THERMOTRON®

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8200 Display Module Instruction Manual

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Table of Contents

Section 1: Setup

Section 2: Operation

Section 3: System Information

Section 4: Computer Interface

Section 5: CM2 Calibration

Section 6: Technical Information and Troubleshooting

Appendix A: Glossary

Appendix B: Tuning Control Parameters

Appendix C: Tuning PTC Control Parameters

Appendix D: 8200 Parameter and System Event Worksheets

Specifications

Operation	
Channels	Up to 4 independently programmable channels and 4 single set point channels
Temperature range	-200°C to +400°C (-328°F to +725°F)
Measuring accuracy	0.25% of span typical
Temperature scale	Celsius or Fahrenheit (user selectable)
Resolution	0.1°C or °F, 0.1% RH, or 0.01 for other linear applications
Sample rate	Process variable sampled every 0.25 seconds
Timing	Real time clock with month/day/year, hour:minute:second
Programming	
Control method	Proportional/integral. One of four parameter groups can be selected for each interval.
Proportional band	Programmable 1.0 to 9999.0 units
Integral time	Programmable 0 to 1,000 seconds
Intervals	300 per program
Interval length	One second to 99 hours and 59 minutes, with one-second resolution
Operation	Automatic or manual mode
Program storage	Limited only by internal storage space
Looping	Up to 300 loops can be used per program; loops can be repeated up to 9,999 times; up to 32 nested loops are allowed per program.
Inputs	
Control channels	Up to 8 (4 programmable, 4 single setpoint); thermocouple, RTD, voltage, and current
Digital inputs	Up to 24 TTL
Analog inputs	Up to 16 available. 0-20 mA or 0-10 Vdc.
Thermocouple inputs	Thermocouple (type T, K, E, or J) or RTD
Monitoring channels	Up to 16 thermocouple, RTD, voltage, current. 0-20 mA or 0-10 Vdc.
Outputs	
Control outputs	Proportional-control outputs, 1- to 15-second duty cycle; 0-5 Vdc, 0-20 mA, staged heating and cooling, bypass, MTO, and system enable; TTL high/low or SSR, up to 32 TTL, 64 SSR (time proportioned/on/off).
Analog outputs	Optional analog outputs to send throttles, setpoints, or process variables; 2 standard, up to 8 current (0 to 20 mA) or voltage (0 to 10 Vdc)
Alarm outputs	Process variable, deviation, refrigeration trip
Auxiliary outputs	Up to 16 programmable outputs; on/off control per program interval.
Auxiliary cooling output	Programmable, 0 to 100% of adjustable time frame
System event outputs	These outputs can be programmed independently or controlled manually; 2 standard, up to 16 event outputs available.
Graphing and data logging	
Graphing mode	• 6 adjustable display intervals • Auto scale Y-axis function • Moveable cursor with automatic data point identification • Drag and zoom feature • "Go To" function for historical data fact navigation
Data log mode	• All data logged every 6 seconds, approximately a 2-year history • Export data wizard • Back-up and restore wizard

Specifications

Hardware	
Operating temperature	5°C to +50°C for the MSBC unit, 0°C to +40°C for the LCD display
Power requirements	95-135 Vac, 47-63 Hertz, 100 volt-amps maximum 12 watts typical, 20 watts maximum
Operating voltage range	18-28 volts (dc)
Open thermocouple protection	Deactivates all controller outputs
Program memory	Programs are stored on the MSBC compact flash card
Compact flash card	2 GB
Onboard flash	32 MB
RAM	64 MB
Processor	200 MHz Arm 9
USB	Two USB 2.0 ports (12 MBps maximum)
Ethernet	100 MBps
Display	
LCD type	7" (diagonal) widescreen color LCD with touch screen interface 800 x 480 resolution
LCD colors	262,144 (18-bit)
LCD backlight	CCFL, one tube
LCD backlight MTBF	25,000 hours
Touch screen type	Four-wire resistive
Options	
Remote interface	Computer I/O: • Ethernet (TCP/IP) [standard] • RS-485 [optional] • RS-232 [optional] • IEEE-488 [optional] Web server: • Ethernet (TCP/IP) [standard]
Optional accessories	• Additional control modules for input/output expansion • Embedded Therm-Alarm(s)

Section 1: Setup

Introduction to the 8200 display module

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

The 8200 display module consists of three main components:

- A miniature single-board computer (MSBC)
- A liquid crystal display (LCD)
- An inverter PCB assembly

The MSBC is a motherboard custom designed to interface with Thermotron's line of instrumentation. The LCD is a seven-inch-diagonal widescreen display that comes with a resistive touch screen mounted to its surface. The inverter PCB assembly converts the five volts provided by the MSBC to a high-voltage signal conditioned to drive the cold cathode fluorescent (CCFL) backlight in the LCD. For more detailed information on the 8200 display module, refer to Section 6 of this manual.

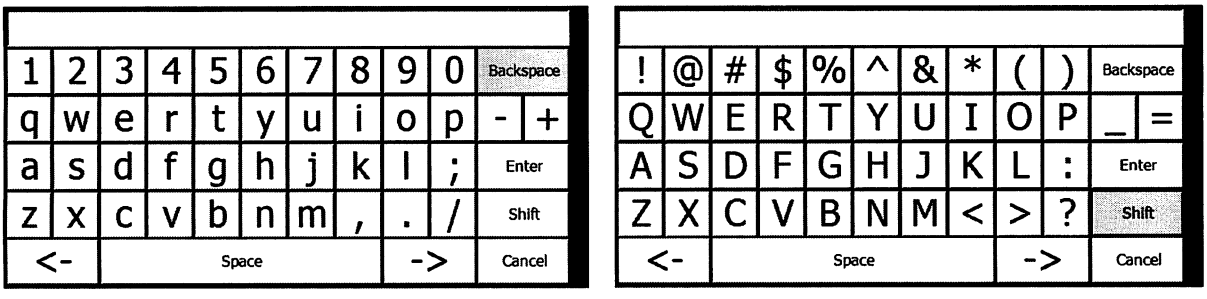
Using the touch screen

The touch screen monitor is the only user input device. To push a button or make a selection, use the supplied stylus to touch the appropriate area of the monitor 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 radio button, check box, or line 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. 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 into the field.



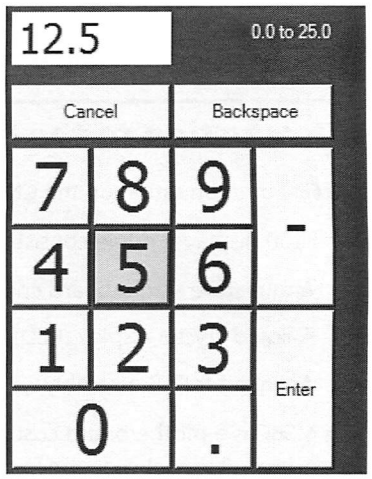
  The alphanumeric keypad defaults to lowercase letters. To enter uppercase letters or the symbols on the number keys, press **Shift** and then the desired letter keys. To return the keypad to lowercase letters, press **Shift** again.

  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 8200 will highlight the last key pressed.

- 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.

  For example, when you touch the **Deviation** field on the **Program Creation** panel, the numeric keypad will appear, indicating you may enter a value between 0.0 and 25.0 into the field.

  The 8200 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 into the field.



Recommended cleaning procedure

Due to the nature of touch screen interfaces, the surface of the LCD has a tendency to accumulate dirt and fingerprints, and requires regular cleaning. The surface of the LCD is very durable and resistant to most cleaners, but the bezel assembly covering the 8200 is not watertight and precautions should be taken to prevent any liquid or cleaner from reaching the surface of the electronics behind the bezel. Wiping the LCD with a soft, dry cloth is the best cleaning procedure, but a liquid glass cleaner may be used to remove stubborn marks. The glass cleaner should be used to moisten the cloth and the damp cloth used to wipe the display, rather than applying the cleaner directly to the surface of the LCD.

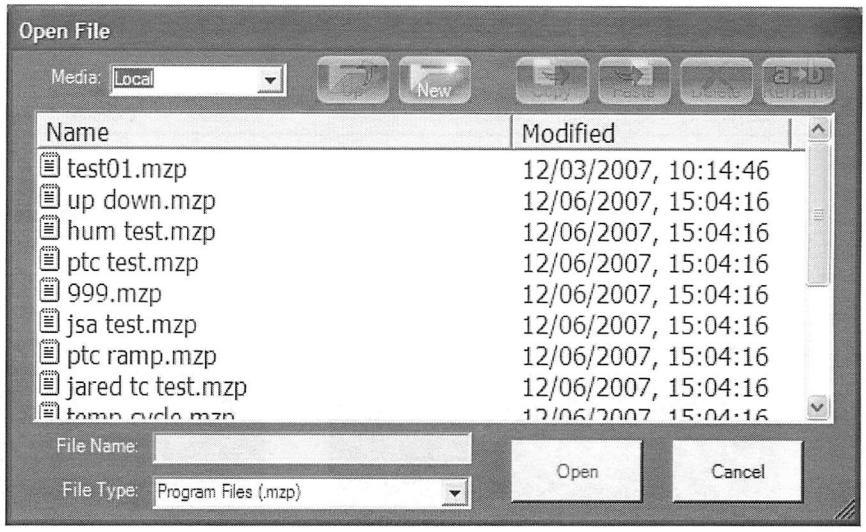
USB support

USB is included in the 8200, mainly for the support of USB flash drives. The 8200 supports all of the most likely USB devices that would be used with a chamber: flash drives, keyboards, mice, hard drives, floppy drives, etc. Any flash drive or other storage device connected to the 8200 must be formatted as FAT32 in order to be recognized by the operating system.

In addition to the USB driver support limitations in the 8200, there is also a USB power distribution limitation. A USB master can provide power to its devices, and the standard allows for two classifications of devices: high power and low power. High-power devices require up to 500 milliamps of current to operate, and typically are larger devices like a USB-powered floppy drive. Low-power devices will be more common in 8200 applications and require no more than 100 milliamps to operate. Examples of low-power devices are flash drives and anything that has its own power supply. Due to limitation on the MSBC, the 8200 can support only one high-power USB device at a time. Multiple low-power devices may be used with the 8200.

File functions

The 8200 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 8200 compact flash card, a network drive, or an external USB drive.



8200 file types

The following table describes the types of files used by the 8200:

File type	File extension	Access screen	8200 functions	Description
Chamber data	.csv	Graph	Save	Comma-delimited data that can be opened in a standard spreadsheet program
Graph settings	.gvs	Graph	Save, Open	Back up and restore customized graph view settings
Image	.png	Graph	Save	Saves an image file of the current graph. The image can be opened in a standard graphics program, or inserted into a standard word processing document.
Program	.mzp	Program	Save, Open	Back up and restore an 8200 program
Control parameters	.prm	Setup/ Control Parameters	Save, Open	Back up and restore control parameter settings

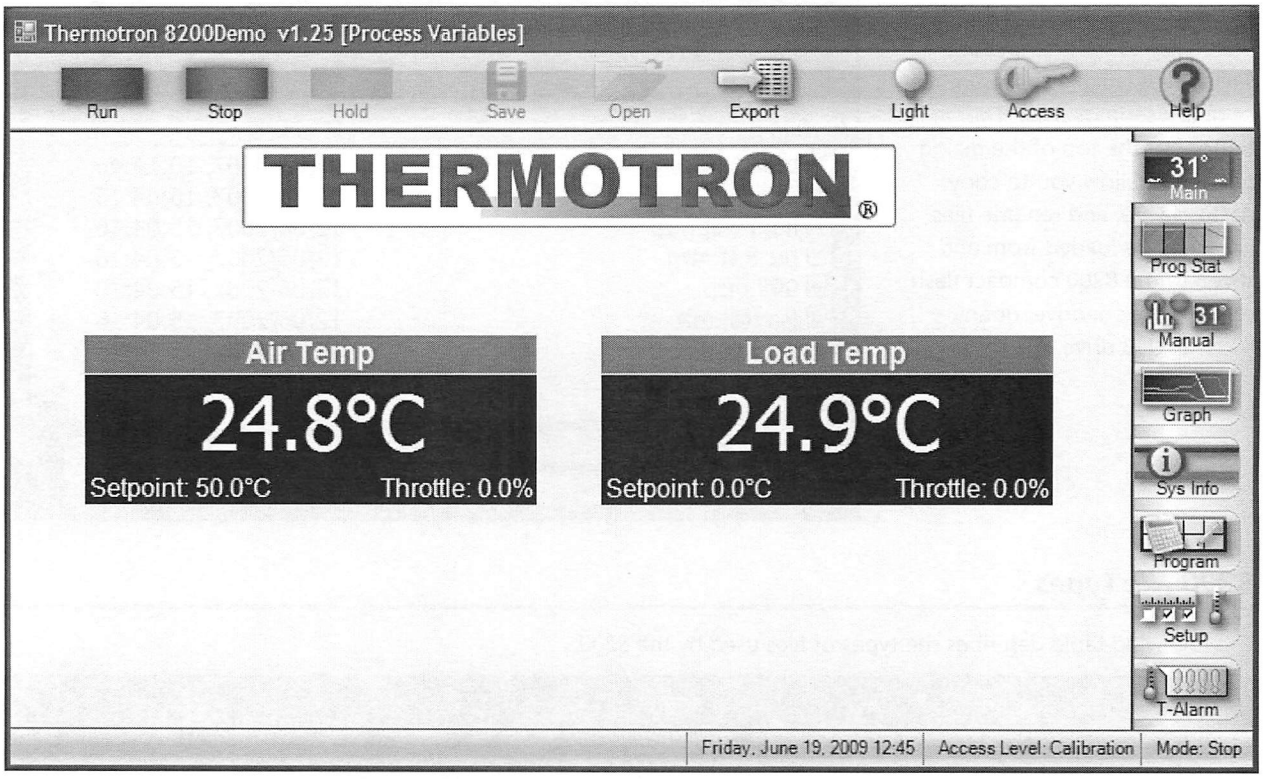
The 8200 has a virtually unlimited amount of storage space for settings and data. The only limit on the 8200 storage capacity is the available space on the 8200 compact flash card (2 GB is standard).

NOTE: The 8200 Backup Wizard helps you create a backup of your programs, settings, and data files so you can prevent data loss and damage caused by disk failures, power outages, and other potentially damaging events. For more information, see "System Backup & Recovery" later in this section.

Exporting 8200 data

Press the **Export** button to start the Export Data Wizard. This wizard provides step-by-step instructions for exporting data log files from the 8200.

8200 display controls

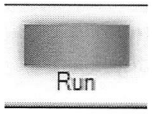


The 8200 display is made up of the following parts:

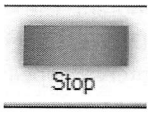
- The selected screen or panel in the center of the touch screen. The above illustration shows the main screen, which displays the channel name, current process variable, setpoint, and throttle for each active channel.
- The action buttons, which are always available at the top of the touch screen. For 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 8200 screens and panels. For more information, see "Function Buttons" later in this section.
- The current date, time, access level, and mode of the 8200 display module. This information is always displayed at the bottom of the touch screen.

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.

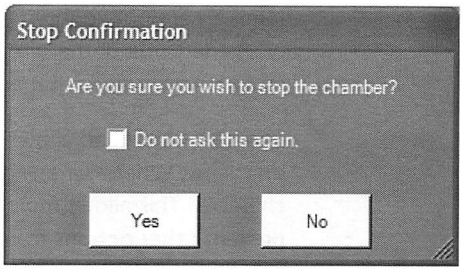


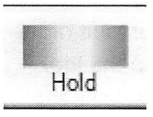
In the **Manual** screen pressing the **Run** button starts running a manual mode test. In any other screen pressing the **Run** button brings up the **Run Program Options** dialog box. When a test is running, the green **Run** indicator is lit.



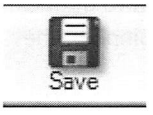
When a test is running, pressing the **Stop** button brings up the **Stop Confirmation** dialog box.

- 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 skip the stop confirmation in the future, check **Do not ask this again**, or uncheck **Confirm Stop Key** on the **System Setup** panel of the **Setup** screen.

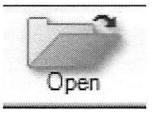




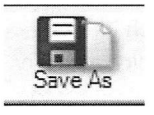
When a test is running, pressing the **Hold** button pauses the test and lights the yellow **Hold** indicator. To resume the test at the same point it was paused, press **Run**.



Pressing the **Save** button saves a new or modified file.

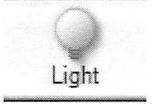


Pressing the **Open** button loads a saved file.

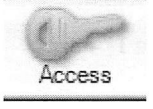


The **Save As** button saves a file under a new name or in a new location.

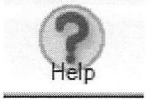
Pressing the **Export** button starts the **Export Wizard**. This wizard provides step-by-step instructions for exporting data log files from the 8200.



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



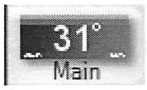
Pressing the **Access** button brings up the **Change Access Level** dialog box, allowing you to change the 8200 access level and password. For more information, see "Changing Access Levels and Passwords" later in this section.



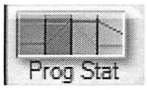
Pressing the **Help** button brings up a help topic. The online help system allows you to get help on many topics relating to the 8200 control system.

Function buttons

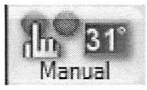
The function buttons are always available on the right side of the touch screen. The following paragraphs list the function buttons and briefly describe their functions.



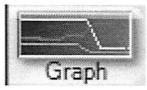
The **Main** screen displays all currently active control channels in a large, easy-to-read format. In addition to the current value of each channel, the current setpoint and throttle also are displayed.



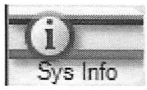
The **Prog Stat** screen displays the status of the currently running or most recently run program. The status bar at the top displays the name of the current test as well as its overall progress. (**NOTE**: GSoak intervals are not counted towards the overall time). Any active channels for the current interval appear on the left side of the screen, with the time remaining for the current interval on the right of the screen. Any options that are enabled are highlighted in the **Active Options** section.



The **Manual** screen allows you to manually control what setpoints and options the chamber goes to on the fly. Whenever any option is changed, you must press **Run** to commit the changes to the chamber. This allows more than one setpoint or option to be changed at once. **NOTE**: Some options prevent other options from being active at the same time. For example, if **PTC** is enabled, **Humidity** will be unavailable until **PTC** is unchecked.



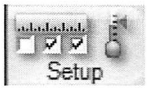
The **Graph** screen allows you to view the history of the chamber in a graphical format. Nearly everything about the chamber is logged to internal storage every six seconds for the entire life of the controller. Press the **Setup** button to select what data you wish to view, and also to set up the look and parameters of the graph. **Goto** allows you to select any date to jump to immediately, while the navigation buttons move back and forth one screen at a time. **Auto Y** will scale the graph to the current minimum and maximum values of the data on the screen. **Cursor** allows you to pinpoint the exact data values of any point in time.



The **Sys Info** panels provide the following status and diagnostic information:

- Monitor channels
- Activity log
- Control module
- IO diagnostics
- General system information

An 8200 **Program** is made up of a series of "intervals" that are executed in sequence. Each interval can have its own set of options configured, including which channels are enabled and which auxiliary outputs are turned on or off. To enable a guaranteed soak (G-Soak) interval, set the deviation for the desired channel to non-zero, then check the **G-Soak** option beneath the time. When the program reaches this interval, the time will not start counting down until the value of the channel is within the defined deviation, ensuring the chamber spends the full time span at the desired temperature, humidity, etc.



The **Setup** panels allow you to modify the following settings:

- General system setup
- Control parameters
- Computer IO
- Service messages
- System events
- Channel and auxiliary output names

The **T-Alarm** panels allow you to set up, view, and calibrate the Therm-Alarm. **NOTE**: The **T-Alarm** button appears only if your chamber is equipped with one or more Therm-Alarms.

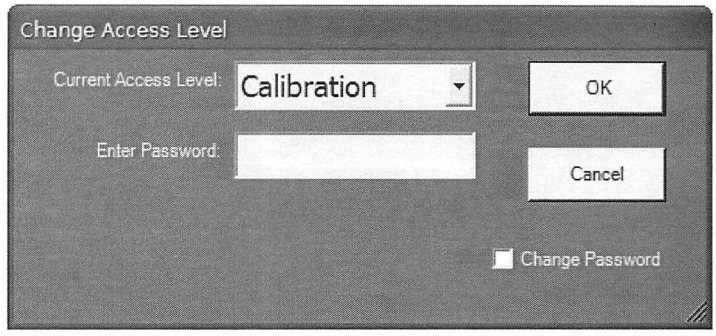
Changing access levels and passwords

The access level function allows you to select from six different levels of access to the 8200 functions. The following table provides a general overview of which functions are available at each access level.

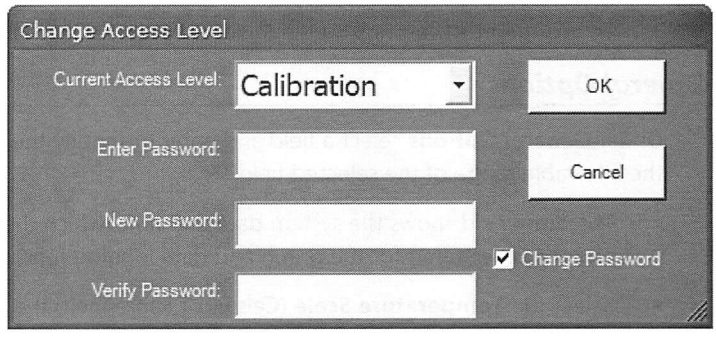
Access level	Functions available
Locked	All functions are locked out. Most information may be viewed but not modified.
Level One	Program run, stop, and hold modes are enabled.
Level Two	Manual mode operation is enabled.
Programmer	Program creation/editing is enabled.
Lab Manager	Control parameters and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

Authorized users can set the access level using a special password. 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.

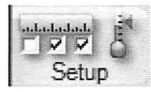


   d. Select the **New Password** field and use the alphanumeric keypad to enter the new password. Passwords may consist of up to 20 keystrokes using any keys except **Enter** and **Cancel**.
   e. Select the **Verify Password** field and enter the new password again.
   f. To accept the new password press **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:

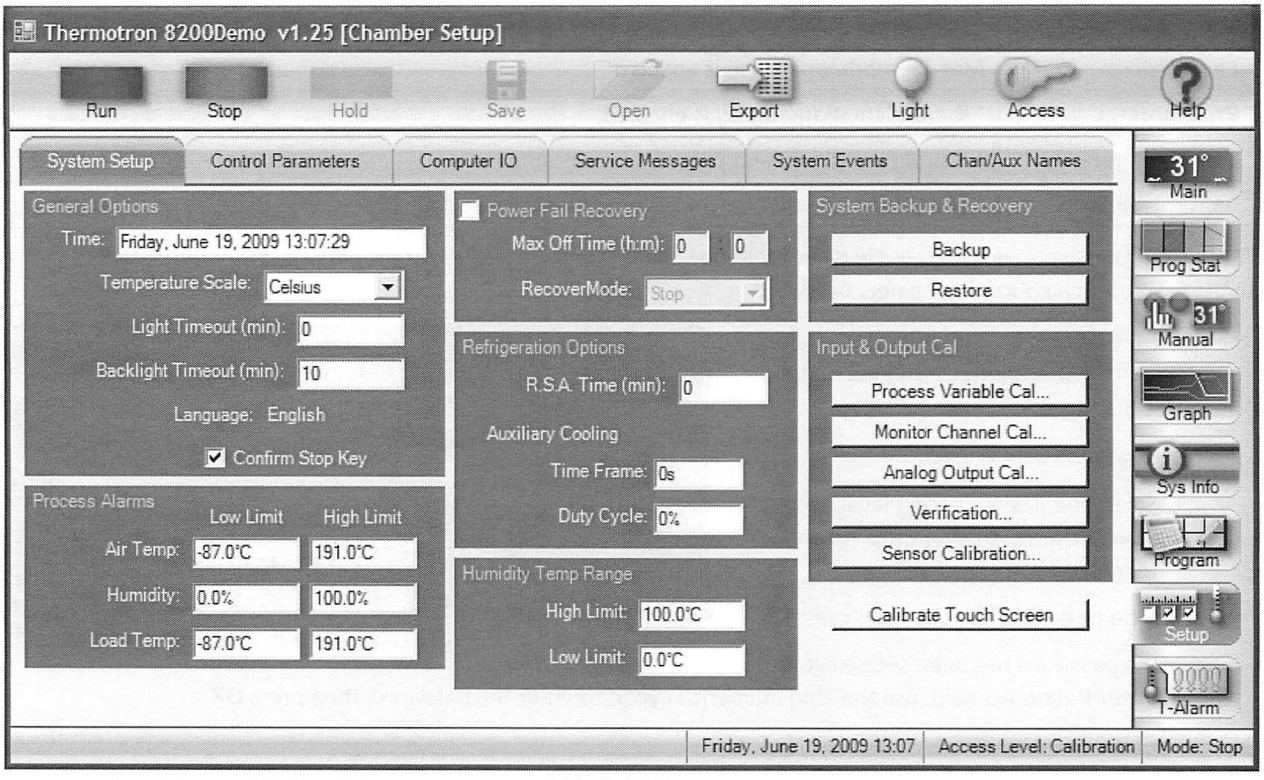
   h. Press **OK** and repeat step c.

Using the Setup panels

To access the setup panels, press **Setup**. These panels allow you to configure the 8200 display module to meet your specific needs. This section describes the setup panels and how to use them.



System Setup panel



NOTE: To change most settings on the **System Setup** panel, the 8200 access level must be Lab Manager or higher.

General Options

Under **General Options** select a field and enter or modify the setting. For numeric values the keypad will display the allowable range of the selected field.

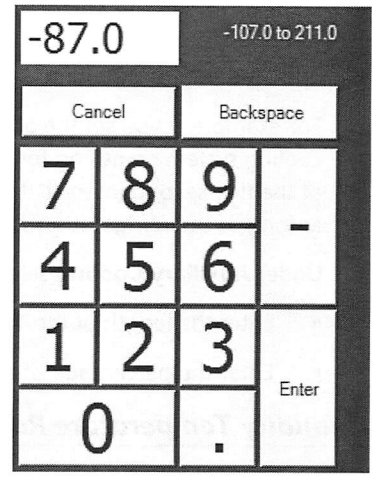
- The **Time** field shows the system date and time, which the 8200 uses for reference, delayed program start, and the time stamp for the graph and data logging functions.
- Select the **Temperature Scale** (Celsius or Fahrenheit) the 8200 will use to display temperature values.
- The **Light Timeout** field allows you to enter the number of minutes before the chamber light is automatically shut off. A value of 0 disables the automatic light shut-off function.
- The **Backlight Timeout** field allows you to enter the number of minutes of idle time before the 8200 screen backlight is automatically shut off. A value of 0 disables the backlight timeout function.
- To disable stop key confirmation, uncheck **Confirm Stop Key**. This will prevent the **Stop Confirmation** dialog box from appearing whenever the **Stop** button is pressed.

Process Alarms

Each channel of the 8200 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 8200 enters stop mode. Factory-specified limits are programmed into the 8200. Air and load temperature channel limits typically are -87°C and +191°C. Humidity channel limits typically are 0 and 100% RH.

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.

1. Under **Process Alarms** select a **Low Limit** or **High Limit** field.
2. The numeric keypad will appear. The allowable range of the selected field appears to the right of the small display field at the top of the keypad.
3. Enter the desired limit for the channel, then press **Enter**.



Power Fail Recovery

If the 8200 is in run or hold mode and a power failure occurs that is longer than the **Max Off Time** setting, the 8200 will automatically power up in the mode selected under **Recover Mode**. If the **Max Off Time** is set to 0:00:00, this feature is disabled and the 8200 will power up in whatever mode it was in when power was lost.

1. To enable or disable power fail recovery, check or uncheck the **Power Fail Recovery** check box.
2. For **Max Off Time** select the number of hours and minutes power must be lost before the 8200 enters power failure recovery mode. The keypad will display the allowable range of each field.
3. 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 8200 will stop the test that was running when power failed.
   - **Hold**: The 8200 will hold the test at the point reached when power failed.
   - **Run**: The 8200 will return to the mode it was in when power failed.
   - **Restart**: The 8200 will start running the test again from interval 1.

Refrigeration Options

R.S.A. Time

When running a program, the refrigeration system anticipator time (**R.S.A. Time**) is the number of minutes the 8200 will pre-cool the mechanical refrigeration system before entering a zero-time cooling interval (normally a guaranteed soak). This reduces the lag time caused by cooling the refrigeration hardware.

- Select the **R.S.A. Time** field and enter or modify the setting. The keypad will display the allowable range.

Auxiliary Cooling

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.

Under **Auxiliary Cooling** select a field and enter or modify the setting.

- Enter the length of the **Time Frame** in seconds. The keypad will display the allowable range.
- Enter the percentage of the **Duty Cycle**.

Humidity Temperature Range

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

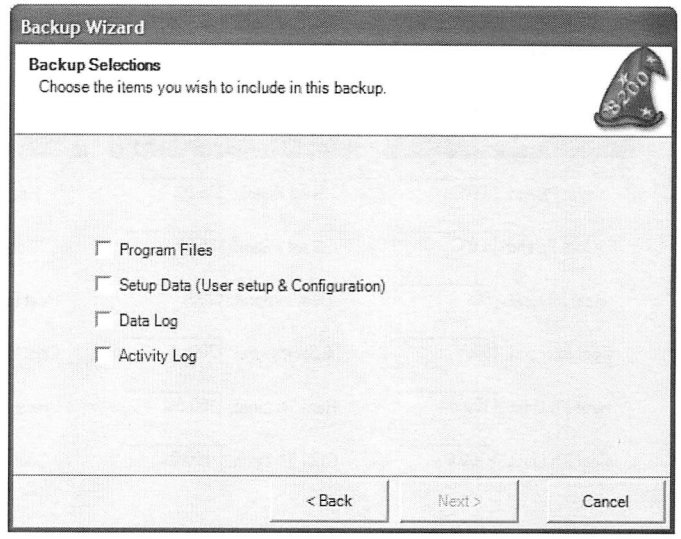
Under **Humidity Temp Range** select the **High Limit** or **Low Limit** field.

1. The numeric keypad will appear. The keypad will display the allowable range.
2. Enter the temperature limit, then press **Enter**.

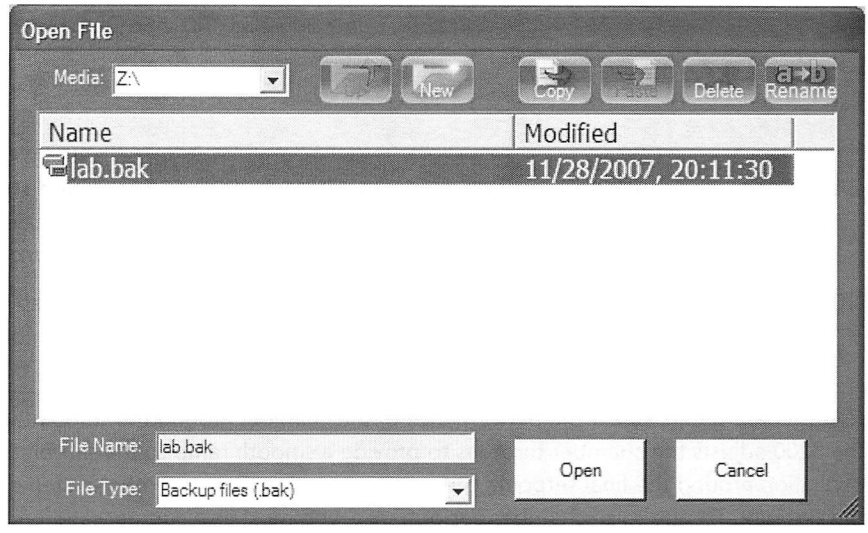
System Backup & Recovery

The Backup Wizard helps you create a backup of your programs, settings, and data files so you can prevent data loss and damage caused by disk failures, power outages, and other potentially damaging events.

- To start the Backup Wizard, press **Backup**, then press **Next** and follow the step-by-step instructions.



- To restore previously backed-up data, press **Restore**, then use the **Open File** dialog box to find, select, and open the appropriate backup (**.bak**) file.



Input & Output Calibration

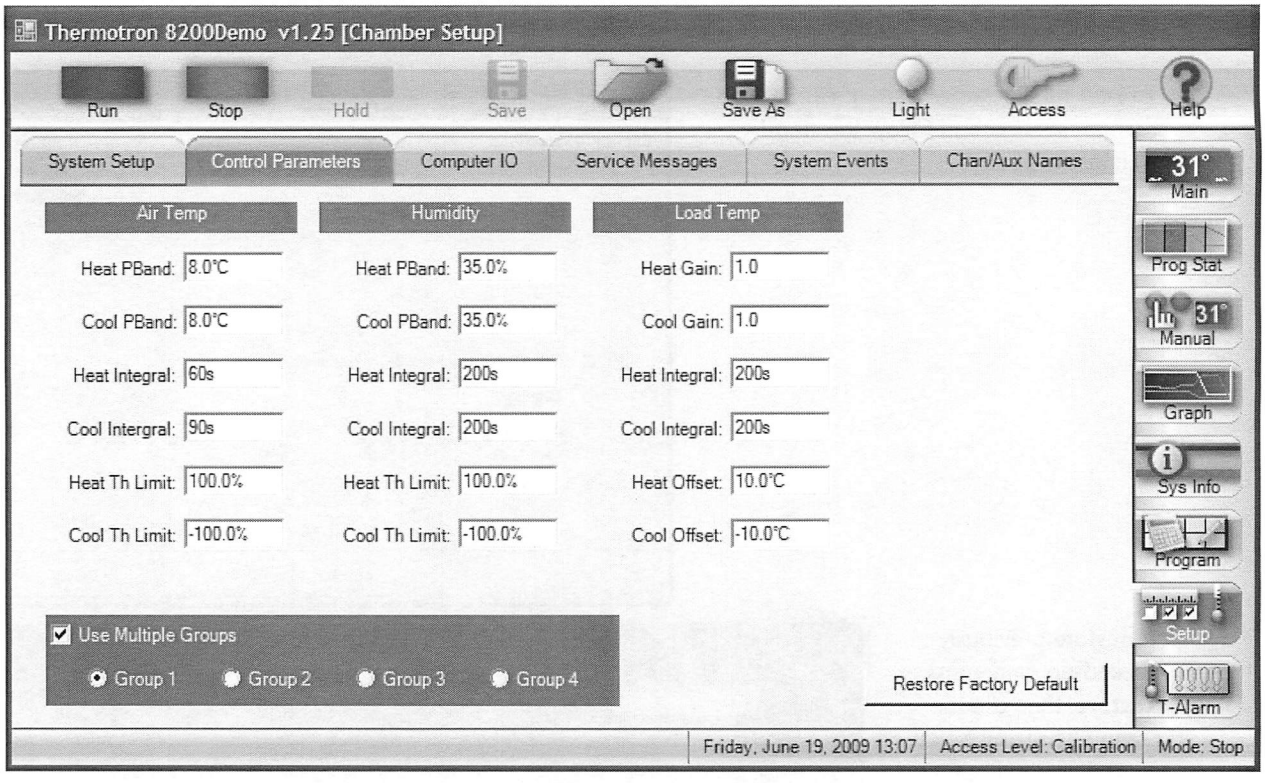
The **Input & Output Cal** buttons function only if the 8200 access level is Calibration. For calibration instructions, refer to the *8200 Technical Manual.*

Calibrate Touch Screen

To start the touch screen calibration procedure, press **Calibrate Touch Screen** and follow the on-screen instructions.

NOTE: To start the calibration procedure from any screen, hold the stylus against the touch screen for 10 seconds.

Control Parameters panel



CAUTION: **The 8200 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.**

NOTE: To tune control parameters, the 8200 access level must be Lab Manager or higher. For information on tuning the control parameters, see Appendix B. For information on tuning the product temperature control (PTC) control parameters, see Appendix C.

Control parameters adjust the performance of the chamber around the setpoint. As the chamber nears the setpoint, the 8200 adjusts the chamber throttles to provide a smooth ramp to the setpoint. To prevent overshooting and oscillation around the final setpoint, the refrigeration, heating, and other systems must be damped as they approach the setpoint. To maximize chamber performance, you must also compensate for lag times.

Up to four groups of chamber parameters can be entered into the 8200 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.

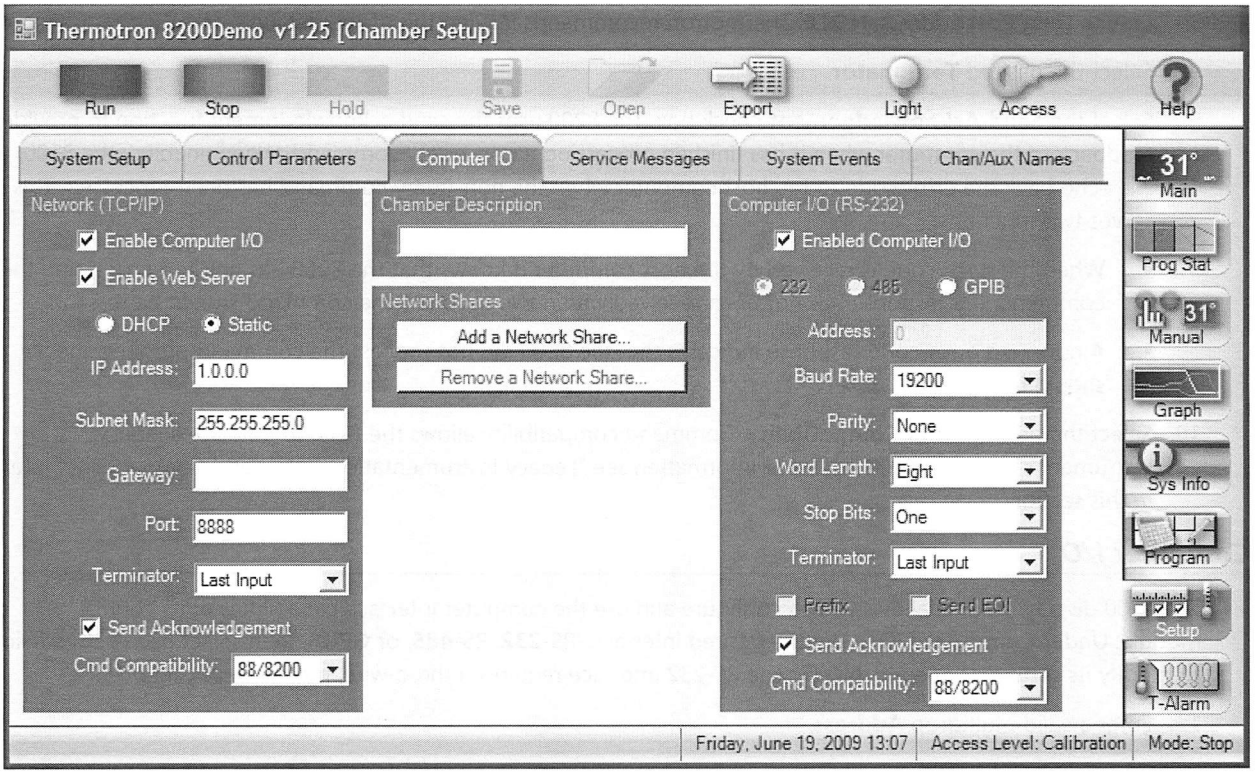
Control parameter files

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 Sample Test.mzp, and you save a set of control parameters in a file named Sample Test.prm, every time you run Sample Test it will automatically use the parameters in the Sample Test.prm file.

Computer IO panel



NOTE: To change any computer interface setting, the 8200 access level must be Lab Manager or higher. For more information on computer interface settings, refer to Section 4 of this manual.

Each 8200 display module is equipped with two independent computer interface ports. The 8200 can communicate through both ports at the same time:

- **Network (TCP/IP)**: Communication through the 8200 display module's Ethernet connector. This connector is a standard eight-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 8200 display module over a standard Ethernet network.
- **Computer I/O**: Communication through the control module com port capable of **either** RS-232, RS-485, or GPIB (IEEE-488).

The following paragraphs discuss the various communications protocols and how to properly configure the 8200 to use them.

Network (TCP/IP)

The TCP server can handle multiple simultaneous connections. Under **Network (TCP/IP)** select each field to modify its setting.

1. Select the **Enable Computer I/O** check box
2. Select the **Enable Web Server** check box
3. Select the type of TCP/IP addressing (either **DHCP** or **Static**).
4. Enter a valid **IP Address**.
5. Enter a valid **Subnet Mask**.
6. Enter a valid **Gateway** address.
7. Enter a valid **Port** address. **NOTE**: Thermotron recommends leaving this at the default.
8. Select the desired **Terminator**.
9. Select the **Send Acknowledgement** check box. The 8200 uses the send acknowledgment function to provide feedback to the computer when it has finished processing a non-query command. When enabled, the 8200 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 8200 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 indicates that the 8200 did not process the command properly and it should be re-sent.
10. Select the desired **Cmd Compatibility**. Command compatibility allows the 8200 to emulate a legacy instrument's command set. For more information see "Legacy Instrumentation Command Compatibility" later in this section.

Computer I/O

The 8200 display module allows you to configure and use the computer interface capabilities of its control module. Under **Computer I/O** select the desired interface (RS-**232**, RS-**485**, or **GPIB**), then select each **active** field to modify its setting as needed. **NOTE**: The RS-232 interface requires a three-wire, null modem cable.

1. Enter a valid multidrop **Address**.
2. From the **Baud Rate** menu select the highest baud rate the host computer's interface card can handle.
3. Select the desired **Parity**. To disable parity checking, select **None**.
4. Select the desired **Word Length**. For most applications, select **Eight**.
5. Select the desired **Stop Bits**. For most applications, select **One**.
6. Select the desired **Terminator**.
7. If needed for multidrop communication, select **Prefix** or **Send EOI**.
8. Select the **Send Acknowledgement** check box. The 8200 uses the send acknowledgment function to provide feedback to the computer when it has finished processing a non-query command. When enabled, the 8200 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 8200 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 indicates that the 8200 did not process the command properly and it should be re-sent. Without this function, the 8200 could send commands too fast, causing some commands to be lost.

9. Select the desired **Cmd Compatibility**. Command compatibility allows the 8200 to emulate a legacy instrument's command set. For more information see "Legacy Instrumentation Command Compatibility" later in this section.

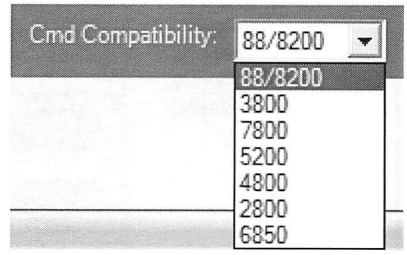
Legacy instrumentation command compatibility

The 8200 is fully compatible with the following legacy instrumentation's computer interface command sets:

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

NOTE: The 8200 computer interface command set is identical to the 8800 computer interface command set.

If you have a program written to control a legacy instrument, it will work seamlessly with an 8200 without any changes. The 8200 can be set up to use any of the legacy command sets per interface, providing you with extra flexibility. To select which instrument's command set to use for each interface, use the **Cmd Compatibility** drop-down menu.



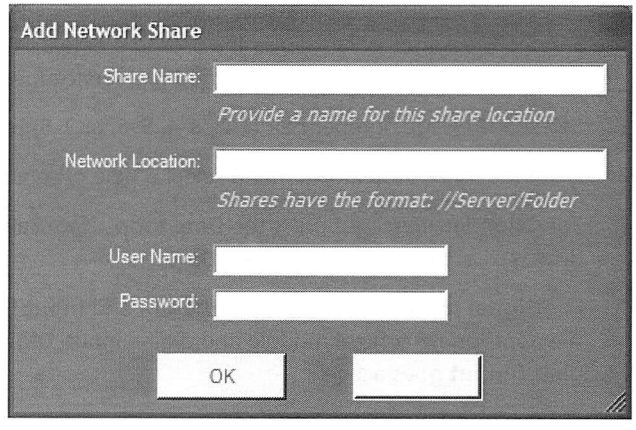
For example, you could use your legacy software to communicate with the 8200 using GPIB, and at the same time use ThermoTrak II to communicate with the 8200 over your network.

Adding and removing network shares

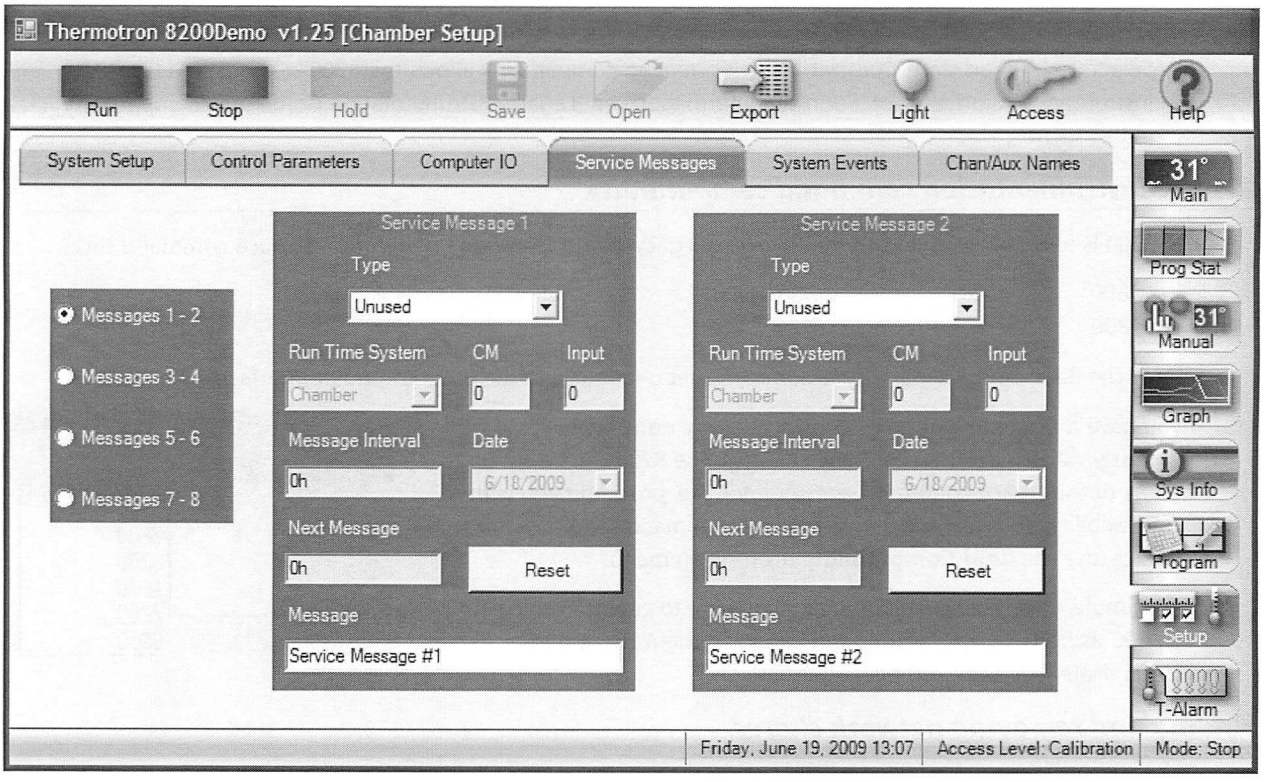
The 8200 allows you to add a network share.

1. Press the **Add a Network Share** button. The **Add Network Share** dialog box will appear.
2. Enter a valid **Share Name**.
3. Enter the **Network Location** in the format indicated.
4. Enter the appropriate **User Name** and **Password**.
5. Press **OK**.

You can remove a network share at any time by pressing the **Remove a Network Share** button and choosing the appropriate share.



Service Messages panel



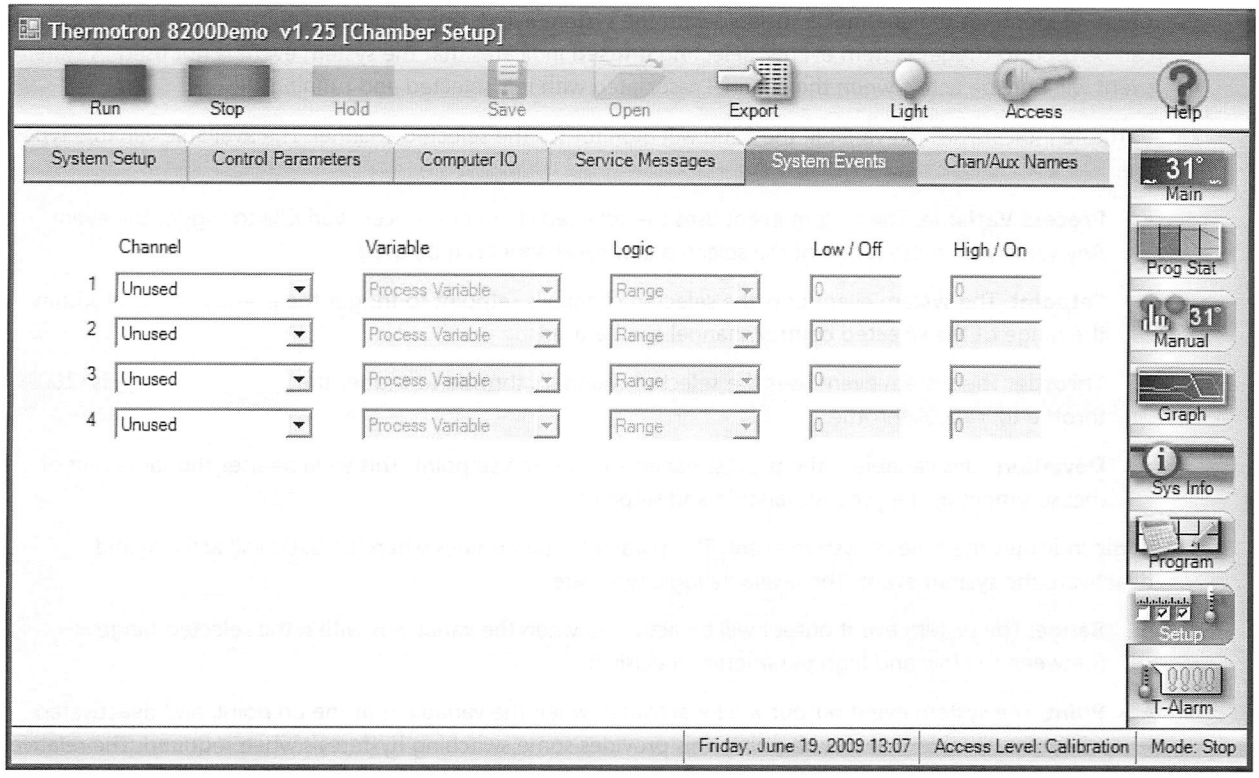
NOTE: To modify service messages, the 8200 access level must be Lab Manager or higher.

The **Service Messages** panel allows the user to create up to eight different messages that can be displayed when certain events take place. To create or modify a service message, follow these steps:

1. Select a message number pair (**1-2**, **3-4**, **5-6**, or **7-8**) to display.
2. From the **Type** drop-down menu select a type of service message.
3. For **Calendar** messages press the **Date** drop-down calendar to select the desired date. **Calendar** messages will be displayed at noon on the selected **Date**.
4. For **Digital Input** messages select the **CM** and **Input** fields and use the numeric keypad to enter the number of the appropriate control module and digital input. **Digital Input** messages will be displayed when the specified digital **Input** goes active.
5. For **Sys Run Time** messages:
   - Select the appropriate system from the **Run Time System** drop-down list.
   - Enter the desired length of the interval in hours in the **Msg Interval** field.
   - **Sys Run Time** messages will be displayed after the selected **Run Time System** has run for the specified **Msg Interval.**
6. Select a **Message** field and use the alphanumeric keypad to enter the text of the message. Messages can be up to 40 characters long.

The **Next Msg** field displays the number of hours left in each service message interval before its service message is displayed. Once the service message has been displayed, return to the **Service Messages** panel and press the message's **Reset** button to reset the selected service message's timer.

System Events panel



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**: The number of system events available for your use depends on your 8200's factory configuration. To configure a system event, the 8200 access level must be Lab Manager or higher.

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 parameters 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. A system event will only be active when the channel associated with it is selected and running.
2. **Variable** indicates which variable the 8200 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 setpoint 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 setpoint. This variable uses the same unit of measurement as the process variable and setpoint.
3. **Logic** indicates the type of system event. This parameter determines when the 8200 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 and off points determine the logic as follows:

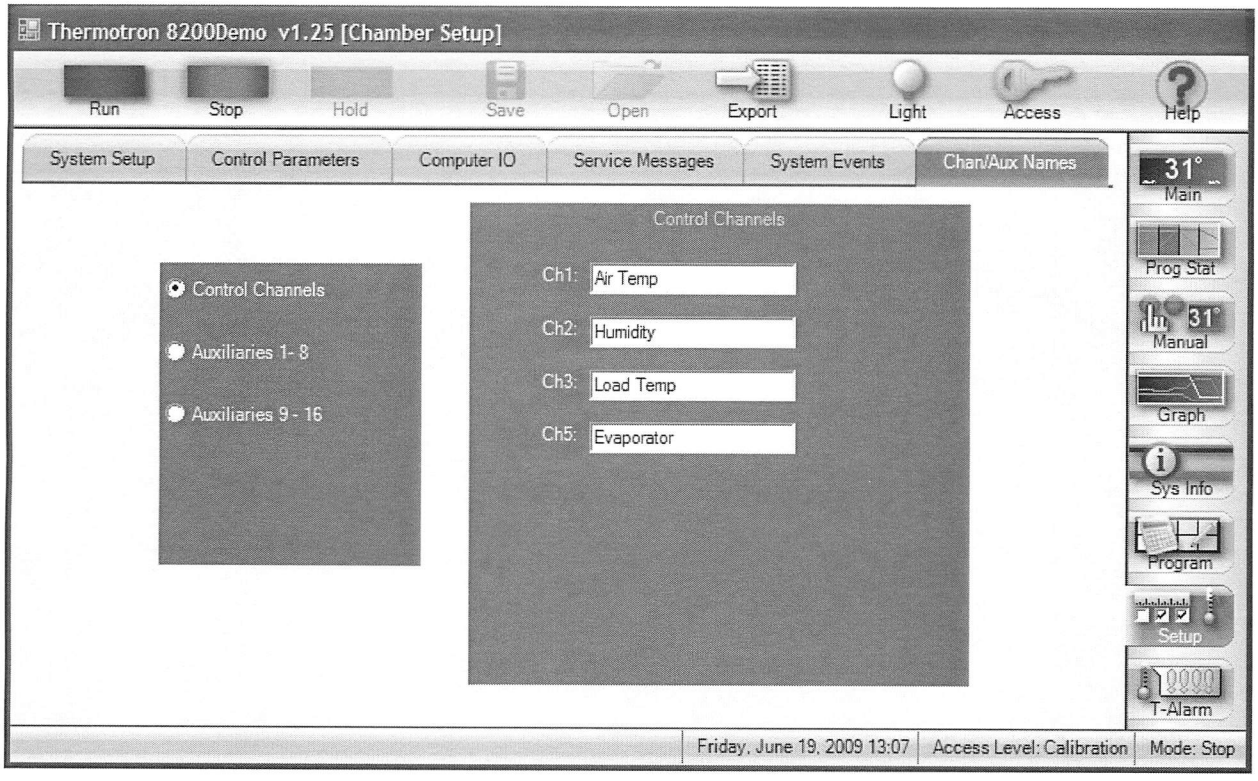
On point ≥ Off point		
Var ≤ Off	Off < Var < On	Var ≥ On
Deactivate	No change	Activate
On point < Off point		
Var ≤ On	On < Var < Off	Var ≥ Off
Activate	No change	Deactivate

   - **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 8200 worksheets in Appendix D. Keep these settings with the 8200 manual.

Chan/Aux Names panel



NOTE: To modify any of these settings, the 8200 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.

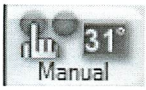
The **Chan/Aux Names** panel allows you to assign descriptive names to control channels, monitor channels, and auxiliaries for display in all screens and data logging. This panel also allows you to enable or disable auxiliary relays.

Changing a channel/auxiliary name

1. Select the type of the name you want to modify (**Control Channels**, **Monitor Channels**, or **Auxiliaries**).
2. Select a name field. The alphanumeric keypad will appear.
3. Enter the desired name. **NOTE**: You may enter a longer name than will fit in the edit box; however, the name may be truncated on various screens.
4. To enable an auxiliary, select the auxiliary's **Enabled** check box.

Section 2: Operation

Manual mode allows you to operate the 8200 controller functions. Manual mode operates the chamber using setpoint 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.

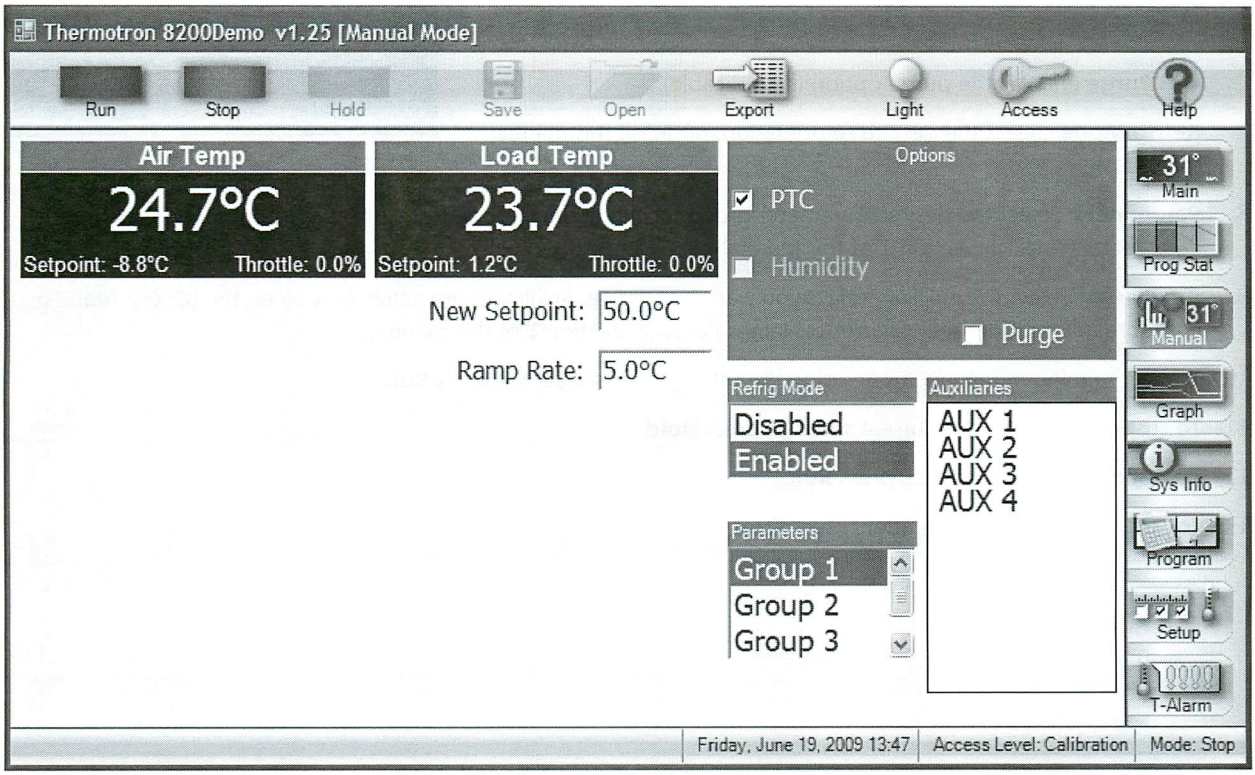


NOTE: You also can enter manual mode from hold program mode if, while running a program, you want to perform a special operation in manual mode and then continue with the program. See Step 7 of "Running a Program" later in this section.

Program mode operates the 8200 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 8200 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 steps describes the manual mode values and options displayed.
3. **New Setpoint**: Enter the desired value for each active channel. When the ramp rate is not zero, the setpoint will change toward this new value at the selected rate.
4. **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 setpoint, changing the setpoint in a timed ramp. If you enter a zero, the

controller performs a step change. During a step change, the 8200 outputs a full demand (±100% throttle) until it enters the setpoint's proportional band.

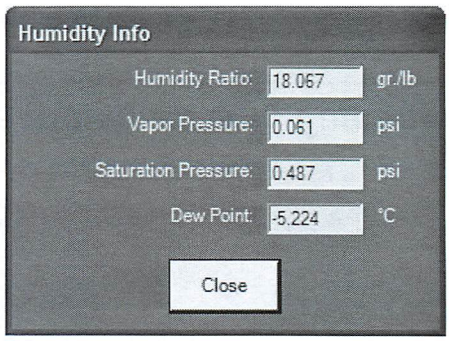
5. **+/- Deviation**: Enter the value for how far you will allow the temperature or other process variable to be from setpoint. The deviation setting will be monitored and the deviation alarm will be activated if the value is exceeded. Enter a positive number only; the 8200 will monitor both positive and negative deviations. **NOTE**: The **+/- Deviation** field appears only if the 8200 was factory-configured with at least one alarm output.

6. **Options**

   NOTE: Not all possible options are listed below. Refer to your chamber manual for a description of the options available on your chamber.

   - **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**) is enabled.

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



   - **Purge** enables the purge option (if applicable).

7. **Refrig Mode**: Select the desired refrigeration mode for this manual mode test.
8. **Parameters**: Select the desired parameter group for this manual mode test. For more information, see "Control Parameters Panel" in Section 1 of this manual.
9. **Auxiliaries**: Select the auxiliary relays you want to activate. Auxiliaries are active only when the 8200 is running. For more information, see "Chan/Aux Names Panel" in Section 1 of this manual.
10. To start running in manual mode using the settings entered above, press **Run**.
11. To suspend a ramp at its current settings, press **Hold**.
12. To resume a suspended test, press **Run**.
13. To stop manual mode operation, press **Stop**.

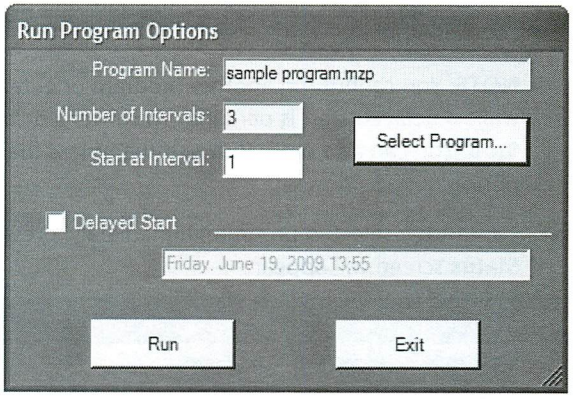
Program mode operation

The programmer function operates the 8200 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 8200 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.

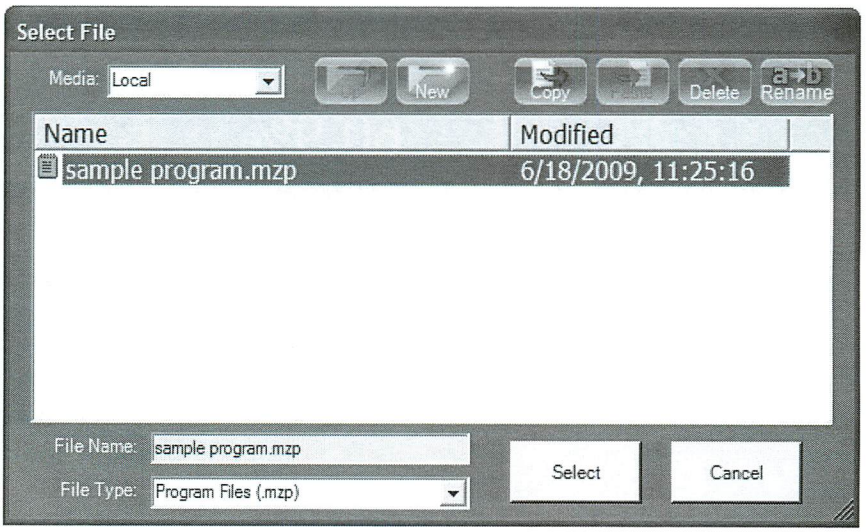
To run an existing program, see "Running a Program" below. To create or modify a program, see "Programmed Cycling" later in this section.

Running a program

1. With the 8200 in stop mode, press **Run** from any screen other than the manual mode screen. The **Run Program Options** dialog box will appear with the name of the currently loaded program in the **Program Name** field.



2. To load a different program:
   a. Press the **Select Program** button. The **Select File** dialog box will appear.
   b. Find and select the program you want to load.
   c. Press **Select**. The name of the newly selected program will appear in the **Program Name** field.



3. The **Number of Intervals** field displays the total number of intervals in the loaded program. The **Start At Interval** field shows the starting interval (the default value is 1). To start the loaded program 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 a delayed start date and time, go to Step 5. To start the selected program immediately, go to Step 6.

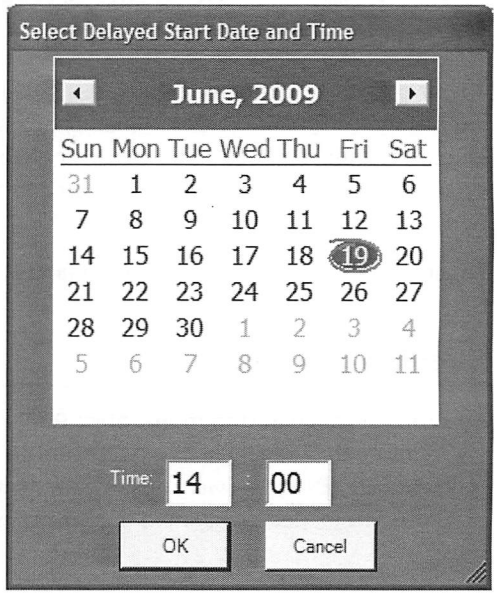
5. To schedule the selected program to start at a preset date and time in the future:

   a. Select the **Delayed Start** check box.

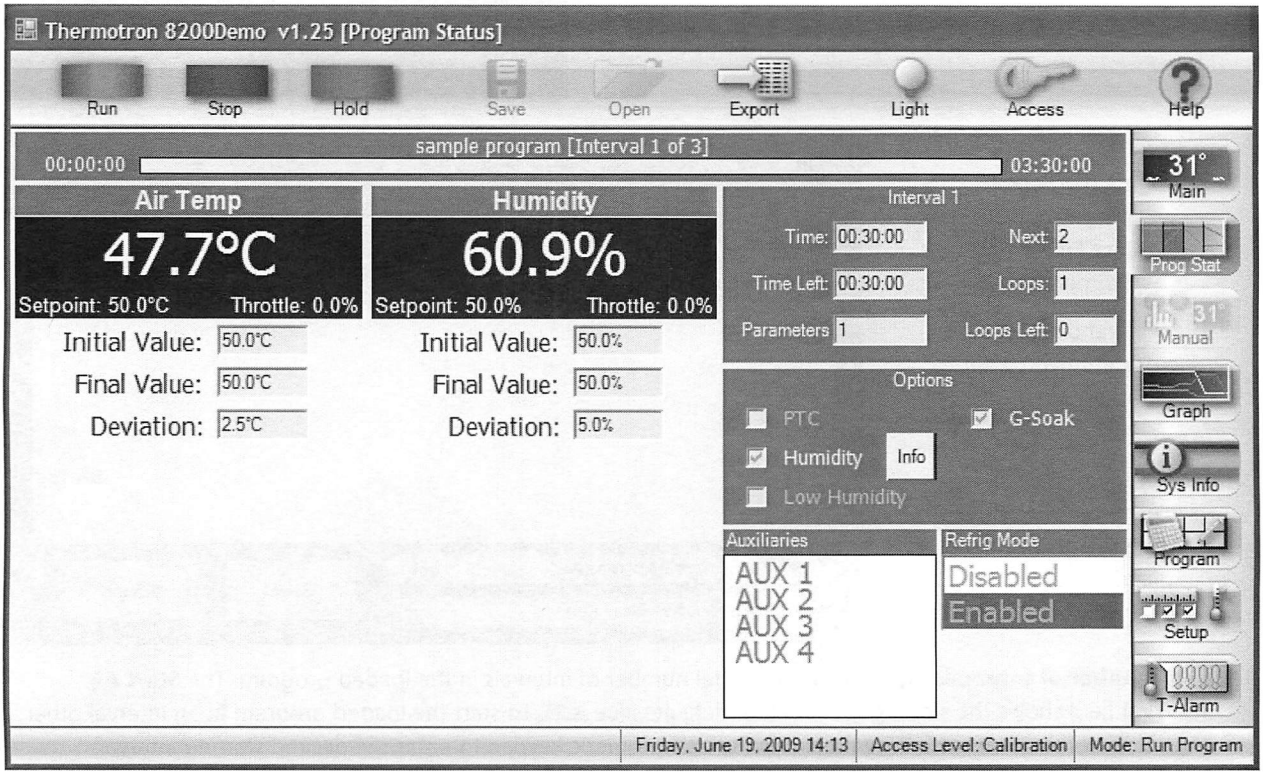
   b. Select the adjacent date and time field. The **Select Delayed Start Date and Time** dialog box will appear with the currently scheduled start date highlighted in blue and today's date circled in red. Choose when to start running the program, then press **OK**.

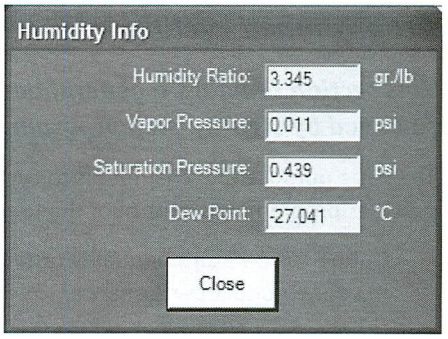
   c. Press **Run**. The 8200 will enter delayed start mode and the status message at the bottom of the screen will read **Mode: Delayed Start**, followed by the date and time the program is scheduled to start.

   NOTE: You cannot run another program or enter manual mode while a delayed start is pending. To cancel a delayed start, press **Stop**. You can also press **Run** and then press the **Cancel Delay** button.



6. To start the selected program immediately, press **Run**. The 8200 will enter run program mode and the **Program Status** screen will appear.





7. For humidity information, press the humidity Info button next to the **Humidity** field. The **Humidity Info** dialog box will appear.
8. To suspend the interval at its current settings, press **Hold**. The 8200 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 8200 will maintain the chamber test space at the last setpoint.
   a. To enter temporary values into the current interval, go to step 9.
   b. To resume running a suspended test, press **Run** and go to step 10.
9. To enter temporary values into the current interval:
   a. Press the **Edit** button.
   b. Select and edit the values and options as desired.
   c. Press the **Edit** button again, then press **Run**. The 8200 will enter run program mode again using the new values for the remainder of the current interval.

   NOTE: Once the interval is completed, the temporary values will be discarded. The next time the interval is run, the original programmed values apply.
10. To stop a running test, press **Stop**.

Programmed cycling

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. The 8200 provides programmed control of the temperature and other process variable cycling operations for your chamber.

- 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. 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 setpoint 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 setpoint for this interval.

Deviation controls how far you will allow the temperature or other process variable to be from setpoint. 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 8200 will immediately set the setpoint 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 8200 cycles a process variable to a new setpoint.

Refrig Mode allows you to select the refrigeration mode for each interval.

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

Auxiliaries (auxiliary relays) may be enabled or disabled for each interval. Auxiliaries are active only when the 8200 is running. For more information, see "Chan/Aux Names Panel" in Section 1 of this manual.

Time is the duration of the interval. This value controls how fast the setpoint is to be cycled from initial value to final value. The image below illustrates a simple temperature program with seven intervals. Each interval represents an action or condition inside the chamber.

1 Ensures the chamber reaches a given starting temperature of -17°C.

2 Increases ("ramps") to the next required temperature of +23°C.

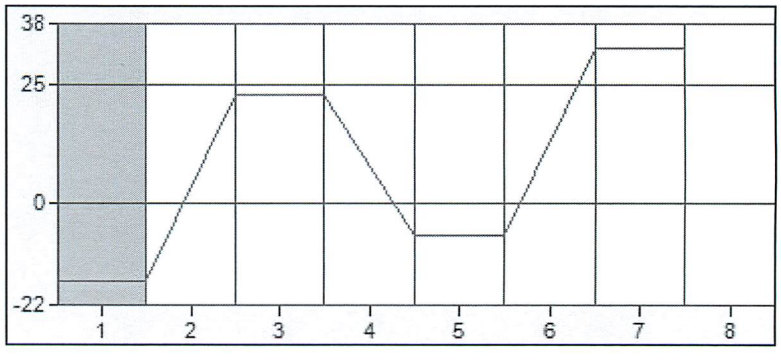
3 Maintains +23°C for 15 minutes.

4 Lowers the temperature to -7°C.

5 Maintains -7°C for 15 minutes.

6 Raises the temperature to +33°C.

7 Maintains +33°C for 15 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:

- If you enter a **Time** greater than zero, the 8200 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 8200 will transition to the next interval when the time runs out anyway.
- If you enable guaranteed soak (**G-Soak**) and set one or more **Deviation**s, the 8200 will immediately set the setpoint 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 8200 to transition to the next sequential interval (the default value in the **Next Interval** field). Programmed looping is selected by using the **Next Interval** and **Num Loops** values.

- **Next Interval** indicates the interval to transition to after completion of the current interval.
- **Num Loops** is the total number of times the programmed loop will be executed.

For programmed looping, the **Next Interval** value is valid only if it is less than or equal to the number of the current interval, and if the **Num Loops** value is greater than 1. The interval will actually loop back to the target interval the **Num 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 64.

Options

NOTE: **Not all possible options are listed below.** Refer to your chamber manual for a description of the options available on your chamber.

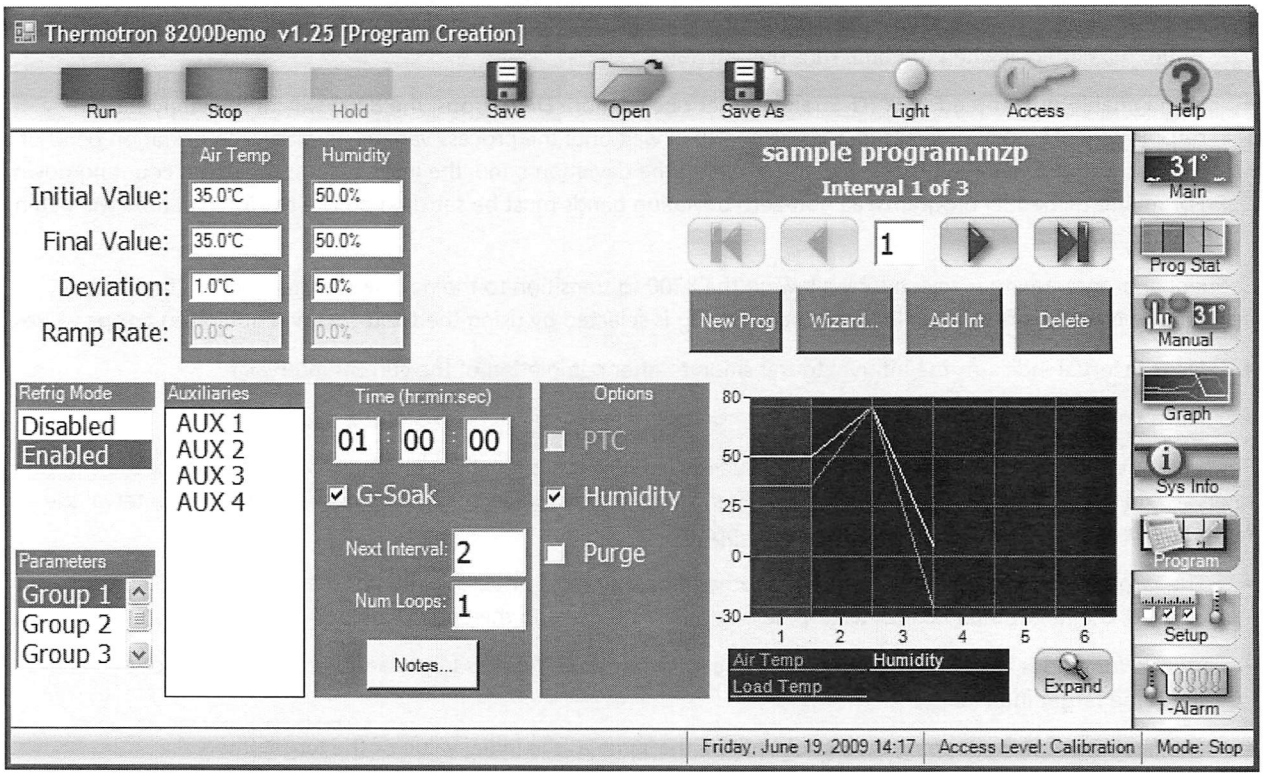
- **PTC** enables product temperature control, an optional heating and cooling process that controls the process variable from the product temperature rather than the test space air temperature. PTC uses the load temperature to control the channel 1 air setpoint for faster load stabilization. **NOTE**: Product temperature control is disabled if humidity is enabled.
- **Humidity** enables or disables 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) is enabled.
- **Purge** enables the purge option (if applicable).

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 operations (such as temperature/humidity), 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 at the same time before the interval time will begin counting down.

Creating or modifying a program

1. Press **Program**. The program creation screen will appear.



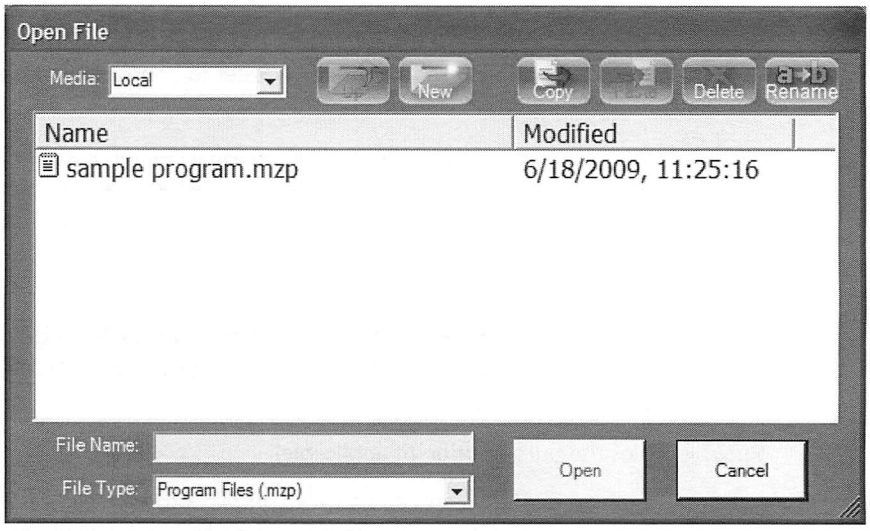
If you want to modify an existing program:

a. Press **Open**. The **Open File** dialog box will appear.

b. Select the desired program.

c. Press **Open**.

d. Go to step 3.



2. If you want to start with a blank program:

   a. Press **New Prog**.

   b. For on-screen, step-by-step instructions, press **Wizard**, press **Next**, and follow the instructions in the **Program Wizard**. Otherwise, go to step 3.

3. Select and change the settings for each interval of the program. The following list describes the program values and options displayed:

   a. For **Initial Value** enter the starting value for each active channel's setpoint for the interval. After interval 1 the initial value will always be the final value of the previous interval and cannot be edited.

   b. For **Final Value** enter the ending value for each active channel's setpoint for the interval.

   c. For **Deviation** enter how far you will allow the selected channel's process variable to be from setpoint. Enter a positive number only; the 8200 will monitor both plus and minus deviations and activate the deviation alarm if the values are exceeded.

   d. If you want to specify a **Ramp Rate**, enter the speed (in units of measurement per minute) for the 8200 to cycle an active channel's process variable to a new setpoint. (To determine change rates, refer to your chamber manual's performance specifications.) The 8200 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. Only one active channel's ramp rate can be set per interval.

   e. Select the desired **Refrig Mode** (refrigeration mode) for the interval.

   f. Select the desired **Parameters** (control parameter group) for the interval. For more information, see "Control Parameters Panel" in Section 1 of this manual.

   g. Select the desired **Auxiliaries** for the interval. Auxiliaries are active only when the 8200 is running.

   h. For **Time** enter the length of the interval in hours, minutes, and seconds. The maximum interval time is 99 hours, 59 minutes, 59 seconds.

   i. To enable guaranteed soak, check **G-Soak** and set one or more **Deviation**s. The 8200 will immediately set the setpoint 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 at the same time before the interval time will begin counting down.

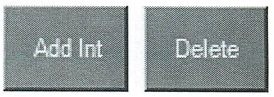
   j. For **Next Interval** enter the number of the interval you want the 8200 to transition to after this interval is complete. For programmed looping this number must be less than or equal to the current interval number, and the **Num Loops** value must be greater than 1. If no loops are programmed, the **Next Interval** field displays the number of the next interval.

   k. For **Num Loops** enter the number of times you want the programmed loop to be executed. A loop can be repeated up to 300 times. Up to 32 separate loop patterns can be used per program. **NOTE**: The interval will actually loop back to the target interval the **Num Loops** value minus 1.

   l. Select the desired **Options** for the interval. **NOTE**: Enabling **PTC** disables the **Humidity** channel. When **PTC** is enabled, only the values for the PTC channel can be edited. Enabling **Humidity** disables the **PTC** (product temperature control) channel. Refer to your chamber manual for a description of the options available on your chamber.

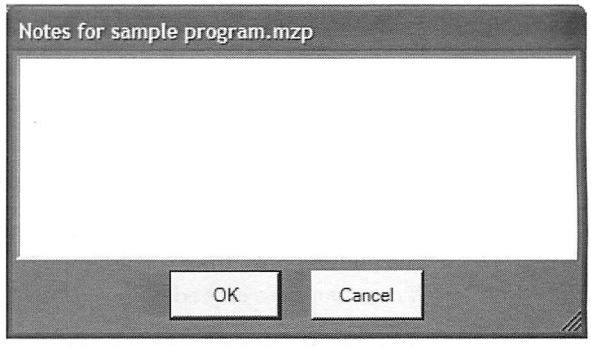
   m. To insert a new interval following the current interval, press **Add Int**.

   n. To delete the current interval, press **Delete**.

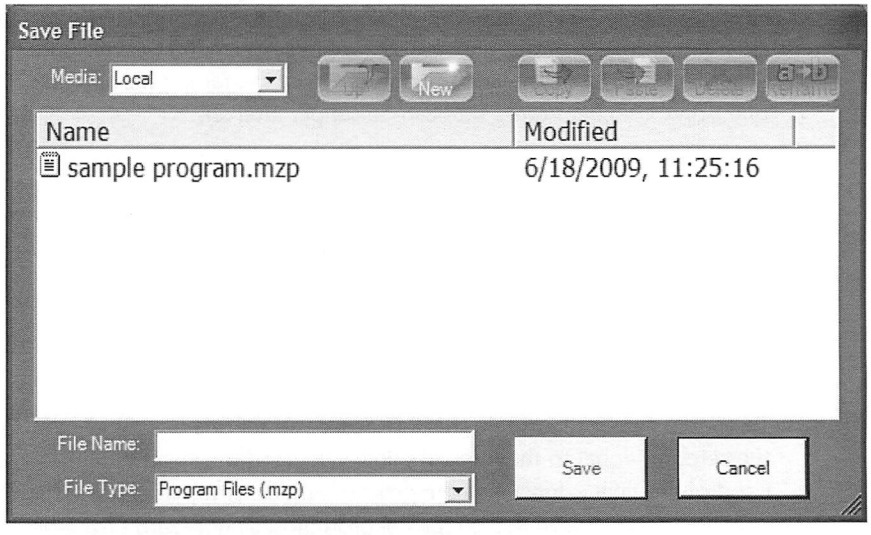


4. The program graph allows you to view your program as you create it. To expand and collapse the graph, press the **Expand/Collapse** button.

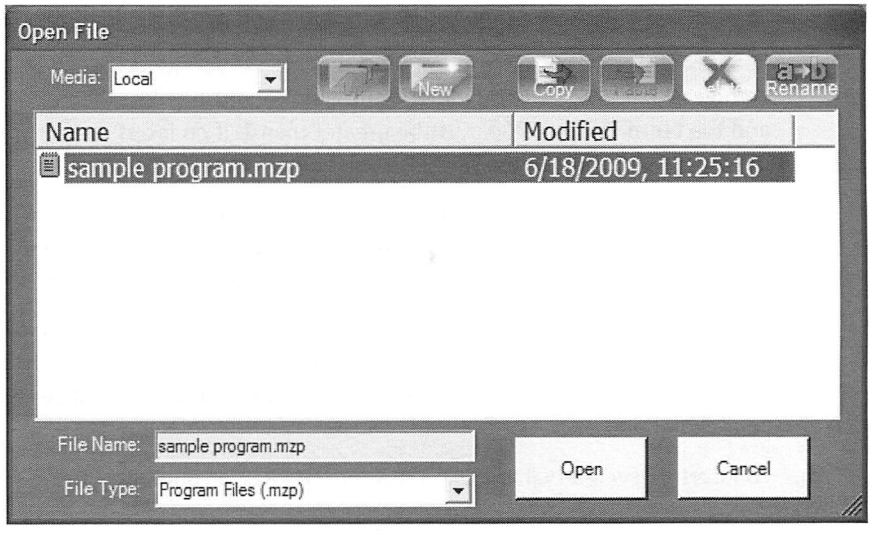
5. To add notes to your program:
   a. Press the **Notes** button. The **Notes** dialog box will open.
   b. Select the notes field and use the alphanumeric keyboard to add your notes.
   c. To save your notes, press **OK**.



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.**

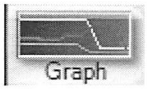


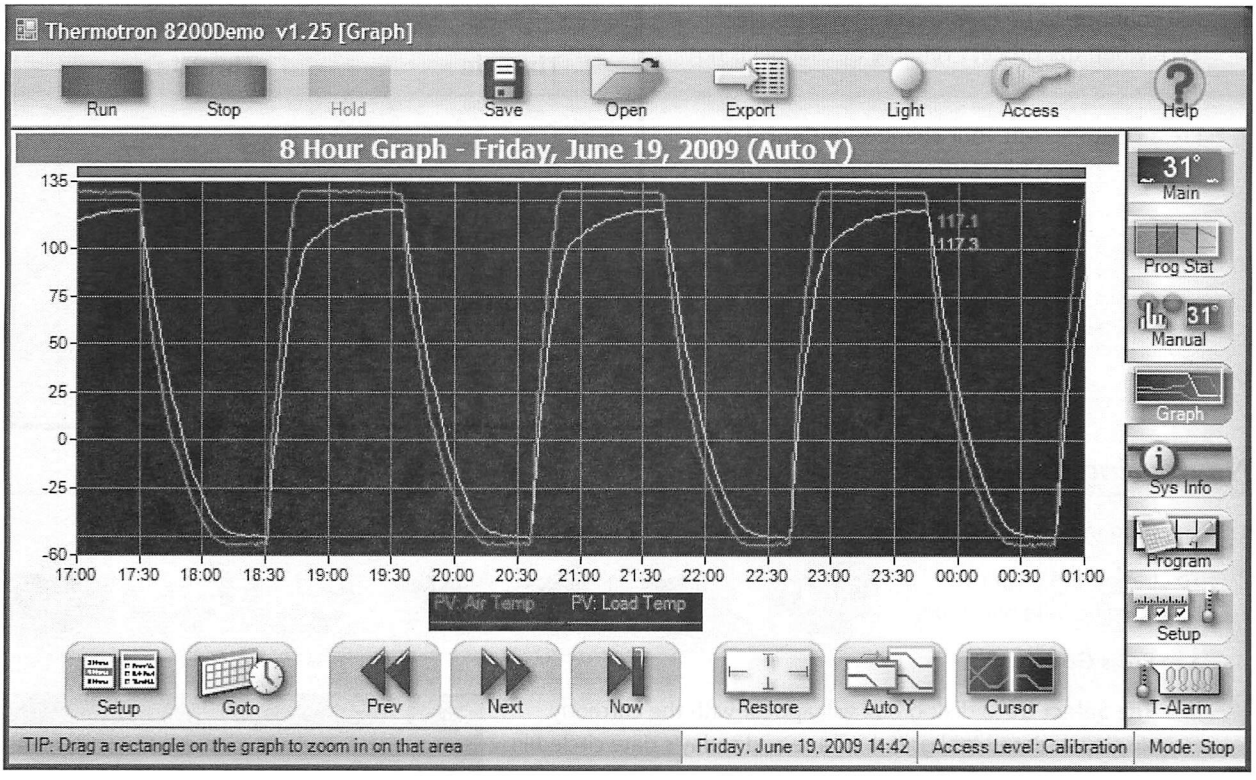
7. To delete a saved program:
   a. Press **Open**. The **Open File** dialog box will appear.
   b. Select the desired program.
   c. Press the **Delete** button at the top right of the **Open File** dialog box.
   d. Press **Yes** to confirm the deletion.



Using the Graph panel

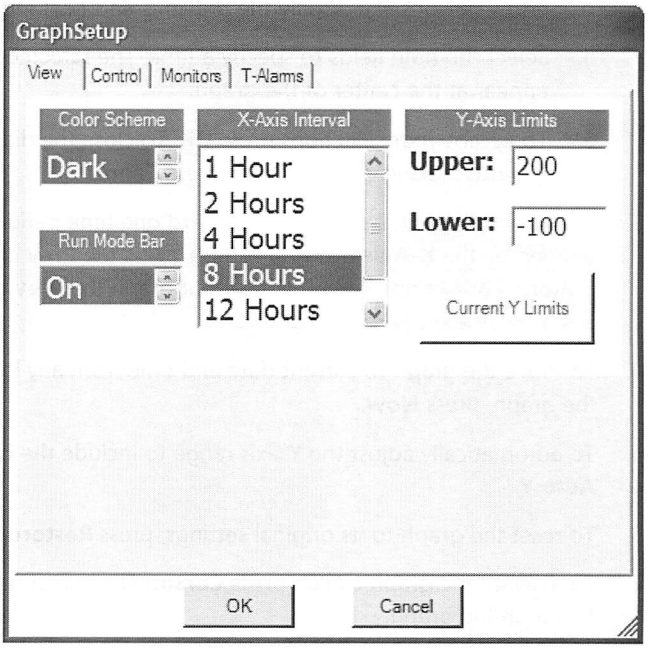
To view the graph screen, press **Graph**. The graph screen allows you to see a graphic representation of chamber data you select, such as process variables, setpoints, and monitor channel readings. The graph setup dialog boxes allow you to customize the graph. The buttons below the graph allow quick navigation of graph data.





Graph setup

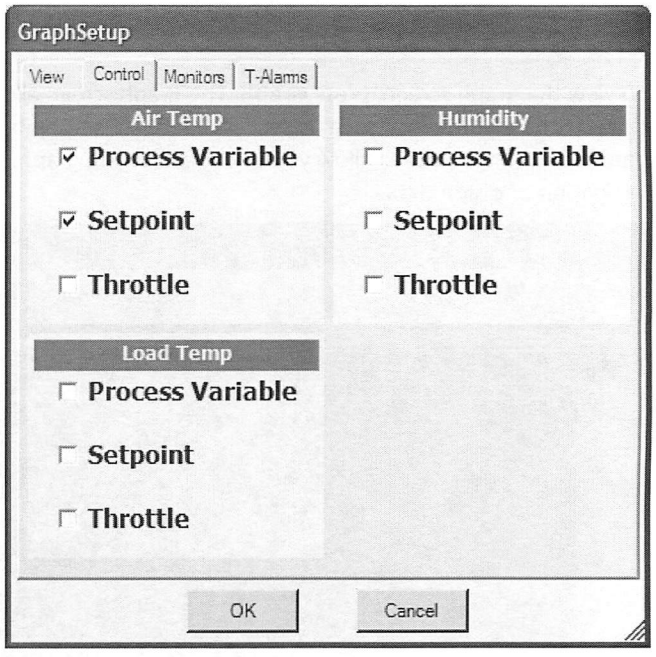
1. Press the **Graph** panel's **Setup** button. The **Graph Setup** dialog box will appear with the **View** tab selected.
2. Under **Color Scheme**, select **Dark** or **Light**.
3. Under **Run Mode Bar**, select **On** or **Off**. The run mode bar displays chamber status information as a colored bar at the top of the graph.
4. Under **X-Axis Interval** select the graph time span.
5. Under **Y-Axis Limits** you can customize the graph's **Upper** and **Lower** limits. To select the current Y-axis, settings press **Current Y Limits**.



6. The other **Graph Setup** tabs allow you to choose to display process variable, setpoint, throttle, monitor channel, and Therm-Alarm readings.

   NOTE: Only eight values can be displayed in the graph's legend, but more than eight can be selected for the graph. Each reading you select will continue to be graphed until you deselect it, even when the process variable or channel is not active.

7. Press **OK** to accept your changes or **Cancel** to close the dialog box without making any changes.



Navigating the graph

1. To zoom in on an area of the graph, drag a rectangle on the graph.
2. To change the graph view to a specific date and time:

   a. Press **Goto**.

   b. The **Select Date** dialog box will appear with the currently displayed date highlighted in blue and today's date circled in red.

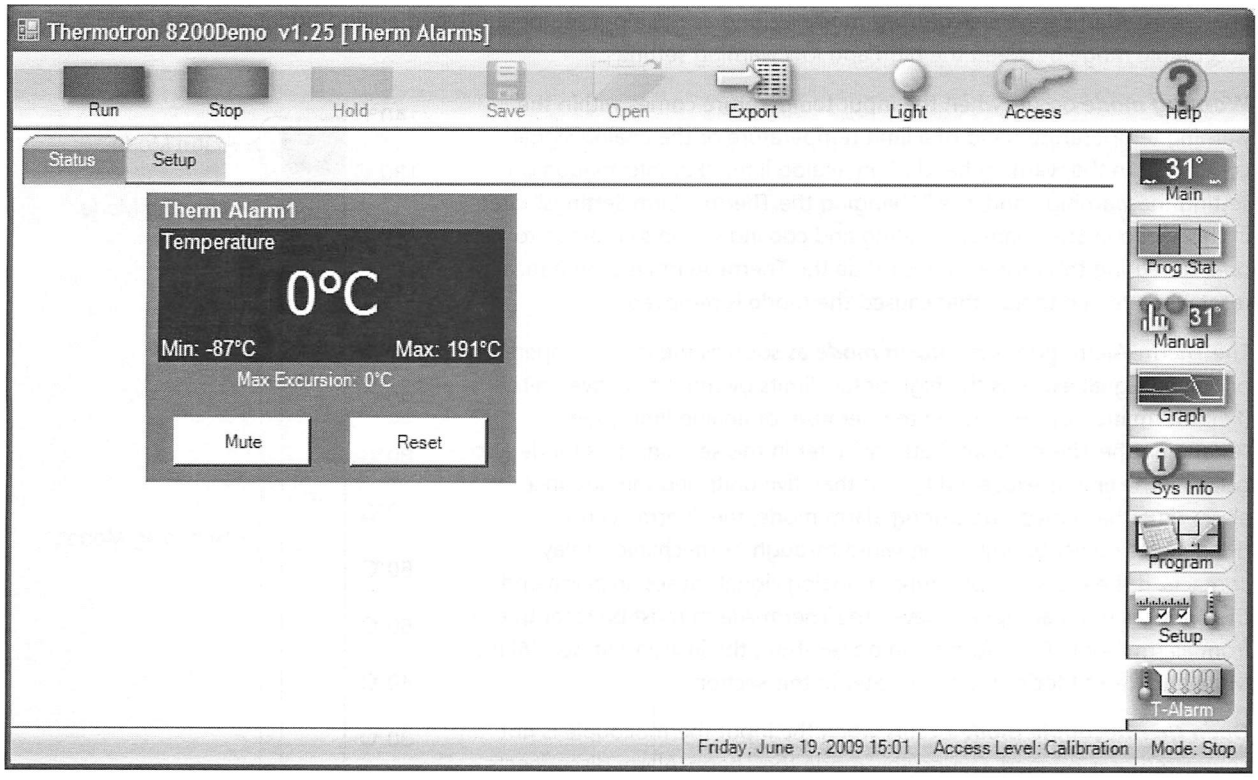
   c. Select a date from the calendar. Pressing the left and right arrow buttons will display the previous and next months.

   d. Select the time fields to specify a time. The selected time will appear at the center of the graph.

   e. To accept your selections press **OK**. To close the dialog box without making any selections press **Cancel**.

3. To move the graph backward or forward one time period as defined by the **X-Axis Interval** setting, press the **Prev** or **Next** buttons. For example, on an eight-hour graph the **Prev** button will move the graph back eight hours.
4. To move the graph to current date and time from any location on the graph, press **Now**.
5. To automatically adjust the Y-axis range to include the highest and lowest values in the current graph view, press **Auto Y**.
6. To reset the graph to its original settings, press **Restore**.
7. To activate the graph cursor, press **Cursor**. The cursor displays the date, time, and data readings at any point you touch on the graph.

Using the Therm-Alarm panels



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, such as a humidity sensor. 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.

In the following instructions "input temperature" refers to the temperature of the product being tested (measured by the input thermocouple). "Limit temperature" refers to the adjustable high and low temperature settings. "Analog signal" refers to the analog channel's signal. "Analog limit" refers to 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.

CAUTION: The image shown above displays the Therm-Alarm factory default settings. 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.

This section includes a description of the Therm-Alarm operating modes, instructions for setting up the Therm-Alarm, instructions for muting and resetting alarms, and calibration instructions.

Therm-Alarm operating modes

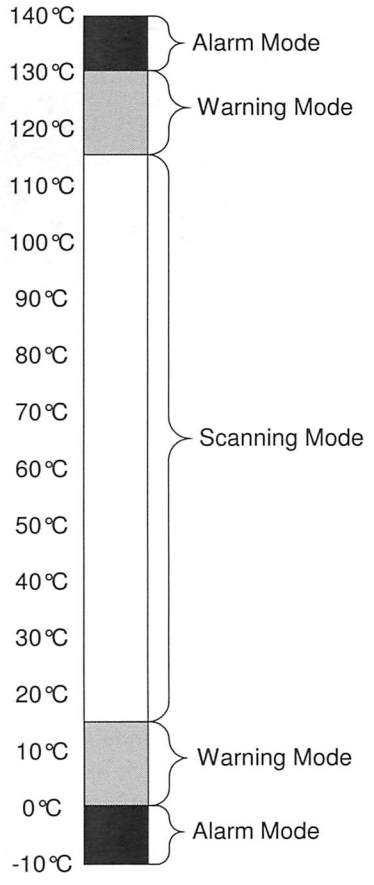
The Therm-Alarm stays in ***scanning mode*** as long as the input temperature and analog signal are within the acceptable range between the high and low warning settings.

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 opened. 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.



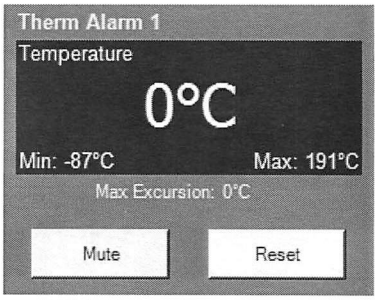
High limit: +130°C
Low limit: 0°C
Warning bandwidth: 15°C

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 near 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.

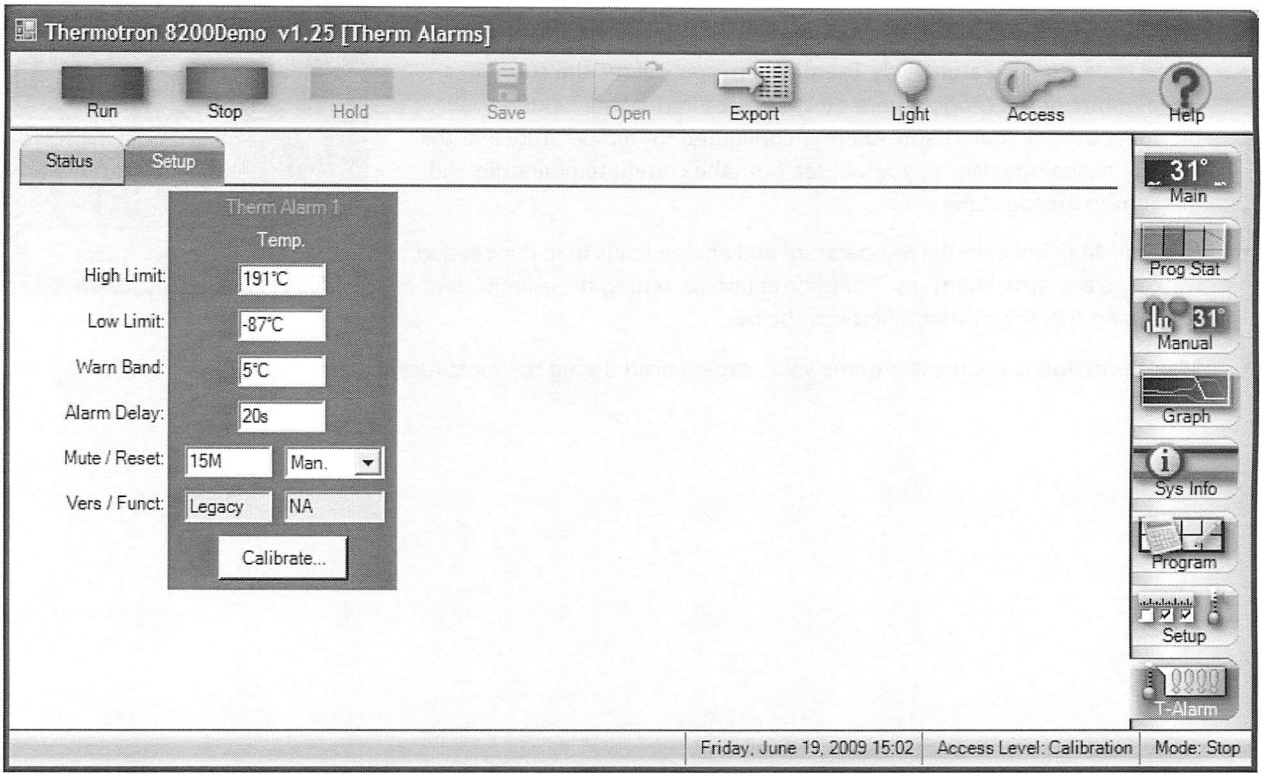
Viewing the Therm-Alarm settings



From any screen press **T-Alarm** to display the Therm-Alarms panel.

- 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.
- **Min** and **Max** 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 value experienced during the most recent alarm condition.

Changing the Therm-Alarm settings



CAUTION: The images shown above display the Therm-Alarm factory default settings. It is *your* responsibility to set Therm-Alarm limits appropriate for your product.

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. 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.
2. Select the **Warn 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 99. To disable the warning mode select 0.
3. 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 99. 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 nuisance delay will not occur.
4. Select the first **Mute / Reset** 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.
5. From the **Mute / Reset** drop-down menu, select **Man.** 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 **Status** 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 **Man.** 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** and select the **Status** 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

NOTE: To calibrate the temperature channel a type 'T' thermocouple calibrator is required.

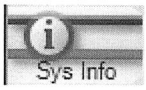
NOTE: Make sure the controller's temperature scale is set to Celsius before beginning any calibration procedure.

NOTE: To calibrate the 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.**
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 complete the calibration.

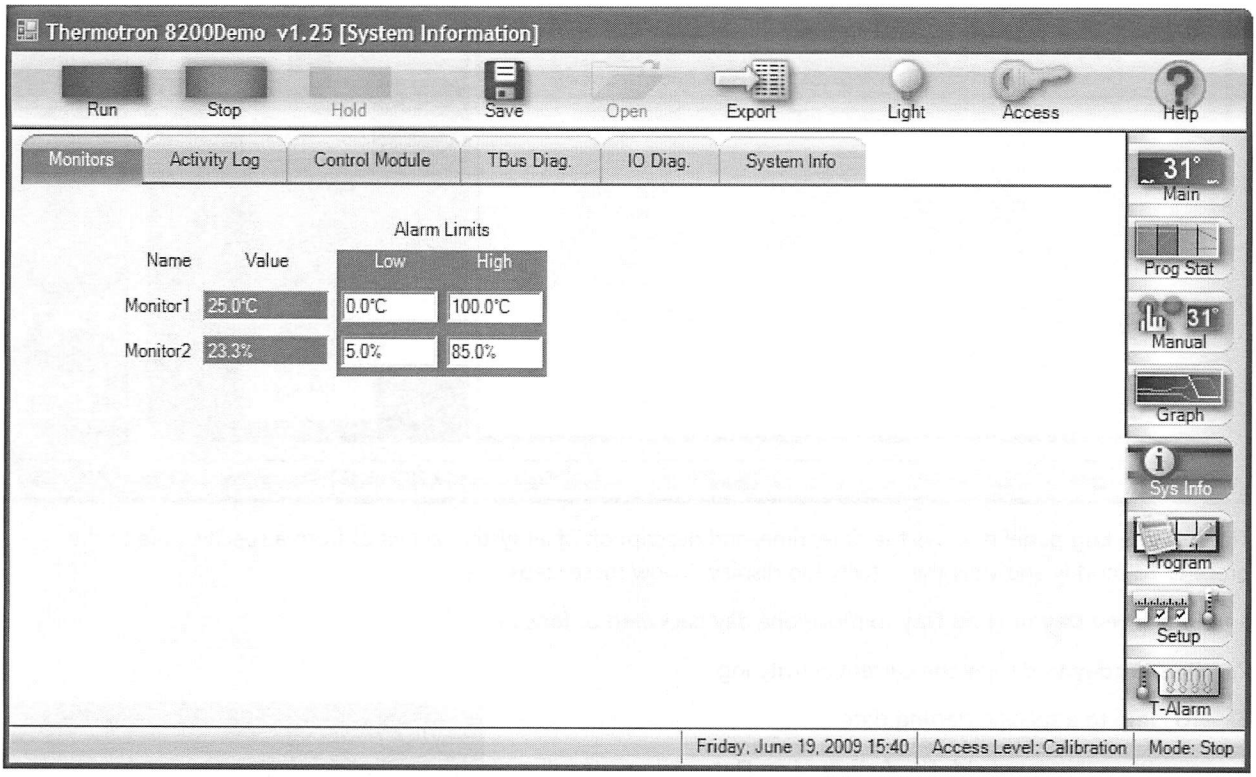
Section 3: System Information

Press **Sys Info** 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.



NOTE: For information on calibration, refer to the *8200 Technical Manual.*

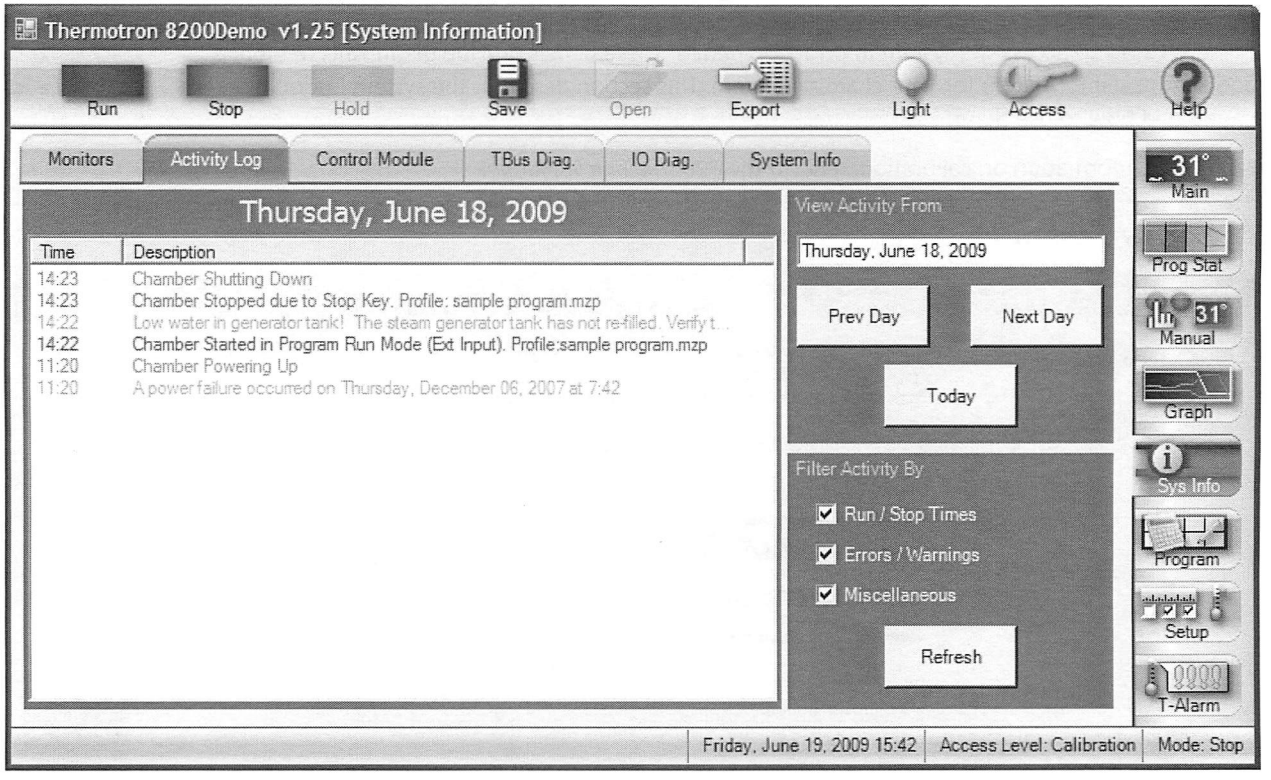
Monitors panel



Monitor channels monitor processes within the chamber. If the high or low alarm limit is exceeded for a monitor channel, the 8200 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 8200 access level must be Lab Manager or higher.

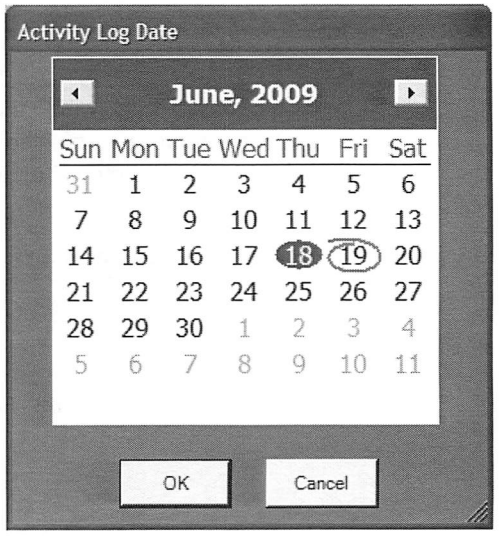
1. Press **Sys Info**, then select the **Monitors** panel.
2. Select a **Low** or **High** alarm limit field.
3. The numeric keypad will appear.
4. Enter the desired alarm limit, then press **Enter**.

Activity Log panel

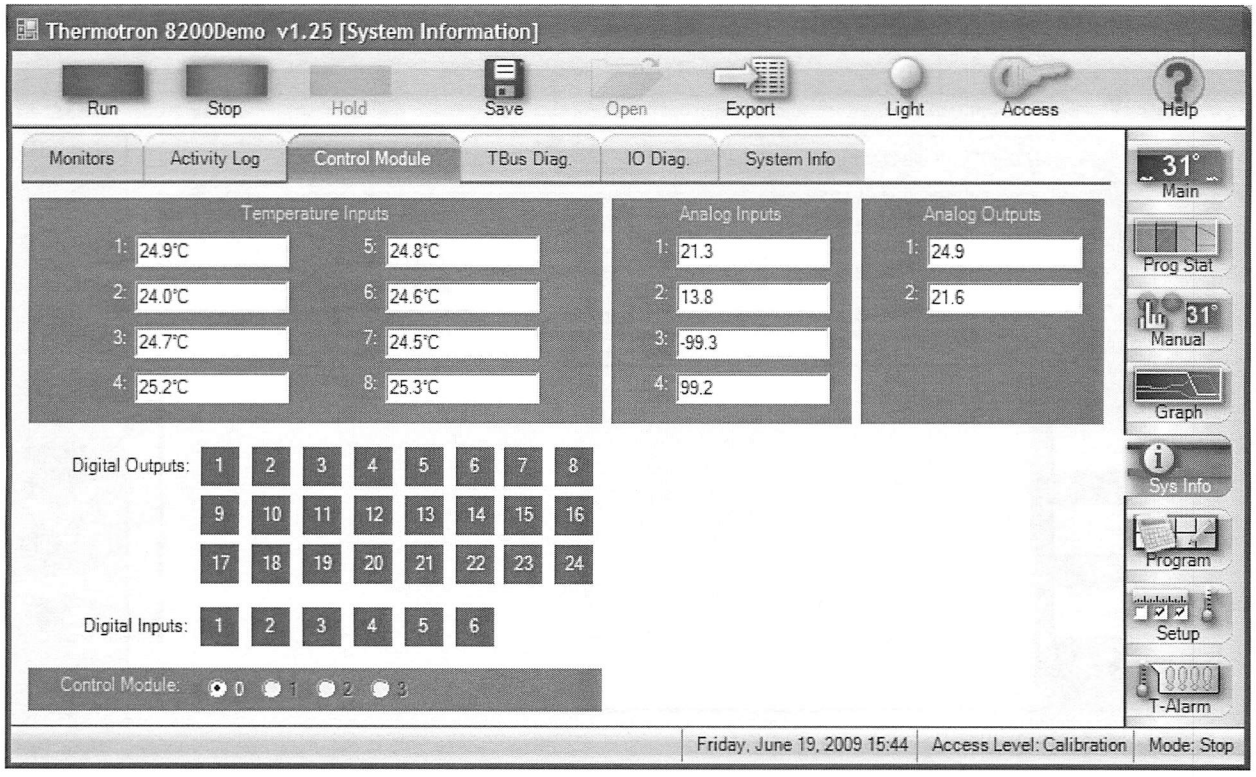


The **Activity Log** panel displays the date, time, and description of all system activities from a specific date to the present. To modify and view the activity log display, follow these steps:

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 **Activity Log Date** dialog box will appear with the currently displayed date highlighted in blue and today's date circled in red.
   b. Select a date from the calendar. The left and right arrow buttons will display the previous and next months.
   c. To accept your selections press **OK**. To close the dialog box without making any selections press **Cancel**.
4. Select the type of activities displayed (such as **Run/Stop Times**, **Errors/Warnings**, or **Miscellaneous**):
   a. Check or uncheck each filter field as desired.
   b. Press **Refresh** to implement your changes and redisplay the activity log.



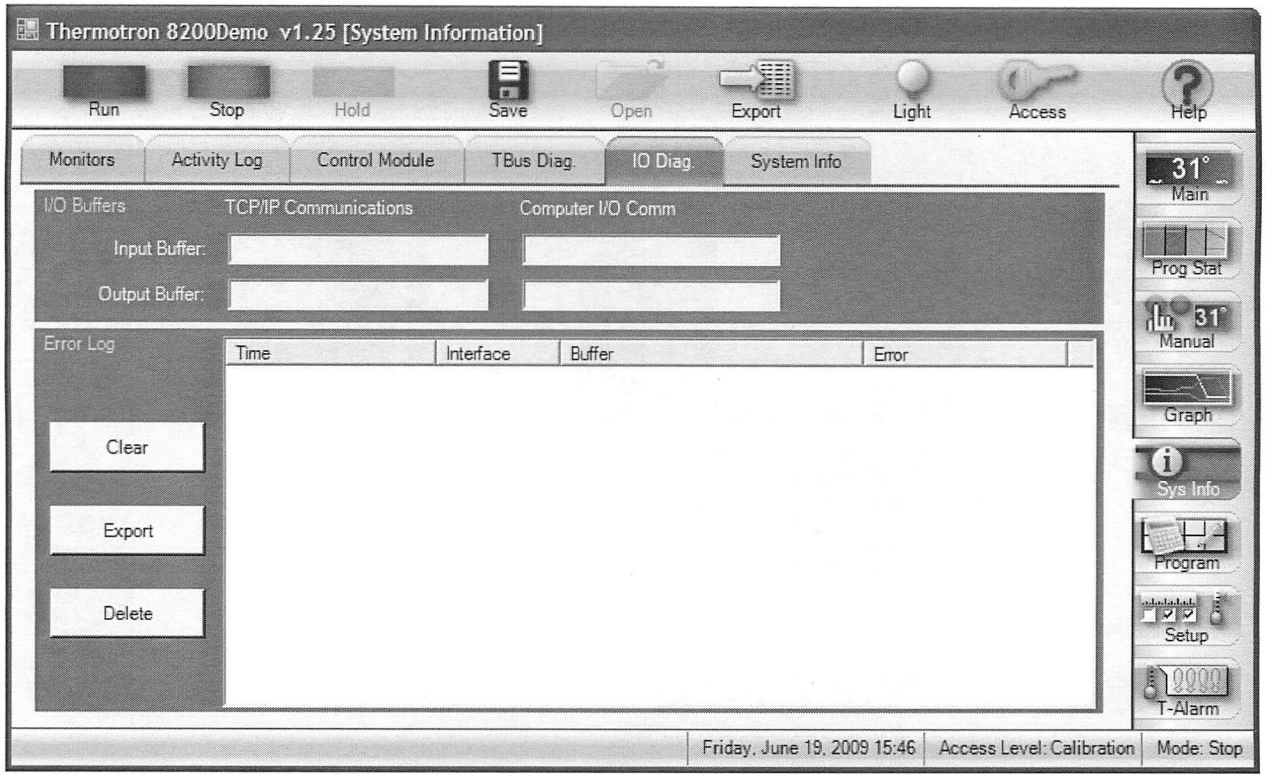
Control Module panel



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 live data for all analog and digital inputs and outputs. The numbers of the digital outputs and inputs light up to indicate activity. All inputs and outputs are numbered for cross reference with chamber electrical and instrument drawings. If the 8200 has more than one control module installed, you can select which to display by choosing the appropriate control module number.

Computer interface diagnostic panel



The **IO Diag.** screen allows you to examine the current computer I/O communications as well as the most recent computer I/O communication errors that have occurred. From this screen you can also export a complete log of all computer I/O errors.

TCP/IP and computer I/O input and output buffers

- **Input Buffer**: Shows any data being received by the 8200.
- **Output Buffer**: Shows any data sent by the 8200.

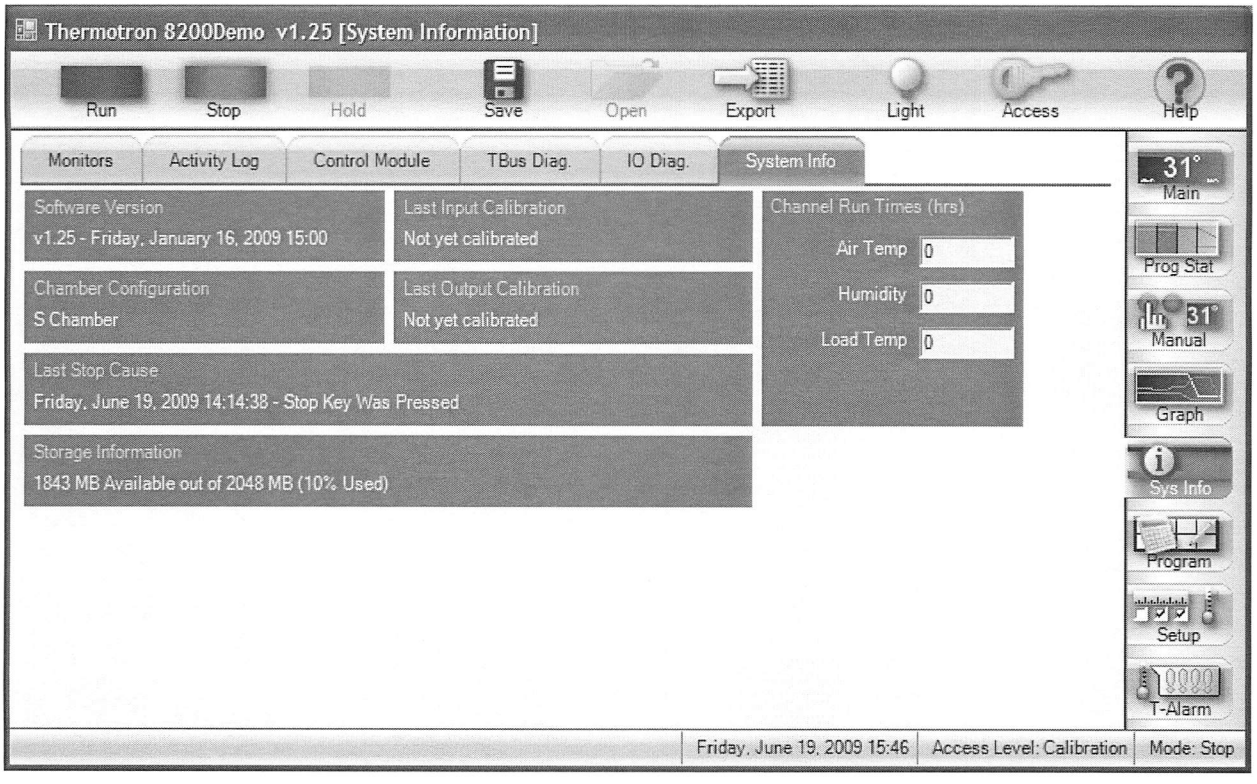
Error log columns

- **Time**: Date and time the error occurred.
- **Interface**: The interface the error occurred on.
- **Buffer**: Contents of the input buffer when the error occurred.
- **Error**: Text describing the actual error that occurred.

Error log buttons

- **Clear** button: Clears the error log on the screen but does not affect the saved log file.
- **Export** button: Allows the user to save their log file. The user may then inspect the file or e-mail it to Product Support. The format is a spreadsheet that displays the time of any errors, the device generating the errors, and the command that generated the errors.
- **Delete** button: Clears the entire log file.

System Info panel



The **System Info** panel provides general information, including:

- The 8200 display module software version
- Chamber configuration
- Input and output calibration status
- Last stop cause
- Storage information
- Channel run times

Section 4: Computer Interface

Overview

The 8200 interface command set allows you to control, monitor, and program the 8200 from a host computer. The commands use a specified structure and syntax for communication. This section describes the 8200 interface command set and gives examples of how to use this command set to operate the 8200 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 8200 responds with the following:

<data><t>

Where:

CMND = command mnemonic (**NOTE**: A comma may immediately follow the command.)

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

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

Multidrop address communication protocol (RS-485)

The RS-485 serial interface require 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 8200 checks the first character after the pound sign. If the character matches the 8200's address, it reads the command and performs the assigned task.
   - When the 8200 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 8200 responds with:

[FF]#a<data><t>

Where:

[FF] = prefix character (FF hexadecimal)

= ASCII pound sign (35 decimal)

a = One-byte address of the 8200 (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 8200 uses the control module's GPIB converter. GPIB communication uses the same commands and syntax required by the serial communication but adds several service request commands.

Service request (SRQ)

The GPIB converter provides service request capability to the 8200 computer interface. The 8200 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 7	Power on reset. This bit is set when the 8200 goes through a power up sequence. It is also set as a result of an INIT command.
Bit 6	Reserved by GPIB.
Bit 5	Error. This bit is set by any type of command and/or interface error.
Bit 4	End of program. This bit is set at the end of a program, when the 8200 enters stop mode.
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 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 1	Alarm status change. This bit is set when there has been a change in the alarm status.
Bit 0	State change. This bit is set when there has there has been a change in the operating state.

Service request related commands

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

For more information see "Interface Command Descriptions" later in this section.

Command syntax

The 8200 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 8200 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 setpoint of -82°C, the 8200 would send -82.0 back to the host computer.

NOTE: The 8200 also can handle commands in the following syntax: **CMND,<data>**.

Operation commands

An operation command causes the 8200 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).
- If needed, the root command is followed by an ASCII numeric character that indicates a channel or group number, followed by an ASCII comma (,).
- 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 OPTN49 command, the 8200 loads the manual mode options register with the PTC, purge, and cascade options.

Another example of an operation command, if the host computer sends the AUXE1,142 command, the 8200 would enable AUX 1-2, AUX 1-3, AUX 1-4, and AUX 1-8.

Command data formats

The 8200 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 number, 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, or 128). The integer sent is the decimal sum of the coded bits that are enabled, for example the 8200'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 setpoint of a temperature channel.
4. **String format**: The data consists of a string of ASCII characters. The information and format varies 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 8200 processes the concatenated commands in the order that it receives them. If you concatenate several query commands, the 8200 sends a separate response for each command.

For example, the commands STOP;RUNM;PVAR1? would stop the 8200, place it in run manual mode, and cause it to send the channel 1 process variable reading back to the host computer.

NOTE: The 8200 can hold up to 128 characters. Make sure the data strings and/or concatenated command strings are not longer than 128 characters.

Functional command sets

The 8200 interface command set can be divided into five functional groups. The following paragraphs are brief descriptions of these functional groups. For more information, see "Interface Command Descriptions" and "Using the Interface Command Set" later in this section.

Control commands

Control commands tell the 8200 to perform a specific operation and/or sets its operating mode. For example, if the host computer sends the STOP command, the 8200 is placed in stop mode.

Program status and edit from hold commands

Program status commands allow you to query the 8200 for real-time, program-specific values, while edit from hold commands allow you to run the 8200 using temporary values in edit from hold mode. Use these commands when you are running the 8200 in run program mode. For example, if the host computer sends the INTN? command, the 8200 responds with the current interval number of the program.

Programming commands

Programming commands allow you to write programs on your host computer, and then load them into the 8200. Additionally, they allow you to load a program from an 8200 into your computer.

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 8200 responds with the type of programmer/controller.

Variable commands

Variable commands can be either query or operation commands. The variable query commands allow you to read the 8200 registers for the current variables and parameters. The variable operation commands allow you to operate the 8200 from the run manual mode only. For example, if the host computer sends the VRSN? command, the 8200 responds with the software version.

Interface command descriptions

The following lists 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 8200 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?

8200 response: T (The analog input of Therm-Alarm 1 is programmed in torr.)

ALRM

Command name: Alarm status

Command type: System status

Description: The 8200 returns the current alarm status for the selected channel. The alarm status is a coded integer type as defined below:

Bit #	Definition	Bit #	Definition
0	Low deviation alarm	**4**	Low process alarm
1	High deviation alarm	**5**	High process alarm
2	Not used	**6**	Not used
3	Not used	**7**	Not used

Syntax: ALRMn?

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

Data type: Coded integer

Example: ALRM2?

8200 response: 1 (Channel 2 high deviation alarm)

AUXE

Command name: Auxiliaries event status

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 indicates that AUX 7, AUX 6, and AUX 1 are on or turns these auxiliaries on.

Data type: See Syntax

Query example: AUXE1?

8200 response: 148. (This value indicates that AUX 8, AUX 5, and AUX 3 of auxiliary group 1 are on.)

Operation example: AUXE1,59

8200 response: 0 (If the 8200 is in run manual mode, AUX 6, AUX 5, AUX 4, AUX 2, and AUX 1 of auxiliary group 1 are enabled. If they are enabled, the 8200 turns off AUX 8, AUX 7, and AUX 3 of auxiliary group 1.)

CCHR

Command name: Send process variable units character

Command type: System status

Description: The 8200 returns the ASCII units for the character. Common unit codes are C (Celsius), F (Fahrenheit), % (percent relative humidity), and T (torr).

Syntax: CCHRn?

Where **n** is any process variable channel (1 to 8) or monitor channel (9-16). **NOTE:** 9 = monitor channel 1, 10 = monitor channel 2, etc.

Data type: ASCII units character

Query example: CCHR1?

8200 response: C (Channel 1 is programmed in degrees Celsius.)

CCNF

Command name: Send process channel configuration information

Command type: System status

Description: The 8200 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 to 8).

Data type: Coded integer

Query example: CCNF2?

8200 response: 4 (Linear % relative humidity)

CHRT

Command name: Channel run time

Command type: System status

Description: Queries the 8200 for a channel's accumulated run time. The 8200 sends an integer to indicate the number of hours the channel has been running.

Syntax: CHRTn?

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

Data type: Integer

Query example: CHRT2?

8200 response: 962. This indicates that channel 2 has accumulated a total run time of 962 hours.

CHST

Command name: Channel on and configured status

Command type: System status

Description: The 8200 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 8200 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 8200 sets the bit for each channel that is configured.

Syntax: CHST?

Data type: Coded integer

Query example: CHST?

8200 response: 769 (Binary value 00000011 00000001. This indicates that channels 1 and 2 are configured and that channel 1 is on.)

CMST

Command name: Comm status

Command type: System status

Description: This query command asks the 8200 for the current comm status. The 8200 sends a coded integer value. The edit operation command changes the current comm status. The CMST data byte is defined as follows:

Bits 0 – 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?

8200 response: 1 (send acknowledge is on)

Operation example: CMST0

8200 response: The 8200 turns off send acknowledge.

CNAM

Command name: Get 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 (1-12 are process variable channels, 13-28 are monitor channels)

Data type: ASCII units character

Query example: CNAM10?

8200 response: PROD MON

CONF

Command name: Send configured options

Command type: System status

Description: The 8200 sends three coded-integer bytes. These are binary-weighted bytes that indicate all the system options selected at the factory for the 8200. The bytes are defined below:

Byte 1 (Bits 0 through 7)		Byte 2 (Bits 8 through 15)	
1	Product temperature control	**1**	Transducers installed
2	Humidity system	Bits 9 through 15 are not used	
4	Low humidity system	**Byte 3 (Bits 16 through 23)**	
8	Altitude	**1**	Chamber control
16	Purge	**2**	SPD SE chamber control
32	Cascade refrigeration system	**4**	System Monitor functions
64	Power Save mode	**8**	Go to stop mode on System Monitor trips
Bit 7 (**128**) is not used		Bits **20** through **23** are not used	

Syntax: CONF?

Data type: Three bytes of coded integers

Query example: CONF?

8200 response: 327987 (Binary value 00000101,00000001,00110011. This indicates that the controller is configured for product temperature control, humidity, purge, and cascade refrigeration, refrigeration transducers are installed, the controller is configured for chamber control, and the System Monitor is enabled.)

DEVN

Command name: Deviation

Command type: Variable; edit from hold

Description: The query command asks the 8200 for the current deviation reading from a selected channel. The 8200 sends the value in the channel's selected units. The operation command loads a deviation setting into the 8200 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 to 4).

Data type: Decimal

Query example: DEVN1?

8200 response: 2.3

Operation example: DEVN2,5

8200 response: 0 (If the 8200 is in manual mode, it loads a deviation value of 5 units into channel 2.)

DIRP

Command name: Program directory

Command type: Programming command

Description: This command queries a specific directory on the 8200 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 8200. 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 8200 or "\" for the root path of the 8200.

Query example: DIRP\?

8200 response: humidity test, 5 (Program called humidity test with five intervals)

Query example: DIRP\?

8200 response: Pre-programmed Tests, -2 (Directory called Pre-programmed Tests)

Query example: DIRP\Pre-programmed Tests?

8200 response: 8200-SE humidity, 6 (Program called 8200-SE humidity with six intervals)

Query example: DIRP\Pre-programmed Tests?

8200 response: No More Files, -1 (You have iterated through all the items in the directory Pre-programmed Tests)

DREF

Command name: Reference data type

Command type: System status

Description: The 8200 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 Kft

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 to 28).

1 – 8: Process variable channels

9 – 12: Unused

13 – 28: Monitor channels (1-16).

Data type: Integer

Query example: DREF2?

8200 response: 1

DTYP

Command name: Data type

Command type: System status

Description: The 8200 sends an integer representing the channel's 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 Kft

7 – Vibration

8 – Scaled linear

9 – Altitude linear (torr)

10 – Temperature average

11 – Humidity ratio

12 – Dew point

13 – Transducer

14 – Temperature minimum

15 – Temperature maximum

Syntax: DTYPn?

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

1 – 8: Process variable channels

9 – 12: Unused

13 – 28: Monitor channels (1-16).

Data type: Integer

Query example: DTYP1?

8200 response: 1

FVAL

Command name: Final value

Command type: Program status; edit from hold

Description: This query command asks the 8200 for the current interval's final value for channel n (1 to 4). The 8200 sends a decimal value for the selected channel. The edit from hold operation command temporarily changes the current interval's final value.

Syntax: FVALn?

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

Data type: Decimal

Query example: FVAL2?

8200 response: 25.0

Operation example: FVAL1,-33

8200 response: 0 (The 8200 loads -33 as the final value for 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

8200 response: 0 (Places the programmer/controller in hold mode.)

*IDEN or *IDN*

Command name: Send device identification

Command type: System status

Description: The 8200 sends an ASCII character string to the host computer.

Syntax: IDEN?

Data type: ASCII character string

Query example: IDEN?

8200 response: 8200 CHAMBER CONTROLLER

IERR

Command name: Send last error code

Command type: System status

Description: The 8200 sends the code of the last error that occurred. For more information see "Error Code Listing" later in this section.

Syntax: IERR?

Data type: Coded integer

Query example: IERR?

8200 response: 3 (This indicates that the 8200 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 8200 returns a error code of 0, the error buffer is empty.

INIT

Command name: Initialize controller

Command type: Control

Description: This command initializes the 8200 programmer/controller.

Syntax: INIT

Data type: No data

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

INTN

Command name: Interval number

Command type: Program status

Description: Queries the 8200 for the current interval number. The 8200 sends an integer to indicate the interval number.

Syntax: INTN?

Data type: Integer

Query example: INTN?

8200 response: 10 (This indicates that the 8200 is on interval 10 of the currently selected program.)

INTV

Command name: Program interval

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 setpoint

hh:mm:ss = hours (0 to 99), minutes (0 to 99), and seconds (0 to 99). See the TLFT command for the time field entry variations.

pgrp = parameter group (1 to 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 1-8 and Auxiliary Group 2 refers to auxiliaries 9-16. 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 (SE-Series only)
128	Single-stage refrigeration (SE-Series only)
256	Rapid cycle operation (AST modules only)
512	Altitude

Data type: Coded integer

Query example 1: INTV0?

8200 response: 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?

8200 response: 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: AUX1-2, AUX1-3, AUX1-4, AUX2-2, AUX2-4, and AUX2-5

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.

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

8200 response: The 8200 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.

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

8200 response: The 8200 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: AUX1-1, AUX1-2, AUX2-1

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

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

ISAA

Command name: Therm-Alarm analog input channel availability

Command type: Variable

Description: The query command asks the 8200 if the analog input channel for Therm-Alarm "n" is available. The 8200 returns a 0 (not available) or a 1(available).

Syntax: ISAAn

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

Data type: Integer

Query example: ISAA1?

8200 response: 1 (This indicates that the analog input channel for Therm-Alarm 1 is available.)

ITIM

Command name: Send interval time

Command type: Program status

Description: Queries the 8200 for the programmed time for the current interval.

Syntax: ITIM?

Data type: String

Query example: ITIM?

8200 response: 0:10:30 (This indicates that the current interval is 10 minutes, 30 seconds long.)

IVAL

Command name: Send initial value

Command type: System status

Description: Queries the 8200 for the current interval's initial value parameter for channel n (1 to 4). The 8200 sends a decimal value for the selected channel.

Syntax: IVALn?

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

Data type: Decimal

Query example: IVAL3?

8200 response: 25.00

LANG

Command name: Get language code

Command type: System status

Description: This command queries the 8200 for the current language mode.

Syntax: LANG?

The 8200 will respond with 0 (English) or 1 (French).

Data type: Integer

Query example: LANG?

8200 response: 1 (This indicates that the 8200 is in the French language mode.)

LGHT

Command name: Send/load the light status

Command type: System status

Description: The query command asks the 8200 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 (light off) or 1 (light on).

Data type: Integer

Query example: LGHT?

8200 response: 1 (Indicates that the chamber light is on.)

Operation example: LGHT0

8200 response: Turns the chamber light off.

LLFT

Command name: Send program loops left

Command type: Program status; edit from hold

Description: The query command asks the 8200 for the number of loops left to be executed for the current loop. On nested looping, the value is for the inside loop. The 8200 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?

8200 response: 8

Operation example: LLFT15

8200 response: Changes the loops left counter to 15.

LOCK

Command name: Lock status

Command type: System status

Description: This is the only system status command that allows you to change the 8200's status. It allows you to read and change the access level of the 8200.

Syntax: LOCK? or LOCKn

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

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

Data type: Coded integer

Query example: LOCK?

8200 response: 3 (This indicated that the 8200 is set to access level 3.)

Operation example: LOCK0

8200 response: This command locks out all user access to the 8200 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?

8200 response: 14 (A service request interrupt will occur at the start of interval 14 when running a program.)

Operation example: MINT3

8200 response: The 8200 loads the match interval parameter with a value of 3.

MNTR

Command name: Send monitor channel value

Command type: Variable

Description: Queries the 8200 for the current value of the selected monitor channel.

Syntax: MNTRn?

Where **n** is the channel number (1 to 24). See Description.

Data type: Decimal

Query example: MNTR1?

8200 response: -35.8

MODE

Command name: Send the operating mode of the 8200.

Command type: System status

Description: The query command asks the 8200 for its current operating mode.

Syntax: MODE?

The 8200 will respond to this query command with a coded integer byte:

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?

8200 response: 0 (This indicates that the 8200 is in program mode.)

MRMP

Command name: Manual ramp

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 8200 (such as °C, °F, torr, %RH, etc.).

Syntax: MRMPn? or MRMPn,data

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

Data type: Integer

Query example: MRMP2?

8200 response: 30 (This indicates the manual ramp for channel 2 is 30 units per minute.)

Operation example: MRMP1,12

8200 response: This 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 8200 for the programmed number of loops assigned to the current loop. For nested looping, the value is for the inside loop. The 8200 sends an integer indicating the number of loops assigned to the current loop.

Syntax: NUML?

Data type: Integer

Query example: NUML?

8200 response: 15

NXTI

Command name: Next interval

Command type: Program status

Description: Queries the 8200 for the next interval that will be executed. The 8200 sends an integer indicating the next interval number.

Syntax: NXTI?

Data type: Integer

Query example: NXTI?

8200 response: 5

OPTN

Command name: Controller options

Command type: Variable

Description: The query command reads the options register of the 8200. If the 8200 is in manual mode, the operation command temporarily changes the 8200 options register to the new set of options. **NOTE**: If the selected options are not available on your chamber, the 8200 will return an error code.

Syntax: OPTN? or OPTN[,]ddd

Where **ddd** is a coded integer where each option has the following weight:

1	Product temperature control
2	Humidity system
4	Low humidity system
8	GSoak
16	Purge
32	Cascade refrigeration (SE-Series chambers only)
64	Power save mode (SE-Series only)
128	Single-stage refrigeration (SE-Series only)
256	Rapid cycle operation (AST modules only)
512	Rapid cycle operation (AST modules only)

The code provides a value between 0 and 1023 that is the sum of the values of all the enabled options. For example, a 49 indicates that the cascade refrigeration system, purge, and product temperature control options are enabled.

Data type: Coded integer; see Syntax

Query example: OPTN?

8200 response: 130 (This indicates that the single-stage refrigeration and humidity options are enabled.)

Operation example: OPTN50

8200 response: 0 (This command sets the 8200 manual mode options to enable humidity, purge, and cascade refrigeration.)

PALH

Command name: High process alarm limit

Command type: Program status

Description: Queries the 8200 for a channel's high process alarm limit. The 8200 sends an integer indicating the alarm limit.

Syntax: PALHn?

Where **n** is a channel number.

Data type: Integer

Query example: PALHn?

8200 response: 100

PALL

Command name: Low process alarm limit

Command type: Program status

Description: Queries the 8200 for a channel's low process alarm limit. The 8200 sends an integer indicating the alarm limit.

Syntax: PALLn?

Where **n** is a channel number.

Data type: Integer

Query example: PALLn?

8200 response: -40

PARM

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

Command name: Parameter values command

Command type: Variable

Description: The query command causes the 8200 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 8200 loads the parameter values into the parameter group registers in any mode.

Query syntax: PARMc, g?

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

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

Where:

c = control channel number (1-4)

g = parameter group number (1-4)

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 (1-4)

g = Parameter group number (1-4)

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?

8200 response: 35.0,35.0,200,200,100.0,-100.0 (These values are the parameter settings for channel 2 in parameter group 3.)

Operation example: To set the channel 1 parameter group 1 cool proportional band to 35.7, send: PARM1,1,,35.7.

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: PARM4,1,0.8,,,128,,12.

PMEM (legacy support)

Command name: Send available program memory

Command type: System status

Description: Queries the 8200 for the available amount of program memory. This command is for legacy support only. The 8200 has a virtually unlimited amount of program storage. The 8200 will always send 300.

Syntax: PMEM?

Data type: Integer

Query example: PMEM?

8200 response: 300

PNAM

Command name: Send program name

Command type: Program status

Description: Queries the 8200 for the name of the currently loaded program. The 8200 responds with the program's assigned name (a string up to 15 characters long). If there is no currently loaded program name available, the 8200 will respond with "Untitled".

Syntax: PNAM?

Data type: String

Query example: PNAM?

8200 response: STRESS SCREEN40

PRGN (legacy support)

Command name: Current program number

Command type: System status

Description: Queries the 8200 for the number of the currently loaded program; 0 indicates none.

Syntax: PRGN?

Data type: Integer

Query example: PRGN?

8200 response: 7 (This indicates that the current program is loaded into program slot 7.)

PRMG

Command name: Parameter group

Command type: Variable; edit from hold

Description: Queries the 8200 for the number of the parameter group that it is currently using. If the 8200 is in manual mode, the operation command selects the parameters group (1 to 4) that the 8200 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 parameters group number (1 to 4).

Data type: Integer; see Syntax

Query example: PRMG?

8200 response: 2 (This indicates that the 8200 is currently using parameters group 2.)

Operation example: PRMG3

8200 response: 0 (In manual mode, the 8200 will use parameters group 3.

PROG

Command name: Program by value command

Command type: Programming

Description: This command sets up the 8200 or host computer to load an entire program into the 8200's program memory. The query command receives the data string from the 8200, while the operation command sends the data string to the 8200. 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 PROGn? 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?

8200 response: temp_test,6 (This indicates that the program "temp_test" is 6 intervals long.)

Operation example: PROG,HI HUMIDITY,25

8200 response: 0 (The 8200 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 8200 for the total estimated time for the current program.

Syntax: PTIM?

Data type: String

Query example: PTIM?

8200 response: 48:30:10 (This indicates that 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 8200 for the estimated time left in the current program.

Syntax: PTLF?

Data type: String

Query example: PTLF?

8200 response: 12:54:30 (This indicates that there is 12 hours, 54 minutes, and 30 seconds left in the current program)

PVAR

Command name: Send process variable

Command type: Variable

Description: Queries the 8200 for the current value of the selected channel. The channel selections for the PVAR command 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

Syntax: PVARn?

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

Data type: Decimal

Query example: PVAR1?

8200 response: -42.3

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 8200 defaults to system 1. The 8200 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, 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 indicates the 8200 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 variable are one decimal place real numbers, and the final variable is an integer.)

Query example: REFG?

8200 response: 25,220,25,249,-23.2,87.5,-23.6,113.4,6. (This string gives the refrigeration system's pressures and temperatures, and indicates that it is in cascade and temperature cooling modes.)

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

8200 response: This command returns the processor to run mode.

RLTM

Command name: Read or load real time clock

Command type: System status

Description: The query command tells the 8200 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?

8200 response: 3/11 14:32:45 (This indicates that the date is March 11 and the time is 2:32 p.m.)

Operation example: RLTM3,11,14,32

8200 response: This command loads the date and time of March 11, 2:32 p.m. into the 8200.

RUNM

Command name: Run manual mode

Command type: Control

Description: Places a stopped 8200 in run manual mode.

Syntax: RUNM

Data type: No data

Query example: RUNM

8200 response: Places a stopped 8200 in run manual mode.

RUNP

Command name: Run program mode

Command type: Control

Description: Places a stopped 8200 in run program mode, and specifies the program and starting interval.

Syntax: RUNPp,i[,S]

Where:

p = program name (**NOTE**: The program must be in the root directory of the 8200's hard drive.)

i = interval number

S = single-step mode 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

8200 response: 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 8200 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 8200 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?

8200 response: 3 (Indicates that the currently loaded test has ended.)

SCRR

Command name: Screen reset

Command type: Control

Description: Forces the 8200 to go to the main screen.

Syntax: SCRR

Data type: No data

Operation example: SCRR

8200 response: Switches the 8200's current screen to the main screen.

SERL

Command name: Serial number

Command type: System status

Description: This query command asks the 8200 for the chamber's serial number.

Syntax: SERL?

Data type: Integer

Query example: SERL?

8200 response: 342679

SETP

Command name: Setpoint

Command type: Variable

Description: The query command asks the 8200 for the current setpoint reading from channel "n". The 8200 sends the setpoint value in the channel's selected units. In manual mode, the operation command loads a new setpoint into the 8200 for the current operation.

Syntax: SETPn? or SETPn,data

Where **n** is any process variable channel (1 to 8) and **data** is the setpoint.

Data type: Decimal

Query example: SETP1?

8200 response: -33.0

Operation example: SETP2,95

8200 response: If the 8200 is in manual mode, a setpoint of 95 units is loaded into channel 2.

SRQB

Command name: Service request status

Command type: System status

Description: The 8200 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?

8200 response: 65 (Binary value 1000001, which indicates RSV + state change.)

SRQM

Command name: Send or load the 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 SRQB. **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?

8200 response: 4 (The end of interval service request bit has been enabled.)

Operation example: SRQM1

8200 response: 0 (The 8200 loads the SRQ mask with the value 1, enabling the state change SRQ event.)

STAT

Command name: Send status word

Command type: System status

Description: The 8200 returns one byte of coded-decimal data to indicate the status of the 8200. 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?

8200 response: 16 (This indicates that the 8200 is in run manual mode.)

STOP

Command name: Stop controller

Command type: Control

Description: Places the 8200 in stop mode.

Syntax: STOP

Data type: No data

Query example: STOP

8200 response: The 8200 goes into stop mode.

TALF

Command name: Send the Therm Alarm flags byte

Command type: 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 – 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?

8200 response: 17 (high alarm and mute)

TALM

Command name: Send or load the Therm-Alarm (T/A) settings

Command type: Setup

Description: The query command allows you to retrieve the Therm-Alarm settings. The 8200 sends the following in response to a TALM? command:

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

where:

temp	T/A temperature
low	T/A low limit
high	T/A high limit
maxex	T/A maximum excursion
mute	T/A mute time
warn	T/A warning band
delay	T/A alarm delay time
reset	T/A reset status: auto (0) or manual (1)
state	T/A operating state (internal use only)
flags	T/A warning/trip flags (internal use only)

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

TALMlow, high, mute, warn, delay, reset.

where:

low	T/A low limit (see chamber documentation for valid ranges)
high	T/A high limit (see chamber documentation for valid ranges)
mute	T/A mute time (0-99 minutes)
warn	T/A warning band (0-15 degrees C)
delay	T/A alarm delay time (0-30 seconds)
reset	T/A reset status (0 = auto reset, 1 = manual reset)

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!

Syntax: TALM? or TALMlow, high, maxex, mute, warn, delay, reset

Data type: Decimal

Query example: TALM?

8200 response: 27, -87, 191, 210, 2, 10, 10, 0, 0, 0

Operation example: TALM, -50, 150, 0, 5, 20, 3, 1

8200 response: 0 (The 8200 loads the Therm-Alarm with the specified settings.)

THAA

Command name: Therm-Alarm analog input value

Command type: Variable

Description: The query command asks the 8200 for the current Therm-Alarm "n" analog input value. The 8200 sends the value as an integer.

Syntax: THAAn

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

Data type: Integer

Query example: THAA1?

8200 response: 65

THAT

Command name: Therm-Alarm temperature

Command type: Variable

Description: The query command asks the 8200 for the current Therm-Alarm "n" temperature reading. The 8200 sends the temperature value as an integer.

Syntax: THATn

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

Data type: Integer

Query example: THAT1?

8200 response: 65

THTL

Command name: Throttle

Command type: Variable

Description: The query command asks the 8200 for the current channel "n" throttle reading. The 8200 sends the throttle value as a percentage.

Syntax: THTLn

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

Data type: Integer (-100 to +100)

Query example: THTL1?

8200 response: -56

NOTE: Do not use the THTL command as an operation command. Using the THTL as an operation command overwrites 8200 internal control functions.

TLFT

Command name: Time left

Command type: Program status; edit from hold

Description: Queries the 8200 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?

8200 response: 1:17:57 (This indicates there is 1 hour, 17 minutes, and 57 seconds left in the current interval.)

Operation example: TLFT::85

8200 response: This command sets the time left in the current interval to 1 minute and 25 seconds.

TMPS

Command name: Temperature scale

Command type: Variable

Description: Allows you to read or change the temperature scale used on the 8200 display. **NOTE**: This command does not affect the 8200 interface commands.

Syntax: TMPS?

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

Query example: TMPS?

8200 response: 0

Operation example: TMPS1

8200 response: The 8200 sets the temperature scale to Fahrenheit.

VRSN

Command name: Send software version

Command type: System status

Description: Queries the 8200 for the version number of the display software.

Syntax: VRSN?

Data type: String

The 8200 returns a string in the "Vx.yy dd/mm/yyyy" format to identify its software version.

Query example: VRSN?

8200 response: V1.18 04/02/2005

WDOG

Command name: Watchdog

Command type: Control

Description: This command provides an extra level of protection for customers operating their chambers entirely through computer I/O. 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 between 0 and 60. A positive value sets the watchdog timer value. A zero value turns off the watchdog feature. Once the watchdog is set the 8200 internally begins counting down. If the internal watchdog timer ever reaches 0 the 8200 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 60.

Data type: No data

Operation example: WDOG30

8200 response: Resets the internal watchdog timer to 30 seconds.

Using the interface command set

The following section describes how to operate the 8200 programmer/controller from a host computer using the interface command set.

Using the manual mode variable and control commands

The 8200 can be operated in manual mode from a host computer using the following interface set commands:

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

Example:

1. Send the STOP command to the 8200. While in stop mode, send the following commands to set up the test run:

   SETP1,75 Makes the channel 1 setpoint +75°C.

   SETP2,5 Makes the channel 2 setpoint 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 8200 in run manual mode. The manual mode screen will now display the selected parameters as the 8200 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 8200 status.

4. At the end of the test, send the STOP command to place the 8200 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	Auxiliary enable	**LLFT**	Loops left
DEVN	Deviation	**PRMG**	Parameter group
FVAL	Final value	**TLFT**	Time left

Example:

1. Send the HOLD command to the 8200. 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 8200 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 8200 and a host computer. The operation commands allow you to send a program to the 8200. The query commands allow you to retrieve a program from the 8200. The following paragraphs describe each type of transfer and provide a program transfer example.

Sample program: 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 program, named **LongSoak25Loops** can be described as follows:

1	Ramps to 20°C in 2 hours, turns on auxiliary relays 1-2, 1-4, 1-7, 1-8, 2-2, 2-4, and 2-7, and uses parameter group 1. The display status enables channel 1, looping, auxiliaries, and deviations displays. The cascade refrigeration and purge options are enabled.
2	Steps to +30°C, waits until the temperature is within ±2° C of the setpoint, turns auxiliary relays 2-2, 2-4, and 2-7 off, and use parameters group 2.
3	Soaks at +30°C for 2 hours, the deviation alarm is set off if the temperature deviates more than ±3°C from the setpoint, turns off all auxiliary relays, and uses parameter group 1.
4	Ramps to +65°C in 1 hour and 10 minutes, turns on auxiliary relays 1-1, 1-3, 1-6, 2-1, and 2-2, and uses parameter group 1.
5	Soaks at +65°C for 8 hours, the deviation alarm is set off if the temperature deviates more than ±3°C from the setpoint, and uses parameter group 1.
6	Steps to +30°C and waits until the temperature is within ±2°C of the setpoint, turns all the auxiliary relays off, loops back to interval 3, repeats intervals 3 through 6 twenty-four times, and uses parameter group 2.

NOTE: This sample program is a simple temperature-only program and uses the same display status and options for all intervals. A more complex program 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 a program into the 8200

Operation commands can be used to load the sample program, LongSoak25Loops, into the 8200. See "Using the Programming Commands" above for descriptions of the intervals.

1. Send the PROG,LongSoak25Loops,6 command string to the 8200. This string loads a 6-interval program named LongSoak25Loops.
2. Send the INTV0,20,,,,1 command string to the 8200. 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 8200 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 a program from the 8200

Query commands can be used to retrieve the sample program, LongSoak25Loops, from the 8200.

1. Send the PROG4? command string to the 8200.

   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 8200.
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 8200 computer interface errors codes.

Common computer interface problems and solutions

Before attempting to run the 8200 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 8200 command syntax.

The 8200 and host computer are not able to communicate using RS-232

If the 8200 and the host computer are not able to send and receive interface commands:

1. Press **Setup**, then select the **Computer IO** panel. Check the RS-232 settings. Typically **Send Acknowledgement** should not be checked 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 8200 and host computer are not able to communicate using RS-485

If the 8200 and the host computer are not able to send and receive interface commands:

1. Check the cabling.
2. Press **Setup**, then select the **Computer IO** 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 ThermoTrakII software and cabling.

The 8200 and host computer are not able to communicate using GPIB

If the 8200 and the host computer are not able to send and receive interface commands:

1. Check the cabling
2. Press **Setup**, then select the **Computer IO** 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 8200 accepts interface commands without returning the required data, check the computer interface terminator and/or the handshake signals.

- **Terminator problem**: When the 8200 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 8200 and the computer agree on the selected termination.
- **Handshake problem**: The 8200 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 8200 to send the last error code after receiving each operation command.

The host computer receives wrong or garbled data from the 8200

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 8200. 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 8200 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 8200 error codes to help troubleshoot these types of problems. Use the IERR? command to read the error codes.
- 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 8200 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 **Computer IO** panel on the 8200 (**Baud Rate**, **Parity**, **Word Length**, **Stop Bits**, etc.). The 8200 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 8200, recheck the value and reload as required.

Error code 02

Command name: Input buffer overflow

Description: The data string sent to the 8200 is too long. The 8200 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 8200 output buffer each time it requests data.

Error code 04

Command name: Unidentified command

Description: The 8200 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 8200 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 8200 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 8200 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 8200 was not an acceptable channel value. Check the 8200 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 8200 in an unrecognizable form. For the proper command syntax see "Interface Command Descriptions" earlier in this section.

Error code 10

The 8200 programmer/controller does not use this error code.

Error code 11

Command name: Illegal interval number sequence

Description: The value sent to the 8200 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 8200's memory; delete any unused programs and reload the program.

Error code 13

Command name: Illegal stop command

Description: The 8200 must be in run or hold mode to execute a STOP command.

Error code 14

Command name: Illegal hold command

Description: The 8200 must be in run mode to execute the HOLD command.

Error code 15

Command name: Illegal run manual command

Description: The 8200 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 8200 must be in hold manual or hold program mode to execute the RESM command.

Error code 19

Command name: Options not configured

Description: The 8200 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 8200 programmer/controller does not use this error code.

Error code 21

Command name: Control module not present

Description: The 8200 returns this error code if a query or operation command attempts to access a control module that is not present and/or that the 8200 is not configured for.

Programming examples

Programs can be written to operate the 8200 programmer/controller 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 8200 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 Read8200 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 Read8200 routine checks for the presence of the carriage return in the string returned by the ibrd function.

```
read8200 (text1.text & chr$(13))

private sub read8200(cmd$) 'send commands to 8200, 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 = write8200(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 8200 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.

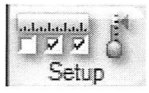
Section 5: CM2 Calibration

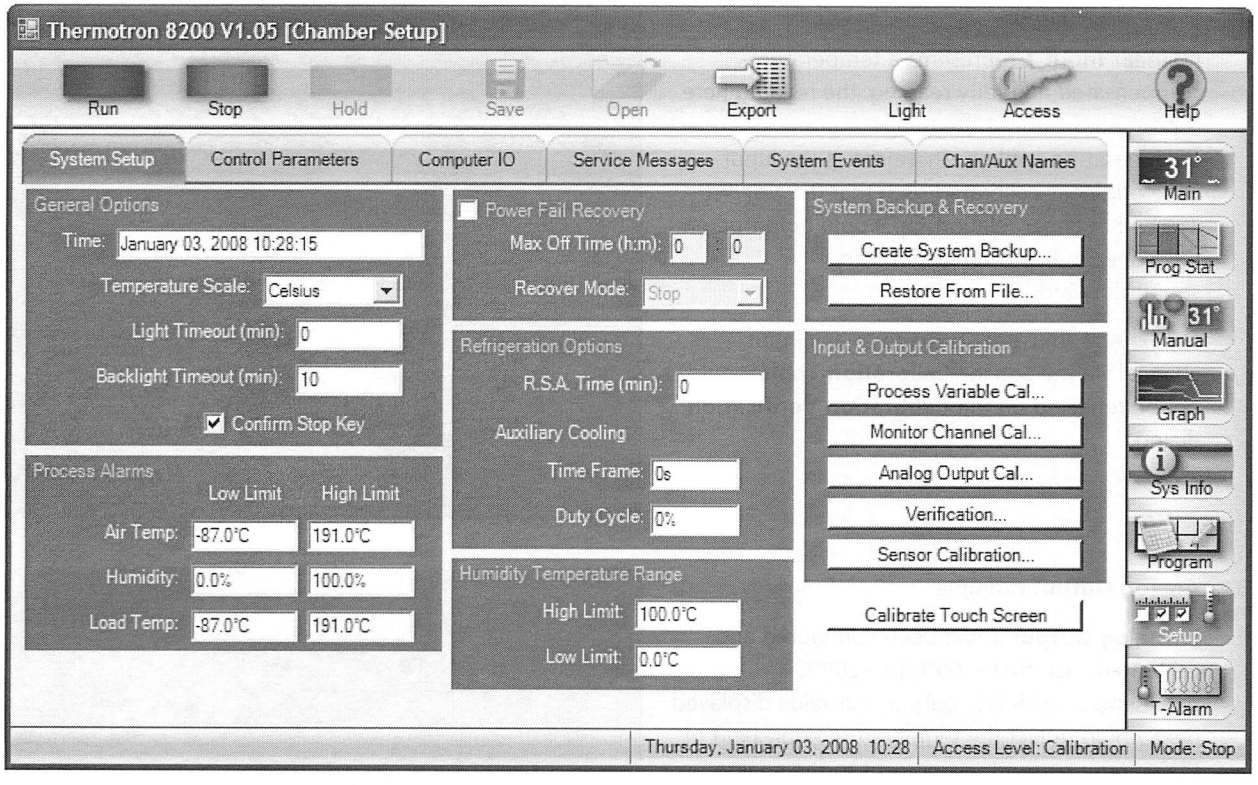
This section describes how to calibrate a CM2 control module's analog inputs and analog outputs.

CAUTION: This section is not a substitute for adequate technical training. Improper calibration could damage your chamber, programmer/ controller, refrigeration system, or products under test.

Calibration functions

Press **Setup** and select the **System Setup** tab to access the **Input & Output Calibration** buttons, These buttons provide access to the calibration functions for process variables (control channels), monitor channels, and analog outputs.





- **Process variable** 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 schematics show 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 schematics show 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.

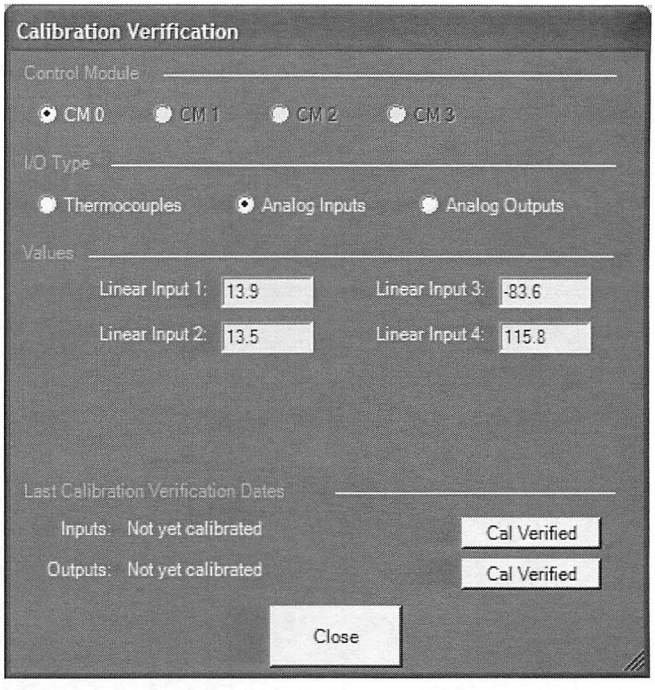
Verifying analog input and analog outputs

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 **Calibration Verification** dialog.

1. Press **Setup**, select the **System Setup** tab, then press the **Verification** button.
2. **Analog Input** example (to make verification easier, the data shown on this panel has not been altered in any way):

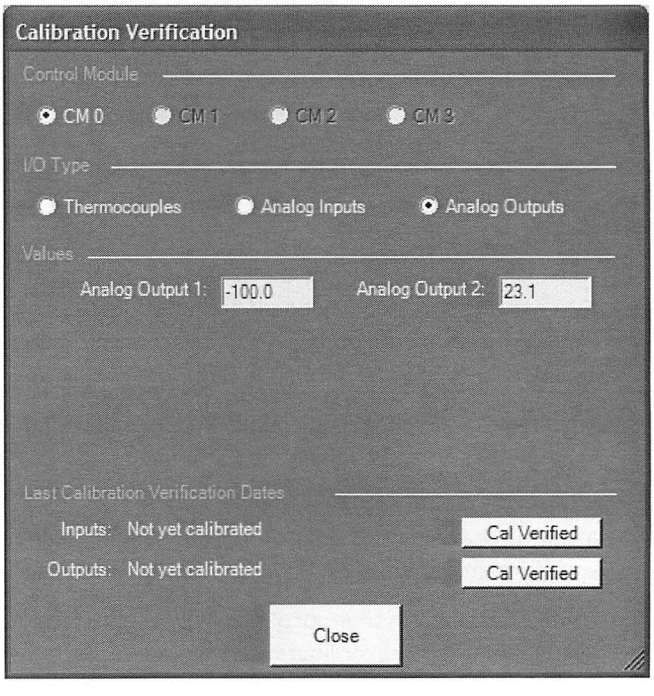
   If **Linear Input 1** represents a temperature-compensated humidity reading, the reading here is presented without the temperature compensation applied. Therefore, if the input were originally calibrated such that 0-5 Vdc = 0-100%, that linear relationship would hold true on this panel, making verification very straightforward.

   NOTE: Any adjustments made to any input channel via the **Sensor Calibration Table** would not be reflected on the **Calibration Verification** dialog.



3. **Analog Output** example:

   If **Analog 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 **Analog Output 1** were reading 50.0°C on the **Calibration Verification** dialog (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. **Last Calibration Verification Dates** can be set by pressing the appropriate **Cal Verified** button. Once input or output verification has been verified, this button can be pressed to record the current date and time. The **Last Calibration Verification** date and time also is recorded whenever a successful calibration is performed.

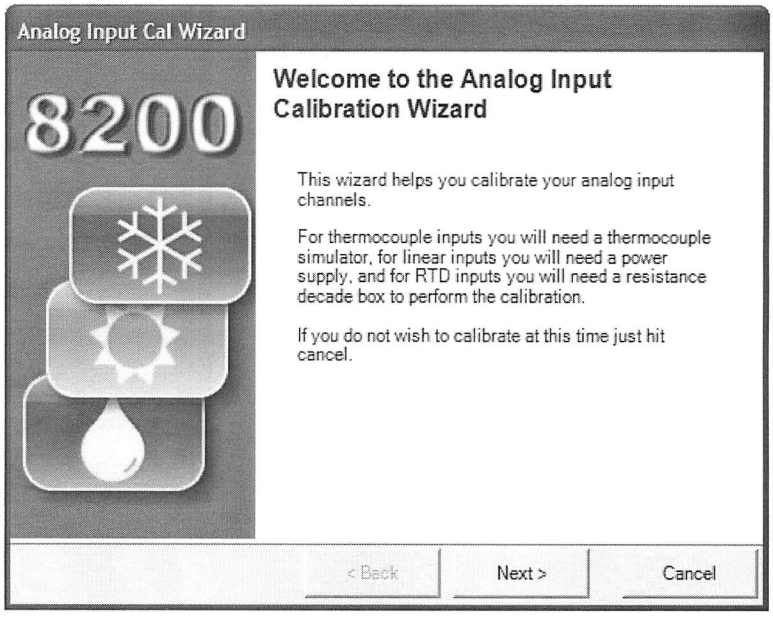


Calibrating analog input and analog output channels

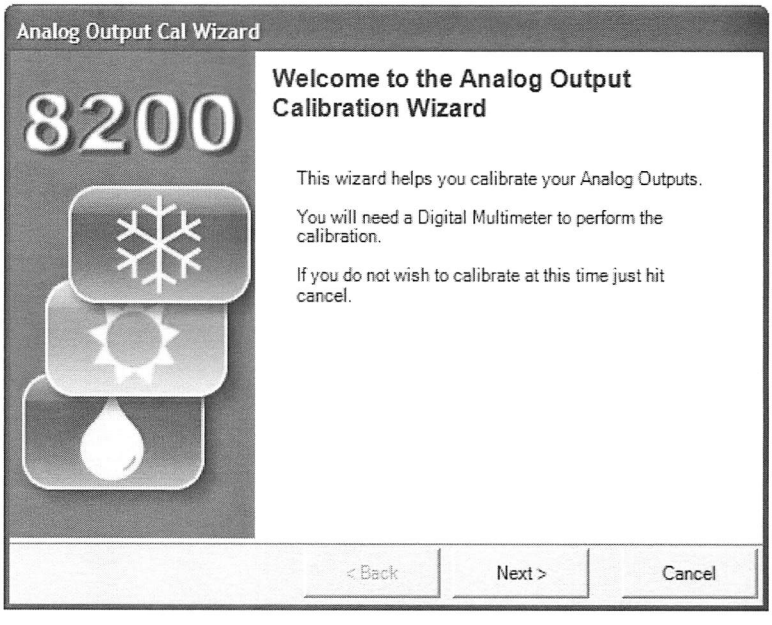
NOTE: The CM2 analog inputs were calibrated by Thermotron for accurate performance. Make sure the instruments used during calibration are properly calibrated themselves, and make sure the display module's temperature scale is set to Celsius before beginning any calibration procedure.

1. Press **Setup**, then select the **System Setup** tab.
2. To calibrate process variable channels, press the **Process Variable Cal** button. To calibrate monitor channels, press the **Monitor Channel Cal** button. 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.
3. Follow the on-screen instructions, pressing **Next** when you are ready.



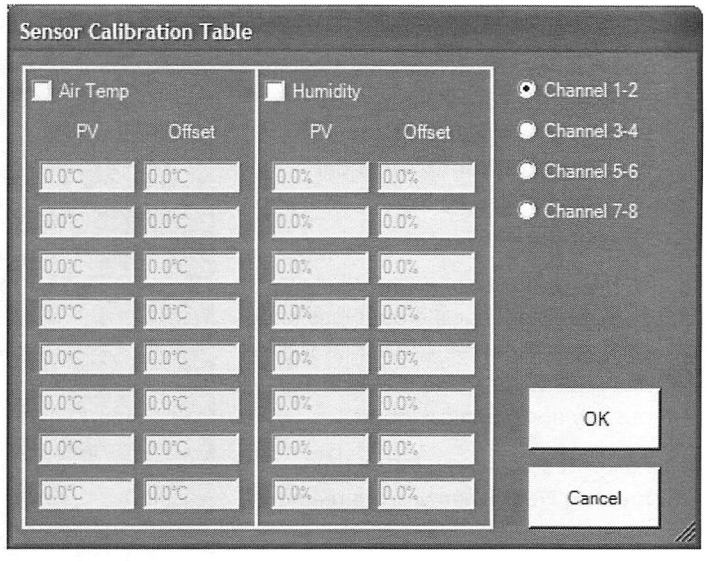
4. To calibrate analog outputs, press the **Analog Output Cal** button The **Analog Output Calibration Wizard** will start.
5. Follow the on-screen instructions, pressing **Next** when you are ready.



Adjusting process variable channels

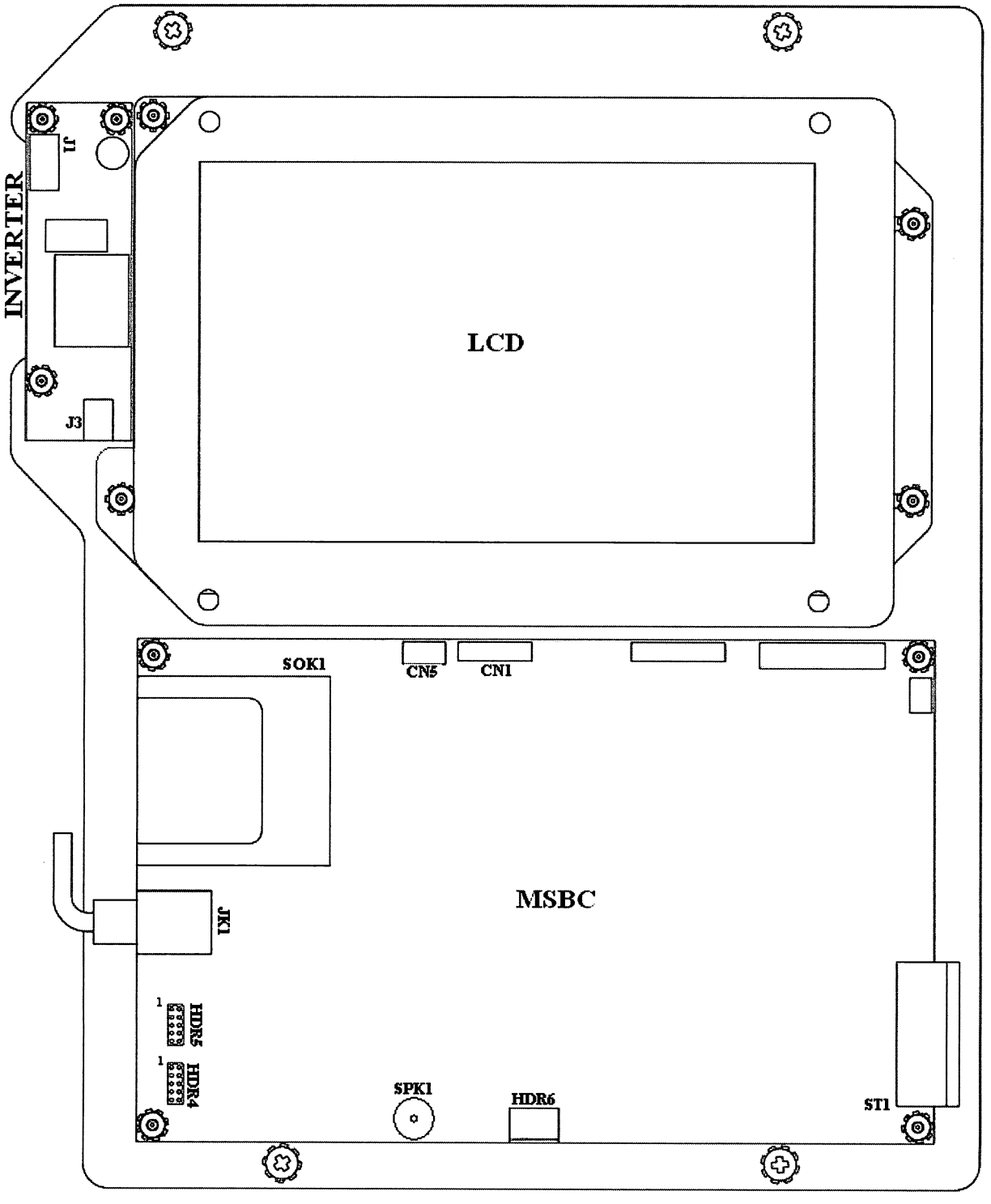
Calibrated process variable channels can be further adjusted to match independent sensors. The adjustment can be a simple offset shift, or up to eight different data breakpoints and offsets throughout the entire range of the channel input.

1. Press **Setup**, select the **System Setup** tab, then press the **Sensor Calibration** button.
2. Select the desired process variable **Channel** pair. **NOTE**: Process variable channels 5 through 8 are factory-set internal control channels.
3. To adjust a channel's input, select the channel's check box.
4. Enter the appropriate adjustment values into the **PV** and **Offset** fields.



Section 6: Technical Information and Troubleshooting

Interconnect diagram



Interconnect description

<table>
<tr><td>CN1</td><td>This connector provides the signals required to drive the video on the LCD. A 30-condutor flex cable is required to make the connection.</td></tr>
<tr><td>CN5</td><td>This is the touch screen connector for the miniature single-board computer (MSBC). The LCD comes with a four-wire resistive touch screen mounted to its surface. The touch screen cabling is molded into the touch screen itself and cannot be replaced apart from the LCD assembly.</td></tr>
<tr><td>HDR4</td><td>This header provides the interface for USB support on the 8200. There are two ports available on HDR4. The header has 10 pins with a two-millimeter pitch in a two-row-by-five-pin configuration. A cable assembly has been designed to convert from the pin header to a female Type-A USB connector. CAUTION: It is possible to plug this cable assembly into the MSBC backwards, which can damage USB devices. Pin 1 on the cable is marked with a white dot on the header and a red conductor. Pin 1 should always be on the top side of the header as shown in the diagram.</td></tr>
<tr><td>HDR5</td><td>Neither this connector nor the supporting circuitry are currently populated.</td></tr>
<tr><td>HDR6</td><td>This connector provides the drive signals required to power and control the backlight inverter PCB (labeled "INVERTER" in the diagram). The MSBC provides five volts to the inverter, which is then boosted up to the several-hundred-volt ac signal required to power the CCFL backlight.</td></tr>
<tr><td>J1</td><td>This connector is located on the inverter PCB assembly, and is the connection for the inverter power cable. See the HDR6 description above for more details.</td></tr>
<tr><td>J3</td><td>This connector provides the high-voltage ac signals required to power the CCFL backlight on the inverter. The LCD has a short, two-wire cable on its left-hand side that should be connected to this connector.</td></tr>
<tr><td>JK1</td><td>This is a standard RJ45 Ethernet connector. Any standard Ethernet cable may be used with the 8200, but a Cat 5 cable is recommended for full 100 MBps operation.</td></tr>
<tr><td>SOK1</td><td>This connector is a standard socket compatible with most compact flash cards. The 8200 comes preloaded with a 2 GB flash card. The flash card must be formatted as FAT32 in order to be compatible with Windows CE.</td></tr>
<tr><td>SPK1</td><td>SPK1 is the audible alarm for the 8200 system. The speaker will sound during certain alarm conditions, such as a Therm-Alarm trip. SPK1 is populated with a piezo audio indicator that emits a 4-kHz tone with a sound pressure (volume) of at least 70 dB when activated.</td></tr>
<tr><td>ST1</td><td>This is the interface between the 8200 and a standard control module (CM2). Power is supplied to the 8200 through this cable, and the pin-out for this cable is shown below. The 8200 requires a voltage input of 18 to 28 Vdc, and requires about 12 watts (typical) to operate. Pins 2-3 in the connector are used for computer I/O through the CM2. Pins 7 and 8 are used for communication with Thermotron's instrumentation line (CM2's, Therm-Alarms, etc).
<table>
<tr><th>Pin number</th><th>Description</th><th>Pin number</th><th>Description</th></tr>
<tr><td>1</td><td>Ground</td><td>6</td><td>Ground</td></tr>
<tr><td>2</td><td>Voltage input</td><td>7</td><td>T-Bus A</td></tr>
<tr><td>3</td><td>Display transmit</td><td>8</td><td>T-Bus B</td></tr>
<tr><td>4</td><td>Display multi-drop enable</td><td>9</td><td>Voltage input</td></tr>
<tr><td>5</td><td>Display receive</td><td>10</td><td>Ground</td></tr>
</table>
</td></tr>
</table>

Troubleshooting procedures

Symptom 1: The touch screen display appears blank

1. Touch the screen to see if the display comes on.
2. Make sure power is applied to the chamber and MSBC unit.
3. Replace the display module.

Symptom 2: The touch screen does not work, works randomly, or produces incorrect results

1. Calibrate the 8200 touch screen monitor:
   a. To start the calibration procedure from any screen, hold the stylus against the touch screen for 10 seconds.
   b. Follow the on-screen instructions.
2. Replace the 8200 display module.

Replacing the 8200 display module

1. Remove the bezel.
2. Remove the display, USB, and Ethernet cables.
3. Remove the mounting hardware.
4. Install the new display assembly.
5. Reconnect the display, USB, and Ethernet cables.
6. Install the bezel.

Appendix A: Glossary

+/- deviation: How far you will allow the temperature, humidity, or other process variable to be from setpoint. If the value is exceeded, the deviation alarm is activated.

access level: A function that allows you to select from six levels of access to the 8200 functions.

alarm band: The maximum area around the current setpoint that the process variable (actual test space or product condition) can deviate from. If the process variable drifts outside the alarm band, the 8200 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 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 8200.

auxiliary output: A programmable signal generated by the 8200 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.

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 8200 screens. Channel names may be customized to reflect the variable they are controlling or monitoring.

command: A code sent to the 8200 by a host computer that the 8200 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 8200, the delimiter is a semicolon.) The computer then transmits the commands together.

conditioning system signals: Signals used by a controller to operate chamber systems such as heating, cooling, and humidity. These signals are dedicated to the system and are internally programmed.

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 8200 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 8200 display module 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 setpoint. As the chamber nears setpoint, the 8200 adjusts the chamber throttles to provide a smooth ramp to setpoint. To prevent overshooting and oscillation around the final setpoint, the refrigeration, heating, and other systems must be damped as they approach the setpoint. To maximize chamber performance, lag times must also be compensated for. Up to four groups of chamber parameters can be entered into the 8200 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 (or group of devices) that monitors the environmental conditions in the chamber's test space for the 8200.

controlled ramp: The process of changing the test space temperature, humidity, or other variable from an initial setpoint to a higher or lower setpoint at a linear rate.

cooling ramp: The process of decreasing the test space temperature from an initial setpoint to a lower temperature setpoint at a linear rate.

csv files: Comma-separated-variable files; the file format that the 8200 uses.

cycle: A set of intervals repeated during a programmed test.

delayed start: A function that causes the 8200 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 setpoint (assigned test space or product condition).

deviation alarm: An 8200 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 process variable can be from setpoint. 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 setpoint.

discharge pressure (head pressure): The pounds per square inch of refrigerant present at the outlet of the compressor.

display module: The 8200 display module is composed of a miniature single-board computer (MSBC), liquid crystal display (LCD), and inverter PCB assembly.

droop: An effect that prevents a process variable from reaching the final setpoint. For example, natural heat loss through the chamber walls can prevent the test space temperature from reaching the final setpoint.

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.

embedded 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.

error code: A two-character byte sent by the 8200 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 8200 function that plots changes in process variables (such as temperature or humidity), setpoints, and other data.

g-soak (guaranteed soak): A g-soak interval will immediately set the setpoint 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 going from one setpoint to a higher setpoint.

heating ramp: The process of increasing the test space temperature from an initial setpoint to a higher temperature setpoint at a linear rate.

high alarm limit: The upper temperature limit which, if exceeded, will cause a Therm-Alarm trip.

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 8200.

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 products 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 setpoint. The integral time parameter adjusts the throttle to take the droop out of the proportional band settings and allow the chamber to reach setpoint.

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 8200 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.

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 8200 display module. To return to the main screen press **Main**.

manual mode: A function that allows you to operate the 8200 controller functions. Manual mode operates the chamber using setpoint 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 8200 for monitoring processes within the chamber. If the high or low limit is exceeded for any channel, the 8200 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 may exceed the final temperature setpoint during product temperature control operation.

operation command: A code sent to the 8200 that causes the 8200 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 8200 operations.

overshoot: A test condition where the process variable runs past final setpoint.

parameter group: One of four selectable sets of control parameters used by the 8200 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 8200 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 8200 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.

power fail recover mode; power fail recover time: A function that allows you to set up how the 8200 will recover after a power failure. If the power fails for longer than the selected power fail recover time, the 8200 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 8200 will recover by returning to its last mode of operation.

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 8200 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 8200 enters stop mode.

process variable: The actual sensed condition within the test space, such as temperature or humidity, that is controlled by the 8200.

process variable channels: See control channels.

product: The device or equipment the chamber tests.

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 setpoint in the specified time. However, the product temperature will approach final setpoint 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 setpoint to make up for the temperature lag. When PTC is disabled, channel 1 operates the chamber's control systems.

program: A set of parameters divided into time intervals that are used to control the 8200 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 setpoint, it enters the proportional band. Once inside the proportional band, the throttle is backed off in proportion to the difference between the setpoint 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 going from one setpoint to a lower setpoint.

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 8200 that causes the 8200 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 8200'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 setpoint. If the number of units is zero, the controller performs a step change.

real time clock: An 8200 function that keeps track of the time and date. These are used for reference, delayed start, and the time stamp for the graph function.

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.

R.S.A. time: Refrigeration system anticipator time; a performance parameter that allows you to set the number of minutes the 8200 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 8200 function that maintains a running count of the number of hours refrigeration systems or control channels operate.

service interval: The frequency of scheduled maintenance.

setpoint: An assigned value for a test space condition. There are three types of setpoint:

- *Initial setpoint:* The value that the chamber is at in the beginning of an interval.
- *Final setpoint:* The final value the chamber is to reach within an interval.
- *Current setpoint:* One of the intermediate setpoints the 8200 sets when ramping from the initial setpoint to the final setpoint.

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 8200 whose bits are set or cleared to indicate the operating conditions of the 8200.

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 program: 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 8200 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: See embedded Therm-Alarm.

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 setpoint. 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 8200 will operate the throttle at +100%. When the process variable (temperature) reaches the proportional band, the 8200 will begin reducing the throttle to control the process variable to equal the setpoint.

throttle limit: A parameter setting that can limit the 8200 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 program, a timed soak period results when the initial and final setpoints 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.

Appendix B: Tuning Control Parameters

CAUTION: **The 8200 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.**

NOTE: To tune control parameters, the 8200 access level must be Lab Manager or higher.

NOTE: Tuning the 8200 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 setpoint for the control channel's process variable. As the process variable nears the setpoint, it enters the proportional band. Once inside the proportional band, the throttle is backed off in proportion to the difference between the setpoint 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 setpoint.
- If the proportional band is too small it can result in overshoot or oscillation around the setpoint.
- 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 setpoint.

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 setpoint 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 setpoint.

Droop is an effect, such as natural heat loss through the test space walls, that prevents the process variable from reaching the final setpoint. 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 setpoint. **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 setpoint.
- Shorter integral times result in shorter times to reach the setpoint.
- If the integral time is too short, the process variable will oscillate indefinitely when it reaches the setpoint.
- 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 setpoint, 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 setpoint slightly and then oscillates around the setpoint slightly until it stabilizes at the setpoint. 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

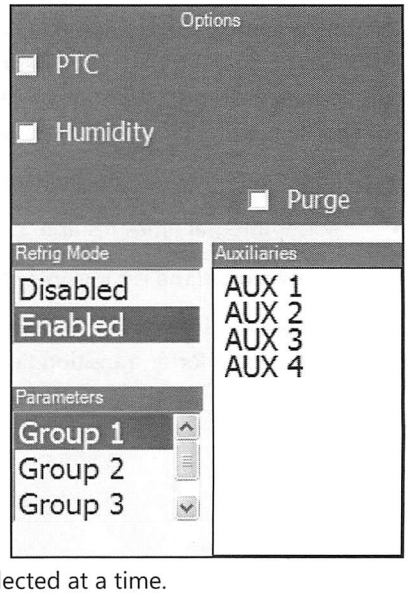
Record the original parameter settings

1. Press **Setup**, then select the **Control Parameters** panel.
2. If needed, select the parameters 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 (**PBand**) 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.
   b. Enter a **New Setpoint** based on which parameters you are tuning, such as a heating setpoint for tuning the heating parameters.

      NOTE: When tuning parameters, the heating parameters are usually tuned before the cooling parameters. Normally you should select the setpoint based on the tests you are running.
   c. Set the **Ramp Rate** to 0.
   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 **Parameters** 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 setpoint and then stabilizes for 10 to 15 minutes.
8. If the current parameter settings are correct, the process variable will overshoot the setpoint slightly and then oscillate around the setpoint slightly until it stabilizes at the setpoint.
   - If the process variable oscillates near the setpoint, the proportional band is too small.
   - If the process variable takes too long to reach the setpoint, the proportional band is too large.
   - If the process variable undershoots the setpoint slightly until it finally reaches the setpoint (if it ever does), the integral time is too large.
   - If the process variable overshoots the setpoint, the integral time is too small.

Adjust the proportional band setting

9. To adjust the proportional band:
   a. Change the setpoint to back the process variable away from the setpoint 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 setpoint (for example, within ±2°C or ±2% RH). As it stabilizes, it oscillates in decreasing amounts until it droops just above or below the setpoint. (**NOTE**: The integral time function will adjust the setpoint up or down to compensate for this droop.)
    - If the process variable continues oscillating, you will need to increase the proportional band setting just until the oscillation stops.
    - If the process variable is not oscillating, you will need to decrease the proportional band setting just until oscillation begins, then increase the setting until the oscillation stops.
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 setpoint to back the process variable away from the setpoint you used to tune the parameter.
    b. Press **Setup** to return to the **Control Parameters** panel.
    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 setpoint.
    - If the process variable oscillates around the setpoint, you should increase the integral time.
    - If the process variable takes too long to achieve the setpoint, you should 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 8200 worksheets in Appendix D. Keep these settings with the 8200 manual.

Summary

When adjusting the control parameters, you want to 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 C: Tuning PTC Control Parameters

CAUTION: **The 8200 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.**

NOTE: To tune PTC parameters, the 8200 access level must be Lab Manager or higher.

NOTE: Tuning the 8200 control parameters is a time-consuming procedure that will take a minimum of two to three hours to complete.

Control parameters adjust the performance of the chamber around the setpoint. As the chamber nears the setpoint, the 8200 adjusts the throttles to provide a smooth ramp to the setpoint. To prevent overshooting and oscillation around the final setpoint, the refrigeration, heating, and other systems must be damped as they approach the setpoint. To maximize chamber performance, you must also compensate for lag times.

To enable multiple groups of control parameters, select the **Use Multiple Groups** check box. Up to four groups of chamber parameters can be entered into the 8200 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.

The product temperature control (PTC) control parameters are tuned in manual mode. The adjustments are made to the **Gain**, **Integral**, and **Offset** parameters.

Gain parameters for PTC

The gain parameter is a **coarse** adjustment to the PTC control algorithm. The larger the gain, the longer the 8200 will wait to start slowing down the throttle as the load temperature approaches the load setpoint.

$$\textbf{gain} = \frac{\textbf{maximum offset}}{\textbf{proportional band}}$$

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 setpoint of the temperature channel in relation to the PTC channel's setpoint. When a PTC program is run, the temperature channel immediately cycles beyond the setpoint by the maximum offset. With the chamber air at maximum offset, the product cycles toward the final setpoint at its maximum rate. The temperature channel remains at the maximum offset above the PTC channel's setpoint until the product temperature enters the proportional band near final setpoint. The throttle of the temperature channel is reduced in relation to the PTC channel until the final setpoint 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. Increase the gain parameter for a faster load response. Additionally, a higher gain causes the load to proportion into the setpoint when the temperature is closer to the final setpoint.

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 setpoint.

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 setpoint 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 setpoint.

Droop is an effect, such as natural heat loss through the test space walls, that prevents the process variable from reaching the final setpoint. 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 setpoint. **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 setpoint.
- Shorter integral times result in shorter times to reach the setpoint.
- If the integral time is too short, the process variable will oscillate when it reaches the setpoint 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

The offset is the number of degrees Celsius that the air temperature setpoint will be allowed to exceed the load temperature setpoint when attempting to move the load temperature to the new load setpoint. The offset allows the air temperature channel to overshoot the setpoint 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 setpoint.

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 setpoint is +100°C and the load could be damaged by temperatures above +110°C, then the maximum heat offset should be +10°C.

CAUTION: It is your responsibility to program the offset value correctly to avoid damaging any products under test.

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 setpoint, 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 setpoint slightly and then oscillates around the setpoint slightly until it stabilizes at the setpoint. This level of control becomes available only with properly tuned PTC control parameters.

NOTE: The PTC 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

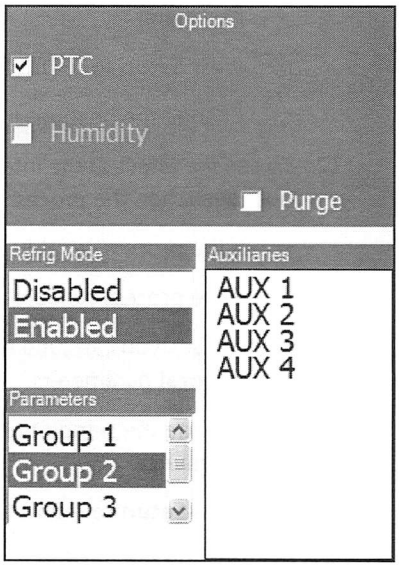
1. Press **Setup**, then select the **Control Parameters** panel.
2. If needed, select the PTC channel parameters group by pressing the appropriate button (such as **Group 1**).

3. Write down the heating and cooling **Gain**, **Integral**, 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.
   b. Enter a **New Setpoint** based on which parameters you are tuning, such as a heating setpoint for tuning the heating parameters.

      NOTE: When tuning parameters, the heating parameters are usually tuned before the cooling parameters. Normally you should select the setpoint based on the tests you are running.
   c. Set the **Ramp Rate** to 0.
   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 **Parameters** 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 setpoint and then stabilizes for 10 to 15 minutes.
8. If the current parameter settings are correct, the process variable will overshoot the setpoint slightly and then oscillate around the setpoint slightly until it stabilizes at the setpoint.
   - If the process variable oscillates near the setpoint, the gain setting is too small.
   - If the process variable takes too long to reach the setpoint, the gain setting is too large.
   - If the process variable undershoots the setpoint slightly until it finally reaches the setpoint (if it ever does), the integral time is too large.
   - If the process variable overshoots the setpoint, the integral time is too small.

Adjust the gain setting

9. To adjust the gain:
   a. Change the setpoint to back the process variable away from the setpoint you will use to tune the parameter.
   b. Press **Setup** to return to the **Control Parameters** panel.
   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 setpoint (for example, within ±2°C). As it stabilizes, it oscillates decreasing amounts until it droops just above or below the setpoint. (**NOTE**: The integral time function will adjust the setpoint 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.

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 setpoint to back the process variable away from the setpoint you will use to tune the parameter.
    b. Press **Setup** to return to the **Control Parameters** panel.
    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 setpoint.
    - If the process variable oscillates around the setpoint, you should increase the integral time.
    - If the process variable never achieves the setpoint, you should decrease the integral time.
13. If necessary, you can tune the current channel's **Offset** parameter once you have tuned the channel's **Gain** and **Integral** parameters.
    a. Change the setpoint to back the process variable away from the setpoint you will use to tune the parameter.
    b. Press **Setup** to return to the **Control Parameters** panel.
    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 setpoint.
    - If the process variable overshoots the setpoint, you should decrease the offset.
    - If the process variable undershoots the setpoint, 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 8200 worksheets in Appendix D. Keep these settings with the 8200 manual.

Summary

When adjusting the product temperature control parameters you want to 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: 8200 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				

8200 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					