THERMOTRON®

A Venturedyne, Ltd. Company

3800 Programmer/Controller Operator Manual

Revision 3: April 16, 2009

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

This manual provides the most current generic operating instructions for this controller at the time of its revision date. Therefore this manual may not include some recent software changes. This manual may also 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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1: July 14, 2005 – Added Therm-Alarm Calibration information.
2: September 12, 2006 – Redundant Therm-Alarm Changes.
3: April 16, 2009 – Legal Statement

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Section 1: Getting Started

This section provides the basic information you need to start using the 3800. This includes an introduction to the instrument, a brief hardware description, and instructions for operating in manual mode, running a program, and checking the chamber status.

- For additional hardware information, see "3800 Basic Functions" later in this section.
- For more detailed hardware information, see the *CMX and CM Control Module Manual*.
- For information on 3800 setup, see Section 2 of this manual.
- For information on programming the 3800, see Section 3 of this manual.
- For definitions of many of the terms used in this manual, see Appendix A (Glossary) of this manual.

Introduction to the 3800

The 3800 is a microprocessor-based programmer and controller. The programmer function allows you to program temperature, temperature/humidity, or other types of tests and store them in program memory. You can use these programs to operate the controller functions of the 3800.

Most 3800 programmer/controllers are configured for either single-channel operation (temperature only), or dual-channel operation (temperature and humidity). If your 3800 is configured for dual-channel operation, it can operate as a temperature-only system or as a temperature/humidity system.

- Typically, channel 1 is dedicated to chamber air temperature using a dry bulb thermocouple. Channel 1 operates the chamber's heating and cooling systems.
- Typically, channel 2 is dedicated to humidity using either a solid-state humidity sensor or a wet bulb thermocouple. Channel 2 operates the chamber's humidifying and dehumidifying systems.

Although the 3800 can be configured for up to three programmable channels, for ease of use this manual is based on the more common one- and two-channel configurations. Three-channel operation follows the same basic principles described in this manual.

NOTE: The 3800 can display only two channels at a time: either channels 1 and 2 or channels 1 and 3. If your 3800 is configured for three channels, press the **CH 2** and **CH 3** keys to switch between displayed channel pairs.

The 3800 can be programmed and operated locally using the display screen, soft keys, and keypad. The 3800 also can be programmed and operated from a host computer. For more information, refer to the *3800 Computer Interface Manual*.

The controller functions operate the chamber and its attached equipment. Analog and transistor-transistor logic (TTL) level signals control and monitor the system. The chamber's conditioning systems, printers, chart recorders, and solid-state relay devices are operated from the controller signals. Other analog devices also can be monitored and operated.

Thermocouples can be mounted throughout the operating systems to feed diagnostic information back to the controller.

Before operating the 3800, several set-up procedures must be completed. Most of the set-up procedures were performed at Thermotron; however, these procedures may need to be performed again if requirements change. Refer to Section 2 for setup instructions.

Display Module

The 3800 is operated using the 4-line by 20-character display, soft keys, and keypad illustrated below:

Accessing Other Screens and Functions

NOTE: In this manual function keys and soft keys are indicated in bold letters. For example, "Press **RUN**, then press **START**" means press the function key labeled **RUN**, and when the run program screen appears press the word **START** on the last line of the 3800 display.

For most 3800 operations you start from the main screen (shown above) and use function keys and soft keys to access other screens and functions. To return to the main screen from any other screen, press the **ESC** key repeatedly until the main screen is displayed.

- To display the cause of the last chamber stop, press **STOP**. **NOTE**: Pressing **STOP** while a program is running will stop the program.
- To turn the chamber light(s) on or off, press the **LIGHT** function key.
- If you try to access a function that is not available at the current access level, this screen will appear:

  For more information on access levels, see "Changing the Access Level or Password" in Section 2 of this manual.

Context Sensitive Help System

Press **HELP** to access the help system from any 3800 screen. A help message such as the one in this illustration will appear:

Some help messages contain more than one pane. Such help messages will have a **MORE** soft key. Press **MORE** to see the next pane.

To exit the help system, press **HELP** a second time.

3800 Basic Functions

The following sections provide brief descriptions of some of the 3800 functions.

Control Channels

Control channels receive inputs from thermocouples and/or other sensing devices used to monitor the environmental conditions inside the chamber's test space. The 3800 adjusts its control outputs based on those inputs.

- Typically, channel 1 uses a dry bulb thermocouple sensor mounted in the chamber airflow to sense air temperature. The sensor inputs through the thermocouple input. Its outputs control the heating and cooling systems.
- Typically, channel 2 uses either a solid-state humidity sensor or a wet bulb thermocouple to monitor chamber humidity. The reading from the solid-state sensor or wet bulb thermocouple is used together with the reading from the channel 1 dry bulb thermocouple to calculate chamber humidity. The channel 2 outputs control the humidity system's steam generator and dehumidify coil.
- Channel 3, if available, can sense temperature or linear inputs. These channels commonly are configured for such options as Product Temperature Control or altitude.
- Channels 5 through 8 can be programmed at the factory as constant control channels. Each channel can be set at the factory to sense either temperature or linear inputs.

Chamber Conditioning System Signals

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

- The system, refrigeration, and humidity enable outputs allow their respective systems to turn on.
- The heat and cool outputs control their systems. For example, the channel 1 cool output normally operates the solenoids that regulate the flow of refrigerant into the chamber's evaporator coil.
- The auxiliary cool output operates any auxiliary cooling system, such as liquid nitrogen (LN_2) or carbon dioxide (CO_2).

Alarm Output Signals

The alarm output transistor-transistor logic (TTL) signals indicate when the chamber temperature or humidity exceeds the programmed limits. Two types of alarms are available for each channel:

- *Deviation alarms* are activated when the chamber temperature, humidity, or other process variable is outside the channel's deviation alarm band. A deviation alarm band restricts how far the process variable 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 from set point.

Deviation alarms can be set for each manual mode test or program interval. For more information, see "Running in Manual Mode" below, or Section 3 later in this manual.

- *Process alarms* are activated when the chamber temperature, humidity, or other process variable is outside the process limits. The process alarm settings restrict the high and low limits of a test. A process alarm stops the programmer/controller. For example, if the high process alarm limit is +125°C, the alarm is activated if the temperature equals or exceeds +125°C.

  Process alarms are a configuration setting that can be adjusted only in setup mode. For more information, see Section 2 later in this manual.

Auxiliary Outputs

Auxiliary outputs provide programmable TTL level outputs. There can be up to two groups of eight auxiliary outputs. These outputs are programmed on and off during each program interval or during manual mode operation. These outputs normally are used to program systems on and off. For information on your chamber's auxiliary outputs, see your chamber manual.

Running in Manual Mode

Manual mode allows you to operate the 3800 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.

Manual Mode

1. From the main screen press **MN/PRG**, then press **MANUAL**. The manual mode screen will appear:

2. Use the left and right arrow keys to cycle through the values, such as set point (**SP**), shown on the last line of the display.
3. To change a value, follow these steps:
   a. Press the setting's edit icon .
   b. If the edit icon becomes a blinking cursor, use the numeric keypad to edit the selected value and press **ENT**.
   c. If the edit icon becomes a down arrow , press **CLR** to toggle the setting on or off.
   d. If you press **MONITR** the monitor channels screen will appear. See "Viewing the Monitor Channel Readings" in Section 2 of this manual.
   e. If you press **SERVCE** the service status screen will appear. See "Service Status Functions" in Section 2 of this manual.
   f. If you press **T-ALRM** the Therm-Alarm status screen will appear. See Section 4 of this manual.

   g. If you press the edit icon for the **CONTROL PARAMETERS** setting, the control parameters screen will appear. See "Adjusting Standard Control Parameters" or "Adjusting PTC Control Parameters" in Section 2 of this manual.

4. The following list describes the manual mode values displayed:

   - **SP** (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.
   - **AUX GRP1** and **AUX GRP2** (auxiliary groups 1 and 2): Enter the numbers of the auxiliary relays you want to activate. Auxiliaries are active only when the 3800 is running. For more information on auxiliary relays, see "Auxiliary Outputs" earlier in this section.
   - **RUN TIME**: The length of the manual mode test in hours, minutes, and seconds. This setting cannot be edited.
   - **PTC** (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.
   - **HUM** (humidity): Enables the optional humidity system. **NOTE**: Humidity is disabled if product temperature control (**PTC**) is enabled.
   - **CONTROL PARAMETERS**: For more information on parameter groups, see "Adjusting Standard Control Parameters" or "Adjusting PTC Control Parameters" in Section 2 of this manual.
   - **TH** (throttle): Positive values indicate heating; negative values indicate cooling. The throttle setting is editable only in manual throttle mode. See "Manual Throttle Mode" below.
   - **DV** (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 3800 will monitor both positive and negative deviations.
   - **RR** (ramp rate): Enter the desired number of degrees 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 3800 outputs a full demand (±100% throttle) until it enters the set point's proportional band.

5. To start running in manual mode using the settings entered above, press **RUN**.
6. To temporarily suspend a manual mode test, press **HOLD**. To resume the test, press **RUN** again.
7. To stop manual mode operation, press **STOP**.

Manual Throttle Mode

Manual throttle mode 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 between 8:00 a.m. and 4:30 p.m. Eastern Standard Time. (**NOTE**: Manual throttle mode is available only at the Cal Lab access level and above.)

To run a test in manual throttle mode, follow these steps:

1. Begin a manual mode test. If needed, see "Manual Mode" above.
2. Use the left and right arrow keys to cycle through the manual mode values until the throttle (**TH**) setting appears.
3. Press the throttle setting's edit icon .

4. You will be asked if you want to enter manual throttle mode. Press **YES**.

5. A small **m** will appear next to the throttle setting to indicate manual throttle mode. To adjust the manual throttle setting, press the edit icon.

6. You will be asked if you want to edit the manual throttle setting. Press **EDIT**.

7. Use the numeric keypad to edit the selected value and press **ENT**.

8. To temporarily suspend a manual mode test, press **HOLD**. To resume the test, press **RUN** again.
9. To exit manual throttle mode, press the throttle (**TH**) edit icon, then press **OFF**.
10. To stop manual mode operation, press **STOP**.

Running a Program

The programmer function operates the 3800 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 3800 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 create a program, see Section 3 of this manual.

NOTE: The sample screens in this procedure show the display for a two-channel 3800 configuration. The 3800 can display only two channels at a time: either channels 1 and 2 or channels 1 and 3. If your 3800 is configured for three channels, press the **CH 2** and **CH 3** keys to switch between displayed channel pairs.

Program Mode

1. From any screen, press **RUN**. The run program screen will appear:
2. Press **CLR** repeatedly until the desired program is displayed. **NOTE**: To create a program, see Section 3 of this manual.
3. By default the program you select will start running with the first interval. To start with a different interval, follow these steps:
   a. Press the left or right arrow key to highlight the **Starting Int** field.
   b. Use the number pad to enter the number of the desired starting interval.
   c. Press **ENT**.
4. Perform one of the following:
   - To schedule a delayed start for the selected program, press **DELAY** and go to step 5.
   - To start the program immediately, press **START** and go to step 7.
   - To exit this screen without starting a program, press **CANCEL** or **ESC**. The 3800 will return to the previous screen.

5. If you pressed **DELAY**, the delayed start screen will appear:
6. To set up a delayed start, follow these steps:
   a. Use the left or right arrow keys to highlight a field.
   b. Use the number pad to enter the desired value.
   c. Press **ENT**.
   d. Press **NEXT** and repeat steps a through c.
   e. To exit without saving any delayed start settings, press **ESC**.
   f. To apply your delayed start settings, press **SET**.
   g. Confirm your settings by pressing **OK**. To indicate a delayed start is pending, the main screen will now begin with **DLAY** and the status screen will now begin with **DS**.

NOTE: You cannot run another program or enter manual mode while a delayed start is pending. To verify, modify, or cancel a delayed start, see "Delayed Start" below.

7. When you press **START**, the 3800 will enter run program mode and the chamber status screen will appear:

   For more information on the chamber status screen, see "Chamber Status" later in this section.

8. To suspend the interval at its current settings, press **HOLD**. The 3800 will enter hold program mode and the edit icon will appear:

   NOTE: In hold program mode the 3800 will maintain the chamber test space at the last set point.

9. To enter temporary values into the current interval, press the edit icon. For additional information, go to step 4 of "Edit From Hold" later in this section.

10. To resume running a suspended test, press **RUN**.

11. To stop a running test, press **STOP**.

Delayed Start

The delayed start function monitors the real time clock and starts a selected program at a pre-determined time. For information on setting up a delayed start, see "Program Mode" above. To verify, modify, or cancel a delayed start, perform one of the following:

- To verify a delayed start, press **RUN**. If the setting is correct, press **ESC**. If the setting is incorrect, perform the following procedure.

- To modify a delayed start:
  a. Press **RUN**.
  b. Press **CHANGE**.
  c. Use the left or right arrow keys to highlight a field.
  d. Use the number pad to enter the desired value.
  e. Press **ENT**.
  f. Press **NEXT** and repeat steps c through e.
  g. To exit without saving any changes, press **ESC**.
  h. To apply your changes, press **SET**.
  i. Confirm the new settings by pressing **OK**.
- To cancel a delayed start, press **RUN**, then press **DELETE**. The delayed start will be cancelled and the run program screen will appear.

Edit From Hold

Edit from hold allows you to place a running program in hold program mode and enter temporary values into the current interval. Once the interval is run and completed, the temporary values are discarded. The next time the interval is run, the original programmed values apply. **NOTE**: In hold program mode the 3800 will maintain the chamber test space at the last set point.

To operate in edit from hold mode, follow these steps:

1. While a program is running, go to the main screen and press the **STATUS** key. The chamber status screen will appear.

2. Press the **HOLD** key. The edit icon will appear.

3. Press the edit icon. The edit from hold screen will appear:

4. Use the left and right arrow keys to cycle through the editable settings. For more detailed descriptions of the settings, see Section 3 of this manual.
5. To change a value press **EDIT**. Use the numeric keypad to edit the selected value, then press **ENT**.
6. To switch channels press **CH 1**, **CH 2**, or **CH 3** as appropriate.
7. When all the settings are acceptable, press **ESC**. The chamber status screen will reappear.
8. To resume running the current interval with the settings entered in step 5 above, press **RUN**.

Chamber Status

The chamber status screen allows you to view the current operating conditions of the chamber, such as set points, process variables, and throttles.

NOTE: The sample screen shows the display for a two-channel 3800 configuration. The 3800 can display only two channels at a time — either channels 1 and 2 or channels 1 and 3. If your 3800 is configured for three channels, press the **CH 2** and **CH 3** keys to switch between displayed channel pairs.

1. From the main screen, press **STATUS**. The status screen will appear:
2. Use the arrow keys to scroll through the following status display values (for more detailed descriptions of these values, see Section 3 of this manual):
   - **TH**: throttle
   - **IV**: initial value
   - **FV**: final value
   - **Int Time**: interval time
   - **Time Left**
   - **Prog**: program name
   - **Interval** number
   - **Next Int**: next interval
   - **OPT**: options enabled
   - **MONITR** | **SERVCE** | **T-ALRM** (see below)
3. Press **MONITR** to review the values of any current monitor channels. These channels are used for monitoring processes within the chamber. If the low or high limit is exceeded for any channel, the 3800 alarm outputs will be activated. For more information on monitor channels, see “Viewing the Monitor Channel Readings” in Section 2 of this manual.
4. Press **SERVCE** to review the service messages. For additional information, see “Service Status Functions” in Section 2 of this manual.
5. Press **T-ALRM** to review the Therm-Alarm status and settings. For additional information, see Section 4 of this manual.
6. When the status screen is displayed while a program is running, the name of the program will be displayed if you press the **9/PROG** alphanumeric key.

Section 2: System Setup

This section provides instructions for viewing or adjusting the following functions:

- Temperature scale
- Screen saver activation
- Audible key beep
- Software version
- Auxiliary cooling system
- Control parameters
- Process alarms
- Access level and password
- Computer interface setup
- System events
- Network settings
- Therm-Alarm calibration
- Real time clock
- Monitor channels
- Service status functions
- Diagnostics

Changing the Temperature Scale

This setting changes the temperature scale for all displayed variables.

1. From the main screen, press **SETUP**. This setup mode screen will appear:
2. Press the **CLR** key to toggle between Celsius and Fahrenheit.

Changing the Screen Saver Activation Time

1. From the main screen, press **SETUP**, then press **MORE**. The second setup mode screen will appear:
2. Use the numeric keypad to enter the number of minutes before the screen saver is activated.
3. Press **ENT**.

Enabling or Disabling the Key Beep

1. From the main screen, press **SETUP**, then press **MORE**. The second setup mode screen will appear.
2. Use the arrow keys to move to the key beep field. A down arrow will appear next to the key beep setting.
3. Press the **CLR** key to toggle on or off an audible key beep each time a key is pressed.

Viewing the Software Version

1. From the main screen, press **SETUP**, then **MORE**, then **MORE**. The third setup screen will appear:
2. From this screen you can see the software version.

Adjusting the Auxiliary Cooling Settings

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

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

1. From the main screen, press **SETUP**, then **MORE**, then **MORE**, then **MORE**. The fourth setup screen will appear:
2. Use the left or right arrow key to select a field.
3. Use the numeric keypad to edit the selected value, then press **ENT**.

Adjusting Standard Control Parameters

CAUTION: The 3800 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: Tuning the 3800 control parameters is a time-consuming procedure that will take a minimum of two to three hours to complete.

Control parameters adjust the performance of the chamber around the set point. As the chamber nears the set point, the 3800 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.

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.

Proportional Band Parameters

The proportional band parameters are a **coarse** adjustment (1 to 9,999 units) to the control algorithm. These parameters set the proportional bandwidth around the set point for the control channel's process variable. As the process variable nears the set point, it enters the proportional band. Once inside the proportional band, the throttle is backed off in proportion to the difference between the set point and the current process variable. **NOTE:** The proportional bands use the same units of measurement as the process variable.

- Smaller proportional bands can result in faster transitions.
- If the proportional band is too large it can result in very slow transition times — the chamber may never reach set point.
- If the proportional band is too small it can result in overshoot or oscillation around the set point.
- As a rule for the proportional band, **smaller = faster** response, **larger = slower** response. Generally, you should adjust the proportional band to the smallest value possible without the process variable excessively overshooting or oscillating around the set point.

Integral Time Parameters

The integral time parameter is a **fine** adjustment to the control algorithm. The integral time parameter is used when the process variable nears the set point and the throttle is backing off. The integral time parameter adjusts the throttle to take the droop out of the proportional band setting and allows the chamber to reach the set point.

Droop is an effect, such as natural heat loss through the test space walls, that prevents the process variable from reaching the final set point. The integral time parameter determines how quickly the throttle will be adjusted to compensate for droop. Without an integral time entered, the process variable will not reach or remain at the set point. **NOTE:** The integral time parameter is programmable from 0 (integral off) to 1,000 seconds.

- Longer integral times result in longer times to reach the set point.
- Shorter integral times result in shorter times to reach the set point.
- If the integral time is too short, the process variable will oscillate indefinitely when it reaches the set point.
- As a rule for the integral time, **shorter = faster** response, **longer = slower** response. Generally, shorter integral times mean shorter transition times.

Tuning Up the Proportional Band and Integral Time Parameters

The proportional band and integral time parameters must be "tuned up" to produce an efficient, controlled environmental test cycle. First you tune up the proportion band for quality control near set point, then you tune up the integral time to achieve accuracy.

For the optimal combination of performance and quality, each control channel is tuned to be critically damped. This occurs when the process variable overshoots the set point slightly and then oscillates around the set point slightly until it stabilizes at the set point. This level of control becomes available only with properly tuned proportional band and integral time parameters.

When tuning up chamber parameters with two or more control channels, tune up one channel at a time, always tuning the proportional band parameters first. Additionally, each control channel's reference channel should be tuned up first. For example, for humidity operations, tune up the temperature channel first because it is the reference channel for the humidity channel. The control stability of the temperature channel directly affects the control stability of the humidity channel. **NOTE:** For most chambers channel 1 is temperature and channel 2 is humidity.

Example Starting Parameters			
Heat proportional band	20	Heat integral time	60
Cool proportional band	40	Cool integral time	90

Record the original parameter settings

1. From the main screen, press **MN/PRG**, then press **MANUAL**. The manual mode screen will appear.
2. Use the left and right arrow keys to cycle through the values shown on the last line of the display until **CONTROL PARAMETERS** appears.
3. Press the edit icon at the end of the word **PARAMETERS**. The first control parameters screen will appear:
4. If needed, select the parameters screen for the channel you are tuning by pressing **CH1**, **CH2**, or **CH3**.
5. Write down the heat and cool proportional band (**PBand**) settings.
6. Press **NEXT**.
7. Write down the heat and cool integral time (**Integ**) settings.

Obtain a performance baseline

8. Press **ESC** until the manual mode screen appears.
9. Use the arrow and alphanumeric keys to select and edit the settings for the channel you are tuning:
   a. Set the deviation (**DV**) to 0.
   b. Enter a new set point (**SP**) 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 (**RR**) to 0.
   d. Disable all unnecessary auxiliaries.
   e. Make sure product temperature control (**PTC**) is disabled. **NOTE**: If you are tuning the temperature channel in a temperature-humidity system, disable humidity (**HUM**) for best results.

10. Press **RUN**. The chamber will enter run manual mode.
11. Watch the process variable (**PV**) for the channel you are tuning as it approaches set point and then stabilizes for 10 to 15 minutes.
12. If the current parameter settings are correct, the process variable will overshoot the set point slightly and then oscillate around the set point slightly until it stabilizes at the set point.
    - If the process variable oscillates near the set point, the proportional band is too small.
    - If the process variable takes too long to reach the set point, the proportional band is too large.
    - If the process variable undershoots the set point slightly until it finally reaches the set point (if it ever does), the integral time is too large.
    - If the process variable overshoots the set point, the integral time is too small.

Adjust the setting

13. To adjust the proportional band:
    a. Change the set point (**SP**) to back the process variable away from the set point you will use to tune the parameter.
    b. Press the **CONTROL PARAMETERS** edit icon.
    c. Change the heating or cooling proportional band (**PBand**) for the channel you are tuning.
14. Repeat steps 8 through 11 to see the effect of the new proportional band setting. The ideal proportional band setting is obtained when the process variable stabilizes near set point (for example, within ±2°C or ±2% RH). As it stabilizes, it oscillates in decreasing amounts until it droops just above or below the set point. **NOTE**: The integral time function will adjust the set point up or down to compensate for this droop.
    - If the process variable continues oscillating, you will need to increase the proportional band setting just until the oscillation stops.
    - If the process variable is not oscillating, you will need to decrease the proportional band setting just until oscillation begins, then increase the setting until the oscillation stops.
15. 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 will use to tune the parameter.
    b. Press the **CONTROL PARAMETERS** edit icon.
    c. Change the heating or cooling integral time (**Integ**) for the channel you are tuning.
16. To see the effect of the integral time setting, repeat steps 8 through 11. 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.

Repeat as needed

17. Once the first set of parameters (such as the heating parameters) have been tuned up, the other set of parameters can be tuned up.
18. Once the parameters for the first channel have been tuned up, the next channel's parameters can be tuned up.
19. Once you have finished tuning up all the channels, record the parameter settings on the duplicate master sheets located with the Configuration Data Sheets. Keep these values on record with the 3800 manual.

Summary

When adjusting the control parameters you should 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.

Adjusting PTC Control Parameters

CAUTION: The 3800 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: Tuning the 3800 control parameters is a time-consuming procedure that will take a minimum of two to three hours to complete.

Control parameters adjust the performance of the chamber around the set point. As the chamber nears the set point, the 3800 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.

The product temperature control (PTC) control parameters are tuned in manual mode. The adjustments are made to the gain, integral time, and offset parameters.

Gain Parameters for PTC

The gain parameter is a **coarse** adjustment to the PTC control algorithm. The larger the gain, the longer the 3800 will wait to start slowing down the throttle as the load temperature approaches the load set point.

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

For example, if the maximum offset is 10°C and the desired proportional band is 5°C, the gain would be set to 10°C/5°C = 2.

The temperature channel will still perform using the air parameters, but the offset parameters control the set point of the temperature channel in relation to the PTC channel's set point. When a PTC program is run, the temperature channel immediately cycles beyond the set point by the maximum offset. With the chamber air at maximum offset, the product cycles toward the final set point at its maximum rate. The temperature channel remains at the maximum offset above the PTC channel's set point until the product temperature enters the proportional band near final set point. The throttle of the temperature channel is reduced in relation to the PTC channel until the final set point is reached.

The gain parameter is related to the time constant of the load. The greater the time constant of the load, the more gain is required to change the temperature of the load. Increase the gain parameter for a faster load response. 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 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 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

The offset is the number of degrees Celsius that the air temperature set point will be allowed to exceed the load temperature set point when attempting to move the load temperature to the new load set point. The offset allows the air temperature channel to overshoot the set point by up to ±100°C.

- Larger offsets can result in faster transitions.
- If the offset is too large it can result in overshoot, and may trip process alarms.
- As a rule for the offset, **smaller = slower** (less aggressive), **larger = faster** (more aggressive). Generally, you should adjust the offset to the highest value possible without the process variable excessively overshooting the set point.

The maximum offset should be programmed to allow the chamber air to overshoot the final value by an amount that will not damage any portion of the load. For example, if the final set point is +100°C and the load could be damaged by temperatures above +110°C, then the maximum heat offset should be +10°C.

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

Tuning Up 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.

Example Starting Parameters					
Heat gain	3.0	Heat integral time	200	Heat offset	10
Cool gain	3.0	Cool integral time	400	Cool offset	-10

Record the original parameter settings

1. From the main screen, press **MN/PRG**, then press **MANUAL**. The manual mode screen will appear.
2. Use the left and right arrow keys to cycle through the values shown on the last line of the display until **CONTROL PARAMETERS** appears.
3. Press the edit icon at the end of the word **PARAMETERS**. The first control parameters screen will appear.
4. Select the parameters screen for the PTC channel, usually channel 3 (**CH3**). The heat and cool gain parameters screen will appear:
5. Write down the heat and cool gain settings.
6. Press **NEXT**.
7. Write down the heat and cool integral time settings.
8. Press **NEXT**.
9. Write down the heat and cool offset settings.

Obtain a performance baseline

10. Press **ESC** until the manual mode screen appears.
11. Use the arrow and alphanumeric keys to select and edit the settings for the PTC channel (usually channel 3):
    a. Set the deviation (**DV**) to 0.
    b. Enter a new set point (**SP**) 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 (**RR**) to 0.
    d. Disable all unnecessary auxiliaries.
    e. Make sure product temperature control (**PTC**) is enabled. **NOTE**: If you are tuning the PTC channel in a temperature-humidity system, disable humidity (**HUM**) for best results.
12. Press **RUN**. The chamber will enter run manual mode.
13. Watch the PTC channel's process variable (**PV**) as it approaches set point and then stabilizes for 10 to 15 minutes.
14. 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 setting

15. To adjust the gain:
    a. Change the set point (**SP**) to back the process variable away from the set point you will use to tune the parameter.
    b. Press the **CONTROL PARAMETERS** edit icon.
    c. Change the heating or cooling gain (**Gain**) for the channel you are tuning.
16. Repeat steps 10 through 13 to see the effect of the new gain setting. The ideal gain setting is obtained when the process variable stabilizes near set point (for example, within ±2°C). As it stabilizes, it oscillates decreasing amounts until it droops just above or below the set point. **NOTE**: The integral time function will adjust the set point up or down to compensate for this droop.
    - If the process variable continues oscillating, you will need to decrease the gain setting just until the oscillation stops.
    - If the process variable is not oscillating, you will need to increase the gain setting just until oscillation begins, then decrease the setting until the oscillation stops.
17. 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 the **CONTROL PARAMETERS** edit icon.
    c. Change the heating or cooling integral time (**Integ**) for the channel you are tuning.
18. To see the effect of the integral time setting, repeat steps 10 through 13. 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.
19. 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 the **CONTROL PARAMETERS** edit icon.
    c. Change the heating or cooling offset (**Offst**) for the channel you are tuning.
20. To see the effect of the offset setting, repeat steps 10 through 13. The ideal offset setting is obtained when the process variable equals the set point.
    - If the process variable overshoots the set point, you should decrease the offset.
    - If the process variable undershoots the set point, you should increase the offset.

Repeat as needed

20. Once the first set of parameters (such as the heating parameters) have been tuned up, the other set of parameters can be tuned up.
21. Record the parameter settings on the duplicate master sheets located with the Configuration Data Sheets. Keep these values on record with the 3800 manual.

Summary

When adjusting the PTC control parameters you should 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.

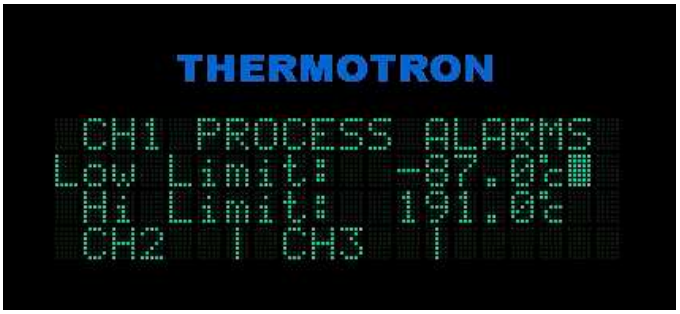
Setting Process Alarms

Each channel of the 3800 can be programmed 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 3800 enters stop mode.

Factory-specified limits are programmed into the 3800. The typical factory settings for temperature-humidity systems are -87°C to +191°C and 0 to 100% RH.

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

1. From the main screen, press **SETUP**, then press **ALARMS**. The process alarm screen will appear:
2. Use the arrow and alphanumeric keys to select and edit the alarm limit settings.
3. To view the process alarms for channel 2 or channel 3, press **CH2** or **CH3**.



Changing the Access Level or Password

The access level function allows you to select from seven different levels of access to the 3800 functions. The following table provides a general overview of which functions are available at each access level.

Level	Name	Functions Available
0	Locked	All functions are locked out. Most information may be viewed but not edited.
1	User level 1	Program run, stop, and hold modes are enabled.
2	User level 2	Manual mode operation is enabled.
3	Programmer	Program creation/editing and clock setting are enabled.
4	Lab manager	System parameters, process alarms, and system events can be set.
5	Calibration lab	Calibration, manual throttle, and other functions are enabled.
6	View configuration	Allows the user to view (but not edit) configuration settings.

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

1. From the main screen, press **SETUP**, then press **MORE**, then press **ACCESS**.
2. The password screen will appear:
   - If no password has been set, press **NEXT**.
   - If a password has been set, use the alphanumeric keys to enter the password, then press **NEXT**.

3. If the password has been entered correctly, this screen will appear:
4. To change the password, go to step 7 below.
5. To change the access level, press **CLR** repeatedly until the desired access level is displayed.
6. Press **ESC** to save the new access level and exit.

7. To change the password, press **PWORD**. This screen will appear:
8. Enter the new password. The password may consist of up to 20 keystrokes.
9. Press **NEXT**. Enter the new password again and press **OK**.
10. Press **ESC** to exit.

Viewing Computer Interface Settings

1. From the main screen, press **SETUP**, then press **MORE**, then press **CMP IO**. The computer interface screen will appear:
2. To view the current settings, press **SETUP**, then press **NEXT** to cycle through the settings.
3. For information on computer interface setup and diagnostics, refer to the *3800 Computer Interface Manual*.

Configuring 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. System events 1 through 4 are available for your use.

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 (RNG)	The low value of the active range.	The high value of the active range.
Point (PNT)	The off point, which may provide hysteresis.	The on point.
Duty cycle output (DCY)	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 (RCY)	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 (**Ch** for control channels, **Mn** for monitor channels) identifies the channel associated with the system event. Control channels 1 through 8 and monitor channels 1 through 8 can be used to trigger system events. Selecting unused (**unu**) indicates that the system event is not used. A system event will only be active when the channel associated with it is selected and running.
2. Variable (**Var**) indicates which variable the 3800 will monitor for the selected channel. The available variable types are:
   - Process variable (**pVar**): 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 (**SetPt**): 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.
   - Output throttle (**Throt**): The system event uses the selected channel's throttle to trigger the event. The range is -100% throttle to +100% throttle.
   - Control deviation (**Dev**): This variable is the process variable minus the set point. This variable uses the same unit of measurement as the process variable and set point.

3. **Logic** indicates the type of system event. This parameter determines when the 3800 will activate and deactivate the system event. The available logic types are:

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

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

   - **Duty Cycle** output: 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** timer: 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 or off point (**Low/Off**)
5. High or on point (**High/On**)

Setting Up System Events

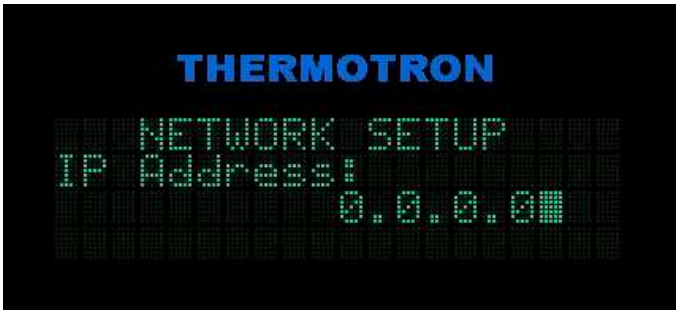
1. From the main screen, press **SETUP**, **MORE**, **MORE**, then press **SYS EV.** The first system event setup screen will appear:
2. Press the number of the system event you want to configure. To see the next two system events, press **MORE**.
3. Before you change any system event parameters, you should record the original settings.
4. To change the channel (**Ch**), variable (**Var**), or **Logic** settings:
   a. Use the arrow keys to highlight the desired field.
   b. Use the **CLR** key to cycle through the list of choices.
   c. To go on to the **Low/Off** and **High/On** settings, press **NEXT**.

5. To change the **Low/Off** or **High/On** settings:
   a. Use the arrow keys to highlight the desired parameter.
   b. Use the alphanumeric keypad to enter a new value.
   c. To reject the new value, press **ESC**.
   d. To accept the new value, press **ENTER**.
   e. Press **ESC** to exit.

6. Keep these values on record with the programmer/controller manual.

Viewing the Network Setup

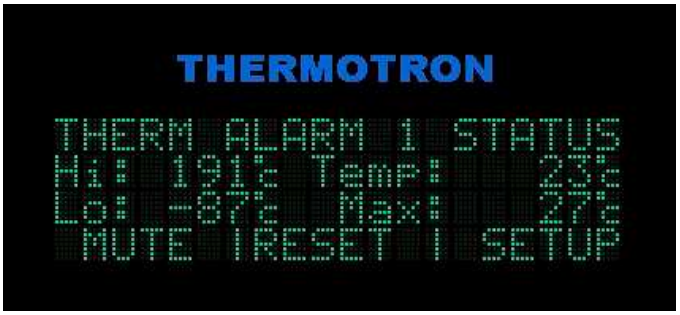
1. From the main screen, press **SETUP**, **MORE**, **MORE**, then press **NET**. The network setup screen will appear:
2. For information on network setup, refer to the *3800 Computer Interface Manual*.



Calibrating the Therm-Alarm Input

NOTE: This calibration procedure requires a type 'T' thermocouple simulator. Before beginning any calibration procedure, make sure the 3800 programmer/controller's temperature scale is set to Celsius.

1. From the main screen, press **STATUS**, then use the left and right arrow keys to cycle through the values shown on the last line of the display until **MONITR** | **SERVCE** | **T-ALRM** appears.
2. Press **T-ALRM**. The Therm-Alarm status screen will appear:
3. Before you change any alarm limits, record the original settings.



4. Press **SETUP.** The Therm-Alarm configuration screen will appear:
5. To avoid nuisance alarms, set the **High Limit** to +300°C and the **Low Limit** to -150°C as follows:
   a. Use the arrow keys to select the desired value.
   b. Use the alphanumeric keys to enter a new value.
      - To reject the new value, press **ESC**.
      - To accept the new value, press **ENTER**.

6. Locate the Therm-Alarm in your chamber. See the instrumentation drawing in your chamber manual.
7. Press **CAL**. The first Therm-Alarm calibration screen will appear:
8. Follow the instructions on the screen, pressing **NEXT** after each step is complete.

9. When you are finished, disconnect the simulator.
10. Repeat steps 5.a and 5.b to return the **High Limit** and **Low Limit** settings to their original values.

CAUTION: The screen shots on this page display the factory-set Therm-Alarm default settings. It is your responsibility to changes these settings to properly protect your product.

Adjusting the Real Time Clock Settings

The real time clock keeps track of the time and date. The time and date are used for reference and delayed program start.

1. From the main screen, press **SETUP**, **MORE**, **MORE**, **MORE**, then **CLOCK**. The real time clock screen will appear:

2. Press **DATE** or **TIME**.
3. Use the left and right arrow keys and the numeric keypad to enter a new date or time.

   The 3800 has a leap year function, eliminating the need to reset the date after February 29 of each leap year.

   For the time, use a 24-hour clock, which displays 8:06 p.m. as 20:06.

4. To load any new date or time setting, press **SET**.
5. To return to the setup screen, press **ESC**.

Viewing the Monitor Channels Readings

The monitor channels screen allows you to view the real-time environmental readings of the input channels configured as monitor-only channels. The 3800 can have up to eight monitor channels. Monitor channels read the same input types as control channels. For more information on your chamber's monitor channels, refer to your chamber manual.

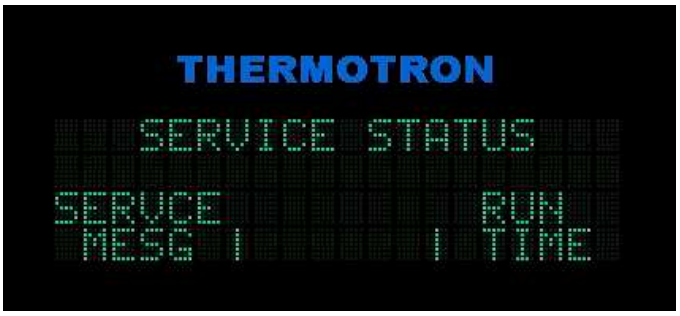
1. From the main screen, press **STATUS** then press **MONITR**. The monitor channel screen will appear:
2. To view any other monitor channels, press **NEXT**.

Service Status Functions

The service status functions include service messages and run times. Service messages allow you to notify yourself of certain events. Up to four service messages can be set up. Run times list how many hours each channel has run.

1. From the main screen, press **STATUS**, then use the arrow keys to cycle through the values shown on the last line of the display until **MONITR** | **SERVCE** | **T-ALRM** appears:

2. Press **SERVCE**. The service status screen will appear:
   - To view, reset, or set up service messages, press **MESG** and go to step 3.
   - To view run times, press **RUN TIME**.



3. The first service message screen will appear:
   - To cycle through the service messages, press **NEXT**.
   - To reset the time left in a selected message's service interval, press **RESET**.
   - To set up a service message, press **SETUP** and go to step 4.

4. The selected service message setup screen will appear:

5. To change the text of the message that will be displayed when the interval setting expires, use the alphanumeric keypad. **NOTE**: Service messages can be up to 19 characters long.

   For example, to change a service message to **CHECK SIGHTGLASS**:

   a. Press the **1** key on the alphanumeric keypad. The letters **A**, **B**, and **C** will appear on the last line of the display:

   b. Press the **C**.

   c. Repeat this process for the rest of the text. **NOTE**: For the space, press the **# _ &** key, then press **SPACE**.

   d. If you enter the wrong letter or number, press **CLR** to delete your last entry.

   e. To reject the new text and restore the original text, press **ESC**.

   f. To accept the new text, press **ENT**.

6. To change the chamber system to monitor:

   a. Use the left or right arrow key to select the **System** field. A down arrow will appear:

   b. Use the **CLR** key to cycle through the available choices.

   When the selected system has run the number of hours set under **Interval**, the service message will be displayed.

7. To change the time until the selected system needs to be serviced:

   a. Use the left or right arrow key to select the **Interval** field.

   b. Use the alphanumeric keypad to enter an interval time.

8. To return to the setup screen, press **ESC**.

Viewing Diagnostic Screens

Access to the diagnostic screens is provided to allow you to troubleshoot your chamber with the assistance of a Thermotron Technical Liason.

1. From the main screen, press **SETUP**, **MORE**, **MORE**, **MORE**, then **DIAG**. The first diagnostics screen will appear:
2. Please call the Thermotron Product Support group at (616) 392-6550 between 8:00 a.m. and 4:30 p.m. Eastern Standard Time for assistance.

Section 3: Programming the 3800

The 3800 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.

Programmed Cycling

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.

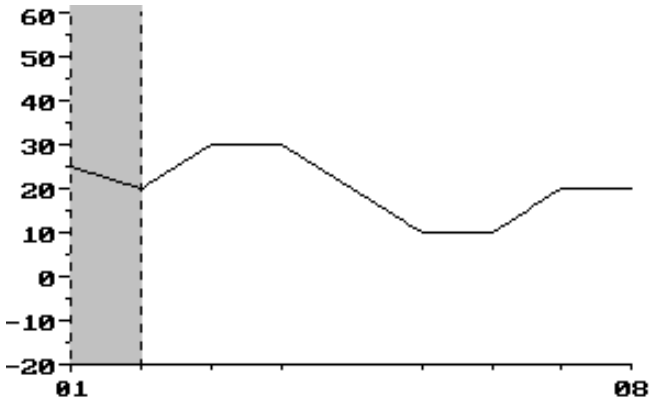
In two-channel mode the 3800 is programmed to control humidity as well as temperature. **NOTE**: Other operations, such as electronic testing of the products, are not a function of the 3800.

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

Each basic interval is programmed with the following entries:

2. Initial value (**IV**) 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.
3. Final value (**FV**) is the ending value of the set point for this interval.
4. +/- deviations (**DV**) control how far you will allow the temperature or other process variable to be from set point. The deviations will be monitored and the deviation alarm will activate if the values are exceeded. **NOTE**: In an interval with guaranteed soak (**GSoak**) enabled, the program will wait in the interval until all deviations are satisfied before moving on to the next interval.
5. Auxiliary relays in auxiliary group 1 (**Aux Grp1**) and auxiliary group 2 (**Aux Grp2**) may be enabled or disabled by pressing the number corresponding to the desired auxiliary relay. For more information, refer to your chamber manual. **NOTE**: Auxiliaries are active only when the 3800 is running.
6. **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 total time of the sample temperature program shown is 40 minutes.

The interval time has two methods of control:

a. If you enter a **Time** greater than zero, the 3800 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 3800 will transition to the next interval when the time runs out anyway.

b. If you enable guaranteed soak (**GSoak**) and set one or more deviations (**DV**), the program will wait in the interval until all deviations are passed before going on to the next interval.

7. Sequential programming is selected by allowing the 3800 to move forward to the next sequential interval. Programmed looping is selected by using the **Loop To** and **Num Loops** values. **Loop To** indicates the interval to loop back to after completion of the current interval. **Num Loops** is the total number of times the programmed loop will be executed.

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

   - The target interval may be the target of another loop, but must not cross into another loop. (When a loop is crossed, the target interval is between the beginning interval and the ending interval of the loop).
   - Nested looping is legal. In nested looping, one loop starts and finishes inside another loop. Both loops can have the same target interval.
   - The final value of the looping interval should be the same as the initial value of the target interval.
   - The maximum number of separate loop patterns per program is 32.

8. **PTC** enables or disables the product temperature control system. Product temperature control uses the load temperature (usually channel 3) to control the channel 1 air set point for faster load stabilization.

9. **Humidity** enables or disables the humidity system. The humidity system should be enabled only in the normal temperature range (0°C to +100°C).

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 method. Controlled temperature cycles can be programmed using the ramp method.

During two-channel (such as temperature/humidity) operations, the program becomes more complex. Each channel's variable is programmed with an initial value and final value. During guaranteed soaks both channels can be programmed with a deviation. All deviations must be satisfied before the 3800 moves to the next interval.

Creating a New Program

1. From the main screen, press **MN/PRG**, then press **PROG**. The current program list screen will appear:

2. Select the program slot (such as **Prg 1**) you want to create the program in. Use the **CLR** key to cycle through the 10 program slots.

   NOTE: To delete an existing program and empty its program slot, see "Deleting a Program" later in this section.

3. When you have selected an empty program slot, press **NEW**. This screen will appear:

   - To load one of the pre-programmed tests included with the 3800, press **PPT** and follow the instructions in "Loading a Pre-Programmed Test," later in this section.
   - To create a new program, press **BLANK**. This screen will appear:

4. There are two ways to select values to edit for this interval. You can use the left and right arrow keys to cycle through the values, or you can use the alternate functions of the alphanumeric keys to jump directly to various groups of values. Each of the following alphanumeric keys, when pressed repeatedly, displays one or more values:
   - **1/CH 1**: Shifts to channel 1 values
   - **2/CH 2**: Shifts to channel 2 values
   - **3/CH 3**: Shifts to channel 3 values

     NOTE: Enabling **Humidity** disables **PTC** and the PTC channel. Enabling **PTC** disables **Humidity** and the humidity channel. When **PTC** is enabled, only the values for the PTC channel can be edited.
   - **4/VALUE**: Initial value (**IV**), final value (**FV**), and deviation (**DV**)
   - **5/TIME**: The length of the current interval
   - **6/AUX**: Auxiliary relays in auxiliary group 1 (**Aux Grp1**) and auxiliary group 2 (**Aux Grp2**)
   - **7/INT**: **Insert Interval?** and **Delete Interval?**
   - **8/LOOPS: Loop to** and **Num Loops**
   - **0/OPTIONS**: Product temperature control (**PTC**), **Humidity**, and guaranteed soak (**GSoak**)
5. To change a displayed value:
   a. Press **EDIT**.
   b. If a solid cursor appears next to the value, use the numeric keypad to edit the value.

c. If a down arrow  appears next to the value, press **CLR** to toggle the setting on or off.

d. To reject the new value and restore the previous value, press **ESC**.

e. To save the new value, press **ENT**.

6. The following list describes the editable program values:

a. For initial value (**IV**) enter the starting value for each active channel's set point for this interval. **NOTE**: After interval 1 the initial value will always be the final value of the previous interval and cannot be edited.

b. For final value (**FV**) enter the ending value for each active channel's set point for this interval.

c. +/- deviations (**DV**) control how far you will allow the selected channel's process variable to be from set point. Enter a positive number only — the 3800 will monitor both plus and minus deviations and activate the deviation alarm if the values are exceeded. **NOTE**: In an interval with guaranteed soak (**GSoak**) enabled, the program will wait in the interval until all deviations are satisfied before moving on to the next interval.

d. Auxiliary relays in auxiliary group 1 (**Aux Grp1**) and auxiliary group 2 (**Aux Grp2**) may be enabled or disabled by pressing the number corresponding to the desired auxiliary relay. For more information, refer to your chamber manual. **NOTE**: Auxiliaries are active only when the 3800 is running.

e. For **Time** enter the length of this interval. To do this, enter the number of hours, press the **•/:** key, enter the number of minutes, press the **•/:** key, and enter the number of seconds. The maximum interval time is 99 hours, 59 minutes, 59 seconds.

f. For **Loop To** enter the number of the interval you want to loop back to after the current interval is complete. For programmed looping this number must be less than or equal to the current interval number, and the **Num Loops** value must be greater than 1. **NOTE**: If no loops are programmed, the **Loop To** field displays the number of the next interval.

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

h. **PTC** enables or disables the product temperature control system. PTC uses the load temperature (usually channel 3) to control the channel 1 air set point for faster load stabilization.

i. **Humidity** enables or disables the humidity system. The humidity system should be enabled only in the normal temperature range (0°C to +100°C).

NOTE: Enabling **Humidity** disables **PTC** and the PTC channel. Enabling **PTC** disables **Humidity** and the humidity channel. When **PTC** is enabled, only the values for the PTC channel can be edited.

j. If you enable guaranteed soak (**GSoak**) and set one or more deviations (**DV**), the program will wait in the interval until all deviations are passed before going on to the next interval.

k. To insert a new interval following the current interval, press **INSERT** when **Insert Interval?** appears. To confirm your decision, press **YES**.

l. To delete the current interval, press **DELETE** when **Delete Interval?** appears. To confirm your decision, press **YES**.

7. When all the settings for this interval are acceptable, advance to the next interval by pressing **ADDINT**. To confirm your decision, press **YES**. Repeat steps 4 through 6 for each interval of the program. The maximum number of intervals is 300. **NOTE**: Once one or more intervals have been created, you can move back and forth between intervals by pressing **PREV** and **NXTINT**.

8. When all intervals have been entered, press **ESC** to exit programming mode. To confirm your decision, press **YES**.

Loading a Pre-Programmed Test

1. From the main screen, press **MN/PRG**, then press **PROG**. The current program list screen will appear:

2. Select the program slot (such as **Prg 1**) you want to load the program into. Use the **CLR** key to cycle through the 10 program slots.

   NOTE: To delete an existing program and empty its program slot, see "Deleting a Program" later in this section.

3. Press **NEW**. The create a new program screen will appear:

4. To load one of the pre-programmed tests included with the 3800, press **PPT**. The pre-programmed tests screen will appear:

5. Use the **CLR** key to cycle through the available pre-programmed tests.

6. When the desired test is displayed, press **LOAD**. The test will be loaded into the program slot selected in step 2 above. To rename the program, see "Editing a Program Name" later in this section.

Editing a Program Name

1. From the main screen, press **MN/PRG**, then press **PROG**. The current program list screen will appear:

2. Select the program you want rename. Use the **CLR** key to cycle through the 10 program slots.
3. When the program you want to rename is displayed, press **NAME**. The edit program name screen will appear:

4. Use the keypad to enter a new program name. Program names can be up to 12 characters long.

   For example, to rename the program **LOAD 1**:

   a. Press the **4** key on the alphanumeric keypad. The letters **J**, **K**, and **L** will appear on the last line of the display:

   b. Press the **L**.

   c. Repeat this process for the rest of the new name:

      - For O, press **5**, then **O**.
      - For A, press **1**, then **A**.
      - For D, press **2**, then **D**.
      - For the space, press the **# _ &** key, then press **SPACE**.
      - For 1, press 1.

5. If you enter the wrong letter or number, press **CLR** to delete your last entry.
6. To reject the new name and restore the original name, press **ESC**.
7. To accept the new name, press **ENT**.

Viewing or Editing a Program

1. From the main screen, press **MN/PRG**, then press **PROG**. The current program list screen will appear:
2. Select the program you want to view or edit. Use the **CLR** key to cycle through the 10 program slots.

3. When the program you want to view or edit is displayed, press **EDIT**. This screen will appear:

4. There are two ways to select values to view or edit for each interval. You can use the left and right arrow keys to cycle through the values, or you can use the alternate functions of the alphanumeric keys to jump directly to various groups of values. Each of the following alphanumeric keys, when pressed repeatedly, displays one or more values:
   - **1/CH 1**: Shifts to channel 1 values
   - **2/CH 2**: Shifts to channel 2 values
   - **3/CH 3**: Shifts to channel 3 values
   - **4/VALUE**: Initial value (**IV**), final value (**FV**), and deviation (**DV**)
   - **5/TIME**: The length of the current interval
   - **6/AUX**: Auxiliary relays in auxiliary group 1 (**Aux Grp1**) and auxiliary group 2 (**Aux Grp2**)
   - **7/INT**: **Insert Interval?** and **Delete Interval?**
   - **8/LOOPS: Loop to** and **Num Loops**
   - **0/OPTIONS**: Product temperature control (**PTC**), **Humidity**, and guaranteed soak (**GSoak**)
5. To edit a displayed value:
   a. Press **EDIT**.
   b. If a solid cursor appears next to the value, use the numeric keypad to edit the value.
   c. If a down arrow appears next to the value, press **CLR** to toggle the setting on or off.
   d. To reject the new value and restore the previous value, press **ESC**.
   e. To save the new value, press **ENT**.

   NOTE: You can move back and forth between intervals by pressing **PREV** and **NXTINT**. For more information on editable program values, see step 6 of "Creating a New Program" earlier in this section.

Deleting a Program

1. From the main screen, press **MN/PRG**, then press **PROG**. The current program list screen will appear:

2. Select the program you want to delete. Use the **CLR** key to cycle through the list of programs.

   NOTE: Deleting a program created by loading a pre-programmed test only removes those intervals from the selected program slot. The pre-programmed tests themselves, which are stored in the 3800's memory, cannot be deleted.

3. When the program you want to delete is displayed, press **DEL**. The confirmation screen will appear:

4. To permanently delete the program, press **YES**.

   NOTE: Deleting a program removes only the program's intervals. The program name is not removed from the program list. To rename a program, see "Editing a Program Name" earlier in this section.

Section 4: Therm-Alarm Functions

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.

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.

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

- For calibration instructions, see "Calibrating the Therm-Alarm Input" in Section 2 of this manual.
- For Therm-Alarm hardware setup instructions, see the *3800 Technical Manual*.
- For information on operating the Therm-Alarm from a host computer, see the *3800 Computer Interface Manual*.

Therm-Alarm Operating Modes

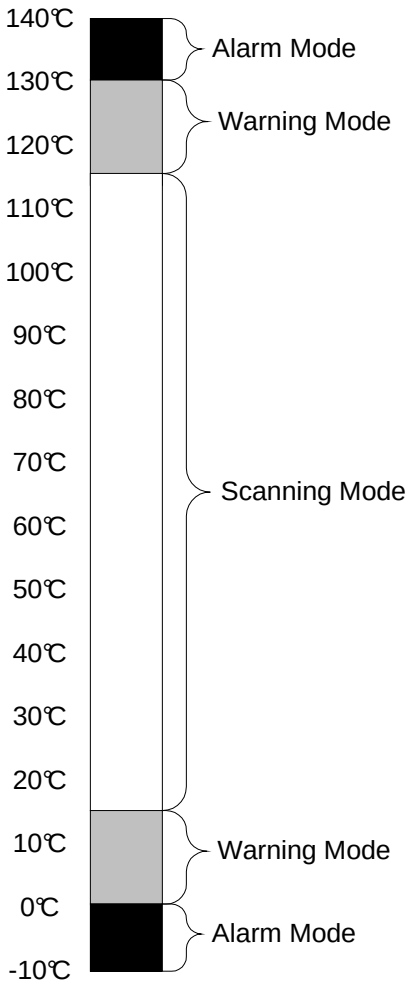
The Therm-Alarm stays in **scanning mode** as long as the input temperature and analog signal are within the acceptable range between the high and low warning settings.

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

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



High limit: +130℃
Low limit: 0℃
Warning bandwidth: 15℃

Positioning the Input Thermocouple or Analog Sensor

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

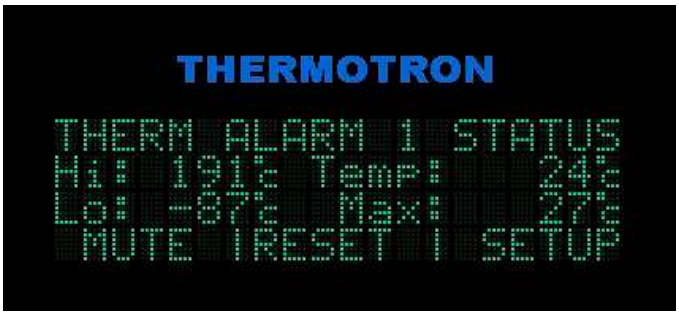
CAUTION: It is *your* responsibility to properly place any Therm-Alarm thermocouples or analog sensing devices. When used properly, the Therm-Alarm is an effective product protection device. However, it is not a fail-safe device and will not guarantee the safety of your product. If you are testing expensive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

Viewing the Therm-Alarm Status

1. From the main screen, press **STATUS**, then use the arrow keys to cycle through the values shown on the last line of the display until **MONITR** | **SERVCE** | **T-ALRM** appears.

2. Press **T-ALRM**.
   - If your 3800 is equipped with one Therm-Alarm, go to step 3.
   - If your 3800 is equipped with more than one Therm-Alarm, this selection screen will appear. If needed, press **NXT TA** until the Therm-Alarm you want to view is displayed, then press **STATUS**.

3. The Therm-Alarm status screen will appear:
   - **Hi** (high alarm limit) and **Lo** (low alarm limit) indicate the temperature and analog limits that, if exceeded, will cause a Therm-Alarm trip. For information on editing these limits, see "Changing the Therm-Alarm Settings" later in this section.



   - **Temp** is 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.
   - **Max** (maximum excursion) is the most extreme temperature or analog value experienced during the most recent alarm condition.

Changing the Therm-Alarm Settings

1. From the main screen, press **STATUS**, then use the arrow keys to cycle through the values shown on the last line of the display until **MONITR** | **SERVCE** | **T-ALRM** appears.

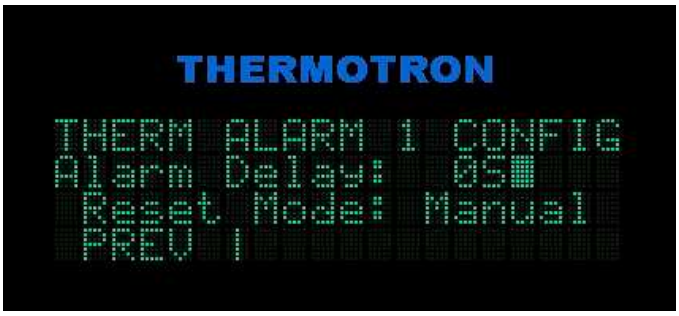
2. Press **T-ALRM**.
   - If your 3800 is equipped with one Therm-Alarm, go to step 3.
   - If your 3800 is equipped with more than one Therm-Alarm, this selection screen will appear. If needed, press **NXT TA** until the Therm-Alarm you want to change is displayed, then press **STATUS**.

3. Press **SETUP**. The first Therm-Alarm configuration screen will appear.
   - Use the arrow and alphanumeric keys to select and edit the settings you are changing, then press **ENT**.
   - For **Reset Mode**, press **CLR** to toggle between settings.
   - Press **PREV** or **NEXT** to move back and forth between configuration screens.

4. For **High Limit** and **Low Limit**, enter the temperature or analog limit that you want to cause a Therm-Alarm trip if it is exceeded at the product under test.

5. For **Mute Time** 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. For **Warning Band** enter the number of degrees from the limit temperature you want the warning band to begin. The maximum setting is 15°. To disable the warning mode enter 0°.

7. For **Alarm Delay** enter the number of seconds you want the alarm mode to be delayed after the input temperature reaches a limit temperature. The maximum setting is 30. If you enter 0, the alarm mode will begin as soon as a limit temperature is reached. **NOTE**: If the limit temperature is exceeded by more than five degrees, the alarm delay will not occur.



8. The **Reset Mode** 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 status screen and press **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 degrees from the limit temperature within the acceptable range.
9. To return to the main screen, press **ESC** repeatedly until it is displayed.

Alarm Mute and Reset Mode Functions

During warning, alarm, open thermocouple, and failure modes, the Therm-Alarm emits an audible alarm and the Therm-Alarm status screen will appear. From the status screen you can mute the alarm and 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 has returned to within the high and low limits, you must reset it to normal operating conditions from the Therm-Alarm status screen. (See the instructions below.)
- If the reset mode has been set to **Auto**, the Therm-Alarm resets itself when the input temperature is two degrees from the limit temperature within the acceptable range. **NOTE**: If the temperature is still inside the warning mode temperature band, the Therm-Alarm drops from alarm mode to warning mode.

In **open thermocouple mode** the Therm-Alarm resets itself once the thermocouple is closed or repaired.

In **failure mode** you must remove power from the Therm-Alarm and then apply power again to reset it.

Muting or Resetting the Therm-Alarm

1. During temperature warning, alarm, open thermocouple, and failure modes, the Therm-Alarm will emit an audible alarm and the Therm-Alarm status screen will appear.
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**.

Initializing the Therm-Alarm Data

CAUTION: Restoring the Therm-Alarm's factory default settings should be done only with the assistance of a Thermotron Technical Liaison Advisor. Please call the Thermotron Product Support group at (616) 392-6550 between 8:00 a.m. and 4:30 p.m. Eastern Standard Time for assistance.

Calibrating a Therm-Alarm

NOTE: This calibration procedure requires a type 'T' thermocouple simulator.

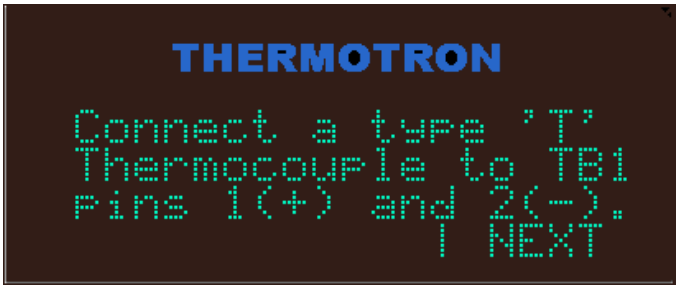
NOTE: Make sure the controller's temperature scale is set to Celsius before beginning any calibration procedure.

1. From the main screen, press **STATUS**, then use the arrow keys to cycle through the values shown on the last line of the display until **MONITR** | **SERVCE** | **T-ALRM** appears.

2. Press **T-ALRM**.
   - If your 3800 is equipped with one Therm-Alarm, go to step 3.
   - If your 3800 is equipped with more than one Therm-Alarm, this selection screen will appear. If needed, press **NXT TA** until the Therm-Alarm you want to change is displayed, then press **STATUS**.

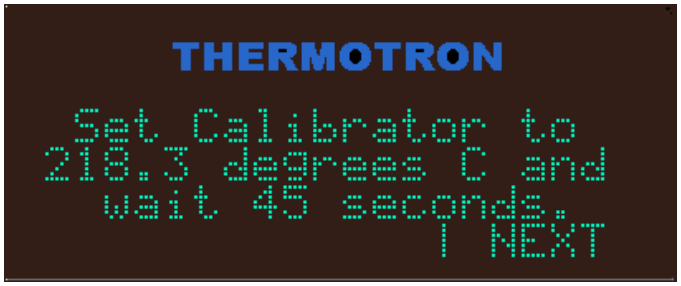
3. Press **SETUP**. The first Therm-Alarm configuration screen will appear.

4. Press **CAL**. The first Therm-Alarm calibration screen will appear. Follow the directions on the screen and then press **NEXT**.



5. Follow the directions on the screen and then press **NEXT.**

6. Follow the directions on the screen and then press **NEXT.**



7. Follow the directions on the screen and then press **NEXT.**

Appendix A: Glossary

access level: A function that allows you to select from six levels of access to the 3800 programmer/controller functions.

alarm band: The maximum amount beyond the current set point that the process variable (actual test space or product condition) can deviate. If the process variable drifts outside the alarm band, the 3800 enables its alarm functions.

alarm delay: The number of seconds the Therm-Alarm alarm mode will be delayed after the input temperature reaches a limit temperature. If the limit temperature is exceeded by more than five degrees, the alarm delay will not occur.

auxiliary cooling: An optional, non-mechanical refrigeration system that uses liquid nitrogen (LN_2) or carbon dioxide (CO_2) to provide cooling.

auxiliary cooling duty cycle; auxiliary cooling time frame: Settings that control an auxiliary cooling system. When the mechanical refrigeration system is operating at full cooling throttle, the auxiliary cooling system can be operated for a programmed percentage or duty cycle (such as 50%) of a selected time frame (such as six seconds).

auxiliary group: One of two groups of eight auxiliary outputs available with the 3800 programmer/controller.

auxiliary output: A programmable TTL-compatible signal generated by the 3800 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 3800.

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

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.

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 3800 operates the chamber control systems based on the process variable readings and the demands of the test.

control module: The 3800 programmer/controller assembly that includes the microprocessor used to perform the chamber interface operations and distribute power to the display module.

control parameter: Settings that adjust the performance of the chamber around set point. As the chamber nears set point, the programmer/controller 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.

control sensor: A device (or group of devices) that monitors the environmental conditions in the chamber's test space for the programmer/controller.

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.

delayed start: A function that causes the 3800 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: A 3800 programmer/controller 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.

display module: The 3800 programmer/controller assembly that includes the screen and keyboard, as well as the primary microprocessor, firmware, and memory.

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. Compare to wet bulb.

dry bulb temperature: The actual test space air temperature. Compare to wet bulb temperature.

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

embedded Therm-Alarm: A product protection instrument that monitors the temperature or other analog signal at the product. If the product temperature or analog signal exceeds either the high or low limits you select, the Therm-Alarm disables the chamber control systems and alerts you with audible and visible alarms.

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.

guaranteed soak: In an interval with guaranteed soak enabled, the program will wait in the interval until all deviations are satisfied before moving on to the next interval.

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.

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

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

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

integral time: A control parameter that determines how quickly the throttle will be adjusted to compensate for droop. Droop is an effect, such as natural heat loss through the test space walls, that prevents the process variable from reaching the final 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 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 a 3800 programmer/controller key is pressed, unless this feature is disabled.

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

loop: A series of intervals programmed to be repeated.

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

main screen: The base or home screen for the 3800 programmer/controller. From the main screen you can access all other screens and control all other functions. To return to the main screen from any other screen, press **ESC** repeatedly until the main screen is displayed.

manual mode: A function that allows you to operate the 3800 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.

monitor channel: A channel used by the 3800 for monitoring processes within the chamber. If the high or low limit is exceeded for any channel, the 3800 alarm outputs are activated.

offset: The amount the test space air temperature may exceed the final temperature set point during product temperature control operation.

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.

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

password: A string of up to 20 keystrokes that must be entered to set the 3800 programmer/controller 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.

pre-programmed test: Factory-installed programs included with the 3800 programmer/controller.

process alarm: A 3800 programmer/controller 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 3800 enters stop mode.

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

process variable channels: See control channels.

product: The device or equipment the chamber tests.

product temperature control (PTC): A heating and cooling process that controls the process variable from the product temperature rather than the test space air temperature. During normal temperature cycling, the chamber is cycled to the final 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 controls and operates the chamber's heating and cooling systems.

program: A relationship between a test space condition and time.

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.

PTC: See product temperature control.

pulldown: The process of the chamber going from one temperature set point to a lower temperature set point.

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 3800'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.

real time clock: A 3800 programmer/controller function that keeps track of the time and date.

relative humidity (RH): A percentage of the maximum amount of moisture that the 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.

RH: See relative humidity.

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 programmer/controller sets when ramping from the initial set point to the final set point.

starting interval: The interval that a program begins with; typically a program begins with interval 1.

stress screening: Changing temperatures as quickly as possible to force any early life failures on each product.

system event: A control device that monitors certain variables, such as temperature or throttle, and turns its outputs on or off based on the monitored variables.

t/c: See thermocouple.

temperature program: The relationship between time and the test space temperature.

temperature scale: Celsius or Fahrenheit.

test space: The space within the test compartment where the product is tested.

Therm-Alarm: See embedded Therm-Alarm.

thermocouple (t/c): A device used to sense temperature as a function of current.

throttle: The percentage of output applied by a chamber's conditioning system to reach 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 programmer/controller will operate the throttle at +100%. When the process variable (temperature) reaches the proportional band, the programmer/ controller will begin reducing the throttle to control the process variable to equal the set point.

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.

wet bulb: A thermocouple with a moistened wick over it. This thermocouple monitors the test space temperature. An instrument compares the dry bulb temperature to the wet bulb temperature to calculate the moisture content of the test space air.

wet bulb temperature: A temperature reading from a thermocouple that is surrounded by a moistened fabric wick. The "wet bulb depression" (the difference between wet bulb and dry bulb readings) is used to calculate relative humidity.