

# THERMOTRON®

*A Venturedyne, Ltd., Company*

## **AST 8800**

### ***Instruction Manual***

***Revision 9: December 6, 2019***

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

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# Section 1: Setup

## Introduction to the AST 8800

The 8800 chamber controller leverages the power and familiarity of the Microsoft Windows operating system to provide the most advanced environmental test software on the market. Unprecedented ease of use, data and activity logging, sophisticated graphing, high precision measurement and reliability combine to take environmental testing to a new level. In this AST edition of the 8800, we have added the ability to control a repetitive shock shaker table. Those already familiar with the 8800 will feel right at home, while those new to the 8800 will find it easy enough to be running in minutes, yet powerful enough to fulfill all of your testing needs.

## Required components

The AST 8800 requires the following components to be operational: a control module, an accelerometer power supply, a computer running Windows 7 with a minimum of 1 GB of RAM or Windows 10 with 2GB of RAM, and a National Instruments DAQ card.

## Using the touch screen (optional)

The AST 8800 is designed to be usable with a touch screen interface, removing the need for a keyboard and mouse. Even with a keyboard and mouse connected, every task can be completed with just a mouse, for those installations where the keyboard may take up too much space. For places where text or numbers need to be entered, the keyboard can be used to speed up data entry.

When you touch or click on a specific area of the monitor one of several things could happen:

- **The button will remain “in” and perform the desired function.** For example, pressing the **Manual** button from the main screen will switch the display to the manual mode screen.
- **A radio button, check box, or line will be selected.** Touching a 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 setup screen, the keypad will appear, indicating that you can enter an alphanumeric value into the field.

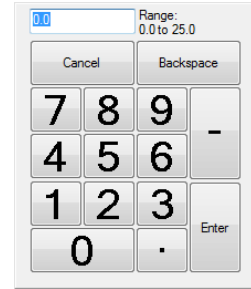
The alphanumeric keypad defaults to lower cases letters. To enter upper case letters, press **Shift** and then the desired letter keys. To return the keypad to lower cases letters, press **Shift** again.

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, can be used to move the cursor to the left and right in the display field at the top of the keypad.



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

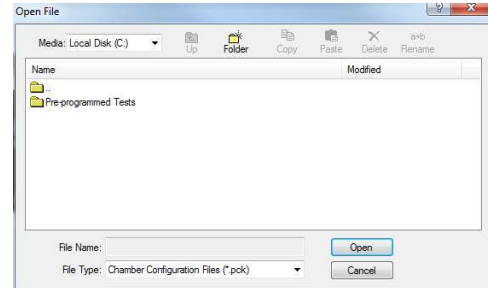
For example, when you touch the **Deviation** field on the program screen, the numeric keypad will appear, indicating you need to enter a value between 0.0 and 25.0 into the field.



## File functions

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

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



## AST 8800 file types

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

File type	Extension	Access screen	8800 functions	Description
Chamber configuration	.pck	Main	Save and open	Allows the user to back up and restore the chamber configuration.
7800 configuration	.cfg	Main	Open	Allows the user to load a 7800 programmer/controller configuration into the AST 8800.
Chamber data	.csv*	Graph	Save	Comma-delimited data that can be opened in standard spreadsheet programs.
Graph picture	.bmp	Graph	Save	A bitmap of the current graph that can be opened in standard graphics programs.
Graph view settings	.gvs	Graph	Save and open	Allows users to save and load customized graph view settings.
Program	.pgm	Program	Save and open	Prints the currently selected program as a combined graph and spreadsheet. <b>(NOTE: Programs can be printed only in interval view. Programs cannot be printed in time or expanded loop view.)</b>
7800 program	.prg	Program	Open	Allows the user to load into the AST 8800 a program written for a 7800 programmer/controller.
Control parameters	.prm	Setup/Control Parameters	Save and open	Allows the user to back up and restore control parameter settings.

\* **NOTE:** CSV files of PSD plots may be loaded back into the PSD page for later analysis.

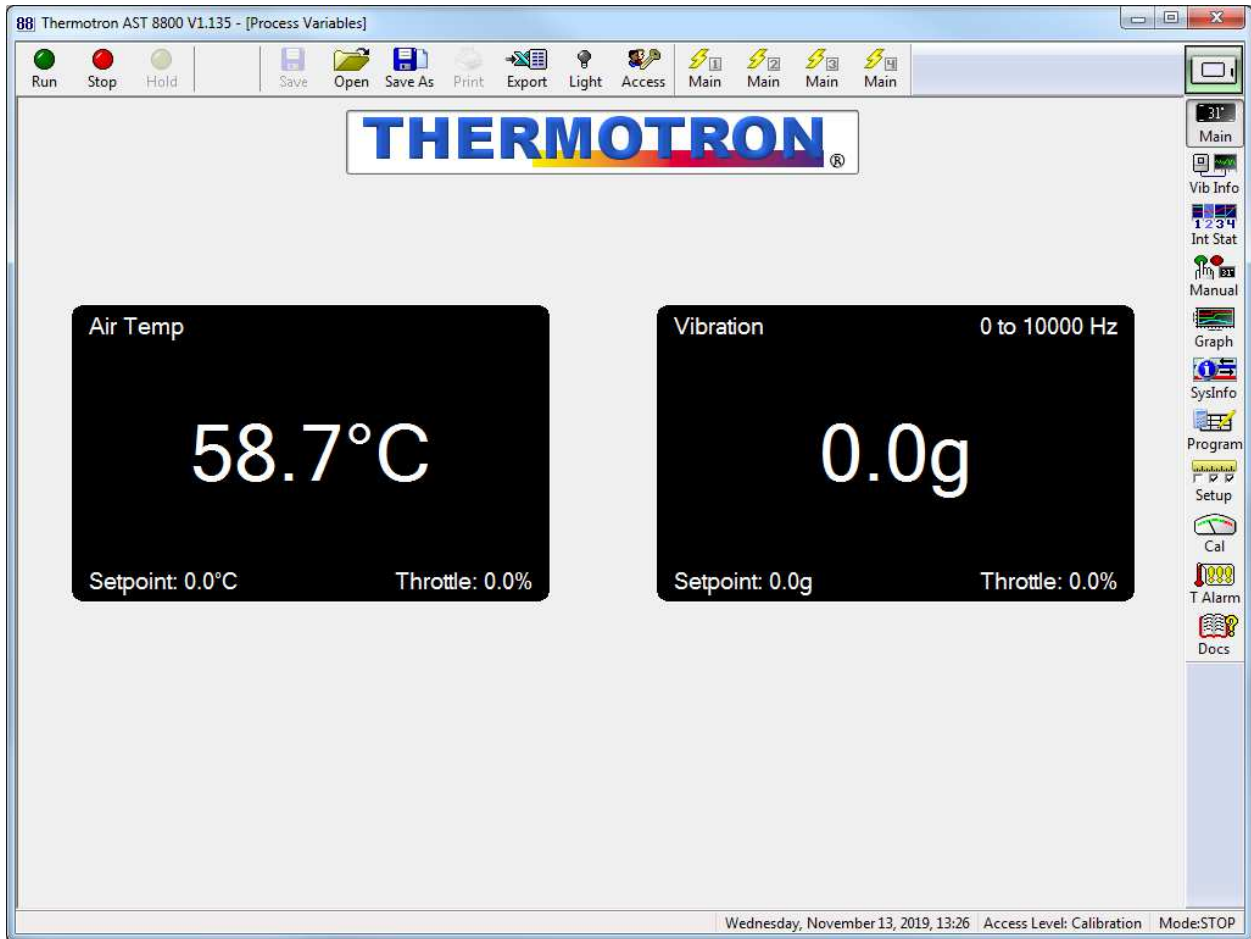
**NOTE:** The AST 8800 Backup Wizard helps you create a backup of your programs, settings, and data files so you can prevent data loss and damage caused by disc failures, power outages, virus infections, and other potentially damaging events. The AST 8800 Restore Wizard helps you restore your previously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

**Exporting AST 8800 data**

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



**AST 8800 display controls**



The AST 8800 display is made up of the following parts:

- The selected screen or panel in the center of the screen. The above illustration shows the main screen, which displays the channel name, current process variable, set point, and throttle for each active channel.
- The action buttons, which are always available at the top of the screen. For more information, see “Action buttons” later in this section.
- The function buttons, which are always available along the right side of the screen. Function buttons are used to select the various AST 8800 screens and panels. For more information, see “Function buttons” later in this section.
- The current date, time, access level, and mode of the AST 8800, which are always displayed at the bottom of the screen.
- On chambers with an optional door switch, a door icon in the upper right corner of the display indicates whether



the chamber door is closed or open. For information on the door options, see “Actions to take when door is opened” later in this section.

## Action buttons

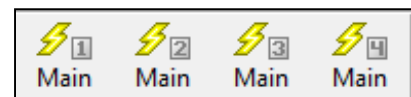
The action buttons are always available at the top of the screen. The following paragraphs list the action buttons and briefly describe their functions.



- Run** In manual mode starts running a manual mode test. In program mode brings up the Run Options dialog box. When a test is running, the indicator is green. When a scheduled program is pending, the indicator is blue.
- Stop** When a test is running the Stop button brings up the Stop Confirmation dialog box.
- Press **Yes** to stop the test. When a test is stopped, the indicator is red.
  - Press **No** to abort the stop request and continue running the test.
  - You can disable stop confirmation by checking **Do not ask this again**, or by unchecking **Confirm Stop Key Press** on the System Setup panel of the setup screen.
- Hold** Pauses a test and lights the yellow hold indicator. To resume the test at the same point it was paused, press **Run**.
- Save** Saves a new or modified file.
- Open** Loads a saved file.
- Save As** Saves a file under a new name or in a new location.
- Print** Prints the currently selected program or graph.
- Export** Starts the Export Data Wizard. This wizard provides step-by-step instructions for exporting program and data log files from the AST 8800.
- Light** Turns the chamber light on and off. When the chamber light is on, the button's yellow light indicator is lit.
- Access** Brings up the Change Access Level dialog box, allowing you to change the access level and password of the AST 8800. For more information, see "Changing access levels and passwords" later in this section.

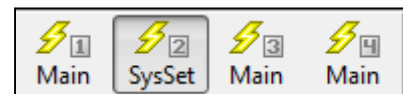
## Quick navigation buttons

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



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

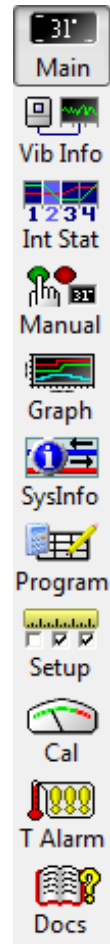
For example, press the **Setup** button and then select the System Setup panel. Press and hold the second quick navigation button. The button name will change to **SysSet**. The button now can be used to take you directly to the System Setup panel.



**Function buttons**

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

- Main** Returns to the main screen.
- Vib Info** Allows you to view frequency domain analysis of the accelerometers in the form of a power spectral density (PSD) plot. In addition, any advanced analysis options that have been purchased may be viewed here.
- Int Stat** Accesses the interval status screen. This screen allows you to view the status and options for the currently loaded program.
- Manual** Accesses the manual mode screen. This screen allows you to run the chamber manually, without preprogrammed times.
- Graph** Accesses the graph screen. This screen allows you to view the logged data as a graph as well as select what data will be graphed and how that data will be displayed.
- SysInfo** Accesses the chamber status panels. These panels provide status and diagnostic information.
- Program** Accesses the program screen. This screen allows you to create, save, load, and modify programs.
- Setup** Accesses the setup panels. These panels allow you to modify system and control parameters, computer interface/network settings, and channel/auxiliary names.
- Cal** Accesses the calibration panels. The **Cal** button appears only if the access level is Calibration.
- T Alarm** Accesses the Therm-Alarm panels. These panels allow you to view and change the Therm-Alarm settings and calibrate the Therm-Alarm. The **T Alarm** button appears only if your chamber is equipped with one or more Therm-Alarms.
- Docs** Accesses the online Help system. Allows you to get help on any topic relating to the AST 8800 control system.



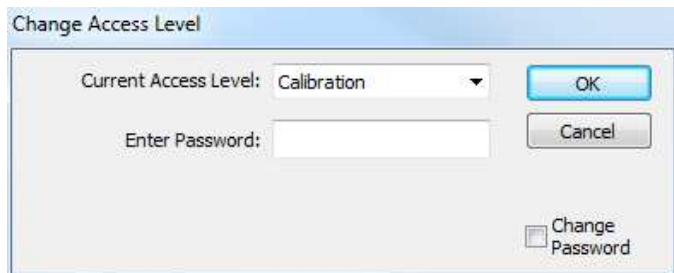
## Changing access levels and passwords

The access level function allows you to select from six different levels of access to the AST 8800 functions. All 8800's ship without any passwords set. It is up to the user to password protect access levels. The following table provides a general overview of which functions are available at each access level.

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

The following steps describe how to change access levels and set passwords:

1. From any screen press **Access**. The Change Access Level dialog box will appear:

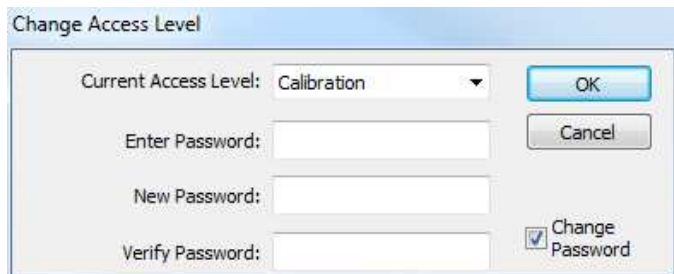


2. To change the access level:

- 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 alpha-numeric 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. Press **OK** to accept the new password or press **Cancel** to exit without changing the current password.
- g. If you did not enter the new password correctly, this error message will appear.
- h. Press **OK** and repeat step c.



## Using the setup panels

Press **Setup** to access the setup panels. These panels allow you to configure the AST 8800 to meet your specific testing needs. This section describes the setup panels and how to use them.



### System Setup panel

The screenshot shows the 'System Setup' panel with the following sections and controls:

- General:** Temperature Scale (Celsius), Calibrate Touch Screen..., Screen Saver (min): 0, Add Printer..., Light Auto Off (min): 0, Update Windows..., Confirm Stop Key Press (checked), Manual Mode Ramp Protection (unchecked), Regional and Language Settings...
- System Time:** Wednesday, November 13, 2019, 13:42:21, Power Fail Recovery (unchecked), Max Off Time: 0 : 00, Recover Mode: Stop, Enable Controlled Stop (unchecked), Controlled Stop Set Point (°C): 30, Controlled Stop Purge Time (s): 60, Controlled Stop +/- Deviation (°C): 2.5, Controlled Stop Controller State: OFF
- Process Alarms:** Low Limit, High Limit, Air Temp: -100.0°C, 200.0°C, Humidity: -100.0°C, 200.0°C, Vibration: 0.0g, 0.0g, Peak: -100.0gpk, 200.0gpk
- Refrigeration Options:** R.S.A. Time (min): 0
- Auxiliary Cooling Parameters:** Time Frame: 6s, Duty Cycle: 25%
- Product Dewpoint Control:** Dew Point Offset: 0.0°C
- HASS Options:** Cooling Offset (%): 0
- Actions to take when door is opened:** Disable Throttles (unchecked), Hold (unchecked), Stop after 60 minutes (unchecked), Turn on Light (unchecked)

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

### General settings

- From any screen press **Setup**, then select the System Setup panel.
- Under General select a field and enter or modify the setting. For numeric values the keypad will display the allowable range of the selected field. The following describes each field:
  - Select the **Temperature Scale** (Celsius or Fahrenheit) the AST 8800 will use to display temperature values.
  - The **Screen Saver** field allows you to enter the number of minutes of idle time before the screen saver is displayed. A value of 0 disables the screen saver function.
  - The **Light Auto Off** field allows you to enter the number of minutes of idle time before the chamber light is automatically shut off. A value of 0 disables the automatic light shut-off function.
  - To disable stop key confirmation, uncheck **Confirm Stop Key Press**. This will prevent the **Stop Confirmation** dialog box from appearing whenever the **Stop** button is pressed.
  - To toggle on or off an audible key beep each time a key is pressed, check or uncheck **Key Beep**.
  - Check **Manual Mode Ramp Protection** to start a ramp from the current process variable. This will start manual mode from stop with a defined ramp rate.
  - To start the touch screen calibration procedure (if a touch screen is installed), press **Calibrate Touch Screen** and follow the instructions on the screen.

- To add a printer, press **Add Printer** and follow the instructions on the screen.
- To update the operating system, press **Update Windows** and follow the instruction on the screen.
- To change the interface language or regional formatting, press **Regional and Language Settings**.

### Setting process alarms

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

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

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

### Refrigeration options

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

1. From any screen press **Setup**, then select the System Setup panel.
2. Select the **RSA Time** field and enter or modify the setting. The keypad will display the allowable range.

### Auxiliary cooling parameters

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Some chambers are equipped with optional liquid nitrogen (LN<sub>2</sub>) or carbon dioxide (CO<sub>2</sub>) auxiliary cooling systems. When the refrigeration system is operating at full cooling throttle, the auxiliary cooling system can be operated for a programmed percentage (duty cycle) of a selected time frame.

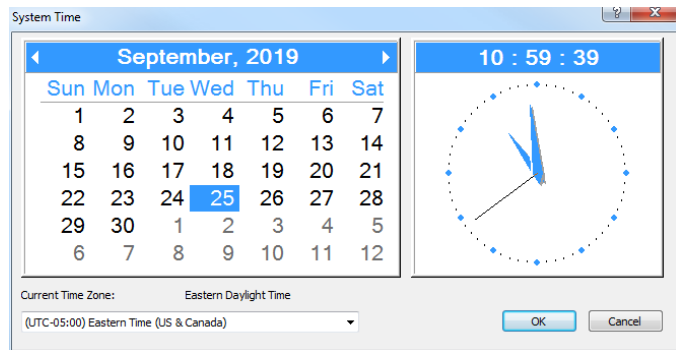
For example, if you set the auxiliary cooling time frame to five seconds and the duty cycle to 30%, the auxiliary cooling system comes on for 1.5 seconds (30% of five seconds) and then goes off for the remaining 3.5 seconds of the five-second interval. If you set the duty cycle to 100, the auxiliary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

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

## System time

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

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



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

## Power failure recovery

If the AST 8800 is in run or hold mode and a power failure occurs that is longer than the **Max Off Time** setting, the AST 8800 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 AST 8800 will power up in whatever mode it was in when power was lost.

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

## Controlled stop

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

1. Press **Setup**, then select the System Setup panel.
2. To enable or disable controlled stop, check or uncheck the **Enable Controlled Stop** check box.
  - **Controlled Stop Set Point:** Upon stopping, the chamber will go to this set point.
  - **Controlled Stop Purge Time:** After getting within +/- the controlled stop deviation of the controlled stop set point, the purge will be enabled for the specified time (in seconds), then the chamber will stop. A setting of zero will disable purge.

- **Controlled Stop +/- Deviation:** The deviation from the controlled stop set point the chamber must reach before the purge output is forced on.
- **Controlled Stop Controller State:** If you want to **control** to the controlled stop set point, select ON. If you want to **drift** to the controlled stop set point, select OFF.

**NOTE:** The chamber will not allow **Run**, **Stop**, or **Hold** to be pressed when controlled stop is active. Channel 1 will display a message, "Controlled Stop Active..." while the chamber waits for the controlled stop to complete.

### **Actions to take when door is opened**

A green door icon in the upper right corner of the 8800 display indicates the chamber door is closed.

A pink door icon in the upper right corner of the 8800 display indicates the chamber door is open.

**NOTE:** The door icon and options are available on chambers with an optional door switch.



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

- The flow of all inert gases, such as liquid nitrogen (LN<sub>2</sub>), gaseous nitrogen (GN<sub>2</sub>), or carbon dioxide (CO<sub>2</sub>), is automatically stopped. This function cannot be overridden by the user.
- The 8800 activity log will display a *Chamber door OPENED* message (with date/time stamp) when the door is opened. The activity log will display a *Chamber door CLOSED* message when the door is closed.



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

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

### **Product Dewpoint Control**

At the 8800 display, press **Setup**, then select the System Setup panel and enter the desired **Dew Point Offset**. The illustration shows the offset adjustment field, which is located in the lower left corner of the System Setup screen. When enabled in manual mode or by interval in program mode, the 8800 will limit the dew point of the chamber to the monitored product temperatures minus this offset. For more information, refer to "Appendix C: Product Dew Point Control" in this manual.

### **HASS Options**

In order to balance disproportionately strong or weak cooling systems, a HASS Cooling Offset is available. This value can be set from -50 to +50. The default is 0. To allow more cooling, enter a negative number. To limit the cooling, enter a positive number.

For example, if the HASS Optimizer is set to 7 and the HASS Cooling Offset is set to -10, the heating throttle is limited to 83% while the cooling throttle is limited to -93% (allowing more cooling). If the Optimizer is set to 7 and the HASS Cooling Offset is set to +10, the heating throttle is still limited to 83% but the HASS Cooling Throttle is now limited to -73% (allowing less cooling).

No matter what value is entered for a HASS Cooling Offset, the cooling throttle is always limited to a value between -50% and -100%. For example, if the HASS Optimizer is set at 7 and the HASS Cooling Offset is set to +50, the cooling throttle will be limited to -50%. For more information, refer to the *AST 8800 Manual Addendum 03: HASS Optimizer*.

## Alerts panel

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

The screenshot shows the 'Alerts' tab in the software interface. The 'Deviation Alarms' section includes the following controls:

- Sound alarm on deviation
- CM:  Output:
- Time for deviations to be satisfied after a new setpoint (s):
- Time to be outside of limits after reaching new setpoint (s):
- When alarm occurs,

- To set up the deviation alarm response, press **Setup**, then select the Alerts panel.
- To cause an alarm to sound when a deviation is violated, select the **Sound alarm on deviation** checkbox.
 

**NOTE:** The deviation setting has to be non-zero for it to be relevant.

  - To define how long the system will wait after a set point change before it starts monitoring the deviation, enter a value in the **Time for deviations to be satisfied after a new setpoint (s)** field.
  - To prevent nuisance alarms, enter a value in the **Time to be outside of limits after reaching new setpoint (s)** field. For example, if the value is set to 60 and the process variable is out of the deviation band for five seconds, no alarm will sound.
- The last option allows you to select the action the AST 8800 will take when a deviation occurs.
  - Continue** will generate an alarm notification and allow the test to continue.
  - Stop** will stop the test.
  - Hold** will put the AST 8800 into hold mode.
- If either of the timer options is non-zero, the following will happen when a deviation occurs:
  - A warning message will appear.
  - The deviation alarm will be recorded in the activity log.

## Vibration configuration panel

The screenshot shows the Vibration configuration panel with the following sections:

- System Setup | Alerts | Vibration Config | Control Parameters | Communication | Service Messages | System Events | Chan / Aux Names | Backup / Restore**
- Accelerometer Setup:** A table with 8 rows. Each row has a 'Type' dropdown (Control, Off), a 'Sensitivity (mV/g)' input (10), and a 'Name' input (Accel 1-8). Below the table are 'Multi-Control' options (Average) and 'Show Accels' radio buttons (1-8, 9-16).
- Control & Analysis:** Includes 'Automatically Save PSD' checkbox, 'Every 30 Minutes' input, 'PSD Lines: 800' dropdown, 'Max Frequency: 10000' dropdown, 'G RMS Averages: 40' input, 'PSD Averages: 40' input, 'Minimum 20 %' and 'Start 25 %' inputs, 'Use Control Band' checkbox, 'Minimum Freq: 0 Hz' and 'Maximum 10000 Hz' inputs.
- Vibration Alarm:** Includes 'Monitor 1' dropdown and 'Limit: 50' input.

### Accelerometer setup

This is where the accelerometer inputs are configured. If sixteen channels are present, the accelerometer options are shown in two pages of eight each. Each accelerometer has three options, **Type**, **Sensitivity** and **Name**:

- **Type:** Can be **Off**, **Control**, or **Monitor**. When Off, this accelerometer is ignored. When set to Control, it is the accelerometer that controls the level of the vibration on the table (for multiple control accelerometers, see below). When set to Monitor, this accelerometer can be monitored and graphed, but does not affect the vibration control.
- **Sensitivity:** Enter the sensitivity as specified by the accelerometer manufacturer.
- **Name:** For easier identification of this accelerometer, you may enter a name that will be used throughout the program.

**Multi-Control** mode becomes active if more than one accelerometer is designated as Control:

- Select **Average** to use a simple average of the control accelerometers as the control signal.
- **Minimum** will use the accelerometer with the lowest G level at any given moment as the control signal.
- Similarly, **Maximum** will use the accelerometer with the highest G level as the control signal.
- **Vector** uses multi-point control that calculates the control channel as the square root of the sum of squares of all of the enabled control channel values.
- Select **RMS** to calculate the root mean square of all of the enabled control channels.

### Control & Analysis

This is where the main options for vibration control and analysis are found. **Changing these parameters can drastically affect vibration tests.**

- **PSD Lines:** This defines how many segments, or lines, the frequency spectrum is broken up into for analysis. A high number of lines provides more detail on the PSD graph, but uses more processing time and is slower to plot.

- **Max Frequency:** This defines the highest frequency that may be analyzed. The max frequency divided by the number of lines gives the **bandwidth**, or resolution, of the system. For example, if a max frequency of 10,000 Hz is defined with 800 lines, the bandwidth is 12.5 Hz per line. Bandwidths of less than 1 Hz take a longer time to compute.
- **G RMS Averages:** Defines how much to average the G RMS values for monitor channels. A higher value gives smoother plots, but takes longer for the values to change from one level to the next. A low value gives good response time for the plots, but the random nature of the shaker table will provide a more uneven plot. A value of 1 disables averaging.
- **PSD Averages:** Defines how much to average the plots on the PSD page. Similar to G RMS averages, a high value gives a more stable but slower changing plot, while a low value gives a quickly changing but less stable plot.
- **Minimum Throttle:** This is the lowest throttle that will be allowed for the vibration channel while running a test.
- **Start Throttle:** When starting a test that uses vibration, this is the throttle that will be used to get started.

**NOTE:** The minimum and start throttles may need to be increased as the weight of the load increases.

---

### **Control band**

---

Normally the full spectrum from 0 Hz to the defined maximum frequency is used to calculate the table's G RMS level. However, if you wish to control using a subset of the full spectrum, check **Use Control Band** and enter the desired minimum and maximum frequencies. These values must be less than or equal to the Max Frequency, defined above.

**NOTE:** When using a control band, you are effectively eliminating energy from your control signal, meaning the table will now have to drive harder in order to achieve the desired G levels. This is also true when selecting low max frequencies.

---

### **Vibration alarm**

---

As a safety precaution, you may have the chamber abort testing if the vibration level exceeds the defined limit.

- **Monitor Input:** This is the channel that will be watched for the vibration limit. It is recommended that you choose an accelerometer other than the control channel.
- **Limit:** Enter the G level that will cause the shaker to abort.

## PSD limits

Power spectral density (**PSD**) limits allows you to abort a test if specific portions of the PSD spectrum go above a user-defined set of limits.

1. From the **PSD Limits** drop-down menu select the PSD limit you want to set. You can select up to eight sets of PSD limits.
2. To prevent nuisance alarms, enter the seconds for the **Nuisance Time (sec)**. This allows the spectrum to go out of range for the given number of seconds before the alarm is activated.
3. To configure a set of PSD limits, select the **Edit** button.
  - In the **Name** field enter a unique name for this set of limits. This name will appear in the list on the setup page.
  - Under **From** enter the minimum (Hz) frequency of the band.
  - Under **To** enter the maximum (Hz) frequency of the band.
  - The limit is set in  $g^2/Hz$ . The limits apply to any of the accelerometer channels that are checked under **Accelerometer Channels**.
4. To accept the new values select **OK**.

PSD Limits  
 PSD Limits 1  
 Edit...  
 Nuisance Time (sec): 0

PSD Limits

Name: PSD Limits 1

	From (Hz):	To (Hz):	Limit (g <sup>2</sup> /Hz):	Accelerometer Channels
1.	0	0	0	<input checked="" type="checkbox"/> Accel 1
2.	0	0	0	<input type="checkbox"/> Accel 2
3.	0	0	0	<input type="checkbox"/> Accel 3
4.	0	0	0	<input type="checkbox"/> Accel 4
5.	0	0	0	<input type="checkbox"/> Accel 5
6.	0	0	0	<input type="checkbox"/> Accel 6
7.	0	0	0	<input type="checkbox"/> Accel 7
8.	0	0	0	<input type="checkbox"/> Accel 8

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 1    2    3    4

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OK Cancel

## Control Parameters panel

System Setup	Alerts	Vibration Config	Control Parameters	Communication	Service Messages	System Events	Chan / Aux Names	Backup / Restore
Air Temp								
Heat Prop. Band	30.0°C	Heat Integral Time	60s	Heat Throttle Limit	100.0%			
Cool Prop. Band	50.0°C	Cool Integral Time	90s	Cool Throttle Limit	-100.0%			
Humidity								
Heat Gain	3.0	Heat Integral Time	200s	Heat Offset	25.0°C			
Cool Gain	3.0	Cool Integral Time	200s	Cool Offset	-25.0°C			
Vibration								
Proportion Band	100.0G	Integral Time	20s	Throttle Limit	100.0%			
Unused	0.0G	Throttle Boost Time	10s	Unused	0.0			
Peak Average								
Proportion Band	0.0gpk	Integral Time	0s	Throttle Limit	0.0%			
Unused	0.0gpk	Throttle Boost Time	0s	Unused	0.0%			
<input checked="" type="checkbox"/> Use Multiple Groups								
<input checked="" type="radio"/> Group 1 <input type="radio"/> Group 2 <input type="radio"/> Group 3 <input type="radio"/> Group 4								
<input type="button" value="Restore Factory Defaults"/>								

**CAUTION:** The AST 8800 programmer/controller was factory-tuned and should not need to be re-tuned unless the product requirements change enough to affect the performance of the chamber. Incorrect values could damage your equipment and/or product.

**NOTE:** For information on turning the control parameters, see Appendix D. For information on turning the product temperature control (PTC) control parameters, see Appendix E.

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

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 AST 8800 for each control channel. This allows you to select chamber performance appropriate for the type of interval or program you are running. For example, in one interval you may want less control during a ramp between two extreme temperatures, but in the next interval you may want more control to maintain a constant temperature. To achieve the two levels of control, two groups of parameters can be programmed.

The control parameters are tuned in manual mode. The same procedure is used to tune up each channel. The adjustments are made to the proportional band and integral time parameters.

## Communication panel

**NOTE:** To change any computer interface setting, the AST 8800 access level must be **Lab Manager** or higher. For more information on computer interface settings, refer to Section 5 of this manual.

### Computer interface ports

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

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

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

#### COM2 (RS-232)

1. From any screen press **Setup**, then select the Communication panel.
2. Under COM2 (RS-232) select each field to modify its setting.
3. From the **Baud Rate** drop-down menu select the highest baud rate the host computer's interface card will use.
4. Select the desired **Parity**. To disable parity checking, select **None**.
5. Select the desired **Word Length**. For most applications, select **Eight**.
6. Select the desired **Stop Bits**. For most applications, select **One**.
7. Select the desired **Terminator**.

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

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

A non-zero error code response could indicate that the AST 8800 did not process the command properly and it should be re-sent, or it could indicate that the AST 8800 processed the command properly but it was invalid for some reason and needs to be corrected before it is re-sent. For more information see "Error codes" in Section 5 of this manual.

9. Select the desired **Cmd** compatibility. Command compatibility allows the AST 8800 to emulate a legacy instrument's command set. For more information see "Legacy instrumentation command compatibility" later in this section.

**Network (TCP/IP)**

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

Local Port	Remote Address	Remote Port	State	Process Name
80			LISTENING	ASTDemo.exe
135			LISTENING	
139			LISTENING	
445			LISTENING	
3389			LISTENING	
5357			TIME-WAIT	
5357			LISTENING	
8888			LISTENING	ASTDemo.exe
49152			LISTENING	
49153			LISTENING	
49154			LISTENING	
49155			LISTENING	
49156			LISTENING	
49183	10.1.1.85	8041	ESTABLISHED	
49197			LISTENING	
49201	127.0.0.1	49202	ESTABLISHED	
49202	127.0.0.1	49201	ESTABLISHED	
49211	10.1.1.86	5721	ESTABLISHED	
49230	10.1.1.6	445	ESTABLISHED	
49363	10.1.1.86	5721	ESTABLISHED	
49364	127.0.0.1	49365	ESTABLISHED	
49365	127.0.0.1	49364	ESTABLISHED	
49366	10.1.1.86	5721	ESTABLISHED	

- The AST 8800 uses the **Send Acknowledgement** function to provide feedback to the computer when the AST 8800 is ready for the next command. The AST 8800 will only send an acknowledgement back to the host computer for non-query commands. When the error code is received by the host computer it knows that the AST 8800 has finished processing the command. If a response has not been received within two seconds, the command should be re-sent. A non-zero error code response could indicate that the AST 8800 did not process the command properly and it should be re-sent, or it could indicate that the AST 8800 processed the command properly but it was invalid for some reason and needs to be corrected before it is re-sent. For more information see "Error codes" in Section 5 of this manual.
  - Select the desired **Command Compatibility**. Command compatibility allows the AST 8800 to emulate a legacy instrument's command set. For details see "Legacy instrumentation command compatibility" later in this section.
5. Selecting **Enable Web Server** allows you to view the AST 8800 controller status from any computer on the network by entering the AST 8800's **IP Address** in a web browser. **NOTE:** This function is enabled by default.
  6. Under Network Identification, enter a valid **Computer Name**, the name of the **Workgroup** this AST 8800 should use, and, if desired, a **Chamber Description**.
  7. To map a remote folder on your network to a local drive letter, press the **Map Network Drive...** button, select the local **Drive** letter, choose a **Local Name**, and select the remote **Network Folder**.
  8. To remove a mapped drive association, press the **Disconnect Network Drive...** button and select the **Network Drive** letter.

### Computer I/O

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

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

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

A non-zero error code response could indicate that the AST 8800 did not process the command properly and it should be re-sent, or it could indicate that the AST 8800 processed the command properly but it was invalid for some reason and needs to be corrected before it is re-sent. For more information see "Error codes" in Section 5 of this manual.

- Select the desired **Cmd Compatibility**. Command compatibility allows the AST 8800 to emulate a legacy instrument’s command set. For details see “Legacy instrumentation command compatibility” below.

**GPIB NOTE:** GPIB communication is normally done using a Thermotron GPIB converter. However, when using the AST 8800 demo software it is possible to do GPIB communication using a GPIB card in your PC by selecting the **Use Internal Card** check box.

**I/O diagnostics**

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

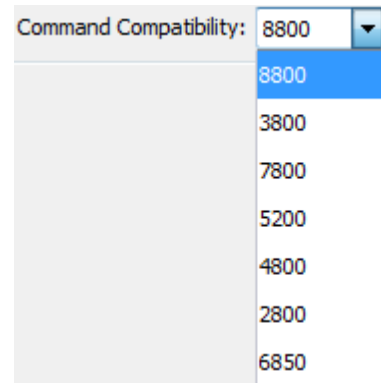
**Legacy instrumentation command compatibility**

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

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

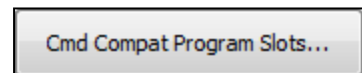
If you have a program written to control a legacy instrument it will work seamlessly with an AST 8800 without any changes. The AST 8800 can be set up to use any of the legacy command sets per interface (COM2, network, computer I/O), providing you with extra flexibility. For example, you could use your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

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

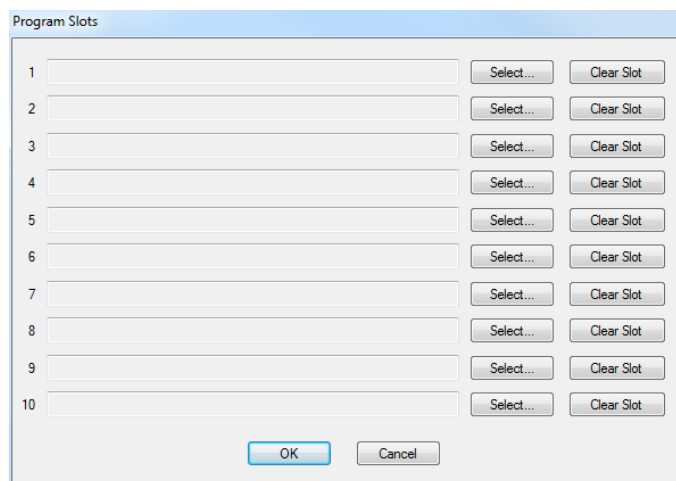


**Legacy program slots**

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



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



## Service Messages panel

Service Message	System	Service Interval	Next Service	
E-STOP HAS BEEN PUSHED	Digital Input ▼	2	0h	Reset
EXCESSIVE VENT PRESSURE WARNING	Digital Input ▼	5	0h	Reset
IMPACTOR HEAT HAS BEEN DISABLED	Digital Input ▼	4	0h	Reset
Service Message #4	Unused ▼	0h	0h	Reset
Service Message #5	Unused ▼	0h	0h	Reset
Service Message #6	Unused ▼	0h	0h	Reset
Service Message #7	Unused ▼	0h	0h	Reset
Service Message #8	Unused ▼	0h	0h	Reset

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

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

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

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

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

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

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

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

- **Digital output:** These service messages will be displayed when the specified digital output (service interval) goes active. **NOTE:** An AST 8800 display module may be equipped with up to four CM2 control modules. Each control module has 40 digital outputs. The valid range for selecting a digital output service message is 1-340, where:

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

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

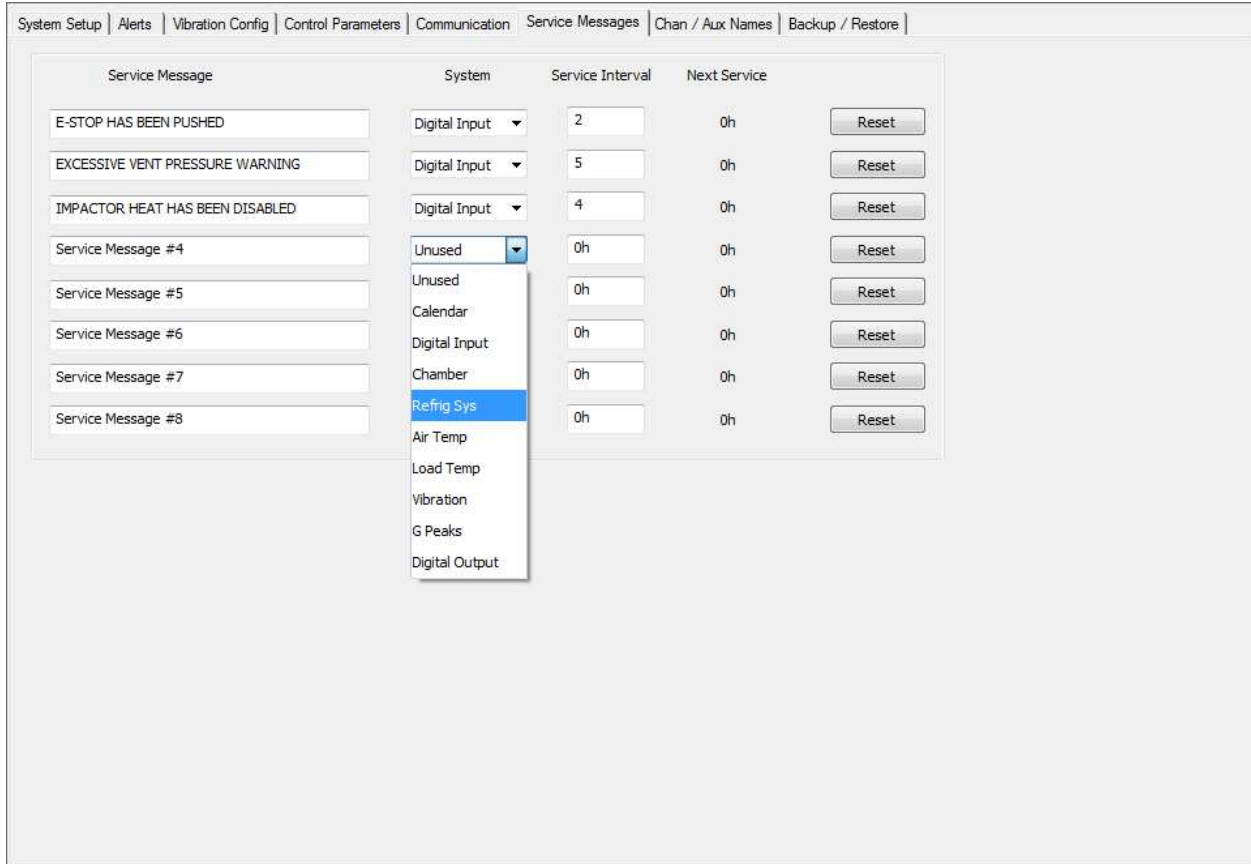
**201-240** refers to the 40 digital outputs of CM2 control module 2

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

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

To modify service messages, follow these steps:

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



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

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

## System Events panel

System Setup   Alerts   Vibration Config   Control Parameters   Communication   Service Messages   System Events   Chan / Aux Names   Backup / Restore						
	Channel:	Variable:	Logic:	Low/Off:	High/On:	Live:
#01	Unused	Process Variable	Range	0	0	<input type="checkbox"/>
#02	Unused	Process Variable	Range	0	0	<input type="checkbox"/>
#03	Unused	Process Variable	Range	0	0	<input type="checkbox"/>
#04	Unused	Process Variable	Range	0	0	<input type="checkbox"/>

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

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

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

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

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

### System event parameters defined

1. **Channel** identifies the channel associated with the system event. Any configured control or monitor channel can be used to trigger system events. Selecting **Unused** indicates that the system event is not used.

For control channels the system event logic will be active only when the channel associated with it is selected and running. For monitor channels the system event logic will be active whenever the system is running. **NOTE:** If its **Live** check box is selected, a system event based on control channels and monitor channels will be active regardless of the operating mode.

2. **Variable** indicates which variable the AST 8800 will monitor for the selected channel. The available variable types are:
  - **Process Variable:** The system event uses the selected channel’s process variable to trigger the event. Any value within the range of the selected control channel can be used.
  - **Set Point:** The system event uses the selected channel’s set point to trigger the event. Any value within the range of the selected control channel can be used.
  - **Throttle:** The system event uses the selected channel’s throttle to trigger the event. The range is -100% throttle to +100% throttle.
  - **Deviation:** This variable is the process variable minus the set point. This variable uses the same unit of measurement as the process variable and set point.
  - **Humidity Ratio:** This system event is an absolute measure of humidity.
3. **Logic** indicates the type of system event. This parameter determines when the AST 8800 will activate and deactivate the system event. The available logic types are:

- **Range:** The system event output will be activated when the variable is within the selected range (between the low and high parameters, inclusive).
- **Point:** The system event output will be activated when the variable is at the on point, and deactivated when the variable is at the off point. This provides some switching hysteresis when required. The relative values of the on point and the off point determine the logic as follows:

<b>On point ≥ Off point</b>		
Var ≤ Off	Off < Var < On	Var ≥ On
Deactivate	No change	Activate
<b>On point &lt; Off point</b>		
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 any 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 AST 8800 worksheets in Appendix F. Keep these settings with the AST 8800 manual.

## Chan / Aux Names panel

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

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

### Modifying auxiliary relay settings

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

### Changing a control channel name

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

### Changing a DAQ/monitor input name

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

## Backup / Restore panel

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

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

### Backup and recovery tools: Chamber settings

System Setup | Alerts | Vibration Config | Control Parameters | Communication | Service Messages | System Events | Chan / Aux Names | Backup / Restore

### Welcome to the 8800 Backup and Recovery Tools

Chamber Settings     Operating System

**Backup Wizard**  
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, virus infections, and other potentially damaging events.

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

Scheduled Backups:

Name	Schedule	Next Run Time	Last Status
+ Add a scheduled backup			

Delete    Restore    Backup

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

To back up your programs, settings, and data files, perform the following:

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

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

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


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

## Backup and recovery tools: Operating system

System Setup | Alerts | Vibration Config | Control Parameters | Communication | Service Messages | System Events | Chan / Aux Names | Backup / Restore


### Welcome to the 8800 Backup and Recovery Tools

Chamber Settings
  Operating System


**Set Restore Point**  
 Setting restore points lets you restore the operating system back to a previous date and time.

System Restore Points:

Date	Description
August 05, 2019	Scheduled Checkpoint

 Restore

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

To set a restore point, perform the following:

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

To restore the system to a previous state, perform the following:

1. From any screen press **Setup**, then select the Backup / Restore panel.
2. Press the **Operating System** radio button.

Choose a restore point from the list and press **Restore**.

## Section 2: Operation

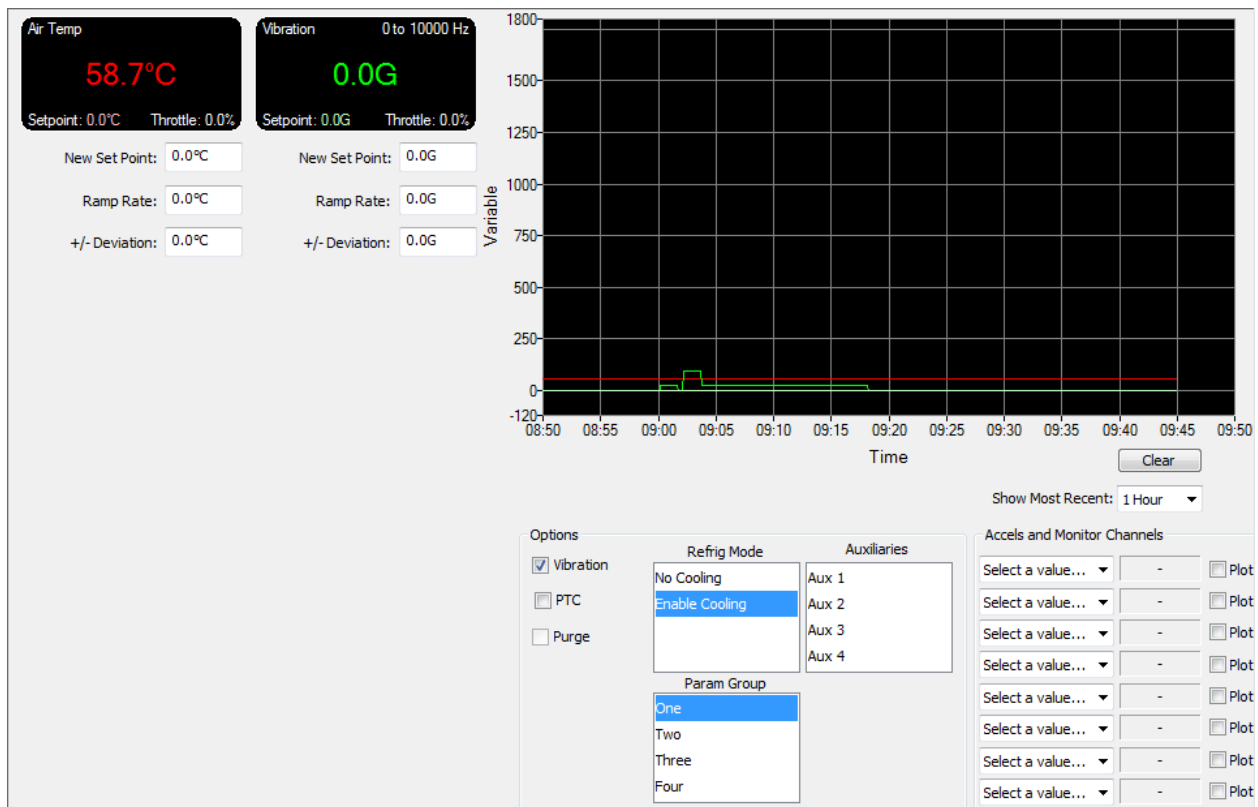
**NOTE:** For information on operating SCI systems, refer to Appendix B of this manual.

**Manual mode** operates the AST 8800 using set point and rate of change (ramp rate) settings. You can enter manual mode when the system is in stop mode. For instructions see “Running in manual mode” below. **NOTE:** You also can enter manual mode from hold program mode if, while running a program, you want to perform a special operation in manual mode and then continue with the program. See Step 6 of “Running a program” later in this section.

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

### Running in manual mode

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



2. Select and change the settings for the manual mode test. The following list describes the manual mode values and options displayed:
  - **New Set Point:** Enter the desired value for each active channel. When the ramp rate is not zero, the set point will change toward this new value at the selected rate.
  - **Ramp Rate:** Enter the desired number of degrees or other units per minute. If you enter a setting other than zero, the controller ramps to the new set point, changing the set point in a timed ramp. If you enter a zero, the controller performs a step change. During a step change, the AST 8800 outputs a full demand ( $\pm 100\%$  throttle) until it enters the set point’s proportional band. **NOTE:** Each active channel can have its own unique ramp rate that runs simultaneously.

- **+/- Deviation:** Enter the value for how far you will allow the temperature or other process variable to be from set point. The deviation setting will be monitored and the deviation alarm will be activated if the value is exceeded. Enter a positive number only; the AST 8800 will monitor both positive and negative deviations. **NOTE:** The **+/- Deviation** field appears only if the AST 8800 was factory-configured with at least one alarm output.
- **Vibration:** Enables vibration. When disabled, the vibration channel will not be shown.
- **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.
- **Purge:** Enables the purge option (if applicable).
- **Humidity:** Enables the optional humidity system. **NOTE:** Humidity is disabled if product temperature control (**PTC**) is enabled.



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

**Humidity Info**

Hum Rat SP:	0.000	gr./lb
Humidity Ratio:	194.4	gr./lb
Hum Tolerance:	0.000	gr./lb
Vapor Press:	0.628	psi
Saturation	2.712	psi
Dew Point:	30.331	
Virtual Wet Bulb	35.581	°C

- **Low Humidity:** Enables the optional low humidity system. **NOTE:** Low humidity is disabled if product temperature control (**PTC**) is enabled.
- **PDC:** Enables product dew point control. The AST 8800 will control the temperature and humidity outputs in order to maintain the dew point at a value less than or equal to the monitored load temperature minus the dew point offset. The PDC option must be enabled before or at the same time as a temperature or humidity transition. Turning the PDC option on during a transition will not allow the function to operate, since the set points will have already changed. **NOTE:** The PDC option can be enabled only when the **Humidity** option is enabled. For more information on product dew point control, see Appendix C of this manual.
- **Refrig Mode:** Select the desired refrigeration mode for this manual mode test. **NOTE:** Power Save is available on SE-Series chambers only.
- **Param Group:** Select the desired parameter group for this manual mode test. For more information, see "Control parameters panel" in Section 1 of this manual.
- **Auxiliaries:** Select the auxiliary relays you want to activate. For information on enabling/disabling the display of auxiliary relay names, see "Chan / Aux Names panel" in Section 1 of this manual. **NOTE:** Standard auxiliaries are active only when the AST 8800 is in run mode. Live auxiliaries can be enabled without the AST 8800 being in run mode. For more information on your live auxiliaries, refer to your chamber manual.
- **Accels and Monitor Channels:** Select up to eight additional pieces of information to display. You may select from a list of all the currently configured accelerometers and monitor channels. Check the **Plot** box to see a plot of the data on the mini graph.
- **Clear:** This will clear the current data from the mini graph (the data is still available in the main graph screen).
- **Show Most Recent:** Select how much time is shown on the mini graph (1, 2, 4, or 8 hours).

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



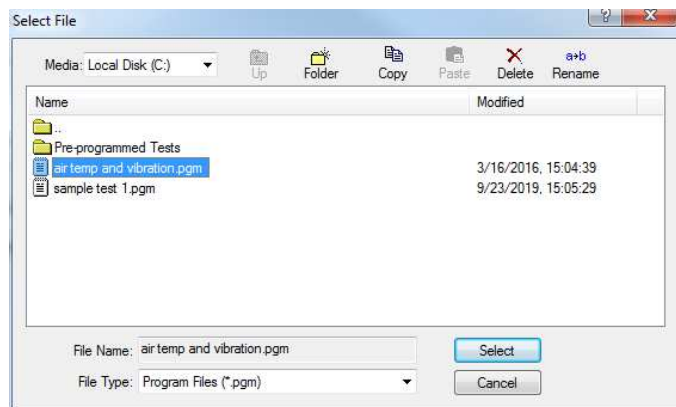
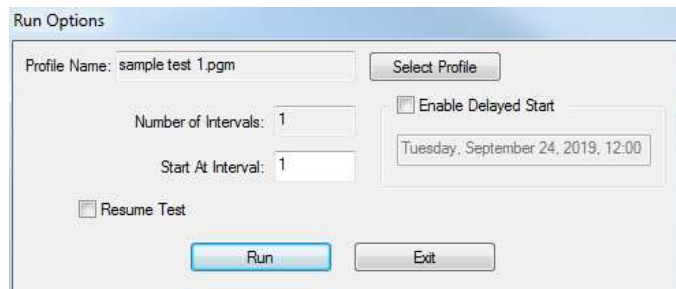
## Program mode operation

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

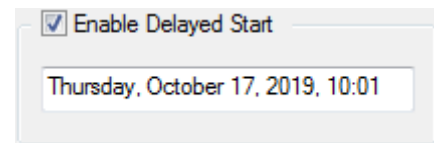
- To run an existing program, see “Running a program” below.
- To resume a test that was previously stopped, see “Resuming a test” later in this section.
- To create or modify a program, see “Programmed cycling” later in this section.

### Running a program

1. With the AST 8800 in stop mode, press **Run** from any screen other than the manual mode screen. The Run Options dialog box will appear:
2. The name of the currently loaded profile appears in the **Profile Name** field. To load a different profile:
  - a. Press the **Select Profile** button. The Select File dialog box will appear:
  - b. Select the profile you want to load.
  - c. Press **Select**.

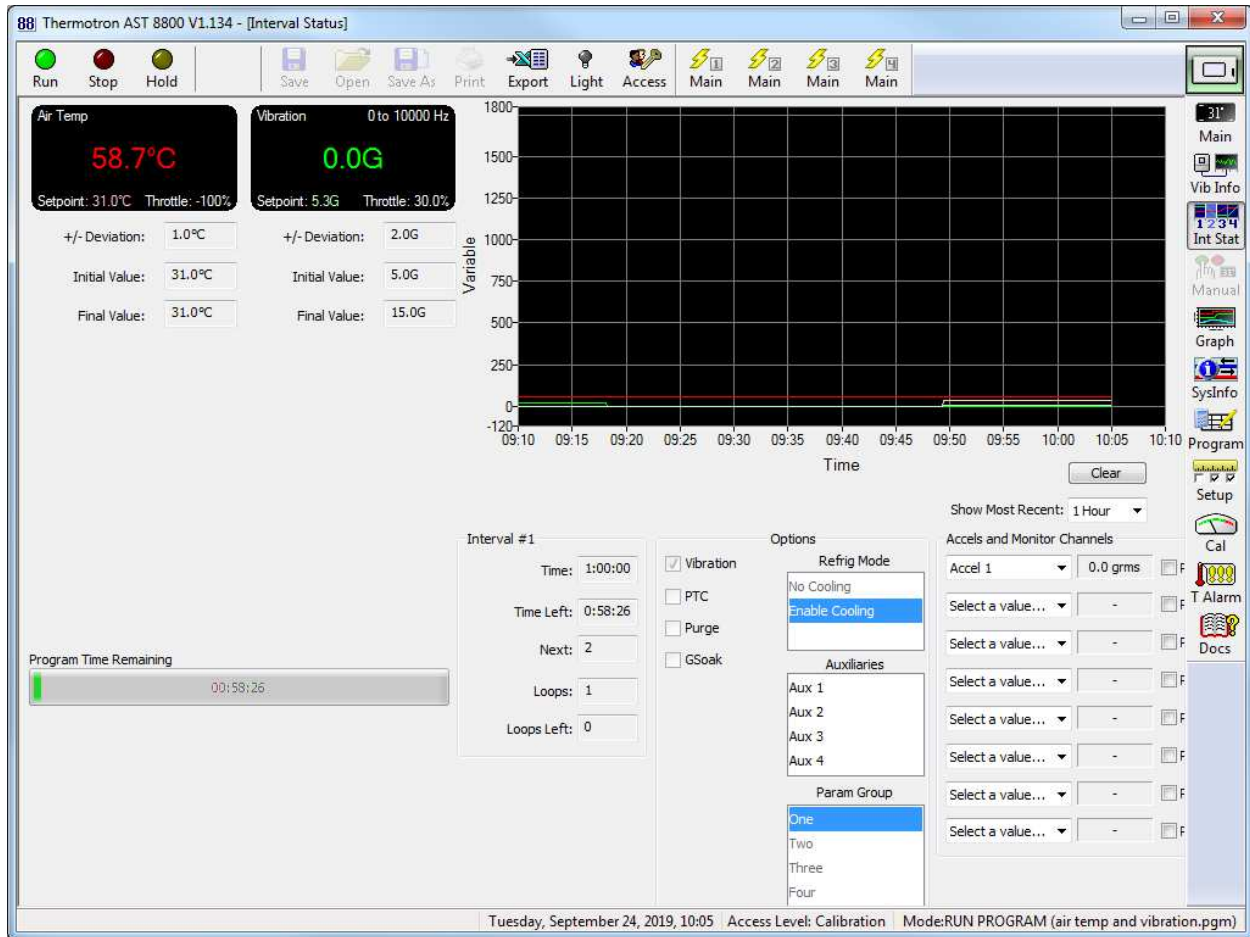


3. The **Number of Intervals** field displays the total number of intervals in the loaded profile. The **Start At Interval** field shows the starting interval (the default value is 1). To start the loaded profile at an interval other than 1, select the **Start At Interval** field and use the numeric keypad to enter the desired starting interval.
4. To schedule the selected profile to start at a preset time in the future:
  - a. Select **Enable Delayed Start**.
  - b. Select the adjacent date and time field to choose when to start running the program.
  - c. Press **Start Delay**. The AST 8800 will enter delayed start mode and the **Run** indicator will turn blue.



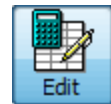
**NOTE:** You cannot run another program or enter manual mode while a delayed start is pending. To cancel a delayed start, press **Run**, then press **Cancel Delay**.

5. To start the program immediately, press **Run**. The 8800 will enter run program mode, the **Run** indicator will turn green, and the interval status screen will appear. A progress bar in the bottom left corner will display the **Program Time Remaining**.



6. To suspend the interval at its current settings, press **Hold**. The AST 8800 will enter hold program mode and the **Edit** button will appear. **NOTE:** In hold program mode the AST 8800 will maintain the chamber test space at the last set point.
  - To enter temporary values into the current interval, go to step 7.
  - To resume running a suspended test, press **Run** and go to step 8.
7. To enter temporary values into the current interval:
  - a. Press the **Edit** button.
  - b. Select and enter the temporary values and options as desired.
 

**NOTE:** If you want to save these changes to the current program permanently, press the **Save** button. If you want to save these changes to a program with a new name, press the **Save As** button. Otherwise, once the interval is completed, the temporary values will be discarded and the next time the interval is run the original programmed values will apply.
  - c. Press the **Edit** button again, then press **Run**. The AST 8800 will enter run program mode again using the new values for the remainder of the current interval.
8. To stop a running test, press **Stop**.



## Resuming a test

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

## Programmed cycling

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

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

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

In temperature-vibration mode the AST 8800 is programmed to control vibration as well as temperature. **NOTE:** Other operations, such as electronic testing of the products, are not a function of the AST 8800.

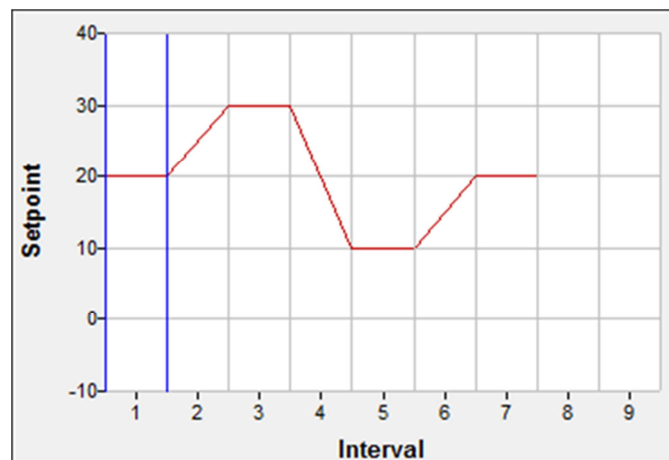
To perform process variable cycling, programs are written to control the chamber. Each program is made up of intervals, up to a maximum of 300 intervals per program. Each interval runs the chamber from an initial value to a final value in a specified amount of time. An interval's time can vary up to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

Each basic interval is programmed with the following entries:

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

- **Low Humidity** enables the optional low humidity system. **NOTE:** Low humidity is disabled if product temperature control (PTC) is enabled.
- **PDC** enables product dew point control, an optional humidity control process. The 8800 will control the temperature and humidity outputs in order to maintain the dew point at a value less than or equal to the monitored load temperature minus the dew point offset. The PDC option must be enabled before or at the same time as a temperature or humidity transition. Enabling the PDC option during a transition will not allow the function to operate, since the set points will have already changed. **NOTE:** The PDC option can be enabled only when the **Humidity** option is enabled. For more information on product dew point control, see Appendix C of this manual.
- **Purge** enables the purge option (if applicable).
- **Vibration** enables vibration for this interval.
- **Refrig Mode** allows you to select the refrigeration mode for each interval. **NOTE:** Power Save is available on SE-Series chambers only.
- **Auxiliaries** (auxiliary relays) may be enabled or disabled for each interval. Auxiliaries are active only when the AST 8800 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 set point is to be cycled from initial value to final value.

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



Along with raising, lowering, and holding the chamber temperature, each interval lasts a specified length of time. The time a temperature is held depends on the product being tested at that temperature.

The interval time has two methods of control:

1. If you enter a **Time** greater than zero, the AST 8800 performs a temperature ramp. This cycles the temperature evenly to the final temperature within the programmed time. If too short a time is programmed, the AST 8800 will transition to the next interval when the time runs out anyway.
  2. If you enable guaranteed soak (**G-Soak**) and set one or more **Deviations**, the AST 8800 will immediately set the set point equal to the interval's final value and then wait until the process variable is within the deviation band of the final value. Once the process variable is within the deviation band, the interval time will begin counting down. For multiple channel programs, all non-zero deviation bands must be satisfied before the interval time will begin counting down.
- Sequential programming is selected by allowing the AST 8800 to increment to the next sequential interval (the default value in the **Next Int** field). Programmed looping is selected by using the **Next Int** and **# Loops** values. **Next Int** indicates the interval to transition to after completion of the current interval; **# Loops** is the total number of times the programmed loop will be executed.

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

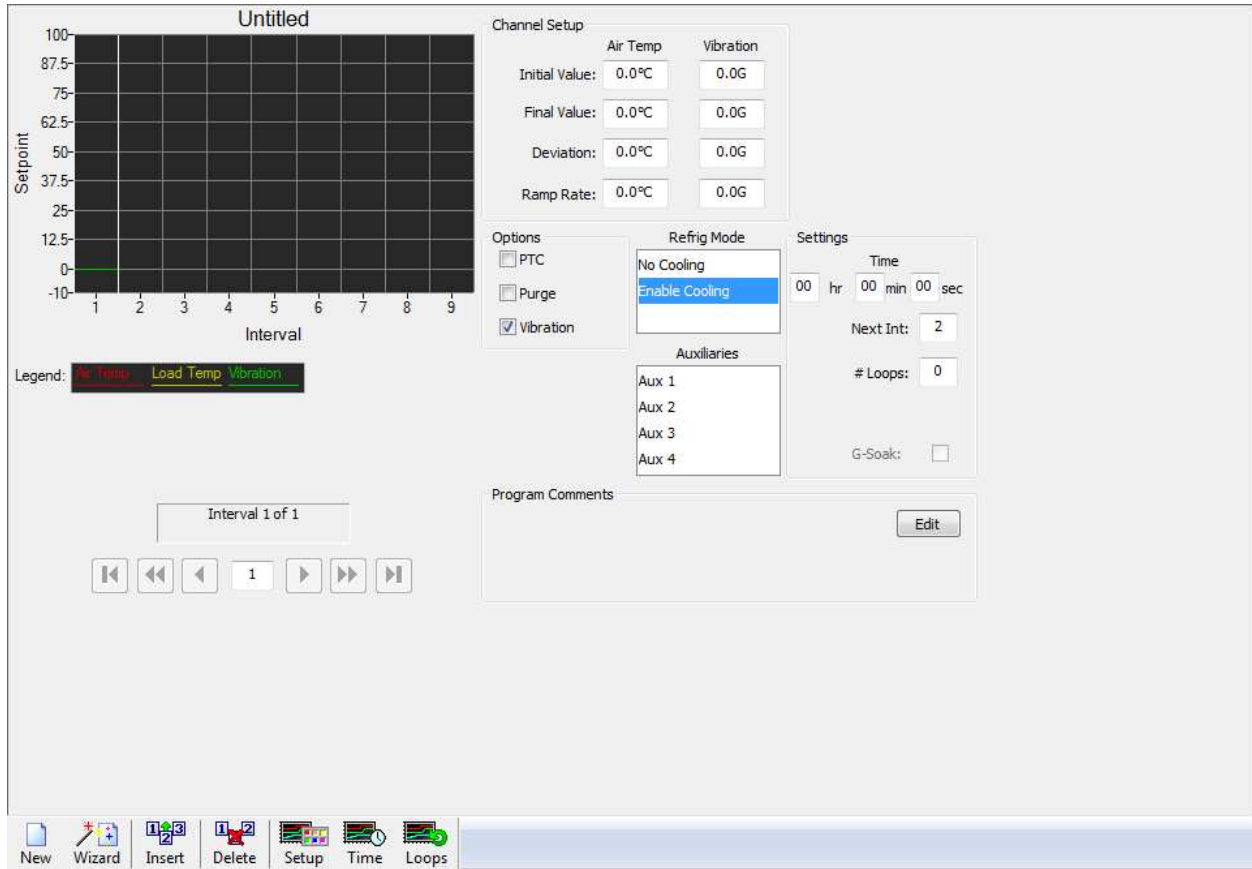
- The target interval may be the target of another loop, but must not cross into another loop. (When a loop is crossed, the target interval is between the beginning interval and the ending interval of the loop).
- Nested looping is legal. In nested looping, one loop starts and finishes inside another loop. Both loops can have the same target interval.
- The final value of the looping interval should be the same as the initial value of the target interval.
- The maximum number of separate loop patterns per program is 64.
- **Param Group** allows you to select the desired parameter group for each interval. For more information, see "Control parameters panel" in Section 1 of this manual.

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

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

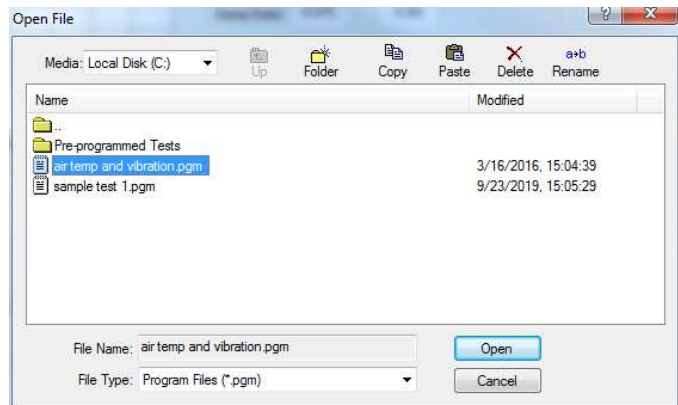
### Creating or modifying a program

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



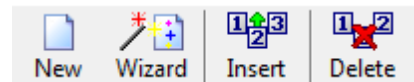
2. If you want to modify an existing program:

- a. Press **Open**. The Open File dialog box will appear.
- b. Select the desired program.
- c. Press **Open**.
- d. Go to step 4.



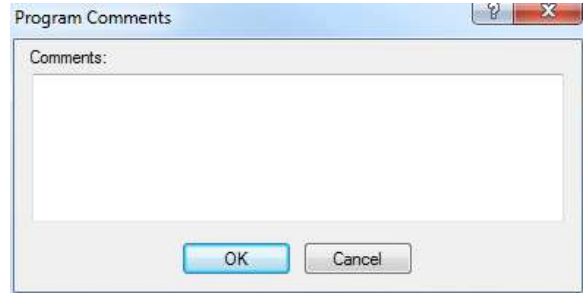
3. If you want to start with a blank profile:

- a. Press **New**.
- b. For on-screen, step-by-step instructions, press **Wizard**, press **Next**, and follow the instructions in the Profile Creation Wizard. Otherwise, go to step 4.

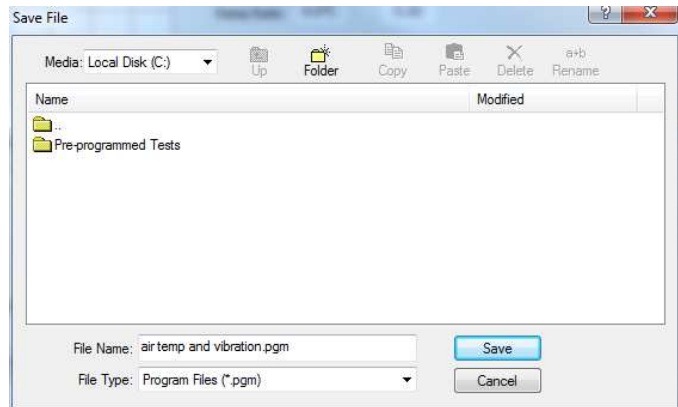


4. Select and change the settings for each interval of the program. The following list describes the program values and options displayed:
  - For **Initial Value** enter the starting value for each active channel's set point for the interval. After interval 1 the initial value will always be the final value of the previous interval and cannot be edited.
  - For **Final Value** enter the ending value for each active channel's set point for the interval.
  - For **Deviation** enter how far you will allow the selected channel's process variable to be from set point. Enter a positive number only; the AST 8800 will monitor both plus and minus deviations and activate the deviation alarm if the values are exceeded.
  - If you want to specify a **Ramp Rate**, enter the speed (in units of measurement per minute) for the AST 8800 to cycle an active channel's process variable to a new set point. (To determine change rates, refer to your chamber manual's performance specifications.) The AST 8800 will calculate the difference between the interval's initial and final values, divide the difference by the ramp rate, and adjust the interval **Time** accordingly. Each active channel can have its own unique ramp rate that runs simultaneously.
  - Select the desired **Options** for the interval. This will allow you to enable or disable vibration, PTC, or other options available on your chamber on a per-interval basis. **NOTE:** Enabling **Humidity** disables the **PTC** (product temperature control) channel. Enabling **PTC** disables the **Humidity** channel. When **PTC** is enabled, only the values for the PTC channel can be edited. Depending on your chamber's configuration, other options also may disable each other.
  - Select the desired **Refrig Mode** (refrigeration mode) for the interval. **NOTE:** Power Save is available only on SE-Series chambers.
  - Select the desired **Auxiliaries** for the interval. Standard auxiliaries are active only when the AST 8800 is in run mode. Live auxiliaries can be enabled without the AST 8800 being in run mode.
  - For **Time** enter the length of the interval in hours, minutes, and seconds. The maximum interval time is 99 hours, 59 minutes, 59 seconds.
  - For **Next Int** enter the number of the interval you want the AST 8800 to transition to after this interval is complete. For programmed looping this number must be less than or equal to the current interval number, and the **# Loops** value must be greater than 1. If no loops are programmed, the **Next Int** field displays the number of the next interval.
  - For **# Loops** enter the number of times you want the programmed loop to be executed. A loop can be repeated up to 9,999 times. **NOTE:** The interval will actually loop back to the target interval the **# Loops** value minus 1.
  - Select the desired **Param Group** (control parameter group) for the interval. For more information, see "Control parameters panel" in Section 1 of this manual.
  - To enable guaranteed soak, check **G-Soak** and set one or more **Deviations**. The AST 8800 will immediately set the set point equal to the interval's final value and then wait until the process variable is within the deviation band of the final value. Once the process variable is within the deviation band, the interval time will begin counting down. For multiple channel programs, all non-zero deviation bands must be satisfied before the interval time will begin counting down.
  - To insert a new interval following the current interval, press **Insert**.
  - To delete the current interval, press **Delete**.

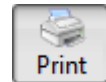
5. To add descriptive comments to your program:
  - a. Press **Edit** under Program Comments. The Program Comments dialog box will open:
  - b. Select the Comments field and use the alphanumeric keyboard to add your comments.
  - c. To save your comments, press **OK**.



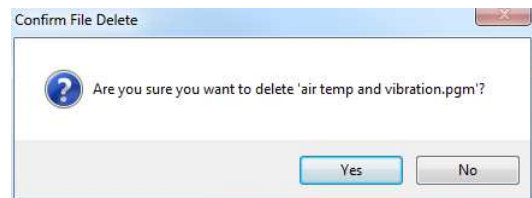
6. You may save your program at any time by pressing **Save**.
  - a. The first time you save the program, select the File Name field and use the alphanumeric keypad to enter a file name.
  - b. Press **Save**.



7. The program graph allows you to view your program in several different ways as you create it. For information on viewing and modifying the graph, see "Using the program graph" below.
8. To print the currently loaded program as a combined graph and spreadsheet, press **Print**.  
**NOTE:** Programs can be printed only in interval view. Programs cannot be printed in time or expanded loop view. For more information, see "Using the program graph" below.



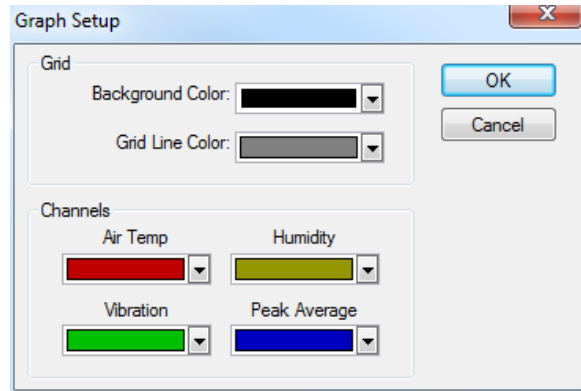
9. To delete a saved program:
  - a. Press **Open**. The Open File dialog box will appear.
  - b. Select the desired program.
  - c. Press **Delete**.
  - d. Press **Yes** to confirm the deletion.



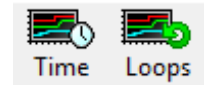
**Using the program graph**

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

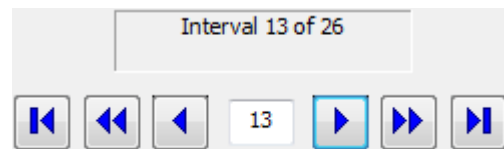
1. To modify the program graph's appearance:
  - a. Press the graph **Setup** button. The Graph Setup dialog box will appear:
  - b. Select the background and grid line colors from the drop-down menus.
  - c. Select the channel colors from the drop-down menus.
  - d. Press **OK** to accept your selections or **Cancel** to close the Graph Setup dialog box without making any selections.



2. The program data can be viewed on the graph in several different ways:
  - To display the program with each interval given space based on its duration, select **Time**.
  - To display the program with each interval given the same amount of space regardless of its duration, deselect **Time**.
  - In either interval or time view, you may display all of the loops in a program by selecting **Loops**.



3. Once a program is loaded, you can use the arrow buttons to move through the graph:
  - To move back to the first interval, press the first button.
  - To move back 12 intervals, press the second button.
  - To move back to the previous interval, press the third button.
  - To move forward to the next interval, press the fourth button.
  - To move forward 12 intervals, press the fifth button.
  - To move to the last interval, press the sixth button.

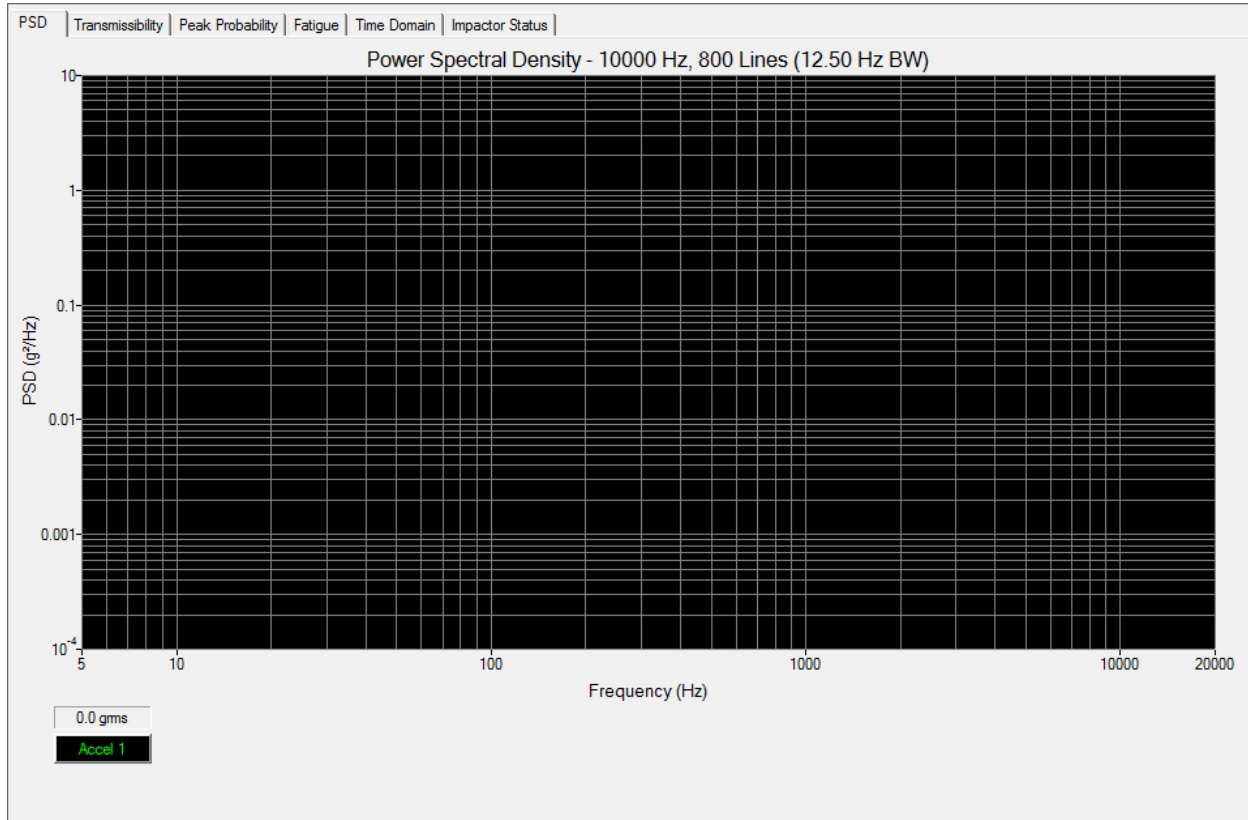


## Vibration analysis

Pressing the **Vib Info** button from anywhere in the program will display the vibration analysis screen. This will allow you to view frequency domain analysis of the accelerometers in the form of a power spectral density (PSD) plot. In addition, any advanced analysis options that have been purchased may be viewed here.



### PSD



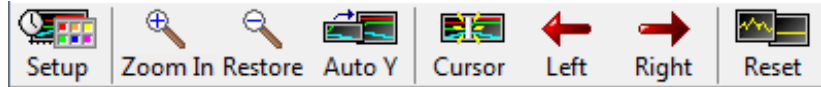
This screen shows how much energy is at each frequency of the response. At the top of the screen, the current FFT analysis options (set in the Vibration configuration setup screen) are shown: the max frequency (in **Hz**), how many **Lines** are being used, and the current bandwidth (**BW**), which is the max frequency divided by the number of lines.

On the graph itself, the x-axis is in Hz, while the y-axis is the PSD value in  $g^2/Hz$ . Each channel that is enabled on the Vibration Configuration screen can be viewed on this screen. Below the graph is the G RMS value for each enabled channel, as well as a button that can be pressed to enable or disable the display of that channel on the PSD graph. For each enabled channel, the text on the button shows what color that channel's plot is on the graph.

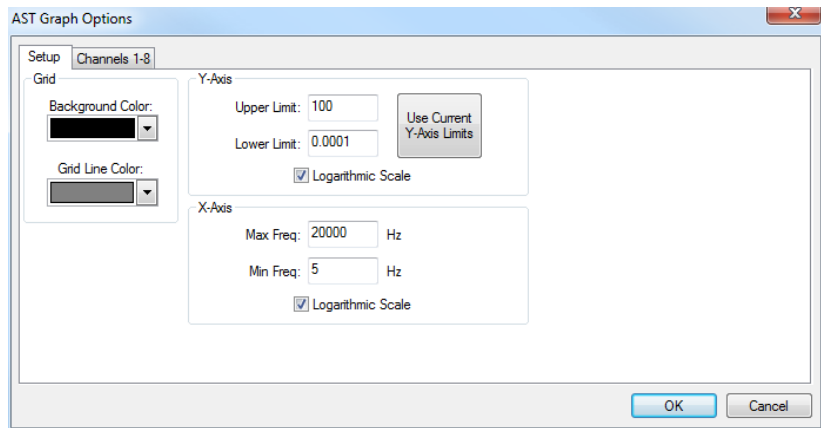
To zoom in on a particular area of the graph, simply click and drag a rectangle around the area of interest. Press the **Restore** button to return to the previous graph settings.

Below the graph are several buttons used for configuring the graph:

- **Setup:** Configure basic graph settings such as axis limits and colors.



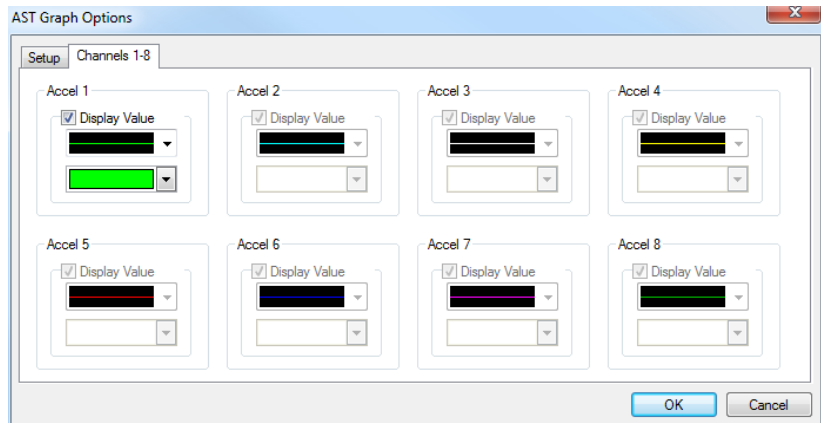
- In the **Grid** section of the Setup tab, set the graph background and grid line colors.
- **Y-Axis** upper and lower limits set the  $g^2/Hz$  range the graph will use.
- **X-Axis** maximum and minimum limits set the frequency range (in Hz) that will be visible.



- Select **Use Current Y-Axis Limits** to import whatever zoomed or **Auto Y** limits are currently being viewed on the graph, setting them as the new default values.
- Check **Logarithmic Scale** to view either axis logarithmically (powers of ten, such as 10, 100 and 1000, are evenly spaced along the axis; this is typically how PSD data is viewed). The limits chosen do not need to be powers of ten.



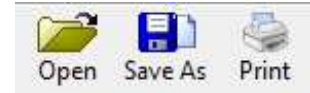
- Individual line colors and patterns can be set under the **Channels 1-8** tab (on 16 channel systems, there will be another tab labeled **Channels 9-16**). Checking the **Display Value** checkbox will hide or display the given channel (it has the same effect as pressing the channel's button on the main PSD screen).



- **Zoom In:** To zoom in on a specific part of the graph, click the **Zoom In** button, then click the area of the graph you wish to center vertically and zoom in on. This will adjust the Y-Axis limits to narrow in on the area clicked. Press **Restore** to return to the previous graph settings. Alternatively, click and drag a rectangle to zoom in on a desired area as described above.
- **Restore:** After zooming in or using the **Auto Y** button, press **Restore** to return to the default graph settings.
- **Auto Y:** Press to automatically display all of the data for all of the enabled plots. Press **Restore** to return to the default graph settings.
- **Cursor:** Press to enable a vertical cursor that will show specific data values on a point-by-point basis on the graph. You can click anywhere on the graph to get the data for that frequency.
- **Left/Right:** These arrow buttons move the cursor to the left or right one data point at a time. Use these buttons to zero in on a specific data point.
- **Reset:** Pressing the **Reset** button clears out the current averaged PSD data buffer and restarts the PSD averaging.  
**NOTE:** It does not affect vibration control in any way.

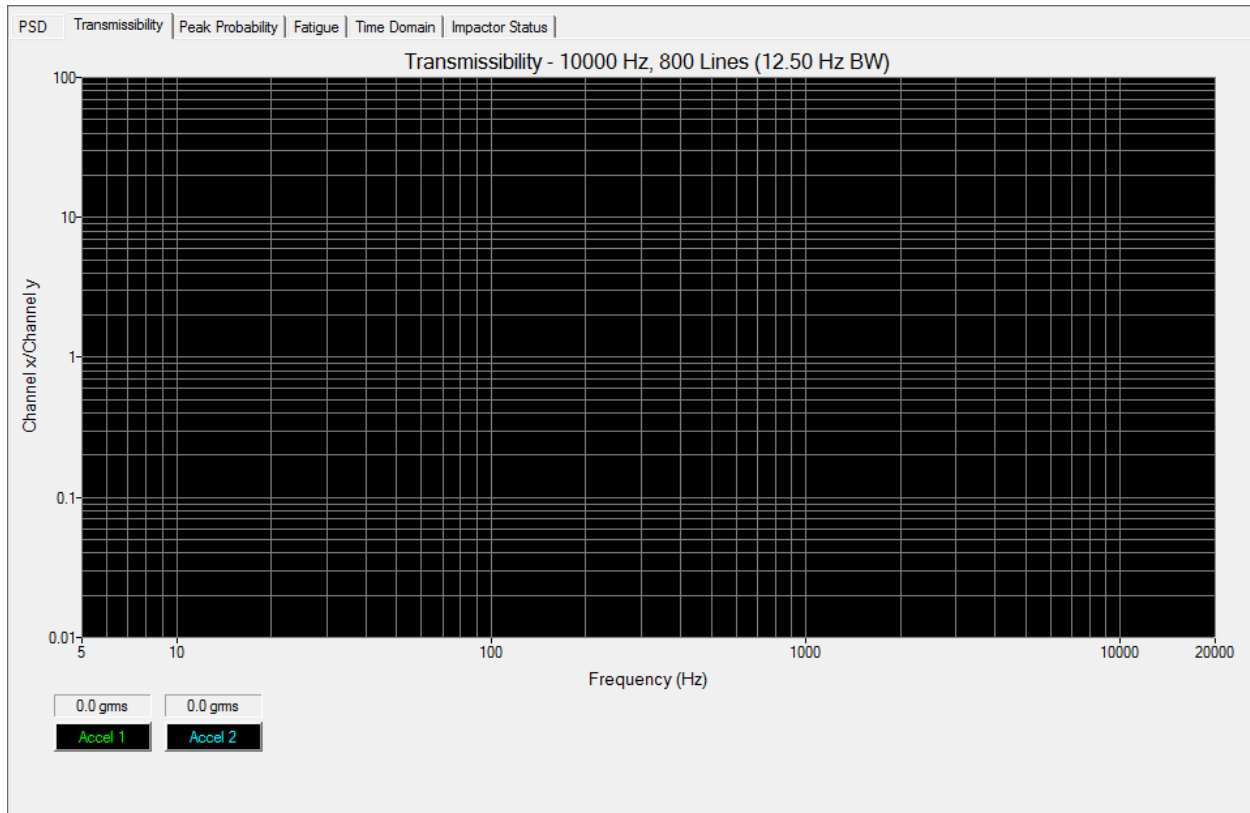
All PSD data can be saved to disk for later viewing or importing into a spreadsheet program such as Excel. Graphs may also be printed from this screen.

- **Saving:** Press the **Save As** button to save the currently active PSD plot. A standard dialog box will allow you to select a location and file name. Select from one of three file types:



- **Chamber Data Files (\*.csv):** Comma-delimited format that allows for later importing into a spreadsheet program. This also saves channel data such as the channel name and current G RMS value for all enabled channels.
  - **Graph Picture Files (\*.bmp):** Standard bitmap format that saves a screenshot of the current data. This may be opened later in the picture editor of your choice, or imported into a word processor such as Microsoft Word for inclusion in a report.
  - **AST LabView File (\*.prn):** This is a comma-delimited format that is backwards compatible with the previous version of Thermotron's AST software. Only use this if you need to maintain backwards compatibility with a previous LabView AST installation.
- **Loading:** To view a previously saved CSV file, press the **Open** button and select the desired CSV file. You may then perform all of the standard PSD graph operations such as zooming in and printing. Press the red "X" in the corner of the graph to return to the live PSD view.
  - **Printing:** To print the current PSD graph, whether live or saved data, press the **Print** button. You will be presented with the option of adding a title, description, and "printed by" line to the printout. When printing to a color printer, the colors you have selected will be used, with the exception of the background color which will always be white to save on printer ink.

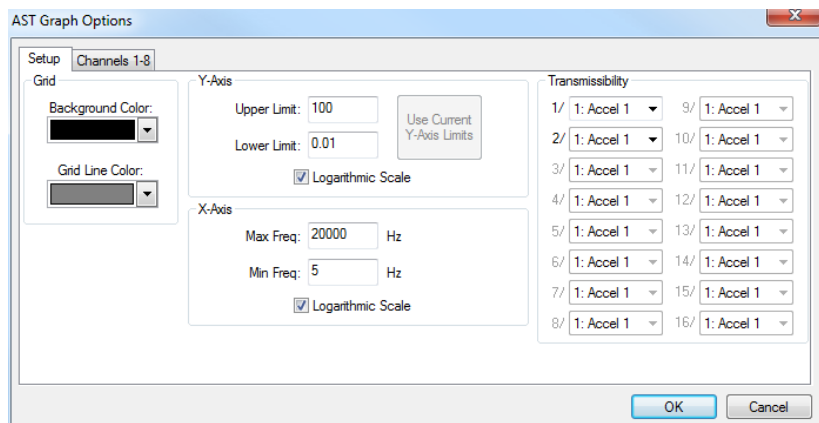
**Transmissibility (optional)**



If you purchased an advanced vibration analysis package with transmissibility, next to the PSD tab there will be a tab labeled Transmissibility. With transmissibility, you can view how any two enabled channels relate to each other. This is done by dividing one channel’s PSD graph, point by point, by one of the other channel’s PSD graph. If the two graphs are equal, the result is 1. The more two channels diverge, the further the transmissibility drifts from 1.

Typically, a monitor channel is divided by the control channel. For example, if the value at 50 Hz is 0.01 g<sup>2</sup>/Hz and the control at 50 Hz is 0.001 g<sup>2</sup>/Hz, the value on the transmissibility graph at 50 Hz will read 10.

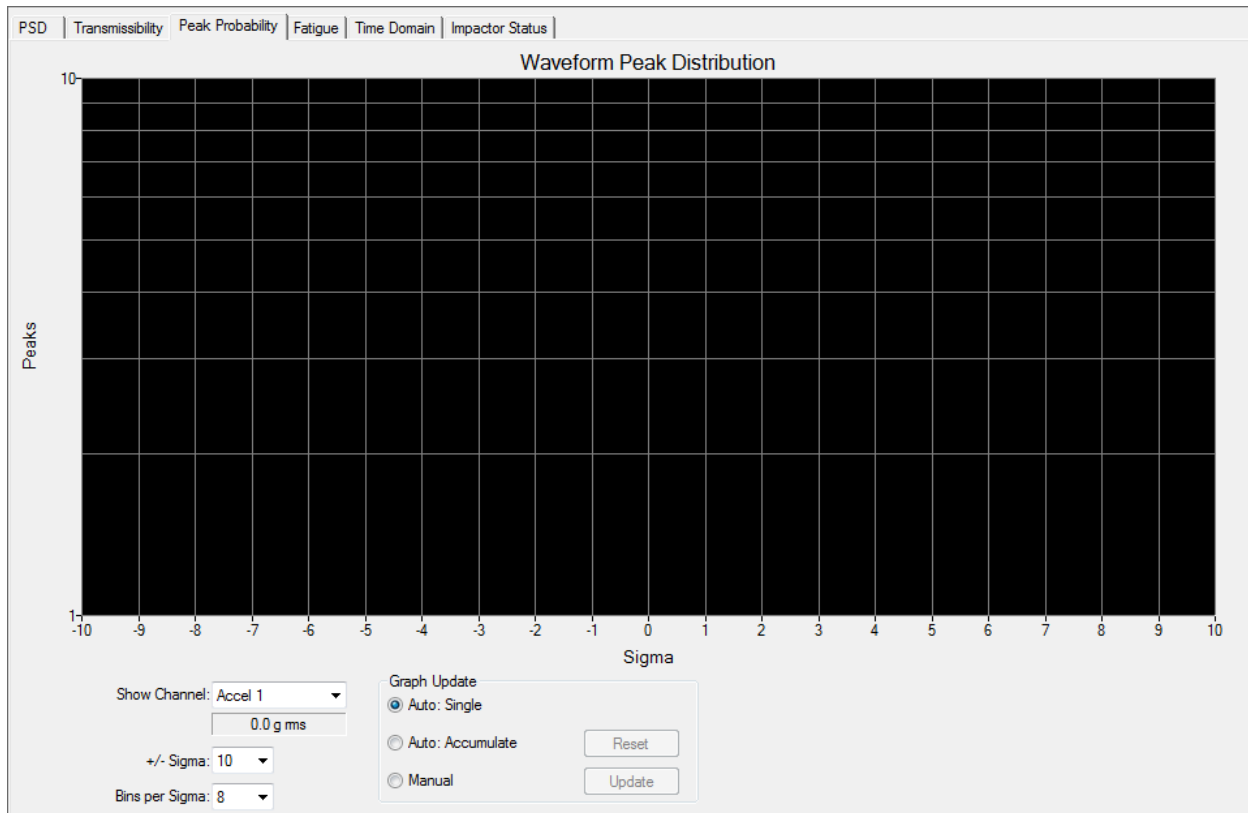
The graph manipulation and setup is the same as the PSD graph described above. To set up which channels should be divided by each other, click the **Setup** button. You will see a setup screen similar to that for the PSD graph, with an additional section that lets you configure the transmissibility channels.



In the **Transmissibility** section, all configured control and monitor channels will be enabled. In the example shown here, both Accel 1 and Accel 2 are divided by Accel 1. This means that Accel 1 will display as a straight line (at 1) and holds no useful information. It can be easily hidden by pressing its button on the graph screen. Accel 2’s transmissibility plot, on the other hand, will display its relationship to Accel 1.

### Peak Probability (optional)

When this option is purchased, a tab titled Peak Probability appears in the Vib Info screen. This option displays a histogram of the probability distribution of the peaks and valleys of the input signal. The histogram is displayed as peaks versus  $\pm$ sigma (standard deviation) distribution. The signal being analyzed is composed of peaks (positive) and valleys (negative). This graph can be used to show the random nature of the input signal. A random signal will have a bell curve shape with some peaks and valleys greater than +3 sigma and some peaks and valleys less than -3 sigma where sigma is equal to one standard deviation.



Select a channel from the **Show Channel** drop-down menu. The menu will list all currently enabled accelerometer channels. Once an accelerometer is selected, its peak probability data will accumulate whenever the controller is in run mode and vibration is enabled.

- **g rms**: The current g rms level for the given accelerometer.
- **+/- Sigma**: Select the range of the X axis of the histogram to display.
- **Bins per Sigma**: Determine the number of bins that each sigma will be divided into for the histogram display.

You can control the way the histogram is updated using the options in the **Graph Update** field:

- In **Auto: Single** mode the histogram displays the latest sample.
- In **Auto: Accumulate** mode the histogram continues to accumulate samples until the **Reset** button is pressed. Pressing the **Reset** button resets all data to zero and begins re-accumulating peak probability data.
- In **Manual** mode an **Update** button appears next to this control. Pressing the **Update** button will cause the software to do a peak probability calculation on the selected accelerometer input signal.

To print the current peak probability data, press the **Print** button at the top of the screen. A dialog will appear that allows you to add a title, notes, and printed-by line.

To save the current peak probability data in a comma-delimited format, press the **Save As** button at the top of the screen. The date and time is saved, followed by the column headers and then the data.

### Fatigue (optional)

When this option is purchased, a tab titled Fatigue appears in the Vib Info screen. Fatigue damage occurs to a product when it is subjected to various stimuli such as temperature, vibration, pressure, etc. The AST fatigue analysis option calculates and accumulates fatigue due to vibration stress.

Select Channel	Beta	GRMS	Fatigue/sec	Fatigue Total	Run Hours	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
Select a value...	4.0	-	-	-	-	Reset
						Reset all

Select a channel from the **Select Channel** drop-down menu. The menu will list all currently enabled accelerometer channels. Once you select a channel, the rest of the row becomes enabled for use. Once an accelerometer is selected, its fatigue statistics will accumulate whenever the controller is in run mode and vibration is enabled.

**Beta:** The negative slope of the material’s S-N curve. Most materials have a beta value between 6 and 25. This is a power function used in fatigue calculations based on Miner’s rule as follows:

$$\text{Fatigue} = ns^b \text{ where: } \begin{aligned} n &= \text{number of stress cycles} \\ s &= \text{amplitude of stress} \\ b &= \text{the negative slope of the material’s S-N curve (beta)} \end{aligned}$$

Many times the device under test (DUT) will not have a known beta power function value. When this is the case you should enter a value that seems most reasonable based on the composition of the DUT. Once a beta value has been chosen for a particular DUT it is important to use the same beta value for all testing of the same type of DUT.

**GRMS:** The current GRMS level for the given accelerometer.

**Fatigue/sec:** The amount of fatigue accumulating per second, averaged over the most recent minute of run time.

**Fatigue Total:** The total amount of fatigue accumulated during run time since the last time **Reset** was pressed.

**Run Hours:** The total elapsed hours since the fatigue calculation was enabled for this accelerometer or **Reset** was pressed.

**Reset:** Press this button to reset the current fatigue totals.

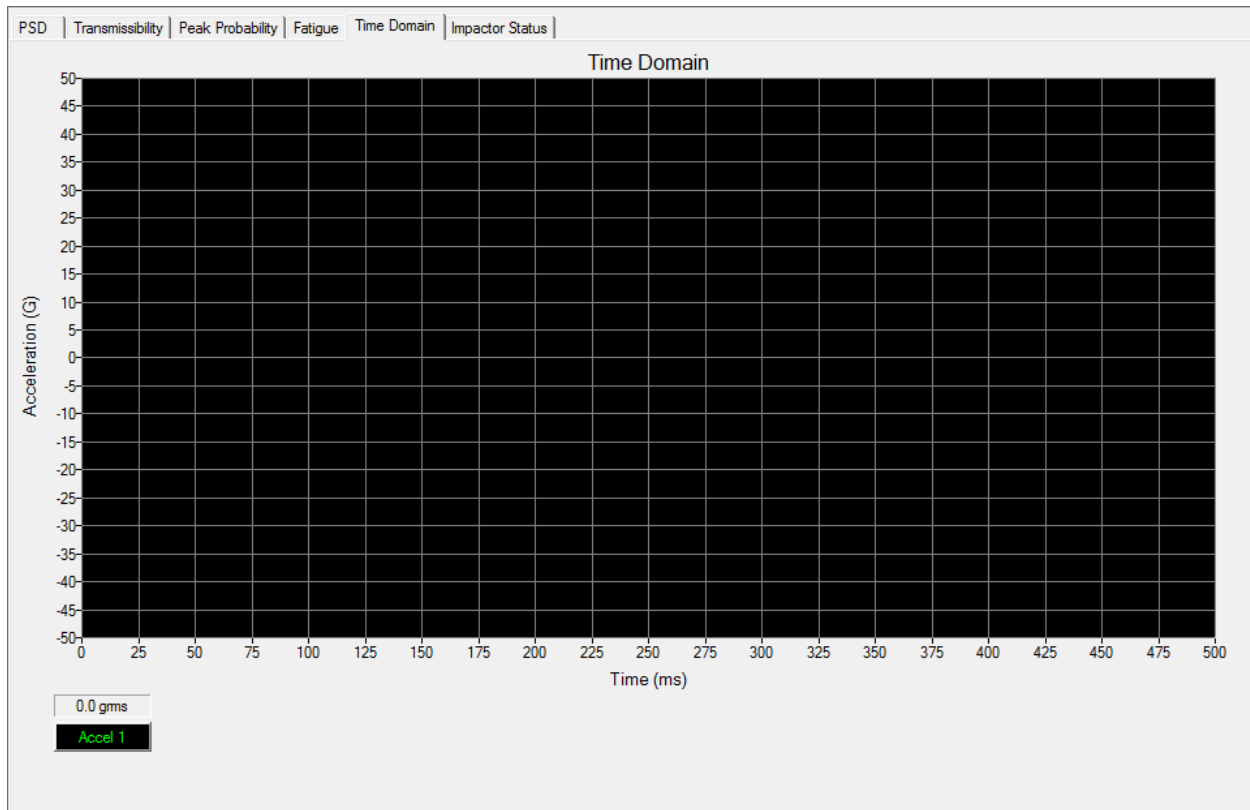
To print the current fatigue data, press the **Print** button at the top of the screen. A dialog will appear that allows you to add a title, notes, and printed by line.

To save the current fatigue data in a comma-delimited format, press the **Save As** button at the top of the screen. The date and time is saved, followed by the column headers and then the data. For example, the above data gets saved as shown here:

4/28/2005, 9:27:13

```
Accel,Beta,GRMS,Fatigue/sec,Fatigue Total,Run Hours
Accel 3,3.0,5.1,8.721e+005,1.342e+008,0.04
Accel 4,3.0,5.2,1.208e+006,1.714e+008,0.04
Accel 5,2.0,9.8,2.903e+004,3.938e+006,0.04
```

**Time Domain**

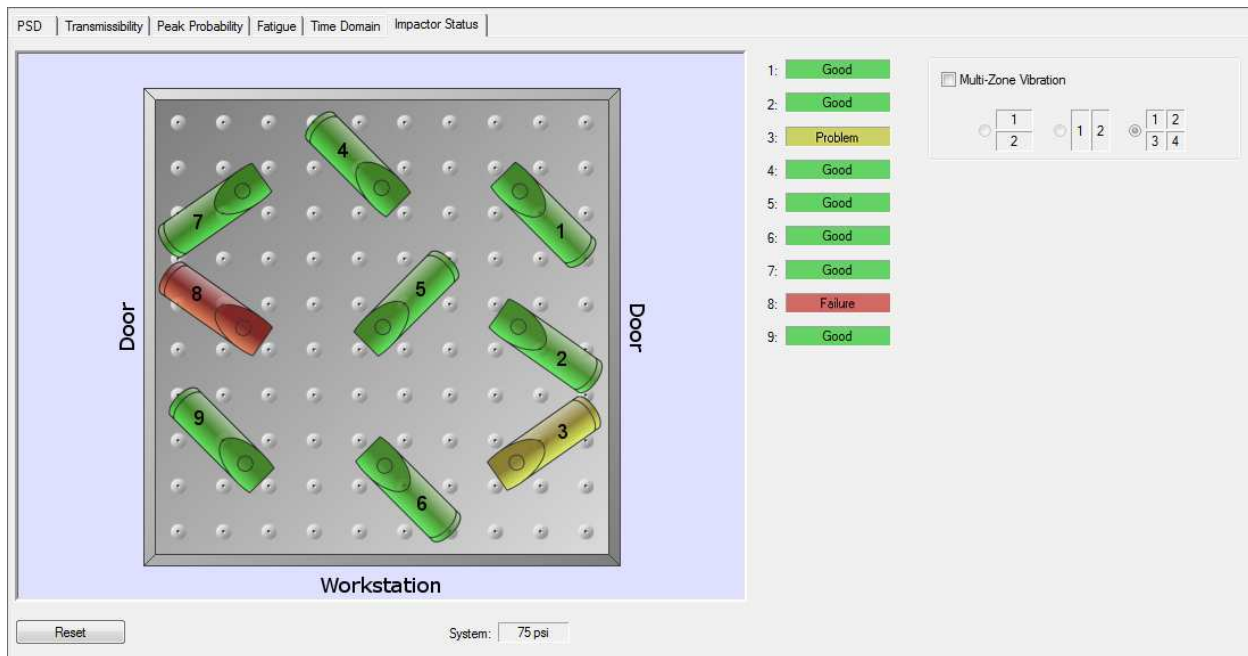


This graph displays an oscilloscope-style reading of the time domain signal of the selected accelerometer(s). It is primarily used for verifying Sync mode operation on SCI systems. For example, if you are running 1000-G peaks in Sync mode, you can look at this graph and verify that you are actually getting 1000-G peaks (spikes) at the proper time interval. For more information on SCI systems, refer to Appendix B of this manual.

**NOTE:** The y axis is in G peak, the x axis is in milliseconds, and the indicators at the bottom show the currently calculated Grms value of the selected accelerometer(s).

## Impactor status

Because the repetitive shock unit is a mechanical shaker, various components will wear over time and use. The impactor status screen warns of potential problems with individual impactors.



The screen illustrated above indicates that some of the impactor components on the RS(L) unit may be wearing. Each impactor appears in green, yellow, or red, with its status described in the numbered list to the right of the illustration:

- Green:** Impactors that are working properly appear in green and are marked **Good**.
- Yellow:** Impactors that show signs of wearing out appear in yellow and are marked **Problem**. Impactors that appear in yellow are able to perform for most tests, but likely have limited life left in them.
- Red:** Impactors that have very little force left in them and are therefore dysfunctional appear in red and are marked **Failure**.

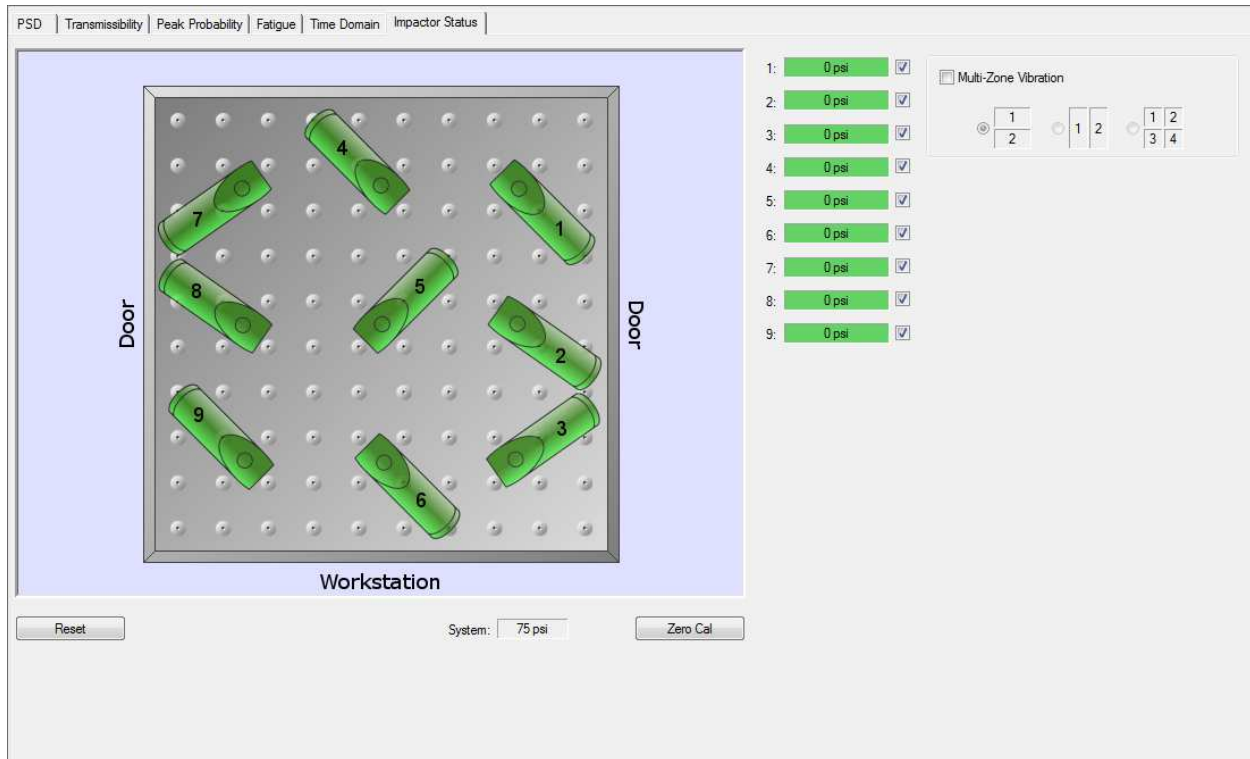
**NOTE:** The diagnosis applies to the impactor, hoses, and the solenoid that controls it. A problem with any one of those components, for example a loose hose, may cause the impactor to appear faulty.

### Reset button and system pressure indicator

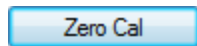
The impactors are constantly monitored while the vibration table is being used. Any impactors that are failing or have failed will normally be detected within three to six minutes of operation. To reset the status of all impactors to **Good**, press the **Reset** button. **NOTE:** If the impactor is still faulty it will go back into the red or yellow state within a few minutes of operation.

The **System** pressure is displayed for reference. Ensure that the pneumatic system maintains a pressure of at least 75 psi while the RS(L) unit compressor is running. This should normally be set to 75 psi, and will vary as air pressure is used during a test. If the pressure is less than 75 psi, physically check the impactor and the shop air supply.

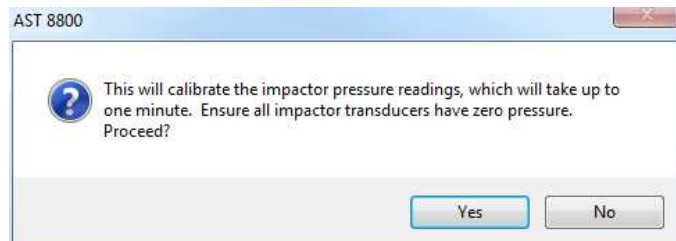
Calibration



In the calibration access level, the impactor list will display the air pressure being read at each impactor. When the system is on and the air has been released from the system, these should all read **0 psi**. If they do not, press the **Zero Cal** button to reset all of the impactors to read **0 psi**. This will correct for minor differences found in the sensor sensitivities.



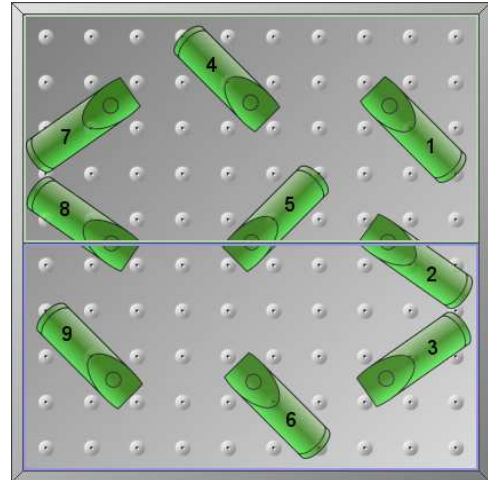
The checkboxes located to the right of the air pressure readings are for turning individual impactors on and off. When an impactor is disabled, the impactor in the illustration above turns gray. This function is useful for troubleshooting individual impactors.



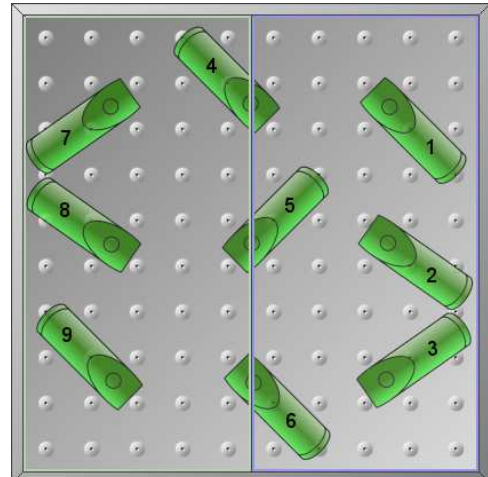
**Multi-zone vibration control**

Repetitive shock systems with the multi-zone control option can use two or four closed vibration control loops instead of only one as in past systems. With this option the RS shaker can operate with the standard one closed vibration control loop, or with one of three multiple closed vibration control loop zone configurations:

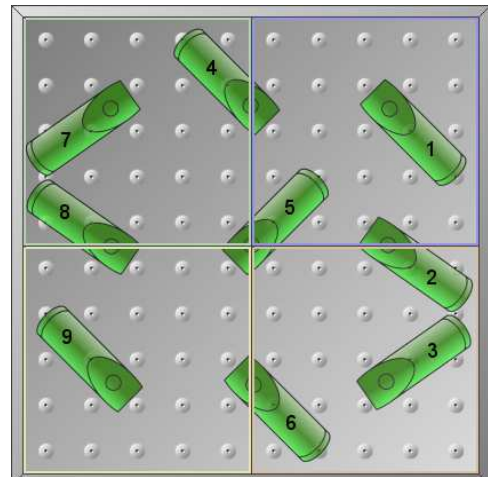
- Two-zone (top and bottom zones)



- Two-zone (left and right zones)



- Four-zone (one zone in each quadrant of the table)



There is one closed vibration control loop in each of the specified zones to ensure that the table is operating at the desired vibration level. The system uses individual impactor control to adjust the air pressure to the impactors, increasing or decreasing the acceleration level independently in each zone. An accelerometer is required in each zone to provide vibration feedback to the controller. Larger tables have more than one impactor in each zone. All impactors in each zone will be at the same throttle.

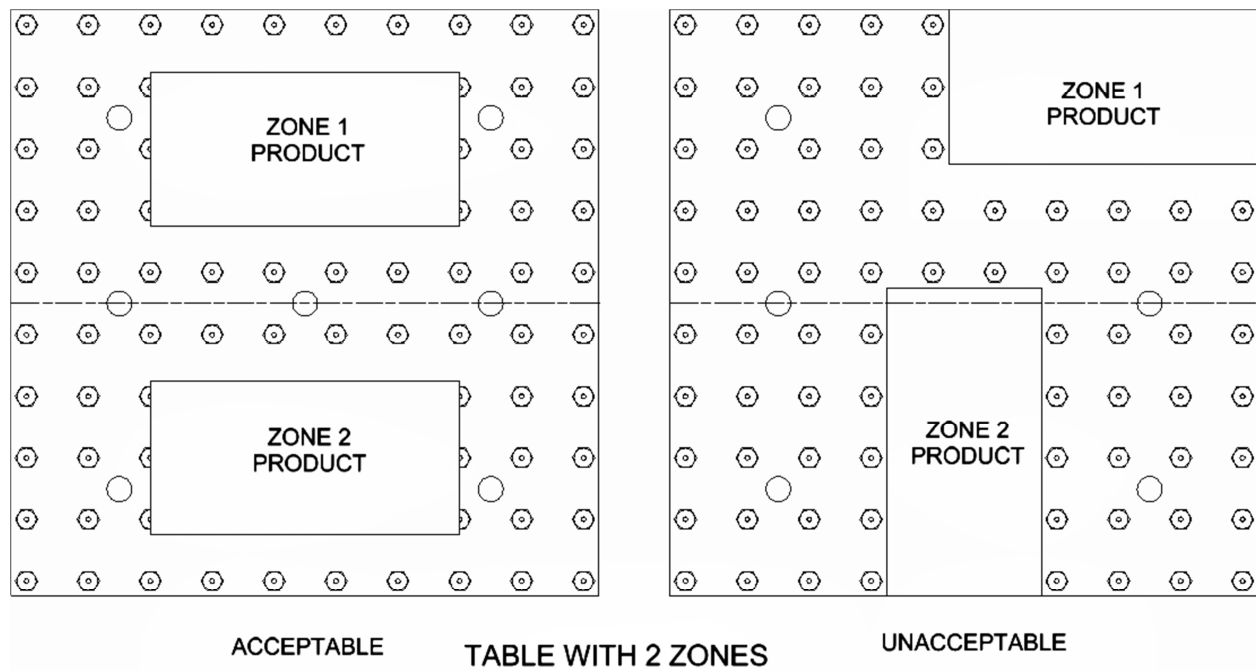
**NOTE:** Although multi-zone control can adjust the acceleration levels in the table zones to compensate for minor mechanical differences, this option is not intended to correct for major system failures. Keep the system in good working condition. Refer to the "Preventive Maintenance" section in the *Accelerated Stress Testing/Repetitive Shock Instruction Manual* or *Repetitive Shock Table Instruction Manual*. The multi-zone control option uses the system monitoring function to detect component failures. Verify that all impactors are functioning correctly and that there are no damaged components that will compromise system operation.

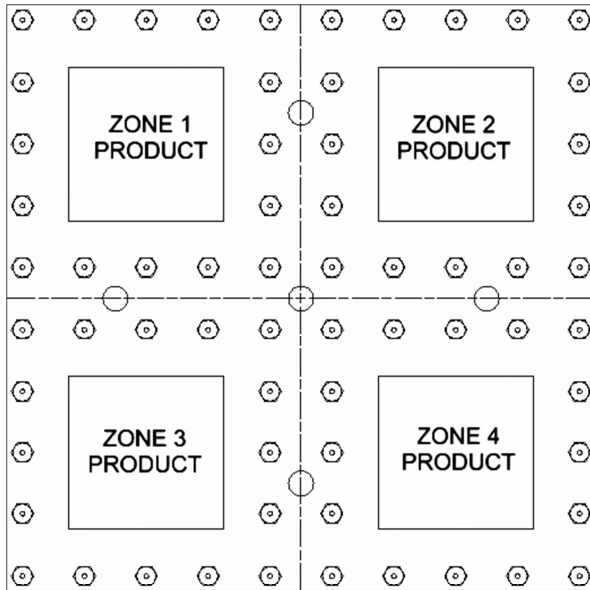
**NOTE:** Multi-zone control can adjust for minor structural differences but is not intended to correct for improper product mounting or inadequate fixture design. Use the same mounting configuration to attach the product to the table in each of the zones. Different fixturing to test the same product will result in different vibration responses. Make sure that all fasteners securing the product and fixture are properly tightened.

**Multi-zone product mounting guidelines**

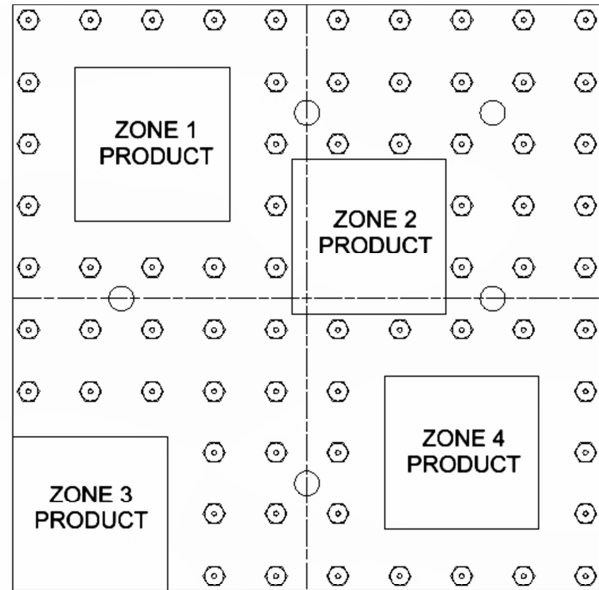
Symmetry is important when using multi-zone control. When using two zones, place products and fixturing across the centerline of the table. Also attach the control accelerometer at the same location on the product. The vibration response at one location or on one component will be different at another location or on a different component.

Refer to the illustrations below for examples of acceptable and unacceptable product mounting locations.





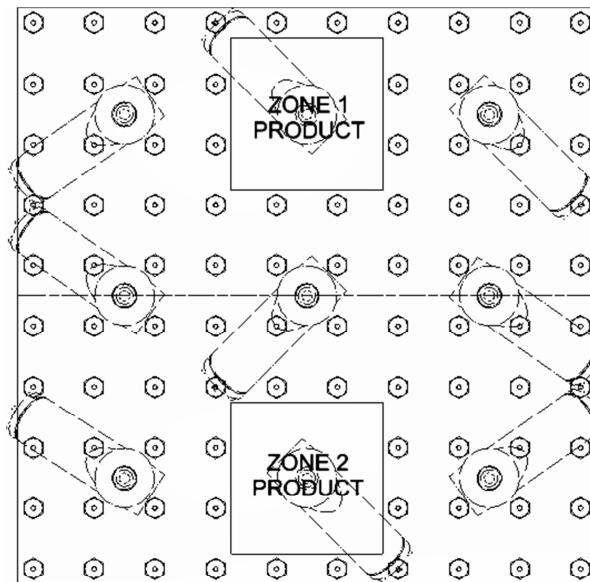
ACCEPTABLE



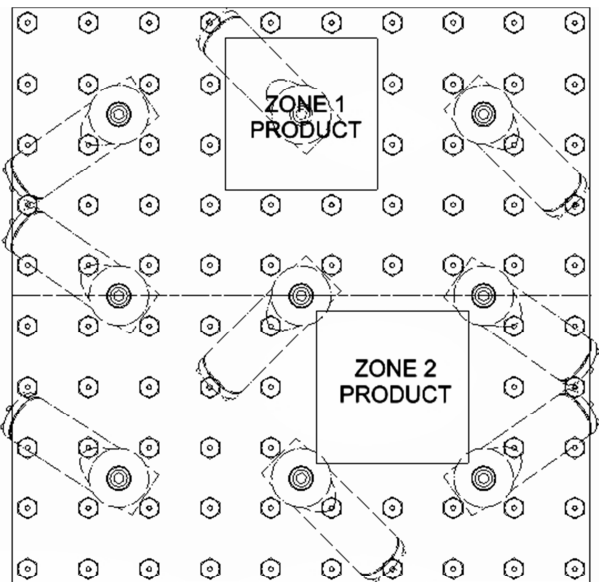
UNACCEPTABLE

TABLE WITH 4 ZONES

Do not place one product above an impactor and another between impactors because the response will be different. The same mounting placement guidelines apply when each quadrant is controlled independently.



RECOMMENDED



NOT RECOMMENDED

TABLE WITH 2 ZONES

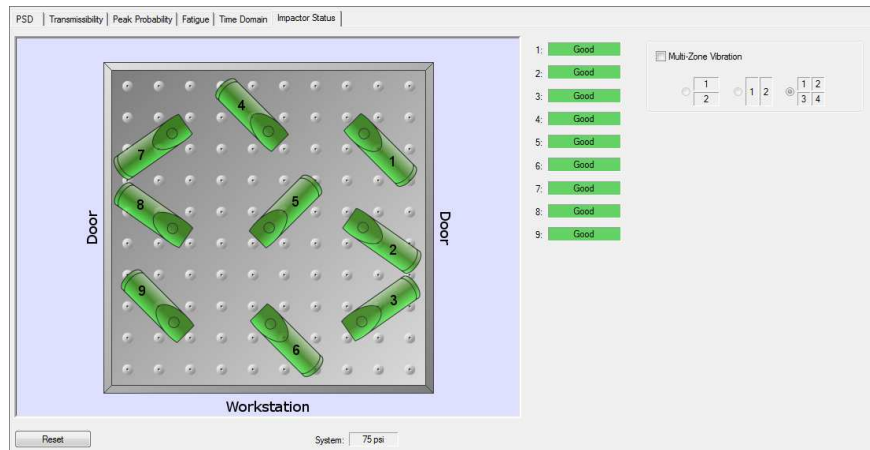
The multi-zone control option is capable of testing a different product in each zone at the same time. Keep in mind, however, that because products vary so widely in such aspects as materials, mass, size, and shape, and because each responds differently to vibration excitation, it is difficult to predict if the system is capable of controlling them. As with any product testing, the user assumes all responsibility to verify that the test is sufficient to ensure a desired result.

When attaching accelerometers in multiple zones to measure vibration responses, Thermotron recommends using the same accelerometer manufacturer and model. Construction and electronics may vary between two different accelerometer models, resulting in different vibration readings. The multi-zone control option may not be able to correct for these differences.

**AST 8800 multi-zone control configuration**

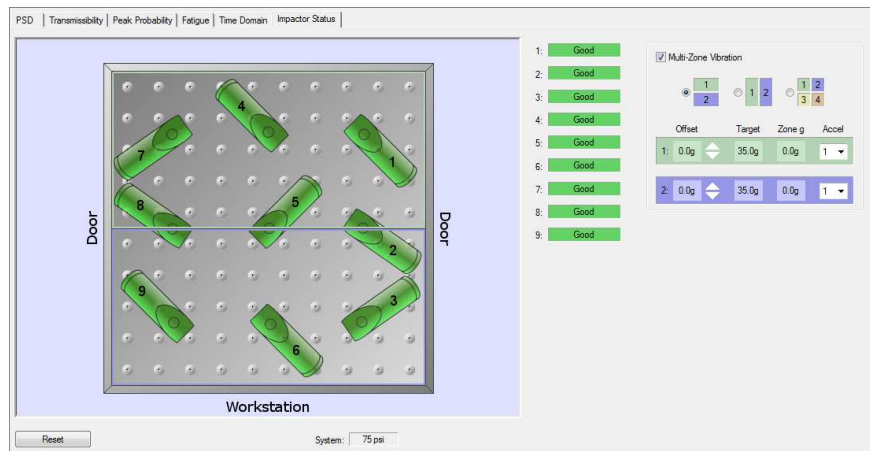
- To view the AST 8800 multi-zone vibration control settings, press **Vib Info**, then select the **Impactor Status** tab.

When the multi-zone option is not enabled, as shown to the right, the AST 8800 operates with a single closed vibration control loop.

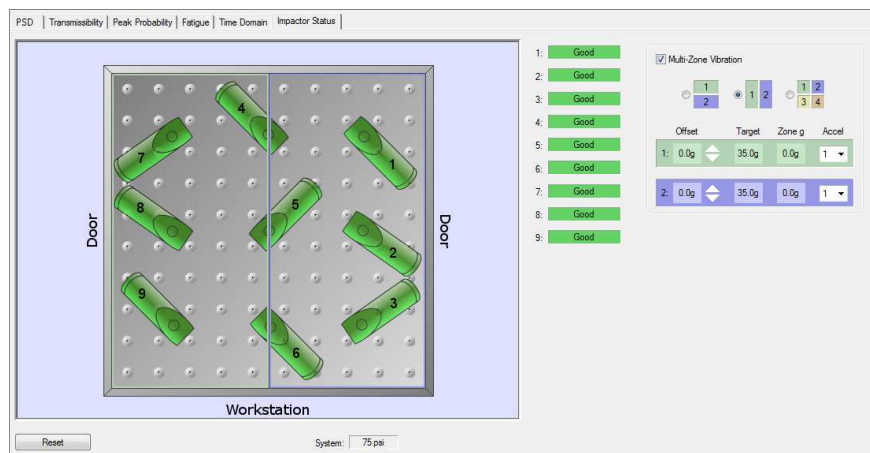


- To enable multi-zone control, select the **Multi-Zone Vibration** check box, then select one of the three multi-zone orientations.

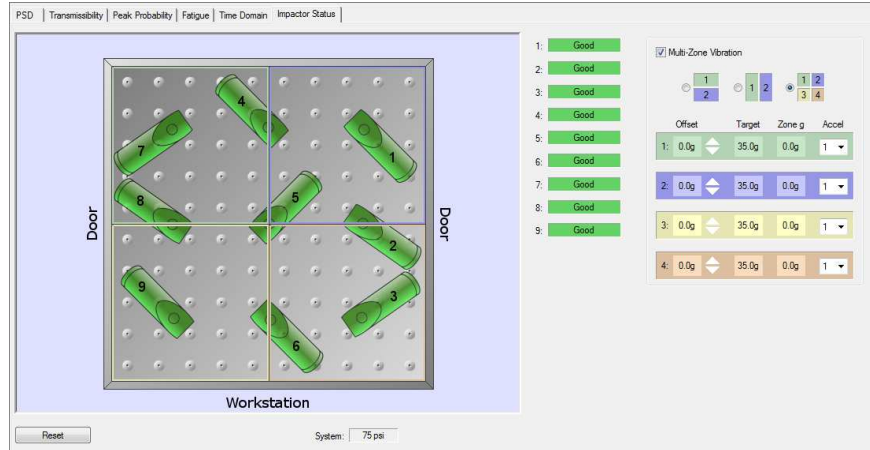
This screen shows multi-zone vibration enabled and the top and bottom two-zone mode selected. The shaker table graphic on the left side of the screen shows the horizontal orientation of the selected two-zone mode.



This screen shows multi-zone vibration enabled and the left and right two-zone mode selected. The shaker table graphic on the left side of the screen shows the vertical orientation of the selected two-zone mode.



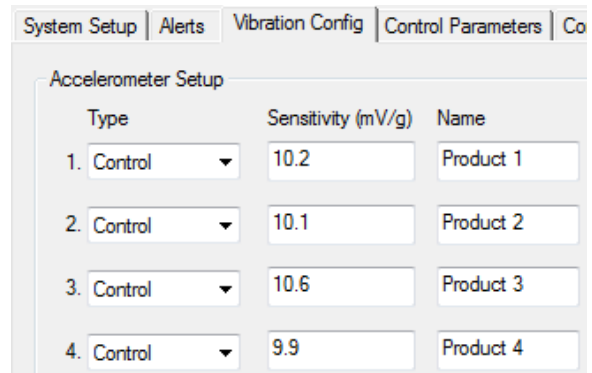
This screen shows multi-zone vibration enabled and the four-zone mode selected. The shaker table graphic on the left side of the screen shows the table divided into four control zones.



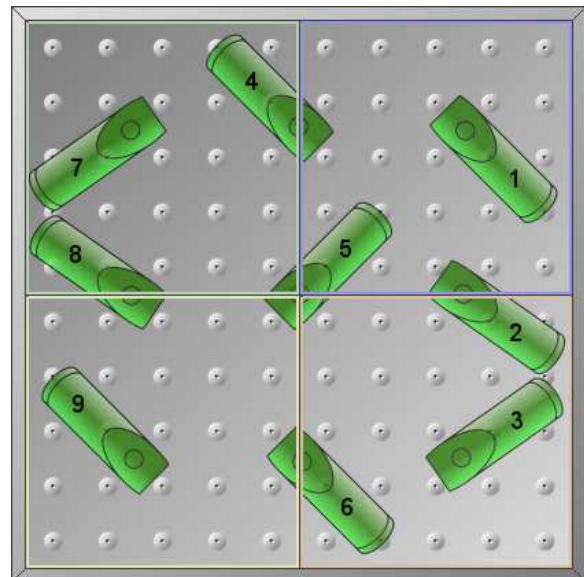
**Example of multi-zone setup and operation**

The following example illustrates how to configure the repetitive shock system for four-zone vibration control.

1. Press **Setup**, then select the **Vibration Config** tab. Under **Accelerometer Setup**, set up the four control accelerometers as shown to the right.



2. Mount a product in the center of each quadrant of the RS table, and mount an accelerometer on the product or fixture in each quadrant of the table.



3. Press **Vib Info**, select the **Impactor Status** tab, make sure **Multi-Zone Vibration** is checked, and select the four-zone mode.

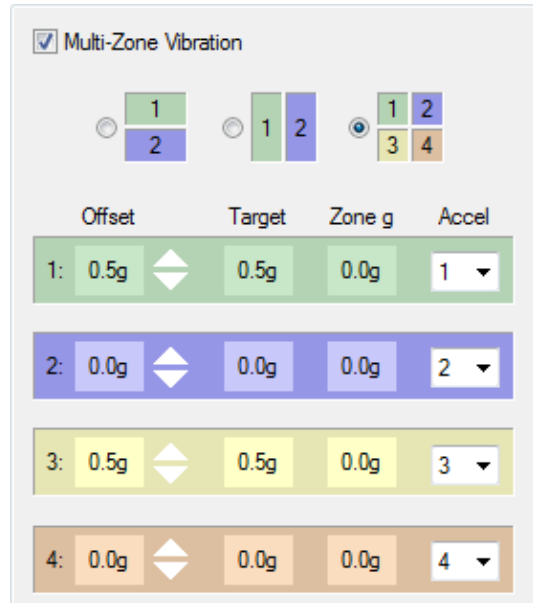
4. For each zone, enter the desired **Offset** and select the control accelerometer as described below:

**Offset** The value that is added to or subtracted from the manual or program mode vibration set point to make up the **Target** grms level (set point) for this zone.

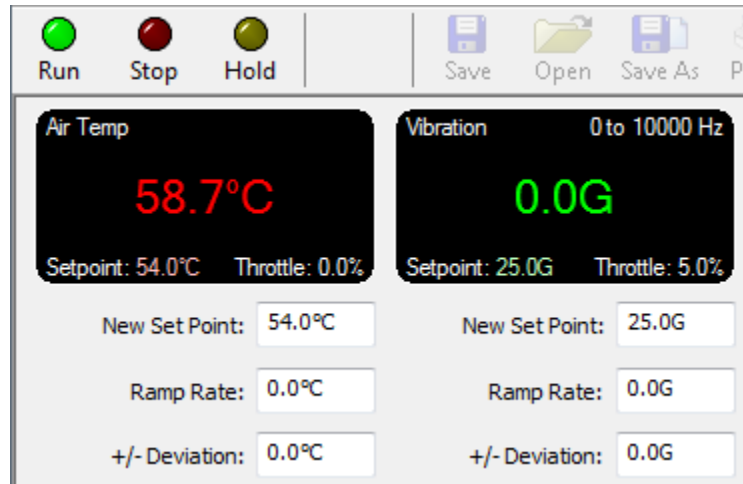
**Target** This value is derived from the manual or program mode vibration set point and the **Offset** value. It is the desired set point for this zone.

**Zone g** This value is the actual grms level for this zone when the controller is in run manual or run program mode.

**Accel** Use this field to select which control accelerometer to use as the process variable (**Zone g**) for this zone. You can select only accelerometers that have been set up as control accelerometers in the **Vibration Config** screen. See step 1 of this example.

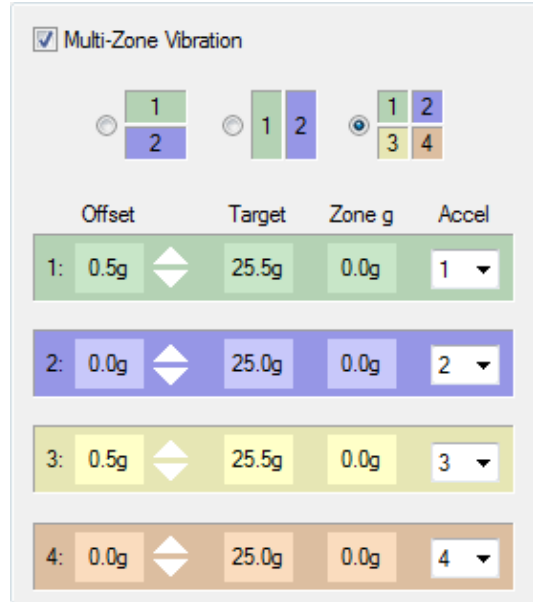


5. To run in manual mode:
  - a. Press **Manual**.
  - b. Enter the desired vibration level in the **New Set Point** field under the vibration channel status indicator.
  - c. Press **Run**.
6. To run in program mode:
  - a. Press **Program**.
  - b. Create one or more program intervals with vibration grms set points for the vibration channel, and save the program.
  - c. Press **Run** and select the desired program.



- To view the multi-zone control status, press **Vib Info**, then select the **Impactor Status** tab. The multi-zone **Target** fields will be adjusted to reflect the main vibration set point (from manual mode or from the program interval being run), plus any programmed **Offset** value.

In the example to the right, zones 1 and 3 are attempting to achieve 25.5g, while zones 2 and 4 are attempting to achieve 25.0g.

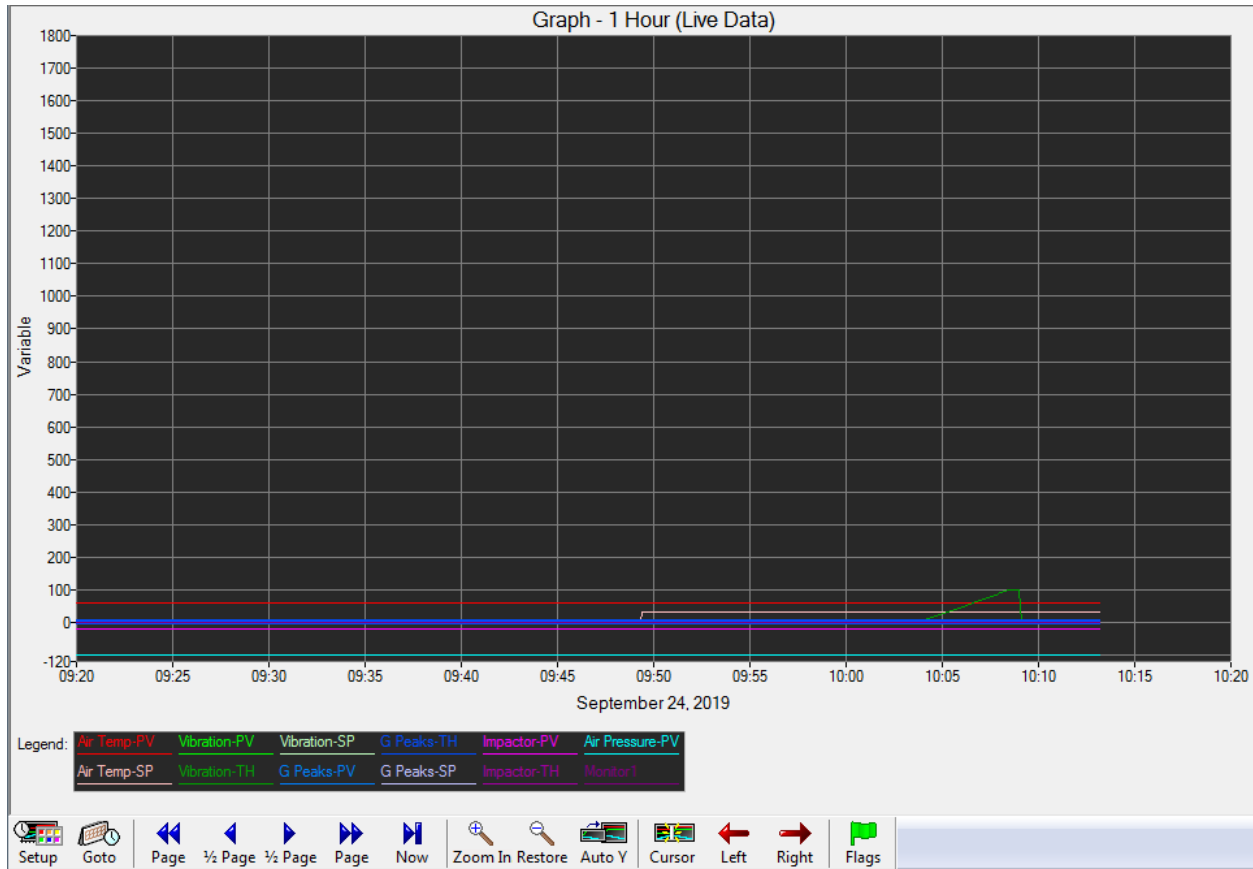
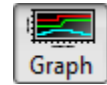


**Multi-zone vibration control notes**

- The most common use for multi-zone vibration control will be to force all zones to the same **Target** value. In such a case the **Offset** value would be 0.0 for all active zones. The example illustrated above is less likely, but is used to demonstrate some of the features of multi-zone vibration control.
- The range for the **Offset** value is  $\pm 5.0g$ . Any offset greater than that would be difficult to achieve.
- If a **Target** value cannot be achieved in a certain zone, it may be due to the physical limitations of the setup, such as accelerometer placement, product placement, product fixture, or physical wear on the impactors.
- Even when multi-zone vibration control is enabled, there is still only one main vibration set point that is entered, either in manual mode or per interval when creating a program. This main vibration set point is used in conjunction with each multi-zone **Offset** value to derive the desired **Target** (set point) for each active zone.

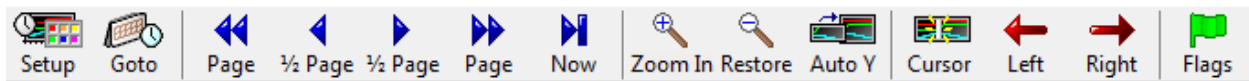
## Using the Graph panel

From any screen press **Graph** to view the graph screen. The graph screen allows you to see a graphic representation of such chamber data as process variables, monitor channel temperatures, and refrigeration system readings. The graph setup screens allow you to customize the graph. The button bar at the bottom of the graph screen allows quick set-up and navigation of graph data.



The AST 8800 has a virtually unlimited amount of storage space for graph settings and data. The only limit on the AST 8800 storage capacity is the available space on the hard drive.

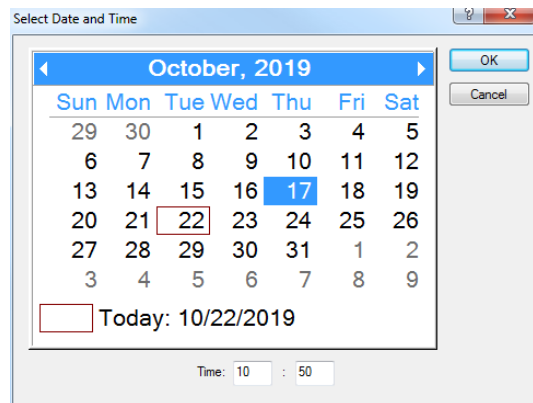
## Using the graph buttons



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

1. To modify the graph settings press **Setup**. See "Graph Setup" below.
2. To change the graph view to a specific date and time:

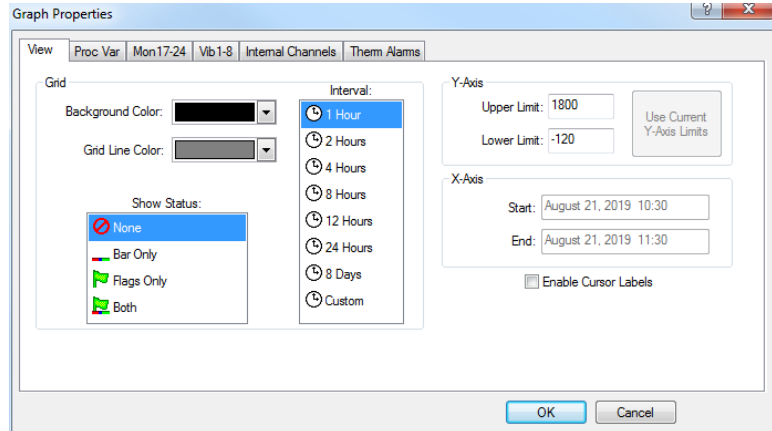
- a. Press **Goto**. The Select Date and Time dialog box will appear:
- b. Select a date from the calendar. The current date is highlighted. The left and right arrow buttons will display the previous and next months.
- c. Select the **Time** fields to specify a time. The select time will appear at the center of the graph.
- d. To accept your selections press **OK**. To close the dialog box without making any selections, press **Cancel**.



3. To move the graph backward one time period as defined by the interval time, press the first **Page** button. For example, on an eight-hour graph this button will move the graph back eight hours.
4. To move the graph backward one half time period as defined by the interval time, press the first  $\frac{1}{2}$  **Page** button. For example, on an eight-hour graph this button will move the graph back four hours.
5. To move the graph forward one half time period as defined by the interval time, press the second  $\frac{1}{2}$  **Page** button. For example, on an eight-hour graph this button will move the graph forward four hours.
6. To move the graph forward one time period as defined by the interval time, press the second **Page** button. For example, on an eight-hour graph this button will move the graph forward eight hours.
7. To move the graph to the current date and time from any location on the graph, press **Now**.
8. To resize the graph to half of its previous Y-axis range, press **Zoom In** and then click a location on the graph. The graph will be centered around the point selected.
9. To reset the graph to its original settings (no zoom), press **Restore**.
10. To automatically adjust the Y-axis range to include the highest and lowest values in the current graph view, press **Auto Y**.
11. To activate a cursor press **Cursor**. The cursor displays the selected data readings at one point on the graph
12. To move the cursor left one time unit, press **Left**.
13. To move the cursor right one time unit, press **Right**.
14. To display chamber start and stop times at the bottom of the graph, press **Flags**. A green (run), red (stop), or yellow (hold) text box is displayed showing the state of the chamber, manual or program mode, and the date and time of the change of state.

### Graph setup

1. Press the **Setup** button to access the graph properties panels. The Graph Properties dialog box will appear with the View panel selected:



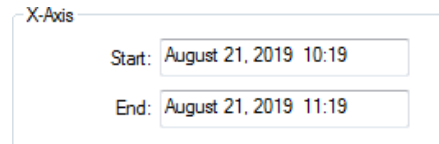
2. Under **Grid**, select the background and grid line colors from their drop-down menus.

3. Under **Show Status**, select how the run/stop/hold status will be displayed at the bottom of the graph.

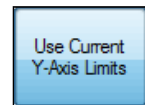
- To display no chamber status information, select **None**.
- To display chamber status information as a bar at the bottom of the graph, select **Bar Only**. Chamber status is displayed as green (run), red (stop), and yellow (hold).
- To display chamber start and stop times at the bottom of the graph, select **Flags Only**. A green (run), red (stop), or yellow (hold) text box is displayed showing the state of the chamber, manual or program mode, and the date and time of the change of state.
- To display chamber status information and stop and start flags at the bottom of the graph, select **Both**.

4. Under **Interval**, select the graph time span:

- Select one of the standard time spans for the graph.
- To specify a non-standard time span, select **Custom**. Under **X-Axis** select the **Start** and **End** date and time fields to modify the graph's X-axis.



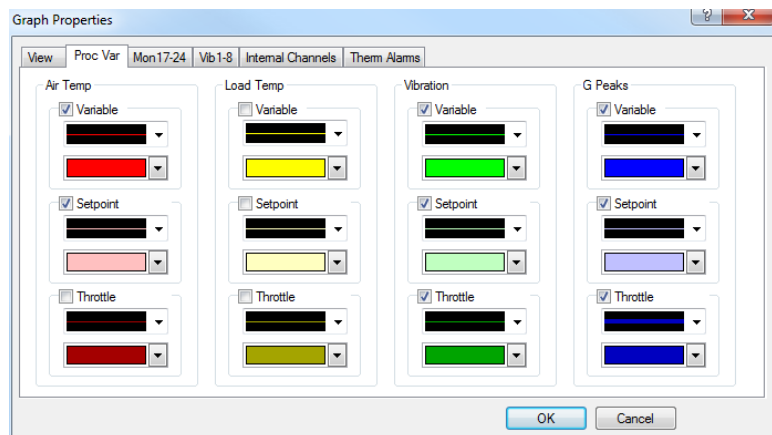
5. Under **Y-Axis** you can customize the graph's upper and lower limits. To select the current Y-axis settings press **Use Current Y-Axis Limits**.



6. The other Graph Properties panels allow you to select how the graph displays process variables, monitor, vibration, or internal channels. (**NOTE:** Each reading you select will continue to be graphed until you deselect it, even when the process variable or channel is not active.) For each panel:

- Select the appropriate check box to display a channel's **Variable**, **Setpoint**, or **Throttle** reading.
- From the drop-down menus select the line type and color for each type of data displayed.

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



## Using the Therm-Alarm panels



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

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

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

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.

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

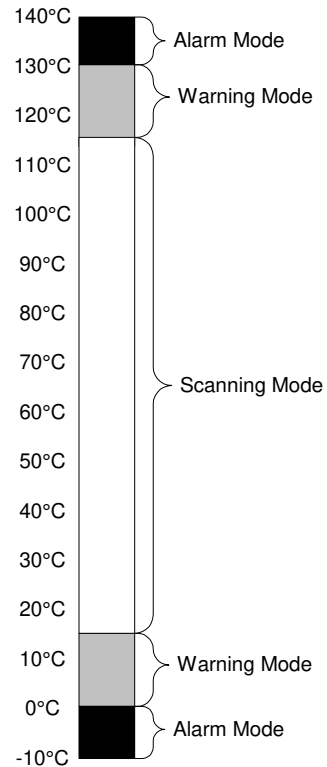
The Therm-Alarm stays in **scanning mode** as long as the input temperature and analog signal are within the acceptable range between the high and low warning settings.

**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 open. During this mode the Therm-Alarm disconnects power to any circuit wired through its mechanical relay contacts. In this mode the Therm-Alarm is automatically reset when the condition that caused the mode is removed.

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



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

### Positioning the input thermocouple or analog sensor

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

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

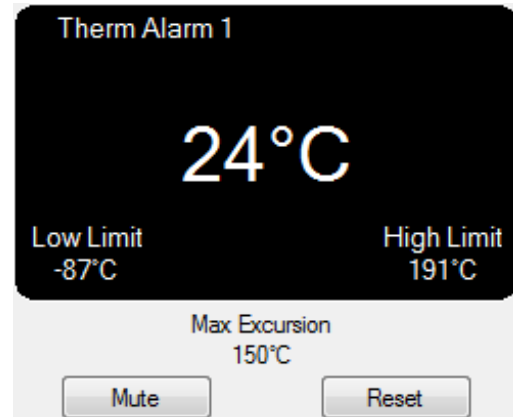
### Viewing the Therm-Alarm settings

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

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

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

**Max Excursion** is the most extreme temperature or analog value experienced during the most recent alarm condition.



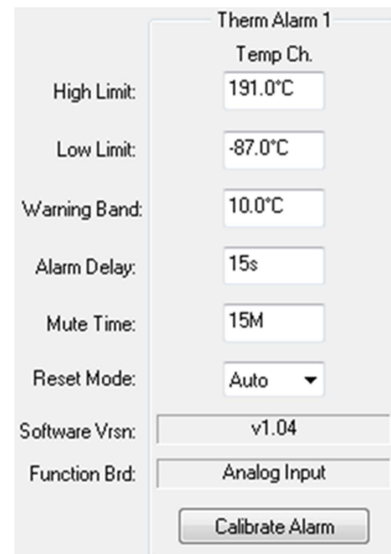
### Changing the Therm-Alarm settings

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

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

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

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



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### **Alarm mute and reset mode functions**

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

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

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

If the reset mode has been set to auto, the Therm-Alarm resets itself when the input temperature or analog signal is at least two units inside the acceptable range. If the temperature or analog signal is still inside the warning mode band, the Therm-Alarm drops from alarm mode to warning mode.

- In **open thermocouple mode** the Therm-Alarm resets itself once the thermocouple is closed or repaired.
- In **failure mode** you must remove power from the Therm-Alarm and then apply power again to reset it.

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### **Muting or resetting the Therm-Alarm**

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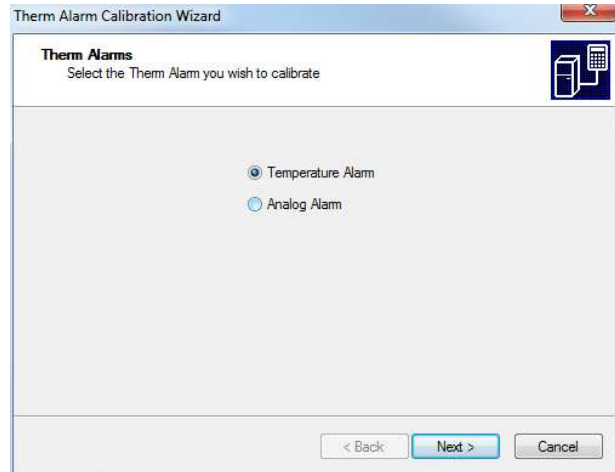
1. From any screen press **T Alarm** to display the Therm-Alarms panel.
2. To mute an audible alarm for the number of minutes set in the Therm-Alarm setup screen, press **Mute**. If an alarm is still active after the mute period, the audible alarm will resume sounding.
3. To reset the Therm-Alarm to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

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

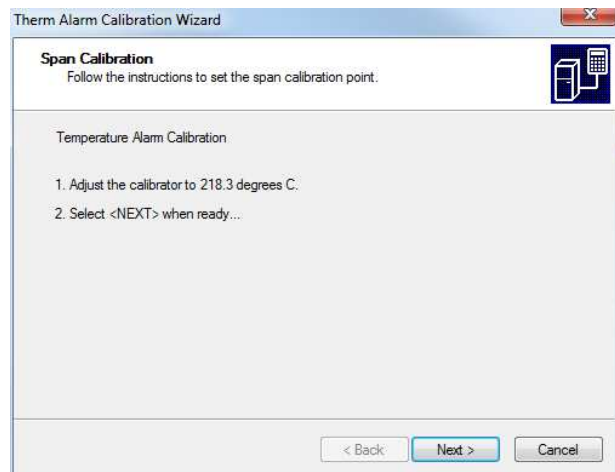
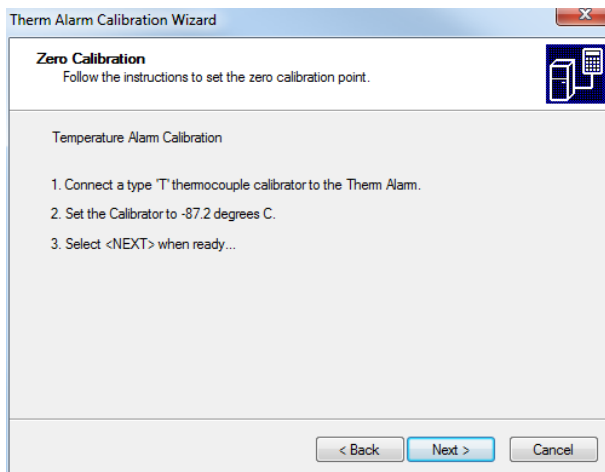
### Calibrating a Therm-Alarm

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

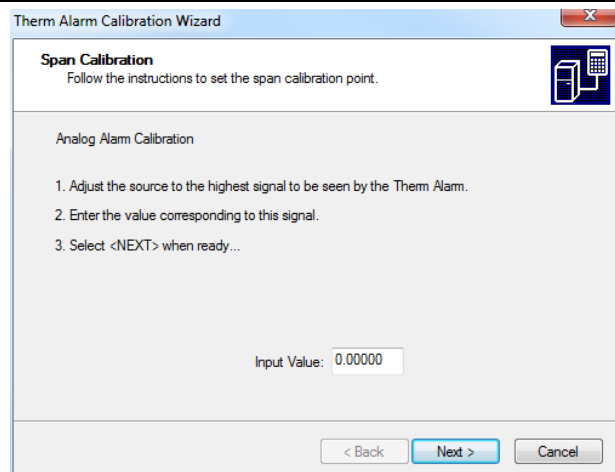
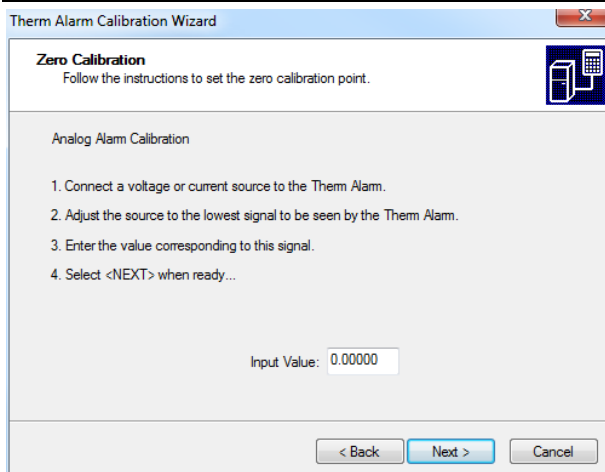
1. From any screen press **T Alarm**, then select the Setup panel.
2. For the Therm-Alarm you want to calibrate, press **Calibrate Alarm**.
3. If your Therm-Alarm has the analog channel configured, choose the channel you wish to configure. Otherwise go to step 4.
4. Follow the on-screen instructions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



### Temperature alarm calibration



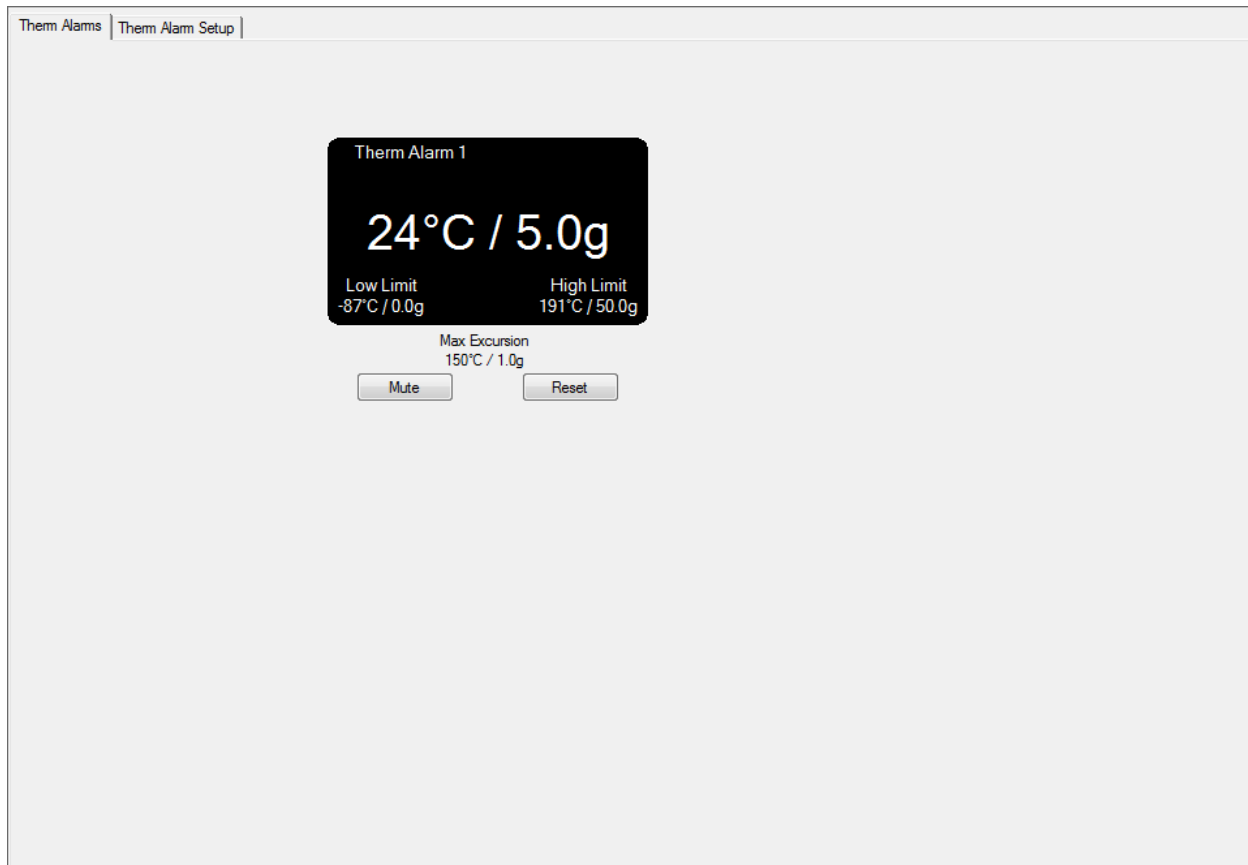
### Analog alarm calibration



## Vibration level monitor

The vibration level monitor attaches to a redundant alarm (even if the vibration level monitor is configured as vibration only) to create a vibration level monitor. This instrument is typically used to stop a test if the vibration levels exceed a safe operating range. There is one BNC connector on the vibration level monitor board.

**NOTE:** The vibration level monitor uses a second accelerometer (typically a high-temperature accelerometer) mounted under the RS/RSL table next to the control accelerometer. Refer to the electrical schematics for correct accelerometer wiring.



## Specifications

- **Acceleration input:** The maximum accelerometer input signal the vibration level monitor can measure is 20 Vac peak-to-peak. **NOTE:** If a 10 mV/g accelerometer is used, the highest level that can be measured by the vibration level monitor is 100 g.

The minimum accelerometer input signal the vibration level monitor can measure is 0.01 Vac peak-to-peak.

**NOTE:** If a 10 mV/g accelerometer is used, the lowest level that can be measured by the vibration level monitor is 1 g. Smaller g levels can be monitored with more sensitive accelerometers.

- **Input power:** The vibration level monitor draws a maximum of 285 mA at 5 Vdc from the redundant alarm.

**NOTE:** The vibration level monitor can be configured by Thermotron to be a grms alarm only (no temperature channel). The screens would then show only grms data and settings, but no temperature information.

## Setting up a vibration level monitor

The screenshot shows the 'Therm Alarm Setup' screen. At the top, there are two tabs: 'Therm Alarms' and 'Therm Alarm Setup'. The main area is titled 'Therm Alarm 1' and contains two columns of settings: 'Temp Ch.' and 'Analog Ch.'. Below these are fields for 'High Limit', 'Low Limit', 'Warning Band', 'Alarm Delay', 'Mute Time', and 'Reset Mode'. At the bottom, there are fields for 'Software Vrsn.' and 'Function Brd.', a 'Calibrate Alarm' button, and a 'Vibration Setup' section with 'Accel Sensitivity' and 'Max Frequency' fields.

Setting	Temp Ch.	Analog Ch.
High Limit:	191.0°C	50.0g
Low Limit:	-87.0°C	0.0g
Warning Band:	10.0°C	1.0g
Alarm Delay:	15s	20s
Mute Time:	15M	
Reset Mode:	Auto	
Software Vrsn.:	v1.04	
Function Brd.:	Vibration	

**Vibration Setup**

Accel Sensitivity	10.000 (mV/g)
Max Frequency	1000

1. From any screen press **T Alarm**, then select the Therm-Alarm Setup panel. When a vibration level monitor board is plugged into a redundant alarm, the Therm-Alarm setup screen will look like the illustration above.

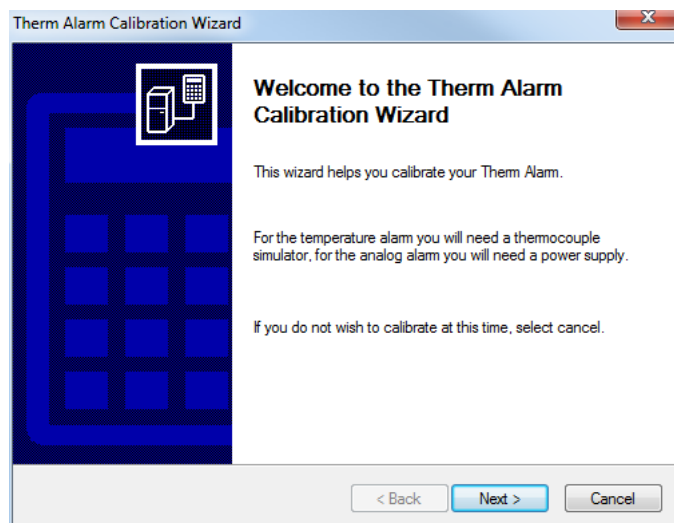
**CAUTION: The screen shot shown above displays the factory default settings. It is your responsibility to set alarm limits appropriate for your product(s).**

- The normal Therm-Alarm settings are displayed in the **Temp Ch.** (temperature channel) column. For additional information, refer to “Changing the Therm-Alarm settings” earlier in this chapter.
  - The vibration level monitor settings are displayed in the **Analog Ch.** column.
2. Select the **High Limit** or **Low Limit** field. In each field, use the numeric keypad to enter the vibration limit, in g’s, that you want to cause a vibration level trip if it is exceeded at the product being tested. **NOTE:** If the **Low Limit** is set to 0 it is disabled.
  3. Select the **Warning Band** field and enter the number of g’s from the vibration limit you want the warning band to begin. You can enter any number from 0 to 99999. To disable the warning mode select 0.
  4. Select the **Alarm Delay** field and enter the number of seconds you want the alarm mode to be delayed after the vibration level reaches a vibration limit. **NOTE:** If the vibration limit is exceeded by more than five g’s, the delay will not occur. You can enter any number of seconds from 0 to 30. If you select 0 seconds, the alarm mode will begin as soon as a vibration limit is reached.
  5. Select the **Mute Time** field and enter the number of minutes you want an audible alarm to remain silent after it is muted. You can enter any number of minutes from 0 to 99. If an alarm is still active after the mute period, the audible alarm will resume sounding. If you select 0 minutes, the tone will remain muted.

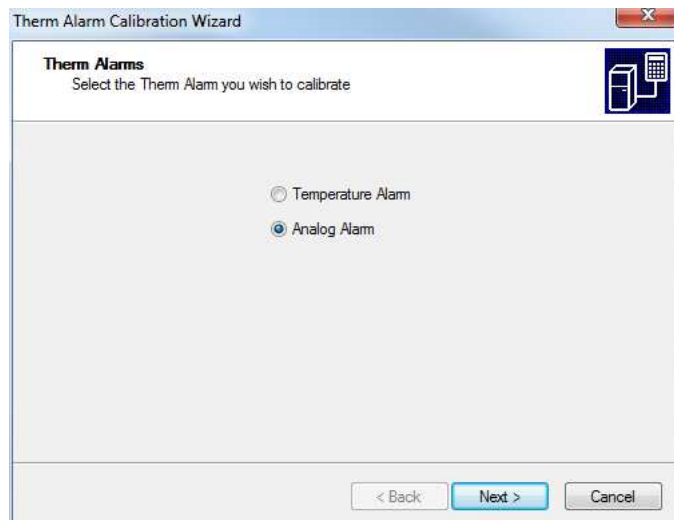
6. From the **Reset Mode** drop-down menu, select **Manual** or **Auto**. This setting determines how the Therm-Alarm is reset when it is in alarm mode.
  - In manual reset mode you must go to the Therm-Alarm main screen and select **Reset** to reset the alarm.
  - In auto reset mode the alarm will reset itself after the vibration level is two g's from the vibration limit within the acceptable range.
7. To calibrate a vibration level monitor, press the **Calibrate Alarm** button. For additional information, refer to "Calibrating a vibration level monitor" below.
8. Select the **Accel Sensitivity** field and enter the mV/g value of the accelerometer connected to the vibration level monitor.
9. From the **Max Frequency** drop-down menu, select the frequency bandwidth that the vibration level monitor uses to calculate the grms value.

### Calibrating a vibration level monitor

1. From any screen press **T Alarm**, then select the Therm-Alarm Setup panel.
2. Press the **Calibrate Alarm** button.

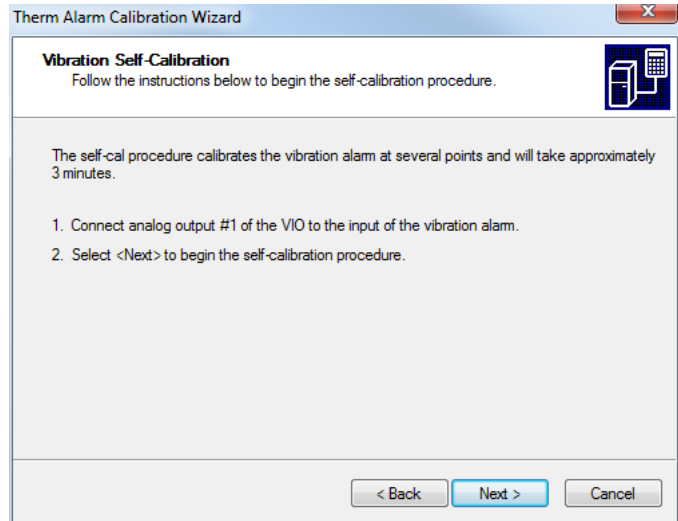


3. Select **Analog Alarm** and press **Next**.

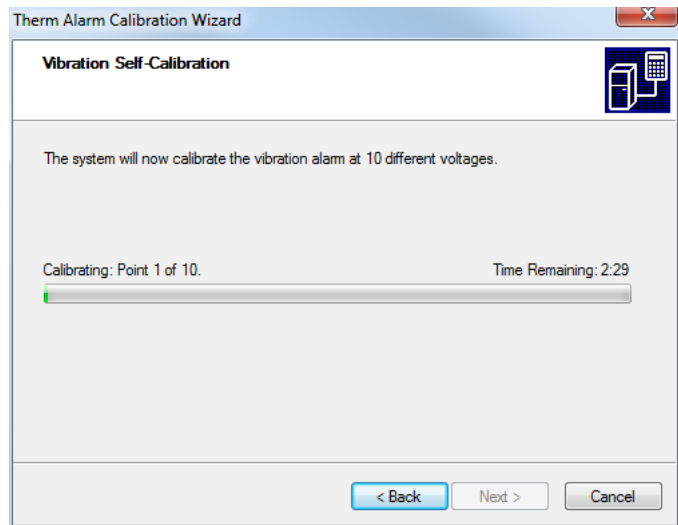


- Connect a cable from analog output 1 of the vibration I/O module to the accelerometer input (**J1**) of the vibration level monitor.

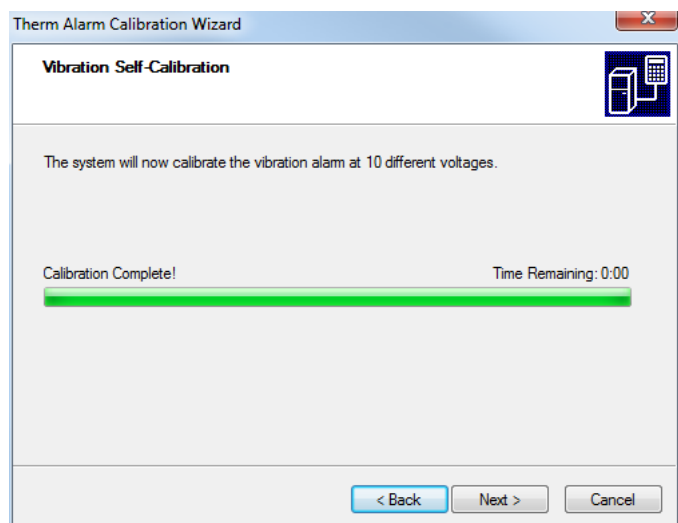
- Press **Next**.



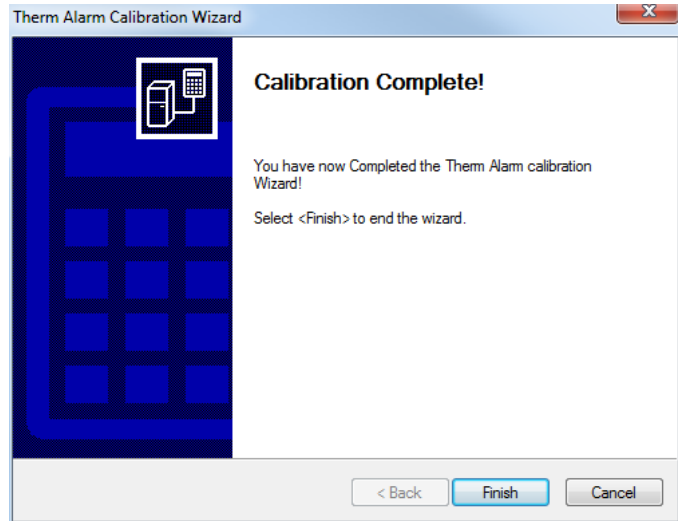
- It takes approximately three minutes to calibrate the vibration level monitor. The **Time Remaining** field indicates how much time is left in the calibration process.



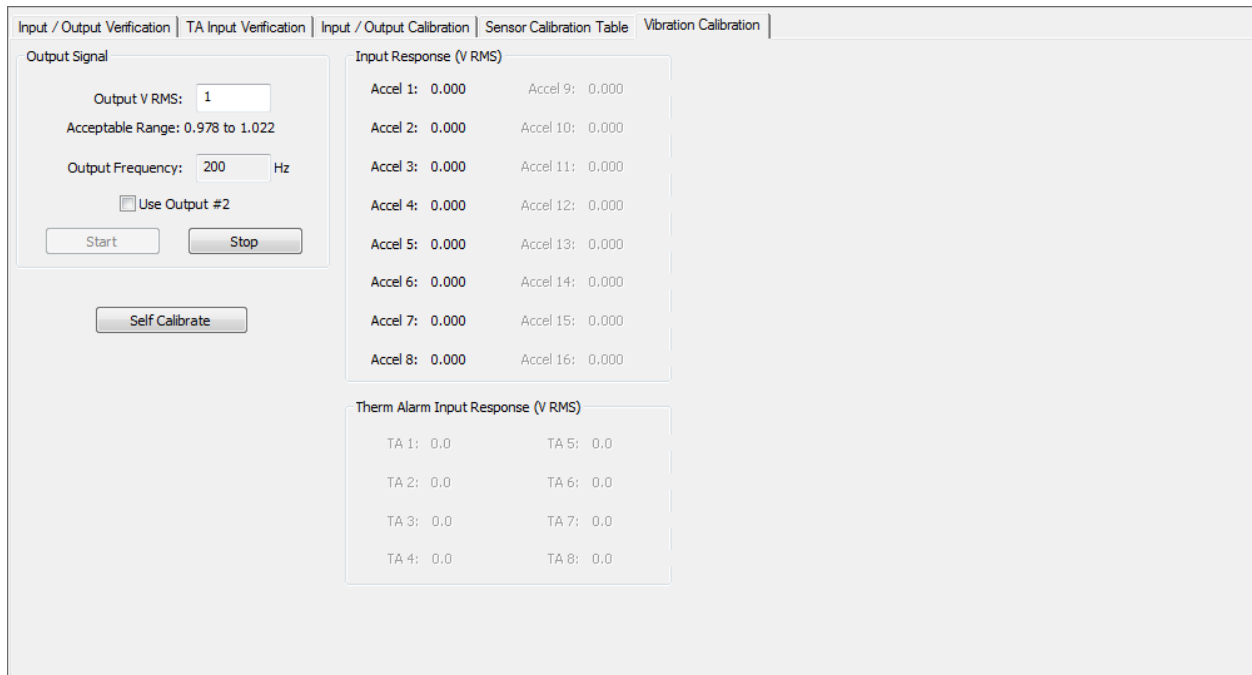
- When the calibration is complete, press **Next**.



8. To verify the accuracy of the vibration level monitor, leave the calibration cable connected and go to "Verifying vibration level monitor accuracy" below.



### Verifying vibration level monitor accuracy



1. If you have not completed the procedure for calibrating a vibration level monitor, follow one of the steps below:
  - Go to "Calibrating a vibration level monitor" earlier in this section and follow the procedure for calibrating the vibration level monitor.
  - If you do not wish to calibrate the vibration level monitor, connect the calibration cable according to step #4 of "Calibrating a vibration level monitor" and proceed to step 2 below.
2. Select a voltage to output. **NOTE:** The vibration level monitor is designed to handle 0 to 1 volt RMS.
3. Press **Start**.
4. Check the **Therm-Alarm Input Response (V RMS)** to verify that the **Output V RMS** matches the **Response V RMS** (within the specified limits).

## Section 3: System Information

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



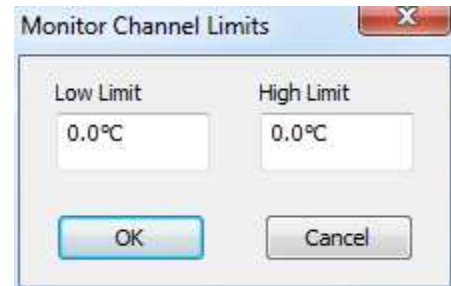
**NOTE:** For information on calibration, refer to section 4 of this manual.

### Monitors panel



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

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



## Refrigeration System panel

The screenshot shows the 'Refrigeration System' panel with the following data:

Low Stage Compressor - OFF		Status	
Suction Pressure:	-101.8Hg	OK	
Temperature:	1.0°C	OK	
Superheat Temperature:	161.8°C	OK	
Discharge Pressure:	600.0Psi	TRIP	
Temperature:	0.0°C	OK	
Run Time:	0h		

High Stage Compressor - OFF		Status	
Suction Pressure:	-90.8Hg	OK	
Temperature:	122.4°C	OK	
Superheat Temperature:	250.3°C	OK	
Discharge Pressure:	600.0Psi	TRIP	
Temperature:	-32.1°C	OK	
Run Time:	0h		

Low Stage Limits			
	Limit	Diff	Offset
Suction Pressure:	-5Hg	10Psi	0Psi
Superheat Temp.:	0.0°C		
Discharge Pressure:	325Psi	30Psi	0Psi
Temperature:	130.0°C		

High Stage Limits			
	Limit	Diff	Offset
Suction Pressure:	0Psi	10Psi	0Psi
Superheat Temp.:	0.0°C		
Discharge Pressure:	320Psi	30Psi	0Psi
Temperature:	116.0°C		

Air Temp

# 58.7°C

Setpoint: 65.0°C Throttle: 0.0%

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

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

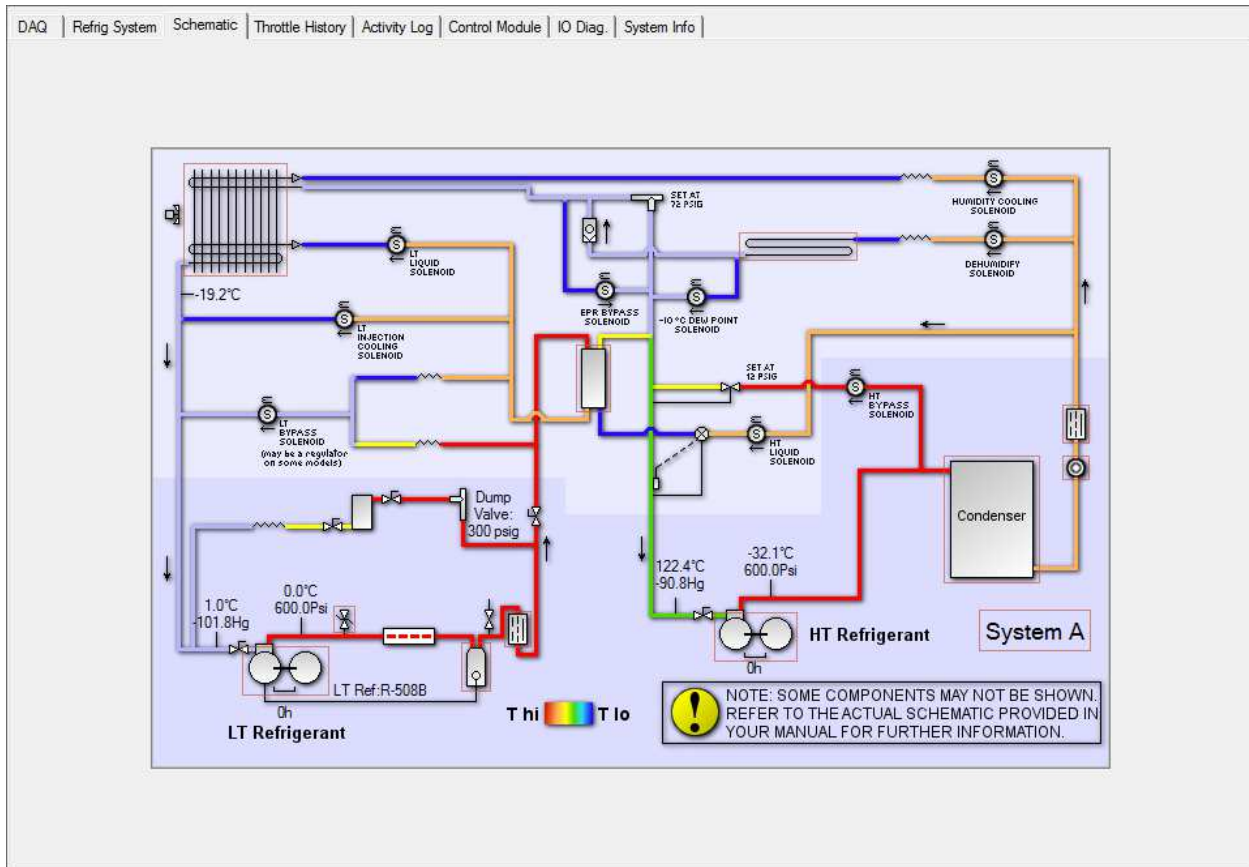
- For a table listing the low-stage refrigerants commonly used by Thermotron, press **Refrigerant Info...** under Low Stage Compressor.
- For a table listing the high-stage refrigerants commonly used by Thermotron, press **Refrigerant Info...** under High Stage Compressor.

High Stage Refrigerants Info

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

Close

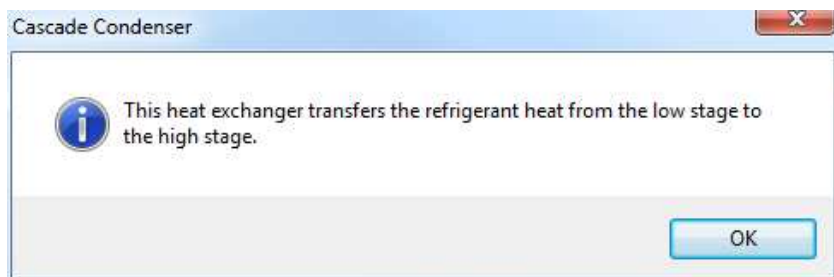
### Schematic panel



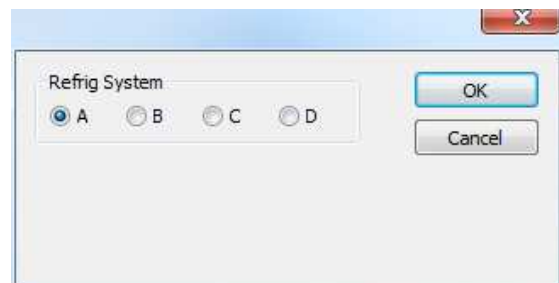
**NOTE:** This panel is available only on SE-Series chambers.

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

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

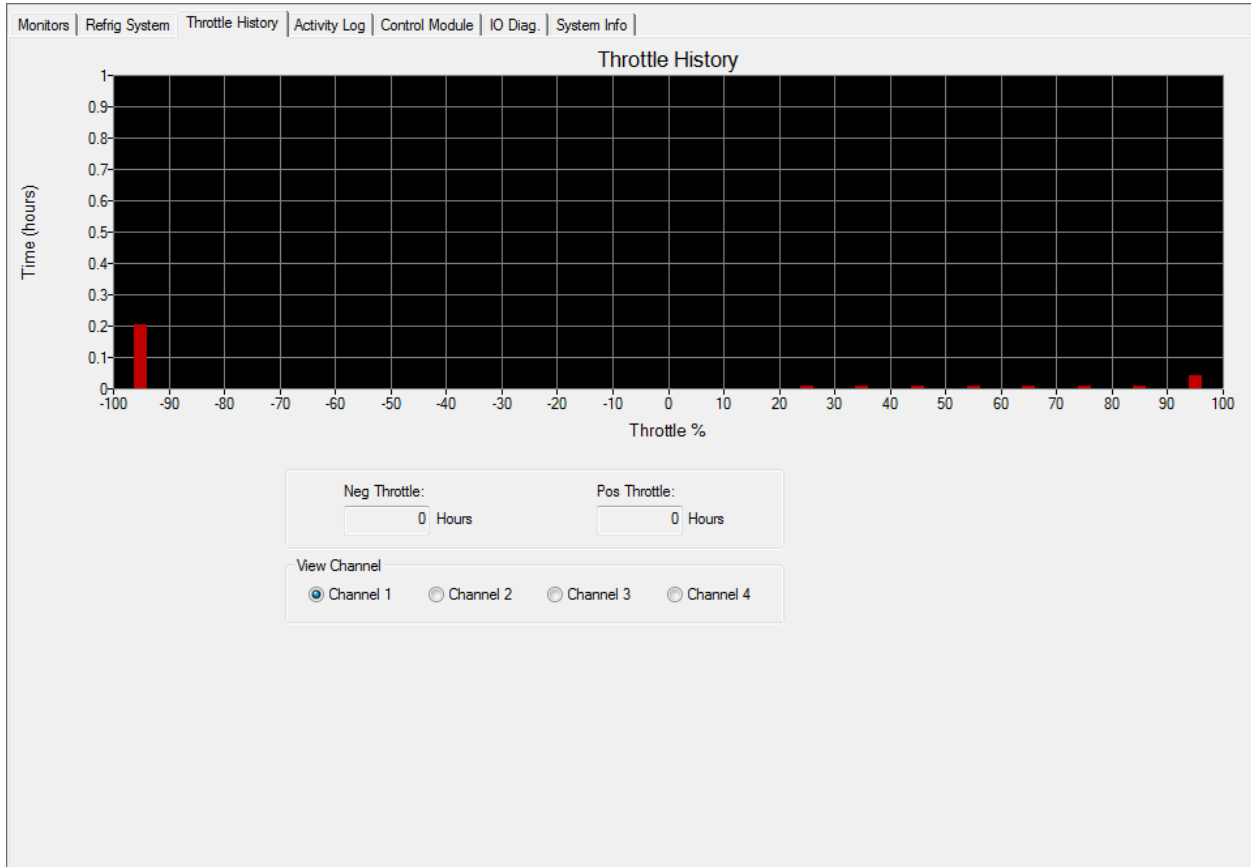


A chamber with more than one refrigeration system will have a schematic for each system. To select the schematic for a different system, press the name of the system displayed just above the bottom right corner of the schematic.



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

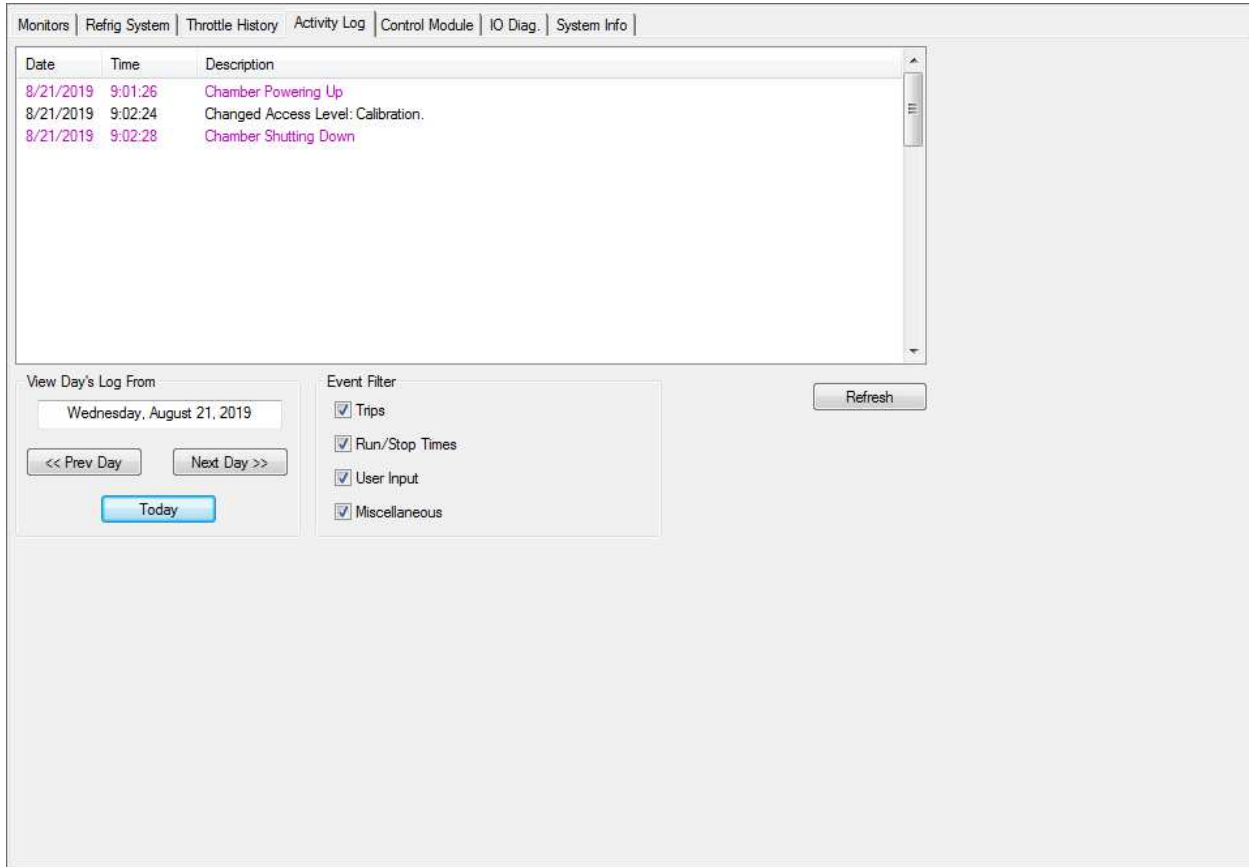
### Throttle History panel



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

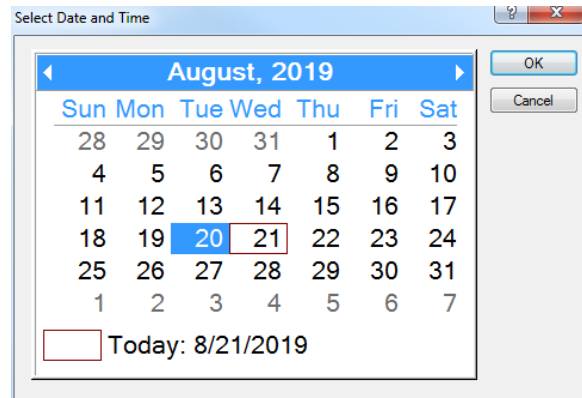
The panel also displays run times in hours for the selected channel's negative and positive throttles.

## Activity Log panel

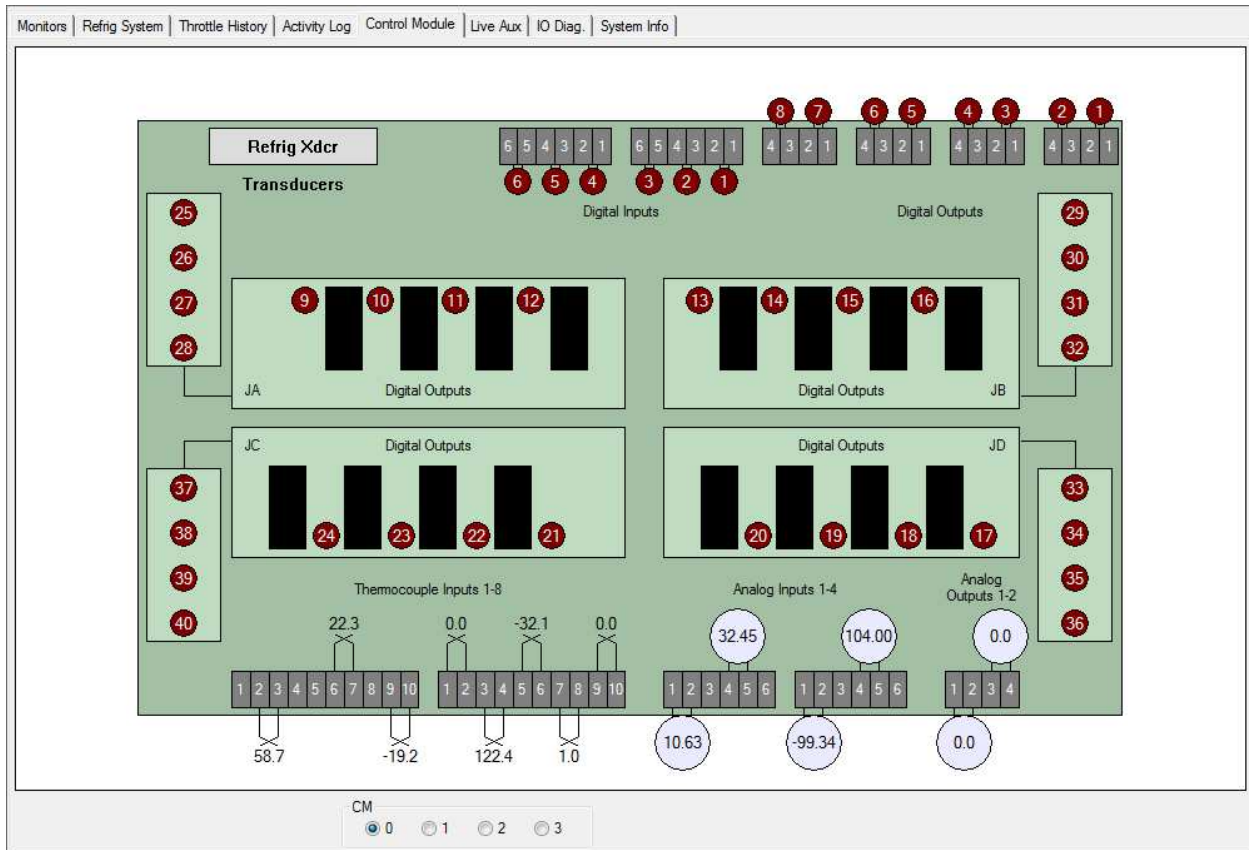


The Activity Log panel displays the date, time, and description of all system activities for a specific date. To modify and view the activity log display, follow these steps:

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 date:
  - a. Press the date field. The Select Date and Time dialog box will appear:
  - b. Select a date from the calendar. The current date is highlighted. The left and right arrow buttons will display the previous and next months.
  - c. Press **OK** to accept your selections or **Cancel** to close the dialog box without making any selections.
4. Select the type of activities displayed (such as trips, run/stop times, or user input):
  - a. Check or uncheck each filter field as desired.
  - b. Press **Refresh** to implement your changes and redisplay the activity log.
5. The activity log can be sorted by pressing the appropriate column header. For example, to sort by description, press the word **Description** at the top of the third column.



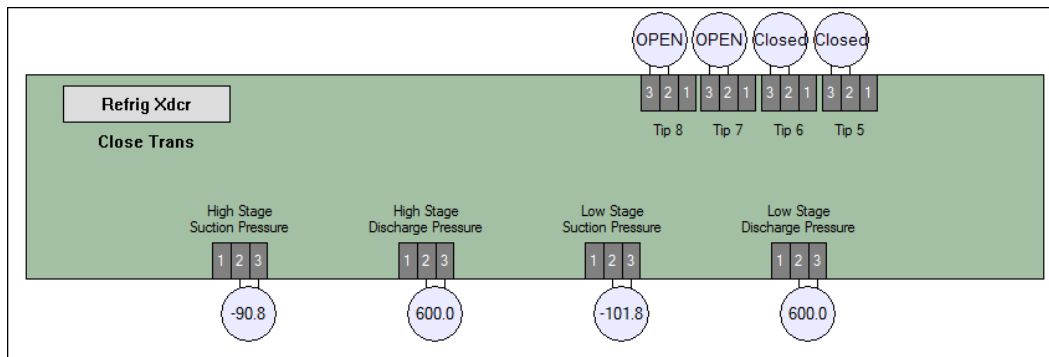
## Control Module panel



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

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

### Transducer data

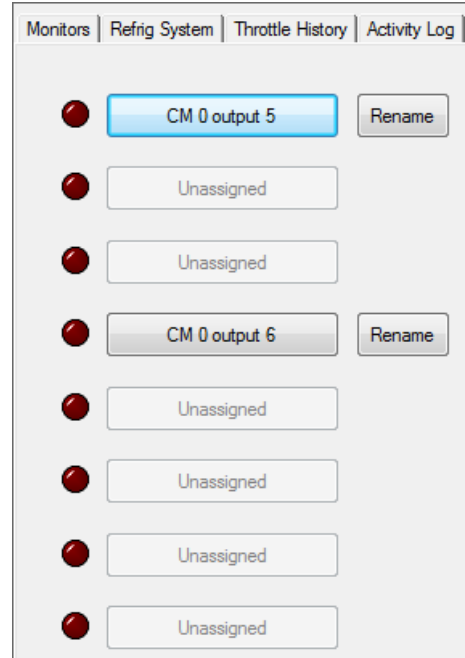


If your chamber is equipped with transducers, you can bring up a schematic of the refrigeration transducer board with live data by pressing the connector above the word **Transducers**. To close the transducer board display, press the connector above the words **Close Trans**.

## Live Aux panel

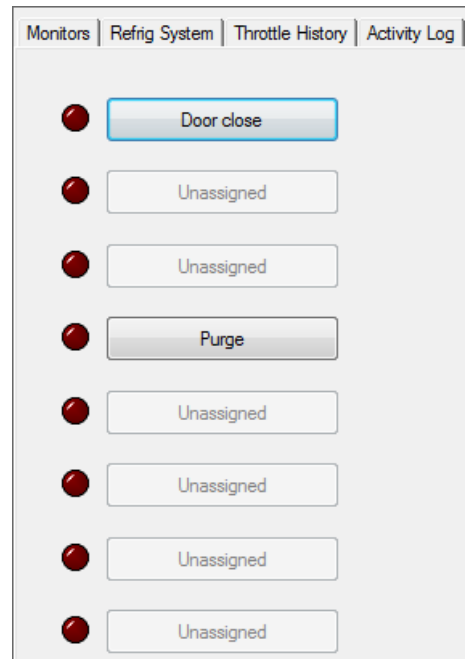
The Live Aux panel will appear only if your AST 8800 has live auxiliaries configured. Live auxiliaries are outputs that the user can turn on or off manually or via computer I/O regardless of the chamber’s operating mode. For more information on your live auxiliaries, refer to your chamber manual.

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



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

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



## Computer interface diagnostic panel

The screenshot shows a software interface with a menu bar at the top containing: Monitors | Refrig System | Throttle History | Activity Log | Control Module | IO Diag. | System Info |. The main area is divided into several sections:

- COM2 Section:** Contains 'Input Buffer:' and 'Output Buffer:' labels with corresponding empty text input fields.
- TCP/IP Section:** Contains 'Input Buffer:' and 'Output Buffer:' labels with corresponding empty text input fields.
- Computer I/O Section:** Contains 'Input Buffer:' and 'Output Buffer:' labels with corresponding empty text input fields.
- Loop Back Test Section:** Includes a dropdown menu set to 'COM2', a 'Cmds Sent:' label with an empty input field, a 'Start Test' button, and an 'Errors:' label with an empty input field.
- Table Section:** A large table with columns 'Time', 'Interface', 'Buffer', and 'Error'. The table content is 'No Errors.' Below the table are three buttons: 'Clear Errors', 'Export Commlog...', and 'Delete Commlog'.

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

### Input and output buffers for the three interfaces

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

### List of the last 25 errors

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

### Commlog file

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

**Loop back test**

---

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

The loop back test allows you to check whether the COM2 serial port of the AST 8800 is working correctly. To perform the test, short together pins 2 and 3 of the COM2 serial port.

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

## System Info panel

The screenshot shows the 'System Info' panel with the following content:

- Navigation:** DAQ | Throttle History | Activity Log | Control Module | IO Diag. | System Info
- Software Version:** AST V1.134 Tuesday, September 17, 2019, 13:58
- Chamber Configuration:** AST 8800
- Last Stop Cause:** Friday, August 23, 2019, 13:45:15 - None
- Last Input Calibration:** Wednesday, November 11, 2015, 8:46
- Last Output Calibration:** Not yet calibrated
- Channel Run Times (hours):**
  - Air Temp: 0
  - Humidity: 0
  - Vibration: 0
  - Peak: 0
- I/O Module Status:**
  - I/O Module 1: 0000 (no DAQ found)
  - I/O Module 2: 0000 (no DAQ found)
- Analysis Options:**
  - Transmissibility
  - Peak Probability
  - Fatigue Analysis
- Patents:**
  - Portions of this design are covered by one or more of the following patents:
  - United States patent no(s): 5,804,732; 6,044,709; 6,446,508; 7,752,914; 7,784,349; 7,861,594; 9,377,375
  - European Patent Number: 1352223
  - Chinese Patent Numbers ZL200880104673.4 and ZL200980123182.9
  - UK Patent Number: 2502196
- USB-DAQ:** Dev1: TC Rev B, Dev2: An/Dig Rev B

The System Info panel provides general information, including:

- The AST 8800 software version
- Chamber configuration
- Last stop cause information
- Input and output calibration status
- Channel run times
- USB-DAQ status (For more information on the DAQ option, refer to the *8800 DAQ Instruction Manual*.)

The I/O module status shows the number and type of data acquisition cards installed in the AST 8800 computer. It also indicates which vibration analysis options are currently enabled for this system. This information is useful to have on hand when speaking with Thermotron Product Support.

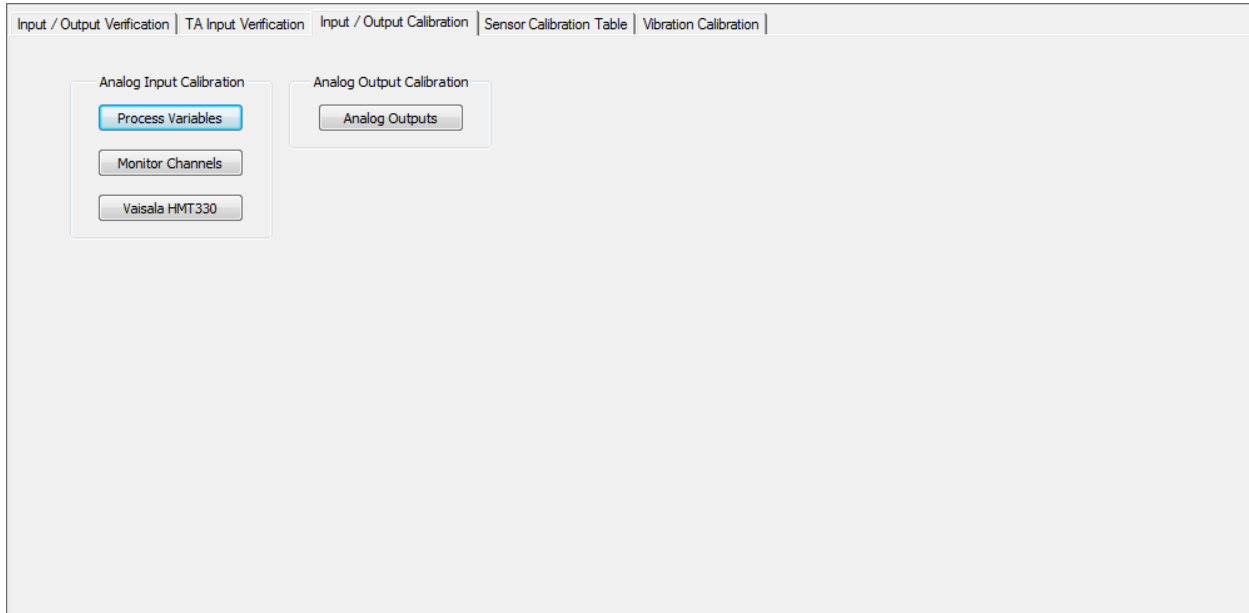
## Section 4: CM2 Calibration

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

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

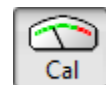
**NOTE:** The calibration screens are only available when the access level is set to **Calibration**.

### Calibration panels



**NOTE:** The CM2 analog inputs were calibrated by Thermotron for accurate performance. Before beginning any calibration procedure, make sure the calibration instruments you use are properly calibrated themselves. Also make sure the display module's temperature scale is set to Celsius.

To access the calibration panels, press the **Cal** button. The calibration panels provide access to the verification and calibration functions for process variables (control channels and monitor channels) and analog outputs:



- *Control channels* are the external and internal channels that both monitor and operate chamber systems. These channels use the CM2's thermocouple, RTD, and analog inputs to sense the chamber's conditions; they can also use the relay board and analog outputs for chamber control. Up to four channels can be factory-configured as chamber process variable control channels. Channels 5 through 8 are factory-set internal control channels.

To determine which thermocouple, RTD, or analog inputs are configured as control channels, refer to your instrumentation and configuration schematics. Instrumentation schematics show the physical interconnects. Configuration schematic shows the channel assignments.

- *Monitor channels* also use the control module's thermocouple, RTD, and analog inputs to sense chamber environmental conditions. However, these channels do not operate control outputs to the chamber.

To determine which thermocouple, RTD, or analog inputs are configured as monitor channels, refer to your instrumentation and configuration schematics. Instrumentation schematics show the physical interconnects. Configuration schematic shows the channel assignments.

- Each CM2 has two *analog outputs* that can be factory-configured to retransmit chamber readings or provide linear control to an instrument or control device. Analog outputs can be set to voltage or current, normally 0-5 VDC or 4-20 mA.

**Verifying analog inputs and analog outputs**

To determine if calibration is necessary, the data from independent calibration equipment attached to the CM2 can be compared to the “raw” analog input and output data shown on the Input / Output Verification panel.

- Press the **Cal** button, then select the Input / Output Verification panel.

The screenshot shows the 'Input / Output Verification' panel with the following data:

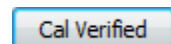
	CM(x) 0	CM(x) 1	CM(x) 2	CM(x) 3	
Thermocouple / RTD Input 1:	58.7°C	58.7°C	58.7°C	58.7°C	Last Input Cal / Verification Date Wednesday, November 11, 2015 at 8:46:55
Thermocouple / RTD Input 2:	22.3°C	22.3°C	22.3°C	22.3°C	
Thermocouple Input 3:	-19.2°C	-19.2°C	-19.2°C	-19.2°C	Cal Verified
Thermocouple Input 4:	0.0°C	0.0°C	0.0°C	0.0°C	
Thermocouple Input 5:	122.4°C	122.4°C	122.4°C	122.4°C	Last Output Cal / Verification Date Not yet calibrated
Thermocouple Input 6:	-32.1°C	-32.1°C	-32.1°C	-32.1°C	
Thermocouple Input 7:	1.0°C	1.0°C	1.0°C	1.0°C	Cal Verified
Thermocouple Input 8:	0.0°C	0.0°C	0.0°C	0.0°C	
Linear Input 1:	10.6	10.6	10.6	10.6	
Linear Input 2:	32.4	32.4	32.4	32.4	
Linear Input 3:	-99.3	-99.3	-99.3	-99.3	
Linear Input 4:	104.0	104.0	104.0	104.0	
Output 1:	0.0	0.0	0.0	0.0	
Output 2:	0.0	0.0	0.0	0.0	

- 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 Input / Output Verification panel.

- Output example:** If **Output 1** had been configured and calibrated such that -100°C to +200°C represented a 0-5 VDC output, the value displayed here would reflect the temperature equivalent of the voltage currently being sent to the analog output. Therefore, if **Output 1** were reading 50.0°C on the Input / Output Verification panel (halfway between -100°C and +200°C) the physical analog output should be reading 2.5 VDC (halfway between 0 VDC and 5 VDC) if calibrated (and configured) properly.

- After verifying the input or output calibration, press the appropriate **Cal Verified** button. The AST 8800 will display the date and time the calibration was verified on the Input / Output Verification panel and on the System Info panel.

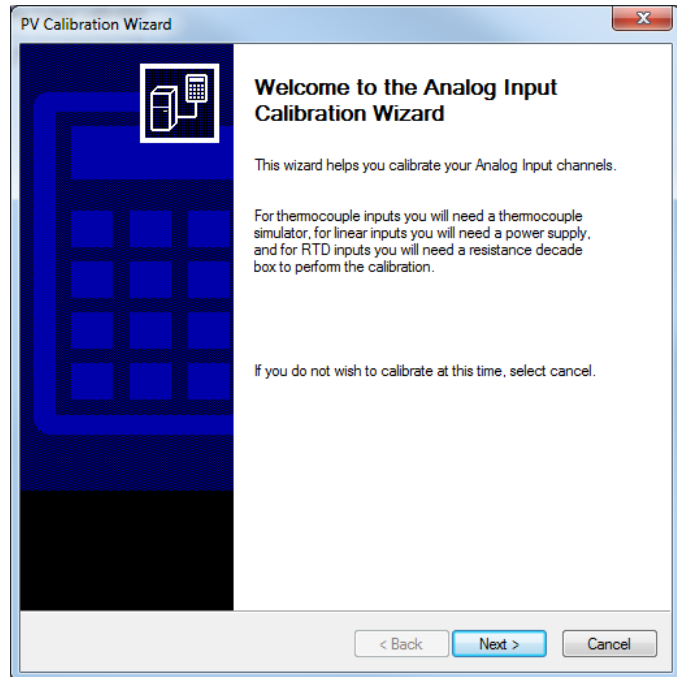


## Calibrating analog input and analog output channels

1. Press the **Cal** button, then select the Input / Output Calibration panel.

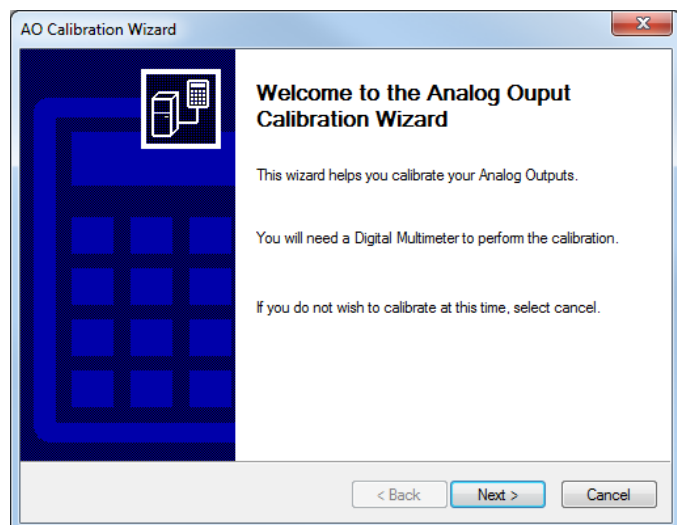
- To calibrate analog inputs, press the **Process Variables** button. The Analog Input Calibration Wizard will start.

**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.



- To calibrate analog outputs, press the **Analog Outputs** button. The Analog Output Calibration Wizard will start.

2. Follow the instructions on the screen, pressing **Next** when you are ready.



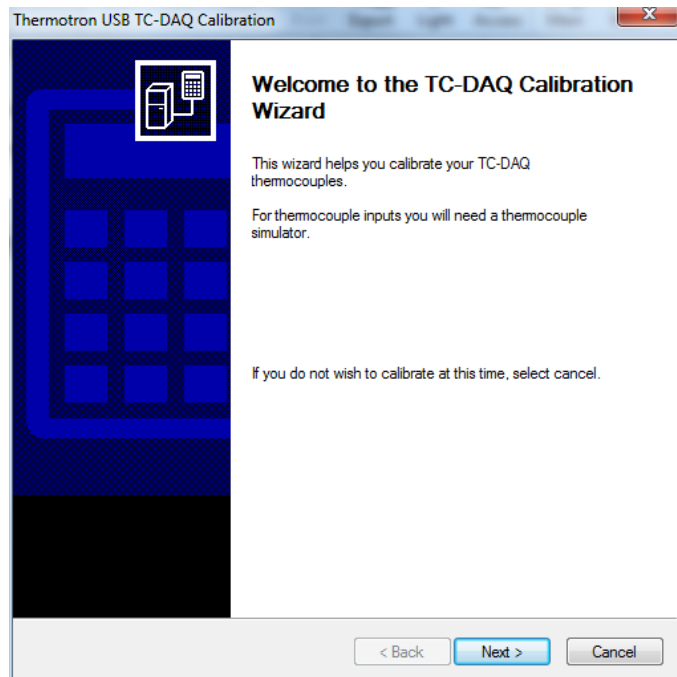
## Calibrating DAQ thermocouple inputs and analog inputs and outputs

The AST 8800 supports revision B of the Thermotron Tier 2 USB-DAQ option. Revision B uses all Thermotron hardware and allows calibration of the thermocouple inputs and analog inputs and outputs. **NOTE:** The USB-DAQ status and revision level are indicated on the System Info panel. For more information, refer to "System Info panel" in Section 3 of this manual.

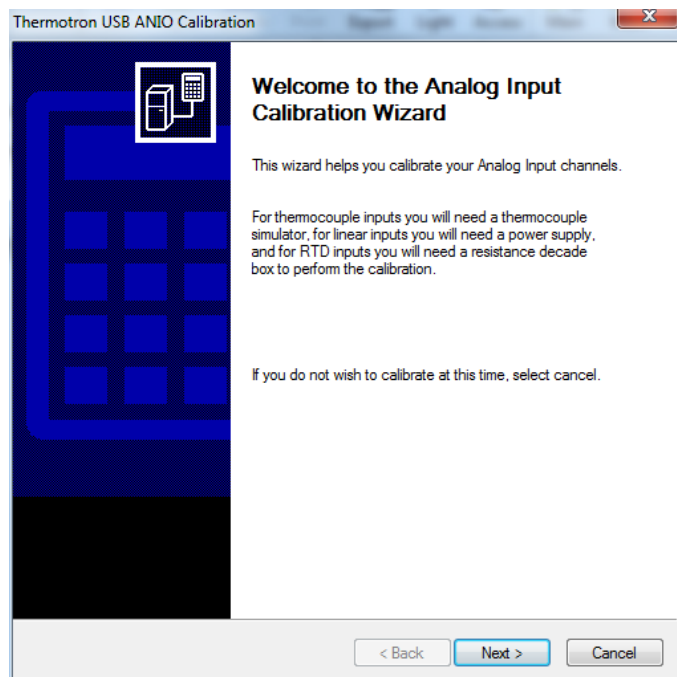
When the AST 8800 detects a revision B USB-DAQ, the Input / Output Calibration panel displays DAQ Calibration buttons that launch calibration wizards similar to those used for process variable and monitor channels.

1. Press the **Cal** button, then select the Input / Output Calibration panel.

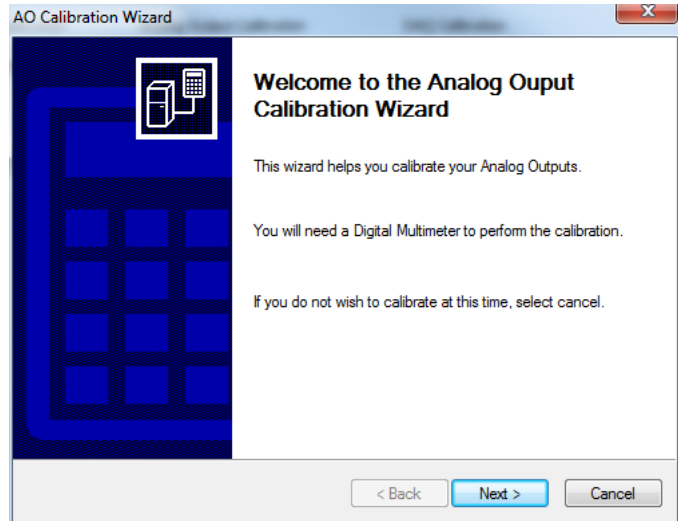
- To calibrate the DAQ thermocouple inputs, press **TC Inputs**. The TC-DAQ Calibration Wizard will start.



- To calibrate the DAQ analog inputs, press **Analog Inputs**. The Analog Input Calibration Wizard will start.



- To calibrate the DAQ analog outputs, under DAQ Calibration press **Analog Outputs**. The Analog Output Calibration Wizard will start.

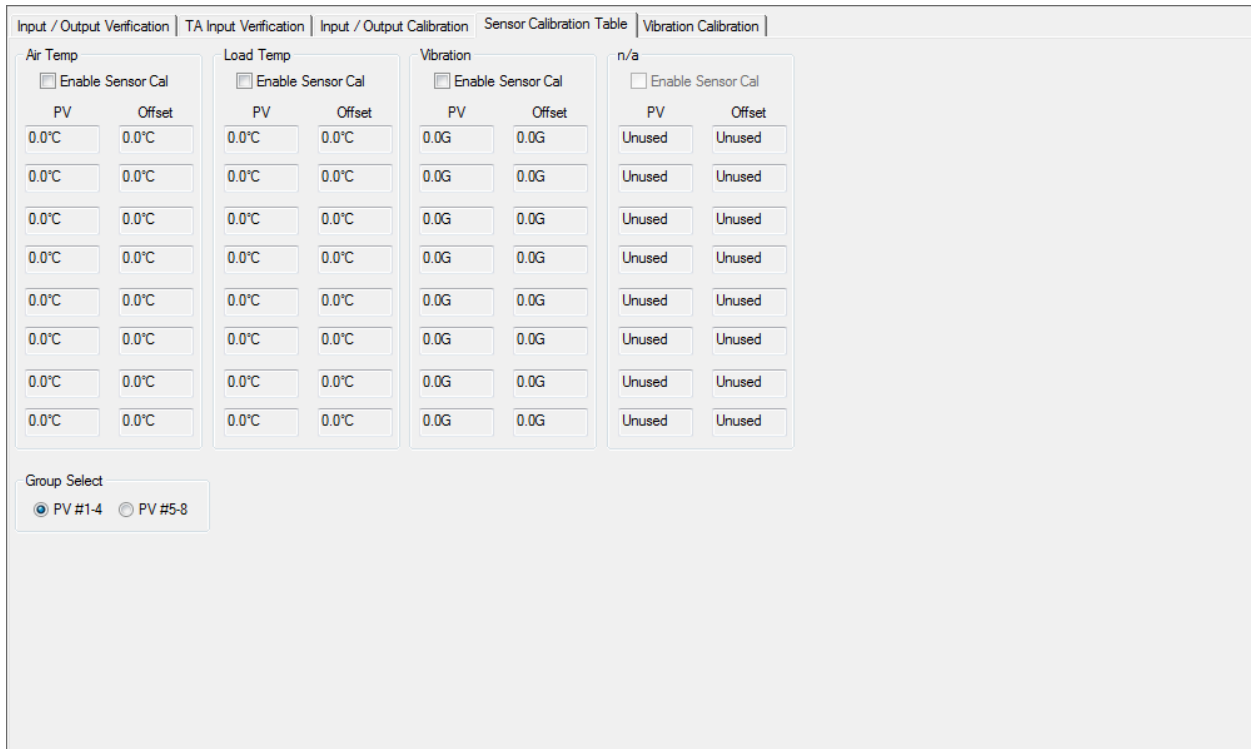


- Follow the instructions on the screen, pressing **Next** when you are ready.

### Adjusting process variable channels

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

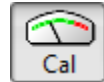
- Press **Cal**, then select the Sensor Calibration Table panel.



- Under Group Select, press the desired process variable group. **NOTE:** Process variable channels 5 through 8 are factory-set internal control channels.
- To adjust a channel's input, select the channel's **Enable Sensor Cal** check box.
- Enter the appropriate adjustment values into the **PV** and **Offset** fields.

### Verifying Therm-Alarm inputs

To determine if Therm-Alarm input calibration is necessary, press the **Cal** button, then select the TA Input Verification panel.



Input / Output Verification	TA Input Verification	Input / Output Calibration	Sensor Calibration Table	Vibration Calibration
	TA 1	TA 2	TA 3	TA 4
Thermocouple Input:	24°C	24°C	24°C	24°C
Analog Input:	0.5	0.5	0.5	0.5
	TA 5	TA 6	TA 7	TA 8
Thermocouple Input:	24°C	24°C	24°C	24°C
Analog Input:	0.5	0.5	0.5	0.5

The data from independent calibration equipment attached to the CM2 can be compared to the “raw” input data shown on the TA Input Verification panel. If Therm-Alarm input calibration is necessary, refer to “Calibrating a Therm-Alarm” in Section 2 of this manual.

## Verifying and calibrating accelerometer inputs

Input / Output Verification | TA Input Verification | Input / Output Calibration | Sensor Calibration Table | Vibration Calibration

Output Signal

Output V RMS: 1

Acceptable Range: 0.978 to 1.022

Output Frequency: 200 Hz

Use Output #2

Start Stop

Self Calibrate

Input Response (V RMS)

Accel 1: 0.000	Accel 9: 0.000
Accel 2: 0.000	Accel 10: 0.000
Accel 3: 0.000	Accel 11: 0.000
Accel 4: 0.000	Accel 12: 0.000
Accel 5: 0.000	Accel 13: 0.000
Accel 6: 0.000	Accel 14: 0.000
Accel 7: 0.000	Accel 15: 0.000
Accel 8: 0.000	Accel 16: 0.000

Therm Alarm Input Response (V RMS)

TA 1: 0.0	TA 5: 0.0
TA 2: 0.0	TA 6: 0.0
TA 3: 0.0	TA 7: 0.0
TA 4: 0.0	TA 8: 0.0

To verify that the input channels are reading correct values:

1. Connect a coaxial cable to output 1 on the back of the accelerometer power supply.
2. Connect the other end of the coaxial cable to input 1 on the accelerometer power supply.
3. Enter a V RMS into the **Output V RMS** field (the default is 1 V RMS).
4. Press **Start** to start generating a 200-Hz sine wave with the V RMS entered above.
5. After a few seconds, the reading on input 1 should settle down and match the entered output value within  $\pm 2.2\%$  (for example, if the desired value was 1 V RMS, the response should be between 0.978 and 1.022).
6. Without pressing **Stop**, you may move the coax cable to the other inputs to verify the response of all inputs.
7. Press **Stop** when done.

To independently verify the output voltage, you may use a true RMS voltmeter.

If one or more channels are outside of the acceptable range, contact Thermotron Product Support for assistance.

### Self-calibration

**NOTE:** The DAQ card is typically factory calibrated at +25°C. If the DAQ card is operating in environmental conditions significantly different from ambient, it may be helpful to perform a self-calibration to remove any gain and offset errors due to the different ambient operating temperatures of the card.

The National Instruments DAQ card in the personal computer may be self-calibrated as often as desired by the user. Absolute accuracy specifications for the DAQ card used in the AST system will be  $\pm 0.2\%$  or better after performing a self-calibration. No other calibration for the DAQ card is required for AST applications.

To have the Data Acquisition (DAQ) card perform an internal self-calibration, press the **Self Calibrate** button. This could take up to two minutes to complete, followed by a success or failure message.

The following are some of the possible error dialogs that may be displayed after a self-calibration:

**Error –10401, Unknown Device**

Use NI's Measurement and Automation program to verify that the NI-DAQ card is recognized by the system and functioning.

**Error –10801, Calibration Error**

This can mean that the DAQ card EEPROM needs to be repaired. The DAQ card needs to be sent either to Thermotron or National Instruments for repair.

**Error –10842, Hardware Error**

If this error dialog is displayed, shut down all software, reboot the computer, and try another self-calibration. If this error dialog is repeatedly displayed, it can mean that some component on the DAQ card is physically damaged. The DAQ card needs to be sent either to Thermotron or National Instruments for repair.

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## Section 5: Computer Interface

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### Overview

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

### Basic serial communication protocol

---

The basic command protocol consists of the command and terminator:

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

The AST 8800 responds with the following:

<data><t>

Where:

**CMND** = command mnemonic

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

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

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

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

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

The host computer sends:

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

The AST 8800 responds with:

**[FF]#a<data><t>**

Where:

**[FF]** = prefix character (FF hexadecimal)

**#** = ASCII pound sign (35 decimal)

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

**CMND** = command mnemonic

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

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

### ***GPIB-specific commands***

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

- Bit 0 State change. This bit is set when there has been a change in the operating state.
- Bit 1 Alarm status change. This bit is set when there has been a change in the alarm status.
- Bit 2 End of interval. This bit is set at the end of each interval, either when the time left has gone to 0:00:00, or when a guaranteed soak is completed.
- Bit 3 Match interval. This bit is set at the start of the match interval. If the match interval parameter is set to 0, then this bit is set at the start of each interval.
- Bit 4 End of program. This bit is set at the end of a program, when the AST 8800 goes into stop mode.
- Bit 5 Error. This bit is set by any type of command and/or interface error.
- Bit 6 Reserved by GPIB.
- Bit 7 Power on reset. This bit is set when the AST 8800 goes through a power up sequence. It is also set as a result of an **INIT** command.

#### ***Service request related commands***

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

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

---

## Command syntax

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

### Query commands

---

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

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

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

### Operation commands

---

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

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

For example, if the host computer sends the command **OPTN49**, the AST 8800 loads the manual mode options register with the PTC, purge, and cascade options.

- If needed to specify a channel or group number, the root command is followed by an ASCII numeric character, followed by an ASCII comma (,) to separate the channel or group number from the data.

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

### Command data formats

---

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

- **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.
- **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 AST 8800's response to an **OPTN?** or **AUXE?** command.
- **Decimal format:** The data consists of an ASCII sign character (+ or -) followed by ASCII decimal digits, decimal point, and the number of digits needed for the selected resolution; for example the set point of a temperature channel.
- **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.

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## Command concatenation

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

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

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

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## Functional command sets

The AST 8800 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.

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### Control commands

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Control commands tell the AST 8800 to perform a specific operation and/or sets its operating mode. For example, if the host computer sends the **STOP** command, the AST 8800 is placed in stop mode.

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### Program status and edit from hold commands

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Program status commands allow you to query the AST 8800 for real-time, program-specific values, while edit from hold commands allow you to run the AST 8800 using temporary values in edit from hold mode. Use these commands when you are running the AST 8800 in run program mode. For example, if the host computer sends the **INTN?** command, the AST 8800 responds with the current interval number of the program.

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### Programming commands

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Programming commands allow you to write programs on your host computer, and then load them into the AST 8800. Additionally, they allow you to load a program from an AST 8800 into your computer.

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### System status commands

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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 AST 8800 responds with the type of programmer/controller.

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### Variable commands

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Variable commands can be either query or operation commands. The variable query commands allow you to read the AST 8800 registers for the current variables and parameters. The variable operation commands allow you to operate the AST 8800 from the run manual mode only. For example, if the host computer sends the **VRSN?** command, the AST 8800 responds with the software version.

## Interface command descriptions

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

### ALRM

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

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

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

**Syntax:** ALRMn?  
 Where **n** is any process variable channel (1 through 8).  
**Data type:** Eight-bit coded integer  
**Query example:** ALRM2?  
**AST 8800 response:** 32. This response means that only bit **5** (32) is active. When bit **5** is active it indicates a high process alarm.

### AUXE

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

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

1 = AUX 1	4 = AUX 3	16 = AUX 5	64 = AUX 7
2 = AUX 2	8 = AUX 4	32 = AUX 6	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. Example: a value of 097 (97 = 64 + 32 + 1) indicates that AUX 7 (64), AUX 6 (32), and AUX 1 (1) are on, or turns these auxiliaries on.

**Data type:** See Syntax.  
**Query example:** AUXE1?  
**AST 8800 response:** 148. (AUX 8, AUX 5, and AUX 3 of auxiliary group 1 are on.)  
**Operation example:** AUXE1,59  
**AST 8800 response:** 0 (If the AST 8800 is in run manual mode, AUX 6, 5, 4, 2, and 1 of auxiliary group 1 are enabled. If they are enabled, the AST 8800 turns off AUX 8, 7, and 3 of auxiliary group 1.)

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**CCHR**

---

<b>Command name:</b>	Send process variable units character
<b>Command type:</b>	System status
<b>Description:</b>	The AST 8800 returns the ASCII units for the character. Common unit codes are C (Celsius), F (Fahrenheit), and % (percent relative humidity). <b>NOTE:</b> If the channel has no units set or is not configured, the AST 8800 will return a blank character.
<b>Syntax:</b>	CCHRn?  Where <b>n</b> is any process variable channel (1 through 8) or monitor channel (101 through 140). <b>NOTE:</b> 101 = monitor channel 1, 102 = monitor channel 2, etc.
<b>Data type:</b>	ASCII units character
<b>Query example:</b>	CCHR1?
<b>AST 8800 response:</b>	Celsius (Channel 1 is programmed in degrees Celsius.)

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**CCNF**

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<b>Command name:</b>	Send process channel configuration information
<b>Command type:</b>	System status
<b>Description:</b>	The AST 8800 sends a single coded integer describing the channel type.  0 Channel not used 1 Percent relative humidity channel using a wet bulb/dry bulb thermocouple pair 2 Temperature channel using a thermocouple 3 Linear channel using a programmable range (for example altitude) 4 Linear 0% to 100% relative humidity channel using a solid-state sensor 5 Product temperature control channel
<b>Syntax:</b>	CCNFn?  Where <b>n</b> is any process variable channel (1 through 8) or monitor channel (101 through 140).
<b>Data type:</b>	Coded integer
<b>Query example:</b>	CCNF2?
<b>AST 8800 response:</b>	4 (Process variable channel 2 is configured for linear % relative humidity.)

**CHST**

**Command name:** Send channel on and configured status  
**Command type:** System status  
**Description:** The AST 8800 sends a two-byte coded integer describing the channel on and configuration status.  
**Byte 1 = channel on status:** Bits 0 through 7 indicate the on status of channels 1 through 8 respectively. The AST 8800 sets the bit for each channel that is on.  
**Byte 2 = channel configured status:** Bits 8 through 15 indicate the configured status of channels 1 through 8 respectively. The AST 8800 sets the bit for each channel that is configured.  
**Syntax:** CHST?  
**Data type:** Coded integer  
**Query example:** CHST?  
**AST 8800 response:** 769 (Binary value 00000011,00000001 = channels 1 and 2 are configured and channel 1 is on.)

**CMST**

**Command name:** Send comm status  
**Command type:** System status  
**Description:** This query command asks the AST 8800 for the current comm status. The AST 8800 sends a coded integer value. The edit operation command changes the current comm status. The CMST data byte is defined as follows:  
**Bits 0 through 7**  
 1 Send acknowledge  
 2, 4, 8, 16, 32, 64, 128 Unused  
**Syntax:** CMST? or CMSTn  
 Where **n** is the new comm status.  
**Data type:** Coded integer  
**Query example:** CMST?  
**AST 8800 response:** 1 (Send acknowledge is on.)  
**Operation example:** CMST0  
**AST 8800 response:** The AST 8800 turns off send acknowledge.

**CNAM**

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

**CONF**

**Command name:** Send configured options

**Command type:** System status

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

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

**Syntax:** CONF?

**Data type:** Three bytes of coded integers

**Query example:** CONF?

**AST 8800 response:** 327987 = 00000**1**01,0000000**1**,00**1**100**1**1

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

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

**DEVN**


---

<b>Command name:</b>	Send deviation reading or load deviation setting
<b>Command type:</b>	Variable; edit from hold
<b>Description:</b>	The query command asks the AST 8800 for the current deviation reading from a selected channel. The AST 8800 sends the value in the channel's selected units. The operation command loads a deviation setting into the AST 8800 for the current manual mode operation, or sends a temporary deviation value during an edit from hold operation.
<b>Syntax:</b>	DEVNn? or DEVNn,data Where <b>n</b> is any control channel (1 through 4).
<b>Data type:</b>	Decimal
<b>Query example:</b>	DEVN1?
<b>AST 8800 response:</b>	2.3 (The current deviation reading for control channel 1 is 2.3.)
<b>Operation example:</b>	DEVN2,5
<b>AST 8800 response:</b>	0 (If the AST 8800 is in manual mode, it loads a deviation value of 5 units into control channel 2.)

**DIRP**


---

<b>Command name:</b>	Send program directory
<b>Command type:</b>	Programming
<b>Description:</b>	This command queries a specific directory on the AST 8800 for a list of program files and directories. This command will return the name of the program or directory followed by a number. If the name refers to a program file, the number will be the number of intervals in the program. If the name refers to a directory, the number will be -2. Continue calling this command to get a list of all directories and programs on the AST 8800. When you have iterated through all the items in the current directory this command will return "No More Files" for the name and -1 for the number.
<b>Syntax:</b>	DIRPpathname? Where: <b>pathname</b> is the name of a path on the AST 8800 or "\" for the root path of the AST 8800.
<b>Query example 1:</b>	DIRP\?
<b>AST 8800 response:</b>	humidity test, 5 (program called humidity test with five intervals)
<b>Query example 2:</b>	DIRP\?
<b>AST 8800 response:</b>	Pre-programmed Tests, -2 (directory called Pre-programmed Tests)
<b>Query example 3:</b>	DIRP\Pre-programmed Tests?
<b>AST 8800 response:</b>	8800-SE humidity, 6 (program called 8800-SE humidity with six intervals)
<b>Query example 4:</b>	DIRP\Pre-programmed Tests?
<b>AST 8800 response:</b>	No More Files, -1 (You have iterated through all the items in the Pre-programmed Tests directory.)

**FVAL**

---

<b>Command name:</b>	Send or load final value
<b>Command type:</b>	Program status; edit from hold
<b>Description:</b>	The query command asks the AST 8800 for the current interval's final value for channel n (1 through 4). The AST 8800 sends a decimal value for the selected channel. The edit from hold operation command temporarily changes the current interval's final value. <b>NOTE:</b> When not running a program, the command returns the manual mode new setpoint.
<b>Syntax:</b>	FVALn? Where <b>n</b> is any control channel (1 through 4).
<b>Data type:</b>	Decimal
<b>Query example 1:</b>	FVAL2?
<b>AST 8800 response:</b>	25.0 (The control channel 2 final value for the current interval is 25.0.)
<b>Query example 2:</b>	FVAL1?
<b>AST 8800 response:</b>	50.0 (In manual mode, the channel 1 new setpoint is 50.0.)
<b>Operation example:</b>	FVAL1,-33
<b>AST 8800 response:</b>	0 (The AST 8800 loads -33 as the final value for control channel 1.)

**HOLD**

---

<b>Command name:</b>	Hold program or manual mode operation
<b>Command type:</b>	Control
<b>Description:</b>	Places a running program or test in hold mode.
<b>Syntax:</b>	HOLD
<b>Data type:</b>	No data
<b>Query example:</b>	HOLD
<b>AST 8800 response:</b>	0 (Places the AST 8800 in hold mode.)

**IDEN**

---

<b>Command name:</b>	Send device identification
<b>Command type:</b>	System status
<b>Description:</b>	The AST 8800 sends an ASCII character string to the host computer.
<b>Syntax:</b>	IDEN?
<b>Data type:</b>	ASCII character string
<b>Query example:</b>	IDEN?
<b>AST 8800 response:</b>	8800 CHAMBER CONTROLLER

---

**IERR**

---

<b>Command name:</b>	Send last error code
<b>Command type:</b>	System status
<b>Description:</b>	The AST 8800 sends the code of the last error that occurred. For more information see "Error codes" later in this section.
<b>Syntax:</b>	IERR?
<b>Data type:</b>	Coded integer
<b>Query example:</b>	IERR?
<b>AST 8800 response:</b>	3 (The AST 8800 output buffer is full.)
<b>NOTE:</b>	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 AST 8800 returns an error code of 0, the error buffer is empty.

---

**INIT**

---

<b>Command name:</b>	Initialize controller
<b>Command type:</b>	Control
<b>Description:</b>	This command is included for legacy purposes only. It doesn't perform any function in the AST 8800.
<b>Syntax:</b>	INIT
<b>Data type:</b>	No data

---

**INTN**

---

<b>Command name:</b>	Send interval number
<b>Command type:</b>	Program status
<b>Description:</b>	Queries the AST 8800 for the current interval number. The AST 8800 sends an integer to indicate the interval number.
<b>Syntax:</b>	INTN?
<b>Data type:</b>	Integer
<b>Query example:</b>	INTN?
<b>AST 8800 response:</b>	10 (The AST 8800 is on interval 10 of the currently selected program.)

**INTV**

<b>Command name:</b>	Send or load program interval string								
<b>Command type:</b>	Programming								
<b>Description:</b>	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).								
<b>Interval 0 syntax:</b>	INTV0? or INTV0,fv1,fv2,fv3,fv4,active channels  Where:  <b>fv1 ... fv4</b> = decimal values for the channel 1 through channel 4 initial values. <b>NOTE:</b> The final values of interval 0 are the initial values of interval 1.  <b>active channels</b> = two-digit coded integer that assigns the active channels the following weight:  1 = Channel 1      2 = Channel 2      4 = Channel 3      8 = Channel 4								
<b>Interval n syntax:</b>	INTVn? or INTVn,fv1,fv2,fv3,fv4,dv1,dv2,dv3,dv4,hh:mm:ss,pgrp,lp,ni,ax1, ax2,display status,options  Where:  <b>n</b> = interval number  <b>fv1 ... fv4</b> = decimal values for the channel 1 through channel 4 final values  <b>dv1 ... dv4</b> = decimal values for the channel 1 through channel 4 deviations from set point  <b>hh:mm:ss</b> = hours, minutes, and seconds. See the TLFT command for the time field entry variations. <b>NOTE:</b> Any combination of hh:mm:ss values can be entered as long as the total converted time doesn't exceed 99:59:59.  <b>pgrp</b> = parameter group (1 through 4)  <b>lp</b> = number of loops (0 to 9999)  <b>ni</b> = next interval (1 to 300)  auxiliaries 1 through 8 and auxiliary group 2 refers to auxiliaries 9 through 16. Each value is a three-digit coded integer with the following values:  <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">1    AUX 1</td> <td style="width: 50%;">16    AUX 5</td> </tr> <tr> <td>2    AUX 2</td> <td>32    AUX 6</td> </tr> <tr> <td>4    AUX 3</td> <td>64    AUX 7</td> </tr> <tr> <td>8    AUX 4</td> <td>128    AUX 8</td> </tr> </table> <b>display status byte</b> = <i>not used</i>  <b>options</b> = 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    AUX 1	16    AUX 5	2    AUX 2	32    AUX 6	4    AUX 3	64    AUX 7	8    AUX 4	128    AUX 8
1    AUX 1	16    AUX 5								
2    AUX 2	32    AUX 6								
4    AUX 3	64    AUX 7								
8    AUX 4	128    AUX 8								

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

**Data type:** Coded integer

**Query example 1:** INTV0?

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

**Query example 2:** INTV22?

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

Interval 22 is programmed as follows:

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

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

**Time:** 1 hour, 10 minutes

**Parameter group:** 3

**Number of loops:** 5

**Next interval:** 18

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

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

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

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

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

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

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

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

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

**Time:** 20 minutes

**Parameter group:** 1

**Number of loops:** 20

**Next interval:** 15

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

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

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

---

**ITIM**

---

<b>Command name:</b>	Send interval time
<b>Command type:</b>	Program status
<b>Description:</b>	Queries the AST 8800 for the programmed time for the current interval.
<b>Syntax:</b>	ITIM?
<b>Data type:</b>	String
<b>Query example:</b>	ITIM?
<b>AST 8800 response:</b>	0:10:30 (The current interval is 10 minutes, 30 seconds long.)

---

**IVAL**

---

<b>Command name:</b>	Send initial value
<b>Command type:</b>	System status
<b>Description:</b>	Queries the AST 8800 for the current interval's initial value parameter for channel n (1 through 4). The AST 8800 sends a decimal value for the selected channel.
<b>Syntax:</b>	IVALn?  Where <b>n</b> is the channel number (1 through 4).
<b>Data type:</b>	Decimal
<b>Query example:</b>	IVAL3?
<b>AST 8800 response:</b>	25.00 (The channel 3 initial value for the current interval is 25.00.)

---

**LANG**

---

<b>Command name:</b>	Send language mode
<b>Command type:</b>	System status
<b>Description:</b>	This command queries the AST 8800 for the current language mode.
<b>Syntax:</b>	LANG?  The AST 8800 will respond with 0 (English) or 1 (French).
<b>Data type:</b>	Integer
<b>Query example:</b>	LANG?
<b>AST 8800 response:</b>	1 (The AST 8800 is in French language mode.)

**LAUX**

---

<b>Command name:</b>	Send or load live auxiliary settings
<b>Command type:</b>	Variable
<b>Description:</b>	Unlike standard auxiliary relays, live auxiliaries can be enabled without the AST 8800 being in run mode. The query command asks the AST 8800 for the status of the selected live auxiliary. The operation command allows you to set the live auxiliary variables.
<b>Query syntax:</b>	LAUXaux?
<b>Operation syntax:</b>	LAUXaux, state Where: <b>aux</b> live auxiliary number (1 through 8) <b>state</b> 0 (off) or 1 (on) <b>NOTE:</b> The AST 8800 will also return a 0 if the specified live aux has never been configured.
<b>Query example 1:</b>	LAUX2?
<b>AST 8800 response:</b>	0 (Live auxiliary 2 is not on)
<b>Query example 2:</b>	LAUX1?
<b>AST 8800 response:</b>	1 (Live auxiliary 1 is on)
<b>Operation example:</b>	LAUX2, 1
<b>AST 8800 response:</b>	0 (The AST 8800 changed live auxiliary 2 to be on, but only if it is enabled.)

**LGHT**

---

<b>Command name:</b>	Send or load the light status
<b>Command type:</b>	System status
<b>Description:</b>	The query command asks the AST 8800 for the status of the light (on or off). The operation command allows you to remotely turn the chamber light on or off.
<b>Syntax:</b>	LGHT? or LGHTn Where <b>n</b> is 0 (off) or 1 (on).
<b>Data type:</b>	Integer
<b>Query example:</b>	LGHT?
<b>AST 8800 response:</b>	1 (The chamber light is on.)
<b>Operation example:</b>	LGHT0
<b>AST 8800 response:</b>	Turns the chamber light off.

**LLFT**


---

<b>Command name:</b>	Send or load program loops left
<b>Command type:</b>	Program status; edit from hold
<b>Description:</b>	The query command asks the AST 8800 for the number of loops left to be executed for the current loop. On nested looping, the value is for the inside loop. The AST 8800 sends an integer to indicate the number of loops left. The edit from hold operation command temporarily changes the current interval's loop counter.
<b>Syntax:</b>	LLFT? or LLFTn Where <b>n</b> is the number of loops.
<b>Data type:</b>	Integer
<b>Query example:</b>	LLFT?
<b>AST 8800 response:</b>	8 (There are 8 loops left to be executed for the current loop.)
<b>Operation example:</b>	LLFT15
<b>AST 8800 response:</b>	Changes the loops left counter to 15.

**LOCK**


---

<b>Command name:</b>	Send or load access level												
<b>Command type:</b>	System status												
<b>Description:</b>	This is the only system status command that allows you to change the AST 8800's status. It allows you to read and change the access level of the AST 8800.												
<b>Syntax:</b>	LOCK? or LOCKn Where <b>n</b> indicates access level (0 through 5): <table> <tr> <td>0</td> <td>Locked</td> <td>3</td> <td>Programmer</td> </tr> <tr> <td>1</td> <td>Level One</td> <td>4</td> <td>Lab Manager</td> </tr> <tr> <td>2</td> <td>Level Two</td> <td>5</td> <td>Calibration</td> </tr> </table>	0	Locked	3	Programmer	1	Level One	4	Lab Manager	2	Level Two	5	Calibration
0	Locked	3	Programmer										
1	Level One	4	Lab Manager										
2	Level Two	5	Calibration										
<b>Data type:</b>	Coded integer												
<b>Query example:</b>	LOCK?												
<b>AST 8800 response:</b>	3 (The AST 8800 is set to the Programmer access level.)												
<b>Operation example:</b>	LOCK0												
<b>AST 8800 response:</b>	This command locks out all user access to the AST 8800 functions at the keyboard.												

---

**MINT**

---

<b>Command name:</b>	Send or load match interval
<b>Command type:</b>	System status
<b>Description:</b>	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.
<b>Syntax:</b>	MINT? or MINTdata
<b>Data type:</b>	Integer (range 0 to 300)
<b>Query example:</b>	MINT?
<b>AST 8800 response:</b>	14 (A service request interrupt will occur at the start of interval 14 when running a program.)
<b>Operation example:</b>	MINT3
<b>AST 8800 response:</b>	The AST 8800 loads the match interval parameter with a value of 3.

**MLTZ**

<b>Command name:</b>	Send or load multi-zone vibration control status	
<b>Command type:</b>	System status	
<b>Description:</b>	The query command asks the AST 8800 for the status of the multi-zone settings. The operation command allows you to remotely modify the multi-zone settings.	
<b>Syntax:</b>	MLTZ? or MLTZe,z,o1,a1,o2,a2,o3,a3,o4,a4	
	Where:	
	<b>e</b> = 0 (multi-zone disabled) or 1 (multi-zone enabled)	
	<b>z</b> = 0 for 2-zone horizontal mode, 1 for 2-zone vertical mode, 2 for 4-zone mode	
	<b>o1</b> = zone 1 offset ( $\pm 5.0g$ )	
	<b>a1</b> = zone 1 accelerometer (1 to 16)	
	<b>o2</b> = zone 2 offset ( $\pm 5.0g$ )	
	<b>a2</b> = zone 2 accelerometer (1 to 16)	
	<b>o3</b> = zone 3 offset ( $\pm 5.0g$ )	
	<b>a3</b> = zone 3 accelerometer (1 to 16)	
	<b>o4</b> = zone 4 offset ( $\pm 5.0g$ )	
	<b>a4</b> = zone 4 accelerometer (1 to 16)	
	<b>NOTE:</b> Empty fields indicate to the AST 8800 to keep the previous setting.	
<b>Data type:</b>	Integer	
<b>Query example:</b>	MLTZ?	
<b>AST 8800 response:</b>	1,2,-0.1,1,0.0,2,0.2,3,0.0,4	Multi-zone enabled 4-zone mode selected Zone 1 offset = -0.1 Zone 1 accelerometer = 1 Zone 2 offset = 0.0 Zone 2 accelerometer = 2 Zone 3 offset = 0.2 Zone 3 accelerometer = 3 Zone 4 offset = 0.0 Zone 4 accelerometer = 4
<b>Operation example:</b>	MLTZ1,2,,,0.0,4,,,0.1,7	
<b>AST 8800 response:</b>	Multi-zone is enabled 4-zone mode is selected Zone 1 offset is unchanged Zone 1 accelerometer is unchanged Zone 2 offset set to 0.0 Zone 2 accelerometer is set to 4 Zone 3 offset is unchanged Zone 3 accelerometer is unchanged Zone 4 offset set to 0.1 Zone 4 accelerometer is set to 7	
<b>Operation example:</b>	MLTZ1	
<b>AST 8800 response:</b>	0 (multi-zone is enabled using all current settings)	
<b>Operation example:</b>	MLTZ0	
<b>AST 8800 response:</b>	0 (multi-zone is disabled)	

**MODE**

**Command name:** Send the operating mode of the AST 8800.

**Command type:** System status

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

**Syntax:** MODE?

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

**Bits 0 through 7**

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

**Data type:** Coded integer

**Query example:** Mode?

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

**MRMP**

**Command name:** Send or load manual ramp setting

**Command type:** Variable

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

**Syntax:** MRMPn? or MRMPn,data

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

**Data type:** Integer

**Query example:** MRMP2?

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

**Operation example:** MRMP1,12

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

**MTHT**

---

<b>Command name:</b>	Send and receive manual throttle command.
<b>Command type:</b>	System status
<b>Description:</b>	The query command allows you to read the current manual throttle mode of the AST 8800. The operation command allows you to change the current manual throttle mode of the AST 8800. <b>NOTE:</b> You have to be in run manual mode to use this command. You can use THTL to modify the throttle values once you enter manual throttle mode.
<b>Syntax:</b>	MTHTn? or MTHTn, data  Where <b>n</b> indicates a process variable channel (1 through 8) and <b>data</b> = 0 (disable manual throttle mode) or 1 (enable manual throttle mode).
<b>Data type:</b>	Integer
<b>Query example:</b>	MTHT1?
<b>AST 8800 response:</b>	0 (Channel 1 is not in manual throttle mode.)
<b>Operation example:</b>	MTHT1,1
<b>AST 8800 response:</b>	Places channel 1 in manual throttle mode.

**NUML**

---

<b>Command name:</b>	Send number of loops
<b>Command type:</b>	Program status
<b>Description:</b>	Queries the AST 8800 for the programmed number of loops assigned to the current loop. For nested looping, the value is for the inside loop. The AST 8800 sends an integer indicating the number of loops assigned to the current loop.
<b>Syntax:</b>	NUML?
<b>Data type:</b>	Integer
<b>Query example:</b>	NUML?
<b>AST 8800 response:</b>	15 (The number of loops assigned to the current loop is 15.)

**NXTI**

---

<b>Command name:</b>	Send next interval
<b>Command type:</b>	Program status
<b>Description:</b>	Queries the AST 8800 for the next interval that will be executed. The AST 8800 sends an integer indicating the next interval number.
<b>Syntax:</b>	NXTI?
<b>Data type:</b>	Integer
<b>Query example:</b>	NXTI?
<b>AST 8800 response:</b>	5 (The next interval that will be executed is interval 5.)

**OPTN**

**Command name:** Send or load controller options

**Command type:** Variable

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

**Syntax:** OPTN? or OPTN[,]dddd

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

1	Product temperature control	256	Rapid cycle (AST module only)
2	Humidity system	512	Altitude
4	Low humidity system	1024	Mechanical boost
8	GSoak	2048	Vibration
16	Purge	4096	Low frequency mode (SCI only)
32	Cascade refrigeration (SE only)	8192	High frequency mode (SCI only)
64	Power Save mode (SE only)	16384	Synchronized mode (SCI only)
128	Single-stage refrig. (SE only) or Refrig mode enabled (non SE)	32768	Product dewpoint control (PDC)

**NOTE:** Only one of the three SCI only flags should ever be set at once. For more information on SCI systems, refer to Appendix B.

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

**Data type:** Coded integer; see Syntax

**Query example:** OPTN?

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

**Operation example:** OPTN50

**AST 8800 response:** 0 (This command sets the AST 8800 manual mode options to enable cascade refrigeration, purge, and humidity.)

**PARM**

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

**Command name:** Send or load parameter values

**Command type:** Variable

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

**Query syntax:** PARMc, g?

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

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

Where:

**c** = control channel number (1 through 4)

**g** = parameter group number (1 through 4)

**hpb/cpb** = heat and cool proportion bands (0.0 – 9999.0)

**hit/cit** = heat and cool integral time (0 to 1000 seconds)

**htl** = heat throttle limit (0.0 to 100.0)

**ctl** = cool throttle limit (-100.0 to 0.0)

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

Where:

**c** = Control channel number (1 through 4)

**g** = Parameter group number (1 through 4)

**hgn/cgn** = Heat and cool gain settings for PTC operations (0.0 – 9999.0)

**hit/cit** = Heat and cool integral time (0 to 1000 seconds)

**hof** = Heat offset (0.0 to 100.0)

**cof** = Cool offset (-100.0 to 0.0)

**Data type:** Integer

**Query example:** PARM2,3?

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

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

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

**PMEM (legacy support)**

---

<b>Command name:</b>	Send available program memory
<b>Command type:</b>	System status
<b>Description:</b>	Queries the AST 8800 for the available amount of program memory. This command is for legacy support only. The AST 8800 has a virtually unlimited amount of program storage. The AST 8800 will always send 300.
<b>Syntax:</b>	PMEM?
<b>Data type:</b>	Integer
<b>Query example:</b>	PMEM?
<b>AST 8800 response:</b>	300

**PNAM**

---

<b>Command name:</b>	Send program name
<b>Command type:</b>	Program status
<b>Description:</b>	Queries the AST 8800 for the name of the currently loaded program. The AST 8800 responds with the program's assigned name (a string up to 15 characters long). If there is no currently loaded program name available, the AST 8800 will respond with "Untitled".
<b>Syntax:</b>	PNAM?
<b>Data type:</b>	String
<b>Query example 1:</b>	PNAM?
<b>AST 8800 response:</b>	STRESS SCREEN40 (The name of the currently loaded program is STRESS SCREEN40.)
<b>Query example 2:</b>	PNAM?
<b>AST 8800 response:</b>	Untitled (There is no currently loaded program name available.)

**PRGN (legacy support)**

---

<b>Command name:</b>	Send current program number
<b>Command type:</b>	System status
<b>Description:</b>	Queries the AST 8800 for the number of the currently loaded program; 0 indicates none.
<b>Syntax:</b>	PRGN?
<b>Data type:</b>	Integer
<b>Query example:</b>	PRGN?
<b>AST 8800 response:</b>	7 (The current program is loaded into program slot 7.)

**PRMG**


---

<b>Command name:</b>	Send or load parameter group
<b>Command type:</b>	Variable; edit from hold
<b>Description:</b>	Queries the AST 8800 for the number of the parameter group that it is currently using. If the AST 8800 is in manual mode, the operation command selects the parameters group (1 through 4) that the AST 8800 will use to control the channels. Edit from hold operations temporarily change the parameter group for the program.
<b>Syntax:</b>	PRMG? or PRMG[,] <i>d</i>  Where <b>d</b> is the parameters group number (1 through 4).
<b>Data type:</b>	Integer; see Syntax
<b>Query example:</b>	PRMG?
<b>AST 8800 response:</b>	2 (The AST 8800 is currently using parameters group 2.)
<b>Operation example:</b>	PRMG3
<b>AST 8800 response:</b>	0 (In manual mode, the AST 8800 will use parameters group 3.)

**PROG**


---

<b>Command name:</b>	Send or load program data string
<b>Command type:</b>	Programming
<b>Description:</b>	This command sets up the AST 8800 or host computer to load an entire program into the AST 8800's program memory. The query command receives the data string from the AST 8800, while the operation command sends the data string to the AST 8800. For additional information, see "Using the interface command set" later in this section.  The query command sets up which program will be retrieved, and responds with the name of the program and the number of intervals in the program. The operation command sets up the name and the number of intervals in the program.
<b>Syntax:</b>	PROGname? or PROG, name, number of intervals  Where:  <b>name</b> = program name  <b>number of intervals</b> = integer (1 to 300)
<b>Data type:</b>	See Syntax.
<b>Query example:</b>	PROGtemp_test?
<b>AST 8800 response:</b>	temp_test,6 (The program named "temp_test" is 6 intervals long.)
<b>Operation example:</b>	PROG,HI HUMIDITY,25
<b>AST 8800 response:</b>	0 (The AST 8800 will load a 25-interval program and name the program HI HUMIDITY.)

**PVAR**

**Command name:** Send process variable

**Command type:** Variable

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

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

**Syntax:** PVARn?

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

**Data type:** Decimal

**Query example:** PVAR1?

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

**REFG**


---

<b>Command name:</b>	Send refrigeration system pressures												
<b>Command type:</b>	System status												
<b>Description:</b>	<p>When used, "n" is the refrigeration system number (1, 2, 3, or 4). When "n" is not used, the AST 8800 defaults to system 1. The AST 8800 returns four pressures and four temperatures in integer format, and a binary-coded decimal refrigeration mode word. The pressures are in psi and the temperatures are in Celsius. The string breaks down as follows:</p> <ul style="list-style-type: none"> <li>• Four pressures for high-stage suction, high-stage discharge, low-stage suction, and low-stage discharge.</li> <li>• Four temperatures for high-stage suction, high-stage discharge, low-stage suction, and low-stage discharge.</li> <li>• One coded integer that indicates the refrigeration mode. Each mode has its own weighting value: <table> <tr> <td>1</td> <td>Humidity cooling mode</td> <td>8</td> <td>Pump-down mode</td> </tr> <tr> <td>2</td> <td>Temperature cooling mode</td> <td>16</td> <td>High-stage compressor trip</td> </tr> <tr> <td>4</td> <td>Cascade mode</td> <td>32</td> <td>Low-stage compressor trip</td> </tr> </table> </li> </ul> <p>For example, a 6 (4 + 2) indicates the AST 8800 is in cascade and temperature cooling modes.</p>	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
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										
<b>Syntax:</b>	REFG(n)?												
<b>Data type:</b>	String ( <b>NOTE:</b> The first four variables in the string are integers, the next four variables are one-decimal-place real numbers, and the final variable is an integer.)												
<b>Query example:</b>	REFG?												
<b>AST 8800 response:</b>	<p>25,220,25,249,-23.2,87.5,-23.6,113.4,6. This string indicates the following:</p> <ul style="list-style-type: none"> <li>• High-stage suction pressure 25, high-stage discharge pressure 220, low-stage suction pressure 25, and low-stage discharge pressure 249.</li> <li>• High-stage suction temperature -23.2, high-stage discharge temperature 87.5, low-stage suction temperature -23.6, and low-stage discharge temperature 113.4.</li> <li>• Refrigeration mode: cascade and temperature cooling.</li> </ul>												

**RESM**


---

<b>Command name:</b>	Resume program or manual mode operation
<b>Command type:</b>	Control
<b>Description:</b>	Returns a program or test from hold mode to its run mode.
<b>Syntax:</b>	RESM
<b>Data type:</b>	No data
<b>Query example:</b>	RESM
<b>AST 8800 response:</b>	The program or test returns to run mode.

**RLTM**


---

<b>Command name:</b>	Send real time clock reading or load real time clock values
<b>Command type:</b>	System status
<b>Description:</b>	The query command tells the AST 8800 to return the date and time reading from its real time clock. The operation command loads new values into the real time clock, and resets seconds to 00.
<b>Syntax:</b>	RLTM? or RLTMmn,dd,hh,mm  Where <b>mn</b> is month, <b>dd</b> is day, <b>hh</b> is hour, and <b>mm</b> is minute.
<b>Data type:</b>	String
<b>Query example:</b>	RLTM?
<b>AST 8800 response:</b>	3/11 14:32:45 (The real time clock date is March 11 and the time is 2:32 p.m.)
<b>Operation example:</b>	RLTM3,11,14,32
<b>AST 8800 response:</b>	This command loads the date and time of March 11, 2:32 p.m. into the AST 8800.

**RUNM**


---

<b>Command name:</b>	Run manual mode
<b>Command type:</b>	Control
<b>Description:</b>	Places a stopped AST 8800 in run manual mode.
<b>Syntax:</b>	RUNM
<b>Data type:</b>	No data
<b>Operation example:</b>	RUNM
<b>AST 8800 response:</b>	The AST 8800 is placed in run manual mode.

**RUNP**


---

<b>Command name:</b>	Run program mode
<b>Command type:</b>	Control
<b>Description:</b>	Places a stopped AST 8800 in run program mode, and specifies the program and starting interval.
<b>Syntax:</b>	RUNPp,I,R[,S]  Where:  <b>p</b> Program name ( <b>NOTE:</b> The program must be in the root directory of the AST 8800's hard drive.)  <b>i</b> Interval number  <b>R</b> Resume from stop  <b>S</b> Single-step mode. This places the program in hold program mode at the end of each interval. To continue executing the program, send the RESM command.
<b>Data type:</b>	See Syntax.
<b>Operation example:</b>	RUNPsimple_test,5,S
<b>AST 8800 response:</b>	The AST 8800 runs program <i>simple_test.pgm</i> , starting at interval 5, in single-step mode.

---

**SCOD**

---

<b>Command name:</b>	Send stop code
<b>Command type:</b>	System status
<b>Description:</b>	<p>The stop code identifies the cause of the most recent transition to the stop state. The stop codes are defined as follows:</p> <ol style="list-style-type: none"><li>0 Cold boot power up. The AST 8800 memory has been initialized.</li><li>1 Currently running. Not in stop.</li><li>2 Stop key pressed.</li><li>3 End of test.</li><li>4 External input. An input defined as stop has been activated.</li><li>5 Computer interface. The AST 8800 received the stop command.</li><li>6 Open input. A thermocouple or analog input is open.</li><li>7 Process alarm. A process alarm setting has been exceeded.</li><li>8 System Monitor trip.</li><li>9 Power fail recovery. The selected power fail recover mode was stop.</li><li>10 Therm-Alarm trip.</li></ol>
<b>Syntax:</b>	SCOD?
<b>Data type:</b>	Integer
<b>Query example:</b>	SCOD?
<b>AST 8800 response:</b>	3 (The currently loaded test has ended.)

**SETP**

**Command name:** Send or load set point

**Command type:** Variable

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

**Syntax:** SETPn? or SETPn,data  
Where **n** is any process variable channel (1 through 8) and **data** is the set point.

**Data type:** Decimal

**Query example:** SETP1?

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

**Operation example:** SETP2,95

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

**SRQB**

**Command name:** Send service request status byte

**Command type:** System status

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

<b>Bit #</b>	<b>Definition</b>	<b>Bit #</b>	<b>Definition</b>
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?

**AST 8800 response:** 65 = 01000001

<i>bit 7</i>	<i>bit 6</i>	<i>bit 5</i>	<i>bit 4</i>	<i>bit 3</i>	<i>bit 2</i>	<i>bit 1</i>	<i>bit 0</i>
0	1	0	0	0	0	0	1

(This response indicates state change + RSV.)

**SRQM**

<b>Command name:</b>	Send or load service request event mask byte
<b>Command type:</b>	System status
<b>Description:</b>	This byte enables the various events for requesting service via the GPIB SRQ line. The coded integer data represents the enabled events using the definitions given under the SRQB command. <b>NOTE:</b> Setting the SRQ mask to zero disables all SRQ interrupts.
<b>Syntax:</b>	SRQM? or SRQMdata
<b>Data type:</b>	Coded integer (0 to 255)
<b>Query example:</b>	SQRM?
<b>AST 8800 response:</b>	4 = 00000100 (The end of interval service request bit has been enabled.)

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

<b>Operation example:</b>	SRQM1
<b>AST 8800 response:</b>	0 (The AST 8800 loads the SRQ mask with the value 1, enabling the state change SRQ event.)

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

**STAT**

<b>Command name:</b>	Send status word																
<b>Command type:</b>	System status																
<b>Description:</b>	The AST 8800 returns one byte of coded-decimal data to indicate the status of the AST 8800. The byte is defined below:																
	<table> <tr> <td>1</td> <td>Run program</td> <td>16</td> <td>Run manual</td> </tr> <tr> <td>2</td> <td>Hold program</td> <td>32</td> <td>Hold manual</td> </tr> <tr> <td>4</td> <td>Suspend program</td> <td>64</td> <td>Undefined</td> </tr> <tr> <td>8</td> <td>Undefined</td> <td>128</td> <td>Undefined</td> </tr> </table>	1	Run program	16	Run manual	2	Hold program	32	Hold manual	4	Suspend program	64	Undefined	8	Undefined	128	Undefined
1	Run program	16	Run manual														
2	Hold program	32	Hold manual														
4	Suspend program	64	Undefined														
8	Undefined	128	Undefined														
<b>Syntax:</b>	STAT?																
<b>Data type:</b>	Coded decimal																
<b>Query example:</b>	STAT?																
<b>AST 8800 response:</b>	16 (The AST 8800 is in run manual mode.)																

**STOP**

<b>Command name:</b>	Stop controller
<b>Command type:</b>	Control
<b>Description:</b>	Places the AST 8800 in stop mode.
<b>Syntax:</b>	STOP
<b>Data type:</b>	No data
<b>Query example:</b>	STOP
<b>AST 8800 response:</b>	The AST 8800 goes into stop mode.

**TALM**

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

**Command name:** Send or load Therm-Alarm settings

**Command type:** Variable

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

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

where:

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

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

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

where:

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

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

**Data type:** Decimal

**Query example:** TALM?

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

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

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

**THTL**

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

<b>Command name:</b>	Send throttle reading
<b>Command type:</b>	Variable
<b>Description:</b>	The query command asks the AST 8800 for the current channel "n" throttle reading. The AST 8800 sends the throttle value as a percentage.
<b>Syntax:</b>	THTLn Where <b>n</b> is any process variable channel (1 through 8).
<b>Data type:</b>	Integer (-100 to +100)
<b>Query example:</b>	THTL1?
<b>AST 8800 response:</b>	-56 (The current throttle reading for process variable channel 1 is -56%.)

**TLFT**

<b>Command name:</b>	Send or load time left
<b>Command type:</b>	Program status; edit from hold
<b>Description:</b>	Queries the AST 8800 for the time left in the current interval. The edit from hold operation command temporarily changes the current interval's time left counter.
<b>Syntax:</b>	TLFT? or TLFThh:mm:ss Where <b>hh</b> is hours, <b>mm</b> is minutes, and <b>ss</b> is seconds.
<b>Data type:</b>	String
<b>Query example:</b>	TLFT?
<b>AST 8800 response:</b>	1:17:57 (The time left in the current interval is 1 hour, 17 minutes, 57 seconds.)
<b>Operation example:</b>	TLFT::85
<b>AST 8800 response:</b>	This command sets the time left in the current interval to 1 minute, 25 seconds.

**TMPS**

<b>Command name:</b>	Send or load temperature scale
<b>Command type:</b>	Variable
<b>Description:</b>	Allows you to read or change the temperature scale used on the AST 8800 display. <b>NOTE:</b> This command does not affect the AST 8800 interface commands.
<b>Syntax:</b>	TMPS?
<b>Data type:</b>	Coded integer (0 = Celsius, 1 = Fahrenheit)
<b>Query example:</b>	TMPS?
<b>AST 8800 response:</b>	0 (The temperature scale used on the AST 8800 display is Celsius.)
<b>Operation example:</b>	TMPS1
<b>AST 8800 response:</b>	The AST 8800 sets the temperature scale to Fahrenheit.

**VRSN**

---

<b>Command name:</b>	Send software version
<b>Command type:</b>	System status
<b>Description:</b>	Queries the AST 8800 for the version number of the display software.
<b>Syntax:</b>	VRSN?
<b>Data type:</b>	String
	The AST 8800 returns a string in the "Vx.yy dd/mm/yyyy" format to identify its software version.
<b>Query example:</b>	VRSN?
<b>AST 8800 response:</b>	V1.59 04/02/2010 (The software is version 1.59, released April 2, 2010.)

---

## Vibration specific I/O commands

### ACCL

---

<b>Command name:</b>	Send accelerometer monitor channel data.
<b>Command type:</b>	Program status command
<b>Description:</b>	Queries the AST system for the current grms value of the selected accelerometer monitor channel. The AST system returns the current grms value of the selected accelerometer monitor channel.
<b>Syntax:</b>	ACCLn?  Where <b>n</b> is an accelerometer monitor channel (01 through 16).
<b>Data type:</b>	Decimal
<b>Query example:</b>	ACCL03? (all values of 'n' must be 2 digits)
<b>AST 8800 response:</b>	17.5 This is the current grms value of accelerometer monitor channel 3.



## Using the interface command set

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

### Using the manual mode variable and control commands

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

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

#### Example:

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

SETP1,75	Makes the channel 1 set point +75°C.
SETP2,5	Makes the channel 2 set point 5% RH.
MRMP1,5	Makes the channel 1 manual ramp rate 5°C 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 AST 8800 in run manual mode. The manual mode screen will now display the selected parameters as the AST 8800 operates the chamber control systems.
3. As the chamber runs, manual mode commands can be sent as needed to change parameter values. Additionally, variable and chamber status commands can be used to monitor the chamber variables and the AST 8800 status.
4. At the end of the test, send the STOP command to place the AST 8800 in stop mode.

### Using the edit from hold commands

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

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

#### Example:

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

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

2. Send the RESM command to resume the program.

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

**Using the programming commands**

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

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

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

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

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

---

### **Using the operation commands to load a program into the AST 8800**

---

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

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

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

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

---

### **Using the query commands to load a program from the AST 8800**

---

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

1. Send the PROG4? command string to the AST 8800.  
**NOTE:** Use the PROGN? command to find out how many intervals a program has, and remember to include interval 0 when you begin to retrieve program intervals from the AST 8800.
2. Send the INTV0? command string to retrieve the initial values of interval 0.
3. Send the INTV1? command string to retrieve the interval 1 data.
4. Send the INTV2? command string to retrieve the interval 2 data.
5. Send the INTV3? command string to retrieve the interval 3 data.
6. Send the INTV4? command string to retrieve the interval 4 data.
7. Send the INTV5? command string to retrieve the interval 5 data.
8. Send the INTV6? command string to retrieve the interval 6 data.

---

## **Computer interface troubleshooting and error codes**

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This section contains basic troubleshooting information and a list of the AST 8800 computer interface error codes.

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### **Common computer interface problems and solutions**

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

---

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

---

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

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

---

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

---

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

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

---

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

---

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

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

---

***The host computer sends commands, but does not receive data***

---

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

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

---

***The host computer receives wrong or garbled data from the AST 8800***

---

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

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

---

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

---

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

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

---

**Error codes**

---

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

---

**Error code 00**

---

**Command name:** No error

**Description:** There was no error.

---

**Error code 01**

---

**Command name:** Serial interface error

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

---

**Error code 02**

---

**Command name:** Input buffer overflow

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

---

**Error code 03**

---

**Command name:** Output buffer overflow

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

---

**Error code 04**

---

**Command name:** Unidentified command

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

---

**Error code 05**

---

**Command name:** Number parser error

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

---

**Error code 06**

---

**Command name:** Value loaded was too high.

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

---

**Error code 07**

---

**Command name:** Value loaded was too low.

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

**Error code 08**

---

**Command name:** Incorrect channel number

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

**Error code 09**

---

**Command name:** Bad command syntax

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

**Error code 10**

---

**Command name:** Illegal program command

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

**Error code 11**

---

**Command name:** Illegal interval number sequence

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

**Error code 12**

---

**Command name:** Not enough program memory

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

**Error code 13**

---

**Command name:** Illegal stop command

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

**Error code 14**

---

**Command name:** Illegal hold command

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

**Error code 15**

---

**Command name:** Illegal run manual command

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

**Error code 16**

---

**Command name:** Incorrect operating mode

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

**Error code 17**

---

**Command name:** Run program error

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

**Error code 18**

---

**Command name:** Resume command error

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

**Error code 19**

---

**Command name:** Options not configured

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

**Error code 20**

---

**NOTE:** The AST 8800 does not use this error code.

**Error code 21**

---

**Command name:** Control module not present

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

---

## Programming examples

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

### Microsoft Visual Basic

---

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

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

private sub read8800(cmd$) 'send commands to 8800, read results or error code ack.
    resp_recd = false
    call ibwrt(dev%, cmd$)
    resp$ = space$(100)
    call ibrd(dev%, resp$)
    crposition = instr(resp$, chr$(13))
    if crposition <> 0 then
        inputstring$ = left$(resp$, crposition)
        resp_recd = true
    end if
end sub
```

### Microsoft Visual C++ (or C)

---

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

#### GPIB example

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

#### TCP example

```
#include "Winsock2.h"

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

//buffer for response
char buf[256];

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

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

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

//always AF_INET
addr.sin_family = AF_INET;

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

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

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

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

//connect to the specified destination
connect(m_hSocket, (sockaddr *)&addr, sizeof(addr));

//send a command
send(m_hSocket, cmd.GetBuffer(0), cmd.GetLength(), 0);

//read a response
recv(m_hSocket, buf, sizeof(buf), 0);

//close the connection
closesocket(m_hSocket);
m_hSocket = INVALID_SOCKET;
```

Note that the carriage return from the 8800 will be included in the response string 'resp'.

---

**National Instruments Interactive Control Utility (IBIC)**

---

It is important to use the special symbols \r and/or \n to add a carriage return (\r), or line feed (\n) to the strings sent to the ibwrt function. The following sequence finds the device at address 10, sends the 'pvar1?' query command, and then reads the data.

Win32 Interactive Control

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type 'help' for help or 'q' to quit.

: ibfind "dev10"

dev10: ibwrt "pvar1?\r"

[0100] ( cmpl )

count: 7

dev10: ibrd 22

[2100] ( end cmpl )

count: 5

32 35 2e 31 0d            2 5 . 1 .

dev10:

Note that even though a count of 22 characters was specified for the ibrd function, it returned complete and no errors since it terminated on the carriage return. Note also that the carriage return (0x0d) is included in the string returned by the ibrd function.

## Appendix A: Glossary

**access level:** A function that allows you to select from six levels of access to the AST 8800 functions.

**alarm band:** The maximum area around the current set point that the process variable (actual test space or product condition) can deviate from. If the process variable drifts outside the alarm band, the AST 8800 enables its alarm functions.

**auxiliary cooling:** An optional, non-mechanical refrigeration system that uses liquid nitrogen (LN<sub>2</sub>) or carbon dioxide (CO<sub>2</sub>) 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 AST 8800.

**auxiliary output:** A programmable signal generated by the AST 8800 that provides on/off control to a system or circuit.

**auxiliary relay:** A solid-state relay operated by an auxiliary output that uses the TTL output to switch a line voltage. Auxiliary relays operate additional systems or circuits. You can turn these outputs on or off during programmed intervals, or you can operate them in manual mode. There are two auxiliary groups of eight outputs each available with the AST 8800.

**calibration:** The process of checking or adjusting an instrument by comparing it with a standard.

**cascade:** A mechanical refrigeration system with two compressors and a cascade condenser. The refrigerant of the first compressor removes heat from the test space. The refrigerant of the second compressor removes heat from the refrigerant of the first compressor. An air-cooled or water-cooled condenser then removes the heat from the refrigerant of the second compressor.

**chamber:** A general name for a Thermotron environmental simulation testing system. The chamber includes the testing section, the machinery section, the console, and on air-cooled chambers, condensers.

**channel names:** Names that appear as channel headings for all channel-dependent AST 8800 screens. Channel names may be customized to reflect the variable they are controlling or monitoring.

**command:** A code sent to the AST 8800 by a host computer that the AST 8800 interprets to perform an action.

**computer interface:** A hardware component, such as an RS-232 or IEEE-488, that connects two or more other components for the purpose of passing information from one to the other.

**concatenation:** A programming technique that allows the programmer to send more than one command in a single data transmission. The programmer enters the commands on one line, separating them with a delimiter. (On the AST 8800, 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 AST 8800 operates the chamber control systems based on the process variable readings and the demands of the test.

**control module:** The hardware assembly that includes the microprocessor used to perform the chamber interface operations and distribute power to the controller. The AST 8800 can have up to four control modules.

**control option:** One of the various options, such as humidity or product temperature control, that can be enabled or disabled for manual mode operation or for each programmed interval.

**control parameter:** Settings that adjust the performance of the chamber around set point. As the chamber nears set point, the AST 8800 adjusts the chamber throttles to provide a smooth ramp to set point. To prevent overshooting and oscillation around the final set point, the refrigeration, heating, and other systems must be damped as they approach the set point. To maximize chamber performance, lag times must also be compensated for. Up to four groups of chamber parameters can be entered into the AST 8800 for each control channel. This allows you to select chamber performance appropriate for the type of interval or program you are running.

**control sensor:** A device that monitors the environmental conditions in the chamber's test space for the AST 8800.

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

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

**csv files:** Comma-separated-variable files; the file format that the AST 8800 uses.

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

**delayed start:** A function that causes the AST 8800 to wait until a specified date and time before running a program.

**deviation:** The difference between the process variable (actual test space or product condition) and the set point (assigned test space or product condition).

**deviation alarm:** An AST 8800 function that can be programmed to activate an alarm if the chamber temperature, humidity, or other process variable is outside the channel's +/- deviation alarm band. A deviation alarm band programs how far the temperature or humidity can be from set point. For example, a deviation alarm band of 5°C activates the alarm output if the chamber temperature is more than 5°C above or below set point.

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

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

**dry bulb:** A thermocouple that monitors the test space temperature.

**dry bulb temperature:** The actual test space air temperature.

**early life failure:** A defect in a product that causes it to fail during its infancy.

**error code:** A two-character byte sent by the AST 8800 to indicate a fault or communication problem.

**event relay:** A relay programmed by a computer. When the relay is programmed on, the operation controlled by the relay is activated.

**final value:** The final temperature or other process variable the chamber is to reach during an interval.

**frequency:** Measurement of how often a signal oscillates.

**GPIB:** General Purpose Interface Bus; a parallel interface bus built under the IEEE-488 standard.

**graph:** An AST 8800 function that plots changes in process variables (such as temperature or humidity), set points, and other data.

**G RMS:** The root mean squared of the G level. Arrived at by adding the squares of the acceleration signal (in g), then taking the square root. Can also be thought of as the square root of the area under the curve of the PSD plot.

**g-soak (guaranteed soak):** A g-soak interval will immediately set the set point equal to the interval's final value and then wait until the process variable is within the +/- deviation band of the final value. Once the process variable is within the deviation band, the interval time will begin counting down. For multiple channel programs, all non-zero deviation bands must be satisfied before the interval time will begin counting down.

**handshaking:** A series of signals acknowledging that communication can take place between devices.

**heat-up:** The process of the test space temperature going from one set point to a higher set point.

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

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

**humidity mode:** One of two humidity options:

- *Humidity:* Enables the humidity system. The standard range is between 20% and 95% relative humidity.
- *Low humidity* (available on SE-Series chambers only): Enables the optional low humidity system. Use this system during low humidity and ultra-low humidity operations (from 5% to 20% relative humidity).

**Hz:** Cycles per second.

**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 AST 8800.

**initial value:** The starting temperature or other process variable of an interval. After the first interval of a program, the initial value is always the final value of the previous interval and cannot be edited.

**input temperature:** The temperature of the product being tested as measured by the input thermocouple.

**input thermocouple:** A dry bulb thermocouple the Therm-Alarm uses to monitor the temperature at the product under test.

**integral time:** A control parameter that determines how quickly the throttle will be adjusted to compensate for droop. Droop is an effect, such as natural heat loss through the test space walls, that prevents the process variable from reaching the final set point. The integral time parameter adjusts the throttle to take the droop out of the proportional band settings and allow the chamber to reach set point.

**interval:** A programmed period during which the chamber operates under a specified set of conditions.

**interval graph:** A graph in which each interval is given the same amount of space regardless of its duration. Compare to *time graph*.

**interval time:** A setting that controls how fast the temperature, humidity, or other process variable is to be cycled from the initial value to the final value.

**key beep:** An audible beep that is sounded each time an AST 8800 key is pressed, unless this function is disabled.

**limit temperature:** The Therm-Alarm adjustable high and low temperature settings. An alarm occurs if the input temperature reaches a limit temperature.

**loop:** A series of intervals programmed to be repeated.

**low alarm limit:** The lower temperature limit that, if exceeded, will cause a Therm-Alarm trip.

**main screen:** The base or home screen for the AST 8800. Press **Main** to return to the main screen.

**manual mode:** A function that allows you to operate the AST 8800 controller functions. Manual mode operates the chamber using set point and rate of change (ramp rate) settings. You can enter manual mode when the system is in stop mode. You also can enter manual mode from hold program mode if, while running a program, you want to perform a special operation in manual mode and then continue with the program.

**maximum excursion:** A Therm-Alarm function; the hottest or coldest temperature experienced during the most recent alarm condition.

**mechanical refrigeration system:** A system that uses pressurized refrigerants to remove heat from the test space.

**monitor channel:** A channel used by the AST 8800 for monitoring processes within the chamber. If the high or low limit is exceeded for any monitor channel, the AST 8800 alarm outputs are activated.

**multidrop addressing:** An addressing protocol used on RS-485 interfaces that allows each instrument to send data to or receive data from another specific instrument using the same physical interface cable.

**nuisance alarm time:** 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 nuisance delay will not occur.

**offset:** The amount the test space air temperature is allowed to exceed the final temperature set point during product temperature control operation.

**operation command:** A code sent to the AST 8800 that causes the AST 8800 to perform an internal action and use any accompanying data to update internal registers or memory storage.

**options byte:** A one-to-three-character data transmission that sets or indicates the function options used in the AST 8800 operations.

**overshoot:** A test condition where the process variable runs past final set point.

**parameter group:** One of four selectable sets of control parameters used by the AST 8800 to tune the performance of each active channel to a specific set of conditions. Different parameter groups may be useful for different control situations. You can select a parameter group for manual mode operation or for each programmed interval.

**parse:** To separate a command expression into sub-units to determine the relationship between the sub-units. The AST 8800 separates the command, channel or group designator, and data to translate the command into action.

**password:** A string of up to 20 keystrokes that must be entered to set the AST 8800 access level. Once the current password is entered, the authorized user can also select a new password.

**percent relative humidity (%RH):** A measurement of the moisture content of air. See also *relative humidity*.

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

**power fail recover mode; power fail recover time:** A function that allows you to set up how the AST 8800 will recover after a power failure. If the power fails for longer than the selected power fail recover time, the AST 8800 will power up in one of four power fail recover modes: stop, hold, run, or restart. If the power failure is shorter than the power fail recover time setting, or if the setting is 0:00:00, the AST 8800 will recover by returning to its last mode of operation.

**Power Save:** A refrigeration mode (available on SE-Series chambers only) that allows the software to decide whether to run in single-stage or cascade mode based on the set point and control demand (throttle).

- If the set point is less than -20°C, the AST 8800 will choose cascade mode.
- If the set point is above -20°C and the throttle is less than -10%, the AST 8800 will switch to single stage mode.
- If the throttle is greater than -80%, the AST 8800 will switch to cascade mode.

**prefix protocol:** A communication convention that places a dummy character in front of each multidrop serial data transmission to help avoid data loss during the time an instrument's receiver drivers are turning on.

**process alarm:** An AST 8800 function that can be programmed to activate an alarm if the chamber temperature, humidity, or other process variable exceeds high or low limits you select. If the variable exceeds the high or low limit, the AST 8800 enters stop mode.

**process variable:** The actual sensed condition within the test space, such as temperature or humidity, that is controlled by the AST 8800.

**process variable channels:** See *control channels*.

**product:** The device or equipment the chamber tests.

**product dew point control (PDC):** The product dew point control (PDC) option operates the chamber temperature and humidity systems in such a way that the chamber dew point is limited to a temperature that is lower (by a user-specified offset) than the temperature of the product or products being monitored in the chamber. Keeping the chamber dew point below the product temperature keeps condensation from forming at the points of product temperature measurement.

**product temperature control (PTC):** A heating and cooling process that controls the process variable from the product temperature rather than the test space air temperature. During normal temperature cycling, the chamber is cycled to the final set point in the specified time. However, the product temperature will approach final set point at an exponentially decreasing rate, lagging behind the chamber air temperature. The PTC software is written to minimize the lag time. The software senses two thermocouple inputs: channel 1 from the chamber air and a second channel from the product under test. When PTC is enabled, the second channel senses the temperature at the product and causes channel 1 to operate the heating and cooling systems at a faster throttle and higher set point to make up for the temperature lag. When PTC is disabled, channel 1 operates the chamber's control systems.

**profile:** A relationship between a test space condition and time.

**program:** A set of parameters divided into time intervals that are used to control the AST 8800 operations.

**proportional band:** A control parameter that determines the point at which the control switches from 100% output to a proportional output. As the process variable nears set point, it enters the proportional band. Once inside the proportional band, the throttle is backed off in proportion to the difference between the set point and the current process variable.

**PSD:** Power spectral density. Displays the energy in a signal per frequency.

**psi:** Pounds per square inch; a unit of pressure.

**PTC:** See *product temperature control*.

**pulldown:** The process of the chamber going from one temperature set point to a lower temperature set point.

**purge:** An option, either dry air or gaseous nitrogen (GN<sub>2</sub>), used to reduce moisture inside the test space.

**query command:** A code sent to the AST 8800 that causes the AST 8800 to send information to the host computer or server.

**ramp:** A controlled process where the process variable transitions from an initial value to a final value in a specified amount of time. During this time, the AST 8800's control parameters maintain a smooth transition.

**ramp rate:** The speed, measured in number of units (such as degrees Celsius) per minute, at which the controller cycles a process variable to a new set point. If the number of units is zero, the controller performs a *step change*.

**real time clock:** An AST 8800 function that keeps track of the time and date. These are used for reference, delayed start, and the time stamp for the graph function.

**refrigeration mode:** One of three SE-Series refrigeration system configurations that can be selected for manual mode operation or for each programmed interval. The three refrigeration modes are:

- *Single stage:* Allows only the high-stage compressor to operate.
- *Cascade:* Operates as a normal cascade cooling system.
- *Power Save:* Allows the software to decide whether to run in single-stage or cascade mode based on the set point and control demand (throttle). See *Power Save*.

**relative humidity (RH):** A percentage of the maximum amount of moisture air can hold at a given temperature and pressure.

**reset mode:** A setting that determines how the Therm-Alarm is reset when it is in alarm mode.

**resistance temperature device (RTD):** An electronic device used to sense temperature as a function of resistance.

**RH:** See *relative humidity*.

**RS-232:** A standard serial data interface between two electronic devices.

**RS-485:** A standard serial half-duplex (shared transmit/receive line) data interface with addressing capabilities.

**RSA time:** Refrigeration system anticipator time; a performance parameter that allows you to set the number of minutes the AST 8800 will precool the refrigeration system before a temperature pulldown set to 00:00:00 time. The precool occurs during the interval before the 00:00:00 time interval.

**RTD:** See *resistance temperature device*.

**run time:** An AST 8800 function that maintains a running count of the number of hours refrigeration systems or control channels operate.

**service interval:** The frequency of scheduled maintenance.

**set point:** An assigned value for a test space condition. There are three types of set point:

- *Initial set point:* The value that the chamber is at in the beginning of an interval.
- *Final set point:* The final value the chamber is to reach within an interval.
- *Current set point:* One of the intermediate set points the AST 8800 sets when ramping from the initial set point to the final set point.

**single-stage:** A mechanical refrigeration system with one compressor. The refrigerant of the compressor removes heat from the chamber. A condenser then removes the heat from the refrigerant. Compare to *cascade*.

**starting interval:** The interval that a program begins with; typically a program begins with interval 1.

**status word:** A one-to-three-character data transmission from the AST 8800 whose bits are set or cleared to indicate the operating conditions of the AST 8800.

**step change:** A process that ensures the test space or product will reach the initial value of the next interval before the chamber finishes the current interval. To enable a step change, program a zero-time interval with a deviation greater than zero. The chamber will run at 100% throttle all the way to the final set point minus the deviation before proceeding to the next interval. Note that an interval with a duration greater than zero must follow.

**stress screening:** Changing temperatures as quickly as possible to force any early life failures on each product.

**system event:** A control device that monitors certain variables, such as temperature or throttle, and turns its outputs on or off based on the monitored variables.

**t/c:** See *thermocouple*.

**temperature profile:** The relationship between time and the test space temperature.

**temperature scale:** Celsius or Fahrenheit.

**terminator:** A code used to indicate the end of a data transmission. The AST 8800 interprets and transmits carriage return and line feed characters as terminators.

**test space:** The space within the test compartment where the product is tested.

**Therm-Alarm:** A product protection instrument that monitors the temperature or other analog signal at the product. If the product temperature or analog signal exceeds either the high or low limits you select, the Therm-Alarm disables the chamber control systems and alerts you with audible and visible alarms.

**thermocouple (t/c):** A device used to sense temperature as a function of current.

**throttle:** The percentage of output applied by a chamber's conditioning system to reach set point. Any positive throttle is a heating demand, and any negative throttle is a cooling demand. For example, to heat the test space as quickly as possible, the AST 8800 will operate the throttle at +100%. When the process variable (temperature) reaches the proportional band, the AST 8800 will begin reducing the throttle to control the process variable to equal the set point.

**throttle limit:** A parameter setting that can limit the AST 8800 controller throttle output.

**time graph:** A graph in which each interval is given space based on its duration. Compare to *interval graph*.

**timed soak:** Maintaining the same test space temperature, humidity, or other variable for a specified time. When entering a test profile, a timed soak period results when the initial and final set points for an interval are the same.

**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.



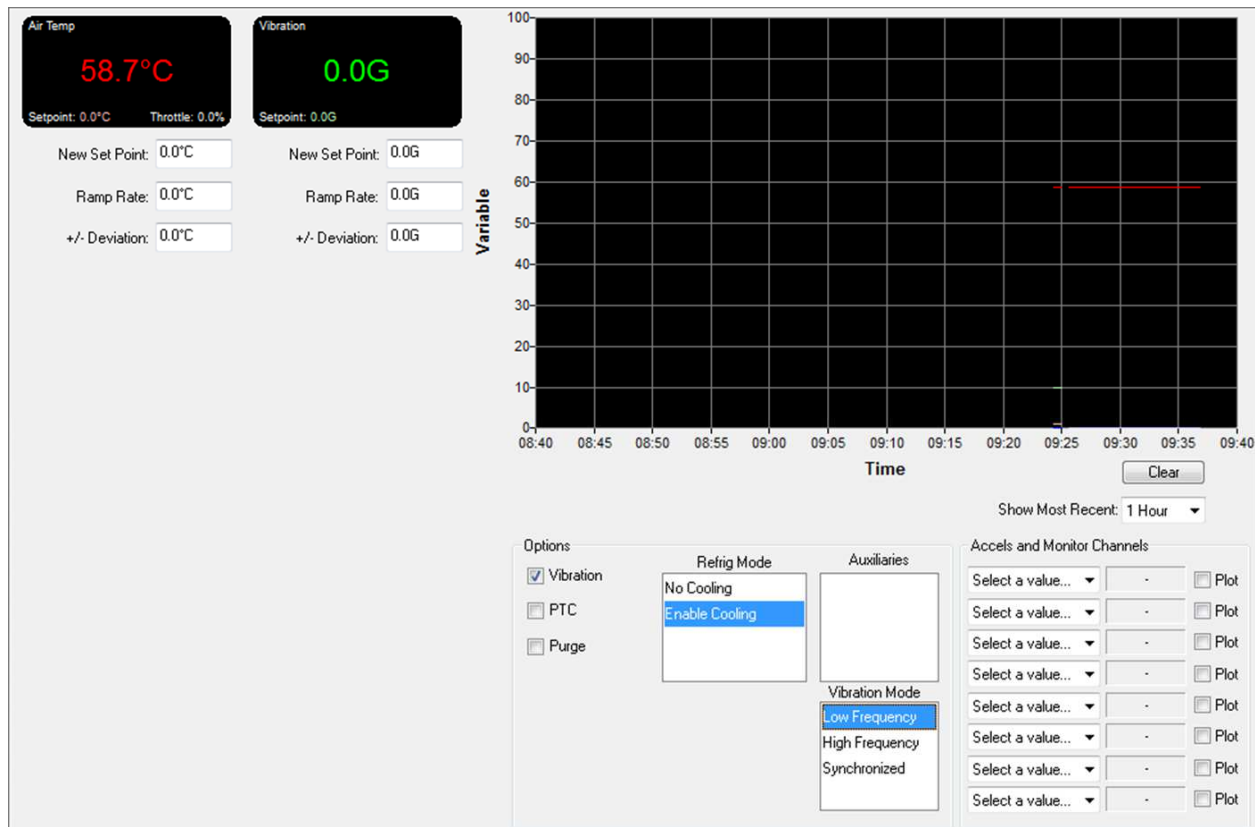
## Appendix B: SCI Capability

SCI is an option available in the AST 8800 software. When enabled, the impactors can be controlled discretely or in any combination. It can be accurately synchronized to deliver bursts of high G shock events or randomly unsynchronized to provide consistent energy covering a wide frequency range.

When this option is purchased, a new option labeled **Vibration Mode** appears in both the program setup and manual mode screens.

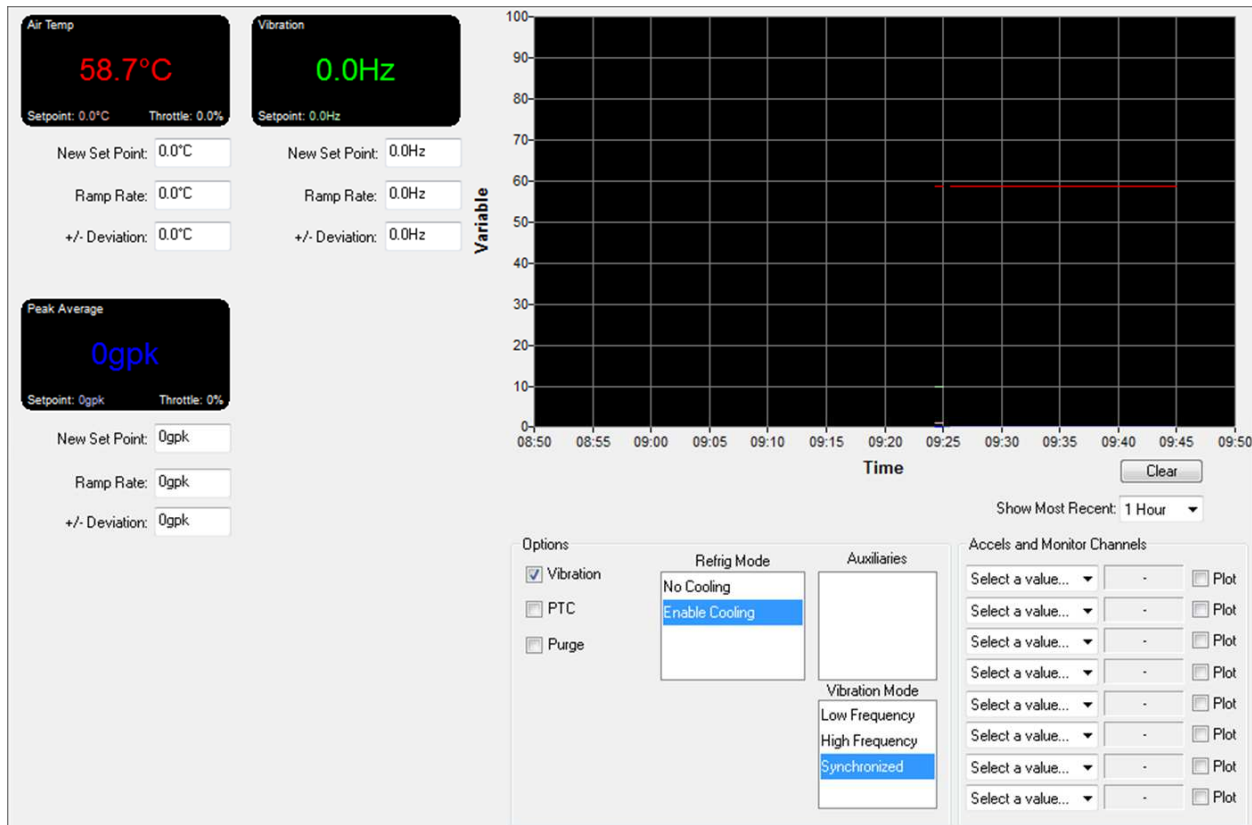
### Running in manual mode

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



2. Select and change the settings for the manual mode test. The following list describes the manual mode values for **Vibration Mode**.
  - **Low Frequency:** In this mode the control module operates the impactors independently to provide random impulses to the table. This generates more energy in the low frequency range and produces a PSD that is relatively flat. The vibration process variable is a grms level.
  - **High Frequency:** In this mode the control module operates the impactors independently to provide random impulse to the table. This generates a PSD that has more energy in the high frequency range. The vibration process variable is a grms level.

- Synchronized:** In this mode the control module operates the impactors so that all the pistons repeatedly impact the table at the same time providing large impulses to the table. This generates a PSD that has more energy in the high frequency range. The vibration process variable is a G peak level. In this mode you must also select the frequency of the impacts.



### Program mode operation

When the **Vibration** option is selected in program mode and when either the **Low Frequency** or **High Frequency** vibration modes are selected. The user can select the desired grms level for an interval.

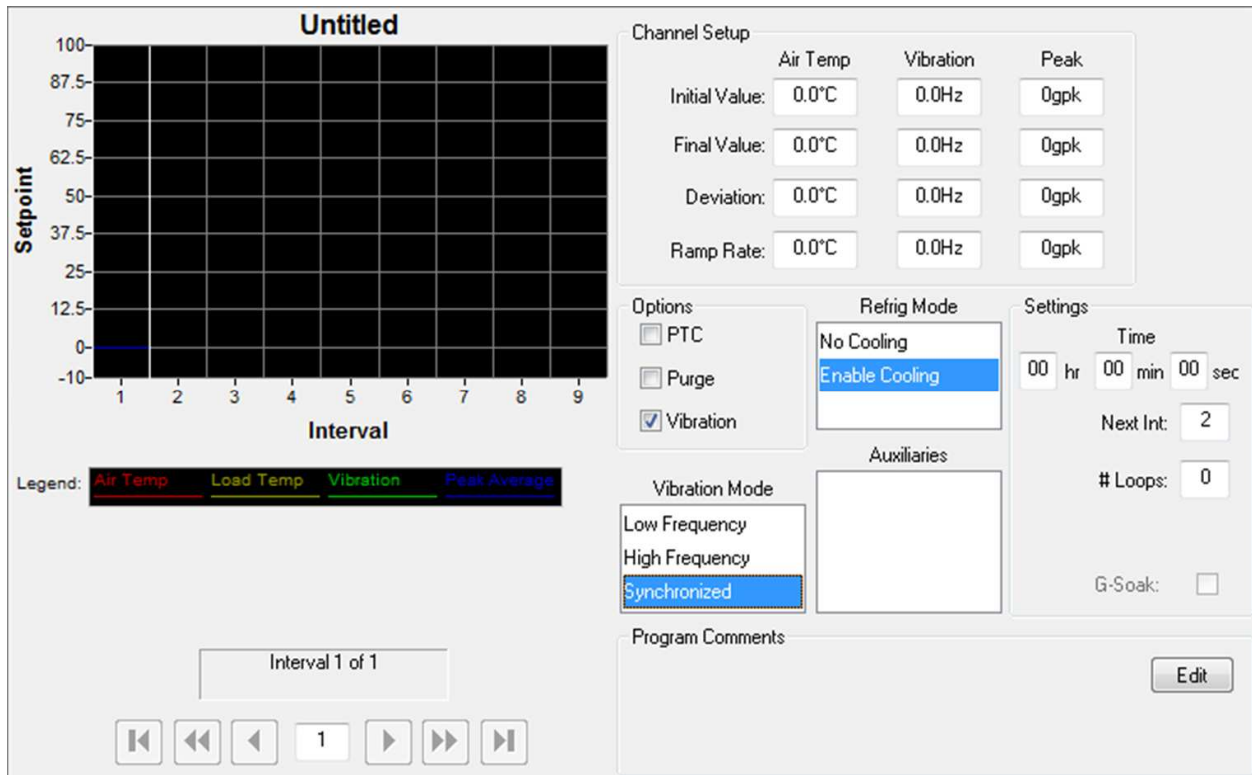
The screenshot displays the control interface for the AST 8800. On the left is a graph titled "Untitled" with "Setpoint" on the y-axis (ranging from -10 to 100) and "Interval" on the x-axis (ranging from 1 to 9). A legend below the graph identifies four data series: Air Temp (red), Load Temp (green), Vibration (blue), and Peak Average (purple). The Vibration series is currently plotted as a flat line at 0.0 Hz. To the right of the graph are several configuration panels:

- Channel Setup:** A table for configuring channels for Air Temp and Vibration.

	Air Temp	Vibration
Initial Value:	0.0°C	0.0Hz
Final Value:	0.0°C	0.0Hz
Deviation:	0.0°C	0.0Hz
Ramp Rate:	0.0°C	0.0Hz
- Options:** A list of checkboxes for PTC, Purge, and Vibration. The Vibration checkbox is checked.
- Refrig Mode:** A dropdown menu with "No Cooling" and "Enable Cooling" options. "Enable Cooling" is selected.
- Auxiliaries:** An empty text box for auxiliary settings.
- Vibration Mode:** A dropdown menu with "Low Frequency", "High Frequency", and "Synchronized" options. "Low Frequency" is selected.
- Settings:** Fields for Time (00 hr, 00 min, 00 sec), Next Int (2), # Loops (0), and G-Soak (unchecked).
- Program Comments:** A text area with an "Edit" button.

At the bottom of the interface, there is a control bar showing "Interval 1 of 1" and navigation buttons for back, forward, and stop.

In **Synchronized** mode the user can select the desired frequency of the **Vibration** impacts and the desired **Peak** average. As with other variables you can do step changes, g-soaks, and ramps with the peak average and/or frequency of vibration impacts.



---

## Appendix C: Product Dew Point Control (PDC)

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### General description

The AST 8800 product dew point control (PDC) option operates the chamber temperature and humidity systems in such a way that the chamber dew point is limited to a temperature that is lower (by a user-specified offset) than the temperature of the product or products being monitored in the chamber. Keeping the chamber dew point below the product temperature keeps condensation from forming at the points of product temperature measurement. Benefits of product dew point control include:

- Keeping humidity from condensing on products under test during temperature/humidity transitions.
- Conserving water supplied to the humidity system by limiting condensation on the chamber and the products under test.
- Improving product transition to the final temperature by eliminating evaporative cooling of the product.

The PDC option uses the standard product monitoring thermocouple — the same thermocouple supplied for the product temperature control (PTC) option.

- If you purchased a group of thermocouples for use with the **PDC** option, the AST 8800 is configured to use the **minimum** temperature in that group when calculating the dew point limit.
- If you use this same optional group of thermocouples for the **PTC** option, the AST 8800 is configured to use the **average** temperature in that group when PTC is enabled.

When using product dew point control, keep the following points in mind:

- PDC operation allows you to program step changes in both temperature and humidity without worrying about moisture condensing on the products under test. Step changes under PDC will affect the fastest possible rates of change while limiting the dew point at the desired level. Programmed ramps may also be used, with the understanding that PDC may limit the rates of change as needed. The programmed rate will be treated as the maximum rate of change allowed.
- Because the PDC function is attempting to maintain the chamber air dew point below the product temperature at the user-specified offset, there may be conditions where the actual chamber humidity may never get to the desired set point for high RH values. This may require program steps to disable the PDC option once the load is near the desired chamber air set point. The controller will then transition to the programmed RH set point when the PDC option is disabled.

For example, a condition +of 25°C and 95% RH implies a dew point of +24.14°C. If you have entered an offset value greater than 0.9°C, the condition will not be reached because the dew point will be limited to the load temperature (at most +25°C) minus the offset. An offset of 2.0°C will result in a limited dew point of +23°C, equivalent to 88.7% RH.

- During negative temperature transitions, the product temperature will generally lag the air temperature during the transition and dew point control will not be needed. Once the product temperature stabilizes at the final chamber temperature, the function will become active as needed.

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### User setup

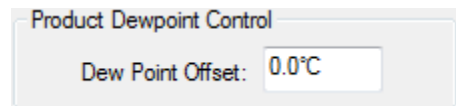
To use the PDC option, you must first make sure that the product temperatures are an accurate representation of the product to be monitored that has the slowest-moving temperature change rate. You must also enter the desired dew point offset value in the System Setup panel.

1. To identify the correct position for the product monitoring thermocouple(s), characterization of the loaded chamber and products under test should be accomplished. Multiple products under test at various positions in the chamber should be monitored to identify the product with the slowest-moving temperature change rate.

**NOTE:** To facilitate loading and unloading, a simulated product that is known to move at a slower temperature change rate than actual products may be used, since the simulated product may remain in the chamber.

2. Attach the product temperature thermocouple or thermocouples to the load or loads to be monitored.
  - If the product temperature is being monitored by a single thermocouple, make sure that the location chosen represents the slowest moving product or simulated product for this test.
  - If the product temperature is being monitored by multiple thermocouples, make sure that the monitored locations include the slowest moving product or simulated product.
  - If any of the thermocouples that are configured for the product monitoring group are not to be used for a specific test, they **MUST** be disconnected (unplugged). This will tell the AST 8800 to ignore these inputs and use the remaining connected thermocouples to derive the PDC and/or PTC temperature.

3. At the AST 8800 display, press **Setup**, then select the System Setup panel. Under **Product Dewpoint Control**, enter the desired **Dew Point Offset**. When enabled in manual mode or by interval in program mode, the AST 8800 will limit the dew point of the chamber to the monitored product temperatures minus this offset.

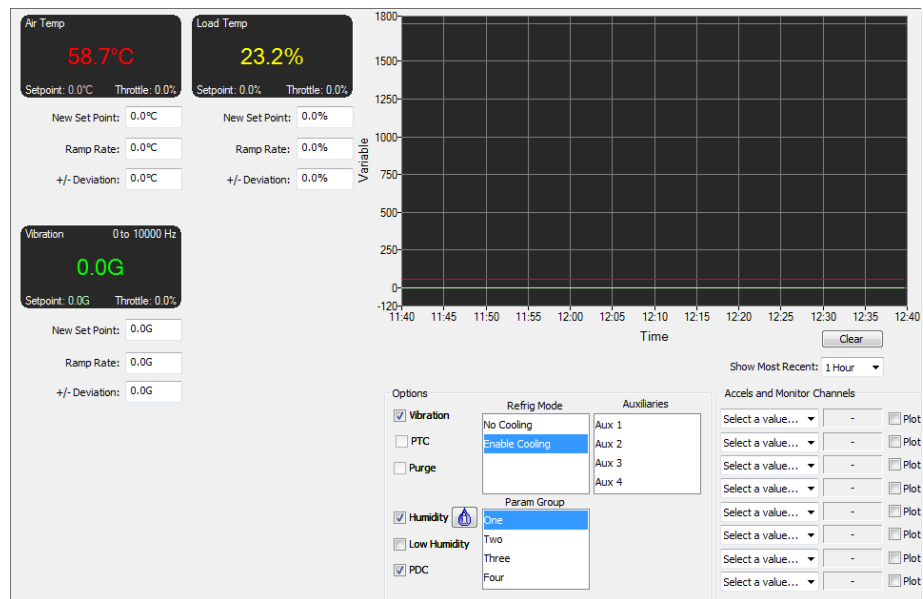


**NOTE:** The amount of water in the chamber at the start of the transition will influence the rise in the dew point as the chamber temperature rises. PDC will do everything it can to keep the chamber air dew point below the product temperature; however, condensation may still occur if there is a lot of water in the chamber and the temperature rises too quickly. This will require slowing the temperature ramp down to a more suitable rate, and/or may require that additional program steps be taken to remove this moisture from the chamber. For example, dry air purge and a low absolute humidity set point may be used to force evaporation and expulsion of moisture.

## User operation

The PDC option must be enabled before or at the same time as a temperature or humidity transition. Turning the PDC option on during a transition, either in manual or program mode, will not allow the function to operate, since the set points will have already changed.

1. From the manual or program screen, select the **PDC** option. This illustration shows the manual mode screen with **PDC** enabled. **NOTE:** The PDC option can be enabled only when the **Humidity** option is enabled.
2. When in run mode, the AST 8800 will control the temperature and humidity outputs in order to maintain the dew point at a value less than or equal to the monitored load temperature minus the dew point offset entered on the System Setup panel.



## Appendix D: Tuning Control Parameters

**CAUTION:** The AST 8800 programmer/controller was factory-tuned and should not need to be re-tuned unless the product requirements change enough to affect the performance of the chamber. Incorrect values could damage your equipment and/or product.

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

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 AST 8800 for each control channel. This allows you to select chamber performance appropriate for the type of interval or program you are running. For example, in one interval you may want less control during a ramp between two extreme temperatures, but in the next interval you may want more control to maintain a constant temperature. To achieve the two levels of control, two groups of parameters can be programmed.

Control parameters are tuned in manual mode. The adjustments are made to the proportional band and integral time parameters. **NOTE:** To tune control parameters, the AST 8800 access level must be Lab Manager or higher. Tuning the AST 8800 control parameters is a time-consuming procedure that will take at least two to three hours to complete.

### ***Proportional band parameters***

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The proportional band parameters are a **coarse** adjustment (1 to 9999 units) to the control algorithm. These parameters set the proportional bandwidth around the set point for the control channel's process variable. As the process variable nears the set point, it enters the proportional band. Once inside the proportional band, the throttle is backed off in proportion to the difference between the set point and the current process variable. **NOTE:** The proportional bands use the same units of measurement as the process variable.

- Smaller proportional bands can result in faster transitions.
- If the proportional band is too large it can result in very slow transition times — the chamber may never reach set point.
- If the proportional band is too small it can result in overshoot or oscillation around the set point.
- As a rule for the proportional band, **smaller = faster** response, **larger = slower** response. Generally, you should adjust the proportional band to the smallest value possible without the process variable excessively overshooting or oscillating around the set point.

### ***Integral time parameters***

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The integral time parameter is a **fine** adjustment to the control algorithm. The integral time parameter is used when the process variable nears the set point and the throttle is backing off. The integral time parameter adjusts the throttle to take the droop out of the proportional band setting and allows the chamber to reach the set point.

Droop is an effect, such as natural heat loss through the test space walls, that prevents the process variable from reaching the final set point. The integral time parameter determines how quickly the throttle will be adjusted to compensate for droop. Without an integral time entered, the process variable will not reach or remain at the set point. **NOTE:** The integral time parameter is programmable from 0 (integral off) to 1,000 seconds.

- Longer integral times result in longer times to reach the set point.
- Shorter integral times result in shorter times to reach the set point.
- If the integral time is too short, the process variable will oscillate indefinitely when it reaches the set point.
- As a rule for the integral time, **shorter = faster** response, **longer = slower** response. Generally, shorter integral times mean shorter transition times.

**Tuning the proportional band and integral time parameters**

The proportional band and integral time parameters must be “tuned up” to produce an efficient, controlled environmental test cycle. First you tune up the proportional band for quality control near set point, then you tune up the integral time to achieve accuracy.

For the optimal combination of performance and quality, each control channel is tuned to be critically damped. This occurs when the process variable overshoots the set point slightly and then oscillates around the set point slightly until it stabilizes at the set point. This level of control becomes available only with properly tuned proportional band and integral time parameters.

When tuning up chamber parameters with two or more control channels, tune up one channel at a time, always tuning the proportional band parameters first. Additionally, each control channel’s reference channel should be tuned up first. For example, for humidity operations, tune up the temperature channel first because it is the reference channel for the humidity channel. The control stability of the temperature channel directly affects the control stability of the humidity channel. **NOTE:** For most chambers channel 1 is temperature and channel 2 is humidity.

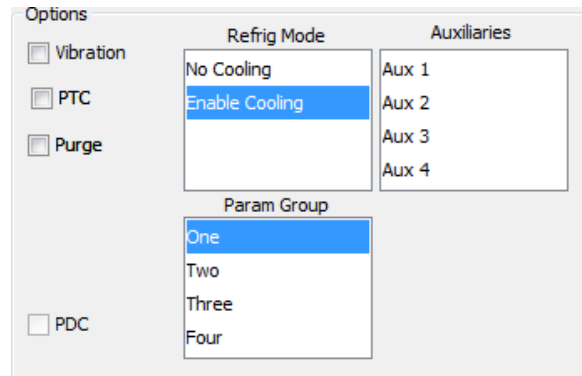
Example starting parameters			
Heat proportional band	20	Heat integral time	60
Cool proportional band	40	Cool integral time	90

**Record the original parameter settings**

1. From the any screen 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 Set Point** based on which parameters you are tuning, such as a heating set point for tuning the heating parameters. **NOTE:** When tuning parameters, the heating parameters are usually tuned before the cooling parameters. Normally you should select the set point based on the tests you are running.
  - c. Set the **Ramp Rate** to 0.
  - d. If necessary, disable chamber options by deselecting items listed under **Options**. Make sure product temperature control (**PTC**) is disabled. **NOTE:** If you are tuning the temperature channel in a temperature-humidity system, disable humidity for best results.
  - e. Disable all unnecessary **Auxiliaries**.
  - f. Make sure the **Param Group** selected is the number of the group you are tuning. **NOTE:** Only one parameter group can be selected at a time.
6. Press **Run**. The chamber will enter run manual mode.



7. Watch the process variable for the channel you are tuning as it approaches set point and then stabilizes for 10 to 15 minutes.
8. If the current parameter settings are correct, the process variable will overshoot the set point slightly and then oscillate around the set point slightly until it stabilizes at the set point.
  - If the process variable oscillates near the set point, the proportional band is too small.
  - If the process variable takes too long to reach the set point, the proportional band is too large.
  - If the process variable undershoots the set point slightly until it finally reaches the set point (if it ever does), the integral time is too large.
  - If the process variable overshoots the set point, the integral time is too small.

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### ***Adjust the proportional band setting***

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9. To adjust the proportional band:
  - a. Change the set point to back the process variable away from the set point you used to tune the parameter.
  - b. Press **Setup** to return to the control parameters panel.
  - c. Change the heating or cooling proportional band (**PBand**) for the channel you are tuning.
10. Repeat steps 4 through 7 to see the effect of the new proportional band setting. The ideal proportional band setting is obtained when the process variable stabilizes near set point (for example, within  $\pm 2^{\circ}\text{C}$  or  $\pm 2\%$  RH). As it stabilizes, it oscillates in decreasing amounts until it droops just above or below the set point. (**NOTE:** The integral time function will adjust the set point up or down to compensate for this droop.)
  - If the process variable continues oscillating, increase the proportional band setting just until the oscillation stops.
  - If the process variable is not oscillating, decrease the proportional band setting just until oscillation begins, then increase the setting until the oscillation stops.

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### ***Adjust the integral time***

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11. If necessary, you can tune the current channel's integral time parameter once you have tuned the channel's proportional band parameter.
  - a. Change the set point to back the process variable away from the set point you used to tune the parameter.
  - b. Press **Setup** to return to the parameters screen.
  - c. Change the heating or cooling integral time for the channel you are tuning.
12. To see the effect of the integral time setting, repeat steps 4 through 7. The ideal integral time setting is obtained when the process variable equals the set point.
  - If the process variable oscillates around the set point, you should increase the integral time.
  - If the process variable takes too long to achieve the set point, you should decrease the integral time.

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### ***Repeat as needed***

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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 AST 8800 worksheets in Appendix F. Keep these settings with the AST 8800 manual.

**Summary**

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When adjusting the control parameters, follow this general outline:

1. Run a heat-up test to see how the chamber controls. If necessary adjust the heat parameters.
2. Run a cool-down test to see how the chamber controls. If necessary adjust the cool parameters.
3. Run a heat-up test to see the effect of the changes from step 1. If necessary adjust the heat parameters again.
4. Run a cool-down test to see the effect of the change from step 2. If necessary adjust the cool parameters again.
5. Continue to run alternating heat-up and cool-down tests, adjusting the heat and cool parameters as needed to achieve the desired level of control.

## Appendix E: Tuning PTC Control Parameters

**CAUTION:** The AST 8800 programmer/controller was factory-tuned and should not need to be re-tuned unless the product requirements change enough to affect the performance of the chamber. Incorrect values could damage your equipment and/or product.

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

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 AST 8800 for each control channel. This allows you to select chamber performance appropriate for the type of interval or program you are running. For example, in one interval you may want less control during a ramp between two extreme temperatures, but in the next interval you may want more control to maintain a constant temperature. To achieve the two levels of control, two groups of parameters can be programmed.

The product temperature control (PTC) control parameters are tuned in manual mode. The adjustments are made to the gain, integral time, and offset parameters. **NOTE:** To tune PTC control parameters, the AST 8800 access level must be Lab Manager or higher. Tuning the AST 8800 control parameters is a time-consuming procedure that will take at least two to three hours to complete.

### Gain parameters for PTC

The gain parameter is a **coarse** adjustment to the PTC control algorithm. The larger the gain, the longer the AST 8800 will wait to start slowing down the throttle as the load temperature approaches the load set point.

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

For example, if the maximum offset is 10°C and the desired proportional band is 5°C, the gain would be set to 10°C/5°C = 2.

The temperature channel will still perform using the air parameters, but the offset parameters control the set point of the temperature channel in relation to the PTC channel's set point. When a PTC program is run, the temperature channel immediately cycles beyond the set point by the maximum offset. With the chamber air at maximum offset, the product cycles toward the final set point at its maximum rate. The temperature channel remains at the maximum offset above the PTC channel's set point until the product temperature enters the proportional band near final set point. The temperature channel throttle is reduced in relation to the PTC channel until the final set point is reached.

The gain parameter is related to the time constant of the load. The greater the time constant of the load, the more gain is required to change the temperature of the load. For a faster load response, increase the gain parameter. Additionally, a higher gain causes the load to proportion into the set point when the temperature is closer to the final set point.

As a rule for the gain setting, **smaller = slower** response, **larger = faster** response. Generally, you will want the largest gain setting possible without the process variable excessively overshooting the set point.

### Integral time parameters for PTC

The integral time parameter is a **fine** adjustment to the PTC control algorithm. The integral time parameter is used when the process variable nears the set point and the throttle is backing off. The integral time parameter adjusts the throttle to take the droop out of the gain setting and allows the chamber to reach the set point.

Droop is an effect, such as natural heat loss through the test space walls, that prevents the process variable from reaching the final set point. The integral time parameter determines how quickly the throttle will be adjusted to compensate for droop. Without an integral time entered, the process variable will not reach or remain at the set point.

**NOTE:** The integral time parameter is programmable from 0 (integral off) to 1,000 seconds.

- Longer integral times result in longer times to reach the set point.
- Shorter integral times result in shorter times to reach the set point.
- If the integral time is too short, the process variable will oscillate when it reaches the set point and will continue to oscillate indefinitely.
- As a rule for the integral time, **shorter = faster** response, **longer = slower** response. Generally, shorter integral times mean shorter transition times.

**Offset parameters for PTC**

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

The offset is the number of degrees Celsius that the air temperature set point will be allowed to exceed the load temperature set point when attempting to move the load temperature to the new load set point. The offset allows the air temperature channel to overshoot the set point by up to  $\pm 100^{\circ}\text{C}$ .

- Larger offsets can result in faster transitions.
- If the offset is too large it can result in overshoot, and may trip process alarms.
- As a rule for the offset, **smaller = slower** (less aggressive), **larger = faster** (more aggressive). Generally, you should adjust the offset to the highest value possible without the process variable excessively overshooting the set point.

The maximum offset should be programmed to allow the chamber air to overshoot the final value by an amount that will not damage any portion of the load. For example, if the final set point is  $+100^{\circ}\text{C}$  and the load could be damaged by temperatures above  $+110^{\circ}\text{C}$ , then the maximum heat offset should be  $+10^{\circ}\text{C}$ .

**Tuning the PTC gain, integral time, and offset parameters**

The gain, integral time, and offset parameters must be “tuned up” to produce an efficient, controlled environmental test cycle. First you tune up the gain parameter for quality control near set point, then you tune up the integral time and offset parameters to achieve accuracy.

For the optimal combination of performance and quality, each control channel is tuned to be critically damped. This occurs when the process variable overshoots the set point slightly and then oscillates around the set point slightly until it stabilizes at the set point. This level of control becomes available only with properly tuned PTC control parameters.

**NOTE:** The PTC parameters should be tuned only after the air temperature control parameters have been tuned, and only with a product load in the chamber.

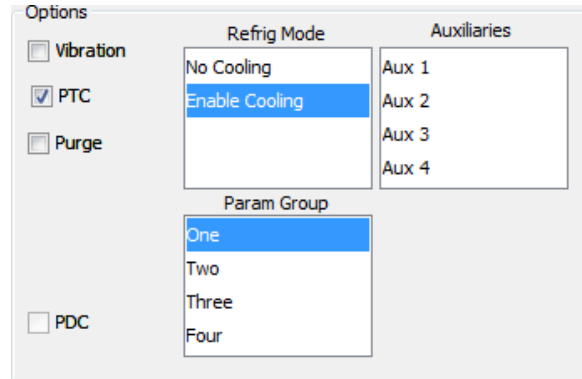
<b>Example Starting Parameters</b>					
Heat gain	3.0	Heat integral time	200	Heat offset	10
Cool gain	3.0	Cool integral time	400	Cool offset	-10

**Record the original parameter settings**

1. From any screen 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 gain, integral time, and offset settings for the parameter group you are tuning.

### Obtain a performance baseline

4. Press **Manual** to go to the manual mode screen.
5. Select and change the settings for the PTC channel (usually channel 3):
  - a. Set the +/- **Deviation** to 0.
  - b. Enter a **New Set Point** based on which parameters you are tuning, such as a heating set point for tuning the heating parameters. **NOTE:** When tuning parameters, the heating parameters are usually tuned before the cooling parameters. Normally you should select the set point based on the tests you are running.
  - c. Set the **Ramp Rate** to 0.
  - d. If necessary, disable chamber options by deselecting items listed under **Options**. Make sure Product Temperature Control (PTC) is enabled.
  - e. Disable all unnecessary **Auxiliaries**.
  - f. Make sure the **Param Group** selected is the number of the group you are tuning. **NOTE:** Only one parameter group can be selected at a time.
6. Press **Run**. The chamber will enter run manual mode.
7. Watch the PTC channel's process variable as it approaches set point and then stabilizes for 10 to 15 minutes.
8. If the current parameter settings are correct, the process variable will overshoot the set point slightly and then oscillate around the set point slightly until it stabilizes at the set point.
  - If the process variable oscillates near the set point, the gain setting is too small.
  - If the process variable takes too long to reach the set point, the gain setting is too large.
  - If the process variable undershoots the set point slightly until it finally reaches the set point (if it ever does), the integral time is too large.
  - If the process variable overshoots the set point, the integral time is too small.



### Adjust the gain setting

9. To adjust the gain:
  - a. Change the set point to back the process variable away from the set point you will use to tune the parameter.
  - b. Press **Setup** and to return to the parameters screen.
  - c. Change the heating or cooling gain for the channel you are tuning.
10. Repeat steps 4 through 7 to see the effect of the new gain setting. The ideal gain setting is obtained when the process variable stabilizes near set point (for example, within  $\pm 2^{\circ}\text{C}$ ). As it stabilizes, it oscillates decreasing amounts until it droops just above or below the set point. (**NOTE:** The integral time function will adjust the set point up or down to compensate for this droop.)
  - If the process variable continues oscillating, you will need to decrease the gain setting just until the oscillation stops.
  - If the process variable is not oscillating, you will need to increase the gain setting just until oscillation begins, then decrease the setting until the oscillation stops.

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**Adjust the integral time**

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11. If necessary, you can tune the current channel's integral time parameter once you have tuned the channel's gain parameter.
  - a. Change the set point to back the process variable away from the set point you will use to tune the parameter.
  - b. Press **Setup** to return to the parameters screen.
  - c. Change the heating or cooling integral time for the channel you are tuning.
12. To see the effect of the integral time setting, repeat steps 4 through 7. The ideal integral time setting is obtained when the process variable equals the set point.
  - If the process variable oscillates around the set point, you should increase the integral time.
  - If the process variable never achieves the set point, you should decrease the integral time.

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**Adjust the offset**

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13. If necessary, you can tune the current channel's offset parameter once you have tuned the channel's gain and integral time parameters.
  - a. Change the set point to back the process variable away from the set point you will use to tune the parameter.
  - b. Press **Setup** to return to the parameters screen.
  - c. Change the heating or cooling offset for the channel you are tuning.
14. To see the effect of the offset setting, repeat steps 4 through 7. The ideal offset setting is obtained when the process variable equals the set point.
  - If the process variable overshoots the set point, you should decrease the offset.
  - If the process variable undershoots the set point, you should increase the offset.

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**Repeat as needed**

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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 AST 8800 worksheets in Appendix F. Keep these settings with the AST 8800 manual.

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**Summary**

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When adjusting the product temperature control parameters, follow this general outline:

1. Run a heat-up test to see how the chamber controls. If necessary adjust the heat parameters.
2. Run a cool-down test to see how the chamber controls. If necessary adjust the cool parameters.
3. Run a heat-up test to see the effect of the changes from step 1. If necessary adjust the heat parameters again.
4. Run a cool-down test to see the effect of the change from step 2. If necessary adjust the cool parameters again.
5. Continue to run alternating heat-up and cool-down tests, adjusting the heat and cool parameters as needed to achieve the desired level of control.

# Appendix F: AST 8800 Parameter and System Event Worksheets

**NOTE:** Thermotron grants you permission to copy this appendix to use for your records.

<b>Channel ___ Non-PTC Parameter Group Entries</b>				
<b>Parameter</b>	<b>Group 1</b>	<b>Group 2</b>	<b>Group 3</b>	<b>Group 4</b>
Heat Proportional Band				
Cool Proportional Band				
Heat Integral Time				
Cool Integral Time				
Heat Throttle Limit				
Cool Throttle Limit				

<b>Channel ___ Non-PTC Parameter Group Entries</b>				
<b>Parameter</b>	<b>Group 1</b>	<b>Group 2</b>	<b>Group 3</b>	<b>Group 4</b>
Heat Proportional Band				
Cool Proportional Band				
Heat Integral Time				
Cool Integral Time				
Heat Throttle Limit				
Cool Throttle Limit				

<b>Channel ___ Non-PTC Parameter Group Entries</b>				
<b>Parameter</b>	<b>Group 1</b>	<b>Group 2</b>	<b>Group 3</b>	<b>Group 4</b>
Heat Proportional Band				
Cool Proportional Band				
Heat Integral Time				
Cool Integral Time				
Heat Throttle Limit				
Cool Throttle Limit				

<b>Channel ___ PTC Parameter Group Entries</b>				
<b>Parameter</b>	<b>Group 1</b>	<b>Group 2</b>	<b>Group 3</b>	<b>Group 4</b>
Heat Gain				
Cool Gain				
Heat Integral Time				
Cool Integral Time				
Heat Offset				
Cool Offset				

<b>AST 8800 System Parameters</b>	
Auxiliary Cool Time Frame	
Auxiliary Cool Duty Cycle	
Refrigeration System Anticipator Time	

<b>System Events</b>					
<b>System Event</b>	<b>Channel</b>	<b>Variable</b>	<b>Logic</b>	<b>Low or Off Setting</b>	<b>High or On Setting</b>
Event 1					
Event 2					
Event 3					
Event 4					