THERMOTRON®

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3800 Programmer/Controller Operator Manual

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For additional manuals, contact Thermotron Industries:

Thermotron Industries
291 Kollen Park Drive
Holland, MI 49423, USA

Phone: (616) 392-6550
Fax: (616) 393-4549
www.thermotron.com

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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.

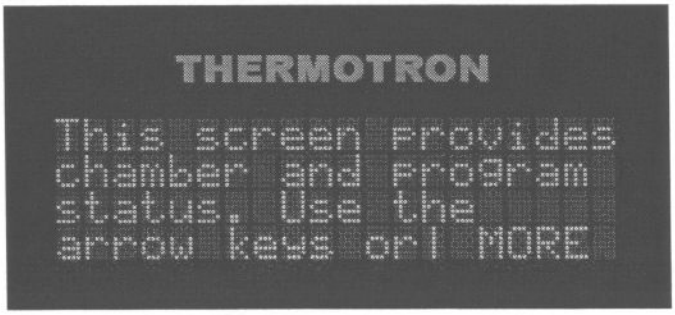
For most 3800 operations you start from the main screen (shown above) and use function keys and soft keys to access other screens and functions. To return to the main screen from any other screen, press the **ESC** key repeatedly until the main screen is displayed.

- 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

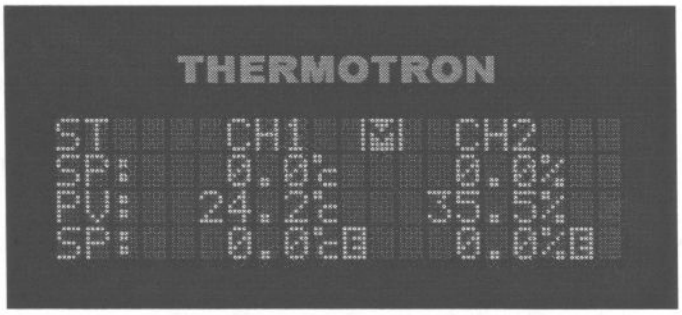
Auxiliary outputs provide programmable TTL level outputs. There can be up to two groups of eight auxiliary outputs. These outputs are programmed on and off during each program interval or during manual mode operation. These outputs normally are used to program systems on and off. For information on your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

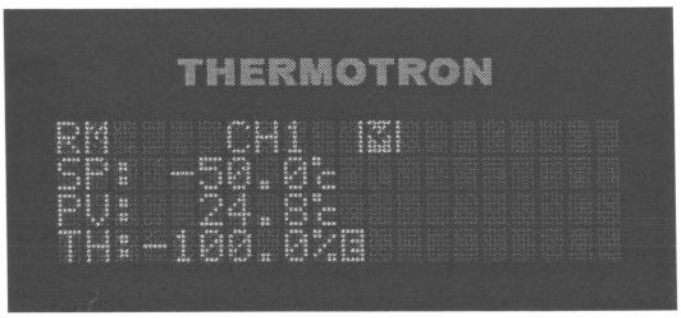
5. To start running in manual mode using the settings entered above, press **RUN**.
6. To temporarily suspend a manual mode test, press **HOLD**. To resume the test, press **RUN** again.
7. To stop manual mode operation, press **STOP**.

Manual Throttle Mode

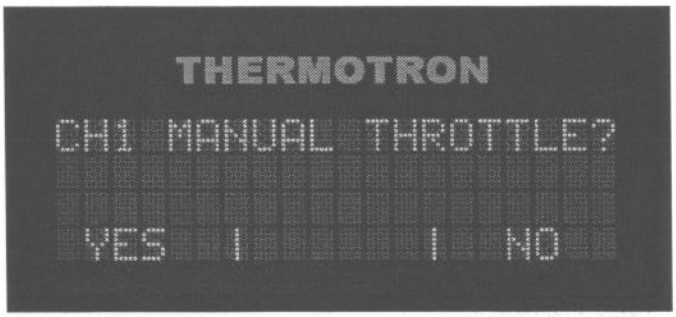
Manual throttle mode is provided to allow you to troubleshoot your chamber with the assistance of a Thermotron Technical Liaison. For assistance please call the Thermotron Product Support group at (616) 392-6550 between 8:00 a.m. and 4:30 p.m. Eastern Standard Time. (**NOTE**: Manual throttle mode is available only at the Cal Lab access level and above.)

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

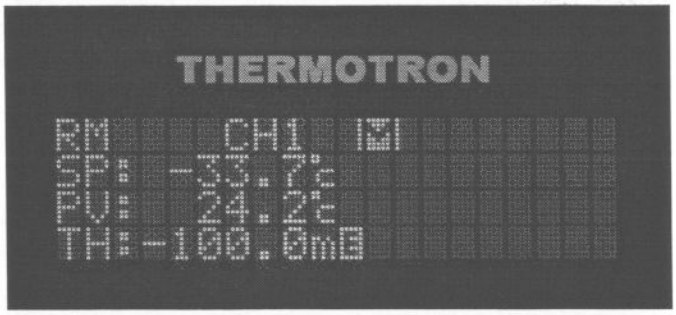
1. Begin a manual mode test. If needed, see "Manual Mode" above.
2. Use the left and right arrow keys to cycle through the manual mode values until the throttle (**TH**) setting appears.
3. Press the throttle setting's edit icon.



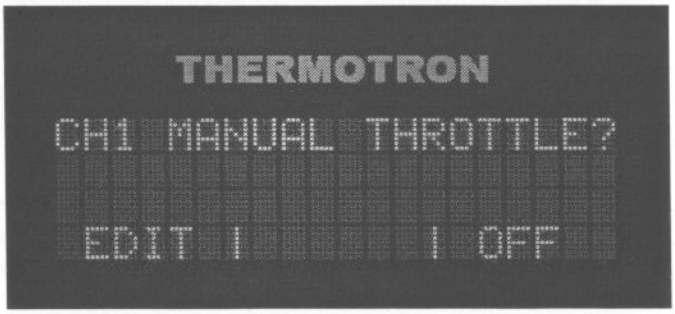
4. You will be asked if you want to enter manual throttle mode. Press **YES**.



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.

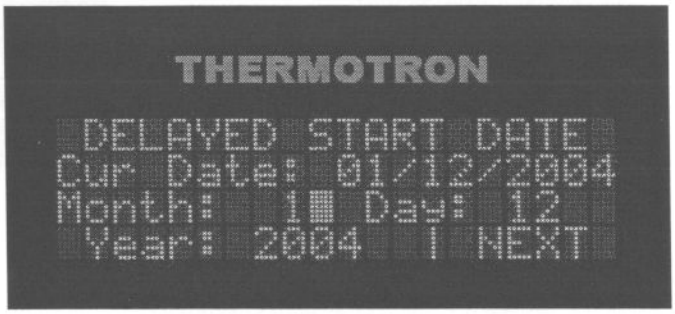
Once a program is entered into memory it can be run immediately, or it can be set up for a delayed start. To create a program, see Section 3 of this manual.

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:

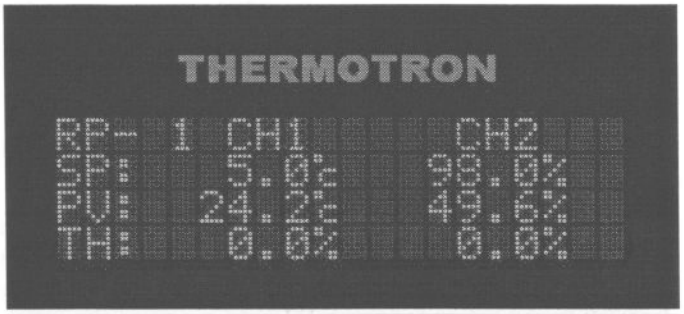


6. To set up a delayed start, follow these steps:
   a. Use the left or right arrow keys to highlight a field.
   b. Use the number pad to enter the desired value.
   c. Press **ENT**.
   d. Press **NEXT** and repeat steps a through c.
   e. To exit without saving any delayed start settings, press **ESC**.
   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:

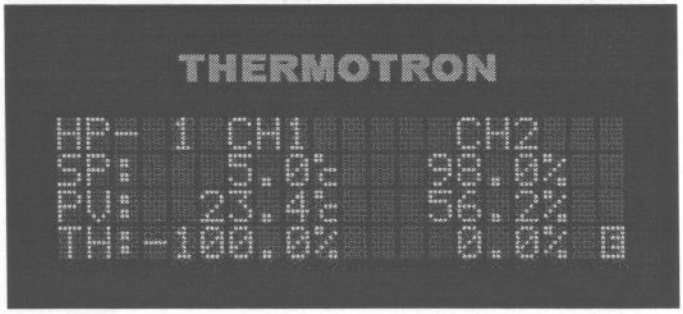
   For more information on the chamber status screen, see "Chamber Status" later in this section.



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.

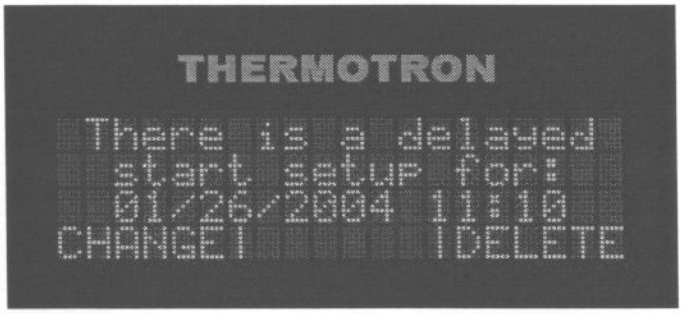
9. To enter temporary values into the current interval, press the edit icon. For additional information, go to step 4 of "Edit From Hold" later in this section.



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:



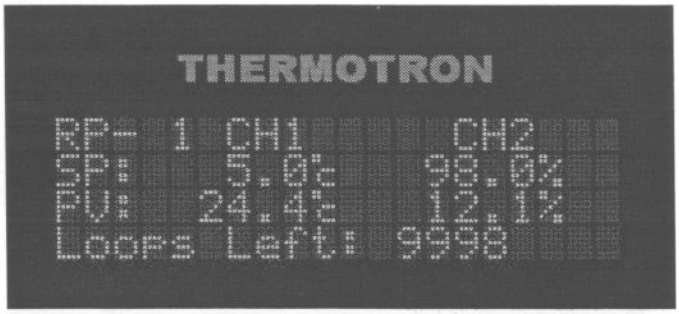
- To verify a delayed start, press **RUN**. If the setting is correct, press **ESC**. If the setting is incorrect, perform the following procedure.
- To modify a delayed start:
  a. Press **RUN**.
  b. Press **CHANGE**.
  c. Use the left or right arrow keys to highlight a field.
  d. Use the number pad 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

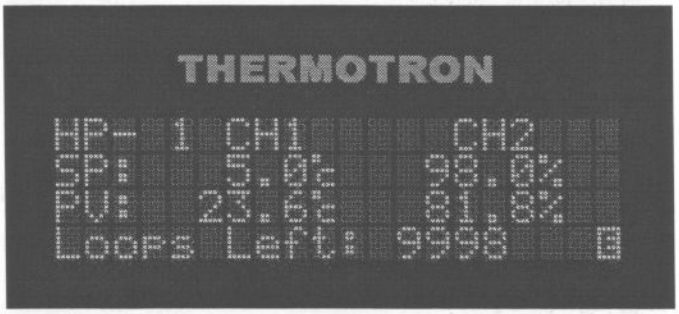
Edit from hold allows you to place a running program in hold program mode and enter temporary values into the current interval. Once the interval is run and completed, the temporary values are discarded. The next time the interval is run, the original programmed values apply. **NOTE**: In hold program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

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

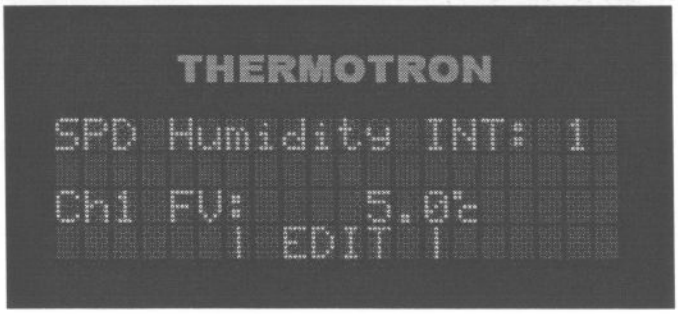
1. While a program is running, go to the main screen and press the **STATUS** key. The chamber status screen will appear.



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



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

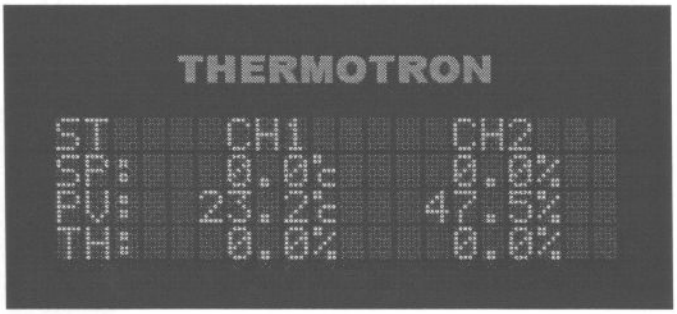


4. Use the left and right arrow keys to cycle through the editable settings. For more detailed descriptions of the settings, see Section 3 of this manual.
5. To change a value press **EDIT**. Use the numeric keypad to edit the selected value, then press **ENT**.
6. To switch channels press **CH 1**, **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

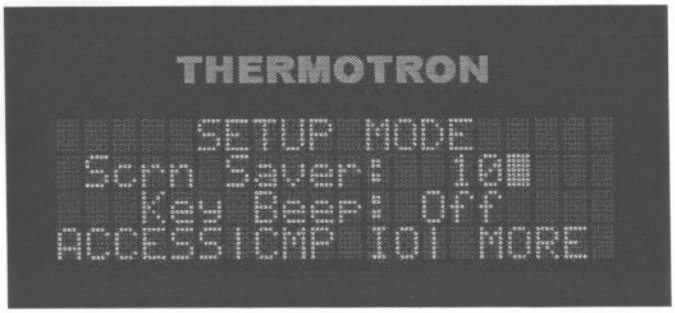
Changing the Temperature Scale

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.

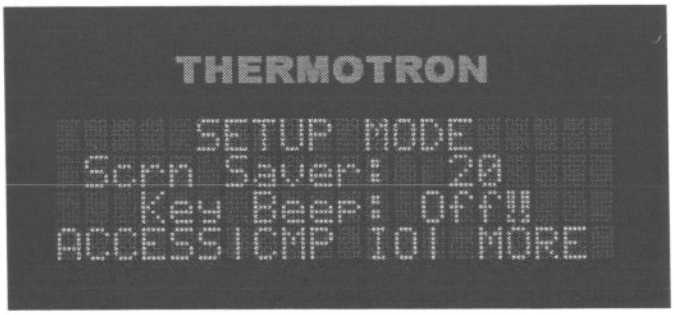
Changing the Screen Saver Activation Time

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**.



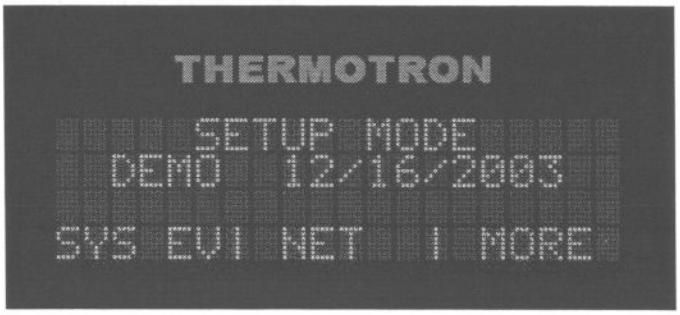
Enabling or Disabling the Key Beep

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.

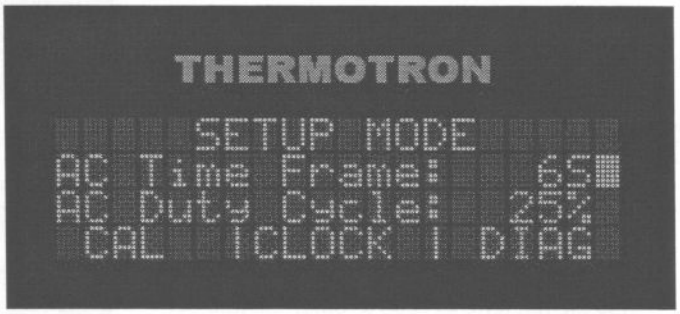


Adjusting the Auxiliary Cooling Settings

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.

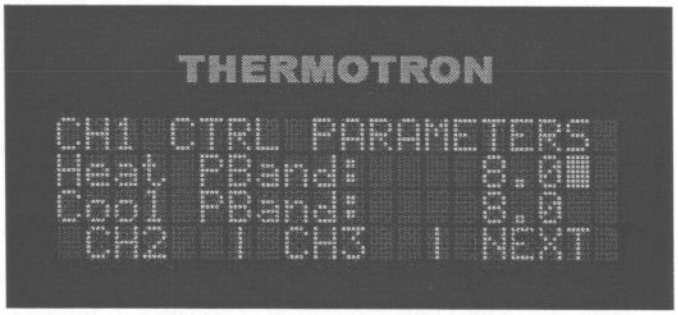
For the optimal combination of performance and quality, each control channel is tuned to be critically damped. This occurs when the process variable overshoots the set point slightly and then oscillates around the set point slightly until it stabilizes at the set point. This level of control becomes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

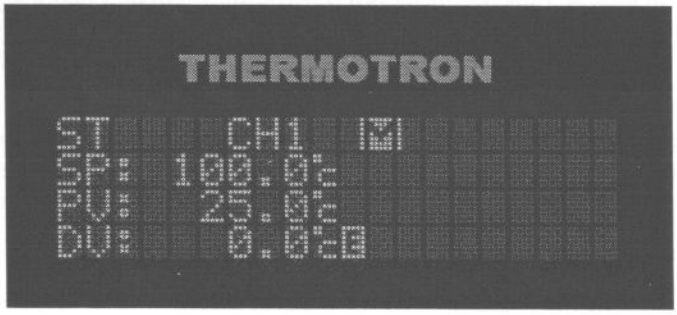
Record the original parameter settings

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.

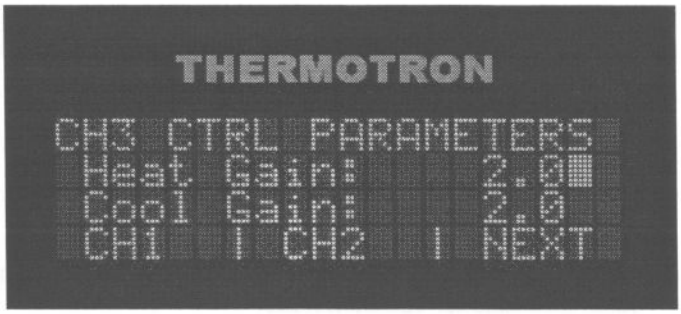
For the optimal combination of performance and quality, each control channel is tuned to be critically damped. This occurs when the process variable overshoots the set point slightly and then oscillates around the set point slightly until it stabilizes at the set point. This level of control becomes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

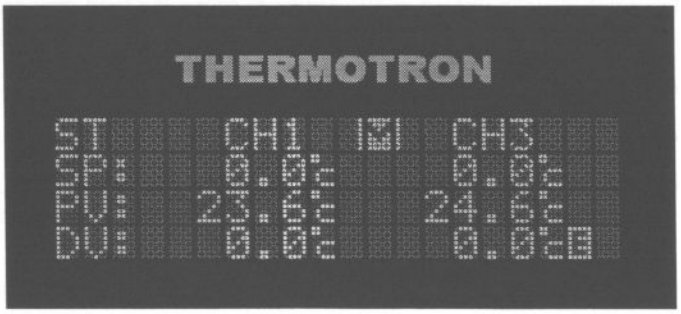


Obtain a performance baseline

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.

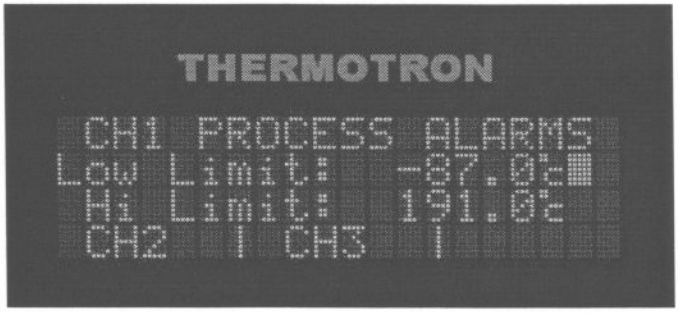
Setting Process Alarms

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**.



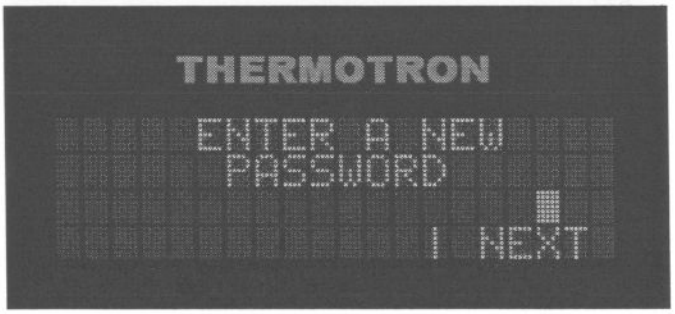
Changing the Access Level or Password

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.

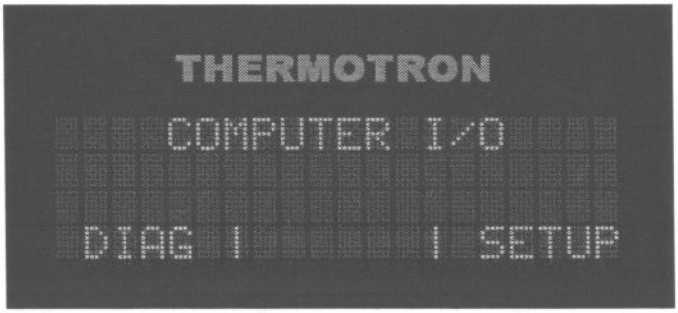
Authorized users can set the access level using a special password. Once the current password is entered, the authorized user can also select a new password.

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:

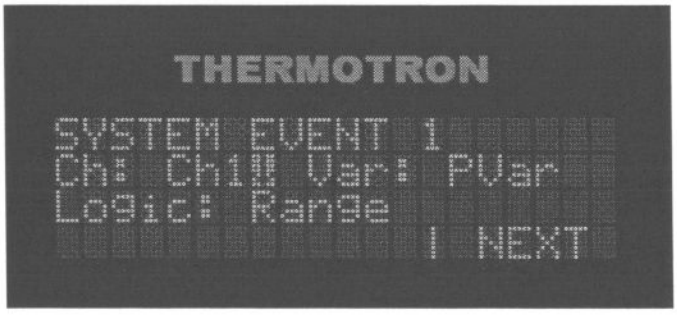
On Point ≥ Off Point		
Var ≤ Off	Off < Var < On	Var ≥ On
Deactivate	No Change	Activate
On Point < Off Point		
Var ≤ On	On < Var < Off	Var ≥ Off
Activate	No Change	Deactivate

   - **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**.

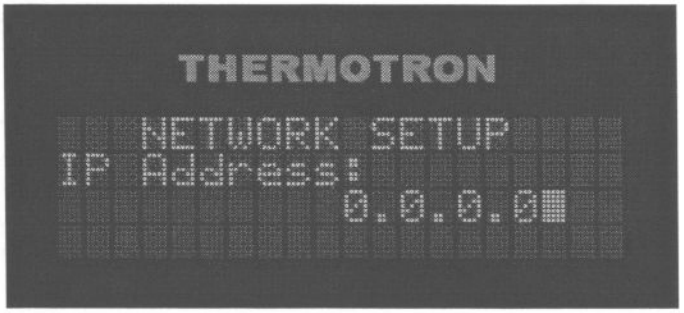


5. To change the **Low/Off** or **High/On** settings:
   a. Use the arrow keys to highlight the desired parameter.
   b. Use the alphanumeric keypad to enter a new value.
   c. To reject the new value, press **ESC**.
   d. To accept the new value, press **ENTER**.
   e. Press **ESC** to exit.

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

Viewing the Network Setup

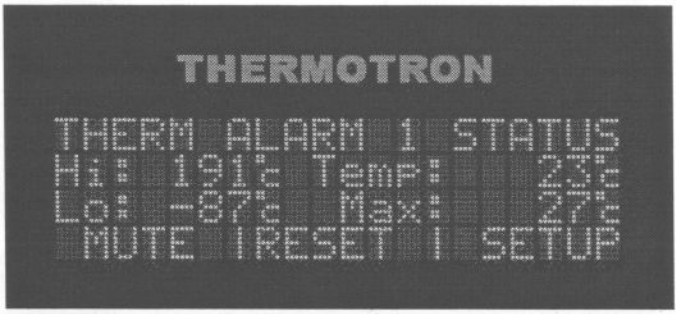
1. From the main screen, press **SETUP**, **MORE**, **MORE**, then press **NET**. The network setup screen will appear:
2. For information on network setup, refer to the *3800 Computer Interface Manual*.



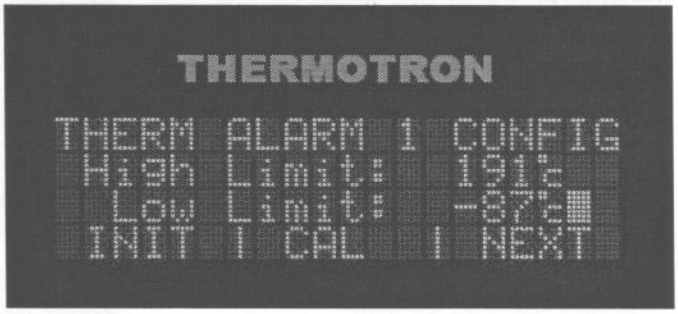
Calibrating the Therm-Alarm Input

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.

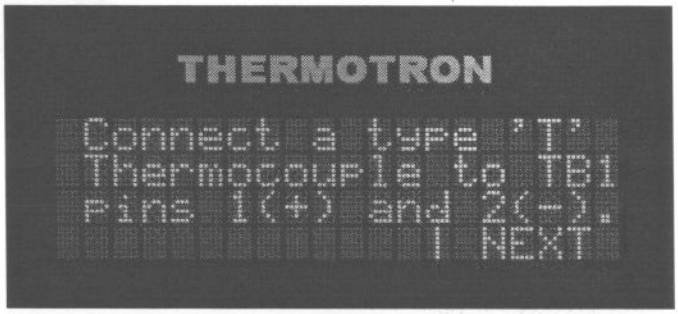
1. From the main screen, press **STATUS**, then use the left and right arrow keys to cycle through the values shown on the last line of the display until **MONITR | SERVCE | T-ALRM** appears.
2. Press **T-ALRM**. The Therm-Alarm status screen will appear:
3. Before you change any alarm limits, record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



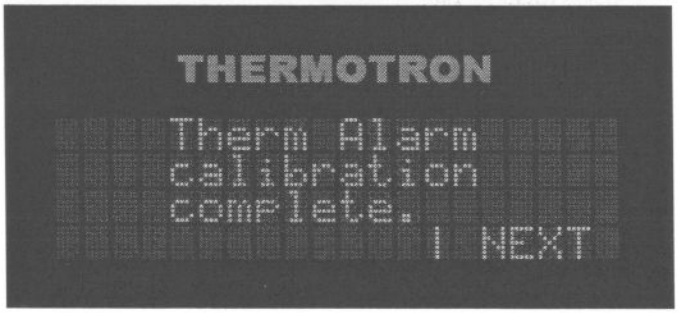
4. Press **SETUP.** The Therm-Alarm configuration screen will appear:
5. To avoid nuisance alarms, set the **High Limit** to +300°C and the **Low Limit** to -150°C as follows:
   a. Use the arrow keys to select the desired value.
   b. Use the alphanumeric keys to enter a new value.
      - To reject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

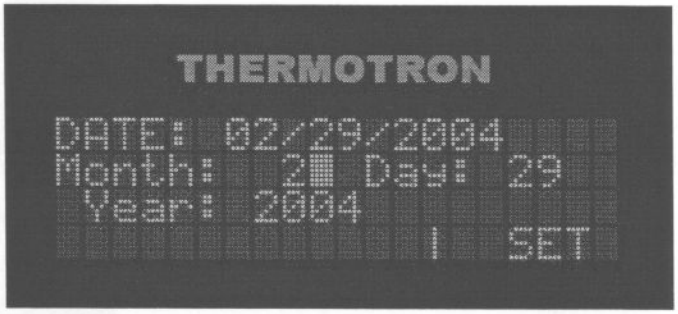
Adjusting the Real Time Clock Settings

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.



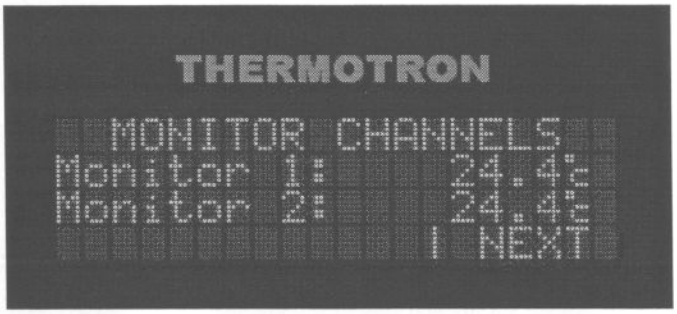
For the time, use a 24-hour clock, which displays 8:06 p.m. as 20:06.

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**.

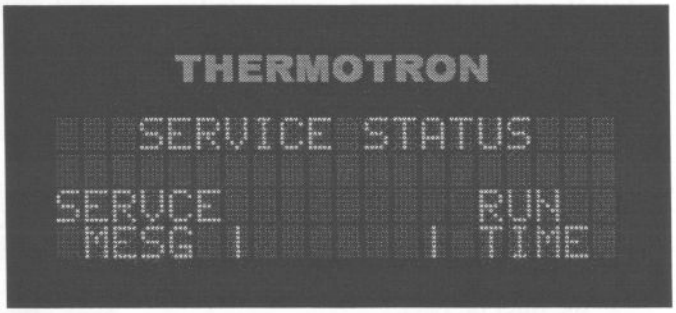


Service Status Functions

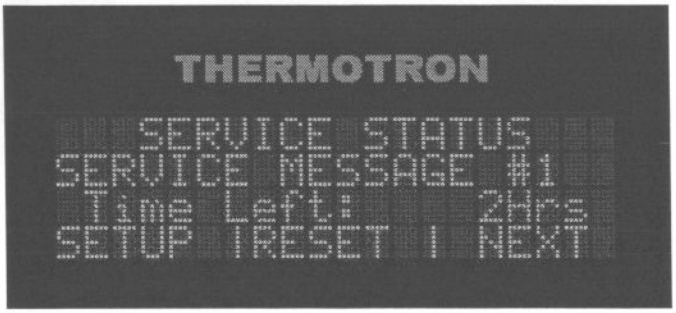
The service status functions include service messages and run times. Service messages allow you to notify yourself of certain events. Up to four service messages can be set up. Run times list how many hours each channel has run.

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 **TIME**.

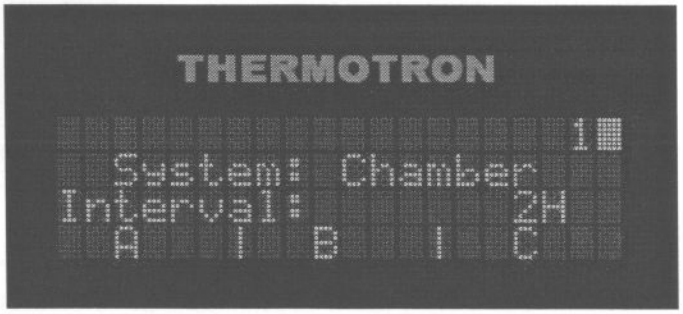


3. The first service message screen will appear:
   - To cycle through the service messages, press **NEXT**.
   - To reset the time left in a selected message's service interval, press **RESET**.
   - To set up a service message, press **SETUP** and go to step 4.



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.

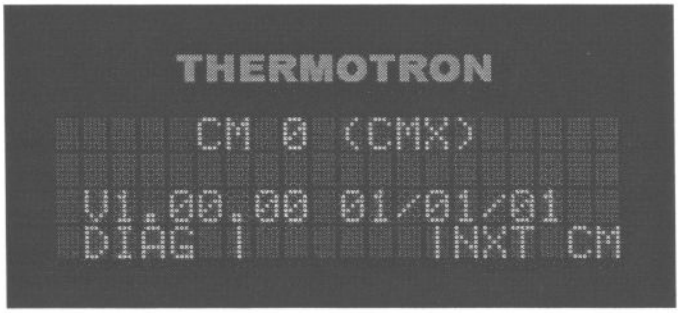
b. Use the alphanumeric keypad to enter an interval time.

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.

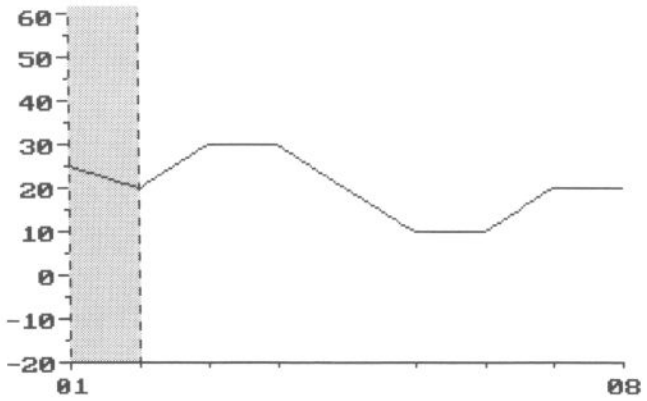
In two-channel mode the 3800 is programmed to control humidity as well as temperature. **NOTE**: Other operations, such as electronic testing of the products, are not a function of the 3800.

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.

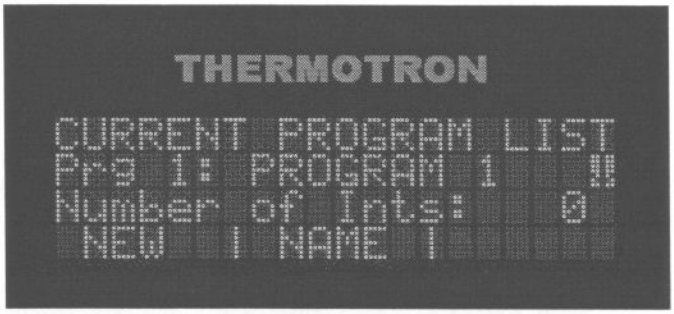
9. **Humidity** enables or disables the humidity system. The humidity system should be enabled only in the normal temperature range (0°C to +100°C).

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

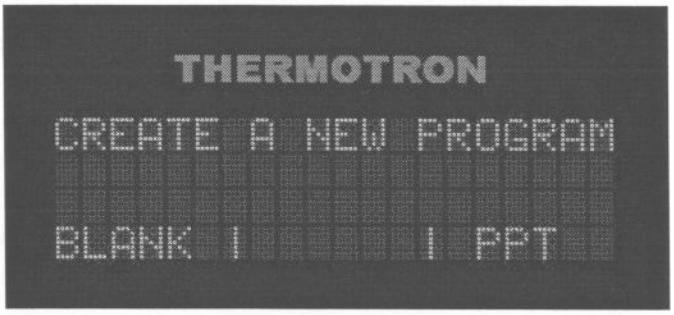
1. From the main screen, press **MN/PRG**, then press **PROG**. The current program list screen will appear:



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**.

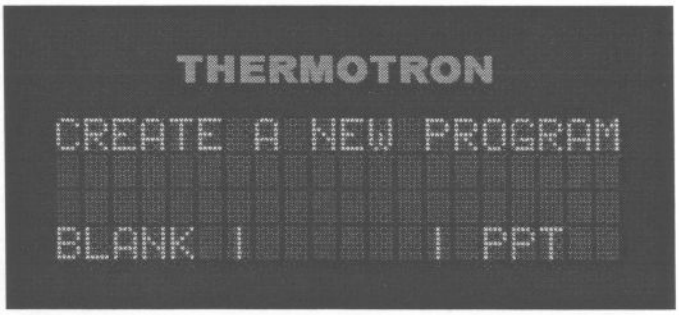
Loading a Pre-Programmed Test

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.

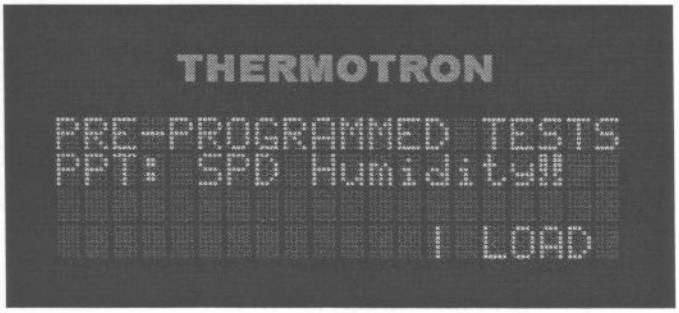
3. Press **NEW**. The create a new program screen will appear:



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.

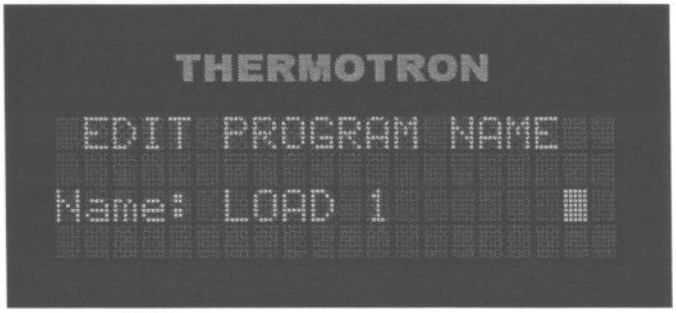
   For example, to rename the program **LOAD 1**:

   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.

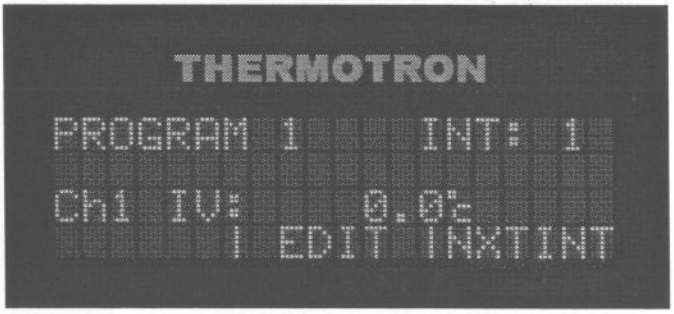


5. If you enter the wrong letter or number, press **CLR** to delete your last entry.
6. To reject the new name and restore the original name, press **ESC**.
7. To accept the new name, press **ENT**.

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:

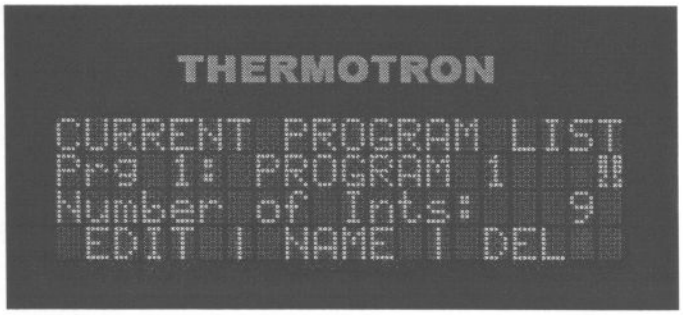


4. There are two ways to select values to view or edit for each interval. You can use the left and right arrow keys to cycle through the values, or you can use the alternate functions of the alphanumeric keys to jump directly to various groups of values. Each of the following alphanumeric keys, when 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

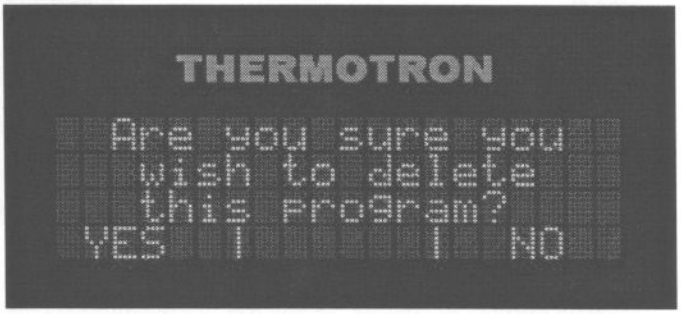
1. From the main screen, press **MN/PRG**, then press **PROG**. The current program list screen will appear:



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 high- and low-temperature alarm and protection system. The Therm-Alarm can detect undesirable temperature 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 uses a thermocouple to monitor the temperature at the products under test. If the product temperature exceeds either the high or low limit, 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. An alarm occurs if the input temperature reaches a limit temperature.

CAUTION: It is *your* responsibility to set Therm-Alarm limits appropriate for your product, and to properly place any Therm-Alarm thermocouples. 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 cut-offs. 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, and instructions for muting and resetting alarms.

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

Therm-Alarm Operating Modes

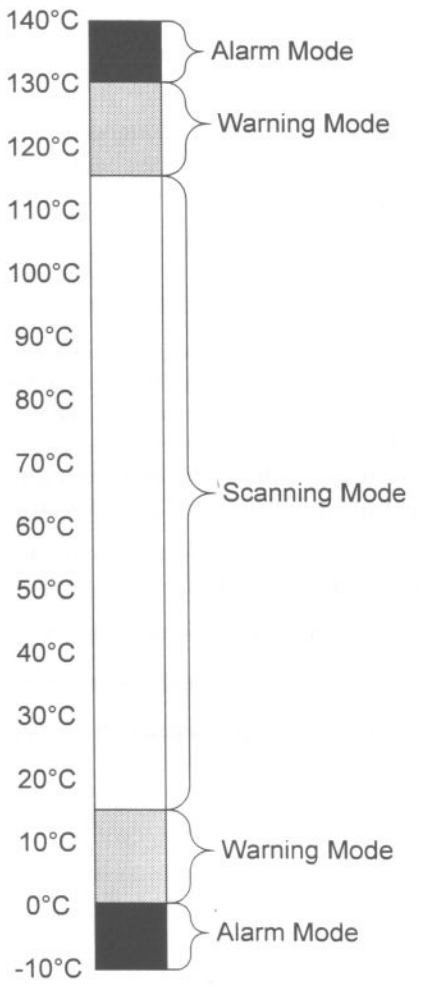
The Therm-Alarm stays in **scanning mode** as long as the input temperature is within the acceptable range between the high and low warning temperatures.

Temperature warning mode occurs when the input temperature comes within the warning temperature band of a limit temperature. (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 exceeds the high or low temperature limit by more than five degrees. (For information on setting the temperature limits, see "Changing the Therm-Alarm Settings" later in this section.) This mode also occurs if the limit temperature is exceeded by less than five degrees and the alarm delay 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 causes an alarm and then returns to an acceptable temperature, the Therm-Alarm must be reset to exit from alarm mode. For information on resetting the instrument, see "Muting or Resetting the Therm-Alarm" later in this section.

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

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



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

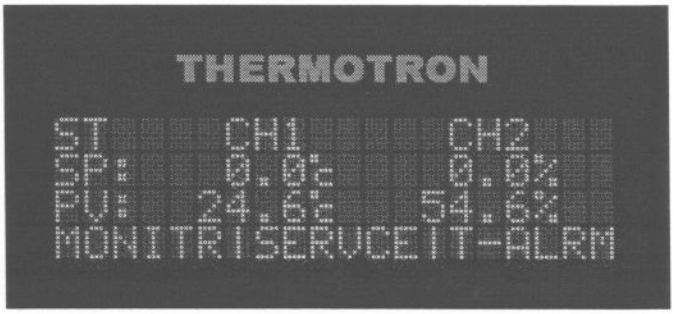
Positioning the Input Thermocouple

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

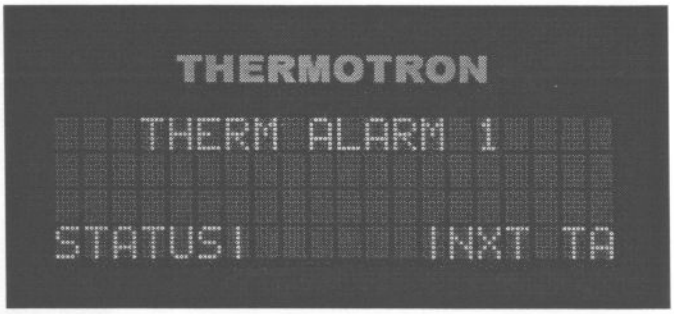
CAUTION: It is *your* responsibility to properly place any Therm-Alarm thermocouples. When used properly, the Therm-Alarm is an effective product protection device. However, it is not a fail-safe device and will not guarantee the safety of your product. If you are testing expensive products, you should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

Viewing the Therm-Alarm Status

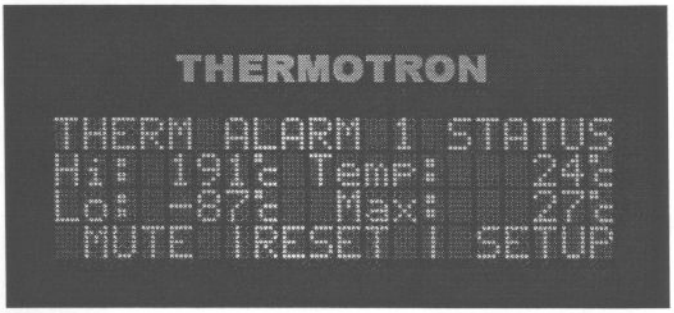
1. From the main screen, press **STATUS**, then use the arrow keys to cycle through the values shown on the last line of the display until **MONITR | SERVCE | T-ALRM** appears.



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**.

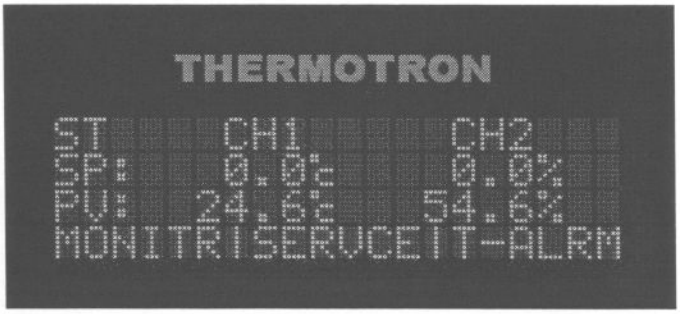


3. The Therm-Alarm status screen will appear:
   - **Hi** (high alarm limit) and **Lo** (low alarm limit) indicate the temperature limits which, if exceeded, will cause a Therm-Alarm trip. For information on editing these limits, see "Changing the Therm-Alarm Settings" later in this section.
   - **Temp** is the current temperature at the product under test as measured by the input thermocouple.
   - **Max** (maximum excursion) is the hottest or coldest temperature experienced during the most recent alarm condition.

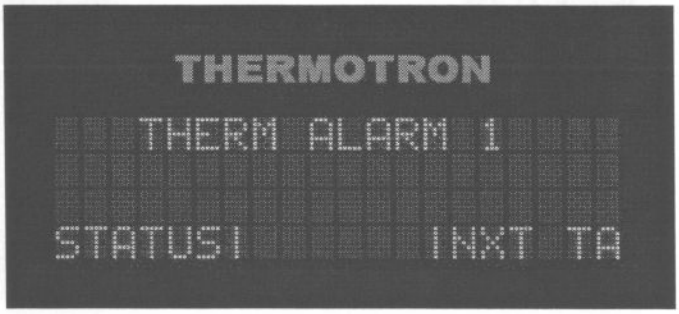


Changing the Therm-Alarm Settings

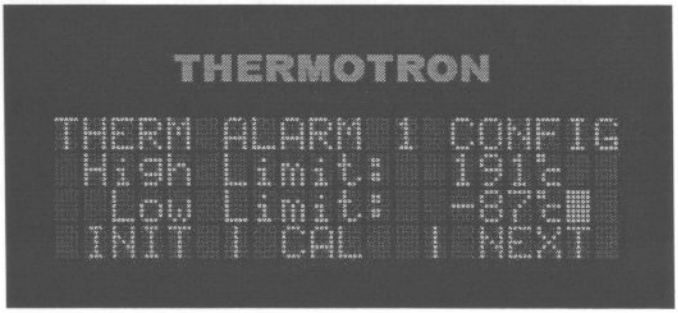
1. From the main screen, press **STATUS**, then use the arrow keys to cycle through the values shown on the last line of the display until **MONITR | SERVCE | T-ALRM** appears.



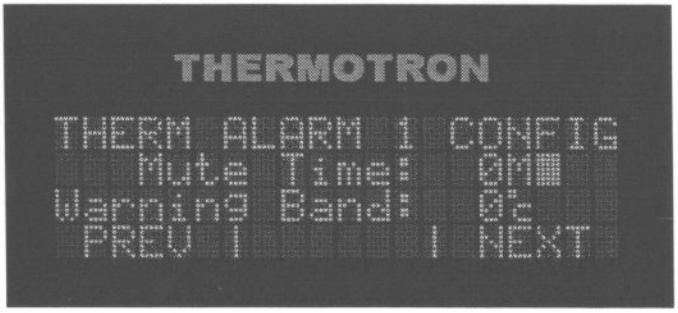
2. Press **T-ALRM**.
   - If your 3800 is equipped with one Therm-Alarm, go to step 3.
   - If your 3800 is equipped with more than one Therm-Alarm, this selection screen will appear. If needed, press **NXT TA** until the Therm-Alarm you want to change is displayed, then press **STATUS**.



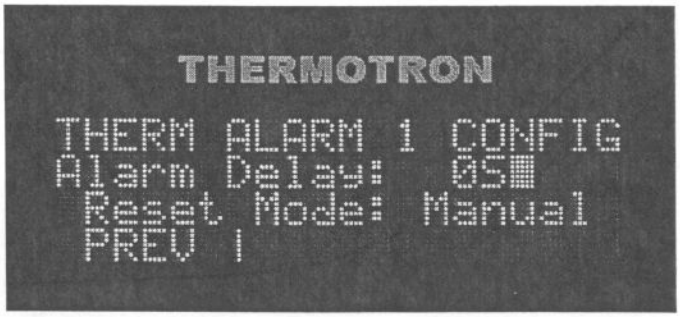
3. Press **SETUP**. The first Therm-Alarm configuration screen will appear.
   - Use the arrow and alphanumeric keys to select and edit the settings you are changing, then press **ENT**.
   - For **Reset Mode**, press **CLR** to toggle between settings.
   - Press **PREV** or **NEXT** to move back and forth between configuration screens.
4. For **High Limit** and **Low Limit**, enter the temperature 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. If you select 0 minutes, the tone will remain mute indefinitely.
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 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 temperature warning, alarm, open thermocouple, and failure modes, the Therm-Alarm will emit 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 **temperature warning mode** the Therm-Alarm resets itself after the input temperature 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 Liason. 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.

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.

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

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

throttle: The percentage of output applied by a chamber's conditioning system to reach set point. Any positive throttle is a heating demand, and any negative throttle is a cooling demand. For example, to heat the test space as quickly as possible, the 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.

THERMOTRON®

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3800 Programmer/Controller Computer Interface Manual

August 30, 2004

For additional manuals, contact Thermotron Industries:

Thermotron Industries
291 Kollen Park Drive
Holland, MI 49423, USA

Phone: (616) 392-6550
Fax: (616) 393-4549
www.Thermotron.com

All relevant issues have been considered in the preparation of this document. Should you notice an omission or any questionable item in this document, please feel free to contact the Thermotron Product Support group between at (616) 392-6550.

Regardless of the above statement(s), Thermotron Industries assumes no responsibility for any errors that may appear in this document nor for results obtained by the user as a result of using this product.

Revision Level:

A	Revised per PTS programming	08-30-04

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Section 1: Introduction

All 3800 programmer/controllers are also equipped with a standard RJ45 connector and Ethernet port. This port enables the 3800 to send and receive computer interface commands over a standard Ethernet network. You can also communicate with a host computer using the using the **optional** RS-232 or RS-485 serial communications protocol.

All 3800 programmer/controllers can also be equipped with an **optional** GPIB interface for serial communications with a host computer.

From a host computer using one of the serial communication protocols, you can:

- Operate the 3800 in manual mode, program mode, or edit from hold mode.
- Monitor environmental test chamber operation by reading the registers and parameters stored in the 3800.
- Transfer programs between the host computer and the 3800. Up to ten programs can be stored in the 3800.

CAUTION: This manual is a guide to the 3800 computer interface. It is not a substitute for adequate training. Improper use or misapplication of the information in this manual could result in damage to the host computer, 3800 programmer/controller, environmental test chamber, and/or products under test.

NOTE: References to control module 0 (CM0) in this manual refer to control module 0 in systems with only one control module and the control module connected to the display module in systems with multiple control modules.

NOTE: TCP/IP is the standard computer interface for 3800 programmer/controllers. All other interfaces are options.

Section 2: Computer Interface Setup

This section describes how to properly configure the 3800 programmer/controller's hardware and firmware for serial and GPIB communication interfaces.

NOTE: The 3800 uses a standard straight through RS-232 cable rather than the proprietary cross-over cable used by earlier Thermotron programmer/controllers.

Basic Serial Communication Protocol

The basic command protocol consists of the command and terminator:

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

The 3800 responds with the following:

<data><t>

Where:

CMND = command mnemonic
<data> = data or character string sent with command mnemonic
<t> = computer terminator, for example a carriage return **<cr>**

Multidrop Address Communication Protocol (RS-485)

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

1. Each instrument on the multidrop network must have a separate address between 1 and 127. The multidrop addressing protocol places a pound sign followed by the address number in front of each command mnemonic.
   - When the host computer transmits a command and data, each 3800 checks the first character after the pound sign. If the character matches the 3800's address, it reads the command and performs the assigned task.
   - When the 3800 sends data to the host computer, the computer reads the first character after the pound sign to determine the source of the data. It then handles the data according to its source.
2. The multidrop prefix protocol places an additional character (FF hexadecimal, shown as [FF]) in front of each command or data transmission (before the multidrop addressing protocol). The interface uses this character to eliminate communication problems that may occur as the interface bus drivers go active. The [FF] character provides these additional advantages to the interface:
   - It provides the necessary time for the receivers to become active.
   - FF hexadecimal is translated to binary and transmitted as all 1's, keeping the interface in a driven state.
   - FF hexadecimal is very unlikely to be interpreted as an ASCII pound sign (35 decimal), the first character of the addressing protocol.

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

The host computer sends:

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

The 3800 responds with:

[FF]#a<data><t>

Where:

[FF] = prefix character (FF hexadecimal)
# = ASCII pound sign (35 decimal)
a = One-byte address of the 3800 (1...127)
CMND = command mnemonic
<data> = data or character string sent with command mnemonic
<t> = computer terminator, for example a carriage return **<cr>**

Setting Up a Serial Interface

Each 3800 programmer/controller is equipped with internal circuitry that enables it to communicate with a host computer using either of the two serial communications protocols: RS-232 or RS-485.

To use the built-in circuitry, you need to connect a serial communications cable to connector J1 of control module 0 and then configure the communications parameters using the display module's keyboard. The following sections discuss the various types of serial communications protocols and how to properly configure the 3800 to use them to communicate with a host computer.

RS-232 Cable Connections

RS-232 is the 3800 programmer/controller's default serial communications protocol. To use this protocol, control module 0 uses a D-type 9-pin connector at connector J1. The cable connections are listed in the table below.

Pin	Name	Description
2	RXD	Receive line to host computer; transmit line for the 3800.
3	TXD	Transmit line from host computer; receive line for the 3800.
5	Grnd	Ground input. Connect the shield to this pin.

NOTE: If the RTS line is connected, it must remain in the inactive state for normal RS-232 operation. When this line is active, the data received on the RXD line is reflected out the TXD, preventing the 3800 from sending data on the RXD line.

NOTE: The 3800 uses a standard straight through RS-232 cable rather than the proprietary cross-over cable used by earlier Thermotron programmer/controllers.

For normal RS-232 operations, use a three-wire shielded cable with the shield carrying the ground connections. Be sure to use a full metal shell to surround the connector for maximum noise protection.

RS-485 Cable Connections

Control module 0 uses terminal block TB7 and a standard shielded RS-485 twisted pair cable for RS-485 communications. TB7 provides screw terminals where you insert the stripped wires and shield. The cable and jumper connections are listed below:

Pin	Name	Description
1,2	TX+, RX+	Jumper these terminals together, and connect the positive line to either terminal.
3,4	TX-, RX-	Jumper these terminals together, and connect the negative line to either terminal.
6	Gnd	Connect the shield to this ground terminal.

CAUTION: Pin 5 of TB7 is an unregulated +15VDC output. **DO NOT** connect any wires to it.

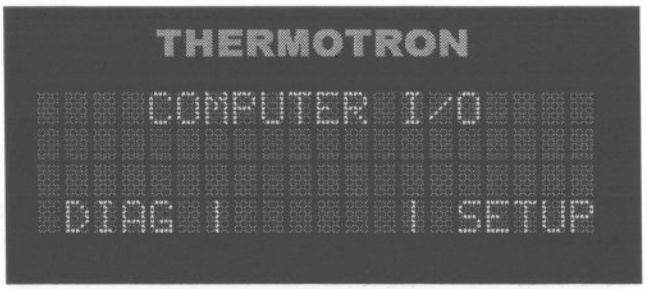
Setting Up the 3800 for Serial Communications

The following sections describe how to set up the 3800 programmer/controller for serial communications with a host computer. The default 3800 serial communication is TCP/IP. All other communication protocols are optional and **must** be purchased from Thermotron before they can be setup.

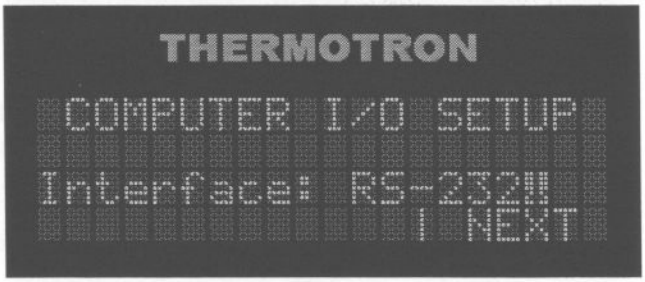
Setting Up the 3800 Firmware for the Optional RS-232 Communications (SCREEN)

The RS-232 interface allows a host computer to communicate with one 3800.

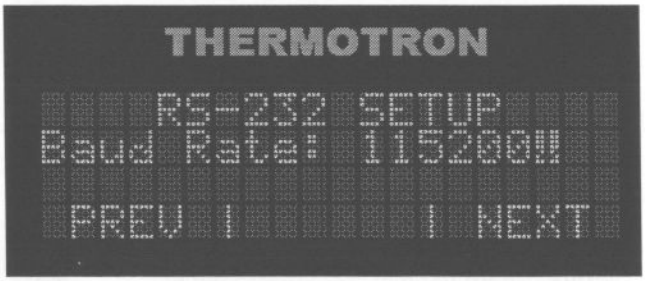
1. From the main screen, press **Setup**, **More**, **More**, **Comp I/O** and then press **Setup** to display the computer I/O Setup screens.



2. Select **RS-232** using the CLR key.
3. Press NEXT to display the setup screens.



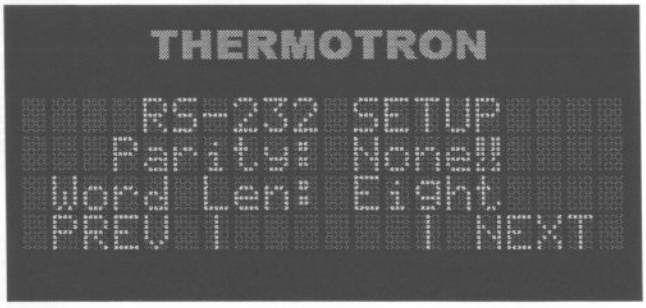
4. Use the arrow and alphanumeric keys to highlight and change the settings.
   a. Select the desired **Baud Rate** from the menu. Select the highest baud rate that the host computer's I/O card can handle.
   b. Press **Next.**



   c. Select the desired **Parity** from the menu. Select NONE to disable parity checking.
   d. Select the desired **Word Length** from the menu. For most applications, select EIGHT.

      NOTE: The 3800 programmer/controller always uses one stop bit.

   e. Press **Next.**



f. Select the desired **Send Acknowledgement** from the menu. The 3800 uses the send acknowledgment function to provide feedback to the host computer when the 3800 is ready for the next command. Without this function, the host computer could send commands too fast, causing some commands to be lost. To prevent that from happening, use either the send acknowledgment function or a time delay. Since the send acknowledgement function provides this feedback automatically, the interface will run faster and without delays.

NOTE: The **Send Acknowledgement** capability is only for use with 3800 style operation commands. DO NOT set this parameter to YES when using 28/4800 style commands.

To duplicate the functionality of the send acknowledgement parameter with 28/4800 style operation commands, concatenate a **DEC** command after all operation commands. For example, sending **L2S,25;DEC** would cause the 3800 to load the channel two set point with 25 and send back an error code to the host computer.

g. Select the desired **Terminator** from the menu.

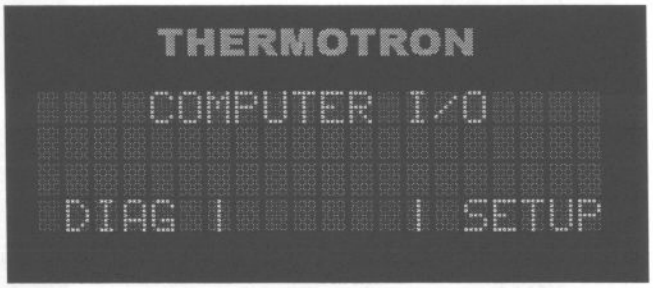
- **Last input** – The 3800 terminates its data with the terminating sequence listed below that most resembles the terminating sequence that accompanied the data it received from the host computer.
- **CR Only** – The 3800 terminates its data transmissions with a carriage return character.
- **LF Only** – The 3800 terminates its data transmissions with a line feed character.
- **CR + LF** – The 3800 terminates its transmissions with both the carriage return and line feed characters.

5. Press **ESC** repeatedly to return to the main screen.

Setting Up the 3800 Firmware for Optional RS-485 Communications

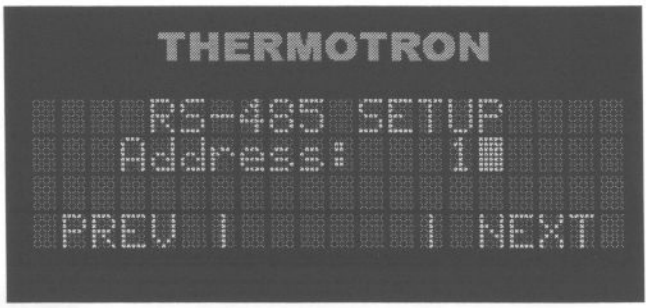
Each 3800 programmer/controller has Setup screens for RS-485 for setting up the parameters for multidrop serial communications.

1. From the main screen, press **Setup**, **More**, **More**, **Comp I/O** and then press **Setup** to display one of the computer I/O Setup screens.



2. Select **RS-485** using the CLR key.
3. Press SETUP to display the setup screens.

4. Use the arrow and alphanumeric keys to highlight and change the settings.

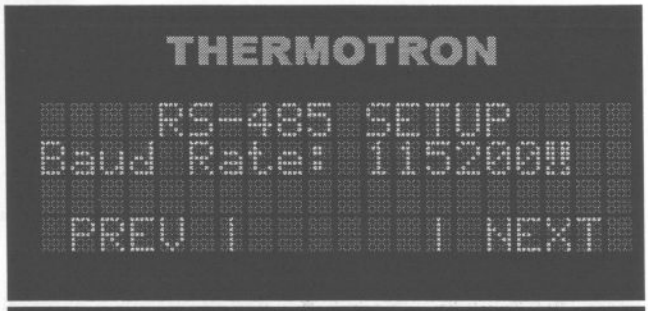


   a. Enter the desired multidrop **Address** (0 to 127). Entering 0 disables addressing.

      NOTE: Each instrument in a multidrop network **MUST** have a unique address. Additionally, avoid using address 10 or 13, because these addresses could be interpreted as carriage return or line feed terminators.

   b. Press **Next**.

   c. Select the desired **Baud Rate** from the menu. Select the highest baud rate that the host computer's I/O card can handle.

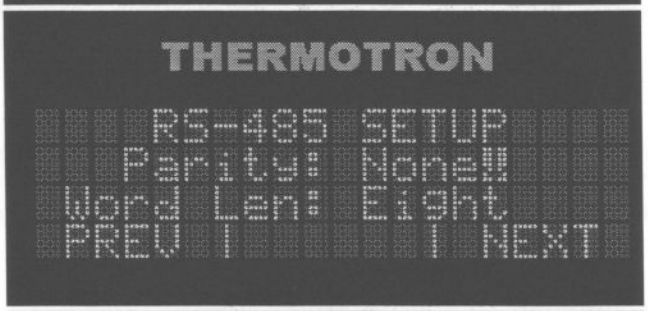


   d. Press **Next**.

   e. Select the desired **Parity** from the menu. Select NONE to disable parity checking.

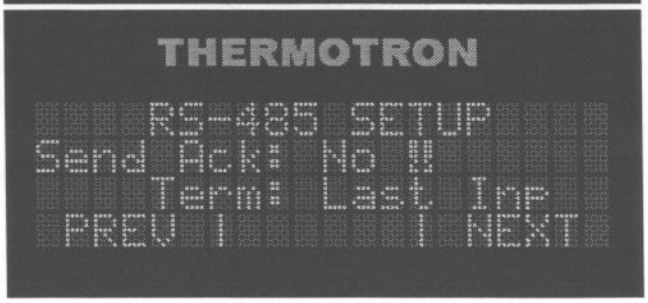
   f. Select the desired **Word Length** from the menu. For most applications, select EIGHT.

      NOTE: The 3800 programmer/ controller always uses one stop bit.



   g. Press **Next.**

   h. Select the desired **Send Acknowledgement** from the menu. The 3800 uses the send acknowledgment function to provide feedback to the host computer when the 3800 is ready for the next command. Without this function, the host computer could send commands too fast, causing some commands to be lost. To prevent that from happening, use either the send acknowledgment function or a transmit delay. Since the send acknowledgement function provides this feedback automatically, the interface will run faster and without delays.



      NOTE: The **Send Acknowledgement** capability is only for use with 3800 style operation commands. DO NOT set this parameter to YES when using 28/4800 style commands.

      To duplicate the functionality of the send acknowledgement parameter with 28/4800 style operation commands, concatenate a **DEC** command after all operation commands. For example, sending **L2S,25;DEC** would cause the 3800 to load the channel two set point with 25 and send back an error code to the host computer.

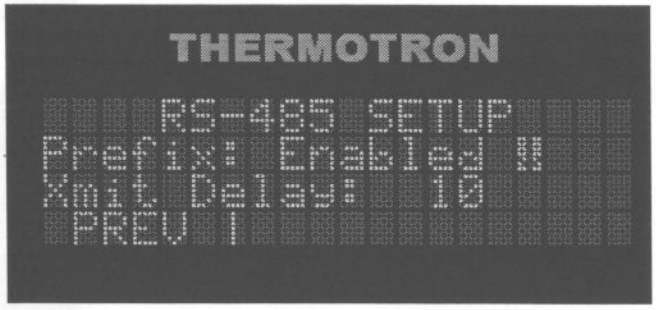
i. Select the desired **Terminator** from the menu.

- **Last input** – The 3800 terminates its data with the terminating sequence listed below that most resembles the terminating sequence that accompanied the data it received from the host computer.
- **CR Only** – The 3800 terminates its data transmissions with a carriage return character.
- **LF Only** – The 3800 terminates its data transmissions with a line feed character.
- **CR + LF** – The 3800 terminates its transmissions with both the carriage return and line feed characters.

j. Press **Next**.

k. Enable the **Prefix Protocol** for multidrop addressing. This allows the 3800 recover time to synchronize on a valid start bit.

l. Enter the desired **Xmit Delay** (0 to 127). The transmit delay is in character periods, and provides the 3800 enough time to respond to the host computer. A character period varies with the baud rate (at 19200 baud, the rate is approximately 0.5 milliseconds per character). The default value is 10 character periods.



NOTE: The host computer should provide a transmit delay time of at least one character period between receiving data from the 3800 and sending a new command to the 3800.

5. Press **ESC** repeatedly to return to the main screen.

Setting Up GPIB Communication Using the Thermotron Converter

The Thermotron GPIB converter is designed to allow the 3800 programmer/controller to communicate with a host computer using the GPIB protocol.

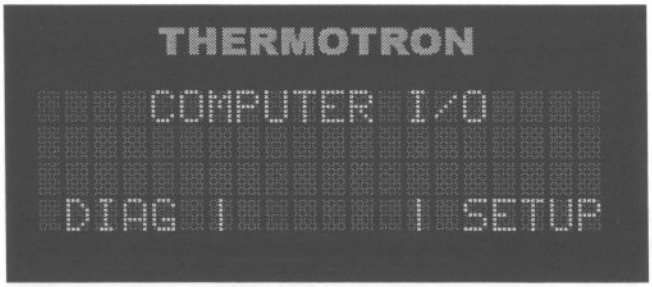
Installing the GPIB Interface

Connect the terminal block on the end of the GPIB cable to terminal block TB10 of a 3800 control module. Use a shielded 6-conductor cable, and wire both ends identically, with the shield drain wire connected to the common terminal (#6).

NOTE: This port provides an unregulated power source around 23 volts in normal conditions (120 VAC 60 Hz). This voltage will vary with varying line conditions.

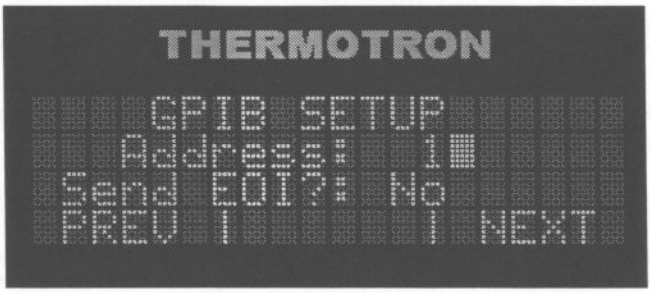
Setting Up the 3800 Firmware for Optional GPIB Communication

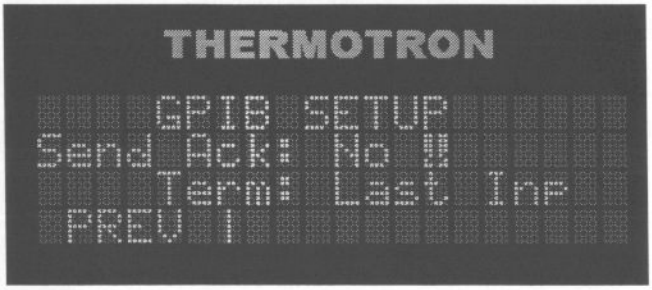
1. From the main screen, press **Setup**, **More**, **More**, **Comp I/O** and then press **Setup** to display one of the computer I/O Setup screens.



2. Select **GPIB** using the CLR key.
3. Press SETUP to display the setup screens.

4. Use the arrow and alphanumeric keys to highlight and change the settings. **NOTE:** All of the serial interface parameters required by the Thermotron GPIB converter are automatically set when the Setup GPIB screen is displayed.
   a. The **GPIB Address** field displays the unique GPIB address of the 3800 (0 to 30).
   b. The **Send EOI?** field indicates if the EOI option has been enabled.
   c. The **Send Acknowledgement** field indicates if the Send Acknowledgement option has been enabled.
   d. The **GPIB Terminator** field displays the selected output terminator.





5. Press **ESC** repeatedly to return to the main screen.

NOTE: The **Send Acknowledgement** capability is only for use with 3800 style operation commands. DO NOT set this parameter to YES when using 28/4800 style commands.

To duplicate the functionality of the send acknowledgement parameter with 28/4800 style operation commands, concatenate a **DEC** command after all operation commands. For example, sending **L2S,25;DEC** would cause the 3800 to load the channel two set point with 25 and send back an error code to the host computer.

Setting Up GPIB Communication Using a Non-Thermotron Converter

The 3800 does not support non-Thermotron GPIB converters.

Special GPIB Commands

The 3800 GPIB converter uses the same commands and syntax required by the 3800 serial communication computer interface but adds several service request commands.

Service Request (SRQ)

The 3800 GPIB converter provides service request capability to the 3800 computer interface. The 3800 can be configured to request service by asserting the GPIB SRQ line when certain events occur. The SRQ mask byte enables these events. The service request status is read using the GPIB serial poll protocol. The status and corresponding mask bits are defined as follows:

Bit 7:	Power on reset. This bit is set when the 3800 goes through a power up sequence. It is also set as a result of an **INIT** command.
Bit 6:	Reserved by GPIB.
Bit 5:	Error. This bit is set by any type of command and/or interface error.
Bit 4:	End of program. This bit is set at the end of a program, when the 3800 goes into stop mode.
Bit 3:	Match interval. This bit is set at the start of the match interval. If the match interval parameter is set to 0, then this bit is set at the start of each interval.
Bit 2:	End of interval. This bit is set at the end of each interval, either when the time left has gone to 0:00:00, or when a guaranteed soak is completed.
Bit 1:	Alarm status change. This bit is set when there has been a change in the alarm status.
Bit 0:	State change. This bit is set when there has there has been a change in the operating state.

Service Request Related Commands

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

For additional information, refer to the *Interface Command Descriptions* in Section 3.

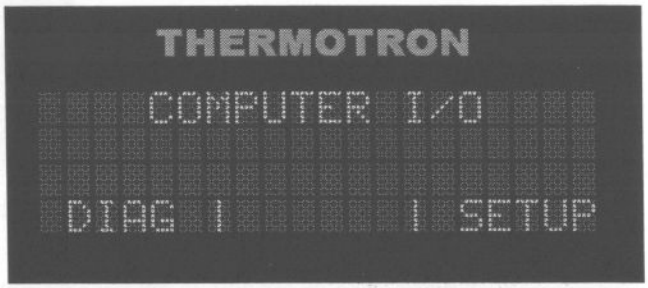
Setting Up the 3800 for TCP/IP Communications

The following sections describe how to set up the 3800 programmer/controller for TCP/IP communications with a host computer or LAN.

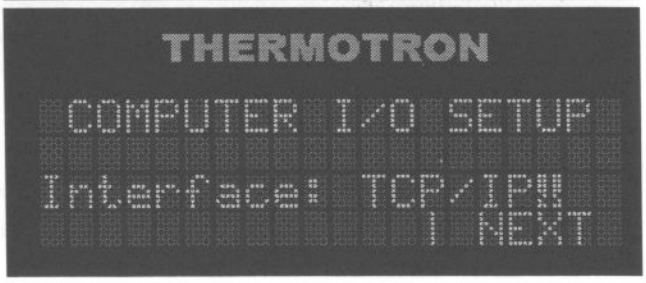
Setting Up the 3800 Firmware for TCP/IP Communications

The TCP/IP interface allows a host computer to communicate with one 3800.

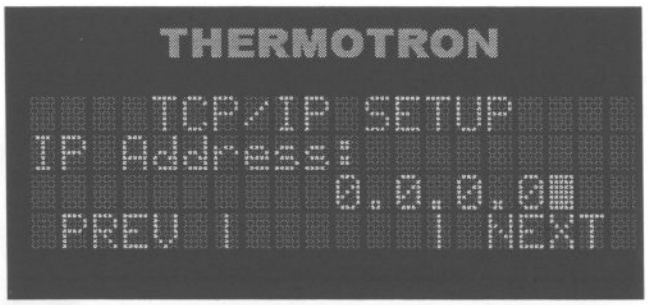
1. From the main screen, press **Setup**, **More**, **More**, **Comp I/O** and then press **Setup** to display one of the computer I/O Setup screens.



1. Select TCP/IP using the CLR key.
2. Press SETUP to display the setup screens.

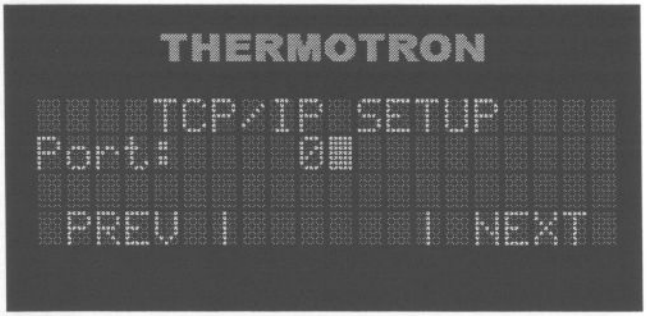


3. Use the arrow and alphanumeric keys to highlight and change the settings.



   a. Enter a valid **IP Address** for the 3800 programmer/controller.

   b. Press **Next**.



   c. Enter a valid **Port** number for the 3800 programmer/controller.

   d. Press **Next**.

   e. Select the desired **Send Acknowledgement** from the menu. The 3800 uses the send acknowledgment function to provide feedback to the host computer when the 3800 is ready for the next command. Without this function, the host computer could send commands too fast, causing some commands to be lost. To prevent that from happening, use either the send acknowledgment function or a time delay. Since the send acknowledgement function provides this feedback automatically, the interface will run faster and without delays.

   NOTE: The **Send Acknowledgement** capability is only for use with 3800 style operation commands. DO NOT set this parameter to YES when using 28/4800 style commands.

   To duplicate the functionality of the send acknowledgement parameter with 28/4800 style operation commands, concatenate a **DEC** command after all operation commands. For example, sending **L2S,25;DEC** would cause the 3800 to load the channel two set point with 25 and send back an error code to the host computer.

   f. Select the desired **Terminator** from the menu.

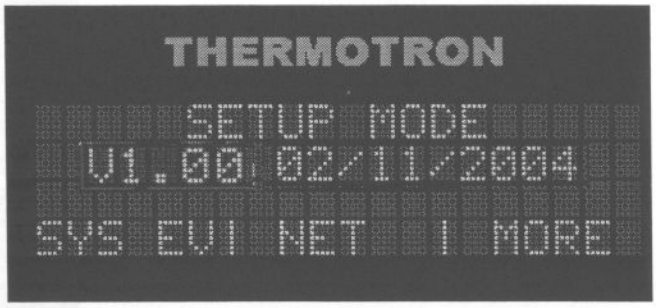
   - **Last input** – The 3800 terminates its data with the terminating sequence listed below that most resembles the terminating sequence that accompanied the data it received from the host computer.
   - **CR Only** – The 3800 terminates its data transmissions with a carriage return character.
   - **LF Only** – The 3800 terminates its data transmissions with a line feed character.
   - **CR + LF** – The 3800 terminates its transmissions with both the carriage return and line feed characters.

4. Press **ESC** repeatedly to return to the main screen.

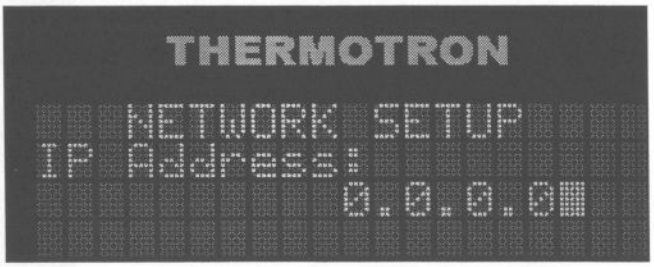
Setting Up the 3800 Firmware for Web Server Communications

The WEB interface sets the 3800 up as a web server, allowing you to view various information from the 3800 as a web page.

1. From the main screen, press **Setup**, **More**, **More**, and then press **NET** to display the Network Setup screens.



2. Use the arrow and alphanumeric keys to highlight and enter a valid IP Address for the 3800 programmer/controller.
3. Press **ESC** repeatedly to return to the main screen.

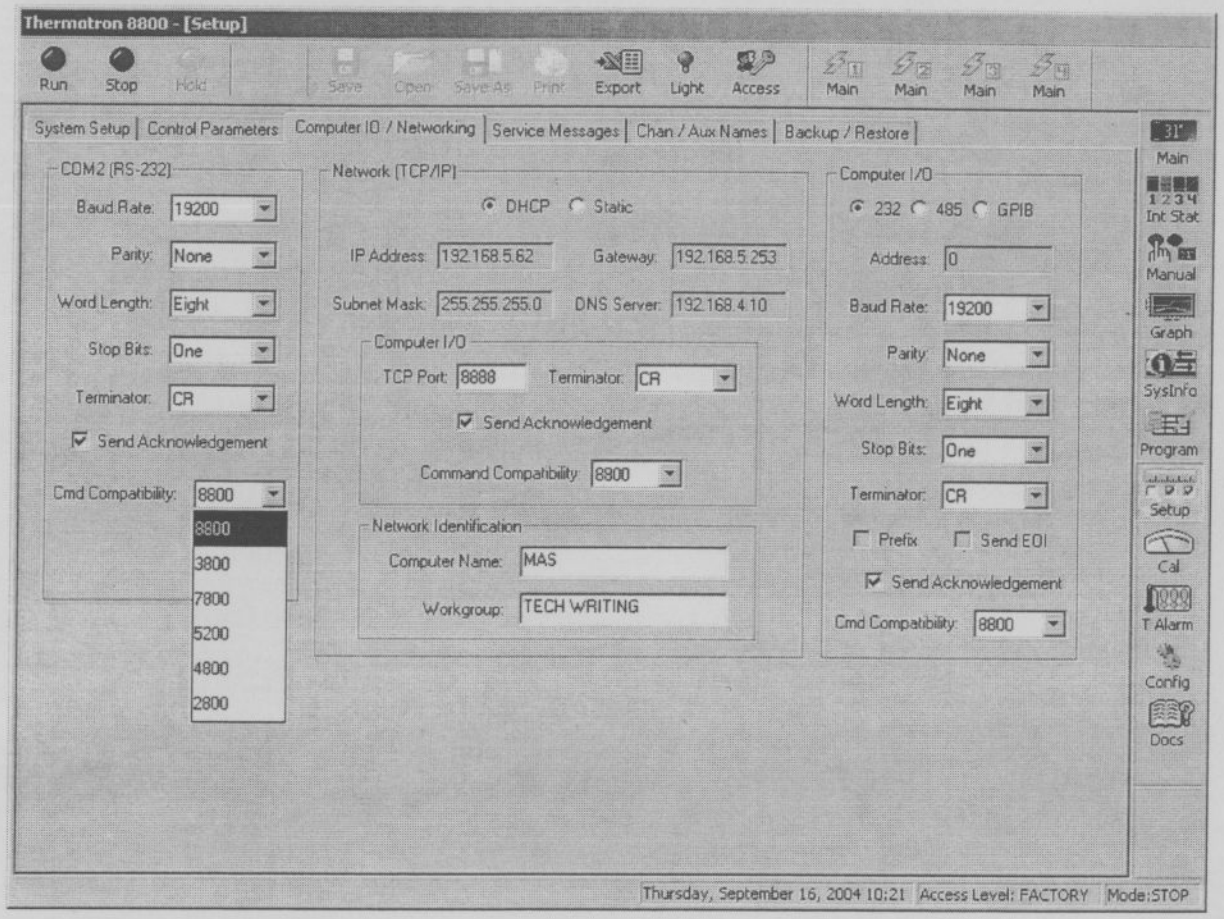


Command Compatibility Addendum

The 3800 and 8800 programmer/controllers have been enhanced to allow 100% compatibility with certain earlier Thermotron programmer/controllers. The table below shows the 3800 and 8800 programmer/controller legacy support for earlier Thermotron programmer/controllers.

Programmer/Controller	100% Legacy Support For:
3800	2800, 4800, 5200
8800	2800, 4800, 3800, 7800, 5200

8800 Computer I/O Legacy Support Setup



Select the desired compatibility mode from the computer I/O set up screen (see above).
NOTE: A different compatibility mode may be chosen for each desired protocol (Ethernet, GPIB, RS-232, etc.).

3800 Computer I/O Legacy Support

1. Press Setup→More→Computer IO→Setup and then select the desired protocol (TCP/IP, RS-232, etc).
2. Press the *Next* soft key and enter all pertinent parameters.
3. The final *Next* key displays a new screen requesting "**Cmd Compatibility**:" Press the CLR key until the desired instrument model is displayed: 2800, 4800, 5200 or 3800.

Software Versions Implemented:

3800: V1.24 (24 Aug 04)
8800: V1.22 (16 Jul 04)

Section 3: Interface Command Set

Overview

The 3800 interface command set allows you to control, operate, monitor, and program the 3800 from a host computer. The commands use a specified structure and syntax for communication. The following section describes the 3800 interface command set and gives examples of how to use this command set to operate the 3800 from a host computer.

Command Syntax

The 3800 computer interface command set provides query commands and operation commands. The command set can use a basic command as either a query command or an operation command.

Query Commands

A query command asks the 3800 to supply information to the computer about the controller's functions, readings, or status. The basic query command is a simple string with the following parts:

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

For example, if the host computer sends the **setp2?** command, and channel 2 has a set point of -82°C, the 3800 would send **-82.0** back to the host computer. For additional information, refer to the *Interface Command Descriptions* later in this section.

Operation Commands

An operation command causes the 3800 to perform an operation. Each operation command consists of the following parts:

- The root command is always four ASCII characters long (upper or lower case letters).
- If needed, the root command is followed by an ASCII numeric character that indicates a channel or group number, followed by an ASCII comma (,).
- All operation commands, except control commands, have some form of data at the end of the command string.

For example, if the host computer sends the **optn49** command, the 3800 loads the manual mode options register with the PTC, purge, and cascade options.

Another example of an operation command, if the host computer sends the **AUXE1,142** command, the 3800 would enable AUX 1-2, AUX 1-3, AUX 1-4, and AUX 1-8.

For additional information, refer to the *Interface Command Descriptions* later in this section.

Command Data Formats

The 3800 can send and receive data in the following formats:

1. **Integer Format** – The data consists of an ASCII sign character (+ or -) followed by ASCII decimal digits representing an integer number, for example an interval number or the number of loops left in an interval.
2. **Coded Integer Format** – A coded integer is a decimal integer that displays the sum of a binary-weighted code. The number of ASCII digits vary with each command type. Each bit in the original code is assigned a binary weight (1, 2, 4, 8, 16, 32, 64, 128). The integer sent is the decimal sum of the coded bits that are enabled, for example the 3800's response to an **optn?** or **auxe?** command.
3. **Decimal Format** – The data consists of an ASCII sign character (+ or -) followed by ASCII decimal digits, decimal point, and the number of digits needed for the selected resolution, for example the set point of a temperature channel.
4. **String Format** – The data consists of a string of ASCII characters. The information and format varies between commands and are defined at each command description.

Command Concatenation

You can concatenate several commands on the same line. To concatenate commands, separate them with a semicolon. The 3800 processes the concatenated commands in the order that it receives them. If you concatenate several query commands, the 3800 sends a separate response for each command.

For example: **stop;runm;pvar1?** These commands would stop the 3800, place it in run manual mode, and cause it to send the channel 1 process variable reading back to the host computer.

Functional Command Sets

The 3800 interface command set can be divided into five functional groups. The following paragraphs are brief descriptions of these functional groups.

Control Commands

The control commands tell the 3800 to perform a specific operation and/or sets its operating mode.

For example, if the host computer sends the **stop** command, the 3800 is placed in stop mode.

Program Status and Edit from Hold Commands

The program status commands allow you to query the 3800 for real-time, program specific values, while edit from hold commands allow you to run the 3800 using temporary values in edit from hold mode. Use these commands when you are running the 3800 in run program mode. For additional information, refer to the *Interface Command Descriptions* and *Using the Interface Command Set* later in this section.

For example, if the host computer sends the **intn?** command, the 3800 responds with the current interval number of the program.

Programming Commands

The programming commands allow you to write programs on your host computer, and then load them into the 3800. Additionally, they allow you to load a program from a 3800 into your computer. See *Using the Interface Command Set* later in this manual for a detailed description of how to use these commands.

NOTE: The 3800 will send any program (query command) regardless of the operating mode. If the computer is loading a program into the currently running program then an error results. Other programs may be loaded while the 3800 is running. For example, if the 3800 is running program #1 you can load program #'s 2 through 10, but loading program #1 will result in an error.

System Status Commands

All of the system status commands (except LOCK and RLTM) are query commands that allow you to read the information from the controller.

For example, if the host computer sends the **iden?** command, the 3800 responds with the type of programmer/controller (**3800 CHAMBER CONTROLLER**).

Variable Commands

Variable commands can be either query or operation commands. The variable query commands allow you to read the 3800 registers for the current variables and parameters. The variable operation commands allow you to operate the 3800 from the run manual mode only.

For example, if the host computer sends the **vrsn?** command, the 3800 responds with the software version (**V1-05 03/21/03**).

Interface Command Descriptions

The following is a list of the various interface commands including the mnemonic for the command, the type of command, a description of the command, proper syntax for the command, and a few examples of how to use the command.

ALRM

Command name: Alarm status

Command type: System status command

Description: The 3800 returns the current alarm status for the selected channel. The alarm status is a coded integer type, and is defined as follows:

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

Syntax: ALRMn?
Where n is any process variable channel (1 to 8).

Data type: Coded integer

Query command example: ALRM2?
3800 response: 0 (channel 2 low deviation alarm)

AUXE

Command name: Auxiliaries event status

Command type: Variable command; edit from hold command

Description: This query command allows you read the on and off states of the auxiliary groups (1 or 2). The operation command allows you to change the auxiliary states for run manual mode operations and/or edit from hold operations.

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

1 = AUX1
2 = AUX2
4 = AUX3
8 = AUX4
16 = AUX5
32 = AUX6
64 = AUX7
128 = AUX8

The code provides a value between 0 and 255 that adds the values of all the enabled auxiliaries in the selected group. For example, a value of 097 indicates that AUX7, AUX6, and AUX1 are on or turns these auxiliaries on.

Data type: See **Syntax**

Query command example: AUXE1?
3800 response: 148. This value indicates that AUX1-8, AUX1-5, and AUX1-3 of auxiliary group 1 are on.

Operation command example: AUXE1,59
3800 response: If 3800 is in run manual mode, AUX1-6, AUX1-5, AUX1-4, AUX1-2, and AUX1-1 of auxiliary group 1 are enabled. If they are enabled, the 3800 turns off AUX1-8, AUX1-7, and AUX1-3.

CCHR

Command name: Send process variable units character

Command type: System status command

Description: The 3800 returns the ASCII units for the character. Common ASCII unit codes are C (Celsius), F (Fahrenheit), % (percent relative humidity) and T (torr).

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

Data type: ASCII units character

Query command example: CCHR1?
3800 response: C (channel 1 is programmed in degrees Celsius)

CCNF

Command name: Send process channel configuration information

Command type: System status command

Description: The 3800 sends a single coded integer describing the channel type.

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

Syntax: CCNFn?
Where n is any process variable channel (1 to 8).

Data type: Coded integer

Query command example: CCNF2?
3800 response: 4 (linear %RH)

CHST

Command name: Channel on and configured status

Command type: System status command

Description: The 3800 sends a two-byte coded integer describing the channel on status and configuration status.

Byte 1 channel on status (Bits 0 through 7): Bits 0 through 7 indicate the on status of channels 1 through 8 respectively. The 3800 sets the bit for each channel that is on.

Byte 2 channel configured status (Bits 8 through 15): Bits 8 through 15 indicate the configured status of channels 1 through 8 respectively. The 3800 sets the bit for each channel that is configured.

Syntax: CHST?

Data type: Coded integer

Query command example: CHST?
3800 response: 769 (which is 00000011 00000001 binary). This indicates that channels 1 and 2 are configured and that channel 1 is on.

NOTE: Binary encoded strings are read right to left.

CONF

Command name: Send configured options

Command type: System status command

Description: The 3800 sends three coded-integer bytes. These are binary-weighted bytes that indicate all the system options selected at the factory for the 3800. The bytes are defined below:

Byte 1 (Bits 0 through 7):
1 = Product Temperature Control
2 = Humidity system
4 = Low humidity system
8 = -10°C dew point
16 = Purge
32 = Cascade refrigeration system
64 = Power saver mode
Bit 7 (128) is unused

Byte 3 (Bits 16 through 23):
1 = Chamber control
2 = SPD SE chamber control
4 = System Monitor functions
8 = Go to stop mode on System Monitor trips
Bits 20 through 23 are not used.

Syntax: CONF?

Data type: Three bytes of coded integers

Query command example: CONF?
3800 response: 327987 (which is 00000101,00000001,00110011 binary). This indicates that the controller is configured for PTC, humidity, purge, and cascade refrigeration, refrigeration transducers are installed, the controller is configured for chamber control, and the embedded System Monitor is enabled.

DEVN

Command name: Deviation

Command type: Variable command; edit from hold command

Description: The query command asks the 3800 for the current deviation reading from a selected channel. The 3800 sends the value in the channel's selected units. The operation command loads a deviation setting into the 3800 for the current manual mode operation, or sends a temporary deviation value during an edit from hold operation.

Syntax: DEVNn? or DEVNn,data
Where n is any control channel (1 to 4).

Data type: Decimal

Query command example: DEVN1?
3800 response: 2.3

Operation Command Example: DEVN2,5
3800 response: If the 3800 is in manual mode, it loads a deviation value of 5 units into channel 2.

FVAL

Command name: Final value

Command type: Program status command; edit from hold command

Description: This query command asks the 3800 for the current interval's final value for channel n (1 to 4). The 3800 sends a decimal value for the selected channel. The edit from hold operation command temporarily changes the current interval's final value.

Syntax: FVALn?
Where n is any control channel (1 to 4).

Data type: Decimal

Query command example: FVAL2?
3800 response: 25.0

Operation command example: FVAL1,-33
3800 response: The 3800 loads -33 as the final value for channel 1.

HOLD

Command name: Hold program or manual mode operation

Command type: Control command

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

Syntax: HOLD

Data type: No data

Query command example: HOLD
3800 response: Places the programmer/controller in hold mode.

IDEN

Command name: Send device identification

Command type: System status command

Description: The 3800 sends an ASCII character string to the host computer.

Syntax: IDEN?

Data type: ASCII character string

Query command example: IDEN?
3800 response: 3800 Chamber Controller

IERR

Command name: Send last error code

Command type: System status command

Description: The 3800 sends the code of the last error that occurred. See Section 4 of this manual for additional information about the 3800 error codes.

Syntax: IERR?

Data type: Coded integer

Query command example: IERR?
3800 response: 3. This indicates that the 3800 output buffer is full.

NOTE: The error code buffer holds the last eight errors. You can use the **IERR?** command to read the entire buffer in a first in – last out format. When the 3800 returns a error code of 0, the error buffer is empty.

INIT

Command name: Initialize controller

Command type: Control command

Description: This command initializes the 3800 programmer/controller.

Syntax: INIT

Data type: No data

NOTE: Wait three seconds after sending this command before sending any other commands.

INTN

Command name: Interval number

Command type: Program status command

Description: Queries the 3800 for the current interval number. The 3800 sends an integer to indicate the interval number.

Syntax: INTN?

Data type: Integer

Query command example: INTN?
3800 response: 10. This indicates that the 3800 is on interval 10 of the currently selected program.

INTV

Command name: Program interval command

Command type: Programming command

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

The operation command sends an interval string to initialize the program (INTV0) or one of the program intervals (INTVn).

Syntax:

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

Where:

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

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

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

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

Where:

n = Interval number

fv1 ... fv4 = Decimal values for the channel 1 through channel 4 final values

dv1 ... dv4 = Decimal values for the channel 1 through channel 4 deviations from set point

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

pgrp = Parameter group (1 to 4)

lp = Number of loops (0 to 9999)

ni = next interval (1 to 300)

ax1, ax2 = Auxiliaries enabled in each AUX group. Each value is a three-digit coded integer with the following values:

1 = AUX1
2 = AUX2
4 = AUX3
8 = AUX4
16 = AUX5
32 = AUX6
64 = AUX7
128 = AUX8

NOTE: The 3800 only has one parameter group, but 'pgrp' can be set to a value between 1 and 4 allowing for command compatibility with other Thermotron controllers.

display status byte = Byte that sets up the program channels and display for the operations being performed. It allows you to set up each interval to run different channels and program functions. It assigns the following weighting values to the program functions and displays:

1 = Looping
2 = Auxiliaries
4 = Deviations
8 = Unassigned
16 = Channel 1
32 = Channel 2
64 = Channel 3
128 = Channel 4

When you use the display status byte, make sure you program all the functions on that you are programming in the string. As an option, you can send a 7 in the lower byte to display all three functions.

options = The options byte for the program (0 to 255). This byte turns the options on or off. You must turn on the option in order to use its programmed values. For example, to use PTC, you must program the PTC channel and turn the PTC option on. This byte assigns the following weighting values to the options:

1 = Product Temperature Control
2 = Humidity system
4 = Not used
8 = GSoak
16 = Not used
32 = Not used
64 = Not used
128 = Refrigeration ON/OFF

NOTE: NEVER assign a PTC channel with a humidity channel.

Data type: Coded integer

Query command example 1: INTV0?

3800 response: 30.0, 50.0, 0.0, 0.0,2 (channel 1 is set to +30 units and channel 2 is set to +50 units; channels 1 and 2 are active.)

Query command example 2: INTV22?

3800 response: 52,-67,,,3,10,,,1:10:00,3,5,18,14,26,55,9

Interval 22 is programmed as follows:

Final values: channel 1 = -52 units; channel 2 = -67 units

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

Time: 1 hour, 10 minutes

Parameter group: 3

Number of loops: 5

Next interval: 18

Auxiliaries enabled: AUX1-2, AUX1-3, AUX1-4, AUX2-2, AUX2-4, and AUX2-5

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

Options enabled: PTC and GSoak

NOTE: The commas are left in any unused parameter locations to maintain the proper parameter positions in the string.

NOTE: The 3800 only has one parameter group, but 'g' can be set to a value between 1 and 4 allowing for command compatibility with other Thermotron controllers.

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

3800 response: The 3800 loads the program with a channel 1 initial value of -10 units, a channel 2 value of 20 units, and sets channels 1 and 2 as active.

Operation command example 2: INTV35,75,98,,,,5,8,,,0:20:00,1,20,15,3,1,55,130

3800 Response: The 3800 loads the following values into interval 35:

Final values: channel 1 = 75 units; channel 2 = 98 units

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

Time: 20 minutes

Parameter group: 1

Number of loops: 20

Next interval: 15

Auxiliaries enabled: AUX1-1, AUX1-2, AUX2-1

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

Options enabled: humidity and refrigeration ON

NOTE: The 3800 only has one parameter group, but 'g' can be set to a value between 1 and 4 allowing for command compatibility with other Thermotron controllers.

ITIM

Command name: Send interval time

Command type: Program status command

Description: Queries the 3800 for the programmed time for the current interval.

Syntax: ITIM?

Data type: String

Query command example: ITIM?

3800 response: 0:10:30. This indicates that the current interval is 10½ minutes long.

IVAL

Command name: Send initial value

Command type: System status command

Description: Queries the 3800 for the current interval's initial value parameter for channel n (1 to 4). The 3800 sends a decimal value for the selected channel.

Syntax: IVALn?

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

Data type: Decimal

Query command example: IVAL3?

3800 response: 25.00

LLFT

Command name: Send program loops left

Command type: Program status command; edit from hold command

Description: The query command asks the 3800 for the number of loops left to be executed for the current loop. On nested looping, the value is for the inside loop. The 3800 sends an integer to indicate the number of loops left. The edit from hold operation command temporarily changes the current interval's loop counter.

Syntax: LLFT? or LLFTn
Where n is the number of loops.

Data type: Integer

Query command example: LLFT?
3800 response: 8

Operation command example: LLFT15
3800 response: Changes the loops left counter to 15.

LOCK

Command name: Lock status

Command type: System status command

Description: This is the only system status command that allows you to change the 3800's status. It allows you to read and change the access level of the 3800. Refer to the 3800 Operator manual for additional information on access levels.

Syntax: LOCK? or LOCKn
Where n indicates access level (0 to 5):

0 = Locked
1 = User Level 1
2 = User Level 2
3 = Programmer
4 = Lab Manager
5 = Cal Lab

Data type: Coded integer

Query command example: LOCK?
3800 response: 3. This indicated that the 3800 is set to access level 3 (programmer).

Operation command example: LOCK0
3800 response: This command locks out all user access to the 3800 functions at the keyboard.

MINT

Command name: Send or load match interval

Command type: System status command

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

Syntax: MINT? or MINTdata

Data type: Integer (range 0 to 300)

Query command example: MINT?
3800 response: 14. A service request interrupt will occur at the start of interval 14 when running a program.

Operation command example: MINT3
3800 response: The 3800 loads the match interval parameter with a value of 3.

MRMP

Command name: Manual ramp

Command type: Variable command

Description: This is a manual mode command. The query command reads the manual ramp setting for the selected channel in units per minute. The units are in the scale selected at the 3800 (such as °C, °F, torr, %RH, etc.).

Syntax: MRMPn? or MRMPn,data
Where n is any control channel (1 to 4) and data is the manual ramp rate.

Data type: Integer

Query command example: MRMP2?
3800 response: 30. This indicates the manual ramp for channel 2 is 30 units per minute.

Operation command example: MRMP1,12
3800 response: This sets the manual ramp for channel 1 to 12 units per minute

NUML

Command name: Send number of loops

Command type: Program status command

Description: Queries the 3800 for the programmed number of loops assigned to the current loop. For nested looping, the value is for the inside loop. The 3800 sends an integer indicating the number of loops assigned to the current loop.

Syntax: NUML?

Data type: Integer

Query command example: NUML?
3800 response: 15

NXTI

Command name: Next interval

Command type: Program status command

Description: Queries the 3800 for the next interval that will be executed. The 3800 sends an integer indicating the next interval number.

Syntax: NXTI?

Data type: Integer

Query command example: NXTI?
3800 response: 5

OPTN

Command name: Controller options

Command type: Variable command

Description: The query command reads the options register of the 3800. If the 3800 is in manual mode, the operation command temporarily changes the 3800 options register to the new set of options.
NOTE: If the selected options are not available on your chamber, the 3800 will return an error code.

Syntax: OPTN? or OPTN[,]ddd

Where ddd is a three-digit coded integer where each option has the following weight:

1 = Product Temperature Control
2 = Humidity system
4 = Not used
8 = Not used
16 = Not used
32 = Not used
64 = Not used
128 = Refrigeration ON/OFF

The code provides a value between 0 and 255 that is the sum of the values of all the enabled options. For example, a 49 indicates that the cascade refrigeration system, purge, and Product Temperature Control options are enabled.

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

Query command example: OPTN?
3800 response: 130. This indicates that the single-stage refrigeration and humidity options are enabled.

Operation command example: OPTN50
3800 response: 0. This command sets the 3800 manual mode options to enable humidity, purge, and cascade refrigeration.

PARM

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

Command name: Parameter values command

Command type: Variable command

Description: The query command causes the 3800 to send the values of the tuning parameters for the selected channel in the selected parameter group. The operation command sends new parameter values for a selected channel of a selected parameter group. The 3800 loads the parameter values into the parameter group registers in any mode.

Syntax:

Query command syntax: PARMc, g?

Where:

c = Control channel number (1-4)
g = Parameter group number (1)

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

Where:

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

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

Where:

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

NOTE: The 3800 only has one parameter group, but 'g' can be set to a value between 1 and 4 allowing for command compatibility with other Thermotron controllers.

Data type: Integer

Query command example: PARM2,3?

3800 response: 35.0,35.0,200,200,100.0,-100.0. These values are the parameter settings for channel 2 in parameter group 3.

Operation command example:

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

With channel 4 in PTC mode, send the following command to set the channel 4 group 1 heat gain to 0.8, cool integral time to 128 seconds, and cool offset to 12.0: PARM4,1,0.8,,,128,,12

PMEM

Command name: Send available program memory

Command type: System status command

Description: Queries the 3800 for the available amount of program memory. The 3800 sends the number of unused intervals remaining in program memory (0 to 300). If a program exceeds the amount of program memory remaining, the 3800 will return an error code.

Syntax: PMEM?

Data type: Integer

Query command example: PMEM?
3800 response: 126. This indicates that there is space in the 3800's program memory for up to 126 additional intervals.

PNAM

Command name: Send program name

Command type: Program status command

Description: Queries the 3800 for the name of the currently loaded program. The 3800 responds with the program's assigned name (a string up to 15 characters long).

Syntax: PNAM?

Data type: String

Query command example: PNAM?
3800 response: STRESS SCREEN40

PRGN

Command name: Current program number

Command type: System status command

Description: Queries the 3800 for the number of the currently loaded program. (0 to 10 where 0 indicates that no program is currently loaded).

Syntax: PRGN?

Data type: Integer

Query command example: PRGN?
3800 response: 7. This indicates that the current program is loaded into program slot 7.

PROG

Command name: Program by value command

Command type: Programming command

Description: This command sets up the 3800 or host computer to load an entire program into the 3800's program memory. The query command receives the data string from the 3800, while the operation command sends the data string to the 3800. For additional information, refer to *Using the Interface Command Set* later in this section.

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

The operation command sets up where the program will be loaded, the name of the program, and the number of intervals in the program.

Syntax: PROGn? or PROGn, name, number of intervals

Where:

n = program number (1 to 10).

name = program name (up to 15 characters)

number of intervals = integer (1 to 300)

Data type: See **Syntax**

Query command example: PROG3?

3800 response: LO COOL,14 This indicates that program 3 is named LO COOL and is 14 intervals long.

Operation command example: PROG4,HI HUMIDITY,25

3800 response: 0. The 3800 will load a 25-interval program into the program number 4 location and name the program HI HUMIDITY.

PVAR

Command name: Send process variable

Command type: Variable command

Description: Queries the 3800 for the current value of the selected channel. The channel selections for the PVAR command are divided up as follows:

Channel n	3800 Channels
1 through 4	External PV channels 1 through 4
5 through 8	Internal PV channels 5 through 8
9 through 16	Monitor channels 1 through 8

NOTE: The 3800 only have three process variable channels (1-3).

Syntax: PVARn?

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

Data type: Decimal

Query command example: PVAR1?

3800 response: -42.3

RESM

Command name: Resume program or manual mode operation

Command type: Control command

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

Syntax: RESM

Data type: No data

Query command example: RESM
3800 response: This command returns the processor to run mode.

RLTM

Command name: Read or load real time clock

Command type: System status command

Description: The query command tells the 3800 to return the date and time reading from its real time clock. The operation command loads new values into the real time clock, and resets the seconds to 00.

Syntax: RLTM? or RLTMmn,dd,hh,mm
Where mn is month, dd is day, hh is hour, and mm is minute.

Data type: String

Query command example: RLTM?
3800 response: 3/11 14:32:45. This indicates that the date is March 11 and the time is 2:32pm.

Operation command example: RLTM3,11,14,32
3800 response: This command loads the date and time of March 11, 2:32pm into the 3800.

RUNM

Command name: Run manual mode

Command type: Control command

Description: Places a stopped 3800 in run manual mode.

Syntax: RUNM

Data type: No data

Query command example: RUNM
3800 response: Places a stopped 3800 in run manual mode.

RUNP

Command name: Run program mode

Command type: Control command

Description: Places a stopped 3800 in run program mode, and specifies the program and starting interval.

Syntax: RUNPp,i[,S]

Where:

p = Program number (1 to 10)
i = Interval number
S = Single-step mode places the program in hold program mode at the end of each interval. Send the RESM command to continue executing the program.

Data type: See **Syntax**

Operation command example: RUNP3,5,S
3800 response: Runs program 3, starting at interval 5, in single-step mode.

SCOD

Command name: Send stop code

Command type: System status command

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

0	Cold boot power up. The 3800 memory has been initialized.
1	Currently running. Not in stop.
2	Stop key pressed.
3	End of test.
4	External input. An input defined as STOP has been activated.
5	Computer I/O. The 3800 received the STOP command.
6	Open input. A thermocouple or analog input is OPEN.
7	Process alarm. A process alarm setting has been exceeded.
8	System Monitor trip.
9	Power fail recovery. The selected power fail recover mode was STOP.
10	Therm-Alarm® trip.

Syntax: SCOD?

Data type: Integer

Query command example: SCOD?
3800 response: 3. Indicates that the currently loaded test has ended.

SETP

Command name: Set point

Command type: Variable command

Description: The query command asks the 3800 for the current set point reading from channel "n". The 3800 sends the set point value in the channel's selected units. In manual mode, the operation command loads a new set point into the 3800 for the current operation.

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

Data type: Decimal

Query command example: SETP1?
3800 response: -33.0

Operation command example: SETP2,95
3800 response: If the 3800 is in manual mode, a set point of 95 units is loaded into channel 2.

SRQB

Command name: Service request status

Command type: System status command

Description: The 3800 returns the same data that a GPIB serial poll would return. The events, which set the associated bits in the response data, must be enabled in the SRQ mask and are loaded using the SRQM command. The bits are defined as follows:

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

Syntax: SRQB?

Data type: Coded integer

Query command example: SRQB?
3800 response: 65 This is 1000001 in binary which indicates RSV + state change.

SRQM

Command name: Send or load the service request event mask byte

Command type: System status command

Description: This byte enables the various events for requesting service via the GPIB SRQ line. The coded integer data represents the enabled events using the definitions given in the SRQB description.

Syntax: SRQM? or SRQMdata

Data type: Coded integer (range is 0 to 255)

Query command example: SQRM?
3800 response: 4. The **End of Interval** service request bit has been enabled.

Query command example: SRQM1
3800 response: 0. The 3800 loads the SRQ mask with the value 1 (enable the state change SRQ event).

STAT

Command name: Send status word

Command type: System status command

Description: The 3800 returns one byte of coded-decimal data to indicate the status of the 3800. The byte is defined below:

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

Syntax: STAT?

Data type: Coded decimal

Query command example: STAT?
3800 response: 16. This indicates that the 3800 is in run manual mode.

STOP

Command name: Stop controller

Command type: Control command

Description: Places the 3800 in stop mode.

Syntax: STOP

Data type: No data

Query command example: STOP
3800 response: The 3800 goes into stop mode.

THTL

Command name: Throttle

Command type: Variable command

Description: The query command asks the 3800 for the current channel "n" throttle reading. The 3800 sends the throttle value as a percentage.

Syntax: THTLn
Where n is any process variable channel (1 to 8).

Data type: Integer (-100 to +100)

Query command example: THTL1?
3800 response: -56

NOTE: Do not use the THTL command as an operation command. Using the THTL as an operation command overwrites 3800 internal control functions.

TLFT

Command name: Time left

Command type: Program status command; edit from hold command

Description: Queries the 3800 for the time left in the current interval. The edit from hold operation command temporarily changes the current interval's time left counter.

Syntax: TLFT? or TLFThh:mm:ss
Where hh is hours, mm is minutes, and ss is seconds.

Data type: String

Query command example: TLFT?
3800 response: 1:17:57. This indicates that there is 1 hour, 17 minutes, and 57 seconds left in the current interval.

Operation command example: TLFT::85
3800 response: This command sets the time left in the current interval to 1 minute and 25 seconds.

TMPS

Command name: Temperature scale

Command type: Variable command

Description: Allows you to read or change the temperature scale used on the 3800 display.
NOTE: This command does not affect the 3800 interface commands.

Syntax: TMPS?

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

Query command example: TMPS?
3800 response: 0

Query command example: TMPS1
3800 response: The 3800 sets the temperature scale to Fahrenheit.

VRSN

Command name: Send software version

Command type: System status command

Description: Queries the 3800 for the version number of the display software.

Syntax: VRSN?

Data type: String
The 3800 returns a string in the "Vx.yy.zz DD Mmm YY" format to identify its software version.

Query command example: VRSN?
3800 response: V1-11-05 5 Dec 01

Using the Interface Command Set

The following section describes how to operate the 3800 programmer/controller from a host computer using the interface command set.

Using the Manual Mode Variable Commands and Control Commands

The 3800 can be operated in manual mode from a host computer using the following interface set commands:

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

Example:

1. Send the STOP command to the 3800. While in stop mode, send the following manual commands to set up the first test run:

setp1,75	Makes the channel 1 set point +75°C
setp2,5	Makes the channel 2 set point 5%RH
runm	Places the 3800 in manual mode
mrmp1,5	Makes the channel 1 manual ramp rate 5C° per minute
mrmp2,3	Makes the channel 2 manual ramp rate 3% RH per minute
auxe1,25	Turns on AUX1-1, AUX1-4, and AUX1-5
optn54	Selects the following options: cascade refrigeration, purge, humidity, and low humidity.

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

2. Send the RUNM command to place the 3800 in run manual mode. The screen will now display the selected parameters as the 3800 operates the chamber control systems.

3. As the chamber runs, manual mode commands can be sent as needed to change parameter values. Additionally, variable and chamber status commands can be used to monitor the chamber variables and the 3800 status.

4. At the end of the test, send the STOP command to place the 3800 in stop mode.

Using the Edit from Hold Commands

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

Use the following commands to change any temporary values:

AUXE	Auxiliary enable
DEVN	Deviation
FVAL	Final value
LLFT	Loops left
TLFT	Time left

Example:

1. Send the HOLD command to the 3800. While in hold program mode, send the following commands to temporarily change the interval values:

fval1,125	Changes the channel 1 final value to +125°.
devn1,3	Changes the channel 1 deviation to ±3°.
tlft0:22:30	Changes the time left counter to 22 minutes and 30 seconds.
llft5	Changes the loops left counter to 5 loops left.

2. Send the RESM command to resume the program.

   The 3800 runs the rest of the interval using the temporary values entered above. When the program runs the interval again, it will use the programmed values for that interval rather than the edited intervals. The only edited value that remains is the loops left value. This value will reset to the original programmed value once it counts down and resets.

Using the Programming Commands

The program by value and send interval values commands allow you to transfer programs between the 3800 and a host computer:

- The operation commands allow you to send a program to the 3800.
- The query commands allow you to retrieve a program from the 3800.

The following paragraphs describe each type of transfer and provide a program transfer example.

Sample Profile

LongSoak25Loops										
int #	fv1	dv1	ax1	ax2	hh:mm:ss	loop to (next int)	# of loops	PTC	Hum	GSoak
1	20		-2-4--78	-2-4—7-	2:00:00	1	0	No	No	No
2	30	2	-2-4--78	--------	0:00:00	2	0	No	No	Yes
3	30	3	--------	--------	2:00:00	3	0	No	No	Yes
4	65		1-3—6--	12------	1:10:00	4	0	No	No	No
5	65	3	1-3—6--	12------	8:00:00	5	0	No	No	Yes
6	30	2	--------	--------	0:00:00	3	25	No	No	Yes

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

Interval 1: Ramps to 20°C in 2 hours, turns on auxiliary relays 1-2, 1-4, 1-7, 1-8, 2-2, 2-4, and 2-7. PTC, humidity, and GSoak are not enabled.

Interval 2: Steps to +30°C, waits until the temperature is within ±2° C of the set point, turns auxiliary relays 2-2, 2-4 and 2-7 off. PTC and humidity are not enabled. GSoak is enabled.

Interval 3: Soaks at +30°C for 2 hours, the deviation alarm is set off if the temperature deviates more than ±3°C from the set point, turns off all auxiliary relays. PTC and humidity are not enabled. GSoak is enabled.

Interval 4: Ramps to +65°C in 1 hour and 10 minutes, turns on auxiliary relays 1-1, 1-3, 1-6, 2-1 and 2-2. PTC, humidity, and GSoak are not enabled.

NOTE: Press the Hold key to move from hours to minutes to seconds.

Interval 5: Soaks at +65°C for 8 hours, the deviation alarm is set off if the temperature deviates more than ±3°C from the set point. PTC and humidity are not enabled. GSoak is enabled.

Interval 6: Steps to +30°C and waits until the temperature is within ±2°C of the set point, turns all the auxiliary relays off, loops back to interval 3, repeats intervals 3 to 6 twenty-four times. PTC and humidity are not enabled. GSoak is enabled.

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

Using the Operation Commands to Load a Program into the 3800

Operation commands can be used to load the sample profile, LongSoak25Loops, into the 3800.

1. Send the prog4,LongSoak25Loops,6 command string to the 3800. This string loads program slot 4 with a 6-interval program named LongSoak25Loops.
2. Send the intv0,20,,,,1 command string to the 3800. This string sets the initial value of interval 0 to +20°C and sets channel 1 active.
3. Send the intv1,20,,,,,,,,2:00:00,1,,,202,74,23,48 command string to the 3800. This is the interval 1 command string, see page 3-26 for a description of the interval.
4. Send the intv2,30,,,,2,,,,,2,,,,0 command string to the 3800. This is the interval 2 command string, see page 3-26 for a description of the interval.
5. Send the intv3,,,,,3,,,,2:00:00,1,,,0 command string to the 3800. This is the interval 3 command string, see page 3-26 for a description of the interval.
6. Send the intv4,65,,,,0,,,,1:10:00,,,,37,3 command string to the 3800. This is the interval 4 command string, see page 3-26 for a description of the interval.
7. Send the intv5,,,,,3,,,,8:00:00 command string to the 3800. This is the interval 5 command string, see page 3-26 for a description of the interval.
8. Send the intv6,30,,,,2,,,,,2,25,3,0,0 command string to the 3800. This is the interval 6 command string, see page 3-26 for a description of the interval.

NOTE: You need to use the commas to maintain proper placement for the values in each string.

NOTE: Each command string ends after the last non-null data field. The null fields (,,) make use of the following 3800 default values:

- Final Values field uses the Initial Values field (Final Values field from the last interval).
- The Deviation and Auxiliary Group fields use the value from the last interval, or 0 if interval 1.
- The Parameter Group field uses the value from the last interval, or 1 if interval 1.
- Number of Loops field defaults to 0.
- Next Interval field defaults to the next sequential interval.
- The Display Status and Options fields default to the last interval's values.
- Additionally, the Time field allows all the "shorthand" variations listed in the TLFT command description on page 3-23.

Using the Query Commands to load a Program from the 3800

Query commands can be used to retrieve the sample profile, LongSoak25Loops, from the 3800.

1. Send the prog4? command string to the 3800.

   NOTE: Use the PROGn? command to find out how many intervals a program has, and remember to include interval 0 when you begin to retrieve program intervals from the 3800.

2. Send the intv0? command string to the 3800. This command retrieves the initial values of interval 0.
3. Send the intv1? command string to the 3800. This command retrieves the interval 1 data.
4. Send the intv2? command string to the 3800. This command retrieves the interval 2 data.
5. Send the intv3? command string to the 3800. This command retrieves the interval 3 data.
6. Send the intv4? command string to the 3800. This command retrieves the interval 4 data.
7. Send the intv5? command string to the 3800. This command retrieves the interval 5 data.
8. Send the intv6? command string to the 3800. This command retrieves the interval 6 data.

Section 4: Troubleshooting and Error Codes

This section contains a listing and description of the 3800 computer interface errors codes as well as some basic troubleshooting information. For additional information, refer to *Appendix B: Frequently Asked Questions*.

Common Computer I/O Problems and Solutions

Before attempting to run the 3800 communication interface in a user application program on the host computer, it is often helpful to use a dumb terminal or a terminal emulation program to test the serial communications. This allows you to become familiar with the 3800 command syntax.

The 3800 and Host Computer Are Not Able to Communicate Using RS-232

If the 3800 and the host computer are not able to send and receive interface commands:

1. Make sure you are using a standard serial cable.
2. Check the RS-232 Setup screen. Typically **Send Acknowledgement** should be set to off and **Terminator** should be set to last input. Check the **Baud Rate**.
3. If using 28/4800 style commands, remember that they are case sensitive; use all capital letters.
4. Verify commands are received by the 3800 -- Remove the standard serial cable from the controller and short pins 2 and 3 together. Send any command from the host computer. It should echo back.
5. Check the Serial Diagnostic screen to verify that the commands are reaching the input buffer.
6. Make sure that you are sending a command that returns information, for example, PVAR1? or IDEN?
7. Try another controller.
8. Try another host computer.
9. Try ThermoTrakII software and cabling.

The 3800 and Host Computer Are Not Able to Communicate Using RS-485

If the 3800 and the host computer are not able to send and receive interface commands:

1. Check the cabling.
2. Check the RS-485 Setup screen.
   a. Verify the **Address** setting.
   b. Set **Terminator** to last input.
   c. Set **Send Acknowledgement** to off.
   d. Set **Prefix Protocol** to enabled.
   e. Check the **Baud Rate**.
3. Try another controller.
4. Try another host computer.
5. Try ThermoTrakII software and cabling.

The 3800 and Host ComputerAre Not Able to Communicate Using GPIB

If the 3800 and the host computer are not able to send and receive interface commands:

1. Check the cabling.
2. Check the GPIB Setup screen. Set the **Terminator** to last input.
3. Try another controller.
4. Try another host computer.
5. Make sure that the 3800 recognizes the GPIB converter.

The 3800 and Host Computer are not able to communicate using TCP/IP"

1. Check the cabling.
2. Check with your IT department to make sure the IP Address is correct.
3. Try another controller.
4. Try another host computer.

The Host Computer Sends Commands, But Does Not Receive Data

If the 3800 accepts interface commands without returning the required data, check the computer interface terminator and/or the handshake signals.

Terminator Problem

Serial interface: When the 3800 is receiving command strings, it recognizes a carriage return, a line feed character, or a carriage return and line feed to signify the end of the command string. Verify that the 3800 and the computer agree on the selected termination.

Handshake Problem

NOTE: The 3800 does not use handshaking.

Serial interface: Verify that handshaking is disabled on the host computer. Instead of handshaking, enable the **Send Acknowledgment** function for all the serial interfaces. This setting programs the 3800 to send the last error code after receiving each operation command.

The Host Computer Receives Wrong or Garbled Data From the 3800

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

Buffer Out of Synch

This typically occurs when the computer does not read all of the data requested from the 3800. Make sure the host computer reads all requested data.

Parameter Mismatch

Check the serial interface setting. For RS-485 applications, check the addressing and prefix protocol parameters. If the prefix protocol and addressing options are enabled, be sure to use the correct protocol syntax at the host computer. **NOTE:** If the serial parameters do not match, the 3800 probably will not receive any commands.

The Host Computer Sends and Receives Data, But Has Problems with Specific Commands

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

- Use the 3800 error codes to help troubleshoot these types of problems. Use the "IERR?" command to read the error codes.
- Verify that the data sent with the command is within the acceptable range.
- Verify that the data sent with the command is in the proper form.
- If you are having problems with "PROG" and "INTV" commands, make sure you set up the command series to include the INTV0 command.

Error Code Listing

The 3800 error codes provide fault indications that aid in debugging programs and identifying interface problems. For error identification, programs should periodically send an "IERR?" command.

Error Code 00

Command name: No error

Description: There was no error.

Error Code 01

Command name: Serial interface error

Description: This error may occur because of problems with the communication parameters set in the **Computer I/O** screen on the 3800 (baud rate, parity, stop bits, word length, etc.). The 3800 will usually have another error (most commonly error code 04) because the data that caused this error will be misinterpreted. If this occurs after loading a value into the 3800, re-check the value and reload as required.

Error Code 02

Command name: Input buffer overflow

Description: The data string sent to the 3800 is too long. The 3800 can hold up to 128 characters; make sure the data strings and/or concatenated command strings are not longer than 128 characters.

Error Code 03

Command name: Output buffer overflow

Description: Make sure your computer is reading the 3800 output buffer each time it requests data.

Error Code 04

Command name: Unidentified command

Description: The 3800 did not recognize the command string; make sure the string sent is a legal command. On RS-422 and RS-485 networks, check to see if you are using multidrop addressing and prefix protocol; you may wish to implement these features if you have not already.

Error Code 05

Command name: Number parser error

Description: The 3800 could not successfully parse the operation command string's data into its discrete parts. Check the command string to ensure you separated it properly with commas and sent the correct number of characters.

Error Code 06

Command name: Value loaded was too high.

Description: The value sent to the 3800 exceeded the high end limit; check the value against the programmed range of the channel or parameter.

Error Code 07

Command name: Value loaded was too low.

Description: The value sent to the 3800 exceeded the low end limit; check the value against the programmed range of the channel or parameter.

Error Code 08

Command name: Incorrect channel number

Description: The value sent to the 3800 was not an acceptable channel value. Check the 3800 channel configuration for the channel. Also, check the options set up for the channel. For example, the PTC and humidity options can enable or disable channels.

Error Code 09

Command name: Bad command syntax

Description: The command was sent to the 3800 in an unrecognizable form, refer to Section 3 for the proper command syntax.

Error Code 10

Command name: Illegal program number

Description: The value sent to the 3800 exceeds the program number range (1-10).

Error Code 11

Command name: Illegal interval number sequence

Description: The value sent to the 3800 is not a valid interval value. During load program by value operations, make sure you are sending "INTV" operation commands that include interval 0 and all the intervals in sequential order.

Error Code 12

Command name: Not enough program memory

Description: The program is too large to load into the 3800's memory; delete any unused programs and reload the program. **NOTE:** You can save programs to the 3.5" floppy disk drive to free program memory in the 3800.

Error Code 13

Command name: Illegal stop command

Description: The 3800 must be in run or hold mode to execute a STOP command.

Error Code 14

Command name: Illegal hold command

Description: The 3800 must be in run mode to execute the HOLD command.

Error Code 15

Command name: Illegal run manual command

Description: The 3800 must be in stop or hold mode to execute the RUNM command.

Error Code 16

Command name: Incorrect operating mode

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

Error Code 17

Command name: Run program error

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

Error Code 18

Command name: Resume command error

Description: The 3800 must be in hold manual or hold program mode to execute the RESM command.

Error Code 19

Command name: Options not configured

Description: The 3800 is factory configured for the options on your chamber. Check to see if your options byte is selecting an option that is not available on your chamber.

Appendix A
Compatible 3800 Commands

3800 vs. 28/4800 Computer I/O Commands		
28/4800 Command	**Description**	**3800 Programmer/Controller Compatibility Note**
P	Print	Will not generate an error, but doesn't do anything.
DPMp	Get program memory	Can not transfer profiles between instruments that contain zero time (g-soak) intervals.
DPIi	Get program interval	See above comment.
DCF	Get configuration data	Supports bits 0, 1 and 3 of the configuration byte.
DID	Get identification string	2800 sends: "2800-V2.01.00" (example) 3800 sends: "3800 V1.00 03/11/2004" (example)
D#X	Get auxiliary group data	28/4800 has three groups of 4 auxiliaries. 3800 has two groups of 8 auxiliaries.
L#Xn	Set auxiliary group data	See *D#X* comment.
LCMn	Set control mode	Will turn on PTC option only if in manual mode and the humidity option is not currently enabled.
MTHT	Manual throttle	No longer supported. Reserved for Thermotron use only.

3800 vs. 7800 Computer I/O Commands		
7800 Command	**Description**	**3800 Programmer/Controller Note**
CNAM	Set/Get channel name	Not supported. 3800 does not have channel names.
LANG	Set/Get user interface language	Not supported. 3800 does not support multiple languages.
REFG	Get refrigeration data	Not supported. 3800 does not support system monitor.
CONF	Get configuration data	Only PTC and humidity bits supported.
PARM	Set/Get control parameters	Always sets/gets the 3800's only parameter group.
PRMG	Set/Get control parameter group number	PRMG? always returns 1. PRMG,<data> has no affect.
MTHT	Manual throttle	No longer supported. Reserved for Thermotron use only.

Appendix B
Programming Examples

Introduction

Programs can be written to operate the 3800 programmer/controller from a host computer in a variety of programming languages. The following section is a brief sampling of the types of programs that can be written to operate the 3800 from a host computer. Thermotron does not support any of the programming languages used in this sampling. For additional information, refer to the documentation included with the programming languages and/or compiliers.

Microsoft Visual Basic

In this example, the command string found in the text box 'Text1.text' is modified by adding an ASCII carriage return to the end of it before it is passed to the Read3800 routine. Note that this is done by using the chr$(13) construct, as opposed to the '\r' method. Visual basic does not pass the '\r' with the string to the ibwrt function. The Read3800 routine checks for the presence of the carriage return in the string returned by the ibrd function.

```
read3800 (text1.text & chr$(13))
private sub read3800(cmd$) 'send commands to 3800, read results or error code ack.
        resp_recd = false
        call ibwrt(dev%, cmd$)
        resp$ = space$(100)
        call ibrd(dev%, resp$)
        crposition = instr(resp$, chr$(13))
        if crposition <> 0 then
                inputstring$ = left$(resp$, crposition)
                resp_recd = true
        end if
end sub
```

National Instruments Interactive Control Utility (IBIC)

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

```
win32 interactive control
copyright 1996 national instruments corporation
all rights reserved.

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

: ibfind "dev10"

dev10: ibwrt "pvar1?\r"

[0100]  ( cmpl )

count:  7


dev10: ibrd 22

[2100]  ( end cmpl )

count:  5

32  35  2e  31  0d              2 5 . 1 .


dev10:
```

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

Microsoft Visual C++ (or C)

Visual C++ does allow the use of the '\r' and '\n' symbols, actually converting them to their ASCII values before passing the string to the ibwrt function.

```
#include "decl-32.h"
#include "windows.h"
int     status,inst;
char    *dev = "dev10\0";
char    *cmd = "pvar1?\r\0";
char    resp[100];
inst = ibfind(dev);
status = write3800(inst,cmd,resp);
status = ibrd(inst,&resp,100l);
```

Note that the carriage return from the 3800 will be included in the response string 'resp'.

Appendix C
Glossary

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.

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

chamber: A general name for a Thermotron environmental simulation testing system. The chamber includes the testing section, the machinery section, and the console. On air-cooled chambers, air-cooled condensers are also part of the chamber.

command: A code sent to the 3800 by a host computer that the 3800 interprets to perform an action.

concatenation: A programming technique that allows the programmer to send more than one command in a single data transmission. The programmer enters the commands on one line, separating them with a delimiter. (On the 3800, the delimiter is a semicolon.) The computer then transmits the commands together.

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 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 above or below set point.

error code: A two-character byte sent by the 3800 to indicate a fault or communication problem.

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

guaranteed soak: A process that ensures the test space or product will reach the final value of the current interval before the chamber finishes the current interval. In order to enable guaranteed soak, the chamber's programmer/controller must be set for a zero time interval and a deviation greater than zero. With these settings, the chamber will run at 100% throttle all the way to final set point minus the deviation before proceeding to the next interval.

handshaking: A series of signals acknowledging that communication can take place between computers or other devices.

I/O: Input/output.

IEEE-488 (GPIB): A parallel interface bus built under the IEEE-488 standard. This is the standard bus used for communication between the host computer and the programmer/controller.

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

loop: A series of intervals programmed to be repeated.

multidrop addressing: An addressing protocol used on RS-422 and RS-485 interfaces that allows each instrument to send or receive data from another specific instrument using the same physical interface cable.

operation command: A code sent to the 3800 that causes the 3800 to perform an internal action and use any accompanying data to update internal registers or memory storage.

options byte: A one-to-three-character data transmission that sets or indicates the function options used in the 3800 operations.

parameter group: A set of control parameters used by the 3800 to tune the performance of each active channel to a specific set of conditions.

parse: To separate a command expression into its sub-units to determine the relationship between the sub-units. For example, the 3800 separates the command, channel or group designator, and data to help translate the command into action.

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

prefix protocol: A communication convention that places a dummy character in front of each multidrop serial data transmission to help avoid data loss during the time an instrument's receiver drivers are turning on.

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

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.

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

program: A set of parameters divided into time intervals that are used to control the 3800 operations.

program number: A designator used to select one of ten allotted locations in the 3800 program memory.

program name: A character string, up to 15 characters in length, used to identify a program.

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

query command: A code sent to the 3800 that causes the 3800 to send information to the host computer or server.

ramp: A controlled process where the process variable transitions from an initial value to a final value in a specified amount of time. During this time, the 3800's control parameters maintain a smooth transition.

relative humidity (RH): A percentage of the maximum amount of moisture that the air can hold at a given temperature and pressure.

RH: See relative humidity.

RS-232: A standard serial data interface between two electronic devices.

RS-422: A standard serial full-duplex (separate transmit and receive lines) data interface between two or more electronic devices with addressing capabilities.

RS-485: A standard serial half-duplex (shared transmit/receive line) data interface between two or more electronic devices with addressing capabilities.

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.

single stage: A mechanical refrigeration system with one compressor. The refrigerant of the compressor removes heat from the chamber. An air-cooled or water-cooled condenser then removes the heat from the refrigerant. Compare to cascade.

status word: A one-to-three-character data transmission from the 3800 whose bits are set or cleared to indicate the operating conditions of the 3800.

step change (guaranteed soak): A process that ensures the test space or product will reach the initial value of the next interval before the chamber finishes the current interval. To enable a step change, the chamber's programmer/controller must be set for a zero time interval and a ± deviation greater than zero. With these settings, the chamber will run at 100% throttle all the way to final set point minus the deviation before proceeding to the next interval. Note that an interval with a duration greater than zero must follow.

syntax: The structural or grammatical rules that define how the symbols in a language are to be combined to form words, phrases, expressions, and other allowable constructs.

terminator: A code used to indicate the end of a data transmission. The 3800 interprets and transmits carriage return and line feed characters as terminators.

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.