. All deviations must be satisfied before the interval time will begin counting down.

Creating or modifying a program

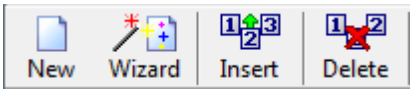
1. Press **Program**. The profile setup screen will appear.



2. If you want to modify an existing program:
   a. Press **Open**. The Open File dialog box will appear.
   b. Select the desired program.
   c. Press **Open**.
   d. Go to step 4.



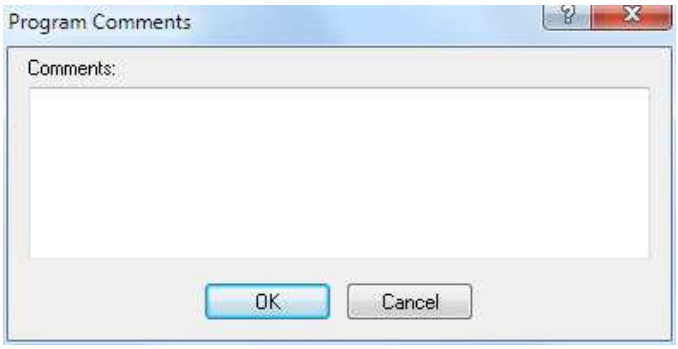
3. If you want to start with a blank profile:
   a. Press **New**.
   b. For on-screen, step-by-step instructions, press **Wizard**, press **Next**, and follow the instructions in the Profile Creation Wizard. Otherwise, go to step 4.



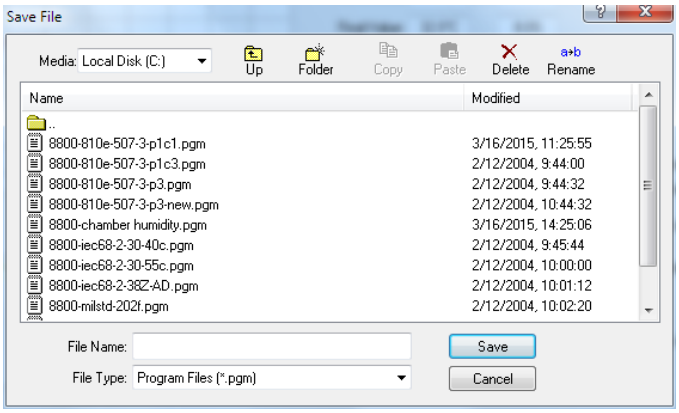
4. Select and change the settings for each interval of the program. The following list describes the program values and options displayed:
   - For **Initial Value** enter the starting value for each active channel's set point for the interval. After interval 1 the initial value will always be the final value of the previous interval and cannot be edited.
   - For **Final Value** enter the ending value for each active channel's set point for the interval.
   - For **Deviation** enter how far you will allow the selected channel's process variable to be from set point. Enter a positive number only; the 8800 will monitor both plus and minus deviations and activate the deviation alarm if the values are exceeded.
   - If you want to specify a **Ramp Rate**, enter the speed (in units of measurement per minute) for the 8800 to cycle an active channel's process variable to a new set point. (To determine change rates, refer to your chamber manual's performance specifications.) The 8800 will calculate the difference between the interval's initial and final values, divide the difference by the ramp rate, and adjust the interval **Time** accordingly. Each active channel can have its own unique ramp rate that runs simultaneously.
   - Select the desired **Options** for the interval. **NOTE**: Enabling **Humidity** disables the **PTC** (product temperature control) and **Altitude** channels. Enabling **PTC** or **Altitude** disables the **Humidity** channel. When **PTC** is enabled, only the values for the PTC channel can be edited. Depending on your chamber's configuration, other options also may disable each other.
   - Select the desired **Refrig Mode** (refrigeration mode) for the interval. **NOTE**: Power Save is available on SE-Series chambers only.
   - Select the desired **Auxiliaries** for the interval. Standard auxiliaries are active only when the 8800 is in run mode. Live auxiliaries can be enabled without the 8800 being in run mode.
   - For **Time** enter the length of the interval in hours, minutes, and seconds. The maximum interval time is 99 hours, 59 minutes, 59 seconds.
   - For **Next Int** enter the number of the interval you want the 8800 to transition to after this interval is complete. For programmed looping this number must be less than or equal to the current interval number, and the **# Loops** value must be greater than 1. If no loops are programmed, the **Next Int** field displays the number of the next interval.

- For **# Loops** enter the number of times you want the programmed loop to be executed. A loop can be repeated up to 9,999 times. **NOTE**: The interval will actually loop back to the target interval the **# Loops** value minus 1.
- Select the desired **Param Group** (control parameter group) for the interval. For more information, see "Control Parameters panel" in Section 1 of this manual.
- To enable guaranteed soak, check **G-Soak** and set one or more **Deviations**. The 8800 will immediately set the set point equal to the interval's final value and then wait until the process variable is within the deviation band of the final value. Once the process variable is within the deviation band, the interval time will begin counting down. For multiple-channel programs, all non-zero deviation bands must be satisfied before the interval time will begin counting down.
- To insert a new interval following the current interval, press **Insert**. **NOTE**: A program can have up to 300 intervals.
- To delete the current interval, press **Delete**.

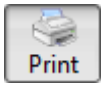
5. To add descriptive comments to your program:
   a. Press **Edit** under Program Comments. The Program Comments dialog box will open.
   b. Select the Comments field and use the alphanumeric keyboard to add your comments.
   c. To save your comments, press **OK**.



6. You may save your program at any time by pressing **Save**.
   a. The first time you save the program, select the File Name field and use the alphanumeric keypad to enter a file name.
   b. Press **Save**.



7. To print the currently loaded program as a combined graph and spreadsheet, press **Print**. **NOTE**: Programs can be printed only in interval view. Programs cannot be printed in time or expanded loop view. For more information, see "Using the program graph" below.



8. To delete a saved program:
   a. Press **Open**. The Open File dialog box will appear.
   b. Select the desired program.
   c. Press **Delete**.
   d. Press **Yes** to confirm the deletion.

Using the program graph

The program graph lets you view your program before running it. The following section describes how to set up and use the program graph.

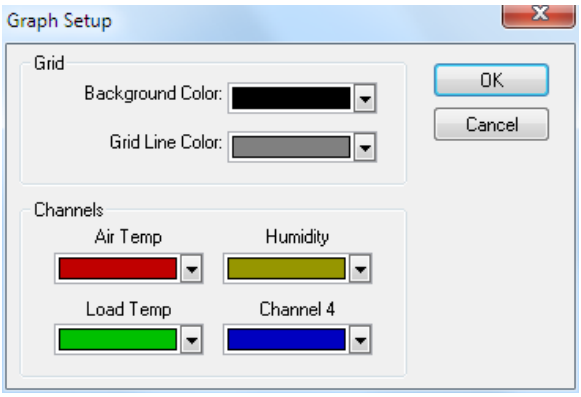
1. To modify the program graph's appearance:

   a. Press the graph **Setup** button. The Graph Setup dialog box will appear.

   b. Select the background and grid line colors from the drop-down menus.

   c. Select the channel colors from the drop-down menus.

   d. Press **OK** to accept your selections or **Cancel** to close the Graph Setup dialog box without making any selections.



2. The program data can be viewed on the graph in several different ways:

   a. To display the program with each interval given space based on its duration, select **Time**.

   b. To display the program with each interval given the same amount of space regardless of its duration, deselect **Time**.

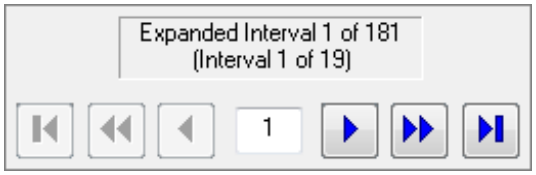
   c. In either interval or time view, you may display all of the loops in a program by selecting **Loops**.
   NOTE: To get an estimated running time of the entire program on the X axis of the graph, select **Loops** and **Time**, and then use the arrow buttons to move to the end of the program.

3. Once a program is loaded, you can use the arrow buttons to move through the graph:

   a. To move back to the first interval, press the first button.

   b. To move back 12 intervals, press the second button.

   c. To move back to the previous interval, press the third button.



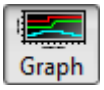
   d. To move forward to the next interval, press the fourth button.

   e. To move forward 12 intervals, press the fifth button.

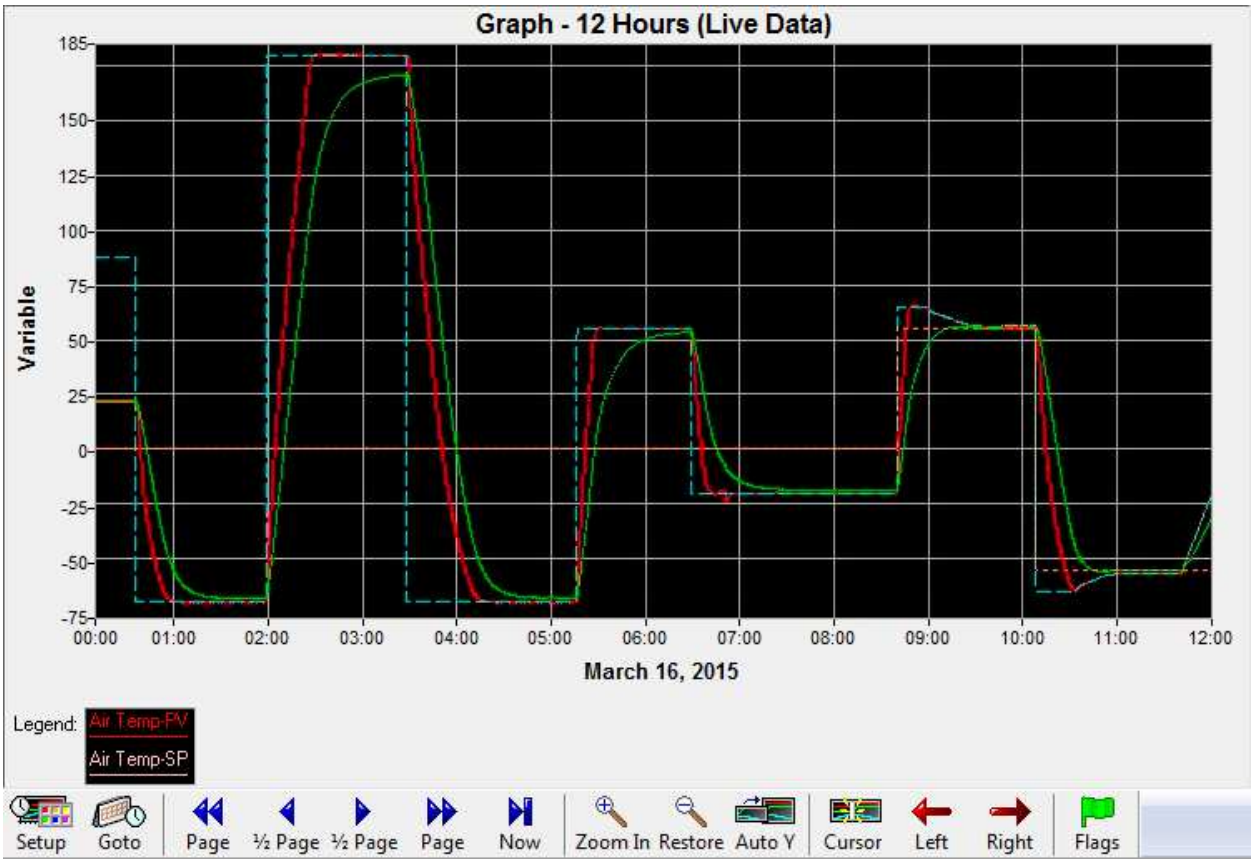
   f. To move to the last interval, press the sixth button.

   NOTE: You can jump to an interval by entering the number of the interval in the field between the arrow buttons, or by clicking on the interval in the graph.

Using the Graph panel



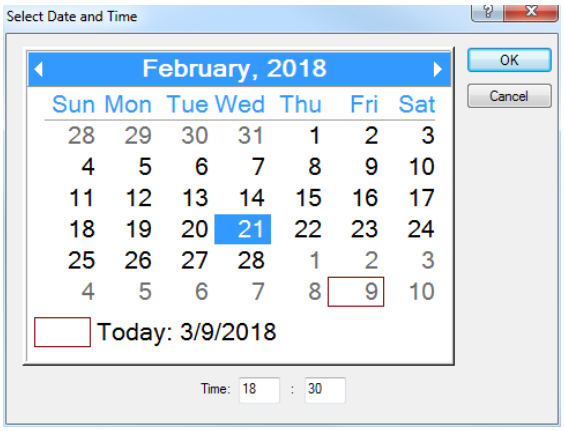
To view the graph screen press **Graph**. The graph screen allows you to see a graphic representation of chamber data you select, such as process variables, monitor channels temperatures, and refrigeration system readings. The graph setup screens allow you to customize the graph. The button bar at the button of the graph screen allows quick setup and navigation of graph data.



Using the graph buttons

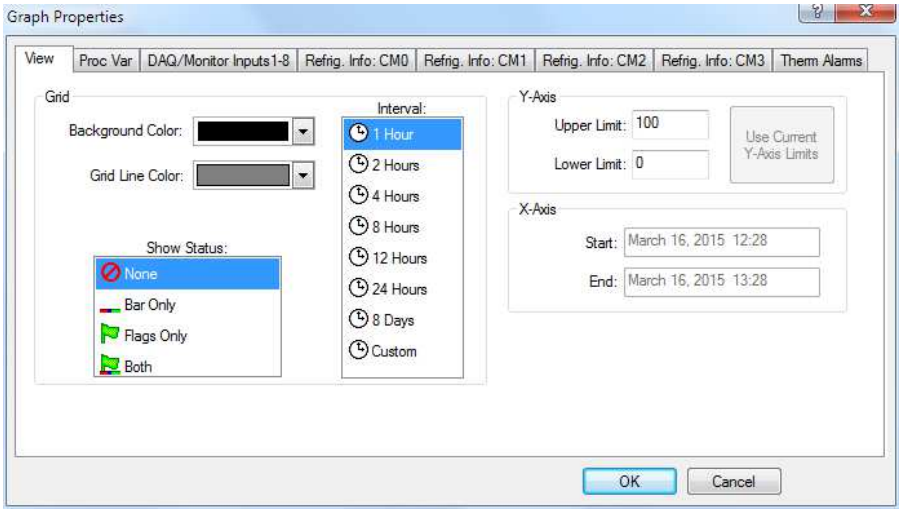
Use the graph buttons to set up and navigate through the recorded chamber data:

1. To modify the graph settings press **Setup**. See "Graph setup" below.
2. To change the graph view to a specific date and time:
   a. Press **Goto**. The Select Date and Time dialog box will appear.
   b. Select a date from the calendar. The currently displayed date is highlighted in blue and today's date is outlined in red. Use the left and right arrow buttons to display the previous and next months.
   c. Select the **Time** fields to specify a time. The selected time will appear at the center of the graph.
   d. Press **OK** to accept your selections or **Cancel** to close the dialog box without making any selections.

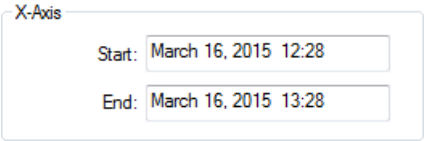


3. To move the graph backward one time period as defined by the interval time, press the first **Page** button. For example, on an eight-hour graph this button will move the graph back eight hours.
4. To move the graph backward one half time period as defined by the interval time, press the first **½ Page** button For example, on an eight-hour graph this button will move the graph back four hours.
5. To move the graph forward one half time period as defined by the interval time, press the second **½ Page** button. For example, on an eight-hour graph this button will move the graph forward four hours.
6. To move the graph forward one time period as defined by the interval time, press the second **Page** button. For example, on an eight-hour graph this button will move the graph forward eight hours.
7. To move the graph to the current date and time from any location on the graph, press **Now**.
8. To resize the graph to half of its previous Y-axis range, press **Zoom In** and then select a location on the graph. The graph will be centered around the point selected.
9. To reset the graph to its original settings (no zoom), press **Restore**.
10. To automatically adjust the Y-axis range to include the highest and lowest values in the current graph view, press **Auto Y**.
11. To activate a cursor press **Cursor**. The cursor displays the selected data readings at one point on the graph
12. To move the cursor left one time unit, press **Left**.
13. To move the cursor right one time unit, press **Right**.
14. To display chamber start and stop times at the bottom of the graph, press **Flags**. A green (run), red (stop), or yellow (hold) text box is displayed showing the state of the chamber, manual or program mode, and the date and time of the change of state.

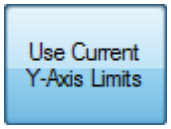
Graph setup



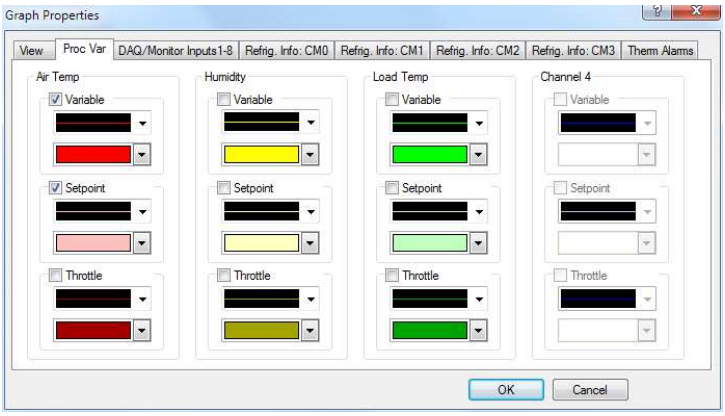
1. Press the **Setup** button to access the graph properties panels. The Graph Properties dialog box will appear with the View panel selected.
2. Under Grid, select the background and grid line colors from their drop-down menus.
3. Under **Show Status**, select how chamber status information will be displayed at the bottom of the graph.
   a. To display no chamber status information, select **None**.
   b. To display chamber status information as a bar at the bottom of the graph, select **Bar Only**. Chamber status is displayed as green (run), red (stop), yellow (hold), and blue (delayed start).
   c. To display chamber start and stop times at the bottom of the graph, select **Flags Only**. A green (run), red (stop), yellow (hold), or blue (delayed start) text box is displayed showing the state of the chamber, manual or program mode, and the date and time of the change of state.
   d. To display both chamber status information and stop and start flags at the bottom of the graph, select **Both**.
4. Under **Interval**, select the graph time span:
   - Select one of the standard time spans for the graph.
   - To specify a non-standard time span, select **Custom**. Under X-Axis select the **Start** and **End** date and time fields to modify the graph's X-axis.



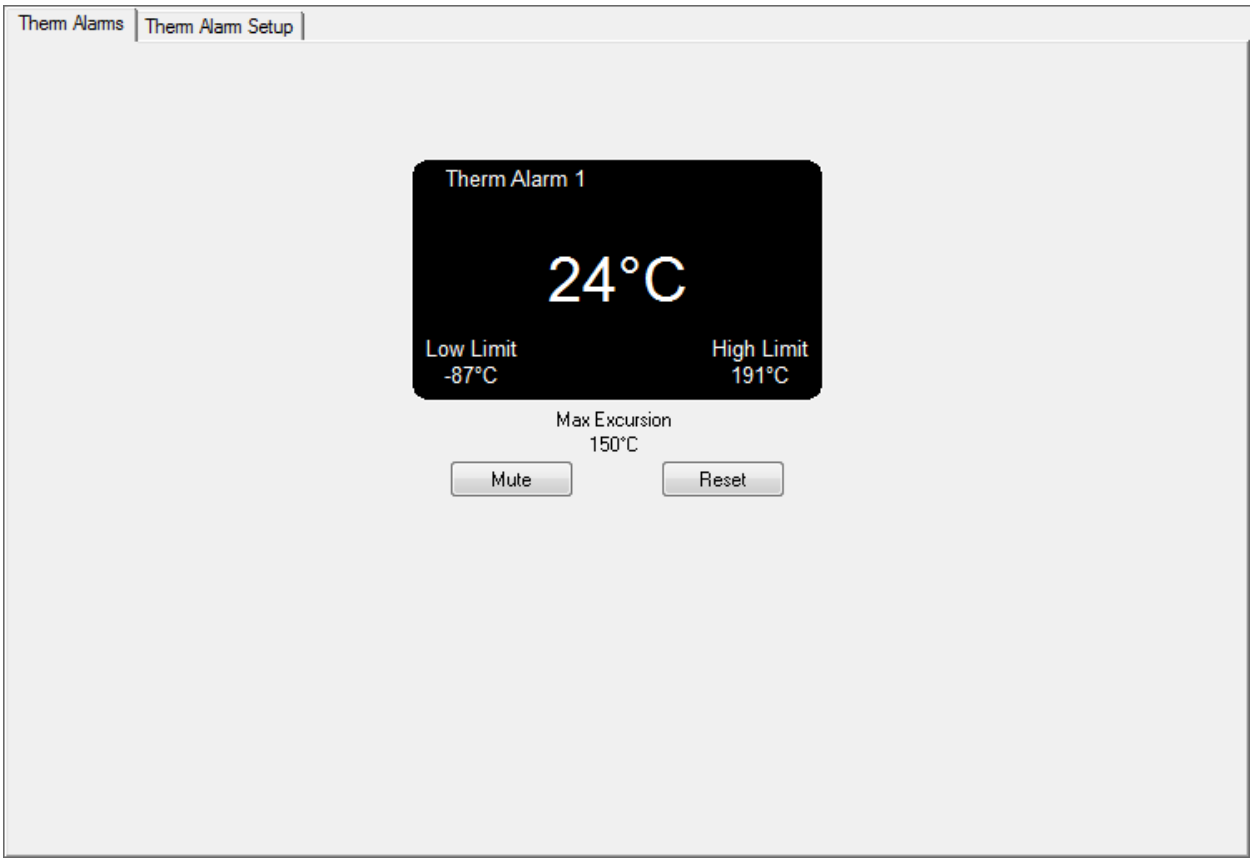
5. Under Y-Axis you can customize the graph's upper and lower limits. To select the current Y-axis settings, press **Use Current Y-Axis Limits**.



6. The other Graph Properties panels allow you to select how the graph displays process variables, monitor or internal channels, and refrigeration data. (**NOTE**: Each reading you select will continue to be graphed until you deselect it, even when the process variable or channel is not active.) For each panel:
   a. Select the appropriate check box to display a channel's **Variable**, **Setpoint**, or **Throttle** reading.
   b. From the drop-down menus, select the line type and color for each type of data displayed.
7. Press **OK** to accept your changes or **Cancel** to close the dialog box without making any changes.



Using the Therm-Alarm panels



CAUTION: It is *your* responsibility to set Therm-Alarm limits appropriate for your product, and to properly place any Therm-Alarm thermocouples or analog sensors. When used properly, the Therm-Alarm is an effective product protection device; however, it is not a fail-safe device and will not guarantee the safety of your product. If you are testing expensive products, you should have an additional back-up product protection device. If you are testing products with live electrical loads, you should install additional power cutoffs. Please call Thermotron Industries if you have any questions on additional product protection.

The Therm-Alarm is a redundant protection system. Each Therm-Alarm has one temperature channel and may also have one linear analog channel. The Therm-Alarm can detect undesirable conditions at the products under test and alert you with audible and visible alarms. The Therm-Alarm can also disconnect power to the products being tested and to the chamber heating and cooling mechanisms.

The Therm-Alarm's temperature channel uses a thermocouple to monitor the temperature at the products under test. Likewise the Therm-Alarm's analog channel monitors the signal from an analog sensing device (humidity sensor, accelerometer, etc.). If the product temperature or the analog signal exceeds either the high or low limits, the Therm-Alarm disables the control circuit at the chamber circulators. This cuts off power to the control circuitry.

This section includes a description of the Therm-Alarm operating modes and instructions for setting up, using, and calibrating the Therm-Alarm. The following terms are used in this section:

- ***Input temperature***: The temperature of the product being tested (measured by the input thermocouple).
- ***Limit temperature***: The adjustable high and low temperature settings.
- ***Analog signal***: The analog channel's signal.
- ***Analog limit***: The adjustable high and low analog channel limit settings. An alarm occurs if the input temperature reaches a limit temperature or the analog signal reaches an analog limit.

Therm-Alarm operating modes

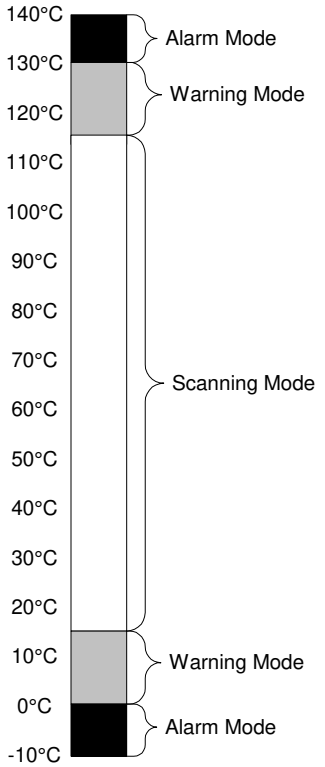
The Therm-Alarm stays in ***scanning mode*** as long as the input temperature and analog signal are within the acceptable range between the high and low warning settings.

Warning mode occurs when the input temperature comes within the warning temperature band of a limit temperature, or the analog signal comes within the warning band of an analog limit. (For information on setting the warning band, see "Changing the Therm-Alarm settings" later in this section.) The chamber heating and cooling systems continue to operate during this mode. In this mode the Therm-Alarm is automatically reset when the condition that caused the mode is removed.

The Therm-Alarm goes into ***alarm mode*** as soon as the input temperature or analog signal exceeds the high or low limits by more than five units. (For information on setting the temperature or analog limits, see "Changing the Therm-Alarm settings" later in this section.) This mode also occurs if the limit is exceeded by less than five units and the nuisance alarm timer has timed out. During alarm mode, the Therm-Alarm disconnects power to any circuit wired through its mechanical relay contacts. If the input temperature or analog signal causes an alarm and then returns to an acceptable level, the Therm-Alarm must be reset to exit from alarm mode. For information on resetting the instrument, see "Alarm mute and reset mode functions" later in this section.

Open thermocouple mode occurs when the input thermocouple is not connected or is open. During this mode the Therm-Alarm disconnects power to any circuit wired through its mechanical relay contacts. In this mode the Therm-Alarm is automatically reset when the condition that caused the mode is removed.

Failure mode occurs if the Therm-Alarm detects a problem within its own circuitry. During this mode the Therm-Alarm disconnects power to any circuit wired through its mechanical relay contacts.



High limit: +130°C
Low limit: 0°C
Warning bandwidth: 15°C

Positioning the input thermocouple or analog sensor

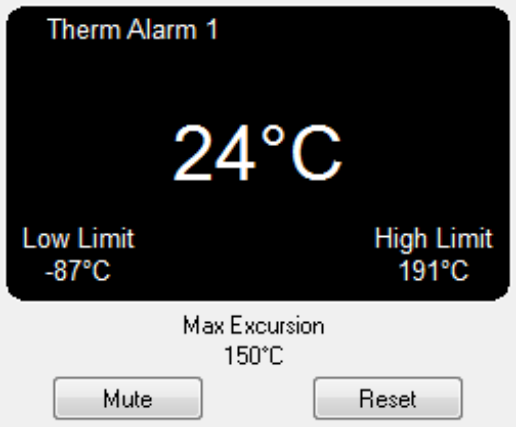
A long wire connects the input thermocouple or analog sensing device to the Therm-Alarm. Because it is important to measure the conditions of the product itself, you must place the thermocouple or analog sensor directly on the product being tested, or as close to the product as possible.

CAUTION: It is *your* responsibility to properly place any Therm-Alarm thermocouples or analog sensing devices. When used properly, the Therm-Alarm is an effective product protection device. However, it is not a fail-safe device and will not guarantee the safety of your product. If you are testing expensive products, you should have an additional back-up product protection device. If you are testing products with live electrical loads, you should install additional power cutoffs. Please call Thermotron Industries if you have any questions on additional product protection.

Viewing the Therm-Alarm settings

NOTE: No more than four Therm-Alarm devices will be displayed in the Therm-Alarm screens and graphed in the graph screens.

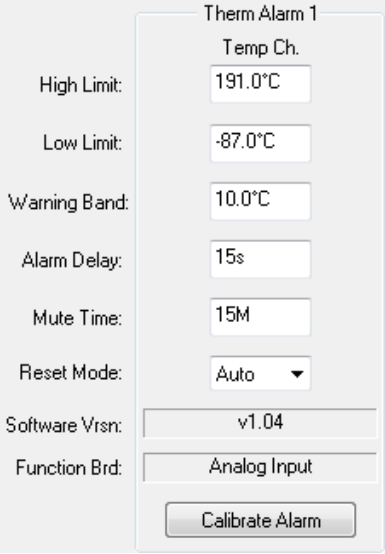
To display the Therm-Alarms panel press **T Alarm** .from any screen.



- If you have a temperature-only Therm-Alarm, you will see the current temperature at the product under test as measured by the input thermocouple. If your Therm-Alarm is configured for temperature and the additional analog channel, you will see both the current temperature and the current analog signal.
- **Low Limit** and **High Limit** indicate the temperature and analog limits that, if exceeded, will cause a Therm-Alarm trip. For information on setting these limits, see "Changing the Therm-Alarm settings" below.
- **Max Excursion** is the most extreme temperature or analog value experienced during the most recent alarm condition.

Changing the Therm-Alarm settings

NOTE: The Therm-Alarm temperature channel settings are based on the temperature scale currently selected. If you change the scale, the Therm-Alarm settings will automatically adjust.



1. From any screen press **T Alarm**, then select the Setup panel.

   CAUTION: The screen shot shown to the right displays the Therm-Alarm factory default settings. It is *your* responsibility to set Therm-Alarm limits appropriate for your product.

2. Select the **High Limit** or **Low Limit** field. In each field, use the numeric keypad to enter the temperature or analog limit that you want to cause a Therm-Alarm trip if it is exceeded at the product being tested.
3. Select the **Warning Band** field and enter the number of units from the limits you want the warning band to begin. You can enter any number from 0 to 15. To disable the warning mode select 0.
4. Select the **Alarm Delay** field and enter the number of seconds you want the alarm mode to be delayed after the input temperature or analog signal reaches a limit. You can enter any number of seconds from 0 to 30. If you select 0 seconds, the alarm mode will begin as soon as a limit temperature is reached. **NOTE**: If the limits are exceeded by more than five units, the alarm delay will not occur.
5. Select the **Mute Time** field and enter the number of minutes you want an audible alarm to remain silent after it is muted. You can enter any number of minutes from 0 to 99. If an alarm is still active after the mute period, the audible alarm will resume sounding.
6. From the **Reset Mode** drop-down menu, select **Manual** or **Auto**. This setting determines how the Therm-Alarm is reset when it is in alarm mode.
   - In manual reset mode you must go to the Therm-Alarm main screen and select **Reset** to reset the Therm-Alarm.
   - In auto reset mode the Therm-Alarm will reset itself after the input temperature or analog signal is two units inside of the acceptable range.

Alarm mute and reset mode functions

During warning, alarm, open thermocouple, and failure modes, the Therm-Alarm emits an audible alarm. From the Therm-Alarm screen you can mute the alarm and/or reset the instrument.

- In ***warning mode*** the Therm-Alarm resets itself after the input temperature or analog signal moves into the scanning mode (normal) range.
- In ***alarm mode*** the Therm-Alarm is reset manually or automatically, depending on the reset mode.

  If the reset mode has been set to manual and the input temperature or analog signal has returned to within the high and low limits, you must reset it to normal operating conditions from the Therm-Alarm screen. (See the instructions below.)

  If the reset mode has been set to auto, the Therm-Alarm resets itself when the input temperature or analog signal is at least two units inside the acceptable range. If the temperature or analog signal is still inside the warning mode band, the Therm-Alarm drops from alarm mode to warning mode.
- In ***open thermocouple mode*** the Therm-Alarm resets itself once the thermocouple is closed or repaired.
- In ***failure mode*** you must remove power from the Therm-Alarm and then apply power again to reset it.

Muting or resetting the Therm-Alarm

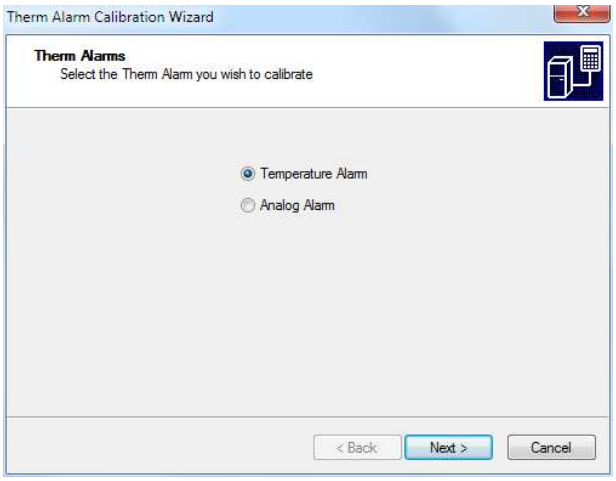
1. From any screen press **T Alarm** to display the Therm-Alarms panel.
2. To mute an audible alarm for the number of minutes set in the Therm-Alarm setup screen, press **Mute**. If an alarm is still active after the mute period, the audible alarm will resume sounding.
3. To reset the Therm-Alarm to normal operating conditions, press **Reset**.

   NOTE: For more information on the mute or reset functions, see “Changing the Therm-Alarm settings” earlier in this section.

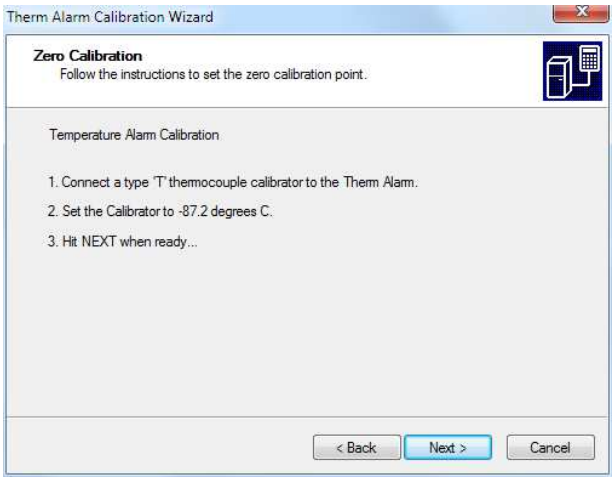
Calibrating a Therm-Alarm

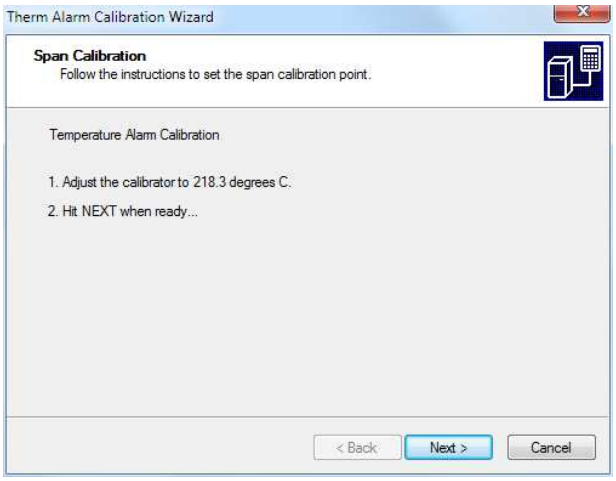
To calibrate the Therm-Alarm temperature channel a type 'T' thermocouple simulator is required. Make sure the controller's temperature scale is set to Celsius before beginning any calibration procedure. To calibrate the Therm-Alarm analog channel an appropriate power supply is required.

1. From any screen press **T Alarm**, then select the Setup panel.
2. For the Therm-Alarm you want to calibrate, press **Calibrate Alarm**.
3. If your Therm-Alarm has the analog channel configured, choose the channel you wish to configure. Otherwise go to step 4.
4. Follow the on-screen instructions to set the **Zero** and **Span** calibration points and complete the calibration.

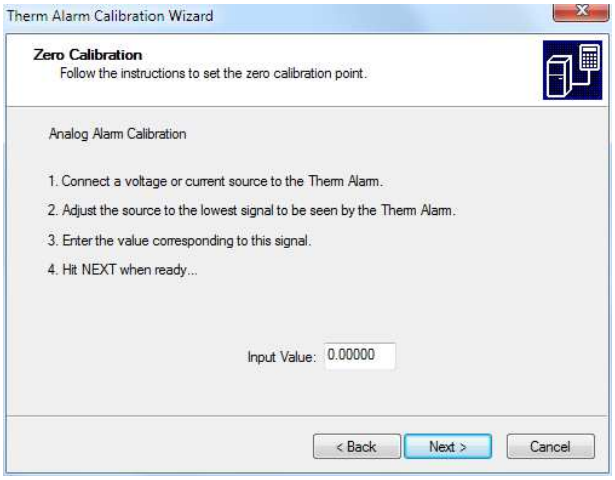


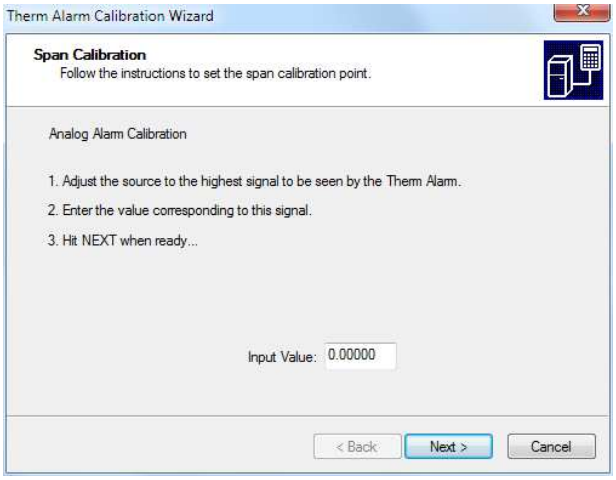
Temperature alarm calibration





Analog alarm calibration



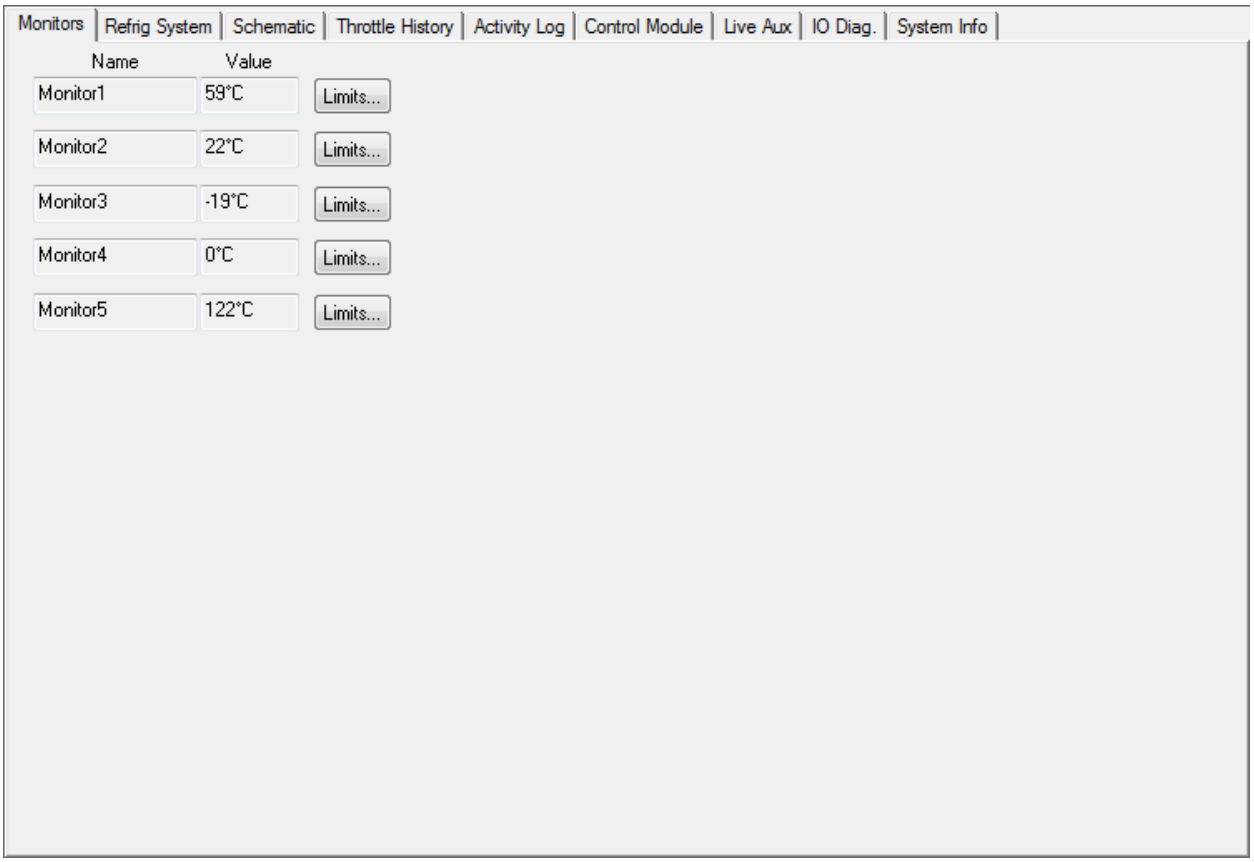


Section 3: System Information

Press **SysInfo** to access the system information panels. These panels provide diagnostic, reference, and historical information for your chamber system. This section describes the system information panels and how to use them. To return to the main screen from any system information panel, press **Main**.

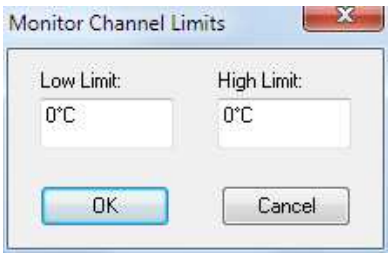
NOTE: For information on calibration, refer to Section 5 of this manual. For more information on the DAQ option, refer to the *8800 DAQ Instruction Manual*.

Monitors panel

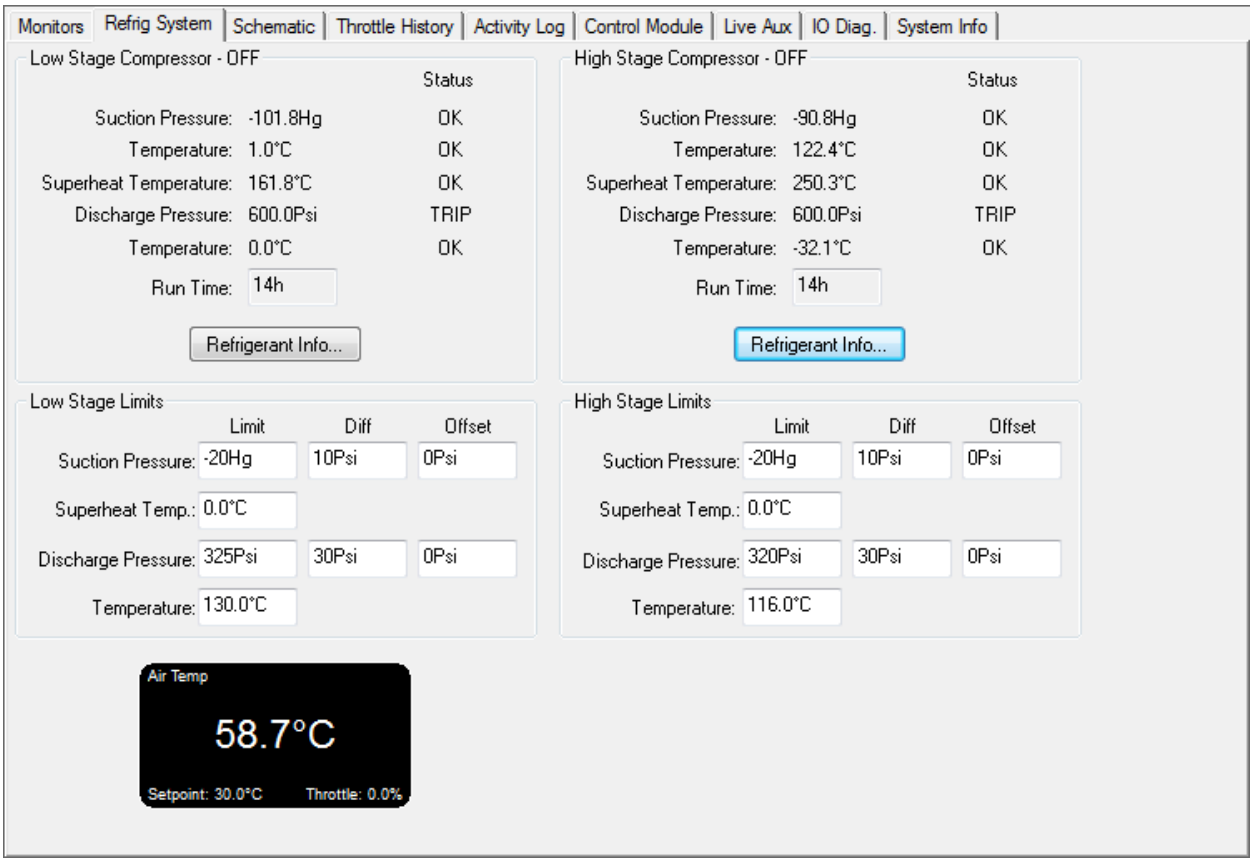


Monitor channels monitor processes within the chamber. If the high or low alarm limit is exceeded for a monitor channel, the 8800 alarm outputs are activated. **NOTE**: The Monitors panel appears only if one or more monitor channels were configured at the factory. To modify a monitor channel alarm setting, the 8800 access level must be Lab Manager or higher.

1. From any screen press **SysInfo**, then select the Monitors panel.
2. Press the **Limits** button of the desired monitor channel. The Monitor Channel Limits dialog box will appear.
3. Select the Low Limit or High Limit field.
4. When the numeric keypad appears, enter the desired alarm limit, then press **Enter**. **NOTE**: If both limits are set to zero, the alarm checking is disabled for this monitor channel.
5. Press **OK** to close the Monitor Channel Limits dialog box.



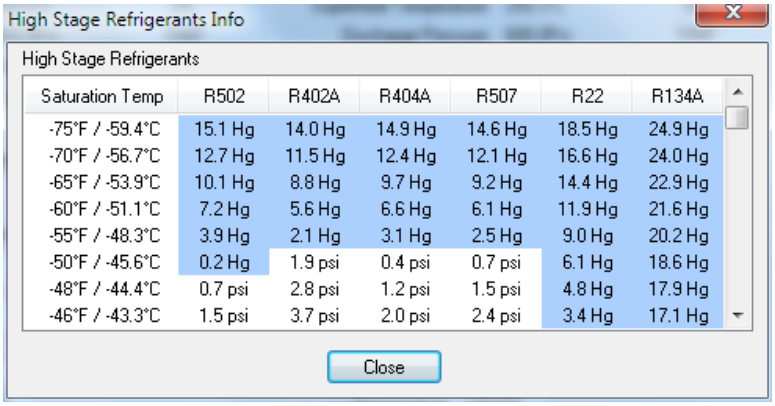
Refrigeration System panel



CAUTION: Access to the low-stage and high-stage limits is provided to allow you to troubleshoot your chamber with the assistance of a Thermotron Technical Liaison. For assistance please call the Thermotron Product Support group at (616) 392-6550.

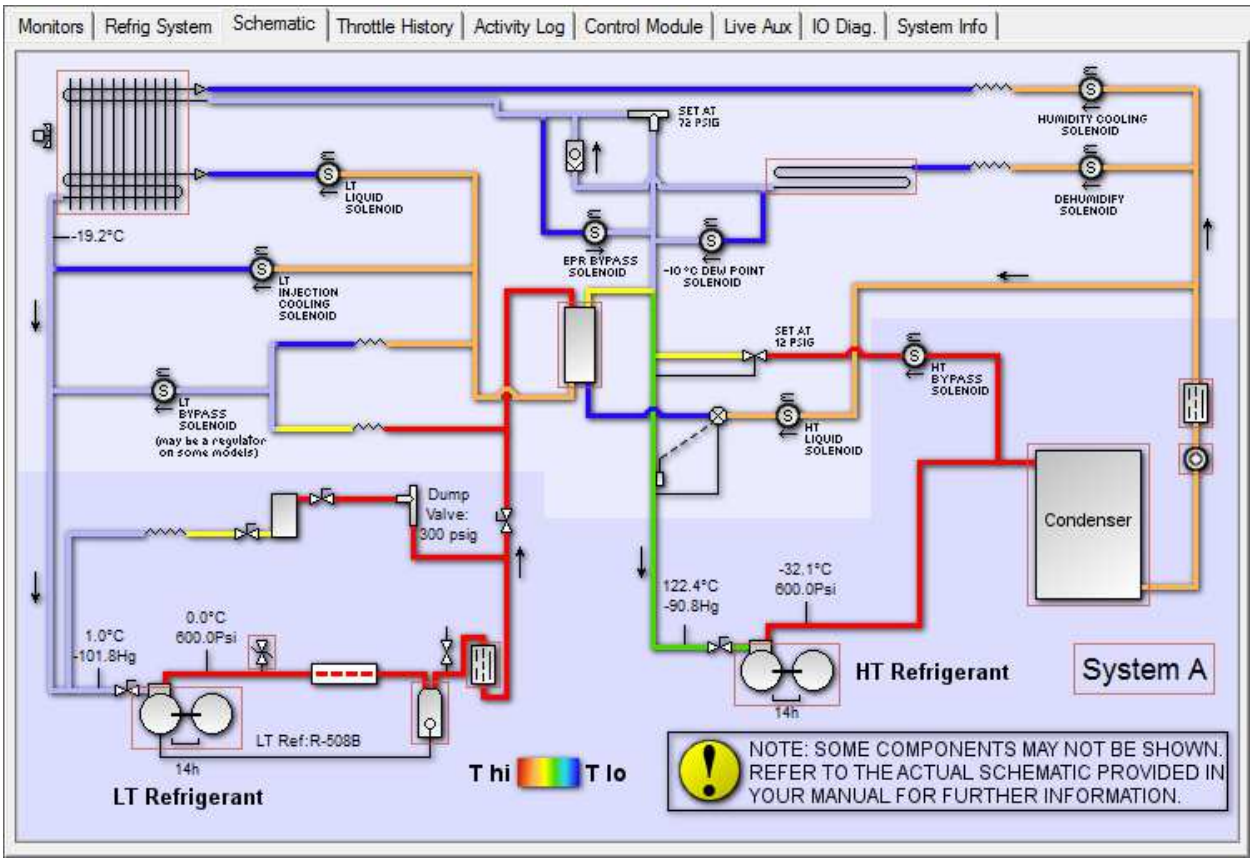
For chambers with refrigeration monitoring, the Refrig System panel provides diagnostic information, such as status, pressures, temperatures, compressor run times, and trip limits. The Refrig System panel also provides access to two pressure/temperature tables:

- For a table listing the high-stage refrigerants commonly used by Thermotron, press **Refrigerant Info...** under High Stage Compressor.
- For a table listing the low-stage refrigerants commonly used by Thermotron, press **Refrigerant Info...** under Low Stage Compressor.



Saturation Temp	R502	R402A	R404A	R507	R22	R134A
-75°F / -59.4°C	15.1 Hg	14.0 Hg	14.9 Hg	14.6 Hg	18.5 Hg	24.9 Hg
-70°F / -56.7°C	12.7 Hg	11.5 Hg	12.4 Hg	12.1 Hg	16.6 Hg	24.0 Hg
-65°F / -53.9°C	10.1 Hg	8.8 Hg	9.7 Hg	9.2 Hg	14.4 Hg	22.9 Hg
-60°F / -51.1°C	7.2 Hg	5.6 Hg	6.6 Hg	6.1 Hg	11.9 Hg	21.6 Hg
-55°F / -48.3°C	3.9 Hg	2.1 Hg	3.1 Hg	2.5 Hg	9.0 Hg	20.2 Hg
-50°F / -45.6°C	0.2 Hg	1.9 psi	0.4 psi	0.7 psi	6.1 Hg	18.6 Hg
-48°F / -44.4°C	0.7 psi	2.8 psi	1.2 psi	1.5 psi	4.8 Hg	17.9 Hg
-46°F / -43.3°C	1.5 psi	3.7 psi	2.0 psi	2.4 psi	3.4 Hg	17.1 Hg

Schematic panel



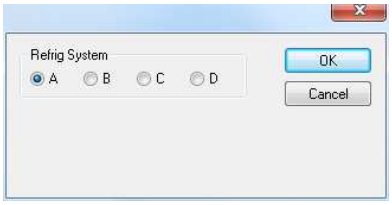
NOTE: This panel is available only on SE-Series chambers.

The Schematic panel provides a graphical view of a typical Thermotron refrigeration system. The schematic is color-coded to indicate the relative temperatures within the system. If transducers are installed, the Schematic panel provides live refrigeration data for key components of the system.

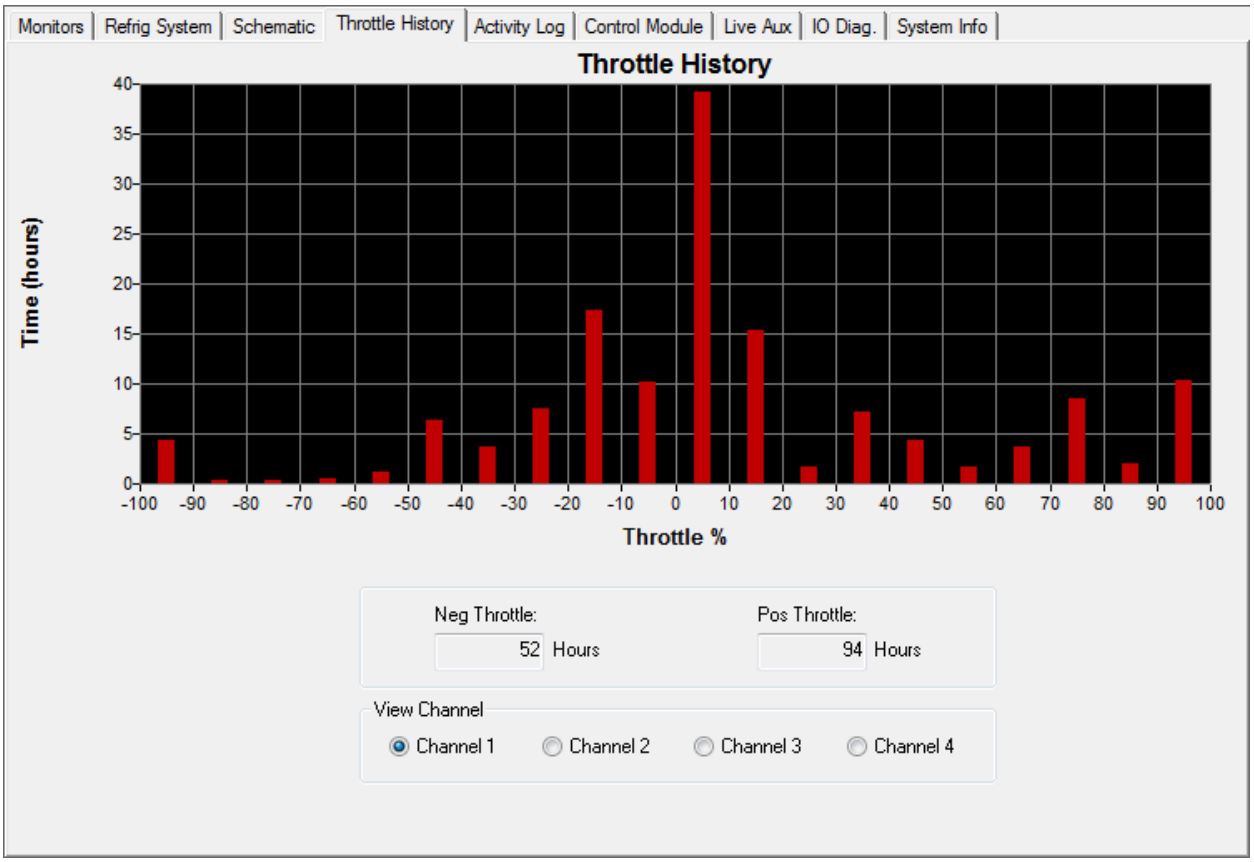
Several of the components in the schematic are outlined with fading boxes. Pressing these components brings up additional information about them. For example, pressing the gray rectangle near the center of the schematic brings up the cascade condenser information shown to the right.

A chamber with more than one refrigeration system will have a schematic for each system. To select the schematic for a different system, press the name of the system displayed just above the bottom right corner of the schematic.

In the sample illustration at the top of this page, pressing **System A** will bring up a dialog box that allows you to select the schematic for refrigeration system A, B, C, or D.



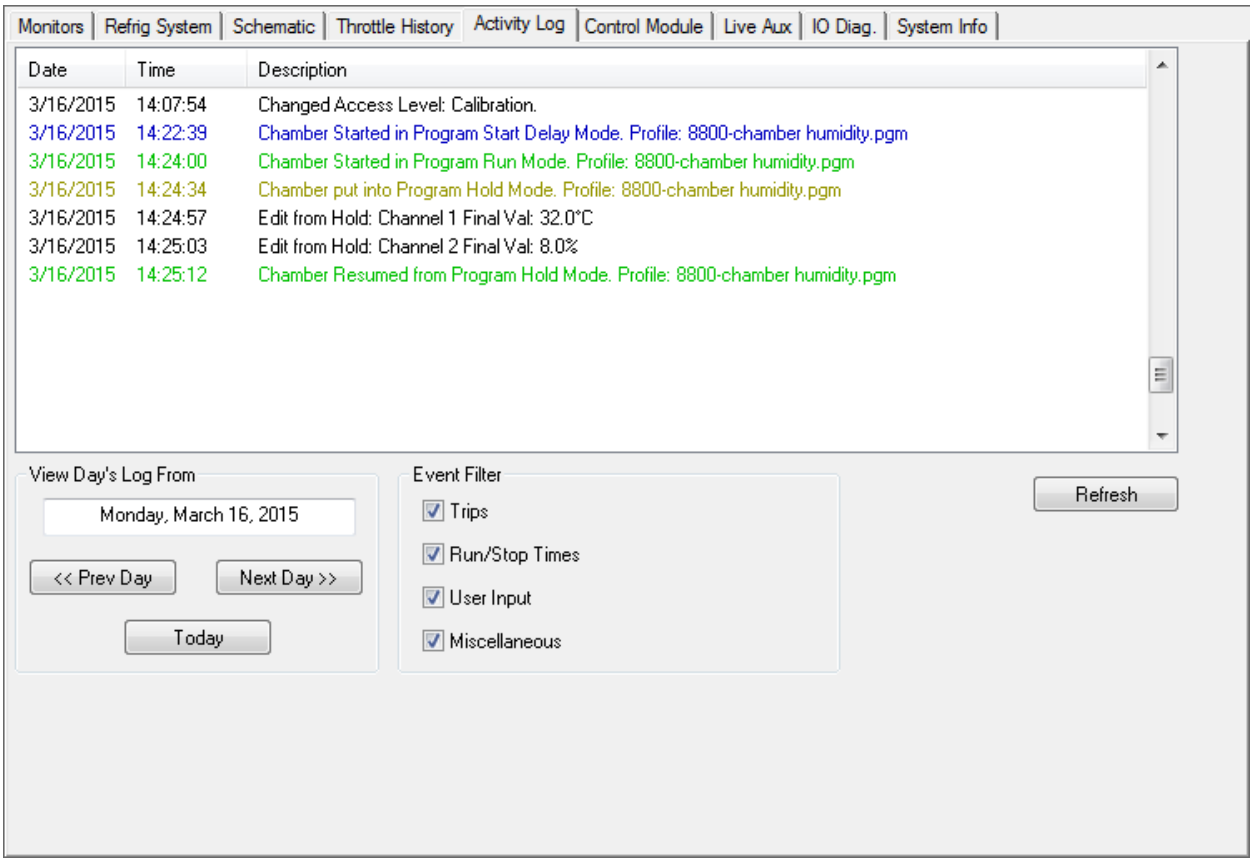
Throttle History panel



The Throttle History panel provides a histogram of percentage of throttle versus time for each control channel. Under View Channel, press a control channel to display that channel's histogram.

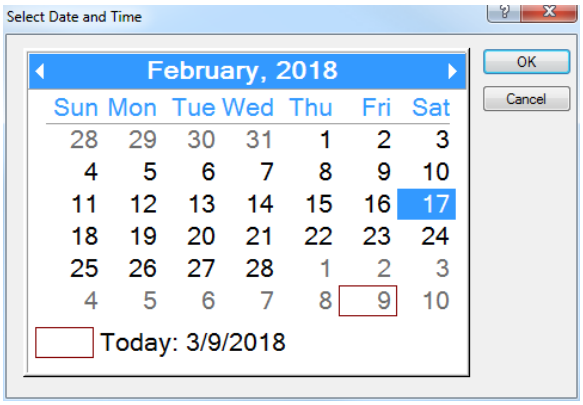
The panel also displays run times in hours for the selected channel's negative and positive throttles.

Activity Log panel



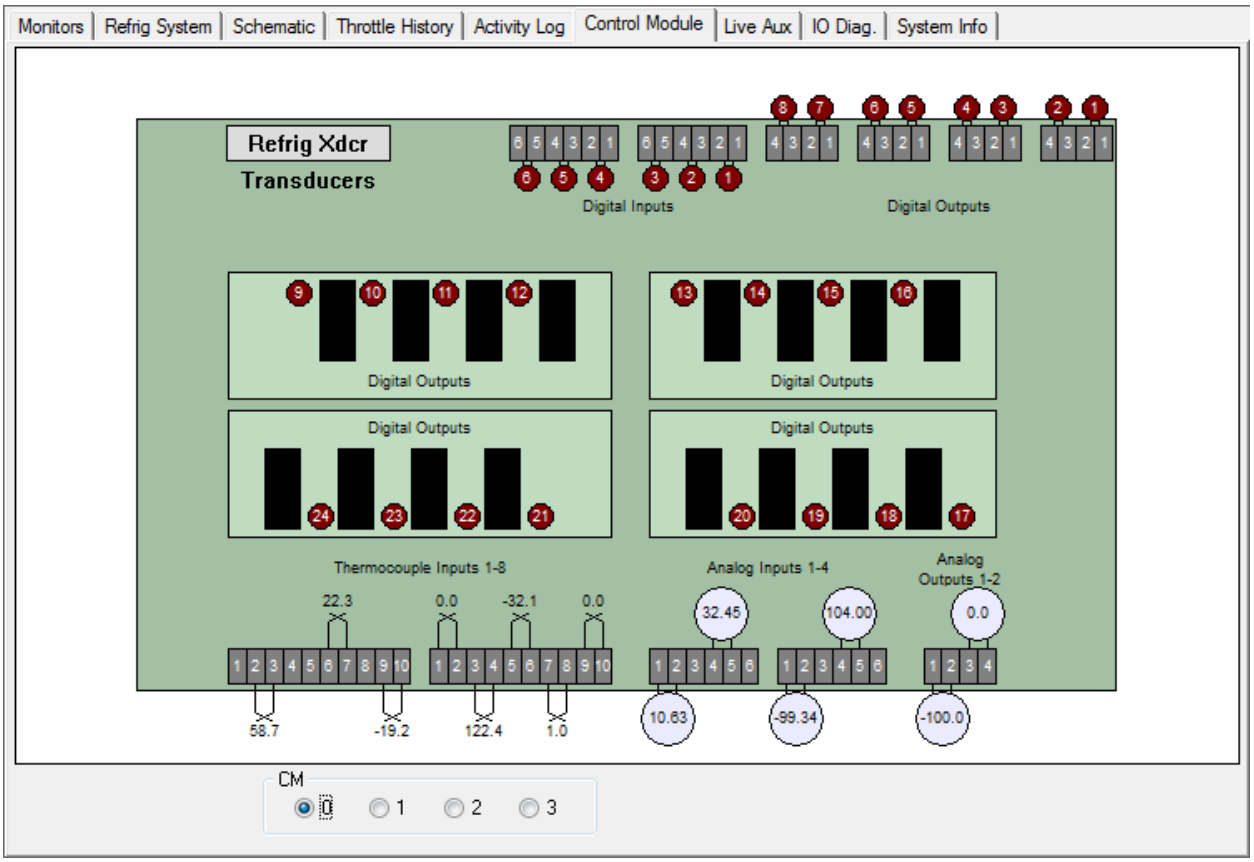
The Activity Log panel displays the date, time, and description of all system activities from a specific date to the present. To modify and view the activity log display, follow these steps:

1. Press **Prev Day** or **Next Day** to move one day backward or forward.
2. Press **Today** to display the current activity log.
3. To jump to a specific starting date:
   a. Press the date field. The Select Date and Time dialog box will appear.
   b. Select a date from the calendar. The currently displayed date is highlighted in blue and today's date is outlined in red. Use the left and right arrow buttons to display the previous and next months.
   c. To accept your selections press **OK**. To close the dialog without making any selections, press **Cancel**.



4. Select the type of activities displayed (such as trips, run/stop times, or user input):
   a. Check or uncheck each filter field as desired.
   b. Press **Refresh** to implement your changes and redisplay the activity log.
5. The activity log can be sorted by pressing the appropriate column header. For example, to sort by description, press the word **Description** at the top of the third column.

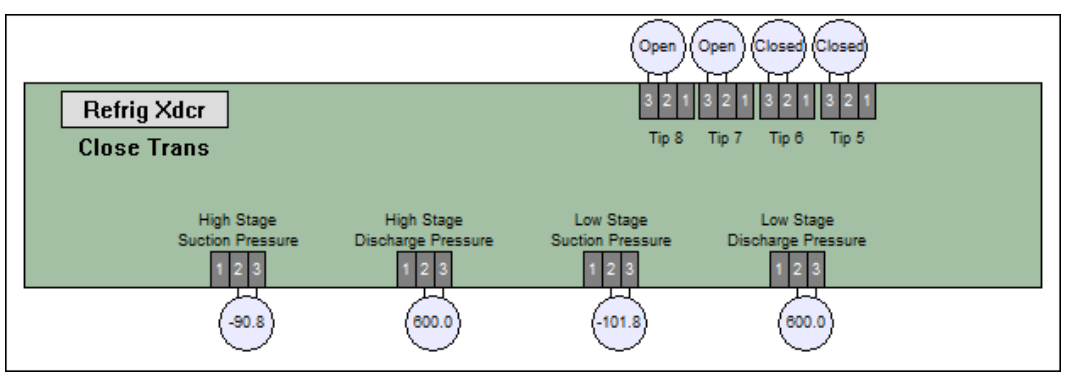
Control Module panel



NOTE: Access to control module information is provided to allow you to troubleshoot your chamber with the assistance of a Thermotron Technical Liaison. For assistance please call the Thermotron Product Support group at (616) 392-6550.

The Control Module panel displays a schematic of the 8800 control module with live data for all analog and digital inputs and outputs. All inputs and outputs are numbered for cross reference with chamber electrical and instrument drawings. The numbers of the digital inputs and outputs light up to indicate activity. If the 8800 has more than one control module installed, you can choose which control module to display by selecting the appropriate **CM** number.

Transducer data

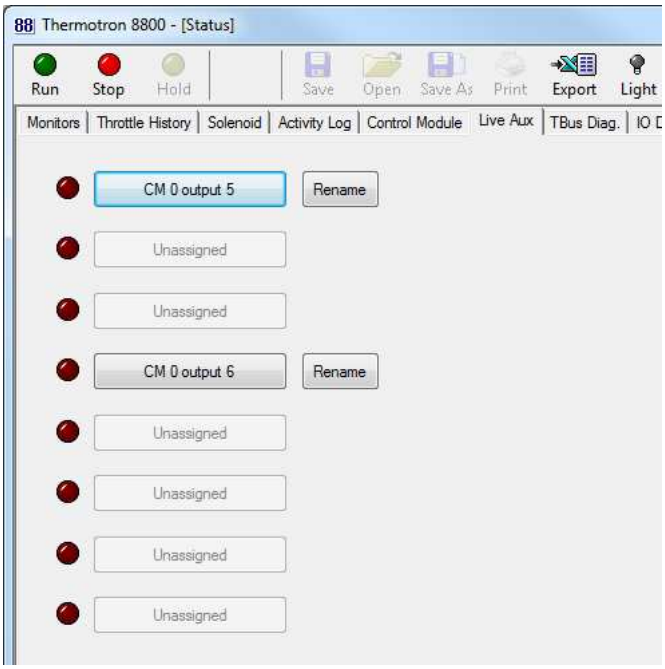


If your chamber is equipped with transducers, you can bring up a schematic of the refrigeration transducer board with live data by pressing the connector above the word **Transducers**. To close the transducer board display, press the connector above the words **Close Trans**.

Live Aux panel

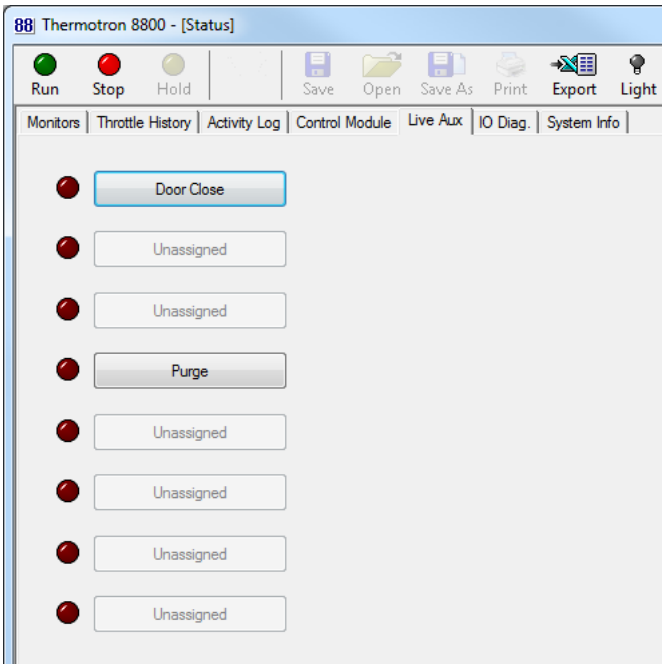
The Live Aux panel will appear only if your 8800 has live auxiliaries configured. Live auxiliaries are outputs that the user can turn on or off manually or via computer I/O regardless of the chamber's operating mode. For more information on your live auxiliaries, refer to your chamber manual.

- When a live auxiliary is first configured, it will automatically be named with its associated control module number and output number. This may be helpful for initial testing and troubleshooting by Thermotron personnel.
- Each assigned live auxiliary button can be renamed by pressing the **Rename** button and entering up to 20 characters. **NOTE**: The **Rename** button will be visible only if the 8800 access level is at or above Calibration level.
- A grayed-out button labeled **Unassigned** indicates that no physical output has been assigned at the factory to this live auxiliary.

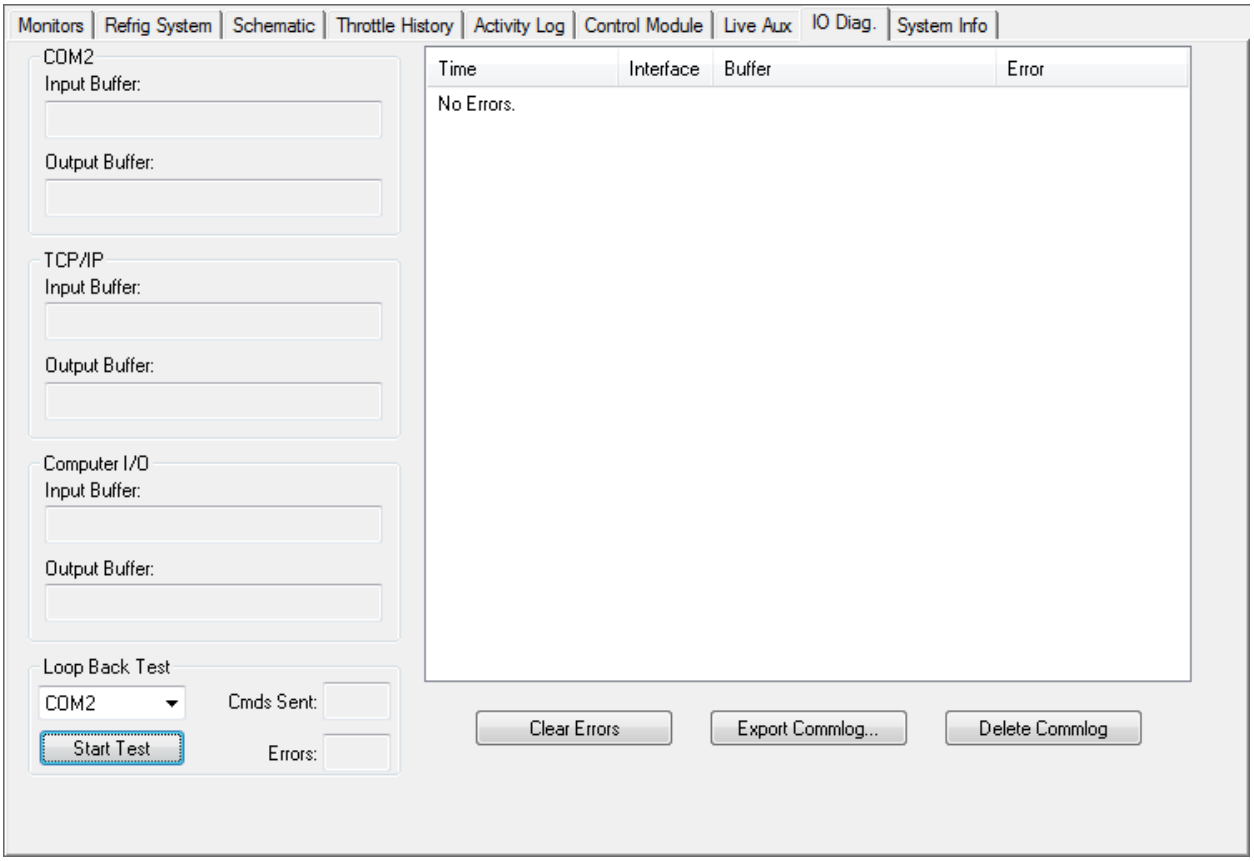


The image to the right shows two live auxiliary buttons that have been renamed **Door Close** and **Purge**. Also, the 8800 access level has been set to Lab Manager, so the **Rename** buttons are no longer visible.

- Each live auxiliary button can be pressed to toggle the configured output on or off regardless of the chamber's operating mode.
- The LED icon to the left of each button will be unlit (dark red) when the live auxiliary is off or unassigned, and will be lit (bright red) when the live auxiliary is on.



Computer interface diagnostic panel



This screen allows you to examine the current computer I/O communications as well as the last 25 computer I/O errors that have occurred. From here you can also export a complete history of all computer I/O communication errors.

Input and output buffers for the three interfaces

- **Input Buffer**: Shows the last data being received by the 8800.
- **Output Buffer**: Shows the last data sent by the 8800.

List of the last 25 errors

- **Time**: Date and time the error occurred.
- **Interface**: The interface the error occurred on. This will be one of the following values: COM2, CM-RS232, CM-RS485, CM-GPIB, or TCP/IP.
- **Buffer**: Contents of the input buffer when the error occurred.
- **Error**: Text describing the actual error that occurred.
- **Clear Errors** button: Clears the error list on the screen but does not affect the commlog file saved on the hard drive.

Commlog file

- **Export Commlog…**: Allows the user to save the commlog file to a flash drive. The user may then inspect the file or e-mail it to Thermotron Product Support. The format is a text file that displays the time of any errors, the device generating the errors, and the command that generated the errors.
- **Delete Commlog…**: Clears the entire commlog file.

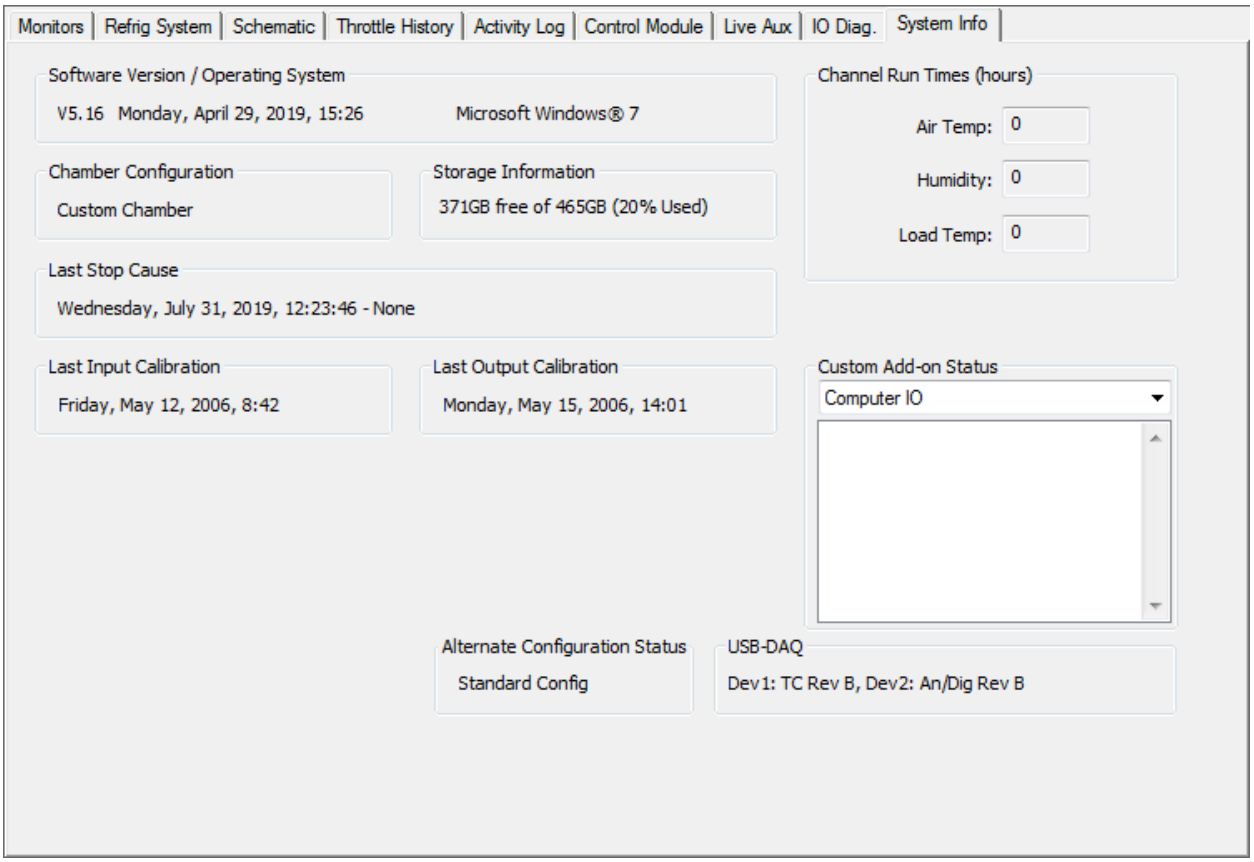
Loop back test

NOTE: To perform the loop back test, the 8800 access level must be Lab Manager or higher.

The loop back test allows you to check whether the COM2 serial port of the 8800 is working correctly. To perform the test, short together pins 2 and3 of the COM2 serial port.

- **Comm Port**: Select the port to test.
- **Start Test**: Press to start the loop back test. Press again to end the loop back test.
- **Cmds Sent**: A running total of the number of commands sent out the selected comm port.
- **Errors**: The total number of errors that have occurred during the test.

System Info panel



The System Info panel provides general information, including:

- The 8800 display module software version and operating system
- Chamber configuration
- Storage information
- Last stop cause information
- Input and output calibration status
- Channel run times
- If your 8800 uses a plugin to talk to a third-party device such as a power supply, the Custom Add-on Status field will display which plugin is being used and report any errors if applicable.
- If your 8800 uses more than one configuration, the Alternate Configuration Status field will indicate which configuration is currently active.
- USB-DAQ status (For more information on the DAQ option, refer to the *8800 DAQ Instruction Manual*.)

Section 4: Computer Interface

Overview

The 8800 interface command set allows you to control, monitor, and program the 8800 from a host computer. The commands use a specified structure and syntax for communication. This section describes the 8800 interface command set and gives examples of how to use this command set to operate the 8800 from a host computer.

Basic serial communication protocol

The basic command protocol consists of the command and terminator:

CMND<t> or **CMND<data><t>**

The 8800 responds with the following:

<data><t>

Where:

CMND = command mnemonic

<data> = data or character string sent with command mnemonic

<t> = computer terminator, for example a carriage return <cr>

NOTE: The 8800 also can handle commands in the following syntax: **CMND,<data><t>**.

RS-485 multidrop address communication protocol

The RS-485 serial interface requires two additional addressing parameters for proper multidrop communication:

1. Each instrument on the multidrop network must have a separate address between 1 and 127. The multidrop addressing protocol places a pound sign (**#**) followed by the address number in front of each command mnemonic.
   - When the host computer transmits a command and data, each 8800 checks the first character after the pound sign. If the character matches the 8800's address, it reads the command and performs the assigned task.
   - When the 8800 sends data to the host computer, the computer reads the first character after the pound sign to determine the source of the data. It then handles the data according to its source.
2. The multidrop prefix protocol places an additional character (FF hexadecimal, shown as **[FF]**) in front of each command or data transmission (before the multidrop addressing protocol). The interface uses this character to eliminate communication problems that may occur as the interface bus drivers go active. The **[FF]** character provides these additional advantages to the interface:
   - It provides the necessary time for the receivers to become active.
   - FF hexadecimal is translated to binary and transmitted as all 1's, keeping the interface in a driven state.
   - FF hexadecimal is very unlikely to be interpreted as an ASCII pound sign (35 decimal), the first character of the addressing protocol.

Thermotron recommends that you use the following syntax for multidrop communications. This syntax incorporates both the multidrop addressing and prefix protocols to help ensure dependable communications.

The host computer sends:

[FF]#aCMND<t> or **[FF]#aCMND<data><t>**

The 8800 responds with:

[FF]#a<data><t>

Where:

[FF] = prefix character (FF hexadecimal)

= ASCII pound sign (35 decimal)

a = One-byte address of the 8800 (1...127)

CMND = command mnemonic

<data> = data or character string sent with command mnemonic

<t> = computer terminator, for example a carriage return <cr>

GPIB-specific commands

The 8800 uses the control module's GPIB converter. GPIB communication uses the same commands and syntax required by serial communication, but adds several service request commands.

Service request (SRQ)

The GPIB converter provides service request capability to the 8800 computer interface. The 8800 can be configured to request service by asserting the GPIB SRQ line when certain events occur. The SRQ mask byte enables these events. The service request status is read using the GPIB serial poll protocol. The status and corresponding mask bits are defined as follows:

Bit 0 State change. This bit is set when there has been a change in the operating state.

Bit 1 Alarm status change. This bit is set when there has been a change in the alarm status.

Bit 2 End of interval. This bit is set at the end of each interval, either when the time left has gone to 0:00:00, or when a guaranteed soak is completed.

Bit 3 Match interval. This bit is set at the start of the match interval. If the match interval parameter is set to 0, then this bit is set at the start of each interval.

Bit 4 End of program. This bit is set at the end of a program, when the 8800 goes into stop mode.

Bit 5 Error. This bit is set by any type of command and/or interface error.

Bit 6 Reserved by GPIB.

Bit 7 Power on reset. This bit is set when the 8800 goes through a power up sequence. It is also set as a result of an **INIT** command.

Service request related commands

SRQB?	Read the service request status byte.
SRQM? or **SRQMddd**	Read or load the service request enable mask byte.
MINT? or **MINTddd**	Read or load the match interval.

For more information see "Interface command descriptions" later in this section.

Command syntax

The 8800 computer interface command set provides query commands and operation commands. The command set can use a basic command as either a query command or an operation command. For more information see "Interface command descriptions" later in this section.

Query commands

A query command asks the 8800 to supply information to the computer about the controller's functions, readings, or status. The basic query command is a simple string with the following parts:

- The root command is always four ASCII characters long (upper or lower case letters).
- If needed, the root command is followed by an ASCII numeric character that indicates a channel or group number.
- The command string ends with an ASCII question mark (?), which defines it as a query command.

For example, if the host computer sends the **SETP2?** command, and channel 2 has a set point of -82°C, the 8800 would send -82.0 back to the host computer.

Operation commands

An operation command causes the 8800 to perform an operation. Each operation command consists of the following parts:

- The root command is always four ASCII characters long (upper or lower case letters).
- All operation commands, except control commands, have some form of data at the end of the command string.

  For example, if the host computer sends the command **OPTN49**, the 8800 loads the manual mode options register with the PTC, purge, and cascade options.
- If needed to specify a channel or group number, the root command is followed by an ASCII numeric character, followed by an ASCII comma (**,**) to separate the channel or group number from the data.

  For example, if the host computer sends the command **AUXE1,142**, the 8800 enables AUX 1-2, AUX 1-3, AUX 1-4, and AUX 1-8.

Command data formats

The 8800 can send and receive data in the following formats:

1. **Integer format**: The data consists of an ASCII sign character (**+** or **-**) followed by ASCII decimal digits representing an integer; for example, an interval number or the number of loops left in an interval.
2. **Coded integer format**: A coded integer is a decimal integer that displays the sum of a binary-weighted code. The number of ASCII digits vary with each command type. Each bit in the original code is assigned a binary weight (1, 2, 4, 8, 16, 32, 64, 128, and so on). The integer sent is the decimal sum of the coded bits that are enabled; for example, the 8800's response to an **OPTN?** or **AUXE?** command.
3. **Decimal format**: The data consists of an ASCII sign character (**+** or **-**) followed by ASCII decimal digits, decimal point, and the number of digits needed for the selected resolution; for example, the set point of a temperature channel.
4. **String format**: The data consists of a string of ASCII characters. The information and format vary between commands and are defined at each command description.

Command concatenation

You can concatenate several commands on the same line. To concatenate commands, separate them with a semicolon. The 8800 processes the concatenated commands in the order that it receives them. **NOTE**: The 8800 will only send a response for the first query command it sees in a concatenated string. Therefore Thermotron recommends that the user include only one query command in any concatenated string.

Example: The concatenated commands **STOP;RUNM;PVAR1?** would stop the 8800, place it in run manual mode, and cause it to send the channel 1 process variable reading back to the host computer.

NOTE: The 8800 can hold up to 128 characters. Make sure the data strings and/or concatenated command strings are not longer than 128 characters. Also, any command with more than 30 parameters will cause the 8800 to return an "Unknown command" error.

Functional command sets

The 8800 interface command set can be divided into five functional groups. The following paragraphs describe and list these functional groups. For more information, see "Interface command descriptions" later in this section.

Control commands

Control commands tell the 8800 to perform a specific operation and/or set its operating mode. For example, if the host computer sends the **STOP** command, the 8800 is placed in stop mode. The control commands are listed below:

HOLD INIT RESM RUNM RUNP SCRR STOP WDOG

Program status and edit from hold commands

In run program mode, program status commands allow you to query the 8800 for real-time, program-specific values. In edit from hold mode, the edit from hold commands allow you to run the 8800 using temporary values. For example, if the host computer sends the **INTN?** command, the 8800 responds with the current interval number of the program. The program status and edit from hold commands are listed below:

AUXE FVAL ITIM NUML PALH PNAM PTIM TLFT
DEVN INTN LLFT NXTI PALL PRMG PTLF

Programming commands

Programming commands allow you to write programs on your host computer and load them into the 8800. They also allow you to load a program from a 8800 into your computer. The programming commands are listed below:

DIRP INTV PROG

System status commands

System status commands (except **LOCK** and **RLTM**) are query commands that allow you to read the information from the controller. For example, if the host computer sends the **IDEN?** command, the 8800 responds with the type of programmer/controller. The system status commands are listed below:

AACH CCNF CMST CONF DIGO DTYP IVAL LOCK PMEM REFG SERL STAT
ALRM CHRT CMVR DCHN DOOR IDEN LANG MINT PRGN RLTM SRQB TALF
CCHR CHST CNAM DIGI DREF IERR LGHT MODE RDAT SCOD SRQM VRSN

Variable commands

Variable commands can be either query or operation commands. Variable query commands allow you to read the 8800 registers for the current variables and parameters. Variable operation commands allow you to operate the 8800 from run manual mode only. The variable commands are listed below:

AALM DEVN LAUX MRMP PARM PVAR SETP TALM THAT TMPS
AUXE ISAA MNTR OPTN PRMG PWRF SSTP THAA THTL

Interface command descriptions

The following pages list the interface commands, including mnemonic, type, description, syntax, and examples.

AACH

Command name: Send Therm-Alarm analog input units value

Command type: System status

Description: The 8800 returns 1-3 characters for the value. Common unit codes are % and T (torr).

Syntax: AACHn?

Where **n** is a Therm-Alarm number (1 to 4).

Data type: 1-3 characters

Query example: AACH1?

8800 response: T (The analog input units value of Therm-Alarm 1 is torr.)

AALM

Command name: Send or load analog Therm-Alarm settings. **NOTE**: You must have an original temperature Therm-Alarm and a secondary analog Therm-Alarm installed.

Command type: Variable

Description: The query command allows you to view the analog information for the Therm-Alarms. The 8800 sends the following response to an AALMn? command:

Syntax: AALMn? or AALMn, type, low, high, units, maxex, mute, warn, delay, reset, accel sens, maxfreq

Where **n** is the Therm-Alarm number (1 to 8). If left blank, the value defaults to 1.

type The type of the analog Therm-Alarm being queried:

0 = linear 1 = RH temp comp 2 = altitude kft 3 = vibration

low Analog Therm-Alarm low limit

high Analog Therm-Alarm high limit

units The units being used for the analog Therm-Alarm

maxex Analog Therm-Alarm maximum excursion

mute Analog Therm-Alarm mute time

warn Analog Therm-Alarm warning band

delay Analog Therm-Alarm delay time

reset Analog Therm-Alarm reset status (0 = auto reset, 1 = manual reset)

accel sens Analog Therm-Alarm accelerometer sensitivity. This is only applicable if the type is vibration. If the type is not vibration, the 8800 returns 0.

maxfreq Analog Therm-Alarm maximum frequency:

0 = 1,000 1 = 2,000 2 = 5,000 3 = 10,000 4 = 20,000

This is only applicable if the type is vibration. If the type is not vibration, the 8800 returns 0.

The operation command allows you to set any of the above settings for any analog Therm-Alarm hooked up to the chamber. The operation command syntax is as follows:

AALMn, type, low, high, units, mute, warn, delay, reset, accel sens, maxfreq

Where **n** is the analog Therm-Alarm you wish to set (1 to 8). If left blank, the value defaults to 1.

type The type of the analog Therm-Alarm:

0 = linear 1 = RH temp comp 2 = altitude kft 3 = vibration

low Analog Therm-Alarm low limit (0 to 100 degrees C)

high Analog Therm-Alarm high limit (0 to 100 degrees C)

units The units being used for the analog Therm-Alarm (any string less than five characters)

mute Analog Therm-Alarm mute time (0 to 99 minutes)

warn Analog Therm-Alarm warning band (0 to 99,999 units)

delay Analog Therm-Alarm delay time (0 to 30 seconds)

reset Analog Therm-Alarm reset status (0 = auto reset, 1 = manual reset)

accel sens Analog Therm-Alarm accelerometer sensitivity. Just leave blank if not dealing with a vibration Therm-Alarm.

maxfreq Analog Therm-Alarm maximum frequency:

0 = 1,000 1 = 2,000 2 = 5,000 3 = 10,000 4 = 20,000

Leave blank if not dealing with a vibration Therm-Alarm.

Data type: Decimal

Query example 1: AALM? (defaults to Therm-Alarm 1)

8800 response: vibration, 10, 150, g, 1.5, 10, 12, 15, 0, 9.9, 1 (The analog Therm-Alarm 1 type is vibration, the low limit is 10, the high limit is 150, the unit being used is g, the maximum excursion is 1.5, the mute time is 10, the warning band is 12, the delay time is 15, the reset status is auto reset, the accelerometer sensitivity is 9.9, and the maximum frequency is 2,000.)

Query example 2: AALM3?

8800 response: 8 (Error code 8 indicates an illegal channel. For more information, see “Error codes” later in this section.)

Operation example: AALM2,0,,,%,20,15,,,,

8800 response: 0 (Analog Therm-Alarm 2 is set to linear, the unit is set to percent, the mute time is set to 20, and the warning band is set to 15.)

ALRM

Command name: Send alarm status

Command type: System status

Description: The 8800 returns the current alarm status for the selected channel. The alarm status is an eight-bit coded integer. The value of each bit when it is active, as well as its definition, is listed below:

Bit #	*Value when active*	*Definition*	*Bit #*	*Value when active*	*Definition*
0	1	Low deviation alarm	**4**	16	Low process alarm
1	2	High deviation alarm	**5**	32	High process alarm
2	4	*Not used*	**6**	64	*Not used*
3	8	*Not used*	**7**	128	*Not used*

NOTE: Only one bit can be set at a time.

Syntax: ALRMn?

Where **n** is any process variable channel (1 through 8).

Data type: Eight-bit coded integer

Query example: ALRM2?

8800 response: 32. This response means that only bit **5** (32) is active. When bit **5** is active it indicates a high process alarm.

AUXE

Command name: Send or load auxiliaries settings

Command type: Variable; edit from hold

Description: The query command allows you read the on and off states of the auxiliary groups (1 or 2). Auxiliary group 1 refers to auxiliaries 1-8 and auxiliary group 2 refers to auxiliaries 9-16. The operation command allows you to change the auxiliary states for run manual mode operations and/or edit from hold operations.

Syntax: AUXEn? or AUXEn,ddd

Where **n** is an auxiliary group (1 or 2), and where **ddd** is a three-digit coded integer defined as follows:

1	AUX 1	16	AUX 5
2	AUX 2	32	AUX 6
4	AUX 3	64	AUX 7
8	AUX 4	128	AUX 8

The code provides a value between 0 and 255 that adds the values of all the enabled auxiliaries in the selected group. For example, a value of 097 (97 = 64 + 32 + 1) indicates that AUX 7 (64), AUX 6 (32), and AUX 1 (1) are on, or turns these auxiliaries on.

Data type: See Syntax.

Query example: AUXE1?

8800 response: 148. (AUX 8, AUX 5, and AUX 3 of auxiliary group 1 are on.)

Operation example: AUXE1,59

8800 response: 0 (If the 8800 is in run manual mode, AUX 6, 5, 4, 2, and 1 of auxiliary group 1 are enabled. If they are enabled, the 8800 turns off AUX 8, 7, and 3 of auxiliary group 1.)

CCHR

Command name: Send process variable units

Command type: System status

Description: The 8800 returns the ASCII string for the process variable units. Common units are Celsius, Fahrenheit, percent relative humidity, and torr. **NOTE**: If the channel has no units set or is not configured, the 8800 will return a blank character.

Syntax: CCHRn?

Where **n** is any process variable channel (1 through 8) or monitor channel (101 through 140). **NOTE**: 101 = monitor channel 1, 110 = monitor channel 2, etc.

Data type: ASCII units string

Query example: CCHR1?

8800 response: Celsius (Channel 1 is programmed in degrees Celsius.)

CCNF

Command name: Send process channel configuration information

Command type: System status

Description: The 8800 sends a single coded integer describing the channel type.

0 Channel not used
1 Percent relative humidity channel using a wet bulb/dry bulb thermocouple pair
2 Temperature channel using a thermocouple
3 Linear channel using a programmable range (for example altitude)
4 Linear 0% to 100% relative humidity channel using a solid-state sensor
5 Product temperature control channel

Syntax: CCNFn?

Where **n** is any process variable channel (1 through 8) or monitor channel (101 through 140).

Data type: Coded integer

Query example: CCNF2?

8800 response: 4 (Process variable channel 2 is configured for linear % relative humidity.)

CHRT

Command name: Send channel run time

Command type: System status

Description: Queries the 8800 for a channel's accumulated run time. The 8800 sends an integer to indicate the number of hours the channel has been running.

Syntax: CHRTn?

Where **n** is any process variable channel (1 through 8).

Data type: Integer

Query example: CHRT2?

8800 response: 962 (Process variable channel 2 has accumulated a total run time of 962 hours.)

CHST

Command name: Send channel on and configured status

Command type: System status

Description: The 8800 sends a two-byte coded integer describing the channel on and configuration status.

Byte 1 = channel on status: Bits 0 through 7 indicate the on status of channels 1 through 8 respectively. The 8800 sets the bit for each channel that is on.

Byte 2 = channel configured status: Bits 8 through 15 indicate the configured status of channels 1 through 8 respectively. The 8800 sets the bit for each channel that is configured.

Syntax: CHST?

Data type: Coded integer

Query example: CHST?

8800 response: 769 (Binary value 000000**11**,0000000**1** = channels 1 and 2 are configured and channel 1 is on.)

CMST

Command name: Send comm status

Command type: System status

Description: This query command asks the 8800 for the current comm status. The 8800 sends a coded integer value. The edit operation command changes the current comm status. The CMST data byte is defined as follows:

Bits 0 through 7

1	Send acknowledge
2, 4, 8, 16, 32, 64, 128	*Unused*

Syntax: CMST? or CMSTn

Where **n** is the new comm status.

Data type: Coded integer

Query example: CMST?

8800 response: 1 (Send acknowledge is on.)

Operation example: CMST0

8800 response: The 8800 turns off send acknowledge.

CMVR

Command name: Send version number of control module

Command type: System status

Description: This command retrieves the version number of the specified control module.

Query syntax: CMVRcm?

Where **cm** = control module (1 through 4)

Query example: CMVR2?

8800 response: V2.18 09/06/11 (Control module 2 is version 2.18, released September 6, 2011.)

CNAM

Command name:	Send name of channel
Command type:	System status
Description:	This command allows you read the assigned name of any process variable or monitor channel.
Syntax:	CNAMn?
	Where **n** = channel number (1 through 12 are process variable channels, 13 through 52 or 101 through 140 are monitor channels)
Data type:	ASCII units character
Query example:	CNAM10?
8800 response:	PROD MON (The name of process variable channel 10 is PROD MON.)

CONF

Command name: Send configured options

Command type: System status

Description: The 8800 sends three coded-integer bytes. These are binary-weighted bytes that indicate all the system options selected at the factory for the 8800. The bytes are defined below:

Byte 1 (Bits 0 through 7)	
0	Product temperature control
1	Humidity system
2	Low humidity system
3	-10°C dew point
4	Purge
5	Cascade refrigeration system
6	Power Save mode
7	*Bit 7 is not used*
Byte 2 (Bits 8 through 15)	
8	Transducers installed
9	Check water level
10	Go to Stop on Therm-Alarm trip
11	Disable TB8/9/11 on refrigeration trip
12	*Bits 12 through 15 are not used*
13	
14	
15	
Byte 3 (Bits 16 through 23)	
16	Custom chamber control
17	SPD SE chamber control
18	System Monitor functions
19	Go to stop mode on System Monitor trips
20	*Bits 20 through 23 are not used*
21	
22	
23	

Syntax: CONF?

Data type: Three bytes of coded integers

Query example: CONF?

8800 response: 327987 = 00000**1**0**1**,0000000**1**,00**1**1001**1**

bit 7	***bit 6***	***bit 5***	***bit 4***	***bit 3***	***bit 2***	***bit 1***	***bit 0***
0	0	**1**	**1**	0	0	**1**	**1**
bit 15	***bit 14***	***bit 13***	***bit 12***	***bit 11***	***bit 10***	***bit 9***	***bit 8***
0	0	0	0	0	0	0	**1**
bit 23	***bit 22***	***bit 21***	***bit 20***	***bit 19***	***bit 18***	***bit 17***	***bit 16***
0	0	0	0	0	**1**	0	**1**

(The 8800 is configured for product temperature control, humidity, purge, and cascade refrigeration; refrigeration transducers are installed; the controller is configured for chamber control; and System Monitor functions are enabled.)

DCHN

Command name: Send active channel status

Command type: System status

Description: This command returns a byte value that describes which channels (1 through 4) are active. The byte value ranges from 0 to 15 based on which channels are active. The byte is defined below:

Bits 0 through 3
1 Channel 1
2 Channel 2
4 Channel 3
8 Channel 4

Syntax: DCHN?

Data type: Coded byte

Query example 1: DCHN?

8800 response: 5 (4 + 1 = channels 1 and 3 are active.)

Query example 2: DCHN?

8800 response: 0 (No channels are active.)

DEVN

Command name: Send deviation reading or load deviation setting

Command type: Variable; edit from hold

Description: The query command asks the 8800 for the current deviation reading from a selected channel. The 8800 sends the value in the channel's selected units. The operation command loads a deviation setting into the 8800 for the current manual mode operation, or sends a temporary deviation value during an edit from hold operation.

Syntax: DEVNn? or DEVNn,data

Where **n** is any control channel (1 through 4).

Data type: Decimal

Query example: DEVN1?

8800 response: 2.3 (The current deviation reading for control channel 1 is 2.3.)

Operation example: DEVN2,5

8800 response: 0 (If the 8800 is in manual mode, it loads a deviation value of 5 units into control channel 2.)

DIGI

Command name: Send digital input (DI) status

Command type: System status

Description: This command returns a 24-bit integer value that indicates which digital inputs are active.

Bits 0 through 23
0 through 5 CM0 digital inputs 1 through 6
6 through 11 CM1 digital inputs 1 through 6
12 through 17 CM2 digital inputs 1 through 6
18 through 23 CM3 digital inputs 1 through 6

DI 6	*DI 5*	*DI 4*	*DI 3*	*DI 2*	*DI 1*	*CM*
bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	0
bit 11	bit 10	bit 9	bit 8	bit 7	bit 6	1
bit 17	bit 16	bit 15	bit 14	bit 13	bit 12	2
bit 23	bit 22	bit 21	bit 20	bit 19	bit 18	3

Query example 1: DIGI?

8800 response: 0 (No digital inputs are active.)

Query example 2: DIGI?

8800 response: 58498 = 000000 00**111**0 0**1**00**1**0 0000**1**0
CM3 CM2 CM1 CM0

DI 6	*DI 5*	*DI 4*	*DI 3*	*DI 2*	*DI 1*	*CM*
bit 5: 0	bit 4: 0	bit 3: 0	bit 2: 0	**bit 1: 1**	bit 0: 0	0
bit 11: 0	**bit 10: 1**	bit 9: 0	bit 8: 0	**bit 7: 1**	bit 6: 0	1
bit 17: 0	bit 16: 0	**bit 15: 1**	**bit 14: 1**	**bit 13: 1**	bit 12: 0	2
bit 23: 0	bit 22: 0	bit 21: 0	bit 20: 0	bit 19: 0	bit 18: 0	3

(CM0 digital input 2, CM1 digital inputs 2 and 5, and CM2 digital inputs 2, 3, and 4 are active.)

DIGO

Command name: Send digital output (DO) status

Command type: System status

Description: This command returns either a 24-bit integer value that indicates which of digital outputs 1 through 24 are active, or a 16-bit integer value that indicates which of digital outputs 25 through 40 are active. You must use the letter "e" to get the status of digital outputs 25 through 40.

Standard digital outputs:

DO 6	*DO 5*	*DO 4*	*DO 3*	*DO 2*	*DO 1*
bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
DO 12	***DO 11***	***DO 10***	***DO 9***	***DO 8***	***DO 7***
bit 11	bit 10	bit 9	bit 8	bit 7	bit 6
DO 18	***DO 17***	***DO 16***	***DO 15***	***DO 14***	***DO 13***
bit 17	bit 16	bit 15	bit 14	bit 13	bit 12
DO 24	***DO 23***	***DO 22***	***DO 21***	***DO 20***	***DO 19***
bit 23	bit 22	bit 21	bit 20	bit 19	bit 18

Extended digital outputs:

DO 28	***DO 27***	***DO 26***	***DO 25***
bit 27	bit 26	bit 25	bit 24
DO 32	***DO 31***	***DO 30***	***DO 29***
bit 31	bit 30	bit 29	bit 28
DO 36	***DO 35***	***DO 34***	***DO 33***
bit 35	bit 34	bit 33	bit 32
DO 40	***DO 39***	***DO 38***	***DO 37***
bit 39	bit 38	bit 37	bit 36

Syntax: DIGOcm,e?

Where:

cm = control module to return (0 through 3)

e= extended. Use **e** to return the status of digital outputs 25 through 40.

Query example 1: DIGO0?

8800 response: 2228224 = 00**1**000 **1**00000 000000 000000

DO 6	***DO 5***	***DO 4***	***DO 3***	***DO 2***	***DO 1***
bit 5: 0	bit 4: 0	bit 3: 0	bit 2: 0	bit 1: 0	bit 0:
DO 12	***DO 11***	***DO 10***	***DO 9***	***DO 8***	***DO 7***
bit 11: 0	bit 10: 0	bit 9: 0	bit 8: 0	bit 7: 0	bit 6: 0
DO 18	***DO 17***	***DO 16***	***DO 15***	***DO 14***	***DO 13***
bit 17: 1	bit 16: 0	bit 15: 0	bit 14: 02	bit 13: 0	bit 12: 0
DO 24	***DO 23***	***DO 22***	***DO 21***	***DO 20***	***DO 19***
bit 23: 0	bit 22: 0	**bit 21: 1**	bit 20: 0	bit 19: 0	bit 18: 0

(CM0 digital outputs 18 and 22 are active.)

Query example 2: DIGO0,e?

8800 response: 186 = 0000 0000 **1**0**11 1**0**1**0

DO 28	***DO 27***	***DO 26***	***DO 25***
bit 27: 1	bit 26: 0	**bit 25: 1**	bit 24: 0
DO 32	***DO 31***	***DO 30***	***DO 29***
bit 27: 1	bit 30: 0	**bit 27: 1**	**bit 27: 1**
DO 36	***DO 35***	***DO 34***	***DO 33***
bit 35: 0	bit 34: 0	bit 33: 0	bit 32: 0
DO 40	***DO 39***	***DO 38***	***DO 37***
bit 39: 0	bit 38: 0	bit 37: 0	bit 36: 0

(CM0 digital outputs 26, 28, 29, 30, and 32 are active.)

DIRP

Command name: Send program directory

Command type: Programming

Description: This command queries a specific directory on the 8800 for a list of program files and directories. This command will return the name of the program or directory followed by a number. If the name refers to a program file, the number will be the number of intervals in the program. If the name refers to a directory, the number will be -2. Continue calling this command to get a list of all directories and programs on the 8800. When you have iterated through all the items in the current directory this command will return "No More Files" for the name and -1 for the number.

Syntax: DIRPpathname?

Where:

pathname is the name of a path on the 8800 or "\" for the root path of the 8800.

Query example 1: DIRP\?

8800 response: humidity test, 5 (program called humidity test with five intervals)

Query example 2: DIRP\?

8800 response: Pre-programmed Tests, -2 (directory called Pre-programmed Tests)

Query example 3: DIRP\Pre-programmed Tests?

8800 response: 8800-SE humidity, 6 (program called 8800-SE humidity with six intervals)

Query example 4: DIRP\Pre-programmed Tests?

8800 response: No More Files, -1 (You have iterated through all the items in the Pre-programmed Tests directory.)

DOOR

Command name: Send door status

Command type: System status

Description: This command returns 1 if there is a "Door" digital input defined and it is currently closed. It returns 0 if the door is open or there is no digital input defined for it.

Syntax: DOOR?

Data type: Integer

Query example: DOOR?

8800 response: 1 (There is a "Door" digital input defined and it is currently closed.)

DREF

Command name: Send reference data type

Command type: System status

Description: The 8800 sends an integer representing the channel's reference channel data type.

Data type codes:
0 *Unused*
1 Temperature
2 RH wet bulb/dry bulb
3 RH linear
4 RH temperature compensated
5 Linear
6 Altitude (kilofeet)
7 Vibration
8 Scaled linear
9 Altitude linear (torr)

For example, assume channel 2 is an RH temperature-compensated channel referencing channel 1, which is a temperature channel. Sending DREF2? will return a 1 (temperature), the data type of channel 2's reference channel.

Syntax: DREFn?

Where **n** is a channel number (1 through 52).

1 through 8	Process variable channels
9 through 12	*Unused*
13 through 52	Monitor channels (1 through 40).

Data type: Integer

Query example: DREF2?

8800 response: 1 (The data type of channel 2's reference channel is temperature.)

DTYP

Command name: Send data type

Command type: System status

Description: The 8800 sends an integer representing the channel's data type.

Data type codes:

0	*Unused*	8	Scaled linear
1	Temperature	9	Altitude linear (torr)
2	RH wet bulb/dry bulb	10	Temperature average
3	RH linear	11	Humidity ratio
4	RH temperature compensated	12	Dew point
5	Linear	13	Transducer
6	Altitude (kilofeet)	14	Temperature minimum
7	Vibration	15	Temperature maximum

Syntax: DTYPn?

Where **n** is a channel number (1 through 28).

1 through 8	Process variable channels
9 through 12	*Unused*
13 through 52	Monitor channels 1 through 40
101 through 140	Monitor channels 1 through 40

Data type: Integer

Query example: DTYP1?

8800 response: 1 (The process variable channel 1 data type is temperature.)

FVAL

Command name: Send or load final value

Command type: Program status; edit from hold

Description: The query command asks the 8800 for the current interval's final value for channel n (1 through 4). The 8800 sends a decimal value for the selected channel. The edit from hold operation command temporarily changes the current interval's final value. **NOTE**: When not running a program, the command returns the manual mode new setpoint.

Syntax: FVALn?

Where **n** is any control channel (1 through 4).

Data type: Decimal

Query example 1: FVAL2?

8800 response: 25.0 (The control channel 2 final value for the current interval is 25.0.)

Query example 2: FVAL1?

8800 response: 50.0 (In manual mode, the channel 1 new setpoint is 50.0.)

Operation example: FVAL1,-33

8800 response: 0 (The 8800 loads -33 as the final value for control channel 1.)

HOLD

Command name: Hold program or manual mode operation

Command type: Control

Description: Places a running program or test in hold mode.

Syntax: HOLD

Data type: No data

Query example: HOLD

8800 response: 0 (Places the 8800 in hold mode.)

IDEN

Command name: Send device identification

Command type: System status

Description: The 8800 sends an ASCII character string to the host computer.

Syntax: IDEN?

Data type: ASCII character string

Query example: IDEN?

8800 response: 8800 CHAMBER CONTROLLER

**IDN?*

Command name: SCPI-compatible device identification

Command type: System status

Description: Manufacturer, chamber description:controller model, chamber serial number, firmware revision

Syntax: *IDN?

Data type: ASCII character string

Query example: *IDN?

8800 response: Thermotron Industries, 8800 Chamber Controller:8800, 45194, V4.71

IERR

Command name: Send last error code

Command type: System status

Description: The 8800 sends the code of the last error that occurred. For more information see "Error codes" later in this section.

Syntax: IERR?

Data type: Coded integer

Query example: IERR?

8800 response: 3 (The 8800 output buffer is full.)

NOTE: The error code buffer holds the last eight errors. You can use the IERR? command repeatedly to read the entire buffer in a first in–last out format. When the 8800 returns an error code of 0, the error buffer is empty.

INIT

Command name: Initialize controller

Command type: Control

Description: This command initializes the 8800.

Syntax: INIT

Data type: No data

NOTE: Wait at least one minute after sending this command before sending any other commands.

INTN

Command name: Send interval number

Command type: Program status

Description: Queries the 8800 for the current interval number. The 8800 sends an integer to indicate the interval number.

Syntax: INTN?

Data type: Integer

Query example: INTN?

8800 response: 10 (The 8800 is on interval 10 of the currently selected program.)

INTV

Command name: Send or load program interval string

Command type: Programming

Description: The query command asks for the interval string that initializes the program (INTV0) or for one of the program intervals (INTVn). During load program by value operations, send an INTV0? command, followed by an INTVn? command for every interval in your program. Use the PROGn? command to determine how many intervals you need to receive. The operation command sends an interval string to initialize the program (INTV0) or one of the program intervals (INTVn).

Interval 0 syntax: INTV0? or INTV0,fv1,fv2,fv3,fv4,active channels

Where:

fv1 … fv4 = decimal values for the channel 1 through channel 4 initial values. **NOTE**: The final values of interval 0 are the initial values of interval 1.

active channels = two-digit coded integer that assigns the active channels the following weight:

1 = Channel 1 2 = Channel 2 4 = Channel 3 8 = Channel 4

Interval n syntax: INTVn? or INTVn,fv1,fv2,fv3,fv4,dv1,dv2,dv3,dv4,hh:mm:ss,pgrp,lp,ni,ax1, ax2,display status,options

Where:

n = interval number

fv1 … fv4 = decimal values for the channel 1 through channel 4 final values

dv1 … dv4 = decimal values for the channel 1 through channel 4 deviations from set point

hh:mm:ss = hours, minutes, and seconds. See the TLFT command for the time field entry variations. **NOTE**: Any combination of hh:mm:ss values can be entered as long as the total converted time doesn't exceed 99:59:59.

pgrp = parameter group (1 through 4)

lp = number of loops (0 to 9999)

ni = next interval (1 to 300)

ax1, ax2 = auxiliaries enabled in each AUX group. Auxiliary group 1 refers to auxiliaries 1 through 8 and auxiliary group 2 refers to auxiliaries 9 through 16. Each value is a three-digit coded integer with the following values:

1	AUX 1	16	AUX 5
2	AUX 2	32	AUX 6
4	AUX 3	64	AUX 7
8	AUX 4	128	AUX 8

display status byte = *not used*

options = The options bytes for the program (0 to 65535). These bytes turn the options on or off. You must turn on the option in order to use its programmed values. For example, to use product temperature control (PTC), you must program the PTC channel and turn the PTC option on. These bytes assign the following weighting values to the options:

1	Product temperature control
2	Humidity system (**NOTE**: NEVER assign a PTC channel with a humidity channel.)
4	Low humidity system
8	GSoak
16	Purge
32	Cascade refrigeration (SE-Series chambers only)
64	Power Save mode (if SE-Series; otherwise sets cascade mode)
128	Single-stage refrigeration (SE-Series only)
512	Altitude
1024	Mechanical boost
32768	Product dew point control

Data type: Coded integer

Query example 1: INTV0?

8800 response: 0,30.0, 50.0, 0.0, 0.0,3 (Channel 1 is set to +30 units and channel 2 is set to +50 units; channels 1 and 2 are active.)

Query example 2: INTV22?

8800 response: 22,52,-67,,,3,10,,,1:10:00,3,5,18,14,26,55,49

Interval 22 is programmed as follows:

Final values: Channel 1 = -52 units, channel 2 = -67 units

Deviations: Channel 1 = 3 units, channel 2 = 10 units

Time: 1 hour, 10 minutes

Parameter group: 3

Number of loops: 5

Next interval: 18

Auxiliaries enabled: AUX 1-2, AUX 1-3, AUX 1-4, AUX 2-2, AUX 2-4, and AUX 2-5

Display status enabled: Looping, auxiliaries, deviations, channel 1, channel 2

Options enabled: PTC, purge, cascade refrigeration. **NOTE**: The commas are left in any unused parameter locations to maintain the proper parameter positions in the string

Operation example 1: INTV0,-10,20,,,3

8800 response: The 8800 loads the program with a channel 1 initial value of -10 units, a channel 2 value of 20 units, and sets channels 1 and 2 as active.

Operation example 2: INTV35,75,98,,,5,8,,,0:20:00,1,20,15,3,1,55,150

8800 response: The 8800 loads the following values into interval 35:

Final values: Channel 1 = 75 units, channel 2 = 98 units

Deviations: Channel 1 = 5 units, channel 2 = 8 units

Time: 20 minutes

Parameter group: 1

Number of loops: 20

Next interval: 15

Auxiliaries enabled: AUX 1-1, AUX 1-2, AUX 2-1

Display status enabled: Looping, auxiliaries, deviations, channel 1, channel 2

Options enabled: Humidity, low humidity, purge, single-stage refrigeration

ISAA

Command name: Send Therm-Alarm analog input channel availability

Command type: Variable

Description: The query command asks the 8800 if the analog input channel for Therm-Alarm "n" is available. The 8800 returns a 0 (not available) or a 1 (available).

Syntax: ISAAn

Where **n** is a Therm-Alarm number (1 through 4).

Data type: Integer

Query example: ISAA1?

8800 response: 1 (The analog input channel for Therm-Alarm 1 is available.)

ITIM

Command name: Send interval time

Command type: Program status

Description: Queries the 8800 for the programmed time for the current interval.

Syntax: ITIM?

Data type: String

Query example: ITIM?

8800 response: 0:10:30 (The current interval is 10 minutes, 30 seconds long.)

IVAL

Command name: Send initial value

Command type: System status

Description: Queries the 8800 for the current interval's initial value parameter for channel n (1 through 4). The 8800 sends a decimal value for the selected channel.

Syntax: IVALn?

Where **n** is the channel number (1 through 4).

Data type: Decimal

Query example: IVAL3?

8800 response: 25.00 (The channel 3 initial value for the current interval is 25.00.)

LANG

Command name: Send language mode

Command type: System status

Description: This command queries the 8800 for the current language mode.

Syntax: LANG?

The 8800 will respond with 0 (English) or 1 (French).

Data type: Integer

Query example: LANG?

8800 response: 1 (The 8800 is in French language mode.)

LAUX

Command name: Send or load live auxiliary settings

Command type: Variable

Description: Unlike standard auxiliary relays, live auxiliaries can be enabled without the 8800 being in run mode. The query command asks the 8800 for the status of the selected live auxiliary. The operation command allows you to set the live auxiliary variables.

Query syntax: LAUXaux?

Operation syntax: LAUXaux, state

Where:

aux live auxiliary number (1 through 8)

state 0 (off) or 1 (on) **NOTE**: The 8800 will also return a 0 if the specified live aux has never been configured.

Query example 1: LAUX2?

8800 response: 0 (Live auxiliary 2 is not on)

Query example 2: LAUX1?

8800 response: 1 (Live auxiliary 1 is on)

Operation example: LAUX2, 1

8800 response: 0 (The 8800 changed live auxiliary 2 to be on, but only if it is enabled.)

LGHT

Command name: Send or load light status

Command type: System status

Description: The query command asks the 8800 for the status of the light (on or off). The operation command allows you to remotely turn the chamber light on or off.

Syntax: LGHT? or LGHTn

Where **n** is 0 (off) or 1 (on).

Data type: Integer

Query example: LGHT?

8800 response: 1 (The chamber light is on.)

Operation example: LGHT0

8800 response: Turns the chamber light off.

LLFT

Command name: Send or load program loops left

Command type: Program status; edit from hold

Description: The query command asks the 8800 for the number of loops left to be executed for the current loop. On nested looping, the value is for the inside loop. The 8800 sends an integer to indicate the number of loops left. The edit from hold operation command temporarily changes the current interval's loop counter.

Syntax: LLFT? or LLFTn

Where **n** is the number of loops.

Data type: Integer

Query example: LLFT?

8800 response: 8 (There are 8 loops left to be executed for the current loop.)

Operation example: LLFT15

8800 response: Changes the loops left counter to 15.

LOCK

Command name: Send or load access level

Command type: System status

Description: This is the only system status command that allows you to change the 8800's status. It allows you to read and change the access level of the 8800.

Syntax: LOCK? or LOCKn

Where **n** indicates access level (0 through 5):

0	Locked	3	Programmer
1	Level One	4	Lab Manager
2	Level Two	5	Calibration

Data type: Coded integer

Query example: LOCK?

8800 response: 3 (The 8800 is set to the Programmer access level.)

Operation example: LOCK0

8800 response: This command locks out all user access to the 8800 functions at the keyboard.

MINT

Command name: Send or load match interval

Command type: System status

Description: The match interval is used to trigger the interval match interrupt event for a service request. The interval match interrupt event occurs at the beginning of the previously loaded match interval. If the value loaded for the match interval is 0, the match interval event will occur at the beginning of every interval.

Syntax: MINT? or MINTdata

Data type: Integer (range 0 to 300)

Query example: MINT?

8800 response: 14 (A service request interrupt will occur at the start of interval 14 when running a program.)

Operation example: MINT3

8800 response: The 8800 loads the match interval parameter with a value of 3.

MNTR

Command name: Send monitor channel value

Command type: Variable

Description: Queries the 8800 for the current value of the selected monitor channel.

Syntax: MNTRn?

Where **n** is the monitor channel number (1 through 24).

Data type: Decimal

Query example: MNTR1?

8800 response: -35.8 (The current value of monitor channel 1 is -35.8.)

MODE

Command name: Send operating mode of 8800

Command type: System status

Description: The query command asks the 8800 for its current operating mode.

Syntax: MODE?

The 8800 will respond to this query command with a coded integer byte:

Bits 0 through 7

Bit 0	Program mode	Bit 4	Manual mode
Bit 1	Edit mode (controller in stop mode)	Bit 5	Delayed start mode
Bit 2	View program mode	Bit 6	*Unused*
Bit 3	Edit mode (controller in hold mode)	Bit 7	Calibration mode

Data type: Coded integer

Query example: Mode?

8800 response: 0 (The 8800 is in program mode.)

MRMP

Command name: Send or load manual ramp setting

Command type: Variable

Description: This is a manual mode command. The query command reads the manual ramp setting for the selected channel in units per minute. The units are in the scale selected at the 8800 (such as °C, °F, torr, %RH, etc.).

Syntax: MRMPn? or MRMPn,data

Where **n** is any control channel (1 through 4) and **data** is the manual ramp rate.

Data type: Integer

Query example: MRMP2?

8800 response: 30 (The manual ramp for channel 2 is 30 units per minute.)

Operation example: MRMP1,12

8800 response: The 8800 sets the manual ramp for channel 1 to 12 units per minute.

NUML

Command name: Send number of loops

Command type: Program status

Description: Queries the 8800 for the programmed number of loops assigned to the current loop. For nested looping, the value is for the inside loop. The 8800 sends an integer indicating the number of loops assigned to the current loop.

Syntax: NUML?

Data type: Integer

Query example: NUML?

8800 response: 15 (The number of loops assigned to the current loop is 15.)

NXTI

Command name: Send next interval

Command type: Program status

Description: Queries the 8800 for the next interval that will be executed. The 8800 sends an integer indicating the next interval number.

Syntax: NXTI?

Data type: Integer

Query example: NXTI?

8800 response: 5 (The next interval that will be executed is interval 5.)

OPTN

Command name: Send or load controller options

Command type: Variable

Description: The query command reads the options register of the 8800. If the 8800 is in manual mode, the operation command temporarily changes the 8800 options register to the new set of options. **NOTE**: If the selected options are not available on your chamber, the 8800 will return an error code.

Syntax: OPTN? or OPTN[,]ddddd

Where **ddddd** is a coded integer up to five digits long, where each option has the following weight:

1	Product temperature control	256	*Reserved (do not use)*
2	Humidity system	512	Altitude
4	Low humidity system	1024	Mechanical boost
8	GSoak	2048	*Reserved (do not use)*
16	Purge	4096	*Reserved (do not use)*
32	Cascade refrigeration (SE-series only)	8192	*Reserved (do not use)*
64	Power Save mode (SE-series only)	16384	*Reserved (do not use)*
128	Single-stage refrig. (SE-series only) or Refrig mode enabled (non SE-series)	32768	Product dewpoint control (PDC)

The code provides a value between 0 and 65535 that is the sum of the values of all the enabled options. For example, a value of 49 (49 = 32 + 16 + 1) indicates that the cascade refrigeration system (32), purge (16), and product temperature control (1) options are enabled.

Data type: Coded integer; see Syntax.

Query example: OPTN?

8800 response: 130 (The single-stage refrigeration and humidity options are enabled.)

Operation example: OPTN82

8800 response: 0 (This command sets the 8800 manual mode options to enable Power Save, purge, and humidity.)

PALH

Command name: Send high process alarm limit

Command type: Program status

Description: Queries the 8800 for a channel's high process alarm limit. The 8800 sends an integer indicating the alarm limit.

Syntax: PALHn?

Where **n** is a channel number.

Data type: Integer

Query example: PALH1?

8800 response: 100 (The channel 1 high process alarm limit is 100.)

PALL

Command name:	Send low process alarm limit
Command type:	Program status
Description:	Queries the 8800 for a channel's low process alarm limit. The 8800 sends an integer indicating the alarm limit.
Syntax:	PALLn?
	Where **n** is a channel number.
Data type:	Integer
Query example:	PALL1?
8800 response:	-40 (The channel 1 low process alarm limit is -40.)

PARM

CAUTION: This command is included for advanced users. Changing parameter group settings can adversely affect chamber control.

Command name: Send or load parameter values

Command type: Variable

Description: The query command causes the 8800 to send the values of the tuning parameters for the selected channel in the selected parameter group. The operation command sends new parameter values for a selected channel of a selected parameter group. The 8800 loads the parameter values into the parameter group registers in any mode. **NOTE**: When using the operation command, you must specify values for every field and not leave any field blank.

Query syntax: PARMc, g?

Where **c** = control channel number (1 through 4) and **g** = parameter group number (1 through 4).

Non-PTC operation: PARMc, g, hpb, cpb, hit, cit, htl, ctl

Where:

c	Control channel number (1 through 4)
g	Parameter group number (1 through 4)
hpb/cpb	Heat and cool proportion bands (0.0 – 9999.0)
hit/cit	Heat and cool integral time (0 to 1000 seconds)
htl	Heat throttle limit (0.0 to 100.0)
ctl	Cool throttle limit (-100.0 to 0.0)

PTC operation: PARMc, g, hgn, cgn, hit, cit, hof, cof

Where:

c	Control channel number (1 through 4)
g	Parameter group number (1 through 4)
hgn/cgn	Heat and cool gain settings for PTC operations (0.0 – 9999.0)
hit/cit	Heat and cool integral time (0 to 1000 seconds)
hof	Heat offset (0.0 to 100.0)
cof	Cool offset (-100.0 to 0.0)

Data type: Integer

Query example: PARM2,3?

8800 response: 35.0,35.0,200,200,100.0,-100.0 (The channel 2 parameter group 3 settings are: heat and cool proportion bands 35.0, heat and cool integral times 200, heat throttle limit 100.0, and cool throttle limit -100.0.)

Operation example: **Non-PTC**: To set the channel 1 parameter group 1 cool proportional band to 35.7 and keep the other channel 1 group 1 parameters at their factory values, send: PARM1,1,20,35.7,60,90,100.0,-100.0.

PTC: With channel 4 in PTC mode, send the following command to set the channel 4 group 1 heat gain to 0.8, cool integral time to 128 seconds, and cool offset to 12.0, keeping the other channel 4 group 1 parameters at their factory values: PARM4,1,0.8,3.0,200,128,10.0,-12.0.

PMEM (legacy support)

Command name: Send available program memory

Command type: System status

Description: Queries the 8800 for the available amount of program memory. This command is for legacy support only. The 8800 has a virtually unlimited amount of program storage. The 8800 will always send 300.

Syntax: PMEM?

Data type: Integer

Query example: PMEM?

8800 response: 300

PNAM

Command name: Send program name

Command type: Program status

Description: Queries the 8800 for the name of the currently loaded program. The 8800 responds with the program's assigned name (a string up to 15 characters long). If there is no currently loaded program name available, the 8800 will respond with "Untitled".

Syntax: PNAM?

Data type: String

Query example 1: PNAM?

8800 response: STRESS SCREEN40 (The name of the currently loaded program is STRESS SCREEN40.)

Query example 2: PNAM?

8800 response: Untitled (There is no currently loaded program name available.)

PRGN (legacy support)

Command name: Send current program number

Command type: System status

Description: Queries the 8800 for the number of the currently loaded program; 0 indicates none.

Syntax: PRGN?

Data type: Integer

Query example: PRGN?

8800 response: 7 (The current program is loaded into program slot 7.)

PRMG

Command name: Send or load parameter group

Command type: Variable; edit from hold

Description: Queries the 8800 for the number of the parameter group that it is currently using. If the 8800 is in manual mode, the operation command selects the parameter group (1 through 4) that the 8800 will use to control the channels. Edit from hold operations temporarily change the parameter group for the program.

Syntax: PRMG? or PRMG[,]d

Where **d** is the parameter group number (1 through 4).

Data type: Integer; see Syntax.

Query example: PRMG?

8800 response: 2 (The 8800 is currently using parameter group 2.)

Operation example: PRMG3

8800 response: 0 (In manual mode, the 8800 will use parameter group 3.)

PROG

Command name: Send or load program data string

Command type: Programming

Description: This command sets up the 8800 or host computer to load an entire program into the 8800's program memory. The query command receives the data string from the 8800, while the operation command sends the data string to the 8800. For additional information, see "Using the interface command set" later in this section.

The query command sets up which program will be retrieved, and responds with the name of the program and the number of intervals in the program. The operation command sets up the name and the number of intervals in the program.

Syntax: PROGname? or PROG, name, number of intervals

Where:

name = program name

number of intervals = integer (1 to 300)

Data type: See Syntax.

Query example: PROGtemp_test?

8800 response: temp_test,6 (The program named "temp_test" is 6 intervals long.)

Operation example: PROG,HI HUMIDITY,25

8800 response: 0 (The 8800 will load a 25-interval program and name the program HI HUMIDITY.)

PTIM

Command name: Send program time

Command type: Program status

Description: Queries the 8800 for the total estimated time for the current program.

Syntax: PTIM?

Data type: String

Query example: PTIM?

8800 response: 48:30:10 (The current program is 48 hours, 30 minutes, 10 seconds long.)

PTLF

Command name: Send program time remaining

Command type: Program status

Description: Queries the 8800 for the estimated time left in the current program.

Syntax: PTLF?

Data type: String

Query example: PTLF?

8800 response: 12:54:30 (The estimated time left in the current program is 12 hours, 54 minutes, 30 seconds.)

PVAR

Command name: Send process variable

Command type: Variable

Description: Queries the 8800 for the current process variable value of the selected channel. The channel selections are divided as follows:

Channel	Description
1 through 4	External process variable channels 1 through 4
5 through 8	Internal process variable channels 5 through 8
9 through 12	*Undefined*
13 through 28	Monitor channels 1 through 16
29 through 32	*Undefined*
33 through 36	System Monitor temperature channels for refrigeration system 1 (high-stage suction, high-stage discharge, low-stage suction, and low-stage discharge)
37 through 48	System Monitor channels for refrigeration systems 2, 3, and 4
101 through 140	Monitor channels 1 through 40

Syntax: PVARn?

Where **n** is the channel number (1 through 48). See Description.

Data type: Decimal

Query example: PVAR1?

8800 response: -42.3 (The current channel 1 process variable value is -42.3.)

PWRF

Command name: Send or load power fail recovery settings.

Command type: Variable

Description: This command is for setting the power failure recovery options. For more information, refer to "Power failure recovery" in Section 1 of this manual. The query command asks the 8800 for the current power fail recovery settings. The operation command allows you to modify the settings.

Syntax: PWRF? or PWRFenabled, time, mode

Where:

enabled = 1 = on; 0 = off

time = maximum off time in minutes from 0 to 300 (5 hours)

mode = 0 = stop; 1 = hold; 2 = run; 3 = restart

Query example: PWRF?

8800 response: 1, 45, 0 (Power fail recovery is enabled, the maximum off time is 45 minutes, and the recovery mode is stop.)

Operation example 1: PWRF1, 15, 3

8800 response: 0 (The 8800 will enable power fail recovery, set the maximum off time to 15 minutes, and set the recovery mode to restart.)

Operation example 2: PWRF0

8800 response: 0 (The 8800 will disable power fail recovery.)

RDAT

Command name: Send refrigeration system status

Command type: System status

Description: This command returns a binary-coded decimal value that displays the status for the refrigeration data. The bits for each data group are explained below:

Syntax: RDATn?

Where:

n = the refrigeration system number (1 through 4)

Bits	**Meaning**
0 and 1	Transducer #4 status
2 and 3	Transducer #3 status
4 and 5	Transducer #2 status
6 and 7	Transducer #1 status
8 through 11	High-stage compressor status
12 through 15	Low-stage compressor status
16 and 17	Refrig. temperature status

Transducer #1		***Transducer #2***		***Transducer #3***		***Transducer #4***	
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Refrig. temp.		***Low-stage compressor***				***High-stage compressor***			
bit 17	bit 16	bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8

For transducer and refrig. temperature status values:

00 = okay 01 = trip 10 = trip delay

For high-stage and low-stage compressor status values:

0000 = off 0001 = on 0010 = pump-down 0011 = tripped 0100 = on delay

Data type: Coded integer

Query example 1: RDAT2?

8800 response: 832 = 0000000**11** 0**1**000000

Transducer #1		***Transducer #2***		***Transducer #3***		***Transducer #4***	
bit 7: 0	**bit 6: 1**	bit 5: 0	bit 4: 0	bit 3: 0	bit 2: 0	bit 1: 0	bit 0: 0
Refrig. temp.		***Low-stage compressor***				***High-stage compressor***			
bit 17: 0	bit 16: 0	bit 15: 0	bit 14: 0	bit 13: 0	bit 12: 0	bit 11: 0	bit 10: 0	**bit 9: 1**	**bit 8: 1**

(Transducer #1 has tripped and the high-stage compressor has tripped.)

Query example 2: RDAT1?

8800 response: 0 (Transducers 1 through 4 are okay, the high-stage and low-stage compressors are off, and the refrig. temperature is okay.)

REFG

Command name: Send refrigeration system pressures

Command type: System status

Description: When used, "n" is the refrigeration system number (1, 2, 3, or 4). When "n" is not used, the 8800 defaults to system 1. The 8800 returns four pressures and four temperatures in integer format, and a binary-coded decimal refrigeration mode word. The pressures are in psi and the temperatures are in Celsius. The string breaks down as follows:

- Four pressures for high-stage suction, high-stage discharge, low-stage suction, and low-stage discharge.
- Four temperatures for high-stage suction, high-stage discharge, low-stage suction, and low-stage discharge.
- One coded integer that indicates the refrigeration mode. Each mode has its own weighting value:

1	Humidity cooling mode	8	Pump-down mode
2	Temperature cooling mode	16	High-stage compressor trip
4	Cascade mode	32	Low-stage compressor trip

For example, a 6 (4 + 2) indicates the 8800 is in cascade and temperature cooling modes.

Syntax: REFG(n)?

Data type: String (**NOTE**: The first four variables in the string are integers, the next four variables are one-decimal-place real numbers, and the final variable is an integer.)

Query example: REFG?

8800 response: 25,220,25,249,-23.2,87.5,-23.6,113.4,6. This string indicates the following:

- High-stage suction pressure 25, high-stage discharge pressure 220, low-stage suction pressure 25, and low-stage discharge pressure 249.
- High-stage suction temperature -23.2, high-stage discharge temperature 87.5, low-stage suction temperature -23.6, and low-stage discharge temperature 113.4.
- Refrigeration mode: cascade and temperature cooling.

RESM

Command name: Resume program or manual mode operation

Command type: Control

Description: Returns a program or test from hold mode to its run mode.

Syntax: RESM

Data type: No data

Query example: RESM

8800 response: The program or test returns to run mode.

RLTM

Command name: Send real time clock reading or load real time clock values

Command type: System status

Description: The query command tells the 8800 to return the date and time reading from its real time clock. The operation command loads new values into the real time clock and resets seconds to 00.

Syntax: RLTM? or RLTMmn,dd,hh,mm

Where **mn** is month, **dd** is day, **hh** is hour, and **mm** is minute.

Data type: String

Query example: RLTM?

8800 response: 3/11 14:32:45 (The real time clock date is March 11 and the time is 2:32 p.m.)

Operation example: RLTM3,11,14,32

8800 response: This command loads the date and time of March 11, 2:32 p.m. into the 8800.

RUNM

Command name: Run manual mode

Command type: Control

Description: Places a stopped 8800 in run manual mode.

Syntax: RUNM

Data type: No data

Operation example: RUNM

8800 response: The 8800 is placed in run manual mode.

RUNP

Command name: Run program mode

Command type: Control

Description: Places a stopped 8800 in run program mode, and specifies the program and starting interval.

Syntax: RUNPp,I,R[,S]

Where:

p Program name (**NOTE**: The program must be in the root directory of the 8800's hard drive.)

i Interval number

R Resume from stop

S Single-step mode. This places the program in hold program mode at the end of each interval. To continue executing the program, send the RESM command.

Data type: See Syntax.

Operation example: RUNPsimple_test,5,S

8800 response: The 8800 runs program *simple_test.pgm*, starting at interval 5, in single-step mode.

SCOD

Command name: Send stop code

Command type: System status

Description: The stop code identifies the cause of the most recent transition to the stop state. The stop codes are defined as follows:

0 Cold boot power up. The 8800 memory has been initialized.
1 Currently running. Not in stop.
2 Stop key pressed.
3 End of test.
4 External input. An input defined as stop has been activated.
5 Computer interface. The 8800 received the stop command.
6 Open input. A thermocouple or analog input is open.
7 Process alarm. A process alarm setting has been exceeded.
8 System Monitor trip.
9 Power fail recovery. The selected power fail recover mode was stop.
10 Therm-Alarm trip.

Syntax: SCOD?

Data type: Integer

Query example: SCOD?

8800 response: 3 (The currently loaded test has ended.)

SCRR

Command name: Reset screen

Command type: Control

Description: Forces the 8800 to go to the main screen.

Syntax: SCRR

Data type: No data

Operation example: SCRR

8800 response: Switches the 8800's current screen to the main screen.

SERL

Command name: Send chamber serial number

Command type: System status

Description: This query command asks the 8800 for the chamber's serial number.

Syntax: SERL?

Data type: Integer

Query example: SERL?

8800 response: 42679 (The chamber's serial number is 42679.)

SETP

Command name: Send or load set point

Command type: Variable

Description: The query command asks the 8800 for the current set point reading from channel "n". The 8800 sends the set point value in the channel's selected units. In manual mode, the operation command loads a new set point into the 8800 for the current operation.

Syntax: SETPn? or SETPn,data

Where **n** is any process variable channel (1 through 8) and **data** is the set point.

Data type: Decimal

Query example: SETP1?

8800 response: -33.0 (The process variable channel 1 set point is -33.0.)

Operation example: SETP2,95

8800 response: If the 8800 is in manual mode, a set point of 95 units is loaded into process variable channel 2.

SRQB

Command name: Send service request status byte

Command type: System status

Description: The 8800 returns the same data that a GPIB serial poll would return. The events, which set the associated bits in the response data, must be enabled in the SRQ mask and are loaded using the SRQM command. The bits are defined as follows:

Bit #	Definition	Bit #	Definition
0	Change in state	4	End of program
1	Change in alarm status	5	Error
2	End of interval	6	Reserved by GPIB (RSV)
3	Match interval	7	Power on reset

Syntax: SRQB?

Data type: Coded integer

Query example: SRQB?

8800 response: 65 = 0**1**000000**1**

bit 7	*bit 6*	*bit 5*	*bit 4*	*bit 3*	*bit 2*	*bit 1*	*bit 0*
0	**1**	0	0	0	0	0	**1**

(This response indicates state change + RSV.)

SRQM

Command name: Send or load service request event mask byte

Command type: System status

Description: This byte enables the various events for requesting service via the GPIB SRQ line. The coded integer data represents the enabled events using the definitions given under the SRQB command. **NOTE**: Setting the SRQ mask to zero disables all SRQ interrupts.

Syntax: SRQM? or SRQMdata

Data type: Coded integer (0 to 255)

Query example: SQRM?

8800 response: 4 = 00000**1**00 (The end of interval service request bit has been enabled.)

bit 7	*bit 6*	*bit 5*	*bit 4*	*bit 3*	*bit 2*	*bit 1*	*bit 0*
0	0	0	0	0	**1**	0	0

Operation example: SRQM1

8800 response: 0 (The 8800 loads the SRQ mask with the value 1, enabling the state change SRQ event.)

bit 7	*bit 6*	*bit 5*	*bit 4*	*bit 3*	*bit 2*	*bit 1*	*bit 0*
0	0	0	0	0	0	0	**1**

SSTP

CAUTION: This command is included for advanced users.

Command name: Send or load controlled stop (safety stop) parameter values

Command type: Variable

Description: The query command causes the 8800 to return the values of the controlled stop parameters. The operation command sends new controlled stop parameter values. **NOTE**: Earlier software versions used the term safety stop instead of controlled stop.

Query syntax: SSTP?

Operation syntax: SSTPm, sp, prg, dev, ctl

Where:

m Controlled stop mode enabled (1) or disabled (0)

sp Controlled stop set point (0-50 degrees C)

prg Controlled stop purge time (0-3,600 seconds)

dev Controlled stop deviation (0-999.9 degrees C)

ctl Controlled stop control mode on (1) or off (0)

Query example: SSTP?

8800 response: 1,25.0,30, 2.5, 1 (Controlled stop mode is enabled, the controlled stop set point is 25°C, the controlled stop purge time is 30 seconds, the controlled stop deviation is 2.5°C, and controlled stop control mode is on.)

Operation examples: SSTP1,30,10,5,1 (Enable controlled stop mode, set the controlled stop set point to 30°C, set the controlled stop purge time to 10 seconds, set the controlled stop deviation to 5°C, and turn on controlled stop control mode.)

SSTP1 (Enable controlled stop mode. Leave the other parameters as they were.)

SSTP0 (Disable controlled stop mode. Leave the other parameters as they were.)

STAT

Command name: Send status word

Command type: System status

Description: The 8800 returns one byte of coded-decimal data to indicate the status of the 8800. The byte is defined below:

1	Run program	16	Run manual
2	Hold program	32	Hold manual
4	Suspend program	64	Undefined
8	Undefined	128	Undefined

Syntax: STAT?

Data type: Coded decimal

Query example: STAT?

8800 response: 16 (The 8800 is in run manual mode.)

STOP

Command name: Stop controller

Command type: Control

Description: Places the 8800 in stop mode.

Syntax: STOP

Data type: No data

Query example: STOP

8800 response: The 8800 goes into stop mode.

TALF

Command name: Send Therm Alarm status flags byte

Command type: System status

Description: The command allows you to retrieve the Therm Alarm status flags byte. The flags byte, a coded integer containing status about the Therm Alarm, is defined as follows:

Bits 0 through 7

1	High alarm
2	Low alarm
4	High warning
8	Low warning
16	Mute
32	Over range
64	*Unused*
128	Open thermocouple

Syntax: TALF?

Data type: Coded integer

Query example: TALF?

8800 response: 17 (The Therm-Alarm status flags byte is mute and high alarm.)

TALM

CAUTION: The use of this command to alter the high and low alarm limits may affect the Therm-Alarm's capability to protect the chamber and/or your unit under test. Use with caution!

Command name: Send or load Therm-Alarm settings

Command type: Variable

Description: The query command allows you to retrieve the Therm-Alarm settings. The 8800 sends the following response to a TALM? query command:

TALMn, temp, low, high, maxex, mute, warn, delay, reset, state, flags

where:

n	Therm-Alarm number (1 through 4). If left blank, the value defaults to 1.
temp	Therm-Alarm temperature
low	Therm-Alarm low limit
high	Therm-Alarm high limit
maxex	Therm-Alarm maximum excursion
mute	Therm-Alarm mute time
warn	Therm-Alarm warning band
delay	Therm-Alarm alarm delay time
reset	Therm-Alarm reset status (0 = auto reset, 1 = manual reset)
state	*Therm-Alarm operating state (internal use only)*
flags	*Therm-Alarm warning/trip flags (internal use only)*

The operation command allows you to set the Therm-Alarm settings. The operation command syntax is as follows:

TALMn, low, high, mute, warn, delay, reset

where:

n	Therm-Alarm number (1 through 4). If left blank, the value defaults to 1.
low	Therm-Alarm low limit (see chamber documentation for valid ranges)
high	Therm-Alarm high limit (see chamber documentation for valid ranges)
mute	Therm-Alarm mute time (0-99 minutes)
warn	Therm-Alarm warning band (0-15 degrees C)
delay	Therm-Alarm alarm delay time (0-30 seconds)
reset	Therm-Alarm reset status (0 = auto reset, 1 = manual reset)

Syntax: TALMn? or TALMn, low, high, maxex, mute, warn, delay, reset

Data type: Decimal

Query example: TALM?

8800 response: 27, -87, 191, 210, 2, 10, 10, 0, 0, 0 (The Therm-Alarm 1 temperature is 27°C, the low limit is -87°C, the high limit is 191°C, the maximum excursion is 210°C, the mute time is 2 minutes, the warning band is 10°C, the alarm delay time is 10 seconds, and the reset status is auto.)

Operation example: TALM, -50, 150, 0, 5, 20, 1

8800 response: 0 (The 8800 sets the Therm-Alarm 1 low limit to -50°C, the high limit to 150°C, the mute time to 0 minutes, the warning band to 5°C, the alarm delay time to 20 seconds, and the reset status to manual.)

THAA

Command name: Send Therm-Alarm analog input value

Command type: Variable

Description: The query command asks the 8800 for the current Therm-Alarm "n" analog input value. The 8800 sends the value as an integer.

Syntax: THAAn

Where **n** is a Therm-Alarm number (1 through 4).

Data type: Integer

Query example: THAA1?

8800 response: 65 (The current analog input value for Therm-Alarm 1 is 65.)

THAT

Command name: Send Therm-Alarm temperature

Command type: Variable

Description: The query command asks the 8800 for the current Therm-Alarm "n" temperature reading. The 8800 sends the temperature value as an integer.

Syntax: THATn

Where **n** is a Therm-Alarm number (1 through 4).

Data type: Integer

Query example: THAT1?

8800 response: 65 (The current temperature reading for Therm-Alarm 1 is 65.)

THTL

CAUTION: Do not use the THTL command as an operation command. Using the THTL as an operation command overwrites 8800 internal control functions.

Command name: Send throttle reading

Command type: Variable

Description: The query command asks the 8800 for the current channel "n" throttle reading. The 8800 sends the throttle value as a percentage.

Syntax: THTLn

Where **n** is any process variable channel (1 through 8).

Data type: Integer (-100 to +100)

Query example: THTL1?

8800 response: -56 (The current throttle reading for process variable channel 1 is -56%.)

TLFT

Command name: Send or load time left

Command type: Program status; edit from hold

Description: Queries the 8800 for the time left in the current interval. The edit from hold operation command temporarily changes the current interval's time left counter.

Syntax: TLFT? or TLFThh:mm:ss

Where **hh** is hours, **mm** is minutes, and **ss** is seconds.

Data type: String

Query example: TLFT?

8800 response: 1:17:57 (The time left in the current interval is 1 hour, 17 minutes, 57 seconds.)

Operation example: TLFT::85

8800 response: This command sets the time left in the current interval to 1 minute, 25 seconds.

TMPS

Command name: Send or load temperature scale

Command type: Variable

Description: Allows you to read or change the temperature scale used on the 8800 display.
NOTE: This command does not affect the 8800 interface commands.

Syntax: TMPS?

Data type: Coded integer (0 = Celsius, 1 = Fahrenheit)

Query example: TMPS?

8800 response: 0 (The temperature scale used on the 8800 display is Celsius.)

Operation example: TMPS1

8800 response: The 8800 sets the temperature scale to Fahrenheit.

VRSN

Command name: Send software version

Command type: System status

Description: Queries the 8800 for the version number of the display software.

Syntax: VRSN?

Data type: String

The 8800 returns a string in the "Vx.yy dd/mm/yyyy" format to identify its software version.

Query example: VRSN?

8800 response: V1.18 04/02/2005 (The software is version 1.18, released April 2, 2005.)

WDOG

Command name: Reset watchdog timer

Command type: Control

Description: This command provides an extra level of protection for users operating their chambers entirely through the computer interface. The watchdog operates as a "everything is OK" command. If the watchdog is enabled and happens to time out due to a loss of communication, the controller will enter a known fail-safe state by running a program called *failsafe.pgm*. If that particular program does not exist, the chamber will simply enter the stop mode. The syntax for the command is WDOGn, where **n** is a number of seconds between 0 and 600. A positive value sets the watchdog timer value. A zero value turns off the watchdog feature. Once the watchdog is set, the 8800 internally begins counting down. If the internal watchdog timer ever reaches 0, the 8800 will enter the fail-safe state. For this reason you must periodically send the WDOGn command to reset the watchdog timer.

Syntax: WDOGn

Where **n** is the number of seconds between 0 and 600.

Data type: No data

Operation example: WDOG30

8800 response: The 8800 resets the internal watchdog timer to 30 seconds.

Using the interface command set

The following section describes how to operate the 8800 from a host computer using the interface command set.

Using the manual mode variable and control commands

The 8800 can be operated in manual mode from a host computer using the following interface set commands:

AUXE	Auxiliaries enable	OPTN	Options	SETP	Set point
DEVN	Deviation	PRMG	Parameter group	STOP	Stop controller
MRMP	Manual ramp	RUNM	Run manual mode	THTL	Throttle

Example:

1. Send the STOP command to the 8800. While in stop mode, send the following commands to set up the test run:

SETP1,75	Makes the channel 1 set point +75°C.
SETP2,5	Makes the channel 2 set point 5% RH.
MRMP1,5	Makes the channel 1 manual ramp rate 5C° per minute.
MRMP2,3	Makes the channel 2 manual ramp rate 3% RH per minute.
AUXE1,25	Turns on AUX 1-1, AUX 1-4, and AUX 1-5.
PRMG4	Selects parameter group 4.
OPTN54	Selects the following options: cascade refrigeration, purge, humidity, and low humidity.

   These commands load the registers and set up the system before running the chamber. Pre-loading the parameters before running a test is optional, but makes for a cleaner and more organized test.

2. Send the RUNM command to place the 8800 in run manual mode. The manual mode screen will now display the selected parameters as the 8800 operates the chamber control systems.

3. As the chamber runs, manual mode commands can be sent as needed to change parameter values. Additionally, variable and chamber status commands can be used to monitor the chamber variables and the 8800 status.

4. At the end of the test, send the STOP command to place the 8800 in stop mode.

Using the edit from hold commands

The edit from hold commands allow the operating parameters for one program interval to be temporarily changed. This allows you to try new values when you are writing and editing a program, and/or it allows you to perform a special test during a program. Use the following commands to change any temporary values:

AUXE	Auxiliaries enable	FVAL	Final value	PRMG	Parameter group
DEVN	Deviation	LLFT	Loops left	TLFT	Time left

Example:

1. Send the HOLD command to the 8800. While in hold program mode, send the following commands to temporarily change the interval values:

FVAL1,125	Changes the channel 1 final value to +125°.
DEVN1,3	Changes the channel 1 deviation to ±3°.
TLFT,0:22:30	Changes the time left counter to 22 minutes and 30 seconds.
LLFT,5	Changes the loops left counter to 5 loops left.

2. Send the RESM command to resume the program.

   The 8800 runs the rest of the interval using the temporary values entered above. When the program runs the interval again, it will use the programmed values for that interval rather than the edited intervals. The only edited value that remains is the loops left value. This value will reset to the original programmed value once it counts down and resets.

Using the programming commands

The program by value and send interval values commands allow you to transfer programs between the 8800 and a host computer. The operation commands allow you to send a program to the 8800. The query commands allow you to retrieve a program from the 8800. The following paragraphs describe each type of transfer and provide a program transfer example.

Sample Profile: LongSoak25Loops										
int #	***fv1***	***dv1***	***hh:mm:ss***	***prgp***	***lp***	***ni***	***ax1***	***ax2***	***display status***	***options***
1	20		2:00:00	1	0	2	-2-4--78	-2-4--7-	23	48
2	30	2	0:00:00	2	0	3	-2-4--78	--------	23	48
3	30	3	2:00:00	1	0	4	--------	--------	23	48
4	65		1:10:00	1	0	5	1-3—6--	12------	23	48
5	65	3	8:00:00	1	0	6	1-3—6--	12------	23	48
6	30	2	0:00:00	2	25	3	--------	--------	23	48

The sample profile, named LongSoak25Loops can be described as follows:

Interval 1: Ramps to +20°C in 2 hours, uses parameter group 1, and turns on auxiliary relays 1-2, 1-4, 1-7, 1-8, 2-2, 2-4, and 2-7. The display status enables channel 1, looping, auxiliaries, and deviations displays. The cascade refrigeration and purge options are enabled.

Interval 2: Steps to +30°C, waits until the temperature is within ±2° C of the set point, uses parameter group 2, and turns auxiliary relays 2-2, 2-4, and 2-7 off.

Interval 3: Soaks at +30°C for 2 hours, the deviation alarm is set off if the temperature deviates more than ±3°C from the set point, uses parameter group 1, and turns off all auxiliary relays.

Interval 4: Ramps to +65°C in 1 hour and 10 minutes, uses parameter group 1, and turns on auxiliary relays 1-1, 1-3, 1-6, 2-1, and 2-2.

Interval 5: Soaks at +65°C for 8 hours, the deviation alarm is set off if the temperature deviates more than ±3°C from the set point, and uses parameter group 1.

Interval 6: Steps to +30°C and waits until the temperature is within ±2°C of the set point, uses parameter group 2, loops back to interval 3, repeats intervals 3 through 6 twenty-four times, and turns all the auxiliary relays off.

NOTE: This sample profile is a simple temperature-only profile and uses the same display status and options for all intervals. A more complex profile involving PTC and humidity would not use the same display status and options for all intervals because PTC and humidity cannot be enabled in the same interval.

Using the operation commands to load the sample profile into the 8800

Operation commands can be used to load the sample profile, LongSoak25Loops, into the 8800. See "Using the programming commands" above for descriptions of the intervals.

1. Send the PROG,LongSoak25Loops,6 command string to the 8800. This string loads a 6-interval program named LongSoak25Loops.
2. Send the INTV0,20,,,,1 command string to the 8800. This string sets the initial value of interval 0 to +20°C and sets channel 1 active.
3. Send the interval 1 command string: INTV1,20,,,,,,,2,1,,,202,74,23,48.
4. Send the interval 2 command string: INTV2,30,,,,2,,,,,2,,,,0.
5. Send the interval 3 command string: INTV3,,,,,3,,,,2,1,,,0.
6. Send the interval 4 command string: INTV4,65,,,,0,,,,1:10:00,,,,37,3.
7. Send the interval 5 command string: INTV5,,,,,3,,,,8.
8. Send the interval 6 command string: INTV6,30,,,,2,,,,,2,25,3,0,0.

NOTE: You need to use the commas to maintain proper placement for the values in each string. Each command string ends after the last non-null data field. The null fields (,,) make use of the following 8800 default values:

- The final values field uses the initial values field (final values field from the last interval).
- The deviation and auxiliary group fields use the value from the last interval, or 0 if interval 1.
- The parameter group field uses the value from the last interval, or 1 if interval 1.
- The number of loops field defaults to 0.
- The next interval field defaults to the next sequential interval.
- The display status and options fields default to the last interval's values.

Using the query commands to load the sample profile from the 8800

Query commands can be used to retrieve the sample profile, LongSoak25Loops, from the 8800.

1. Send the PROG4? command string to the 8800.

   NOTE: Use the PROGn? command to find out how many intervals a program has, and remember to include interval 0 when you begin to retrieve program intervals from the 8800.
2. Send the INTV0? command string to retrieve the initial values of interval 0.
3. Send the INTV1? command string to retrieve the interval 1 data.
4. Send the INTV2? command string to retrieve the interval 2 data.
5. Send the INTV3? command string to retrieve the interval 3 data.
6. Send the INTV4? command string to retrieve the interval 4 data.
7. Send the INTV5? command string to retrieve the interval 5 data.
8. Send the INTV6? command string to retrieve the interval 6 data.

Computer interface troubleshooting and error codes

This section contains basic troubleshooting information as well as a list of the 8800 computer interface errors codes.

Common computer interface problems and solutions

Before attempting to run the 8800 communication interface in a user application program on the host computer, it is often helpful to use a dumb terminal or a terminal emulation program to test the serial communications. This allows you to become familiar with the 8800 command syntax.

The 8800 and host computer are not able to communicate using RS-232

If the 8800 and the host computer are not able to send and receive interface commands:

1. Press **Setup**, then select the Communication panel. Check the RS-232 settings. Typically **Send Acknowledgement** should be set to off and **Terminator** should be set to last input. Check the **Baud Rate**.
2. Make sure that you are sending a command that returns information; for example, PVAR1? or IDEN?
3. Check the cabling.
4. Try another controller.
5. Try another host computer.
6. Try ThermoTrakII software and cabling.

The 8800 and host computer are not able to communicate using RS-485

If the 8800 and the host computer are not able to send and receive interface commands:

1. Check the cabling.
2. Press **Setup**, then select the Communication panel. Check the RS-485 settings.
   a. Verify the **Address** setting.
   b. Check the **Baud Rate**.
   c. Set **Terminator** to Last Input.
   d. Make sure **Prefix** is checked.
   e. Make sure **Send Acknowledgement** is not checked.
3. Try another controller.
4. Try another host computer.
5. Try ThermoTrak II software and cabling.

The 8800 and host computer are not able to communicate using GPIB

If the 8800 and the host computer are not able to send and receive interface commands:

1. Check the cabling
2. Press **Setup**, then select the Communication panel. Check the GPIB settings. Set **Terminator** to Last Input.
3. Try another controller.
4. Try another host computer.

The host computer sends commands, but does not receive data

If the 8800 accepts interface commands without returning the required data, check the computer interface terminator and/or the handshake signals.

- **Terminator problem**: When the 8800 is receiving command strings, it recognizes a carriage return, a line feed character, or a carriage return and line feed to signify the end of the command string. Verify that the 8800 and the computer agree on the selected termination.
- **Handshake problem**: The 8800 does not use handshaking. Verify that handshaking is disabled on the host computer. Instead of handshaking, enable **Send Acknowledgment** for all serial interfaces. This setting programs the 8800 to send the last error code after receiving each operation command.

The host computer receives wrong or garbled data from the 8800

Wrong or garbled data can be caused by the improper use of command sequences or by entering improper communication parameters. The more common problems and solutions are described below.

- **Buffer out of synch**: This typically occurs when the computer does not read all of the data requested from the 8800. Make sure the host computer reads all requested data.
- **Parameter mismatch**: Check the serial interface setting. For RS-485 applications, check the addressing and prefix protocol parameters. If the prefix protocol and addressing options are enabled, be sure to use the correct protocol syntax at the host computer. **NOTE**: If the serial parameters do not match, the 8800 probably will not receive any commands.

The host computer sends and receives data, but has problems with specific commands

Some commands may cause problems if you do not send them in the proper manner or sequence.

- Use the 8800 error codes to help troubleshoot these types of problems. Use the IERR? command to read the error codes. For more information, see “Error codes” later in this section.
- Verify that the data sent with the command is within the acceptable range.
- Verify that the data sent with the command is in the proper form.
- If you are having problems with PROG and INTV commands, make sure you set up the command series to include the INTV0 command.

Error codes

The 8800 error codes provide fault indications that aid in debugging programs and identifying interface problems. For error identification, programs should periodically send an IERR? command.

Error code 00

Command name: No error

Description: There was no error.

Error code 01

Command name: Serial interface error

Description: This error may occur because of problems with the communication parameters set in the Communication panel on the 8800 (baud rate, parity, stop bits, word length, etc.). The 8800 will usually have another error (most commonly error code 04) because the data that caused this error will be misinterpreted. If this occurs after loading a value into the 8800, recheck the value and reload as required.

Error code 02

Command name: Input buffer overflow

Description: The data string sent to the 8800 is too long. The 8800 can hold up to 128 characters; make sure the data strings and/or concatenated command strings are not longer than 128 characters.

Error code 03

Command name: Output buffer overflow

Description: Make sure your computer is reading the 8800 output buffer each time it requests data.

Error code 04

Command name: Unknown command

Description: The 8800 did not recognize the command string; make sure the string sent is a legal command. On RS-485 networks, check to see if you are using multidrop addressing and prefix protocol. You may wish to implement these features if you have not already.

Error code 05

Command name: Number parser error

Description: The 8800 could not successfully parse the operation command string's data into its discrete parts. Check the command string to ensure you separated it properly with commas and sent the correct number of characters.

Error code 06

Command name: Value loaded was too high.

Description: The value sent to the 8800 exceeded the high end limit; check the value against the programmed range of the channel or parameter.

Error code 07

Command name: Value loaded was too low.

Description: The value sent to the 8800 exceeded the low end limit; check the value against the programmed range of the channel or parameter.

Error code 08

Command name: Incorrect channel number

Description: The value sent to the 8800 was not an acceptable channel value. Check the 8800 channel configuration for the channel. Also, check the options set up for the channel. For example, the PTC and humidity options can enable or disable channels.

Error code 09

Command name: Bad command syntax

Description: The command was sent to the 8800 in an unrecognizable form. For the proper command syntax see "Interface command descriptions" earlier in this section.

Error code 10

Command name: Illegal program command

Description: The 8800 received an INTV command without having first received a valid PROG command.

Error code 11

Command name: Illegal interval number sequence

Description: The value sent to the 8800 is not a valid interval value. During load program by value operations, make sure you are sending INTV operation commands that include interval 0 and all the intervals in sequential order.

Error code 12

Command name: Not enough program memory

Description: The program is too large to load into the 8800's memory; delete any unused programs and reload the program.

Error code 13

Command name: Illegal stop command

Description: The 8800 must be in run or hold mode to execute a STOP command.

Error code 14

Command name: Illegal hold command

Description: The 8800 must be in run mode to execute the HOLD command.

Error code 15

Command name: Illegal run manual command

Description: The 8800 must be in stop or hold mode to execute the RUNM command.

Error code 16

Command name: Incorrect operating mode

Description: Do not send programming commands while in manual mode, or manual mode commands while in program mode, etc.

Error code 17

Command name: Run program error

Description: If you are running from stop mode, the command requires the program name and the interval number.

Error code 18

Command name: Resume command error

Description: The 8800 must be in hold manual or hold program mode to execute the RESM command.

Error code 19

Command name: Options not configured

Description: The 8800 is factory configured for the options on your chamber. Check to see if your options byte is selecting an option that is not available on your chamber.

Error code 20

The 8800 does not use this error code.

Error code 21

Command name: Control module not present

Description: The 8800 returns this error code if a query or operation command attempts to access a control module that is not present and/or that the 8800 is not configured for.

Programming examples

Programs can be written to operate the 8800 from a host computer in a variety of programming languages. The following section is a brief sampling of the types of programs that can be written to operate the 8800 from a host computer. Thermotron does not support any of the programming languages used in this sampling. For additional information, refer to the documentation included with the programming languages and/or compilers.

Microsoft Visual Basic

In this example, the command string found in the text box 'Text1.text' is modified by adding an ASCII carriage return to the end of it before it is passed to the Read8800 routine. Note that this is done by using the chr$(13) construct, as opposed to the '\r' method. Visual Basic does not pass the '\r' with the string to the ibwrt function. The Read8800 routine checks for the presence of the carriage return in the string returned by the ibrd function.

```
read8800 (text1.text & chr$(13))

private sub read8800(cmd$) 'send commands to 8800, read results or error code ack.

        resp_recd = false
        call ibwrt(dev%, cmd$)
        resp$ = space$(100)
        call ibrd(dev%, resp$)
        crposition = instr(resp$, chr$(13))
        if crposition <> 0 then
                inputstring$ = left$(resp$, crposition)
                resp_recd = true
        end if
end sub
```

Microsoft Visual C++ (or C)

Visual C++ does allow the use of the '\r' and '\n' symbols for carriage returns and line feeds

GPIB example

```
#include "decl-32.h"
#include "windows.h"
int     status,inst;
char    *dev = "dev10\0";
char    *cmd = "pvar1?\r\0";
char    resp[100];
inst = ibfind(dev);
status = write8800(inst,cmd,resp);
status = ibrd(inst,&resp,100l);
```

TCP example

```
#include "Winsock2.h"

//command to send
CString cmd = "IDEN?\r";

//buffer for response
char buf[256];

//IP Address and Port to connect to
CString address = "192.168.4.27";
int port = 8888;
```

```
//handle to a windows socket
SOCKET m_hSocket = INVALID_SOCKET;

//The SOCKADDR_IN structure is used by Windows Sockets
//to specify a local or remote endpoint address
//to which to connect a socket.
SOCKADDR_IN addr;

//always AF_INET
addr.sin_family = AF_INET;

//port number in big-endian form
addr.sin_port = htons(port);

//IP Address converted from a dotted address (x.x.x.x) form to the SOCKADDR_IN form.
*(ULONG *)&(addr.sin_addr) = inet_addr(address.GetBuffer(0));

//create a socket
m_hSocket = socket(AF_INET, SOCK_STREAM, 0);

// Set the timeouts for the socket
int timeout = 1000;
setsockopt(m_hSocket, SOL_SOCKET, SO_RCVTIMEO, (char *)&timeout, sizeof(timeout));
setsockopt(m_hSocket, SOL_SOCKET, SO_SNDTIMEO, (char *)&timeout, sizeof(timeout));

//connect to the specified destination
connect(m_hSocket, (sockaddr *)&addr, sizeof(addr));

//send a command
send(m_hSocket, cmd.GetBuffer(0), cmd.GetLength(), 0);

//read a response
recv(m_hSocket, buf, sizeof(buf), 0);

//close the connection
closesocket(m_hSocket);
m_hSocket = INVALID_SOCKET;
```

Note that the carriage return from the 8800 will be included in the response string ‘resp’.

National Instruments Interactive Control Utility (IBIC)

It is important to use the special symbols \r and/or \n to add a carriage return (\r), or line feed (\n) to the strings sent to the ibwrt function. The following sequence finds the device at address 10, sends the 'pvar1?' query command, and then reads the data.

Win32 Interactive Control

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```
type 'help' for help or 'q' to quit.
: ibfind "dev10"
dev10: ibwrt "pvar1?\r"
[0100]   ( cmpl )
count:  7


dev10: ibrd 22
[2100]   ( end cmpl )
count:  5
32  35  2e  31  0d                  2 5 . 1 .


dev10:
```

Note that even though a count of 22 characters was specified for the ibrd function, it returned complete and no errors since it terminated on the carriage return. Note also that the carriage return (0x0d) is included in the string returned by the ibrd function.

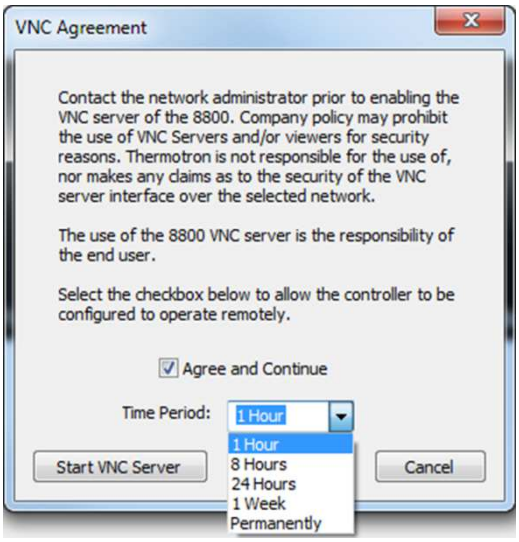
Virtual Network Computing (VNC)

NOTE: In this section *italicized* text indicates features that cannot be demonstrated using the Thermotron 8800 controller demo software.

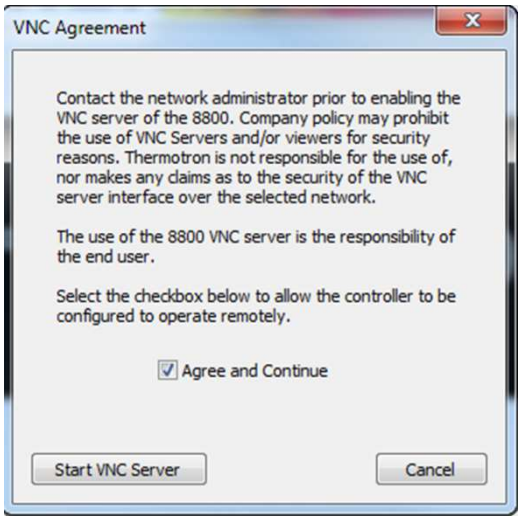
Virtual Network Computing (VNC) in 8800 and 8825 controllers

NOTE: All VNC messages refer to the controller as an 8800, even if it is an 8825 controller.

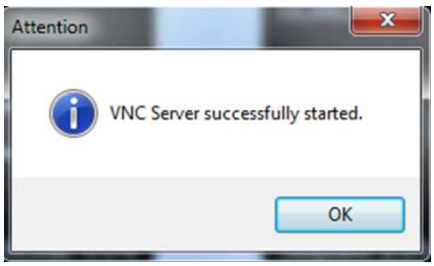
1. To allow the controller to be configured to be operated remotely for a specified length of time, enter the RUNVNC password. The **VNC Agreement** dialog will appear:
   - Check the **Agree and Continue** checkbox.
   - Select a time period for the VNC server to run.
   - To start the VNC server, select the **Start VNC Server** button. To cancel starting the VNC server, select the **Cancel** button.



2. To allow the controller to be configured to be operated remotely for an indefinite length of time, enter the RUNVNCPERM password. The **VNC Agreement** dialog will appear:
   - Check the **Agree and Continue** checkbox.
   - To start the VNC server, select the **Start VNC Server** button. To cancel starting the VNC server, select the **Cancel** button.



3. If the **Start VNC Server** button is pressed an acknowledgement message will appear:

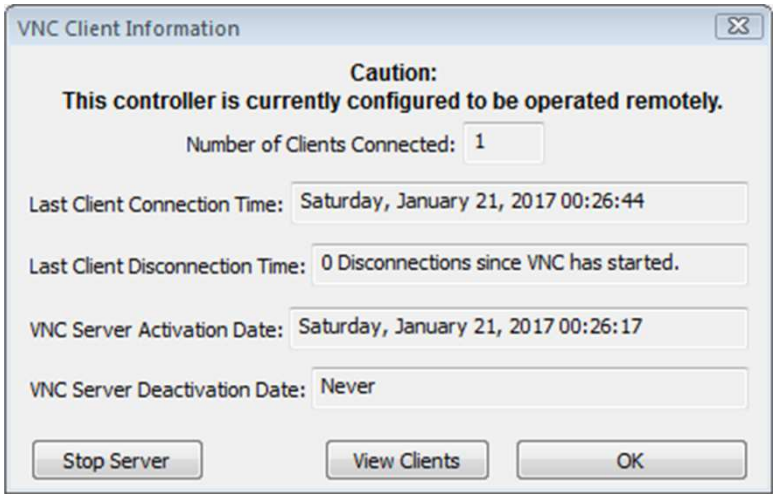


4. When the VNC server is running a new **VNC** button now appears on the top button bar between the **Hold** and **Save** buttons. If the **VNC** LED is red and unlit it means that the VNC server is running but there are no remote clients connected to this 88xx controller.

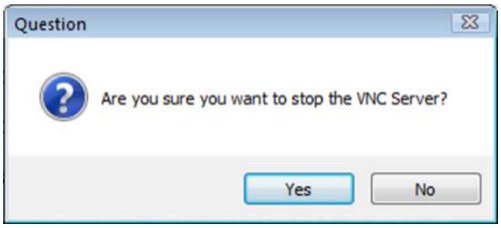
*If the **VNC** LED is green and flashing it means that the VNC server is running and one or more remote clients are currently connected to this 88xx controller.*

5. You can press the **VNC** button at any time to display the **VNC Client Information** dialog, which displays the following information:

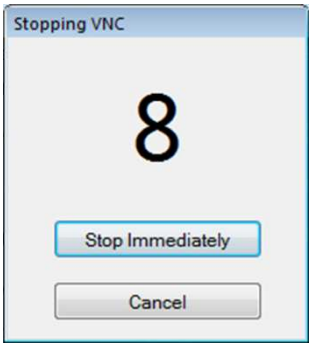
   - A reminder that this 88xx controller is configured to be operated remotely.
   - The number of remote clients that are currently connected.
   - The last time any client connected or disconnected.
   - When the VNC server was activated.
   - When the VNC server will deactivate.



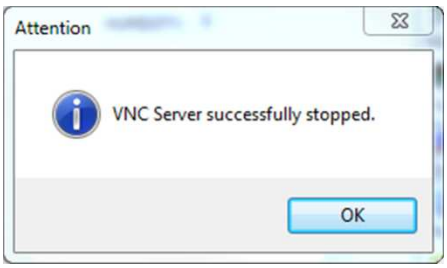
6. From this dialog you can stop the VNC server by pressing the **Stop Server** button. It prompts with a confirmation pop-up:



   - If you select **Yes** another pop-up will appear indicating that the VNC server will time out in 10 seconds (the timer counts down from 10 to 0). During this 10-second period you can press the **Stop Immediately** button to stop the VNC server right away, or press the **Cancel** button if you decide you don't want to stop the VNC server. Otherwise, after 10 seconds the VNC server will stop.

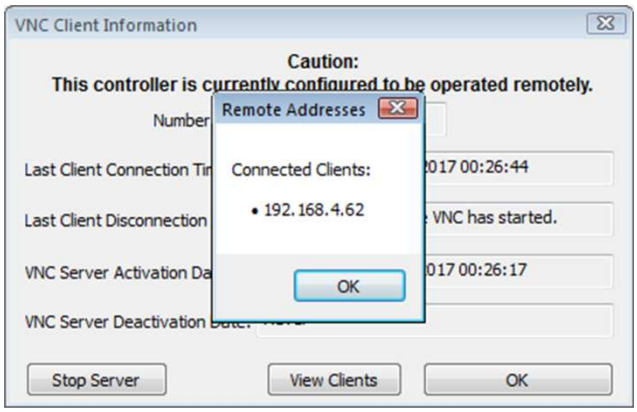


- Once the VNC server has stopped a confirmation pop-up will be displayed:

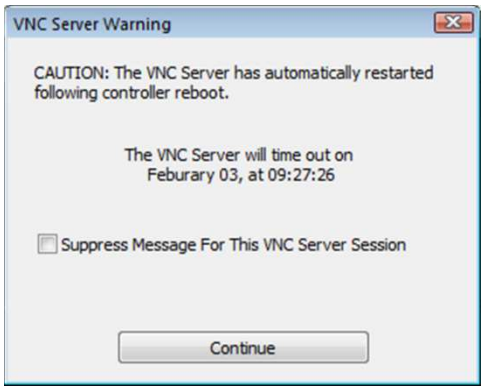


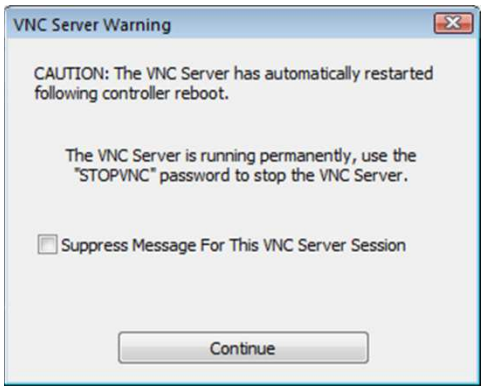
NOTE: When the VNC server is stopped the VNC button on the top button bar will also disappear.

7. Pressing the **View Clients** button on the **VNC Client Information** dialog will display the IP addresses of all clients currently connected to this 88xx controller. In this example there is one client connected to this 88xx. The client is at IP address 192.168.4.62. **NOTE**: The demo software will never show any clients connected.



8. *If the VNC server is running when a power cycle occurs, one of these messages will be displayed at startup (depending on whether the VNC server is running for a specified time period or running permanently):*

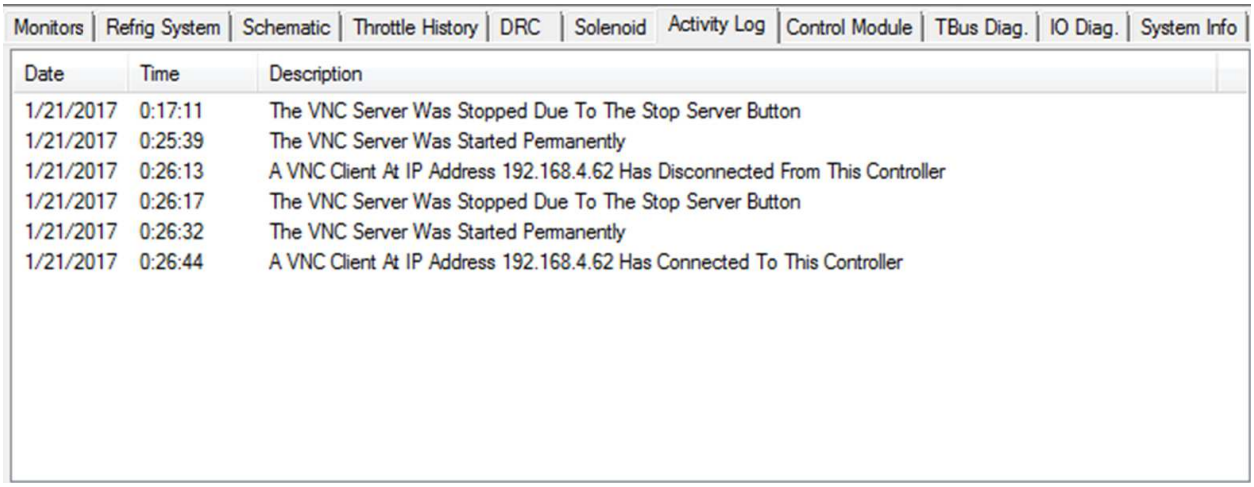




- *Press **Continue** to dismiss this message.*
- *Checking the **Suppress Message For This VNC Server Session** checkbox will keep this message from being displayed on future power cycles until the next time the VNC server is stopped and restarted.*

VNC activity logging

All VNC activity is logged in the Activity Log.

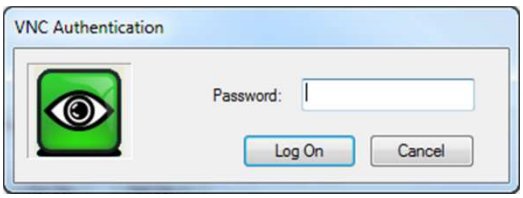


The Activity Log displays the following information:

- When the VNC server started and for how long.
- When the VNC server stopped and why.
- *When a client connects or disconnects, including IP address.*

VNC authentication

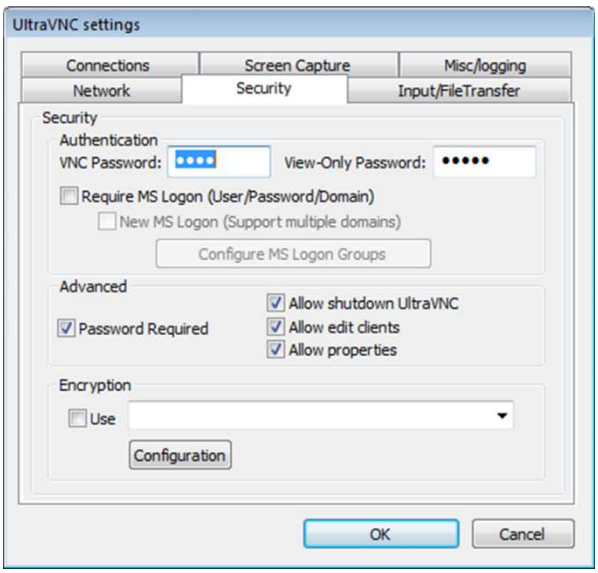
When a client connects to the 8800 or 8825 controller, the default **VNC Authentication** password is "8800".



Changing the VNC password

*To change the VNC password, enter the CFGVNC password. The **UltraVNC settings** dialog will appear:*

- *You can set up separate passwords for view-only and full control.*
- *Other VNC configuration functions are not supported by the 88xx controller.*

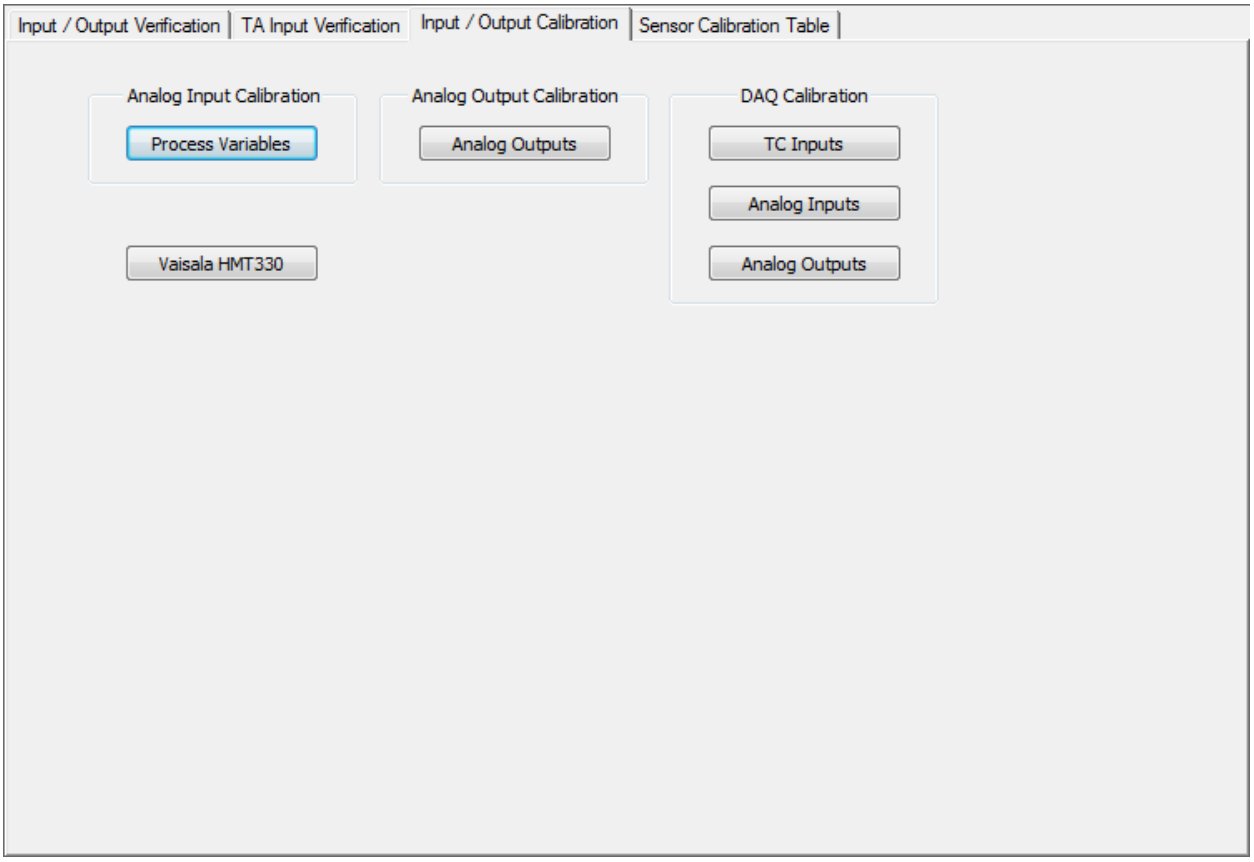


Section 5: CM2 Calibration

This section describes how to verify and calibrate a CM2 control module's analog inputs and analog outputs.

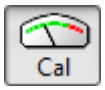
CAUTION: This section is not a substitute for adequate technical training. Improper calibration could damage your 8800, chamber, refrigeration system, or products under test.

Calibration panels



NOTE: The CM2 analog inputs were calibrated by Thermotron for accurate performance. Before beginning any calibration procedure, make sure the calibration instruments you use are properly calibrated themselves. Also make sure the display module's temperature scale is set to Celsius.

To access the calibration panels, press the **Cal** button. The calibration panels provide access to the verification and calibration functions for process variables (control channels and monitor channels) and analog outputs:



- *Control channels* are the external and internal channels that both monitor and operate chamber systems. These channels use the CM2's thermocouple, RTD, and analog inputs to sense the chamber's conditions; they can also use the relay board and analog outputs for chamber control. Up to four channels can be factory-configured as chamber process variable control channels. Channels 5 through 8 are factory-set internal control channels.

  To determine which thermocouple, RTD, or analog inputs are configured as control channels, refer to your instrumentation and configuration schematics. Instrumentation schematics show the physical interconnects. Configuration schematic shows the channel assignments.

- *Monitor channels* also use the control module's thermocouple, RTD, and analog inputs to sense chamber environmental conditions. However, these channels do not operate control outputs to the chamber.

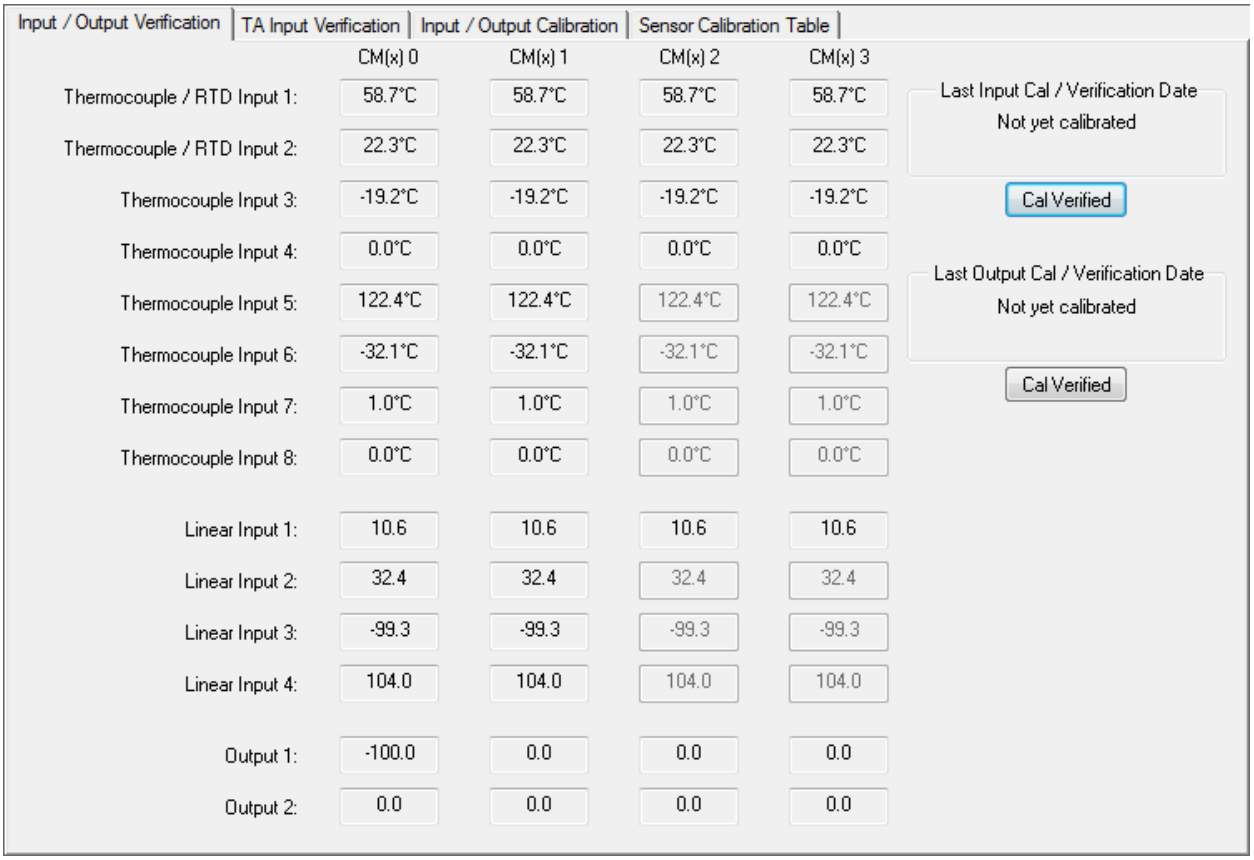
To determine which thermocouple, RTD, or analog inputs are configured as monitor channels, refer to your instrumentation and configuration schematics. Instrumentation schematics show the physical interconnects. Configuration schematic shows the channel assignments.

- Each CM2 has two *analog outputs* that can be factory-configured to retransmit chamber readings or provide linear control to an instrument or control device. Analog outputs can be set to voltage or current, normally 0-5 VDC or 4-20 mA.

Verifying analog inputs and analog outputs

To determine if calibration is necessary, the data from independent calibration equipment attached to the CM2 can be compared to the "raw" analog input and output data shown on the Input / Output Verification panel.

1. Press the **Cal** button, then select the Input / Output Verification panel. To make verification easier, the data shown on this panel has not been altered in any way.



2. **Input examples**

   - *Example 1*: If **Linear Input 1** represents a temperature-compensated humidity reading, the reading here is presented without the temperature compensation applied. Therefore, if the input were originally calibrated such that 0-5 VDC = 0-100%, that linear relationship would hold true on this panel, making verification very straightforward.

   - *Example 2*: If **Linear Input 2** represents altitude in thousands of feet, the 8800 would expect a torr reading from a sensor, then convert that torr reading to thousands of feet using a software algorithm for the user display. The reading indicated on the Input / Output Verification panel would be the torr reading. Therefore, if the input were originally configured such that 0-3.8 VDC = 0-760 torr, that relationship would hold true on this panel, making verification very straightforward.

NOTE: Any adjustments made to any input channel via the Sensor Calibration Table would not be reflected on the Input / Output Verification panel.

3. *Output example*: If **Output 1** had been configured and calibrated such that -100°C to +200°C represented a 0-5 VDC output, the value displayed here would reflect the temperature equivalent of the voltage currently being sent to the analog output. Therefore, if **Output 1** were reading 50.0°C on the Input / Output Verification panel (halfway between -100°C and +200°C), the physical analog output should be reading 2.5 VDC (halfway between 0 VDC and 5 VDC) if calibrated and configured properly.

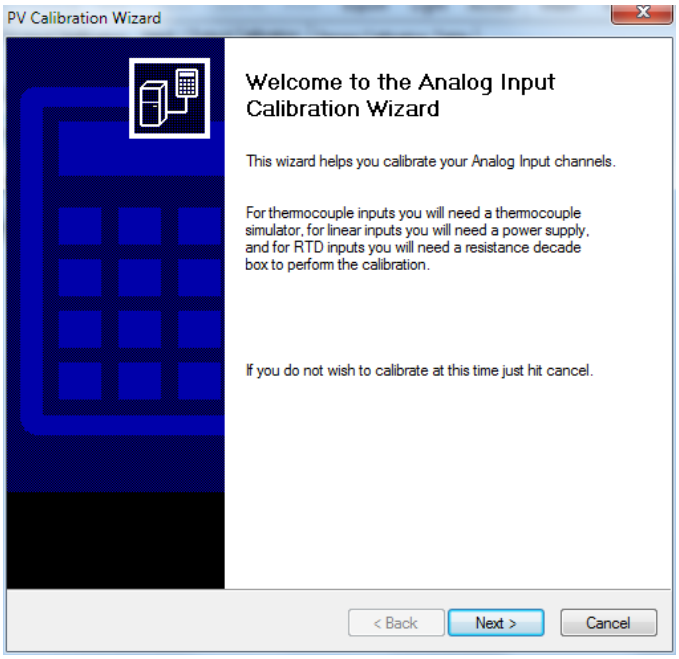
4. After verifying the input or output calibration, press the appropriate **Cal Verified** button. The 8800 will display the date and time the calibration was verified on the Input / Output Verification panel and on the System Info panel.

Calibrating analog input and analog output channels

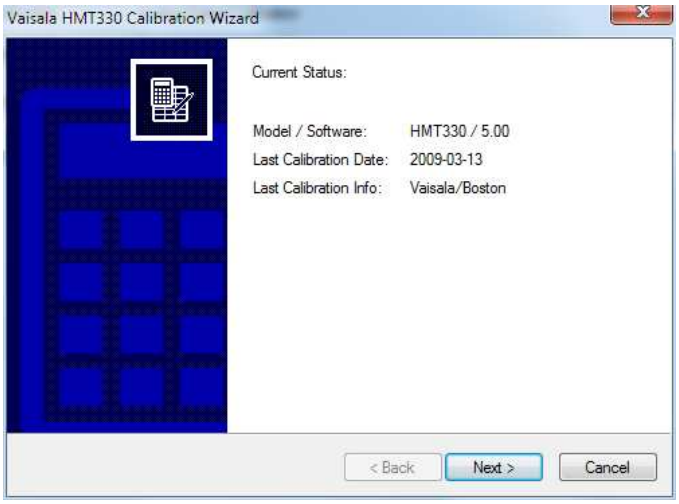
1. Press the **Cal** button, then select the Input / Output Calibration panel.

   - To calibrate analog inputs, press **Process Variables**. The Analog Input Calibration Wizard will start.
   - To calibrate monitor channels, press **Monitor Channels**. The Analog Input Calibration Wizard will start.

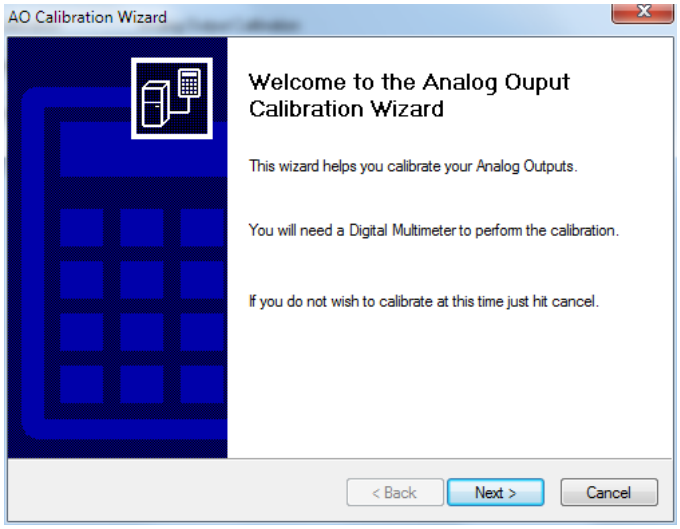
     NOTE: The calibration wizard allows channels of identical input types to be calibrated together. As soon as the first selection is made, the wizard grays out any non-identical inputs.



   - To calibrate a Vaisala HMT330 solid-state humidity sensor, press **Vaisala HMT330**. The Vaisala HMT330 Calibration Wizard will start.



- To calibrate analog outputs, press **Analog Outputs**. The Analog Output Calibration Wizard will start.



2. Follow the instructions on the screen, pressing **Next** when you are ready.

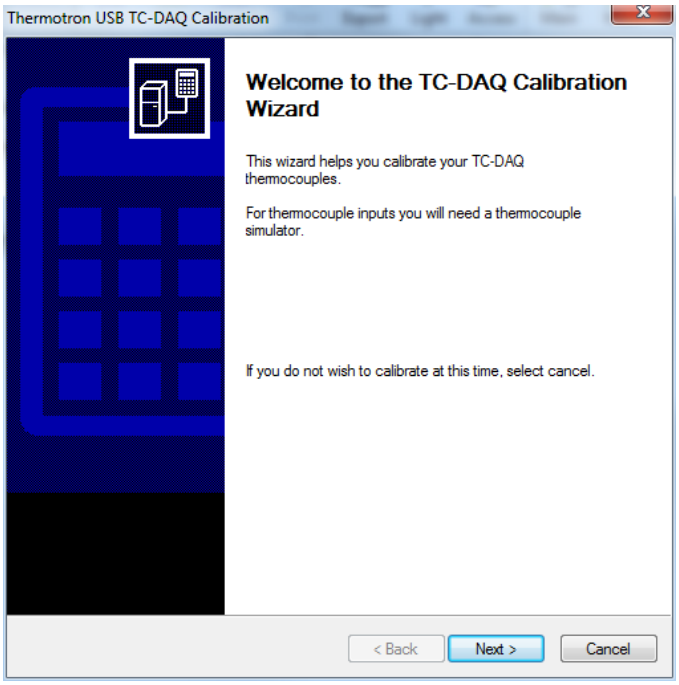
Calibrating DAQ thermocouple inputs and analog inputs and outputs

The 8800 supports revision B of the Thermotron Tier 2 USB-DAQ option. Revision B uses all Thermotron hardware and allows calibration of the thermocouple inputs and analog inputs and outputs. **NOTE**: The USB-DAQ status and revision level are indicated on the System Info panel. For more information, refer to "System Info panel" in Section 3 of this manual.

When the 8800 detects a revision B USB-DAQ, the Input / Output Calibration panel displays DAQ Calibration buttons that launch calibration wizards similar to those used for process variable and monitor channels.

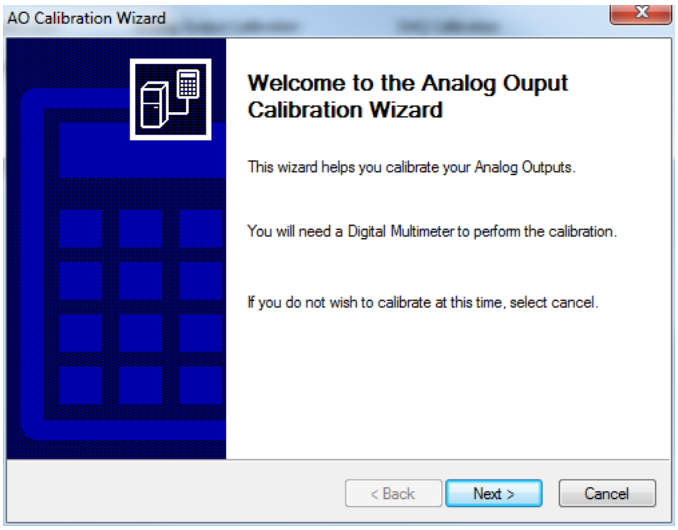
1. Press the **Cal** button, then select the Input / Output Calibration panel.

- To calibrate the DAQ thermocouple inputs, press **TC Inputs**. The TC-DAQ Calibration Wizard will start.



- To calibrate the DAQ analog inputs, press **Analog Inputs**. The Analog Input Calibration Wizard will start.

- To calibrate the DAQ analog outputs, under DAQ Calibration press **Analog Outputs**. The Analog Output Calibration Wizard will start.

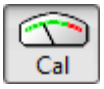


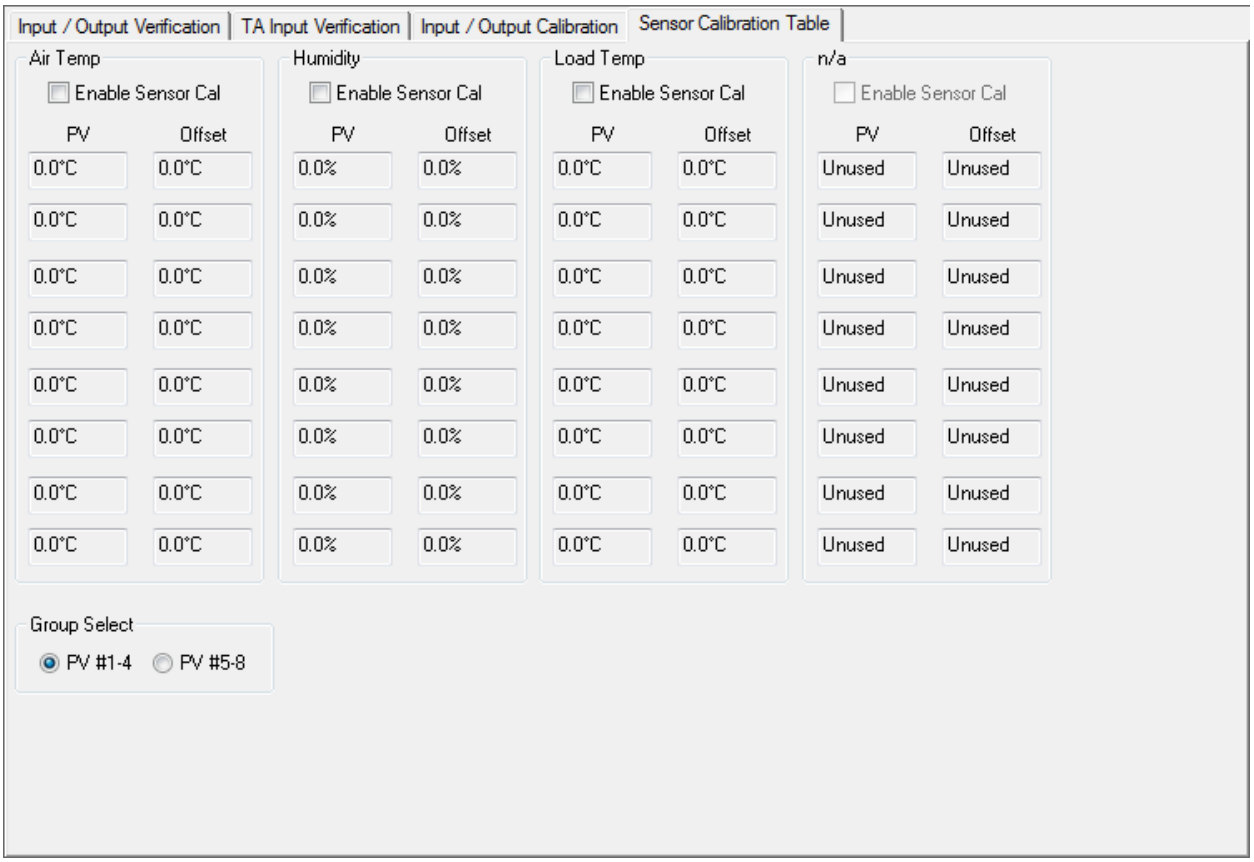
2. Follow the instructions on the screen, pressing **Next** when you are ready.

Adjusting process variable channels

Calibrated process variable channels can be further adjusted to match independent sensors. The adjustment can be a simple offset shift, or up to eight different data breakpoints and deviations throughout the entire range of the channel input.

1. Press **Cal**, then select the Sensor Calibration Table panel.

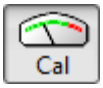


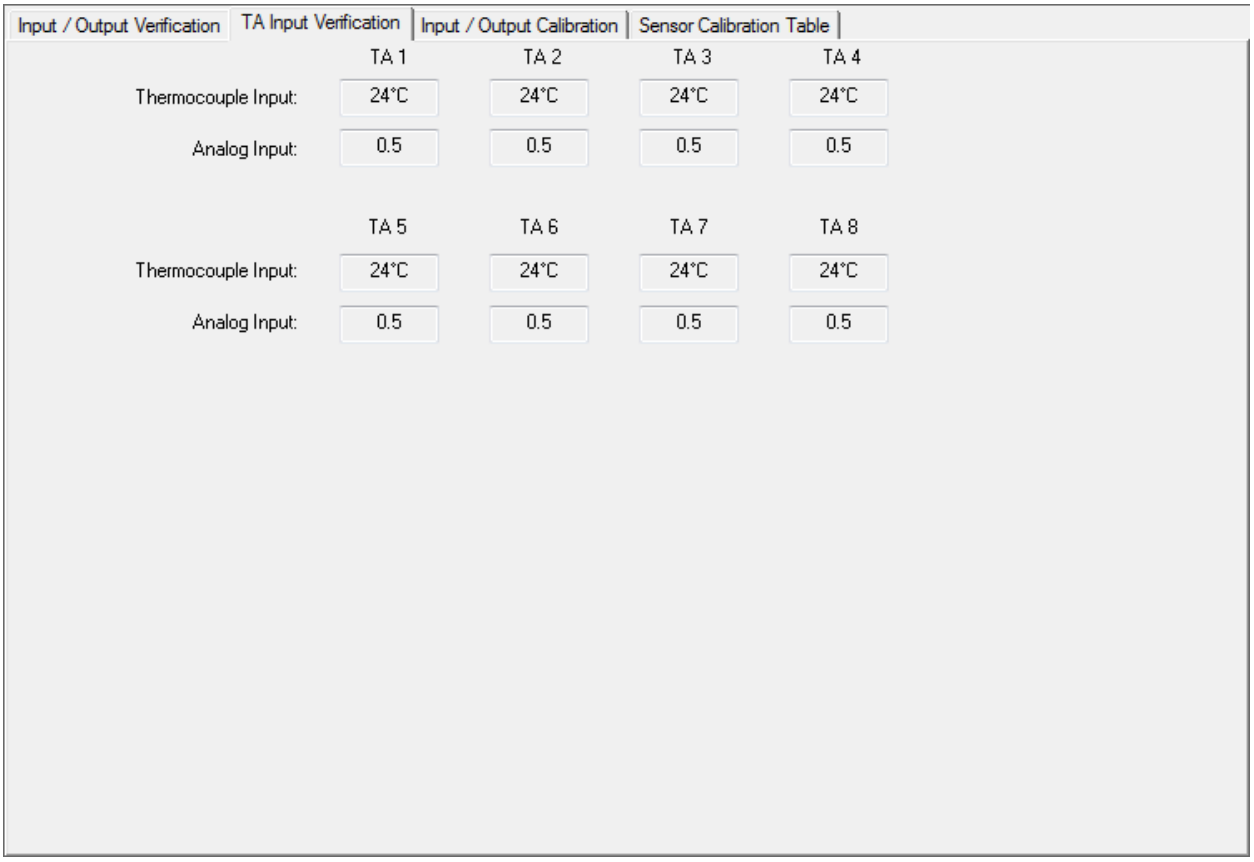


2. Under Group Select, press the desired process variable group. **NOTE**: Process variable channels 5 through 8 are factory-set internal control channels.
3. To adjust a channel's input, select the channel's **Enable Sensor Cal** check box.
4. Enter the appropriate adjustment values into the **PV** and **Offset** fields.

Verifying Therm-Alarm inputs

To determine if Therm-Alarm input calibration is necessary, press the **Cal** button, then select the TA Input Verification panel.





The data from independent calibration equipment attached to the CM2 can be compared to the “raw” input data shown on the TA Input Verification panel. If Therm-Alarm input calibration is necessary, refer to “Calibrating a Therm-Alarm” in Section 2 of this manual.

Section 6: Technical Information and Troubleshooting

This section provides technical information and troubleshooting procedures for the 8800 display module. For information on the CM2 control module, refer to the *CM2 Control Module Technical Manual*.

NOTE: Units equipped with an 8800 display module ship from the factory with all of the necessary hardware and software installed. If you need to reinstall any of the hardware or software, please call the Thermotron Product Support group at (616) 392-6550.

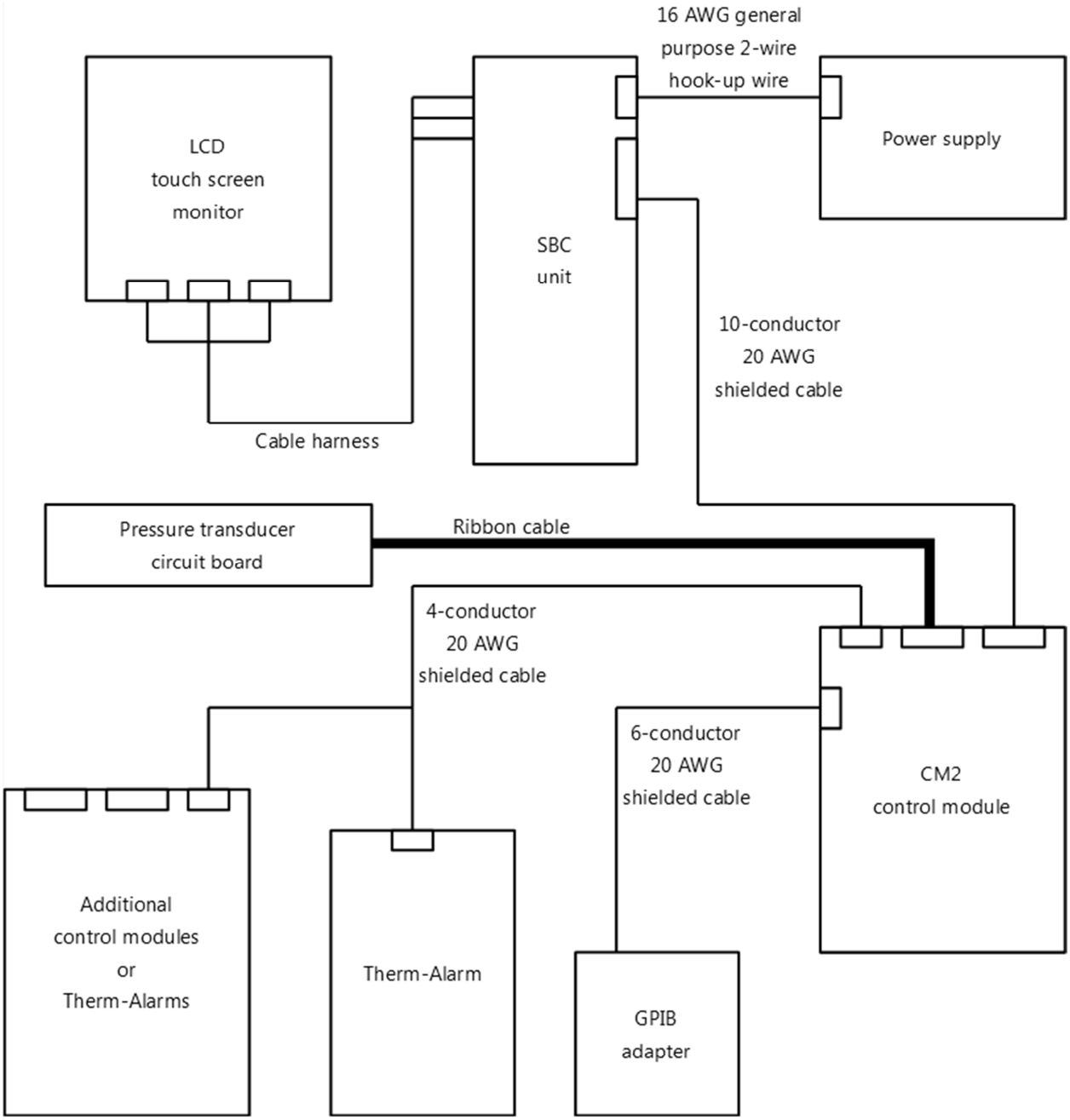


Figure 1. 8800 system block diagram

SBC unit specifications

Operating temperature	0-50°C
Power requirements	35 watts at 15 volts
Hard drive	160 GB SSD min
RAM	2 GB
Processor	Intel Atom 1.66GHz Dual Core Hyper Threaded Processor
Operating system	Windows Embedded Standard
USB	Four USB 2.0 ports

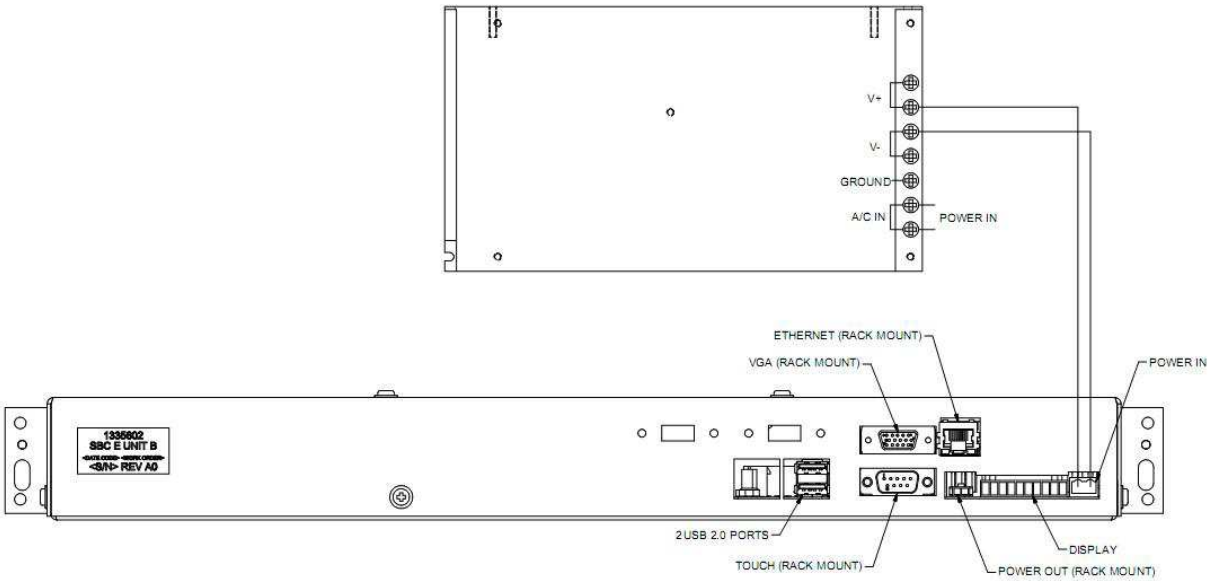


Figure 2. Rear view of the SBC unit and power supply

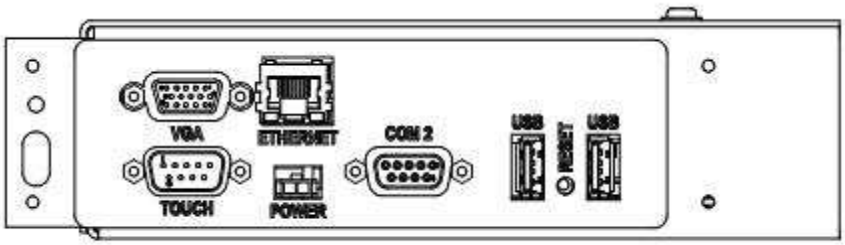


Figure 3. Detail of the front side of the SBC unit

Required components

The 8800 enhanced display module requires three separate components to be operational: the 8800 SBC (single board computer) unit, a power supply, and a touch screen monitor. The SBC unit comes in two versions, an SE version and a rack mount version. The only difference between the two is the location of the connectors for the touch screen monitor (VGA, TOUCH, ETHERNET, and POWER). The SE version has all of these connectors coming out the front of the box and the rack mount has these routed to the back. The SE version SBC unit is intended for use on SE chambers; the rack mount version of the SBC unit is intended for use in applications where a cleaner front side of the box is desired. Either option can fit into a standard 19-inch rack.

Power supply

The 8800 power supply is a 150-watt, 15-volt, off-the-shelf power supply. It is intended to be mounted in the electrical compartment and hooked up to the 8800 with general 16 AWG hook-up wire (a pluggable terminal block is provided on the 8800). All of the power required by the 8800 is supplied by this power supply, which means an 8800 can operate outside of a chamber without a control module.

SBC unit

The SBC unit contains the single board computer (SBC), hard drive, and a circuit board assembly that distributes power to the components of the 8800 and provides the interface between the SBC and the control module. The SBC unit has connectors coming out of two sides. The front side is shown above in Figure 3. The back side is shown in Figure 2. Refer to these two figures for the connector descriptions shown below:

Power in The 15-volt power supply is connected to this connector located on the back of the SBC unit. Positive voltage is connected to pin 1, which is on the left when facing the connector as shown in the diagrams. The 8800 unit consumes a worst case 35 watts of power. The power supply has been sized to work over a 0-70°C operating range.

Display The display connector located in the back of the SBC unit is the connection point to a control module. The pins of this connector are numbered left to right when facing the back of the SBC unit as shown in Figure 2. The 8800 does not need the power pins in the display cable, but they can be connected and energized without harming the SBC unit.

COM 2 An extra serial port is provided on the front of the SBC unit to enable the 8800 to communicate with a personal computer using Thermotron's serial communications protocol. This port will only handle RS-232 communications, but it has a standard 9-pin, female, D-subminiature connector with a pin-out compatible with the standard 9-pin RS-232 pin-out. Any off-the-shelf RS-232 cable will work with this port. Any other communications protocol (RS-422, RS-485, TCIP, or GPIB) will have to be done through the control module.

USB Four standard USB 2.0 ports have been provided: two on the front side and two on the back side of the SBC unit. These ports will work with any standard USB cable or device. The 8800 can handle four high-power USB devices (500 mA per port) at the same time.

Reset A recessed hardware reset button has been provided in case problems ever arise with the system. This button may be pressed by pushing a small, pointed object into the hole between the USB connectors on the front of the SBC unit.

CAUTION: Because any unsaved setup or programming data will be lost after a reset, performing a reset while editing setup data or entering programs is not recommended.

The following four connectors are part of the monitor connector cluster. They are located either on the front of the SBC unit for an SE version (as shown in Figure 3), or in the back of the SBC unit for a rack version (as shown in Figure 2). A special cable harness that contains all of the cabling necessary to run the monitor in one sheath has been designed and built.

VGA The VGA connector is a standard high-density, 15-pin, female D-subminiature connector intended to connect the LCD monitor to the SBC on the 8800. Any standard VGA cable will work in this situation, but a special cable harness that contains all of the cabling necessary to run the monitor in one sheath has been designed and built.

Touch The communication between the SBC and the touch screen controller is done on a standard RS-232 serial port. This connector has been dedicated for that purpose and is a standard 9-pin, male, D-subminiature connector. The pin-out of this connector abides by the 9-pin serial standard, so that any standard female-to-male RS-232 cable will work.

Power out This connector provides power for the LCD monitor. The power supply behind this connector has been sized to power a 12-volt, 15-watt, 12.1-inch monitor.

Ethernet The Ethernet connector is part of the monitor connector cluster due to space reasons only. This connector is a standard 8-pin, RJ45 connector, but only makes use of four pins (two twisted pair). It is intended to enable a personal computer to communicate with an 8800 over a standard Ethernet network.

Troubleshooting procedures

NOTE: If you need to reinstall any of the hardware or software, please call the Thermotron Product Support group at (616) 392-6550.

Symptom 1: The touch screen display appears blank

1. Make sure the LCD monitor is turned on.
2. Touch the screen to see if the display comes on.
3. Make sure power is applied to the chamber and SBC unit.
4. Check the cable harness for proper connections and conductivity. Replace any bad cables.
5. Replace the LCD monitor.

Symptom 2: The touch screen does not work, works randomly, or produces incorrect results

1. Calibrate the 8800 touch screen monitor:
   a. From any screen, hold the stylus against the touch screen for 10 seconds.
   b. Follow the instructions on the screen.
2. Check the cable connections at connectors P9 or labeled “Touch” on the LCD monitor.
3. Replace the LCD monitor.

Replacing the touch screen monitor

1. Remove power from the chamber.
2. Disconnect the LCD cable harness from the back of the LCD monitor. **NOTE**: The LCD cable harness consists of a VGA cable, RS-232 serial cable, and a DC power cable bundled in one sheath.
3. Remove the four screws connecting the LCD monitor to the mounting bracket. Be careful not to drop the monitor during this process.
4. Attach the new LCD monitor to the bracket with the screws removed in the previous step. **NOTE**: The LCD mounting screws are metric screws and new screws are not provided with new monitors.
5. Reconnect the LCD cable harness to the back of the LCD monitor.

Appendix A: Glossary

access level: A function that allows you to select from six levels of access to the 8800 functions.

alarm band: The maximum area around the current set point that the process variable (actual test space or product condition) can deviate from. If the process variable drifts outside the alarm band, the 8800 enables its alarm functions.

alarm delay: The number of seconds the Therm-Alarm alarm mode will be delayed after the input temperature reaches a limit temperature. If the limit temperature is exceeded by more than five degrees, the alarm delay will not occur.

auxiliary cooling: An optional, non-mechanical refrigeration system that uses liquid nitrogen (LN_2) or pressurized carbon dioxide (CO_2) to provide cooling.

auxiliary cooling duty cycle; auxiliary cooling time frame: Settings that control an auxiliary cooling system. When the mechanical refrigeration system is operating at full cooling throttle, the auxiliary cooling system can be operated for a programmed percentage or duty cycle (such as 50%) of a selected time frame (such as six seconds).

auxiliary group: One of two groups of eight auxiliary outputs available with the 8800.

auxiliary output: A programmable signal generated by the 8800 that provides on/off control to a system or circuit.

auxiliary relay: A solid-state relay operated by an auxiliary output that uses the TTL output to switch a line voltage. Auxiliary relays operate additional systems or circuits. You can turn these outputs on or off during programmed intervals, or you can operate them in manual mode. There are two auxiliary groups of eight outputs each available with the 8800.

calibration: The process of checking or adjusting an instrument by comparing it with a standard.

cascade: A mechanical refrigeration system with two compressors and a cascade condenser. The refrigerant of the first compressor removes heat from the test space. The refrigerant of the second compressor removes heat from the refrigerant of the first compressor. An air-cooled or water-cooled condenser then removes the heat from the refrigerant of the second compressor.

chamber: A general name for a Thermotron environmental simulation testing system. The chamber includes the testing section, the machinery section, the console, and, on air-cooled chambers, condensers.

channel names: Names that appear as channel headings for all channel-dependent 8800 screens. Channel names may be customized to reflect the variable they are controlling or monitoring.

command: A code sent to the 8800 by a host computer that the 8800 interprets to perform an action.

computer interface: A hardware component, such as an RS-232 or IEEE-488, that connects two or more other components for the purpose of passing information from one to the other.

concatenation: A programming technique that allows the programmer to send more than one command in a single data transmission. The programmer enters the commands on one line, separating them with a delimiter. (On the 8800, the delimiter is a semicolon.) The computer then transmits the commands together.

console: The section where you control the test functions of the chamber. The console usually contains the control panel and the instrumentation. A console can be a separate, remote unit, or it can be attached to the chamber.

control channels (process variable channels): Channels that receive analog inputs from thermocouples and other sensing devices used to monitor the environmental conditions inside the chamber's test space. The 8800 operates the chamber control systems based on the process variable readings and the demands of the test.

control module: The hardware assembly that includes the microprocessor used to perform the chamber interface operations and distribute power to the display module. The 8800 can have up to four control modules.

control option: One of the various options, such as humidity or product temperature control, that can be enabled or disabled for manual mode operation or for each programmed interval.

control parameter: Settings that adjust the performance of the chamber around set point. As the chamber nears set point, the 8800 adjusts the chamber throttles to provide a smooth ramp to set point. To prevent overshooting and oscillation around the final set point, the refrigeration, heating, and other systems must be damped as they approach the set point. To maximize chamber performance, lag times must also be compensated for. Up to four groups of chamber parameters can be entered into the 8800 for each control channel. This allows you to select chamber performance appropriate for the type of interval or program you are running.

control sensor: A device that monitors the environmental conditions in the chamber's test space for the 8800.

controlled ramp: The process of changing the test space temperature, humidity, or other variable from an initial set point to a higher or lower set point at a linear rate.

cooling ramp: The process of decreasing the test space temperature from an initial set point to a lower temperature set point at a linear rate.

csv files: Comma-separated-variable files; the file format that the 8800 uses.

cycle: A set of intervals repeated during a programmed test.

delayed start: A function that causes the 8800 to wait until a specified date and time before running a program.

deviation: The difference between the process variable (actual test space or product condition) and the set point (assigned test space or product condition).

deviation alarm: An 8800 function that can be programmed to activate an alarm if the chamber temperature, humidity, or other process variable is outside the channel's +/- deviation alarm band. A deviation alarm band programs how far the temperature or humidity can be from set point. For example, a deviation alarm band of 5°C activates the alarm output if the chamber temperature is more than 5°C above or below set point.

discharge pressure (head pressure): The pounds per square inch of refrigerant present at the outlet of the compressor.

display module: The 8800 display module is composed of a single-board computer, touch screen monitor, and power supply.

droop: An effect that prevents a process variable from reaching the final set point. For example, natural heat loss through the chamber walls can prevent the test space temperature from reaching the final set point.

dry bulb: A thermocouple that monitors the test space temperature.

dry bulb temperature: The actual test space air temperature.

early life failure: A defect in a product that causes it to fail during its infancy.

error code: A two-character byte sent by the 8800 to indicate a fault or communication problem.

event relay: A relay programmed by a computer. When the relay is programmed on, the operation controlled by the relay is activated.

final value: The final temperature or other process variable the chamber is to reach during an interval.

GPIB: General Purpose Interface Bus; a parallel interface bus built under the IEEE-488 standard.

graph: An 8800 function that plots changes in process variables (such as temperature or humidity), set points, and other data.

g-soak (guaranteed soak): A g-soak interval will immediately set the set point equal to the interval's final value and then wait until the process variable is within the +/- deviation band of the final value. Once the process variable is within the deviation band, the interval time will begin counting down. For multiple-channel programs, all non-zero deviation bands must be satisfied before the interval time will begin counting down.

heat-up: The process of the test space temperature transitioning from one set point to a higher set point.

heating ramp: The process of increasing the test space temperature from an initial set point to a higher temperature set point at a linear rate.

high alarm limit: The upper temperature limit which, if exceeded, will cause a Therm-Alarm trip.

humidity mode: One of two humidity options:

- *Humidity*: Enables the humidity system. The standard range is between 20% and 95% relative humidity.
- *Low humidity* (available on SE-Series chamber only): Enables the optional low humidity system. Use this system during low humidity and ultra-low humidity operations (from 5% to 20% relative humidity).

hysteresis: A property of a system such that an output value is not a strict function of the corresponding input, but also incorporates some lag, delay, or history dependence, and in particular when the response for a decrease in the input variable is different from the response for an increase.

I/O: Input/output.

IEEE-488 (GPIB): A parallel interface bus built under the IEEE-488 standard. This is the standard bus used for communication between the host computer and the 8800.

initial value: The starting temperature or other process variable of an interval. After the first interval of a program, the initial value is always the final value of the previous interval and cannot be edited.

input temperature: The temperature of the product being tested as measured by the input thermocouple.

input thermocouple: A dry bulb thermocouple the Therm-Alarm uses to monitor the temperature at the product under test.

integral time: A control parameter that determines how quickly the throttle will be adjusted to compensate for droop. Droop is an effect, such as natural heat loss through the test space walls, that prevents the process variable from reaching the final set point. The integral time parameter adjusts the throttle to take the droop out of the proportional band settings and allow the chamber to reach set point.

interval: A programmed period during which the chamber operates under a specified set of conditions.

interval graph: A graph in which each interval is given the same amount of space regardless of its duration. Compare to *time graph*.

interval time: A setting that controls how fast the temperature, humidity, or other process variable is to be cycled from the initial value to the final value.

key beep: An audible beep that is sounded each time an 8800 key is pressed, unless this function is disabled.

limit temperature: The Therm-Alarm adjustable high and low temperature settings. An alarm occurs if the input temperature reaches a limit temperature.

live aux: Unlike standard auxiliary relays, live auxiliaries can be enabled without the 8800 being in run mode.

loop: A series of intervals programmed to be repeated.

low alarm limit: The lower temperature limit which, if exceeded, will cause a Therm-Alarm trip.

main screen: The base or home screen for the 8800 display module. Press **Main** to return to the main screen.

manual mode: A function that allows you to operate the 8800 controller functions. Manual mode operates the chamber using set point and rate of change (ramp rate) settings. You can enter manual mode when the system is in stop mode. You also can enter manual mode from hold program mode if, while running a program, you want to perform a special operation in manual mode and then continue with the program.

maximum excursion: A Therm-Alarm function; the hottest or coldest temperature experienced during the most recent alarm condition.

mechanical refrigeration system: A system that uses pressurized refrigerants to remove heat from the test space.

monitor channel: A channel used by the 8800 for monitoring processes within the chamber. If the high or low limit is exceeded for any channel, the 8800 alarm outputs are activated.

multidrop addressing: An addressing protocol used on RS-485 interfaces that allows each instrument to send data to or receive data from another specific instrument using the same physical interface cable.

offset: The amount the test space air temperature is allowed to exceed the final temperature set point during product temperature control operation.

operation command: A code sent to the 8800 that causes the 8800 to perform an internal action and use any accompanying data to update internal registers or memory storage.

options byte: A one-to-three-character data transmission that sets or indicates the function options used in the 8800 operations.

overshoot: A test condition where the process variable runs past final set point.

parameter group: One of four selectable sets of control parameters used by the 8800 to tune the performance of each active channel to a specific set of conditions. Different parameter groups may be useful for different control situations. You can select a parameter group for manual mode operation or for each programmed interval.

parse: To separate a command expression into sub-units to determine the relationship between the sub-units. The 8800 separates the command, channel or group designator, and data to translate the command into action.

password: A string of up to 20 keystrokes that must be entered to set the 8800 access level. Once the current password is entered, the authorized user can also select a new password.

percent relative humidity (%RH): A measurement of the moisture content of air. See also *relative humidity*.

+/- deviation: How far you will allow the temperature, humidity, or other process variable to be from set point. If the value is exceeded, the deviation alarm is activated.

power fail recover mode; power fail recover time: A function that allows you to set up how the 8800 will recover after a power failure. If the power fails for longer than the selected power fail recover time, the 8800 will power up in one of four power fail recover modes: stop, hold, run, or restart. If the power failure is shorter than the power fail recover time setting, or if the setting is 0:00:00, the 8800 will recover by returning to its last mode of operation.

Power Save: A refrigeration mode (available on SE-Series chambers only) that allows the software to decide whether to run in single-stage or cascade mode based on the set point and control demand (throttle).

- If the set point is less than -20°C, the 8800 will choose cascade mode.
- If the set point is above -20°C and the throttle is less than -10%, the 8800 will switch to single-stage mode.
- If the throttle is greater than -80%, the 8800 will switch to cascade mode.

prefix protocol: A communication convention that places a dummy character in front of each multidrop serial data transmission to help avoid data loss during the time an instrument's receiver drivers are turning on.

process alarm: An 8800 function that can be programmed to activate an alarm if the chamber temperature, humidity, or other process variable exceeds high or low limits you select. If the variable exceeds the high or low limit, the 8800 enters stop mode.

process variable: The actual sensed condition within the test space, such as temperature or humidity, that is controlled by the 8800.

process variable channels: See *control channels*.

product: The device or equipment the chamber tests.

product dew point control (PDC): The product dew point control (PDC) option operates the chamber temperature and humidity systems in such a way that the chamber dew point is limited to a temperature that is lower (by a user-specified offset) than the temperature of the product or products being monitored in the chamber. Keeping the chamber dew point below the product temperature keeps condensation from forming at the points of product temperature measurement.

product temperature control (PTC): A heating and cooling process that controls the process variable from the product temperature rather than the test space air temperature. During normal temperature cycling, the chamber is cycled to the final set point in the specified time. However, the product temperature will approach final set point at an exponentially decreasing rate, lagging behind the chamber air temperature. The PTC software is written to minimize the lag time. The software senses two thermocouple inputs: channel 1 from the chamber air and a second channel from the product under test. When PTC is enabled, the second channel senses the temperature at the product and causes channel 1 to operate the heating and cooling systems at a faster throttle and higher set point to make up for the temperature lag. When PTC is disabled, channel 1 operates the chamber's control systems.

profile: A relationship between a test space condition and time.

program: A set of parameters divided into time intervals that are used to control the 8800 operations.

proportional band: A control parameter that determines the point at which the control switches from 100% output to a proportional output. As the process variable nears set point, it enters the proportional band. Once inside the proportional band, the throttle is backed off in proportion to the difference between the set point and the current process variable.

psi: Pounds per square inch; a unit of pressure.

PTC: See *product temperature control*.

pulldown: The process of the test space temperature transitioning from one set point to a lower set point.

purge: An option, either dry air or gaseous nitrogen (GN_2), used to reduce moisture inside the test space.

query command: A code sent to the 8800 that causes the 8800 to send information to the host computer or server.

ramp: A controlled process where the process variable transitions from an initial value to a final value in a specified amount of time. During this time, the 8800's control parameters maintain a smooth transition.

ramp rate: The speed, measured in number of units (such as degrees Celsius) per minute, at which the controller cycles a process variable to a new set point. If the number of units is zero, the controller performs a *step change*.

real time clock: An 8800 function that keeps track of the time and date. These are used for reference, delayed start, and the time stamp for the graph function.

refrigeration mode: One of three SE-Series refrigeration system configurations that can be selected for manual mode operation or for each programmed interval. The three refrigeration modes are:

- *Single-stage*: Allows only the high-stage compressor to operate.
- *Cascade*: Operates as a normal cascade cooling system.
- *Power Save*: Allows the software to decide whether to run in single-stage or cascade mode based on the set point and control demand (throttle). See *Power Save*.

relative humidity (RH): A percentage of the maximum amount of moisture air can hold at a given temperature and pressure.

reset mode: A setting that determines how the Therm-Alarm is reset when it is in alarm mode.

resistance temperature device (RTD): An electronic device used to sense temperature as a function of resistance.

RH: See *relative humidity*.

RS-232: A standard serial data interface between two electronic devices.

RS-485: A standard serial half-duplex (shared transmit/receive line) data interface with addressing capabilities.

RSA time: Refrigeration system anticipator time; a performance parameter that allows you to set the number of minutes the 8800 will precool the refrigeration system before a temperature pulldown set to 00:00:00 time. The precool occurs during the interval before the 00:00:00 time interval.

RTD: See *resistance temperature device*.

run time: An 8800 function that maintains a running count of the number of hours refrigeration systems or control channels operate.

service interval: The frequency of scheduled maintenance.

set point: An assigned value for a test space condition. There are three types of set point:

- *Initial set point:* The value that the chamber is at in the beginning of an interval.
- *Final set point:* The final value the chamber is to reach within an interval.
- *Current set point:* One of the intermediate set points the 8800 sets when ramping from the initial set point to the final set point.

single-stage: A mechanical refrigeration system with one compressor. The refrigerant of the compressor removes heat from the chamber. A condenser then removes the heat from the refrigerant. Compare to *cascade*.

starting interval: The interval that a program begins running with; typically a program begins with interval 1.

status word: A one-to-three-character data transmission from the 8800 whose bits are set or cleared to indicate the operating conditions of the 8800.

step change: A process that ensures the test space or product will reach the initial value of the next interval before the chamber finishes the current interval. To enable a step change, program a zero-time interval with a deviation greater than zero. The chamber will run at 100% throttle all the way to the final set point minus the deviation before proceeding to the next interval. Note that an interval with a duration greater than zero must follow.

stress screening: Changing temperatures as quickly as possible to force any early life failures on each product.

system event: A control device that monitors certain variables, such as temperature or throttle, and turns its outputs on or off based on the monitored variables.

t/c: See *thermocouple*.

temperature profile: The relationship between time and the test space temperature.

temperature scale: Celsius or Fahrenheit.

terminator: A code used to indicate the end of a data transmission. The 8800 interprets and transmits carriage return and line feed characters as terminators.

test space: The space within the test compartment where the product is tested.

Therm-Alarm: A product protection instrument that monitors the temperature or other analog signal at the product. If the product temperature or analog signal exceeds either the high or low limits you select, the Therm-Alarm disables the chamber control systems and alerts you with audible and visible alarms.

thermocouple (t/c): A device used to sense temperature as a function of current.

throttle: The percentage of output applied by a chamber's conditioning system to reach set point. Any positive throttle is a heating demand, and any negative throttle is a cooling demand. For example, to heat the test space as quickly as possible, the 8800 will operate the throttle at +100%. When the process variable (temperature) reaches the proportional band, the 8800 will begin reducing the throttle to control the process variable to equal the set point.

throttle limit: A parameter setting that can limit the 8800 controller throttle output.

time graph: A graph in which each interval is given space based on its duration. Compare to *interval graph*.

timed soak: Maintaining the same test space temperature, humidity, or other variable for a specified time. When entering a test profile, a timed soak period results when the initial and final set points for an interval are the same.

torr: A unit of pressure used in altitude and vacuum applications. 760 torr = 1 atmosphere = 0 feet of altitude (the pressure at sea level).

transducer: A device that converts information from one medium, such as pressure, to another, such as current.

transition: The crossing point at which a value changes from one condition to another.

TTL: Transistor-transistor logic.

variable: An actual value of a test space condition. For example, if the temperature in the test space is +100°C, the temperature variable is +100°C.

verification: Provision of objective evidence that a given item fulfils specified requirements, taking any measurement uncertainty into consideration.

Appendix B: Product Dew Point Control (PDC)

General description

The 8800 product dew point control (PDC) option operates the chamber temperature and humidity systems in such a way that the chamber dew point is limited to a temperature that is lower (by a user-specified offset) than the temperature of the product or products being monitored in the chamber. Keeping the chamber dew point below the product temperature keeps condensation from forming at the points of product temperature measurement. Benefits of product dew point control include:

- Keeping humidity from condensing on products under test during temperature/humidity transitions.
- Conserving water supplied to the humidity system by limiting condensation on the chamber and the products under test.
- Improving product transition to the final temperature by eliminating evaporative cooling of the product.

The PDC option uses the standard product monitoring thermocouple — the same thermocouple supplied for the product temperature control (PTC) option.

- If you purchased a group of thermocouples for use with the **PDC** option, the 8800 is configured to use the ***minimum*** temperature in that group when calculating the dew point limit.
- If you use this same optional group of thermocouples for the **PTC** option, the 8800 is configured to use the ***average*** temperature in that group when PTC is enabled.

When using product dew point control, keep the following points in mind:

- PDC operation allows you to program step changes in both temperature and humidity without worrying about moisture condensing on the products under test. Step changes under PDC will affect the fastest possible rates of change while limiting the dew point at the desired level. Programmed ramps may also be used, with the understanding that PDC may limit the rates of change as needed. The programmed rate will be treated as the maximum rate of change allowed.
- Because the PDC function is attempting to maintain the chamber air dew point below the product temperature at the user-specified offset, there may be conditions where the actual chamber humidity may never get to the desired set point for high RH values. This may require program steps to disable the PDC option once the load is near the desired chamber air set point. The controller will then transition to the programmed RH set point when the PDC option is disabled.

  For example, a condition +of 25°C and 95% RH implies a dew point of +24.14°C. If you have entered an offset value greater than 0.9°C, the condition will not be reached because the dew point will be limited to the load temperature (at most +25°C) minus the offset. An offset of 2.0°C will result is a limited dew point of +23°C, equivalent to 88.7% RH.
- During negative temperature transitions, the product temperature will generally lag the air temperature during the transition and dew point control will not be needed. Once the product temperature stabilizes at the final chamber temperature, the function will become active as needed.

User setup

To use the PDC option, you must first make sure that the product temperatures are an accurate representation of the product to be monitored that has the slowest-moving temperature change rate. You must also enter the desired dew point offset value in the System Setup panel.

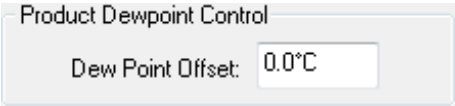
1. To identify the correct position for the product monitoring thermocouple or thermocouples, characterization of the loaded chamber and products under test should be accomplished. Multiple products under test at various positions in the chamber should be monitored to identify the product with the slowest-moving temperature change rate.

NOTE: To facilitate loading and unloading, a simulated product that is known to move at a slower temperature change rate than actual products may be used, since the simulated product may remain in the chamber.

2. Attach the product temperature thermocouple or thermocouples to the load or loads to be monitored.

- If the product temperature is being monitored by a single thermocouple, make sure that the location chosen represents the slowest moving product or simulated product for this test.
- If the product temperature is being monitored by multiple thermocouples, make sure that the monitored locations include the slowest moving product or simulated product.
- If any of the thermocouples that are configured for the product monitoring group are not to be used for a specific test, they **MUST** be disconnected (unplugged). This will tell the 8800 to ignore these inputs and use the remaining connected thermocouples to derive the PDC and/or PTC temperature.

3. At the 8800 display, press **Setup**, then select the System Setup panel and enter the desired **Dew Point Offset**. The illustration to the right shows the offset adjustment field, which is located in the lower left corner of the System Setup screen. When enabled in manual mode or by interval in program mode, the 8800 will limit the dew point of the chamber to the monitored product temperatures minus this offset.



NOTE: The amount of water in the chamber at the start of the transition will influence the rise in the dew point as the chamber temperature rises. PDC will do everything it can to keep the chamber air dew point below the product temperature; however, condensation may still occur if there is a lot of water in the chamber and the temperature rises too quickly. This will require slowing the temperature ramp down to a more suitable rate, and/or may require that additional program steps be taken to remove this moisture from the chamber. For example, dry air purge and a low absolute humidity set point may be used to force evaporation and expulsion of moisture.

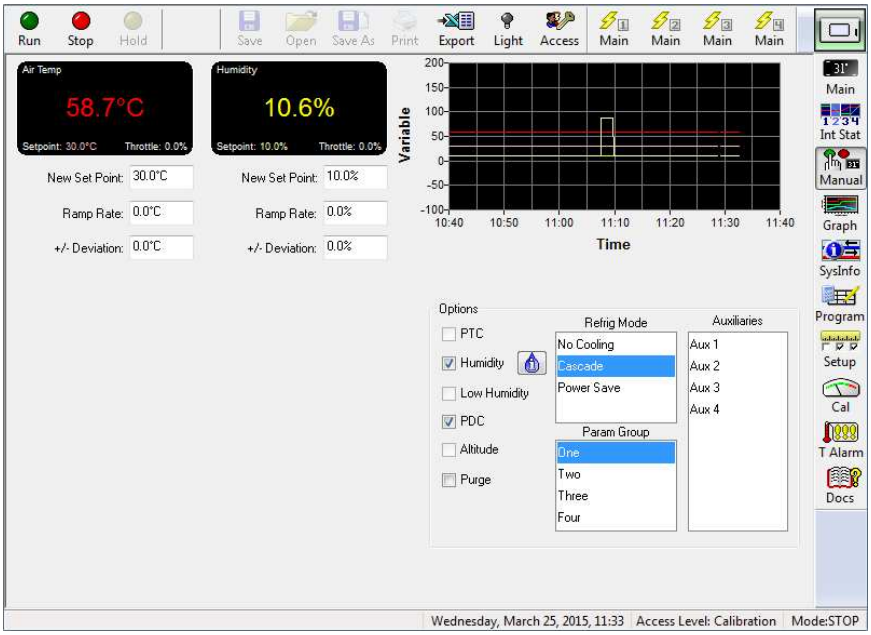
User operation

The PDC option must be enabled before or at the same time as a temperature or humidity transition. Turning the PDC option on during a transition, either in manual or program mode, will not allow the function to operate, since the set points will have already changed.

1. From the manual mode or program mode screen, select the **PDC** option. This illustration to the right shows the manual mode screen with **PDC** enabled.

   NOTE: The PDC option can be enabled only when the **Humidity** option is enabled.

2. When in run mode, the 8800 will control the temperature and humidity outputs in order to maintain the dew point at a value less than or equal to the monitored load temperature minus the dew point offset entered on the System Setup panel.



Appendix C: Tuning Control Parameters

CAUTION: The 8800 programmer/controller was factory-tuned and should not need to be re-tuned unless the product requirements change enough to affect the performance of the chamber. Incorrect values could damage your equipment and/or product.

Control parameters are tuned in manual mode. The adjustments are made to the proportional band and integral time parameters. **NOTE**: To tune control parameters, the 8800 access level must be Lab Manager or higher. Tuning the 8800 control parameters is a time-consuming procedure that will take a minimum of two to three hours to complete.

Proportional band parameters

The proportional band parameters are a **coarse** adjustment (1 to 9999 units) to the control algorithm. These parameters set the proportional bandwidth around the set point for the control channel's process variable. As the process variable nears the set point, it enters the proportional band. Once inside the proportional band, the throttle is backed off in proportion to the difference between the set point and the current process variable. **NOTE**: The proportional bands use the same units of measurement as the process variable.

- Smaller proportional bands can result in faster transitions.
- If the proportional band is too large it can result in very slow transition times — the chamber may never reach set point.
- If the proportional band is too small it can result in overshoot or oscillation around the set point.
- As a rule for the proportional band, **smaller = faster** response, **larger = slower** response. Generally, you should adjust the proportional band to the smallest value possible without the process variable excessively overshooting or oscillating around the set point.

Integral time parameters

The integral time parameter is a **fine** adjustment to the control algorithm. The integral time parameter is used when the process variable nears the set point and the throttle is backing off. The integral time parameter adjusts the throttle to take the droop out of the proportional band setting and allows the chamber to reach the set point.

Droop is an effect, such as natural heat loss through the test space walls, that prevents the process variable from reaching the final set point. The integral time parameter determines how quickly the throttle will be adjusted to compensate for droop. Without an integral time entered, the process variable will not reach or remain at the set point. **NOTE**: The integral time parameter is programmable from 0 (integral off) to 1,000 seconds.

- Longer integral times result in longer times to reach the set point.
- Shorter integral times result in shorter times to reach the set point.
- If the integral time is too short, the process variable will oscillate indefinitely when it reaches the set point.
- As a rule for the integral time, **shorter = faster** response, **longer = slower** response. Generally, shorter integral times mean shorter transition times.

Tuning the proportional band and integral time parameters

The proportional band and integral time parameters must be "tuned up" to produce an efficient, controlled environmental test cycle. First you tune up the proportion band for quality control near set point, then you tune up the integral time to achieve accuracy.

For the optimal combination of performance and quality, each control channel is tuned to be critically damped. This occurs when the process variable overshoots the set point slightly and then oscillates around the set point slightly until it stabilizes at the set point. This level of control becomes available only with properly tuned proportional band and integral time parameters.

When tuning up chamber parameters with two or more control channels, tune up one channel at a time, always tuning the proportional band parameters first. Additionally, each control channel's reference channel should be tuned up first. For example, for humidity operations, tune up the temperature channel first because it is the reference channel for the humidity channel. The control stability of the temperature channel directly affects the control stability of the humidity channel. **NOTE**: For most chambers channel 1 is temperature and channel 2 is humidity.

Example starting parameters			
Heat proportional band	20	Heat integral time	60
Cool proportional band	40	Cool integral time	90

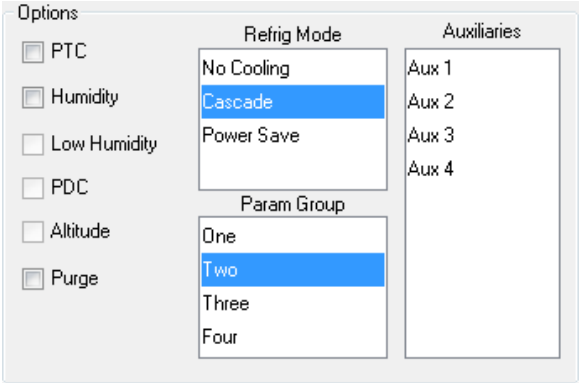
Record the original parameter settings

1. Press **Setup**, then select the Control Parameters panel.
2. If needed, select the parameter group for the channel you are tuning by pressing the appropriate button (such as **Group 1**).
3. Write down the heating and cooling proportional band and integral time settings for the parameter group you are tuning.

Obtain a performance baseline

4. Press **Manual** to go to the manual mode screen.
5. Select and change the settings for the channel you are tuning:
   a. Set the **+/- Deviation** to 0.0°C.
   b. Enter a **New Set Point** based on which parameters you are tuning, such as a heating set point for tuning the heating parameters.

      NOTE: When tuning parameters, the heating parameters are usually tuned before the cooling parameters. Normally you should select the set point based on the tests you are running.
   c. Set the **Ramp Rate** to 0.0°C.
   d. If necessary, disable chamber options by deselecting items listed under **Options**. Make sure product temperature control (**PTC**) is disabled. **NOTE**: If you are tuning the temperature channel in a temperature-humidity system, disable humidity for best results.
   e. Disable all unnecessary **Auxiliaries**.
   f. Make sure the **Param Group** selected is the number of the group you are tuning. **NOTE**: Only one parameter group can be selected at a time.



6. Press **Run**. The chamber will enter run manual mode.
7. Watch the process variable for the channel you are tuning as it approaches set point and then stabilizes for 10 to 15 minutes.
8. If the current parameter settings are correct, the process variable will overshoot the set point slightly and then oscillate around the set point slightly until it stabilizes at the set point.
   - If the process variable oscillates near the set point, the proportional band is too small.
   - If the process variable takes too long to reach the set point, the proportional band is too large.
   - If the process variable undershoots the set point slightly until it finally reaches the set point (if it ever does), the integral time is too large.
   - If the process variable overshoots the set point, the integral time is too small.

Adjust the proportional band setting

9. To adjust the proportional band:
   a. Change the set point to back the process variable away from the set point you used to tune the parameter.
   b. Press **Setup** to return to the control parameters panel.
   c. Change the heating or cooling proportional band (**PBand**) for the channel you are tuning.
10. Repeat steps 4 through 7 to see the effect of the new proportional band setting. The ideal proportional band setting is obtained when the process variable stabilizes near set point (for example, within ±2°C or ±2% RH). As it stabilizes, it oscillates in decreasing amounts until it droops just above or below the set point. (**NOTE**: The integral time function will adjust the set point up or down to compensate for this droop.)
    - If the process variable continues oscillating, increase the proportional band setting just until the oscillation stops.
    - If the process variable is not oscillating, decrease the proportional band setting just until oscillation begins, then increase the setting until the oscillation stops.

Adjust the integral time

11. If necessary, you can tune the current channel's integral time parameter once you have tuned the channel's proportional band parameter.
    a. Change the set point to back the process variable away from the set point you used to tune the parameter.
    b. Press **Setup** to return to the parameters screen.
    c. Change the heating or cooling integral time for the channel you are tuning.
12. To see the effect of the integral time setting, repeat steps 4 through 7. The ideal integral time setting is obtained when the process variable equals the set point.
    - If the process variable oscillates around the set point, increase the integral time.
    - If the process variable takes too long to achieve the set point, decrease the integral time.

Repeat as needed

13. Once the first set of parameters (such as the heating parameters) have been tuned up, the other set of parameters can be tuned up.
14. Once the parameters for the first channel have been tuned up, the next channel's parameters can be tuned up.
15. Once you have finished tuning up all the channels, record the parameter settings on the 8800 worksheets in Appendix E. Keep these settings with the 8800 manual.

Summary

When adjusting the control parameters, follow this general outline:

1. Run a heat-up test to see how the chamber controls. If necessary adjust the heat parameters.
2. Run a cool-down test to see how the chamber controls. If necessary adjust the cool parameters.
3. Run a heat-up test to see the effect of the changes from step 1. If necessary adjust the heat parameters again.
4. Run a cool-down test to see the effect of the change from step 2. If necessary adjust the cool parameters again.
5. Continue to run alternating heat-up and cool-down tests, adjusting the heat and cool parameters as needed to achieve the desired level of control.

Appendix D: Tuning PTC Control Parameters

CAUTION: The 8800 programmer/controller was factory-tuned and should not need to be re-tuned unless the product requirements change enough to affect the performance of the chamber. Incorrect values could damage your equipment and/or product.

The product temperature control (PTC) control parameters are tuned in manual mode. The adjustments are made to the gain, integral time, and offset parameters. **NOTE**: To tune PTC control parameters, the 8800 access level must be Lab Manager or higher. Tuning the 8800 control parameters is a time-consuming procedure that will take a minimum of two to three hours to complete.

Gain parameters for PTC

The gain parameter is a **coarse** adjustment to the PTC control algorithm. The larger the gain, the longer the 8800 will wait to start slowing down the throttle as the load temperature approaches the load set point.

$$\textbf{gain} = \frac{\textbf{maximum offset}}{\textbf{proportional band}}$$

For example, if the maximum offset is 10°C and the desired proportional band is 5°C, the gain would be set to 10°C/5°C = 2.

The temperature channel will still perform using the air parameters, but the offset parameters control the set point of the temperature channel in relation to the PTC channel's set point. When a PTC program is run, the temperature channel immediately cycles beyond the set point by the maximum offset. With the chamber air at maximum offset, the product cycles toward the final set point at its maximum rate. The temperature channel remains at the maximum offset above the PTC channel's set point until the product temperature enters the proportional band near final set point. The throttle of the temperature channel is reduced in relation to the PTC channel until the final set point is reached.

The gain parameter is related to the time constant of the load. The greater the time constant of the load, the more gain is required to change the temperature of the load. For a faster load response, increase the gain parameter. Additionally, a higher gain causes the load to proportion into the set point when the temperature is closer to the final set point.

As a rule for the gain setting, **smaller = slower** response, **larger = faster** response. Generally, you will want the largest gain setting possible without the process variable excessively overshooting the set point.

Integral time parameters for PTC

The integral time parameter is a **fine** adjustment to the PTC control algorithm. The integral time parameter is used when the process variable nears the set point and the throttle is backing off. The integral time parameter adjusts the throttle to take the droop out of the gain setting and allows the chamber to reach the set point.

Droop is an effect, such as natural heat loss through the test space walls, that prevents the process variable from reaching the final set point. The integral time parameter determines how quickly the throttle will be adjusted to compensate for droop. Without an integral time entered, the process variable will not reach or remain at the set point. **NOTE**: The integral time parameter is programmable from 0 (integral off) to 1,000 seconds.

- Longer integral times result in longer times to reach the set point.
- Shorter integral times result in shorter times to reach the set point.
- If the integral time is too short, the process variable will oscillate when it reaches the set point and will continue to oscillate indefinitely.
- As a rule for the integral time, **shorter = faster** response, **longer = slower** response. Generally, shorter integral times mean shorter transition times.

Offset parameters for PTC

CAUTION: It is your responsibility to program the offset value correctly to avoid damaging any products under test.

The offset is the number of degrees Celsius that the air temperature set point will be allowed to exceed the load temperature set point when attempting to move the load temperature to the new load set point. The offset allows the air temperature channel to overshoot the set point by up to ±100°C.

- Larger offsets can result in faster transitions.
- If the offset is too large it can result in overshoot, and may trip process alarms.
- As a rule for the offset, **smaller = slower** (less aggressive), **larger = faster** (more aggressive). Generally, you should adjust the offset to the highest value possible without the process variable excessively overshooting the set point.

The maximum offset should be programmed to allow the chamber air to overshoot the final value by an amount that will not damage any portion of the load. For example, if the final set point is +100°C and the load could be damaged by temperatures above +110°C, then the maximum heat offset should be +10°C.

Tuning the PTC gain, integral time, and offset parameters

The gain, integral time, and offset parameters must be "tuned up" to produce an efficient, controlled environmental test cycle. First you tune up the gain parameter for quality control near set point, then you tune up the integral time and offset parameters to achieve accuracy.

For the optimal combination of performance and quality, each control channel is tuned to be critically damped. This occurs when the process variable overshoots the set point slightly and then oscillates around the set point slightly until it stabilizes at the set point. This level of control becomes available only with properly tuned PTC control parameters.

NOTE: The PTC control parameters should be tuned only after the air temperature control parameters have been tuned, and only with a product load in the chamber.

Example starting parameters					
Heat gain	3.0	Heat integral time	200	Heat offset	10
Cool gain	3.0	Cool integral time	400	Cool offset	-10

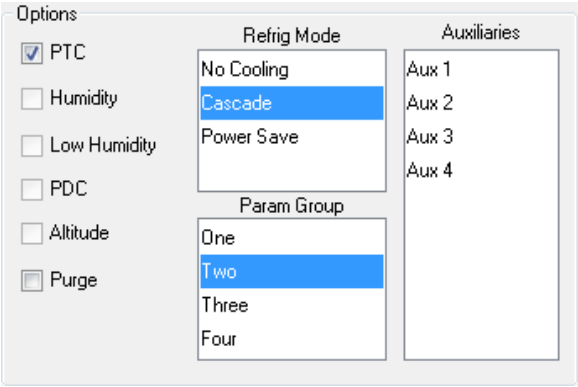
Record the original parameter settings

1. Press **Setup**, then select the Control Parameters panel.
2. If needed, select the PTC channel parameter group by pressing the appropriate button (such as **Group 1**).
3. Write down the gain, integral time, and offset settings for the parameter group you are tuning.

Obtain a performance baseline

4. Press **Manual** to go to the manual mode screen.
5. Select and change the settings for the PTC channel (usually channel 3):
   a. Set the **+/- Deviation** to 0.0°C.
   b. Enter a **New Set Point** based on which parameters you are tuning, such as a heating set point for tuning the heating parameters.

      NOTE: When tuning parameters, the heating parameters are usually tuned before the cooling parameters. Normally you should select the set point based on the tests you are running.
   c. Set the **Ramp Rate** to 0.0°C.



d. If necessary, disable chamber options by deselecting items listed under **Options**. Make sure product temperature control (**PTC**) is enabled.

e. Disable all unnecessary **Auxiliaries**.

f. Make sure the **Param Group** selected is the number of the group you are tuning. **NOTE**: Only one parameter group can be selected at a time.

6. Press **Run**. The chamber will enter run manual mode.

7. Watch the PTC channel's process variable as it approaches set point and then stabilizes for 10 to 15 minutes.

8. If the current parameter settings are correct, the process variable will overshoot the set point slightly and then oscillate around the set point slightly until it stabilizes at the set point.

   - If the process variable oscillates near the set point, the gain setting is too small.
   - If the process variable takes too long to reach the set point, the gain setting is too large.
   - If the process variable undershoots the set point slightly until it finally reaches the set point (if it ever does), the integral time is too large.
   - If the process variable overshoots the set point, the integral time is too small.

Adjust the gain setting

9. To adjust the gain:

   a. Change the set point to back the process variable away from the set point you will use to tune the parameter.

   b. Press **Setup** to return to the parameters screen.

   c. Change the heating or cooling gain for the channel you are tuning.

10. Repeat steps 4 through 7 to see the effect of the new gain setting. The ideal gain setting is obtained when the process variable stabilizes near set point (for example, within ±2°C). As it stabilizes, it oscillates decreasing amounts until it droops just above or below the set point. (**NOTE**: The integral time function will adjust the set point up or down to compensate for this droop.)

    - If the process variable continues oscillating, you will need to decrease the gain setting just until the oscillation stops.
    - If the process variable is not oscillating, you will need to increase the gain setting just until oscillation begins, then decrease the setting until the oscillation stops.

Adjust the integral time

11. If necessary, you can tune the current channel's integral time parameter once you have tuned the channel's gain parameter.

    a. Change the set point to back the process variable away from the set point you will use to tune the parameter.

    b. Press **Setup** to return to the parameters screen.

    c. Change the heating or cooling integral time for the channel you are tuning.

12. To see the effect of the integral time setting, repeat steps 4 through 7. The ideal integral time setting is obtained when the process variable equals the set point.
    - If the process variable oscillates around the set point, you should increase the integral time.
    - If the process variable never achieves the set point, you should decrease the integral time.

Adjust the offset

13. If necessary, you can tune the current channel's offset parameter once you have tuned the channel's gain and integral time parameters.
    a. Change the set point to back the process variable away from the set point you will use to tune the parameter.
    b. Press **Setup** to return to the parameters screen.
    c. Change the heating or cooling offset for the channel you are tuning.
14. To see the effect of the offset setting, repeat steps 4 through 7. The ideal offset setting is obtained when the process variable equals the set point.
    - If the process variable overshoots the set point, you should decrease the offset.
    - If the process variable undershoots the set point, you should increase the offset.

Repeat as needed

15. Once the first set of parameters (such as the heating parameters) have been tuned up, the other set of parameters can be tuned up.
16. Record the PTC parameter settings on the 8800 worksheets in Appendix E. Keep these settings with the 8800 manual.

Summary

When adjusting the product temperature control parameters you want to follow the following general outline:

1. Run a heat-up test to see how the chamber controls. If necessary adjust the heat parameters.
2. Run a cool-down test to see how the chamber controls. If necessary adjust the cool parameters.
3. Run a heat-up test to see the effect of the changes from step 1. If necessary adjust the heat parameters again.
4. Run a cool-down test to see the effect of the change from step 2. If necessary adjust the cool parameters again.
5. Continue to run alternating heat-up and cool-down tests, adjusting the heat and cool parameters as needed to achieve the desired level of control.

Appendix E:
8800 Parameter and System Event Worksheets

NOTE: Thermotron grants you permission to copy this appendix to use for your records.

Channel ____ non-PTC parameter group entries				
Parameter	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Heat proportional band				
Cool proportional band				
Heat integral time				
Cool integral time				
Heat throttle limit				
Cool throttle limit				

Channel ____ non-PTC parameter group entries				
Parameter	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Heat proportional band				
Cool proportional band				
Heat integral time				
Cool integral time				
Heat throttle limit				
Cool throttle limit				

Channel ____ non-PTC parameter group entries				
Parameter	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Heat proportional band				
Cool proportional band				
Heat integral time				
Cool integral time				
Heat throttle limit				
Cool throttle limit				

Channel ___ PTC parameter group entries				
Parameter	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Heat gain				
Cool gain				
Heat integral time				
Cool integral time				
Heat offset				
Cool offset				

8800 system parameters	
Auxiliary cool time frame	
Auxiliary cool duty cycle	
Refrigeration system anticipator time	

System events					
System event	**Channel**	**Variable**	**Logic**	**Low or off setting**	**High or on setting**
Event 1					
Event 2					
Event 3					
Event 4					