

# M2B+ Controller

Part Number: 682.92011.00  
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Write Down Your Serial Numbers Here For Future Reference:

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We are committed to a continuing program of product improvement.  
Specifications, appearance, and dimensions described in this manual are subject to change without notice.

DCN No. \_\_\_\_\_

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# Shipping Information

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## ***Unpacking and Inspection***

You should inspect your equipment for possible shipping damage. Thoroughly check the equipment for any damage that might have occurred in transit, such as broken or loose wiring and components, loose hardware and mounting screws, etc.

## ***In the Event of Shipping Damage***

According to the contract terms and conditions of the Carrier, the responsibility of the Shipper ends at the time and place of shipment.

Notify the transportation company's local agent if you discover damage

Hold the damaged goods and packing material for the examining agent's inspection. **Do not return any goods before the transportation company's inspection and authorization.**

File a claim with the transportation company. Substantiate the claim by referring to the agent's report. A certified copy of our invoice is available upon request. The original Bill of Lading is attached to our original invoice. If the shipment was prepaid, write us for a receipted transportation bill.

Advise customer service regarding your wish for assistance and to obtain an RMA (return material authorization) number.

## ***If the Shipment is Not Complete***

Check the packing list as back-ordered items are noted on the packing list. In addition to the equipment itself, you should have:

- Bill of lading
- Packing list
- Operating and Installation packet
- Electrical schematic and panel layout drawings
- Component instruction manuals (if applicable)

Re-inspect the container and packing material to see if you missed any smaller items during unpacking.

## ***If the Shipment is Not Correct***

If the shipment is not what you ordered, **contact the shipping department immediately**. For shipments in the United States and Canada, call 1 (800) 233-4819; for all other countries, call our international desk at (630) 475-7491. Have the order number and item number available. *Hold the items until you receive shipping instructions.*

## ***Returns***

Do not return any damaged or incorrect items until you receive shipping instructions from the shipping department.

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# Chapter 1: Safety

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## 1-1 How to Use This Manual

Use this manual as a guide and reference for installing, operating, and maintaining your equipment. The purpose is to assist you in applying efficient, proven techniques that enhance equipment productivity.

This manual covers only light corrective maintenance. No other maintenance should be undertaken without first contacting a service engineer.

The Functional Description section outlines models covered, standard features, and optional features. Additional sections within the manual provide instructions for installation, pre-operational procedures, operation, preventive maintenance, and corrective maintenance.

The Installation chapter includes required data for receiving, unpacking, inspecting, and setup of the equipment. We can also provide the assistance of a factory-trained technician to help train your operator(s) for a nominal charge. This section includes instructions, checks, and adjustments that should be followed before commencing with operation of the equipment. These instructions are intended to supplement standard shop procedures performed at shift, daily, and weekly intervals.

The Operation chapter includes a description of electrical and mechanical controls, in addition to information for operating the equipment safely and efficiently.

The Maintenance chapter is intended to serve as a source of detailed assembly and disassembly instructions for those areas of the equipment requiring service. Preventive maintenance sections are included to ensure that your equipment provides excellent, long service.

The Troubleshooting chapter serves as a guide for identification of most common problems. Potential problems are listed, along with possible causes and related solutions.

The Appendix contains technical specifications, drawings, schematics, and parts lists. A spare parts list with part numbers specific to your machine is provided with your shipping paperwork package. Refer to this section for a listing of spare parts for purchase. Have your serial number and model number ready when ordering.

### **Safety Symbols Used in this Manual**

The following safety alert symbols are used to alert you to potential personal injury hazards. Obey all safety messages that follow these symbols to avoid possible injury or death.

**Danger!** *DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.*

**Warning!** *WARNING indicates a potentially hazardous situation or practice which, if not avoided, could result in death or serious injury.*

**Caution!** *CAUTION indicates a potentially hazardous situation or practice which, if not avoided, may result in minor or moderate injury or in property damage.*

## 1-2 Warnings and Precautions

Our equipment is designed to provide safe and reliable operation when installed and operated within design specifications, following national and local safety codes.

To avoid possible personal injury or equipment damage when installing, operating, or maintaining this equipment, use good judgment and follow these safe practices:

- ☑ Follow all **SAFETY CODES**.
- ☑ Wear **SAFETY GLASSES** and **WORK GLOVES**.
- ☑ Disconnect and/or lock out power before servicing or maintaining the equipment.
- ☑ Use care when **LOADING, UNLOADING, RIGGING, or MOVING** this equipment.
- ☑ Operate this equipment within design specifications.
- ☑ **OPEN, TAG, and LOCK ALL DISCONNECTS** before working on equipment. You should remove the fuses and carry them with you.
- ☑ Make sure the equipment and components are properly **GROUND** before you switch on power.
- ☑ When welding or brazing in or around this equipment, make sure **VENTILATION** is **ADEQUATE**. **PROTECT** adjacent materials from flame or sparks by shielding with sheet metal. An approved **FIRE EXTINGUISHER** should be close at hand and ready for use if needed.
- ☑ Refrigeration systems can develop refrigerant pressures in excess of 500 psi (3,447.5 kPa/ 34.47 bars). **DO NOT CUT INTO THE REFRIGERATION SYSTEM. This must be performed by a qualified service technician only.**
- ☑ Do not restore power until you remove all tools, test equipment, etc., and the equipment and related components are fully reassembled.
- ☑ Only **PROPERLY TRAINED** personnel familiar with the information in this manual should work on this equipment.

We have long recognized the importance of safety and have designed and manufactured our equipment with operator safety as a prime consideration. We expect you, as a user, to abide by the foregoing recommendations in order to make operator safety a reality.

## 1-3 Responsibility

These machines are constructed for maximum operator safety when used under standard operating conditions and when recommended instructions are followed in the maintenance and operation of the machine.

All personnel engaged in the use of the machine should become familiar with its operation as described in this manual.

Proper operation of the machine promotes safety for the operator and all workers in its vicinity.

Each individual must take responsibility for observing the prescribed safety rules as outlined. All warning and danger signs must be observed and obeyed. All actual or potential danger areas must be reported to your immediate supervisor.



# Chapter 2: Functional Description

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## 2-1 Models Covered in This Manual

This manual provides operation, installation, and maintenance instructions for the M2B+ Controller. The M2B+ Controller is available for use with several models of temperature control units (TCUs) and portable chillers. A separate manual covers operation, installation, and maintenance instructions for the TCU or chiller itself.

## 2-2 General Description

The M2B+ Controller is a microprocessor-based process controller designed for use with temperature control units. The M2B+ Controller monitors and maintains the temperature of the fluid in any given process to a selected set point using a unique proportional integral derivative (PID) auto-tuning program. The controller employs PID algorithms to automatically tune the system to heat or cool the fluid as required by the process.

The M2B+ has LED displays for set point and process temperatures. A Liquid Crystal Display (LCD) provides all operational status and programming menus. The controller includes self-diagnostics to check hardware functions. All diagnostic information is displayed in the second line of the Liquid Crystal Display.

The M2B+ is panel-mounted and has a membrane keypad with tactile feedback. When properly installed with a sealing gasket, the M2B+ meets NEMA4 or IP66 integrity.

## 2-3 Standard Features

- PID Control for both heating and cooling
- 2 line x 20 character LCD Display Screen
- Setpoint, To Process, From Process, and DT displays
- System status
- Password protection
- Selectable sensor types (Type K, J, & T thermocouples; 100 ohm and 1000 ohm RTDs)
- Autovent sequence (adjustable from 1 to 10 minutes)
- Sixteen segment Ramp/Soak program
- Start, stop, vent, and alarm silence switches
- D.C. dry contact inputs for pressure switch, pump rotation/phase loss, safety thermostat, second setpoint/remote start, weld contact, and for pump tank applications high and low water level.
- Cascade control with remote input sensor
- Triac outputs for heating and cooling
- Crash (Quick) cool feature
- Alarm outputs for temperature (absolute and deviation), low or high flow (with optional flow meter), open temperature sensor, low water pressure, pump failure, over temperature, contactor weld, high and low water level (for pump tank units).
- Analog setpoint temperature input (current or voltage)

## 2-4 Optional Features

- Analog output for heating (SCRs) and cooling (modulating valves)
- Analog retransmission of Setpoint or To Process temperature
- Analog retransmission of flow (with optional flow meter)
- Flow sensor input, pulse or analog, with voltage excitation
- RS-232 or RS-485 Modbus communications
- RS-485 SPI communications

## 2-5 Panel Layout and Keypad

See Figure 1 on page 15 for an illustration of the control panel and its buttons. The LCD backlight lights up whenever any button is pressed. The backlight turns off after five minutes if no other keypad activity occurs.

### ***LED Indicator Lights***

The M2B+ has one LED that will light up to indicate the control process has been started. This LED is located inside the Start button of the controller's front panel. When power is applied, the LED will remain off until the Start button is pushed. The LED will then illuminate green.

### ***LED Displays***

**Setpoint LED.** The setpoint LED display has four digits. The desired control setpoint is shown as temperature, in either °F or °C. The setpoint can be displayed as either an integer or as a decimal.

**Process LED.** The process LED display has four digits. The "To Process" temperature is shown in either °F or °C. The To Process temperature can be displayed as either an integer or as a decimal.

### ***LCD Display***

A 2-line by 20-character liquid crystal display (LCD) will show operational status, alarms and programming menus.

**1st Line.** The first line of the LCD continuously displays the "From Process" temperature (the delta temperature of the "To Process" and the "From Process"), and the flow in GPM or LPM if applicable.

**2nd Line.** The second line displays all menu items used in the controller setup. This line also displays the status of the pump, outputs for the heater, as well as cooling and elapsed time for the vent cycle. The second line also explains all alarm conditions along with status.

**LCD Messages**

**Autotuning.** Appears while tuning is in process.

**High Water Alarm.** Appears if the option is selected and the switch is closed

**Water Pressure/Low Level Alarm.** Appears when the Low Water Pressure switch is open or the optional Low Water switch is closed.

**Auto Vent Indicator.** Appears in the LCD display when the unit is in Auto Vent mode. The vent time remaining will also be displayed.

**Pump Rotation/Loss Indicator.** Appears in the LCD display when the Pump Rotation switch is open.

**Safety Thermostat Indicator.** Appears in the LCD display when the Safety Thermostat switch is open.

**'To Process' Sensor Open Indicator.** "999" appears in the process LED displays when the 'To Process' probe is open.

**'From Process' Sensor Open Indicator.** "999" appears in the LCD display for return temperature (RT) when the 'From Process' probe is open.

**Remote Probe Sensor Open Indicator.** "999" appears in the LCD display for mold temperature (MT) when the Remote probe is open.

**High Alarm Indicator.** Appears in the LCD display when a High Alarm condition occurs.

**Low Alarm Indicator.** Appears in the LCD display when a Low Alarm condition occurs.

**'From Process' Temp Indicator.** Appears in the LCD display when the temperature display is showing the 'To Process' temperature.

**Delta Temp Indicator.** Appears in the LCD display when the temperature display is showing temperature differential.

**High Heat Output Indicator.** Displays status in the LCD display when full power heat output is applied.

**Low Heat Output Indicator.** Displays status in the LCD display when half power heat output is applied. When the optional proportional output is installed, the display will show the percentage of output.

**Cool Output Indicator.** Displays status in the LCD display when the cool output is applied. When the optional proportional output is installed, the display will show the percentage of output.

**Ramp/Soak Indicator.** Displays the ramp/soak segment status and remaining time in the LCD display.

**Second Setpoint/Remote Start.** Displays status in the LCD display when either function is selected.

**Communications Local/Remote.**

**Weld Contact.** Appears in the LCD Display when a Weld Contact Alarm condition occurs.

## Keypad

Four keys, 'Index', 'Up', 'Down', and 'Enter' are used primarily to gain access to the menu structure and modify the controller's parameters and features. The remaining six keys are used to direct the controller to start or stop a process.

Button	Function
 Index	<ul style="list-style-type: none"> <li>Used to advance to one of the three setup menus.</li> <li>Used to advance to the next menu item when in a setup mode.</li> <li>Used in conjunction with the Down button to go back to a previous menu item when in a setup mode.</li> <li>Used in conjunction with the Enter button at power-on to break into Factory mode.</li> </ul>
 Up	<ul style="list-style-type: none"> <li>Used to increment the current setpoint value while system is in the normal running mode. Note that the rate speeds up when the key is held down.</li> <li>Used to increment the current parameter value when in a setup mode. Note that the rate speeds up when the key is held down.</li> <li>If pressed when the oil unit is in the "PmpRev" Shutdown mode, the Vent Output and the Alarm2 Output will be energized while the key is pressed. Use this function to reverse the pump in order to purge the mold of hot oil.</li> </ul>
 Down	<ul style="list-style-type: none"> <li>Used to decrease the current setpoint value while the system is in the normal running mode. Note that the rate speeds up when the key is held down.</li> <li>Used to decrease the current parameter value when in a setup mode. Note that the rate speeds up when the key is held down.</li> <li>If pressed when the Index button is being held down, returns to the previous menu item when in a setup mode.</li> </ul>
 Enter	<ul style="list-style-type: none"> <li>Used to select one of the three setup modes.</li> <li>Used to accept (save/write to EEPROM) the current indicated parameter value. Note: No save/write occurs unless the Enter key is pressed before going to the next/previous item or Setup mode is terminated.</li> <li>Used in conjunction with the INDEX key at power-on to enter into the Factory mode.</li> </ul>
 Tune	<ul style="list-style-type: none"> <li>If no Autotune operation is in progress, this button starts an Autotune operation. If an Autotune operation is in progress, pressing this button will immediately stop the Autotune operation. While the Autotune is running, the "Autotune" message is displayed on the LCD in place of the normal "Running" message.</li> <li>This key will not function if the Security Level is less than 3.</li> <li>This key will not function if the Ramp/Soak operation is in progress.</li> <li>This key will not function while in the Factory mode.</li> </ul>
 Run/Hold	<ul style="list-style-type: none"> <li>This key controls the Ramp/Soak process. If no Ramp/Soak operation is in progress, it starts the Ramp/Soak operation. When Ramp/ Soak is running, this key puts the Ramp/Soak operation into a hold condition. While the Ramp/Soak is running, the "Ramp/Soak" message is displayed on the LCD in place of the normal "Running" message.</li> <li>This key will not function if the Security Level is less than 3.</li> <li>This key will not function if the autotune operation is in progress.</li> <li>This key will not function while in the Factory mode.</li> </ul>
 Start	<ul style="list-style-type: none"> <li>When system is powered-on, the controller initializes and then displays the "[SYSTEM OFF]" message on the LCD. The controller is not functioning at this point. Pressing this START key enables all controller functions and lights the green power-on LED. After the system has been started, the "[Running]" message is displayed on the LCD.</li> </ul>
 Stop	<ul style="list-style-type: none"> <li>Stops all controller functions and turns off the green power-on LED (overrides Remote Start input). After the system has been stopped, the "Stopped" message is displayed on the LCD.</li> <li>This key will override an existing Remote Start input switch closure.</li> </ul>

Button	Function
 <b>Vent</b>	<ul style="list-style-type: none"> <li>When the system is first powered-on and the “Power Available - System Off” message is displayed, pressing the VENT key will turn on the Vent Output for a period of 8 seconds. The message “VENT” will be displayed during this period.</li> <li>When the system is running, pressing the VENT key shall manually turn on the Vent Output for as long as the key is held down, provided the ‘To Process’ temperature is below 150°F (65.5°C) for a water unit and 250°F (121°C) for an Oil unit. The message “Vent Time = MANUAL” will be displayed while the key is held down.</li> </ul>
 <b>Alarm Silence</b>	<ul style="list-style-type: none"> <li>Turns off the Alarm 1 Output. The cause of the alarm will continue to appear in LCD until the fault is cleared.</li> <li>Used to immediately terminate any of the three Setup modes without having to cycle through to the end of the menu items. Note that the current displayed parameter value is not saved to EEPROM when this key is pressed.</li> <li>Can be used as a means of turning on the LCD backlight without affecting any operation.</li> </ul>

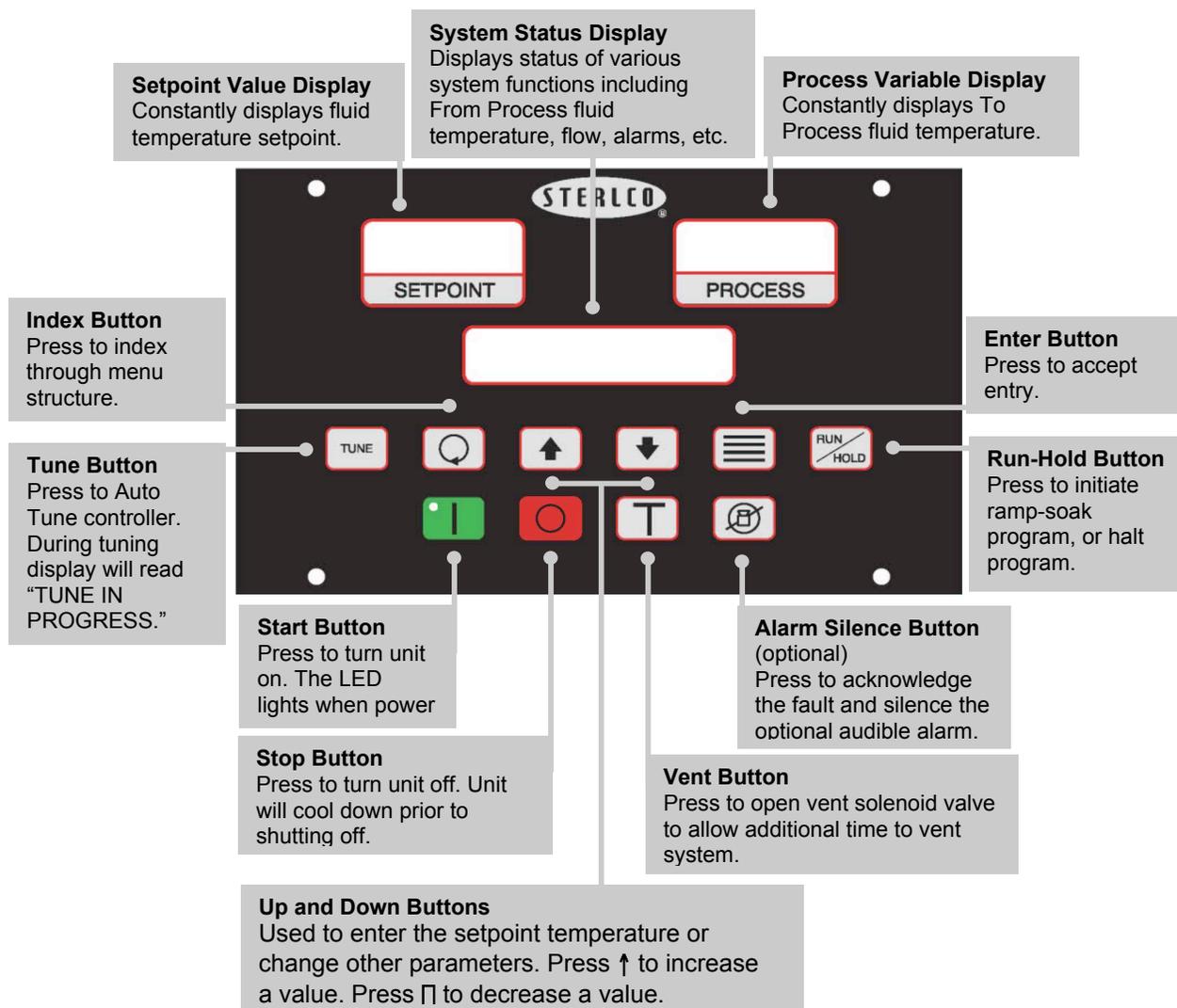


Figure 1: Panel Layout

## 2-6 Menu Structure

The parameter menu structure is organized into three basic menus: Primary, Secondary, and Secure. To access the menus, press the Index button until the menu label appears in the second line of the LCD display. Additional menus display when an option is selected; however, the options are non-functional unless the appropriate menu option or option board has been installed. See the Menu Parameter Tables in the Appendix of this manual for more information.

Continuing to press the Index button scrolls from menu to menu. Press the Enter button to enter the menu, and use the Index button to scroll through the parameters of the menu. Once you find the parameter that needs to be changed, use the Up and Down buttons to change the parameter. Press the Enter button to accept the new value.

You can exit the setup menus by scrolling through the menu to its end or by pressing the Alarm Silence button. The controller will automatically exit the setup menu if no buttons have been pressed for more than one minute.

### ***Primary Menu***

The Primary menu includes all non-critical parameters for standard operation including but not limited to standby mode, mold temperature, alarm trip points, ramp soak settings, and high heat.

### ***Secondary Menu***

The Secondary menu includes all non-critical parameters for optional equipment including but not limited to degrees F/C, Alarm parameters, ramp/soak segments, remote setpoint scaling, communication setup, and retransmission scaling.

### ***Secure Menu***

The Secure menu includes all critical parameters for setting up the controller including but not limited to controller function, select either Water TCU or Oil TCU default values, flow meter on/off, remote control probe on/off, pressure switch, high and low level, safety thermostat on/off, output parameters, and scale limits.

## 2-7 Passwords and Security

The controller provides four levels of security. Depending on the security level, some or all of the setup menus may be locked. The security level must be changed in order to unlock these menus. The current security level is displayed in the lower right corner of the menu display. The default security level is 3.

Security levels are changed by changing the password value using the Up and Down buttons and pressing the Enter button. Values in the setup menus can be changed only when the correct security level is set. Note that the security level value itself can be changed in any security level.

Use the following procedure to change the security level:

1. Press the Index button three times to access the Secure menu.
2. Press the Enter button. The LCD screen will display the current security level.
3. Use the Up or Down buttons to change the value in the display line to the password of the new desired security level.
4. Press the Enter button to select this new security level and retain the value in EEPROM. The display will change from the password value to the selected security level for that password.

Level	Password	Menu	Status	Description
1	110	Primary	Locked	No parameter values can be changed. Setpoint cannot be changed.
		Secondary	Locked	
		Secure	Locked	
2	101	Primary	Unlocked	Only the primary menu values can be changed. Setpoint can be changed.
		Secondary	Locked	
		Secure	Locked	
3	011	Primary	Unlocked	Only the primary and secondary menu values can be changed. Setpoint can be changed.
		Secondary	Unlocked	
		Secure	Locked	
4	111	Primary	Unlocked	All parameter values can be changed. Setpoint can be changed.
		Secondary	Unlocked	
		Secure	Unlocked	

# Chapter 3: Installation

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## 3-1 Location

Mount the instrument in a location that will not be subject to excessive temperature, shock or vibration. All models are designed for mounting in an enclosed panel.

When properly mounted in an enclosed panel using a gasket at the panel/ controller interface, the keypad can be washed down with water. Do not use high pressure fluids.

## 3-2 Electrical Connections

Microprocessor based instruments require a “clean” source of power that is steady and free of noise. Electrical noise may be caused by line faults, power switching, motors, motor controllers, or power controllers containing SCR devices. Without a clean source, any microprocessor is prone to failure. If your power source is not from a clean line, your system can be protected by installing a line filter.

Where external contactors or solenoids are used with relay output instruments, an R/C Snubber Network should be used. The snubber installs easily directly across the field coil terminals of the relay or solenoid.

Do not run thermocouples, RTD's or other class 2 wiring in the same conduit or area as the power leads. Maintain separation between wiring of sensors, process signals and other power and control wiring.

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# Chapter 4: Basic Operation

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## 4-1 Turning the Power On

When AC power is first applied to the unit, the following sequence of events will occur:

1. The LCD backlight lights up.
2. The LCD displays dashes: LEDs have all segments on.
3. The LCD displays the PROM Rev/Date.
4. The LCD displays “SelfTest in Progress.”
5. If the ‘Debug’ parameter is enabled, the following messages about Option Cards can be displayed:
  - Re-Transmit Detected
  - Cool Analog Detected
  - Heat Analog Detected
  - Serial Comm Detected
  - None Installed
6. The LED segments turn off.
7. The LCD backlight turns off.
8. The LCD displays “Power Available/System OFF.”

At this point, a Manual Vent Operation can be initialized for 8 seconds by pressing the Vent button.

The unit is now in a standby mode of operation. No system process control will occur until the Start button is pressed.

## 4-2 Starting and Stopping Water TCUs

### ***Starting the Unit***

Press the Start button to begin the following sequence of events:

1. The green LED inside the Start button lights up.
2. The LCD backlight lights up.
3. The Pump Output turns on.
4. The LCD displays the setpoint value, process temperature, return temperature, and delta temperature.
5. If the Auto Vent Cycle parameter is enabled, the Vent Output turns on, and the LCD displays “Vent Time = mm:ss.”
6. When the Auto Vent timer expires or if the Auto Vent Cycle parameter is disabled, the LCD displays “RUNNING,” and system control begins.

### ***Stopping the Unit***

While the system is running, press the Stop button to shut down the system. If the process temperature is below 150°F, the system will immediately shut down. If the current process temperature is above 150°F, pressing the Stop button will begin the following sequence of events:

1. The LCD displays “SHUTDOWN [Cool Down].”
2. The setpoint changes to 150°F.
3. The Heat Outputs will turn off.
4. The Cool Output will turn on.
5. The system waits for the process temperature to drop down to 150°F.
6. At 150°F, the LCD displays “SHUTTING DOWN.”
7. All outputs immediately turn off.
8. The system re-cycles to the “Power Available/System OFF” state.

**Note:** *Pressing the Stop button a second time while the controller is in the “SHUTDOWN [Cool Down]” mode will abort this cool down operation and the system will immediately go into the “SHUTTING DOWN” phase of the operation.*

## 4-3 Starting and Stopping Hot Oil TCUs

### ***Starting the Unit***

Press the Start button to begin the following sequence of events:

1. The green LED inside the Start button lights up.
2. The LCD backlight lights up.
3. The Pump Output turns on.
4. The LCD displays the setpoint value, process temperature, return temperature, and delta temperature.
5. If the Auto Vent Cycle parameter is enabled, the Vent Output turns on, the green LED blinks, and the LCD alternates between “Mode is OFF,” “Press START to Run,” and “Vent Time = mm:ss.”
6. When the Auto Vent timer expires or if the Auto Vent Cycle parameter is disabled, the LCD alternates between “Mode is Off” and “Press START to Run.”
7. Press the Start button. The display reads “Vent Time = mm:ss.”
8. When the vent time expires, the LCD displays “RUNNING,” and system control begins.

### ***Stopping the Unit***

While the system is running, press the Stop button to shut down the system. If the current process temperature is above 150°F, pressing the Stop button will begin the following sequence of events:

1. The LCD displays “SHUTDOWN [Cool Down].”
2. The setpoint changes to 150°F.
3. The Heat Outputs will turn off.
4. The Cool Output will turn on.
5. The system waits for the process temperature to drop down to 150°F.
6. At 150°F, the LCD displays “SHUTTING DOWN.”
7. All outputs immediately turn off.
8. The system re-cycles to the “Power Available/System OFF” state.

**Note:** *Pressing the Stop button a second time while the controller is in the “SHUTDOWN [Cool Down]” mode will abort this cool down operation and the system will immediately go into the “SHUTTING DOWN” phase of the operation.*

If the process temperature is below 150°F, all outputs will turn off, and the controller will enable Pump Reverse mode. The LCD will display “Shutdown [PmpRevOff]” for 30 seconds before the system re-cycles to the “Power Available/System OFF” state.

During the 30-second “Shutdown[PumpRevOff] mode, press the Up button to reverse the pump and purge oil from the mold. During pump reverse, the Vent Output and Pump Reverse outputs will turn on. The LCD will display “Shutdown[PmpRevON] until the Up button is released, at which time the 30-second time-out will restart. After 30-seconds, the system will recycle to the “Power Available/System OFF” state.

## 4-4 Tuning

### **Autotuning**

**Caution!** *The factory default for the controller is automatic half/full heat for a water TCU and full heat for an oil TCU. If an autotune cycle is completed, do not switch to low heat without performing a new autotune cycle. Failure to autotune will result in poor control of the process. Subsequent changes from one heat setting to another require autotune to be run.*

The Tune button is used to toggle the autotune process. If no autotune operation is in progress, pressing the Tune button starts the autotune operation. The “AutoTune” message is displayed on the LCD. If an autotune operation is already in progress, pressing this button again will immediately stop the autotune operation. The display will return to the “Running” message.

During the autotune process, the control point is the ‘To Process’ probe or the ‘Remote Selected’ probe. The tuning constants (i.e. rate, reset and gain) can be altered in setup mode.

The unit’s cycle time is selectable in one-second increments. The heat and cool cycles have a minimum pulse of one second.

**Manual Tuning (Zeigler-Nichols PID Method)**

This tuning method may be used if the spread between ambient temperature and process operating temperature is small. For best results, use a recording device when tuning with this method.

1. Disable the cooling valve by removing the output signal to the device. For solenoid valves, remove plug from the solenoid. For modulating valves, remove the J7 plug located on the back of the controller.
2. Press the Index button one time to access the Primary Menu.
3. Press the Enter button.
4. In the Primary Menu, change the Reset Time and Rate Time OFF, and change the Prop Band Heat to 100.
5. Adjust setpoint to the desired value.
6. While monitoring the process temperature or recording device, decrease the proportional value by repeatedly halving the value until a small, sustained temperature oscillation is observed. Measure the period of one cycle of oscillation "T".
7. Divide the period of oscillation "T" by eight; the resulting number is the correct Rate Time in seconds.
8. Multiply the Rate Time by four. This is the correct Reset Time in seconds.
9. Multiple the bandwidth value "T" by 1.66, and enter this as the new Prop Band Heat value.
10. Re-enable the cooling valve by reversing step 1.

## 4-5 Selecting a Local Probe

The controller has two standard temperature probe inputs for delivery (to process) and return (from process). The probes are typically set up at the factory, but they can be re-configured in the field. To set up this feature you must have access to the Secure Menu. See Section 2-6 on page 16 to review accessing the Secure Menu.

Use the following procedure to select a local probe:

1. Press the Index button three times to access the Secure menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Sensor type = RTDIK.”
4. Use the Up and Down buttons to select the sensor type.
5. Press the Enter button to accept the value.

When changing the sensors from RTDs to thermocouples, you must also change the jumpers JMP1 and JMP3 to pins 2 and 3.

6. Press the Alarm Silence button to return to Running mode.

### ***Using a Remote Input Probe for Monitoring***

The Remote Probe Input can be used for two different functions: To control or monitor the temperature of a process outside of the temperature control loop. To set up this feature you must have access to the Secure Menu. See Section 2-6 on page 16 to review accessing the Secure Menu.

This option can be purchased with or without the manufacturer supplying the actual temperature-sensing device. If the manufacturer supplies the probe, the controller is preconfigured, and the user needs to set up the controller as local or remote input.

Use the following procedure to monitor the process from the remote probe:

1. Press the Index button three times to access the Secure menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Sensor Monitor.”
4. Press the Enter button.
5. Use the Up and Down buttons to select the type of input desired. Select “MON” for monitor. The LCD display will change to have MT display the monitored temperature from the probe.

If the display reads “999,” the probe is not plugged into the back of the controller at pins 3 and 4 of the 8-pin connector.

6. Press the Enter button to save the sensor monitor parameter.
7. Press the Index button until the display reads “Mold Sensor Type.”
8. Press the Enter button.
9. Use the Up and Down buttons to select the type of mold sensor (Type J, K, or T thermocouples or 100 or 1000 ohm RTD).
10. Press the Enter button to save the mold sensor type.
11. Press the Alarm Silence button to return to Running mode.

## 4-6 Setting Up Cascade Control

The controller is provided with an internal cascade control feature. Cascade control is used to enable a process having multiple lags to be controlled with the fastest possible response to process disturbances. The system uses a remote control probe in the downstream process and a local delivery and return probe in the TCU. The controller uses the remote probe to drive the heating and cooling outputs, while the local delivery probe is the process fluid temperature limit control. To set up this feature you must have access to the Secure Menu. See Section 2-6 on page 16 to review accessing the Secure Menu.

Use the following procedure to enable the cascade control:

1. Press the Index button three times to access the Secure menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Sensor Monitor = Off.”
4. Use the Up and Down buttons to change the value to “CTRL.”
5. Press the Enter button to accept the value.
6. Press the Index button until the display reads “Mold Sensor Type = “J.”
7. Use the Up and Down buttons to select the probe type: J, K, T thermocouples or 100 or 1000 OHM .00385 coef. RTDs.
8. Press the Enter button to accept the value.
9. Press the Alarm Silence button to return to Running mode.

The process temperature display will show the remote probe variable. The local delivery probe will be in the top line of the LCD display “DT”.

The autotuner will tune the control using the mold probe as the process variable.

## 4-7 Adjusting the Automatic Venting Timer

When the Auto Vent Cycle Timer is set, the controller will open the venting valve for the set time at the startup of the unit. The Auto Venting Timer can be turned off, or it can be set to a specified time period. For water TCUs, Auto Vent can be set between 1 and 10 minutes. For hot oil TCUs, the vent time can be set between 1 and 60 minutes. TCUs are programmed at the factory to Auto Vent for 1 minute for water units, and 10 minutes for oil units.

Use the following procedure to adjust the Auto Vent Cycle parameter:

1. Press the Index button one time to access the Primary menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Auto Vent Cycle.”
4. Press the Enter button.
5. Use the Up and Down buttons to set the cycle time to the desired time.
6. Press the Enter button to save the cycle time.
7. Press the Alarm Silence button to return to Running mode.

## 4-8 Using Crash Cool

The Crash Cool feature allows the user to quickly cool the process down. Once Crash Cool is turned on, the setpoint is automatically adjusted to 0°F, and the cooling valve is opened. Oil TCUs not equipped with the optional heat exchanger will cool only through convection and radiation.

Use the following procedure to being “Crash Cool”:

1. Press the Index button one time to access the Primary menu.
2. Press the Enter button
3. Press the Index button until the display reads “Crash Cool.”
4. Press the Enter button.
5. Use the Up and Down buttons to set the “Crash Cool” parameter to “ON.”
6. Press the Enter button to begin crash cooling. The setpoint will change to 0, and the cool output will turn on.
7. Press the Alarm Silence button to return to Running mode.

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# Chapter 5: Advanced Operation

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## 5-1 Using the Analog Remote Input

This feature is typically setup at the factory, but can be installed as a retrofit in the field. It is used to accept a remote analog setpoint value or flow value. If the analog signal is set up for remote setpoint input, the Up and Down arrow keys are locked out for changing the setpoint at the controller. The analog signal can be configured to be 0-20 mA, 4-20 mA, 0-5 VDC, 1-5 VDC, 0-10 VDC, or 2-10 VDC via jumper 4 and menu selection.

Use the following procedure to set up the Analog Remote Input:

1. Press the Index button two times to access the Secondary menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Remote Input.”
4. Press the Enter button.
5. Use the Up and Down buttons to change value to either SETP for setpoint or FLOW for flow.
6. Press the Enter button.
7. Press the Index button one time to access the “Remote Signal” parameter.
8. Press the Enter button.
9. Use the Up and Down buttons to change the range of the analog input.
10. Press the Enter button.
11. Press the Alarm Silence button to return to Running mode.

From the factory, the remote setpoint temperature range is set up to be the same as the range of the controller (Water: 0°F to 250°F; Oil: 0°F to 550 °F). These parameters can be changed through the Secondary Menu.

Use the following procedure to adjust the remote setpoint temperature range:

1. Press the Index button two times to access the Secondary menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Remote SetPtLo” for the low limit, or “Remote SetPtHi” for the high limit.
4. Press the Enter button.
5. Use the Up and Down buttons to change the value.
6. Press the Enter button to accept the value change.
7. Press the Alarm Silence button to return to Running mode.

**Note:** *If there is no signal present, the controller’s setpoint will automatically default to 0 °F.*

## 5-2 Retransmission Analog Signal

This feature is typically set up at the factory, but it can also be installed as a retrofit in the field. It is used to transmit an analog signal for process temperature, setpoint temperature, and flow. The analog signal can be configured to be 0-20mA, 4-20mA, 0-5VDC, 1-5VDC, 0-10VDC, and 2-10VDC.

**Note:** *The Process Output Low and High values must match the high and low limits of the controller setup in the Secure menu.*

Use the following procedure to set up the analog retransmission output:

1. Insert the analog retransmission card (P/N 691-00537-00) into header “J9.” The card must be inserted into the header to activate the analog output setpoint menus.
2. Press the Index button two times to access the Secondary menu.
3. Press the Enter button.
4. Press the Index button until the display reads “Analog Out=Process Signal Type.”
5. Use the Up and Down buttons to change the value.
6. Press the Enter button to accept the value.
7. Press the Index button until the display reads “Process Outlow.”
8. Use the Up and Down buttons to change the low limit value.
9. Press the Enter button to accept the value.
10. Press the Index button until the display reads “Process OutHig.”
11. Use the Up and Down buttons to change the high limit value.
12. Press the Enter button to accept the value.
13. Press the Index button until the display reads “Process Out SrC.”
14. Use the Up and Down buttons to change the analog signal source to PROC, SETP, or FLOW.

**Note:** *Selecting “FLOW” requires additional setup. See the next procedure.*

15. Press the Enter button to accept the value.
16. Press the Alarm Silence button to return to Running mode.

### ***Setting the Analog Signal Source to FLOW***

If the analog signal source is set to “FLOW,” follow steps 1 through 15 on page 28, and then complete the following procedure:

1. Press the Index button until the display reads “Remote Input.”
2. Use the Up and Down buttons to change the value to “FLOW.”
3. Press the Enter button to accept the value.
4. Press the Index button until the display reads “Remote Signal.” Do not alter this value; use the default setting.
5. Press the Enter button to accept the default setting.
6. Press the Index button until the display reads “Remote Flowslo=Minimum Flow Value.”
7. Use the Up and Down buttons to change the value to 0.
8. Press the Enter button to accept the value.
9. Press the Index button until the display reads “Remote Flowshi=Maximum Flow Value.”
10. Press the Enter button to accept the default value.
11. Press the Alarm Silence button to return to Running mode.
12. Press the Index button two times to access the Secondary menu.
13. Press the Enter button.
14. Press the Index button until the display reads “Remote Input.”
15. Use the Up and Down buttons to select “OFF.”
16. Press the Enter button to accept the value.
17. Press the Alarm Silence button to return to Running mode.

### ***Using Analog Output for Heating and Cooling***

This feature is typically set up at the factory, but it can also be installed as a retrofit in the field. It is used to control a modulating valve or heating SCR proportionally. The analog signal can be configured to be 0-20mA, 4-20Ma, 0-5VDC, 1-5VDC, 0-10VDC, and 2-10VDC. Inserting the card into header “J5” for cooling or “J6” for heating automatically configures the controller to direct its outputs through these boards.

Use the following procedure to set up the analog outputs:

1. Insert the analog card (P/N 691-00537-00) into the appropriate header.
2. Press the Index button two times to access the Secondary menu.
3. Press the Enter button.
4. Press the Index button until the display reads “Cool Output” or “Heat Output.”
5. Use the Up and Down buttons to select the analog signal type.
6. Press the Enter button to accept the value.
7. Press the Alarm Silence button to return to Running mode.

### 5-3 Using the Flow Monitor

The controller is set up to accept a pulsed or current input from a flow sensor. The controller translates the pulse or current into either gpm (gallons per minute) or lpm (liters per minute). If the flow sensor is of the pulsed variety, it is connected to block J1 on the main controller board. For analog signal sensors, see Section Chapter 5: on page 27. Use the following procedure to set up a pulsed flow sensor:

1. Press the Index button three times to access the Secure menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Flow Monitor.”
4. Press the Enter button.
5. Use the Up or Down buttons to change the value to PUL for pulsed input.
6. Press the Enter button to accept the value.
7. Press the Index button one time to access the “Flow Constant B” parameter.
8. Press the Enter button.
9. Use the Up and Down buttons to change the offset of the displayed flow reading. This value should be determined by using a certified sensor to determine the offset.
10. Press Enter to accept the value.
11. Press the Index button one time to access the “Flow Constant K” parameter.
12. Press the Enter button.
13. Use the Up and Down buttons to change the scaling factor to the K factor (pulses per gallon) provided by the sensor manufacturer. If the K factor isn’t known, use the GPM flow rate and frequency. (A factor = GPM/Hz, K factor = 60 sec./A factor)
14. Press the Enter button to accept the value.
15. Press the Alarm Silence button to return to Running mode.

At this point, the controller should display the flow as “FL=X.X.” The user can now set up as many as two alarms that will annunciate when the flow drops below or rises above a set value. Use the following procedure to set up the flow alarm:

1. Press the Index button one time to access the Primary menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Flow Alarm Low” for a low flow alarm or “Flow Alarm High” for a high flow alarm.
4. Press the Enter button.
5. Use the Up and Down buttons to change the value.
6. Press the Enter button to accept the value.
7. Press the Alarm Silence button to return to running mode.

Use the following procedure to change the units of the displayed flow:

1. Press the Index button two times to access the Secondary menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Flow Display.”
4. Press the Enter button.
5. Use the Up and Down buttons to change the value between GPM and LPM.
6. Press the Enter button to accept the change.
7. Press the Alarm Silence button to return to Running mode.

## 5-4 Programming the Alarms

The controller is set up to monitor both critical and non-critical operations within the process. Based on the severity of the condition, the controller will alarm and perform a specific function based on the type of unit being controlled. If an alarm is tripped, the LCD display will flash the backlight and if an audible alarm is present, turn it on. Below is a brief explanation of each of the eight areas that the controller monitors and how to set them up.

### **Temperature**

This alarm is used to monitor the difference between the setpoint and the “to process” temperatures. The alarm can be configured as an absolute or deviation alarm. When setting the alarm value for an absolute alarm (Alarm1 Mode = ABS), simply set the value at which the alarm is to occur.

When setting the value for the deviation alarm (Alarm1 Mode = DEV), set the difference in value from the Setpoint desired. For example if you want to configure Alarm 1 as a high and low deviation alarm (Alarm1 Cfg = HILO and Alarm1 Mode = DEV), and you want the low alarm to be 5 degrees below the setpoint, then set Alarm 1 Low = 5. If a high alarm is to be 20 degrees above the setpoint, then set Alarm 1 High = 20. If the setpoint is changed, the alarm will continue to maintain that deviation.

Use the following procedure to set up the temperature alarm to be either an absolute alarm or a deviation alarm:

1. Press the Index button two times to access the Secondary menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Alarm1 Cfg.”
4. Press the Enter button.
5. Press the Up and Down buttons to select the alarm type: low, high, hilo, or evtnt.
6. Press the Enter button.
7. Press the Index button one time to see “Alarm1 Mode.”
8. Use the Up and Down buttons to select ABSL for absolute or DEV for deviation.
9. Press the Enter button.
10. Press the Alarm Silence button to return to the Running mode.
11. Press the Index button one time to access the Primary menu.
12. Press the Enter button.
13. Press the Index button until the alarm type you selected in Step 5 appears (example Alarm 1 Low).
14. Press the Enter button.
15. Use the Up and Down buttons to select the temperature for the configured alarm.
16. Press the Enter button.
17. Repeat Steps 15 and 16 until all of the alarm configurations are set up.
18. When finished, press the Alarm Silence button to return to Running mode.

**Note:** *The factory setup of the alarms is to be in an On/Off reset mode (Alarm1 Reset = ONOF). The reset declares how the controller is supposed to function when the alarm is tripped. The On/Off mode allows the controller to reset the alarm when the offending parameter is cleared. The HOLD mode makes the alarm a critical one in which the user has to turn the controller off and then on to clear the alarm.*

**Flow Alarm**

This alarm is used to monitor the flow rate input from either a pulse or analog style flow meter. Once the Flow Monitor is turned on (in the Secure Menu; Flow Monitor = PUL or CUR) either a low flow alarm or high flow alarm or both can be set up.

Use the following procedure to set up the Flow Alarm:

1. Press the Index button one time to access the Primary menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Flow Alarm Low.”
4. Press the Enter button.
5. Use the Up and Down buttons to adjust the value of the alarm.
6. Press the Enter button to accept the value.
7. Press the Index button until the display reads “Flow Alarm High.”
8. Press the Enter button.
9. Use the Up and Down buttons to adjust the value of the alarm.
10. Press the Enter button to accept the value.
11. Press the Alarm Silence button to return to Running mode.

**Open Sensor**

This alarm occurs when the controller loses the signal from the To Process (process display 999), From Process (return display 999), or Remote probes (mold display 999). This alarm is not critical and will disable the heating and cooling outputs, but the pump will remain operating. The controller will reset once the alarm condition is cleared. There are no menu items that affect this function.

**Low Pressure**

This alarm occurs when the controller loses the signal from the pressure switch. In water units, this alarm immediately disables the pump motor, heat, and cool outputs. In the water unit, this alarm is not critical and will automatically reset the controller once the pressure signal is regained.

In water units with manual fill reservoir tanks, the pressure switch input can be bypassed during initial start-up with an adjustable timer located in the Secure menu. This time period should be kept as short as possible to prevent damage to the pump seal.

In oil units, during the Auto Mode, the loss of the pressure switch disables the heater output and the pump motor output will remain on for a preset time period (Pressure Timer = OFF, 2sec, 5sec, 30sec, or 1 to 10 minutes).

Use the following procedure to change the Pressure Timer for oil TCUs:

1. Press the Index button three times to access the Secure menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Pressure Timer.”
4. Press the Enter button.
5. Use the Up and Down buttons to adjust the value of the timer.
6. Press the Enter button to accept the change.
7. Press the Alarm Silence button to return to Running mode.

***Low Fluid Level Alarm***

This factory-set alarm occurs when the low level switch is in a closed condition. This is not a critical alarm and will reset once the condition is cleared. For water TCUs the Low Level alarm disables the heater and the pump motor outputs. For oil TCUs it disables the heater output. There are no menus that affect this alarm.

***High Fluid Level Alarm***

This factory-set alarm occurs when the high level switch is in a closed condition. This alarm is only applicable for water TCUs. This is not a critical alarm and will reset once the condition is cleared. It is an alarm only and no outputs are disabled.

***Pump Failure Alarm***

This critical, factory-set alarm occurs when one of three conditions occurs: phase loss, phase reversal, or motor overload trip. If any of these occur, the heat, cool, and pump motor outputs are disabled. Turn the unit off and then on again to reset the fault.

***Safety Thermostat Alarm***

This critical, factory-set alarm occurs when the thermostat sensor opens on a high temperature condition. For both water and oil TCUs, the heater output is disabled, but the pump and cooling outputs are still active. For water TCUs, the cooling output will latch on. Turn the unit off and then on again to reset the fault.

***Welded Contactor Alarm***

This critical factory-set alarm occurs when the controller senses that an auxiliary contact has remained closed after a preset time period after the heater output has been turned off. The heater output is disabled, and the cool and pump motor outputs are enabled to prevent temperature runaway. This alarm is an option for water TCUs and is standard for oil units. Turn the unit off and then on again to reset the fault.

## 5-5 Using the Second Setpoint Function

With this function, the user can send the controller a dry contact closed signal to activate the second setpoint. Opening the dry contact causes the controller to revert to the primary setpoint. To reinitiate the second setpoint, the switch must be closed again.

Use the following procedure to enable the second setpoint function:

1. Press the Index button three times to access the Secure menu.
2. Press the Enter button.
3. Press the Index button until the display reads “SP2/RmtStart.”
4. Press the Enter button.
5. Use the Up and Down buttons to change the value to “SP2.”
6. Press the Enter button to accept the change.
7. Press the Alarm Silence button to return to Running mode.
8. Press the Index button to access the Primary menu.
9. Press the Enter button.
10. Press the Index button until the display reads “Aux Set Point.”
11. Press the Enter button.
12. Use the Up and Down buttons to change the value. The range is between the SetPtLoLimit and the SetPtHiLimit in the Secure menu.
13. Press the Enter button to accept the change.
14. Press the Alarm Silence button to return to Running mode.

## 5-6 Using the Remote Start Function

With this function, the user can send the controller a dry contact closed signal to activate the controller. Stopping the unit can be done one of two ways: removing the signal or pressing the Stop button on the face of the controller. Either method will initiate the Automatic Shutdown routine within the controller. The remote contact must be opened to reset the controller.

### **5-7 Changing the Temperature Display Units**

The controller is set up to display the temperature, and all related temperature settings, in either degrees Fahrenheit or degrees Celsius. Use the following procedure to change the display units:

1. Press the Index button two times to access the Secondary menu.
2. Press the Enter button.
3. Press the Index button one time to access the “Degrees (F/C)” parameter.
4. Use the Up and Down buttons to change the value.
5. Press the Enter button to accept the change.
6. Press the Alarm Silence button to return to Running mode.

### **5-8 Setting the Temperature Display Precision**

The controller is factory-set to display the temperature, and all related settings, as an integer. The user has the ability to change the display precision to tenths of a degree. Use the following procedure to change the display precision:

1. Press the Index button two times to access the Secondary menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Precision.”
4. Use the Up and Down buttons to change the value.
5. Press the Enter button to accept the change.
6. Press the Alarm Silence button to return to Running mode.

## 5-9 Using the Elapsed Time Meter

The controller is equipped with an elapsed time meter that keeps track of the time that the pump motor has run in hours. The meter is enabled or reset in the Secure menu and viewed in the Primary menu.

Use the following procedure to enable the elapsed time meter:

1. Press the Index button three times to access the Secure menu.
2. Press the Enter button.
3. Press the Index button until the display reads “ElapsedTimeMode.”
4. Use the Up and Down buttons to change the value to “ON.”
5. Press the Enter button to accept the value.
6. Press the Alarm Silence button to return to Running mode.

Use the following procedure to view the elapsed time meter:

1. Press the Index button one time to access the Primary menu.
2. Press the Enter button.
3. Press the Index button until the display reads “ElapsedTime.”
4. Press the Alarm Silence button to return to Running mode.

Use the following procedure to reset the elapsed time meter:

1. Press the Index button three times to access the Secure menu.
2. Press the Enter button.
3. Press the Index button until the display reads “ElapsedTimeMode.”
4. Use the Up and Down buttons to change the value to “RST.”
5. Press the Enter button to accept the value.
6. Press the Alarm Silence button to return to Running mode. At this point the meter has been reset to zero hours.

## 5-10 Programming Ramp/Soak

The controller has a 16-segment, front-face programmable Ramp/Soak feature. Unused alarms can be programmed as a segment.

**Caution!** *Do not attempt to auto-tune the controller during a ramp/soak program. The Tune button will not function during this process.*

Instead of requiring the operator to calculate an approach rate, the controller does the calculation automatically. The operator needs to program the target setpoint and the time desired to reach that setpoint. When the controller executes the ramp segment, it calculates the ramp required to reach the process temperature from starting setpoint to the programmed setpoint in the time allowed. (See Figure 2 for sample ramp/soak program.)

Dwells (or soaks) are ramp segments with target setpoint equal to starting process temperature. This allows for multistage ramps without wasting intermediate soak steps.

**Note:** *Before programming Ramp/Soak, evaluate your program on paper. Test any program for best results before running production material.*

**Caution!** *Make sure to run auto-tune before operating Ramp/soak because Ramp functions will interfere with the operation of the auto-tune*

Segment Prompt	Function	Time (min.)	Setpoint, °F
1TI	1st Event	1	
1SP			50
2TI	2nd Event	2	
2SP			150
3TI	3rd Event	2	
3SP			150
4TI	4th Event	2	
4SP			100
5TI	5th Event	1	
5SP			100
6TI	6th Event	2	
5SP			50
7TI	Un-Used	0	
7SP	Hold Last Setpoint		50
□	Un-Used		
GTI	Un-Used	0	
GSP			50
END	Stay at present setpoint (GSP)		HOLD
END	Revert to SP1 value		SETP
END	Repeat program at 1TI		LOOP

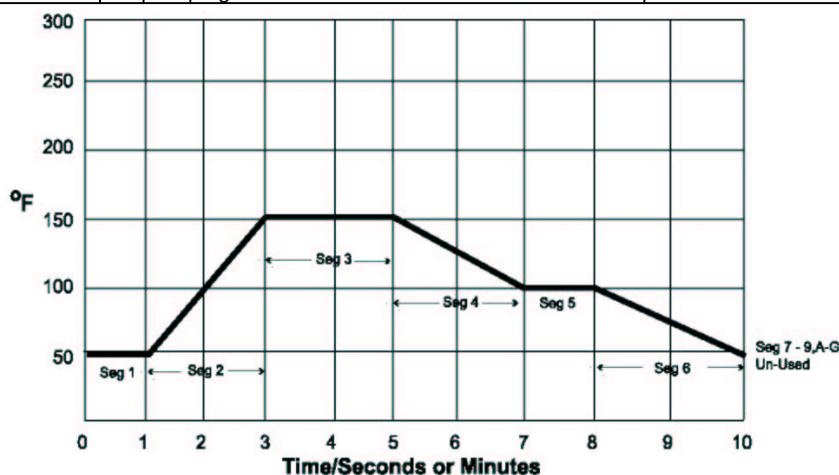


Figure 2: Sample Ramp Soak Program

Use the following procedure to program the Ramp/Soak functions:

**Starting Ramp/Soak Programming:**

1. Press the Index button two times to access the Secondary menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Prog Ramp/Soak.”
4. Use the Up and Down buttons to change the parameter to “On.”
5. Press the Enter button to accept the change.
6. Press the Index button one time to access the “Prog Values” parameter.
7. Press the Enter button.
8. Use the Up and Down buttons to change the parameter to “On.”
9. Press the Enter button to accept the change.
10. Press the Index button until the display reads “Prog Time Base.”
11. Press the Enter button.
12. Use the Up and Down buttons to change the time base for each segment. Choose seconds or minutes (1s = seconds; 60s = minutes).
13. Press the Enter button to accept the change.

**Programming the Ramp/Soak Segments:**

1. Press the Index button one time to access the “Seg 1 Time” parameter.
2. Press the Enter button.
3. Use the Up and Down buttons to change the length of time for Segment 1.
4. Press the Enter button to save the segment time for Segment 1.
5. Press the Index button one time to access the “Seg 1 SetPoint” parameter.
6. Press the Enter button.
7. Use the Up and Down arrows to set the desired setpoint at the end of Segment 1.
8. Press the Enter button to save the setpoint for Segment 1.
9. Repeat steps 1-8 for each of the 16 segments. Segment time should be set to 0 for unused segments.

**Finishing the Ramp/Soak Programming:**

1. Press the Index button until the display reads “Prog End.”
2. Press the Enter button.
3. Use the Up and Down buttons to change the value for the desired reaction at the end of the program. “OFF” will power down the TCU after the program; “HOLD” will control the setpoint from the last segment after the program; “LOOP” will continuously loop through the program; “SETP” will control at the setpoint prior to the program.
4. Press the Enter button to accept the value.
5. Press the Alarm Silence button to return to Running mode.
6. Press the Run/Hold button to activate the program.

### ***Controlling Ramp/Soak***

The Secondary Menu parameter “Prog Ramp/Soak = “ must be set to ‘ON’ in order to control the ramp/soak operation.

Press the ‘RUN/HOLD’ button on the panel to put the ramp/soak operation into the Run state. The LCD display will change from “Running” to “RAMPSOAK”. The setpoint will step to the programmed value over the programmed time period and the process will be changed accordingly.

Press the ‘RUN/HOLD’ button again to toggle the ramp/soak operation into the Hold state. The LCD display will change from “RAMPSOAK” to “R/S HOLD”. The setpoint will be held at its current value and the process will control at that value for as long as the Hold state continues.

Press the ‘RUN/HOLD’ button again to toggle the ramp/soak operation back into the ramp/soak Run state.

While the Ramp/Soak operation is running, there are two ways to abort the operation:

- Hold down the RUN/HOLD key for 3 seconds.
- In the Secondary Menu, set the “Prog Ramp/Soak = “ parameter to ‘OFF’.

### ***Monitoring Ramp/Soak***

If the “Status of Prog” parameter in the Secondary menu is set to “ON”, the Primary menu will display the following items:

- “PrgSeg# Remain = ###” displays the remaining time in the current segment.
- “PrgSeg# Time = ###” displays total time of the current segment.
- “PrgSeg# StPt = ###” displays the setpoint of the current segment.

If the “Status of Prog” parameter is set to “OFF”, the additional menu items will not appear in the Primary menu.

## 5-11 Setting the Approach Rate

The controller is provided with a selectable up and down ramp to setpoint feature, located in the secure menu. The time base is in minutes and is adjustable from off to 99 minutes in 1 minute increments.

Use the following procedure to enable the approach rate feature:

1. Press the Index button three times to access the Secure menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Approach Rate.”
4. Use the Up and Down buttons to select the time period in minutes.
5. Press the Enter button to accept the value.
6. Press the Alarm Silence button to return to Running mode.

## 5-12 Level Input Operation (Water Units)

All level inputs have a three-second input suppression timer to prevent false input signals caused by turbulent fluid. The level input has a menu selection for CONTROL or ALARM in the Secure menu.

When the machine is started, the controller will determine if a high- or low-level condition is present. If the water level is below the low-level mark, the fill solenoid is enabled, filling the tank. Once the water level is above the high-level mark, filling stops, and the pump, cooling, and heating outputs are enabled.

As the process fluid is circulated through the system, the fluid level may fall. The control system will continue to function without interruption. If a low-level condition exists for more than three seconds, the pump, cooling, and heating outputs are disabled while the fill solenoid re-fills the tank.

The controller has a Water Fill Timer, which can be set in the Secondary menu. The timer can be set to “OFF” or from 1 to 180 minutes. When it is set to off, there is no time limit for the fill solenoid. When it is set to on, and the low level does not clear in the preset time, the fill solenoid valve will turn off.

## 5-13 Adjusting the LCD Display Contrast

Potentiometer R82, on the controller main PC board, is used to adjust the contrast of the LCD. The range of adjustment varies from completely off, where nothing is displayed on the LCD, to fully on, where the display “blooms” and may not be readable. Adjust the potentiometer to achieve an acceptable viewing condition somewhere between the two extremes.

## 5-14 Calibrating the T/C, RTD, and V Inputs

This calibration procedure describes the operator procedures for calibrating the Controller Sensor Input (T/C and RTD) and the Analog input (V).

Use the following procedure to calibrate all three sensor inputs:

1. While the controller is powering on, hold the Index button and the Enter button when the “Selftest in Progress” message is displayed. This will put the controller into Factory mode.
2. Press the Index button two times so that the display reads “Calibrate?<ENT=YES>”.
3. Press the Enter button to begin calibration.
4. Use the Index button to cycle through the six calibration parameter menu selections:
  - LOCalJTC(25C) = nn.n
  - HICalJTC(345C) = nn.n
  - LOCalR1K(10R) = nn.n
  - HICalR1K(2K1) = nn.n
  - LOCalRSp(0.1V) = nn.n
  - HICalRSp(9.9V) = nn.n
5. Use the Up and Down buttons to select the calibration value for each parameter.
6. Press the Enter button to save the value.

### Calibrating the Thermocouple Input (T/C)

**Note:** *This thermocouple calibration procedure requires a “J” T/C reference source to calibrate this analog input circuit. Once the circuit is calibrated, either a Type “J” or a Type “K” thermocouple can be selected for operation.*

1. Put a jumper on pins 2 and 3 of JMP2 on the main PC board to select the T/C input type.
2. Connect the “J” thermocouple calibration source to pins 3 (+) and 4 (-) on the J5 connector on the main PC board.
3. Select the “LOCalJTC(25C)” parameter.
4. Set the “J” thermocouple low calibration source to 25°C. Use the Up and Down buttons to change the value on the display to 25.0.
5. Press the Enter button to save the value.
6. Select the “HICalJTC(345C)” parameter.
7. Set the “J” thermocouple high calibration source to 345°C. Use the Up and Down buttons to change the value on the display to 345.0.
8. Press the Enter button to save the value.
9. Cycle between the Low and High parameters and readjust the values if needed to compensate for any interaction that may occur between the two parameters.

### Calibrating the RTD Input

**Note:** *This RTD calibration procedure requires a 0 to 1000 ohm Decade Resistance box to calibrate this analog input circuit. Once the circuit is calibrated, either a 100 ohm RTD or a 1000 ohm RTD can be selected for operation.*

1. Put a jumper on pins 1 and 2 of JMP1 on the main PC board to select the RTD input type.
2. Connect the Decade Resistance Box to pins 1 and 2 on the J5 connector on the main PC board.
3. Select the “LOCalJR1k(10R)” parameter.
4. Set the decade resistance box low calibration value to 10 Ohm. Use the Up and Down buttons to change the value on the display to 10.0.
5. Press the Enter button to save the value.
6. Select the “HICalR1K(2K1)” parameter.
7. Set the decade resistance box high calibration value to 2100 Ohm. Use the Up and Down buttons to change the value on the display to 2100.0.
8. Press the Enter button to save the value.
9. Cycle between the Low and High parameters and readjust the values if needed to compensate for any interaction that may occur between the two parameters.

### Calibrating the Analog Input (V)

**Note:** *This analog input calibration procedure uses a Voltage source for this analog input circuit. Once the circuit is calibrated, the JMP4 jumper can be changed for a Milliamp or Voltage input source for operation.*

1. Put a jumper on pins 2 and 3 of JMP4 on the main PC board to select a Voltage input source.
2. Connect the voltage calibration source to pins 7 (+) and 8 (-) on the J5 connector on the main PC board.
3. Select the “LOCalRSp(0.1V)” parameter.
4. Set the voltage low calibration source to 0.1V. Use the Up and Down buttons to change the value on the display to 0.100.
5. Press the Enter button to save the value.
6. Select the “HICalRSp(9.9)” parameter.
7. Set the voltage high calibration source to 9.9V. Use the Up and Down buttons to change the value on the display to 9.900.
8. Press the Enter button to save the value.
9. Cycle between the Low and High parameters and readjust the values if needed to compensate for any interaction that may occur between the two parameters.

## 5-15 Accessing the Debug Menu

The controller has a troubleshooting tool in the secure menu. Use this menu to assist in debugging communications errors and flow sensor input errors.

Use the following procedure to troubleshoot communications errors:

1. Press the Index button three times to access the Secure menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Debug”.
4. Press the Enter button.
5. Press the Up button until the top display reads “Comm. Activity [TX and RX]” and the bottom display reads “Debug 1.”
6. Press the Enter button.
7. Press the Alarm Silence button to return to Running mode. The top line of the LCD display will indicate by flashing “TX” and “RX”, the transfer of commands between the host and the slave controllers. If one of the characters isn’t flashing, it is not communicating.
8. Return to the Debug program and turn it off after the troubleshooting task is complete.

Use the following procedure to troubleshoot flow sensor input errors:

1. Press the Index button three times to access the Secure menu.
2. Press the Enter button.
3. Press the Index button until the display reads “Debug”.
4. Press the Enter button.
5. Press the Up button until the top display reads “Flow Freq # # # HZ” and the bottom display reads “Debug 2.”
6. Press the Enter button.
7. Press the Alarm Silence button to return to Running mode. The top line of the display will read “Flow Freq” with a value in Hertz. Use this value to verify calibration or verify the presence of an input signal.
8. Return to the Debug program and turn it off after the troubleshooting task is complete.

## 5-16 Reloading Factory Defaults

When factory default settings are reloaded, all special configurations (i.e., 4-20 ma scaling) will be lost. Please record menu variables before restoring the factory defaults.

Restoring factory defaults for low-heat water TCUs can be accomplished by entering "Factory mode." Use the following procedure to restore factory defaults:

**Note:** *TCUs will default to a 250°F (121.1°C) set-stop limit. For 550°F (287.7°C) applications, the controller must be reset for a high-heat configuration (see below).*

1. Cycle control power to system Off and On.
2. While the controller is performing the self test, simultaneously press the Index and Enter button together to enter Factory mode.
3. Press the Index button until the display reads "Default<ENT=YES>."
4. Press the Enter button to accept the factory defaults. Both displays will flash the words "OFF" and "ON" indicating reboot is complete.
5. Restart the controller to automatically return to Running mode.

TCUs will default to a 250°F (121.1°C) set-stop limit. For 550°F (287.7°C) applications, the controller must be reset for a high-heat configuration. Use the following procedure to configure the TCU for high-heat applications:

1. Press and hold the Up button and the Enter button simultaneously for 5 seconds to enter the Secure menu. The LCD will read "Security Level n."
2. Use the Up and Down buttons to change the security level to 4.
3. Press the Index button until the display reads "Function."
4. Use the Up and Down buttons to select the type of TCU. Select "HL" for a low-heat water TCU, or select "HH" for a high-heat oil TCU.
5. Press the Enter button and the Down button simultaneously to accept the factory default settings. The LCD will flash off and then on to indicate the default settings have been restored. The controller will automatically reboot and return to the Home Display mode.

## 5-17 Serial Communications Operation

The M2B+ controller communicates with a host machine via an RS232 or RS485 communication link when the communication option card is installed in the J8 slot on the motherboard. There are two versions of this option card; one is populated with the ICs to support RS232, and the other is populated with the ICs to support RS485. All data is sent and received in the bit data format, using 10 bits: 1 start bit, 8 data bits, no parity bits, and 1 stop bit. This communications options card uses the J12 connector.

The software supports two protocols, SPI and MODBUS, which are user selectable in the menus. All communication parameters can be accessed through the setup menus only when a communication option card is installed:

Primary Menu: “Comm Addr(HEX)=xxxx” specifies the operating address in hex from 0001H to 03E7H. (This parameter is duplicated in Menu 3.)

Secure Menu: “Comm Protocol = xxx” select either SPI or MODBUS.

Secure Menu: “Comm Addr(Hex)=xxxx” specifies the operating address in hex from 0001H to 03E7H.

Secure Menu: “Comm Baud Rate=xxxx” select 300, 1200, 2400, 4800, 9600, or 19.2KB.

### **Port Address**

Operator selection of the address to use is from a menu parameter selection of 1H to 3E7H.

**Note:** *For MODBUS configuration, this address setting must be set between 1 and 247 (0x00Hex to 0xF7Hex).*

The default value for this parameter is 1H. The SPI DEVID specified in the SPI Protocol Specification field is set by this PORT address setting.

**Note:** *For SPI configuration, the address setting must be set between 32 and 255 (x20Hex to 0x0xFFHex).*

### **Baud Rate and Data Format**

Operator selection of the baud rate to use is from a menu parameter selection of 300, 1200, 2400, 4800, 9600, or 19.2KB. The default value for this parameter is 9600 Baud. The data format is 1 start bit, 8 data bits, no parity, and 1 stop bit for all protocols.

### **Protocols**

Onboard protocols are Modicon Modbus RTU and SPI. SPI is only available in RS485. These follow the standard rules for these protocols. All other desired protocols will require an external gateway to be supplied by the manufacturer. Operator selection of the protocol to uses is from a menu parameter selection. The default protocol is MODBUS.

**Note:** *When the protocol is changed, the port address must be set correctly in the range appropriate for the protocol.*

### **MODBUS Protocol**

Every message sent from a MODBUS master to a slave on to the network contains a function code that represents the action the slave device should take in response to the message. So that a MODBUS master can read and write the controller parameters, setpoints, and status values in an Athena Temperature controller, the Athena implementation of the MODBUS protocol supports the following function codes:

**function 03 (\$03)** This function is used to read to one or more contiguous “holding registers” (database locations that are next to one another in the register map).

**function 06 (\$06)** This function is used to write to a single holding register. A message containing function 06 can be broadcast to all controllers on the network simultaneously by sending the message to the controller ID of 0 (zero), instead of to the controller ID of a specific device.

**function 16 (\$10)** This function is used to write to a single register or to multiple contiguous holding registers, that is, to two or more registers that are next to one another in the register map. A message containing function 16 (\$10) can be broadcast to all controllers on the network simultaneously by sending the message to the controller ID of 0 (zero), instead of to the controller ID of a specific device.

So that you can test communication over the MODBUS network, Athena also supports the diagnostic **function 08 (\$08), subfunction 00 (\$00)** to perform a loopback test. When a loopback test is performed, the MODBUS master sends a message to a controller and the controller sends the same message back to the master. (No changes are made to the controller database as a result of processing the command.) If the master does not receive a reply, it is time to troubleshoot the network or the controller’s communication setup.

The controllers will not take any action, nor will they reply in response to any messages they cannot interpret. This includes any messages that contain a function code other than 03, 06, 16 (\$10), or 08 subfunction 00.

**Modbus Register Addressing Regions.** The regions (ranges) of register relative addresses used for the various types of representations of controller values are shown in the table below. Each register type used to transmit controller values was described in more detail earlier in this section (see the cross-references in the table).

**Figure 3: Modbus Address Regions**

Register Address Range	Region	Type of Value Used by the Controller	How Data is Transmitted in the Register
0000 to 0999	Integer	Integer	16-bit Integer
1000 to 1999	10X mirror of 0000 to 0999 base region	Can include fractional values	16-bit Integer
4000 to 4999	32-bit IEEE mirror of 0000 to 0999 base region	Can include fractional values	32-bit IEEE floating point
All others	Reserved	Reserved	Reserved

**Note:** *The Register Address field in the Message protocol should be offset (-1), from the point number shown in Table 13*

**Modbus Accessible Parameter Mapping.** The customized controller allows access to (29) controller parameters and settings, which can be accessed in Integer Mode or Floating point mode. This is accomplished with (2) Point Address ranges, allowing data exchange in either integer or floating point format, for all controller parameters and settings. All data conversion such as rounding, integer float, Etc, is transparent and handled by the controllers, since internal variables data type can be different for the MODBUS data exchange types.

The M2003 customized controller software supports the following Modbus Parameters and Settings:

**Figure 4: Modbus Parameters List**

Parameter / Item Index	R/W	Integer Data Region Point Address	Float Data Region Point Address	Min Value	Max Value	Description
0	R	0001	4001	0	0	Version ID
1	R	0002	4003	-34	343	Delivery Temp (°C)
2	R	0003	4005	-34	343	Mold Temp (°C)
3	R	0004	4007	-34	343	Return Temp (°C)
4	R	0005	4009	0	999	Flow Value
5	R/W	0006	4011	0	1	System Standby Heat/cool
6	R/W	0007	4013	0	1	Temp Units
7	R/W	0008	4015	-34	343	Setpoint 1 (°C)
8	R/W	0009	4017	-34	343	Setpoint 2 (°C)
9	R/W	0010	4019	-34	343	Alarm 1 Low (°C)
10	R/W	0011	4021	-34	343	Alarm 1 High (°C)
11	R/W	0012	4023	1	343	Prop. Band Heat (°C)
12	R/W	0013	4025	1	343	Prop. Band Cool (°C)
13	R/W	0014	4027	0	999	Reset (seconds)
14	R/W	0015	4029	0	999	Rate (seconds)
15	R/W	0016	4031	0	999	Autotune.State
16	R/W	0017	4033	0	999	Autotune.TuneDutyPercent
17	R/W	0018	4035	0	999	Autotune.PeakOverShoot
18	R/W	0019	4037	0	999	Autotune.PeakUnderShoot
19	R/W	0020	4039	0	999	Autotune.InitialTempDeviation
20	R/W	0021	4041	0	999	Autotune.ProcessTripTemp
21	R	0022	4043	-34	343	Delivery Temp (°C)
22	R/W	0023	4045	-34	343	Setpoint 1 (°C)
23	R/W	0024	4047	0	999	Proportional Percent (%)
24	R/W	0025	4049	0	999	Integral Percent (%)
25	R/W	0026	4051	0	999	Direvative Percent (%)
26	R/W	0027	4053	0	999	PID Output Percent (%)
27	R/W	0028	4055	0	999	Heater Output Percent (%)
28	R/W	0029	4057	0	999	Cooling Output Percent (%)

**Function 03 Request.** The format for a function 03 request is shown below.

Device Address	Function Code	Register Address		Number Of Words To Read		CRC	
1 byte	03	MSB	LSB	MSB	LSB	MSB	LSB
	1 byte containing \$03						

**Function 03 Request Example.** Suppose you want to Read Delivery Temperature in Float 32 Bit IEEE Format, which has registers address of "4003" and if the controller ID is "01".

Device Address	Function Code	Register Address		Number Of Words To Read		CRC	
\$01	\$03	\$0F	\$A2	\$00	\$02	\$02	\$66

**Note:** *Since point address requires an address adjustment, the Register Address field in the serial data packet is offset by (-1), resulting in register address of 4002 = \$0FA2 (Hexadecimal)*

**Function 03 Normal Reply.** The controller reply will consist of the following data:

- the controller ID of the device responding
- the function code \$03
- the quantity of bytes read
- the value of the first word read
- the value of the second word read, and so on until
- the value of the last word read

The controller will append a CRC value to the message.

Following is an example of normal reply response showing Process Temperature = 37.6° C

Device Address	Function Code	Number Bytes of Data	IEEE32 BitFloat Data Field See Modbus Spec.				CRC	
\$01	\$03	\$04	\$C0	\$93	\$42	\$16	\$87	\$70

### ***SPI Protocol***

The Society of the Plastics Industry (SPI) communication protocol specifies a connection management Protocol, a packetized communication format, and communication error mechanisms passing commands and data between a host computer and a slave. A host computer initiates all communications. The protocol used corresponds to the 3.01 version of the SPI communication protocol specification dated October 1990. The data is transmitted via a multi-drop EIA485 (half-duplex) hookup. The controller will support a number of commands that will allow the host computer to retrieve status and assign setpoints. The commands correspond to a mold temperature controller device.

#### **Commands Descriptions**

- (20H) Echo poll-Controller integrity command. Return the 4 bytes of ASCII assigned by the Echo Select command in an open format.
- (21H) Echo Select -Controller integrity command. Supplies 4 bytes of ASCII in an open format that is to be returned when an Echo Poll command is received.
- (22H) Version poll>Returns a version number (MBB =0101) as 4 bytes of ASCII in an open format where: AA = SPI assigned version level, BB = Vendor assigned version level
- (30H) Setpoint poll - Returns the current process setpoint value in numeric format.
- (31H) Setpoint select -Assigns a value to the process setpoint in numeric format.
- (32H) Alarm, high temperature deviation poll -Return the high temperature deviation setpoint value in numeric format. This value when added to the process setpoint gives the temperature at which a high alarm will occur.
- (33H) Alarm, high temperature deviation select -Assigns a value to the high temperature deviation setpoint in numeric format.
- (34H) Alarm, low temperature deviation poll -Returns the low temperature deviation setpoint value in numeric format. This value when subtracted from the process setpoint gives the temperature at which a low alarm will occur.
- (40H) Status process poll -Returns the status of the process as 16 flag bits in open format. The following bits are supported. The rest are set to 0.
- Bit 0 - Processing
  - Bit 1 -Alarm, System
  - Bit 2 -Alarm, Process
  - Bit 3 -Alarm, Machine
  - Bit 4 -Alarm, High Temperature
  - Bit 5 -Alarm, Low Temperature
  - Bit 7 -Alarm, Low Pressure
  - Bit 9- Alarm, Low Flow
- (42H) Status, machine 1 poll - Returns the status of the machine as 16 flag bits in open format. The following bits are supported. The rest are set to 0.
- Bit 0 - Processing
  - Bit 1 -Alarm, System
  - Bit 2 -Alarm, Process
  - Bit 3 -Alarm, Machine
  - Bit 4 -Alarm, High Temperature

- Bit 5 -Alarm, Low Temperature
- Bit 7 -Alarm, Low Pressure
- Bit 14 -Alarm, Phase Reversed or Lost
- (44H) Status, machine 2 poll-Returns the status of the machine as 16 flag bits in open format. The following bits are supported. The rest are set to 0.
  - Bit 0 -Processing
  - Bit 1 -Alarm, System
  - Bit 2 -Alarm, Process
  - Bit 3 -Alarm, Machine
  - Bit 4 -Fault, Sensor, Delivery
  - Bit 5 -Fault, Sensor, Return
- (48H) Mode, Machine Poll-Returns the current status of temperature control unit if the machine is On (1) or Off{O).
- (49H) Mode, Machine Select-Commands the temperature control unit to turn On(1) or Off(D)
  - Bit 0- Machine On/Off, Bit 1 -Alarm Acknowledge
- (70H) Temperature, to process poll-Returns the delivery temperature in numeric format.
- (72H) Temperature, from process poll -Returns the return temperature in numeric format.

## Chapter 6: Troubleshooting

This Troubleshooting section should be used in conjunction with the Troubleshooting section of the unit that the controller was supplied with. The problems listed below are displayed on the LCD and the action the user takes will depend on whether the alarm is critical or non-critical.

Problem	Possible Cause	Solution
Process Temperature Alarm does not acknowledge when Process Temperature is lower than Setpoint	Alarm configuration is set up incorrectly.	Change the configuration to Low, High, High/Low, or Event. See 5-4 on page 31.
	Alarm Mode is configured incorrectly	Change the Mode to either Absolute or Deviation. See 5-4 on page 31.
	Alarm trip point incorrect set.	Change the value of the high or low tripping point for the alarm. See 5-4 on page 31.
Process Temperature Alarm does not acknowledge when Process Temperature is higher than Setpoint	Alarm configuration is set up incorrectly.	Change the configuration to Low, High, High/Low, or Event. See 5-4 on page 31.
	Alarm Mode is configured incorrectly	Change the Mode to either Absolute or Deviation. See 5-4 on page 31.
	Alarm trip point incorrect set.	Change the value of the high or low tripping point for the alarm. See 5-4 on page 31.
Setpoint will not change with a change of Remote Analog Setpoint value or setpoint displays "0"	Remote input is not enabled.	Change the value for "Remote Input" in the Secondary Menu to SETP.
	Remote input is incorrectly configured.	
	Remote Signal value is incorrect.	Change the range for "Remote Signal" to desired setting.
Ramp/Soak program does not transition to desired setpoint.	The status of the program has been stopped.	Either Press the Run/Hold button on the face of the controller or change the value of "Prog Ramp/Soak" in the Secondary Menu to ON.
	The segment setpoint is incorrect.	Change the value of "Seg # SetPoint" to desired temperature.
	The program time is too short for the heating/cooling capacity of the unit.	Change the value of "Seg # Time" to a longer timer period.
Last setpoint in Ramp/Soak program reverts back to first setpoint	The Program End function is incorrectly configured.	Change the value of "Prog End" to HOLD.
Ramp/Soak program never stops cycling through steps	The Program End function is incorrectly configured.	Change the value of "Prog End" from LOOP to desired action at the end of program.

Problem	Possible Cause	Solution
Unit shuts down after running through Ramp/Soak program	The Program End function is incorrectly configured.	Change the value of “Prog End” from OFF to desired action at the end of the program.
Setpoint temperature does not change when using the Up or Down Arrow keys	Security password set to lockout status	Change security setting to gain access to parameters.
	Controller setup in remote analog input.	Change “Remote Input” parameter in Secondary Menu to “OFF.”
Buttons on the face of the controller do not function when pressed	Security password set to lockout status	Change security setting to gain access to parameters.
	Controller parameters setup in remote function.	Change parameters to be in local function.
	Excessive environment noise	Consult factory.
Controller does communicate with remote host computer	Communications board improperly installed.	Check slot J8 on the secondary controller board to ensure proper board installation
	Incorrect protocol selected	Change parameter “Comm Protocol” in the Secure Menu to proper protocol (MOD for MODBUS® RTU or SPI)
	Incorrect address selected	Change the parameter “Comm Addr (Hex)” in the Secure Menu to a unique address in hexadecimal. This parameter will depend on the type of protocol being used. (See debug menu on page 43)
	Incorrect communications speed.	The parameter “Comm Baud Rate” in the Secure menu must equal the speed of the host computer to communicate properly.
No Flow display	Check flow amp. JMR 5’ Lo for low signal level <IVPP Hi for high signal level >IVPP	Change jumper location
	Check for pull up or pull down resistor on sensor input	Replace IK Resistor per elementary diagram. (See debug menu on page 43)
LCD Display is dark	Contrast needs to be adjusted	Adjust POT, R82 to left or right until display illuminates.
Backlight is on, display reads “Power Available” [System off], Setpoint and process display has all 8’s.	“J6” DC input connector isn’t inserted into socket or all DC inputs are open at the same time	Insert 12 pin plug into the “J6” socket and recycle power to the controller.
Sensor Low Display	Process temperature is outside of the sensor ref. Table range.	Consult factory.

## 6-1 Operating Mode and Error Display Messages

**Figure 5: Display Messages, Operational and Errors**

Message Type	Display Presentation	Description
Normal Autotune	Autotuning [ ]	
Normal Running	Running [ ]	Running. (High Heat and Cool shown is Normal)
Normal RampSoak	Rampsoak [ ]	
Alarm	Alarm1/2 [LoFluid LVL]	This Indicates Alarm Low Fluid Level
Alarm	Alarm1/2 [Lo Pressure]	This Indicates Alarm Low Pressure
Alarm	Alarm1/2 [High LEVEL]	This Indicates Alarm High Fluid Level
Alarm	Alarm1/2 [Process]	This Indicates Alarm Temperature Process Exceeded
Alarm	Alarm1/2 [Deviation]	This Indicates Alarm Temperature Deviation Exceeded
Alarm (Major Fault)	Alarm1/2 [SafetyTherm]	This Indicates Alarm Safety Thermostat Alarm Input Detected
Alarm [Major Fault]	Alarm1/2 [SensorRange]	This Indicates Sensor Over-range or beyond range of the unit.
Alarm [Major Fault]	Alarm1/2 [Sensor Open]	This Indicates Delivery, Return or Remote Sensor Open or Not Connected to the input connector
Alarm (Major Fault)	Alarm1/2 [WeldContact]	This Indicates Heater Weld Contact Input Detected
Alarm (Major Fault)	Alarm1/2 [Pump Fail]	This Indicates Pump Phase Error Input Detected
Alarm	Alarm1/2 [Event]	This Indicates Ramp Soak Segment Event Alarm
Alarm	Alarm1/2 [Lo Flow]	This Indicates Flow Sensor Alarm Low Flow
Alarm	Alarm1/2 [Hi Flow]	This Indicates Flow Sensor Alarm High Flow
Tank Fill	Running [TankFill]	Automatic Tank Fill Mode Active

# Chapter 7: Appendix

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## 7-1 Warranty

We warrant all of our equipment to be free from defects in workmanship and material when used under recommended conditions. The manufacturer's obligation is limited to repair or replace FOB the factory any parts that are returned prepaid within one year of equipment shipment to the original purchaser, and which, in the manufacturer's opinion, are defective. Any replacement part assumes the unused portion of this warranty.

This parts warranty does not cover any labor charges for replacement of parts, adjustment repairs, or any other work. This warranty does not apply to any equipment which, in the manufacturer's opinion, has been subjected to misuse, negligence, or operation in excess of recommended limits, including freezing or which has been repaired or altered without the manufacturer's express authorization. If the serial number has been defaced or removed from the component, the warranty on that component is void. Defective parts become the property of the warrantor and are to be returned.

The manufacturer is not liable for any incidental, consequential, or special damages or expenses. The manufacturer's obligation for parts not furnished as components of its manufactured equipment is limited to the warranty of the manufacturers of said parts.

Any sales, use, excise, or other tax incident to the replacement of parts under this warranty is the responsibility of the purchaser.

The manufacturer neither assumes nor authorizes any other persons to assume for it any liability in connection with the sale of its equipment not expressed in this warranty.

Many types of the manufacturer's equipment carry an additional one-year service policy. Consult your sales representative for specific details.

## 7-2 Technical Assistance

### ***Parts Department***

Call Toll-Free 7am–6pm CST [800] 783-7835 or call [414] 354-0970

Our Parts Department is ready to provide the parts to keep your systems up and running. OEM replacement parts ensure operation at design specifications. Please have the model and serial number of your equipment when you call. Consult the Customer Parts List included in your information packet for replacement part numbers.

### ***Service Department***

Call toll-free 8am–5pm CST [800] 783-7835 or call [414] 354-0970.

Emergencies after 5pm CST, call [847] 439-5655 We have a qualified service department ready to help. Service contracts are available for most of our products.

### ***Sales Department***

Call [414] 354-0970 Monday–Friday, 8am–5pm CST

Our products are sold by a world-wide network of independent sales representatives. Contact our Sales Department for the name of the sales representative nearest you.

## 7-3 Menu Structure

SECURE MENU
Security Level
Unit Function
Tune% Reduction
InputCorrection
Sensor Filter
Display Filter
Setpoint Source
Link Terms PB2
Approach Rate
Sensor Monitor
Flow Monitor
<i>Flow Constant B</i>
<i>Flow Constant K</i>
<i>Flow Filter</i>
Safety Thermo
PressLevel Inp
Press Level
<i>Pressure Timer</i>
SF2/RmtStart
HighLevelInp
Weld Cont. Inp
Sensor Type
MoldSensorType
InputFaultTimer
Out1 Type
Out2 Type
Sensor Rate/Chg
SetPtLoLimit
SetPtHiLimit
Alarm2 Cfg
<i>Alarm2 Mode</i>
<i>Alarm2 Reset</i>
<i>Alarm2 PwrIntr</i>
<i>Alarm2 PwrInhb</i>
Contact@Alarm2
Alarm2 LoopBrk
ElapsedTimeMode
<i>Comm Protocol</i>
<i>Comm Addr(Hex)</i>
<i>Comm Baud Rate</i>
<i>NoActivityTime</i>
Debug
<i>TuneFallOffStrt</i>
<i>TuneFallOffStop</i>
<i>TuneFinal%P</i>
<i>TuneFinal%I</i>
<i>TuneFinal%D</i>
<i>PIDResetTrigger</i>
<i>PID K1</i>
<i>PID K2</i>
<i>PID K3</i>

SECONDARY MENU
Degrees (F/C)
Precision
Alarm1 Cfg
<i>Alarm1 Mode</i>
<i>Alarm1 Reset</i>
<i>Alarm1 PwrIntr</i>
<i>Alarm1 PwrInhb</i>
Contact@Alarm1
Alarm1 LoopBrk
Prog Ramp/Soak
Prog Values
<i>Status of Prog</i>
<i>Prog Time Base</i>
<i>Seg # Time</i>
<i>Seg # SetPoint</i>
<i>Seg # A1 Event</i>
<i>Seg # A2 Event</i>
<i>Prog End</i>
<i>Alarm 2 Low</i>
<i>Alarm 2 High</i>
<i>Alarm 2 Deadbnd</i>
AntiRst Windup
PerCent Output
Loop Break Time
<i>Analog Output</i>
<i>Process OutLow</i>
<i>Process OutHigh</i>
<i>Process Out Src</i>
<i>Heat Output</i>
<i>Cool Outpu</i>
Remote Input
<i>Remote Signal</i>
<i>Remote SetPtLo</i>
<i>Remote SetPtHi</i>
<i>Remote FlowSLo</i>
<i>Remote FlowSHi</i>
<i>Flow Display</i>
<i>WaterFill Timer</i>
Peak PV
Valley PV
<i>Comm Local/Rmt</i>

PRIMARY MENU
System
<i>Monitor Temp</i>
<i>Alarm 1 Low</i>
<i>Alarm 1 High</i>
<i>PrgSeg#Remain</i>
<i>PrgSeg# Time</i>
<i>PrgSeg SetPt</i>
Tune Choice
<i>Damping Factor</i>
Prop Band Heat
Prop Band Cool
Reset Time
Rate Time
Cool Ratio
Aux Set Point
<i>Flow Alarm Low</i>
<i>Flow Alarm High</i>
Auto Vent Cycle
Crash Cool
High Heat
ElapsedTime
<i>Comm Addr(Hex)</i>

Menu Items in *Italics* are only present when appropriate options or option boards have been installed

Primary Menu Parameter Table

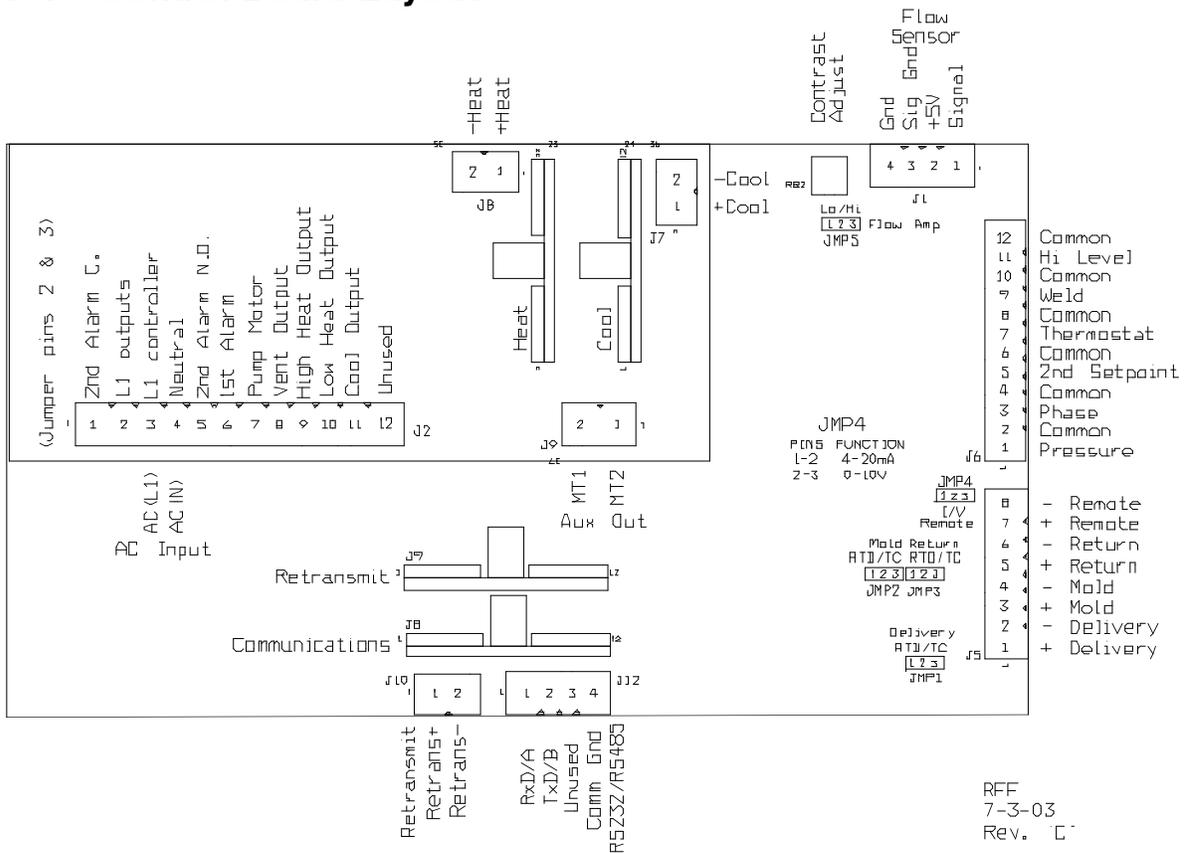
<i>LCD Text Message</i>	<i>Range</i>	<i>Units</i>	<i>Presets Water</i>	<i>Presets Oil</i>	<i>Presets Chiller</i>	<i>Parameter Description</i>
System = nnn	OFF/ON	-	ON	ON	ON	'ON' = normal operation 'OFF' = This will place the PID Control Loop on Standby and the heat and cool outputs will be turned off. Cannot change setpoint. LCD will display "System Standby". PV temp is still monitored.
Monitor Temp = ###	###	-	0	0	0	This is a status parameter indicating the current Mold temperature.
Alarm 1 Low =nnnn	(SPL) to (SPH)	F/C	0	0	0	This is the Alarm 1 Low Trip Point Setting. This setting applies in absolute and deviation alarm configuration modes. (Default setting shown is when Alarm 1 Mode = ABSL).
Alarm 1 High =nnnn	(SPL) to (SPH)	F/C	200	200	200	This is the Alarm 1 High Trip Point Setting. This setting applies in absolute and deviation alarm configuration modes. (Default setting shown is when Alarm 1 Mode = ABSL).
PrgSeg#Remain = ###	# ###	-	0	0	0	This is a status parameter indicating the Ramp Soak Time Remaining Status. This shows in real time, the time remaining for the current active ramp/soak segment.
PrgSeg# Time = ###	# ###	-	0	0	0	This is a status parameter indicating the Ramp Soak Time Status. This shows the time setting for the current active ramp/soak segment.
PrgSeg# SetPt = ###	# ###	-	0	0	0	This is a status parameter indicating the Ramp Soak Setpoint Status. This shows the final setpoint target for the current active ramp/soak segment.
Prop Band Heat = nnn	2 to 650	-	13	10	12	This is the PID Control Heat Proportional Band Setting.
Prop Band Cool = nnn	2 to 650	-	15	25	---	This is the PID Control Cool Proportional Band Setting.
Reset Time = nnn	OFF, 1 to 999	Sec	24	40	90	This is the PID Control Reset (Integral) Time
Rate Time = nnn	OFF, 1 to 999	Sec	6	8	100	This is the PID Control Rate (Derivative) Time
Cool Ratio = nnn	OFF, 1 to 50	-	2	10	1	This is the PID Control Cooling Ratio
Aux Set Point = nnn	(SPL) to (SPH)	F/C	0	0	65	This sets the Auxiliary Set Point Value
Flow Alarm Low = nnn	OFF, 1 to 250 Gal / 946 Lit	-	1	1	1	This select the Flow Alarm Low Trip Point Setting
Flow Alarm High= nnn	OFF, 1 to 250 Gal / 946 Lit	-	100	100	100	This select the Flow Alarm High Trip Point Setting
Auto Vent Cycle= nnn	OFF, 1 to 10(Water), 1 to 60(Oil)	Min	1	1	OFF	Value causes an Auto Vent operation at power on
Crash Cool = nnn	OFF/ON	-	OFF	OFF	OFF	'ON' sets the Setpoint to 0 and turns on the COOL output
High Heat =nnnn	OFF/ON/AUTO	-	AUTO	ON	OFF	'OFF' = alternate Low A Heat and Low B Heat 'ON' = always High Heat 'AUTO' = High Heat outside PB, alternate Low A / Low B inside PE
ElapsedTime=#####	#####	Hrs	0	0	0	This is a status parameter indicating the total hours system is on
Comm Addr (Hex) =nnnn	0001 to 03E7	-	0001H	0001H	0001H	Same as Comm Addr parameter in Secure Menu

Secondary Menu Parameter Table						
LCD Text Message	Range	Units	Presets Water	Presets Oil	Presets Chiller	Parameter Description
Degrees (F/C) = n	C/F	F/C	F	F	F	Thermal Units
Precision = nnnnnn	Integer/Decimal	-	Integer	Integer	Integer	Thermal Variable Precision. Integer or Decimal
Alarm1 Cfg = nnnn	OFF/LOW/HIGH/HILO/EVNT	-	OFF	OFF	OFF	Selects the Alarm 1 Configuration mode
Alarm1 Mode = nnnn	ABS/DEVI	-	DEVI	DEVI	DEVI	Selects Absolute or Deviation for Alarm 1
Alarm1 Reset = nnnn	HOLD/ONOF	-	ONOF	ONOF	ONOF	Alarm Reset – auto reset / manual reset
Alarm1 PwrInhb = nnn	OFF/ON	-	ON	ON	ON	Power Inhibit – suspend alarm until PV enters non-alarm condition
Contact@Alarm1=nnnn	OPEN/CLOSE	-	CLOSE	CLOSE	CLOSE	Alarm1 Output Configuration (Open or Close for alarm condition)
Prog Ramp/Soak = nnn	OFF/ON	-	OFF	OFF	OFF	Disable/Enable the Ramp Soak Operation
Prog Values = nnn	OFF/ON	-	OFF	OFF	OFF	Disable/Enable changing of the 16 segments values
Status of Prog = nnn	OFF/ON	-	OFF	OFF	OFF	Disable/Enable R/S Status parameters display in Primary Menu
Prog Time Base = nnn	60s/1s	Sec	1s	1s	1s	Time base for each R/S segment
Seg # Time = nnn	0 to 999	Sec	0	0	0	Ramp Soak Segment Time for indicated segment
Seg # SetPoint=nnnn	(SPL) to (SPH)	F/C	0	0	0	Ramp Soak Setpoint for indicated segment
Seg # A1 Event = nnn	OFF/ON	-	OFF	OFF	OFF	Ramp Soak Alarm 1 Event for indicated segment
Seg # A2 Event = nnn	OFF/ON	-	OFF	OFF	OFF	Ramp Soak Alarm 2 Event for indicated segment
Prog End = nnn	OFF/HOLD/LOOP/SETP	-	OFF	OFF	HOLD	Ramp Soak Program End Task. OFF = system will power off at end of the sequence HOLD = system will control at last segments setpoint LOOP = system will continuously loop through sequence SETP = system will control at setpoint prior to sequence
Alarm 2 Low = nnnnn	(SPL) to (SPH)	F/C	100	100	100	This is the Alarm 2 Low Trip Point Setting. This setting applies in absolute and deviation alarm configuration modes. (Default setting shown is when Alarm2 Mode = ABSL).
Alarm 2 High = nnnnn	(SPL) to (SPH)	F/C	200	200	200	This is the Alarm 2 High Trip Point Setting. This setting applies in absolute and deviation alarm configuration modes. (Default setting shown is when Alarm2 Mode = ASL).
Alarm 2 DeadBnd= nnn	0 to 180	-	5	5	5	Alarm 2 Hysteresis for Process Alarms
AntiRst Windup = nnn	OFF/ON	-	ON	ON	ON	Anti-Reset Windup
PerCent Output = nnn	OFF/ON	-	OFF	OFF	OFF	*ON* allows display of % Output on LCD
Analog Output=nnnnn	0-20mA,4-20mA, 0-5V,1-5V,0-10V,2-10V	-	4-20ma	4-20ma	4-20ma	This Selects the Interface Type and Range for the Analog Output
Process OutLow = nnnn	(SCL) to (SCH)	F/C	0	0	0	Process Output Low value
Process OutHigh=nnnn	(SCL) to (SCH)	F/C	250	550	250	Process Output High value
Process Out Src=nnnn	PROC/SETP/FLOW	-	PROC	PROC	PROC	Process Output Source Select – process / setpoint / flow
Heat Output = nnnn	0-20ma,4-20ma 1-5V,0-5V,0-10V,2-10V	-	4-20ma	4-20ma	4-20ma	This selects the Interface Type and Range for the Heat Output Option Card
Cool Output = nnnn	0-20ma,4-20ma 0-5V,1-5V,0-10V,2-10V	-	4-20ma	4-20ma	4-20ma	This Selects the Interface Type and Range for the Cool Output Option Card
Remote Input = nnnn	OFF,SETP,FLOW	-	OFF	OFF	OFF	This Selects the Function of the Remote Input
Remote Signal = nnn	0-20ma,4-20ma, 0-5V,1-5V,0-10V,2-10V	-	4-20ma	4-20ma	4-20ma	This Selects the Interface Type and the rang for the Analog Input
Remote SetPtLo = nnn	(SCL) to (SCH)	-	0	0	0	Remote Set Point Low value
Remote SetPtHi = nnn	(SCL) to (SCH)	-	250	550	250	Remote Set Point High value
Remote FlowSLo = nnn	-999 to +999	-	0	0	0	Flow Scale Low when Remote Input is used as Flow
Remote FlowSHi = nnn	-999 to +999	-	100	100	100	Flow Scale High when Remote Input is used as Flow
Flow Display = xxx	GPM / LPM	-	GPM	GPM	GPM	Flow Units – Gallons per minute or Liters per minute
WaterFill Timer= nnn	OFF/1 to 180	Min	60	60	60	Water Fill Timer in minutes
Peak PV = ###	###	F/C	-	-	-	This is a status parameter indicating the highest process temperature. Pressing the ENTER key while this parameter is displayed will cause the current process temperature to be saved as this value.
Valley PV = ###	###	F/C	-	-	-	This is a status parameter indicating the lowest process temperature. Pressing the ENTER key while this parameter is displayed will cause the current process temperature to be saved as this vale.

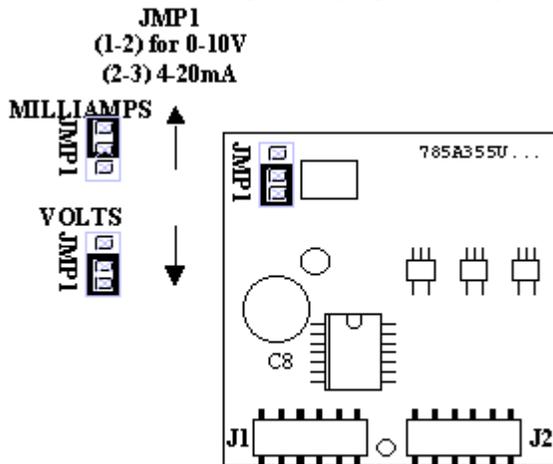
Secure Menu Parameter Table

LCD Year Message	Range	Unit	Presets Water	Presets Oil	Presets Chiller	Parameter Descriptive
Security Level = nnn	0 to 99	-	3	3	3	Refer to the section on "Changing the Security Level"
Unit Function = nnnnnn	HEATLO/HEATHI/CHILLER	-	HEATLO	HEATHI	CHILLER	This selects the Unit Function. There are three types of applications, water, oil, and chiller. The water unit has functions at systems level that detect pump and level status different from oil units. Refer to the section on restoring factory defaults
Tune% Reduction = nnn	OFF/1 TO 100	-	15	15	15	Adjusts the Actuator Duty Percentage
Input Correction = 0	-99 to 99	-	0	0	0	Offsets the PV temperature display value
Sensor Filter = nnn	OFF/1 TO 99	-	1	1	1	Sensor filter value
Display Filter = nnn	OFF/1 TO 99	-	3	3	3	Display filter value
SetPoint Source = nnn	AUT/SP1/SP2	-	AUT	AUT	AUT	Function Select - auto/setpoint 1/setpoint 2
Approach Rate = nnn	OFF/1 TO 99	Min	OFF	OFF	OFF	Time, in minutes, that it will take to get to a new setpoint change. MUST POWER OFF THEN POWER ON TO ACTIVATE
Sensor Monitor = snnn	OFF/HON/CTRL	-	OFF	OFF	OFF	Off = normal delivery probe PID control, Delivery probe display MOD = normal delivery probe PID control, Mold probe display CTRL = cascade Mold probe PID control, Mold probe display
Flow Monitor = nnn	OFF/PUL/CUR	-	OFF	OFF	OFF	Off = no flow value is displayed on the LCD PUL = flow is measured in pulses, value is displayed on LCD CUR = flow is measured in current, value is displayed on LCD
Flow Constant B = snnn	-999 TO +999	-	0	0	0	Offset of the displayed flow reading
Flow Constant K = snnn	-999 TO +999	-	1	0	0	Flow sensor scaling (K Factor or Pulses/gallon)
Flow Filter = nnn	OFF/1 TO 100	-	2	2	2	Flow Filter value
Safety Thermo = nnn	OFF/ON	-	ON	ON	ON	Disable/enable monitoring for a safety thermo error
Pressure/Level Imp = nnn	Pres/LVLAIR/LVLCNT	-	PRES	PRES	LEVL	Pressure select - pressure/level alarm/level control
PressLevel = nnn	OFF/ON	-	ON	ON	ON	Pressure input = off/on
Pressure Timer = nnn	OFF/1 TO 16	Sec	OFF	1	OFF	Pressure timer value
SP2/RelStart = nnn	OFF/SP2/HotF	-	SP2	SP2	SP2	Function select = off/set point 2/ remote start
HighLevelImp = nnn	OFF/LVHI/LvLo	-	OFF	LVLO	LVHI	Level select = off/high/Low
Mold Cont. Imp = nnn	OFF/ON	-	ON	ON	ON	Disable/enable monitoring for a mold contact error
Sensor Type = nnn	J/K/RTO/RTOIK	-	RTOIK	RTOIK	RTOIK	Selection for type of sensor being used for delivery/return temp
MoldSensorType = nnn	J/K/RTO/RTOIK	-	J	J	J	Selection for type of sensor being used for mold temp
Out1 Type = snnnn	1-80#	Sec	10#	10#	10#	Selects the output 1 cycle time in seconds
Out2 Type = snnnn	1-80#	Sec	8#	8#	8#	Selects the output 2 cycle time in seconds
SetPLimit = nnnnn	-30 to 650	-	0	0	32	Sets the lowest value allowed for setpoint
SetPHLimit = nnnnn	-30 to 650	-	550	550	65	Sets the highest value allowed for setpoint
Alarm2 Cfg = nnnn	OFF/LOM/HIGH/NIHL/EVNT	-	OFF	OFF	OFF	Selects the Alarm 2 Configuration mode
Alarm2 Mode = nnnn	ABSZ/DEVI	-	DEVI	DEVI	DEVI	Selects Absolute or Deviation for Alarm 2
Alarm2 Reset = nnnn	HOLD/ONCF	-	ONCF	ONCF	ONCF	Alarm Reset - auto reset / manual reset
Alarm2 PerInhb = nnnn	OFF/ON	-	ON	ON	ON	Power inhibit - suspended alarm until PV enters non-alarm condition
ContactAlarm2 = nnnnn	OPEN/CLOSE	-	CLOSE	CLOSE	CLOSE	Alarm 2 output configuration (open or close for alarm condition)
ElapsedTimeMode = nnn	OFF/ON/RET	-	ON	ON	ON	Enables/Disables elapsed time meter, or clears time value to zero
Comm Protocol = nnn	MOD/5PI	-	MOD	MOD	MOD	Selects either Modbus comm. Protocol or GPI comm. Protocol
Comm Addr (Hex) = nnnn	0001 TO 03E7	-	0001	0001	0001	Selects the comm. Address
Comm Baud Rate = nnnn	300/1200/2400/4800/9600/19K2/28K8/38K4/57K6	-	9600	9600	9600	Selects the comm. Baud rate.

## 7-4 Control Board Layout



## 7-5 DAC Board Layout (Optional)



NOTE: NOT ALL COMPONENTS ARE SHOWN

## 7-6 Electrical Specifications

### **General**

Dimensions	5.5" X 9" X 4"
Range of the Unit	-30°F to 650°F

### **Normal Operating Environment**

Operating Temperature Range	0° C to 60° C (LCD Display up-to 50° C)
Humidity	0 to 95% RH (Non condensing)

### **Storage Environment**

Storage Temperature Range	-10° C to 95° C
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### **Primary, Power Supply (Line Power)**

Typical Supply Voltages	120VAC, 60Hz
Operating Range	85 to 150Vac 50/60 Hz, Single Phase
Consumption (Max/Typical)	15 Max/ 12 Watts Typ.
Connector Type/Model	5.8 mm Terminal Connector

### **Alarm Outputs**

Mechanical relay Type (2 Outputs)	1A @120VAC INDUCTIVE (Alarm 1 tied to incoming AC, Alarm 2 contacts only/no applied power).
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### **External System Outputs**

SCR/Triac Type	120Vac, 1A continuously @ 60° C for all output loads. Snubbers to be applied externally by customer; there will be no board mounted snubbers
System Output Variables	Pump, Vent, Heater High/Low Cool, Aux (Purge), Alarm 1, Alarm 2

### **User Interface**

Keyboard	Membrane Type, with Snap Dome Contacts
LCD Backlight	LCD Brightness fixed/preset with Adjustable Pot. Backlight will automatically turn off when there is 5 minutes of inactivity on the Keyboard
Display	LCD Alphanumeric Display with Backlight

**Temperature Sensor Inputs**

Thermocouple Type	J, K, T Thermocouple Types (Class 2)
RTD Type	100 $\Omega$ , 1000 $\Omega$ RTD Type, 00385 COEF. 2 Wire (Class 2)
Measurement (Full Scale) Range	-30 °F to 650°F
Process/Setpoint Display Resolution	1° C, 1° F, 0.1° C, 0.1° F
Measurement Accuracy	$\pm$ 0.25% OF SPAN, $\pm$ LEAST SIGNIFICANT DIGIT
Number of Sensors Measured	Up-to, Three (3)
Common Mode Noise Rejection	100db MINIMUM AT 60 Hz.
Temperature Stability	4 uV/° C TYPICAL, 5 uV/° C MAX

**Flow Sensor Inputs**

Ranges	15-250Hz@80mV-1.6Vpp (sine) JMP5, pins 1-2 8-125Hz, 0-5Vdc pulsed JMP5, pins 2-3 (HI)
Resolution	15-250Hz@80mV-1.6Vpp (sine) JMP5, pins 1-2 8-125Hz, 0-5Vdc pulsed JMP5, pins 2-3 (HI)

**System Inputs**

Type	Dry Contact (0.5mA @ 5 Vdc Sense) CLASS 2
System Input Variables	Pressure / Low Level Phase Detection (2 Switches In Series) 2nd Setpoint / Remote Start Safety Thermostat Weld Contact Detect High Level
System / Dry Contact Input Ground	Common Grounding

**Optional Analog Output Modules**

Range	4-20mA @ 500 OHMS or 0-10Vdc, Jumper Selectable
Variables	Process Temperature, Setpoint Temperature, Heat, Cool
DAC Resolution	12 Bits

## Quick Start Guide: Water TCUs

This Quick Start Guide can be used only if the controller has been properly installed and wired. All operators must be familiar with the Operation and Installation Manual before proceeding.

### Turning the Power On

When AC power is first applied to the unit, the following sequence of events will occur:

1. The LCD backlight lights up.
2. The LCD displays dashes: LEDs have all segments on.
3. The LCD displays the PROM Rev/Date.
4. The LCD displays "SelfTest in Progress."
5. If the 'Debug' parameter is enabled, the following messages about Option Cards can be displayed:
  - Re-Transmit Detected
  - Cool Analog Detected
  - Heat Analog Detected
  - Serial Comm Detected
  - None Installed
6. The LED segments turn off.
7. The LCD backlight turns off.
8. The LCD displays "Power Available/System OFF."

At this point a Manual Vent Operation can be initialized for 8 seconds by pressing the Vent button.

The unit is now in a standby mode of operation. No system process control will occur until the Start button is pressed.

### Starting the Unit

Press the Start button to begin the following sequence of events:

1. The green LED inside the Start button lights up.
2. The LCD backlight lights up.
3. The Pump Output turns on.
4. The LCD displays the setpoint value, process temperature, return temperature, and delta temperature.
5. If the Auto Vent Cycle parameter is enabled, the Vent Output turns on, and the LCD displays "Vent Time = mm:ss."
6. When the Auto Vent timer expires or if the Auto Vent Cycle parameter is disabled, the LCD displays "RUNNING," and system control begins.

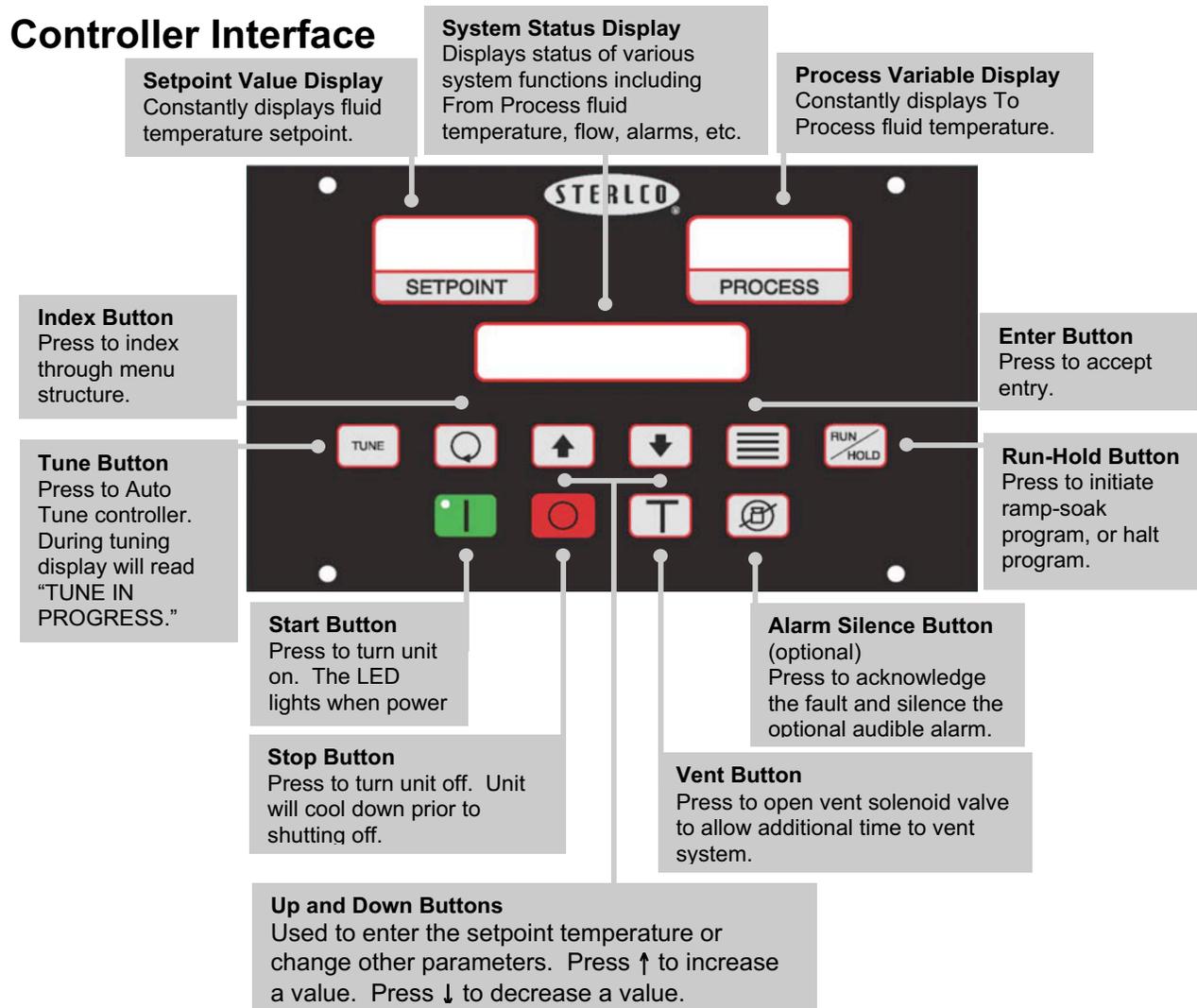
### Stopping the Unit

While the system is running, press the Stop button to shut down the system. If the process temperature is below 150°F, the system will immediately shut down. If the current process temperature is above 150°F, pressing the Stop button will begin the following sequence of events:

1. The LCD displays "SHUTDOWN [Cool Down]."
2. The setpoint changes to 150°F.
3. The Heat Outputs will turn off.
4. The Cool Output will turn on.
5. The system waits for the process temperature to drop down to 150°F.
6. At 150°F, the LCD displays "SHUTTING DOWN."
7. All outputs immediately turn off.
8. The system recycles to the "Power Available/System OFF" state.

Note: Pressing the Stop button a second time while the controller is in the "SHUTDOWN [Cool Down]" mode will abort this cool down operation and the system will immediately go into the "SHUTTING DOWN" phase of the operation.

## Controller Interface



### LED Displays

**Setpoint LED.** The setpoint LED display has four digits. The desired control setpoint is shown as temperature, in either °F or °C. The setpoint can be displayed as either an integer or as a decimal.

**Process LED.** The process LED display has four digits. The "To Process" temperature is shown in either °F or °C. The To Process temperature can be displayed as either an integer or as a decimal.

### LED Indicator Lights

The M2B+ Controller has one LED that will light up to indicate the control process has been started. This LED is located inside the Start button of the controller's front panel. When power is applied, the LED will remain off until the Start button is pushed. The LED will then illuminate green.

### LCD Display

A 2-line by 20-character liquid crystal display (LCD) will show operational status, alarms and programming menus.

**1st Line.** The first line of the LCD continuously displays the "From Process" temperature (the delta temperature of the "To Process" and the "From Process"), and the flow in GPM or LPM if applicable.

**2nd Line.** The second line displays all menu items used in the controller setup. This line also displays the status of the pump, outputs for the heater, as well as cooling and elapsed time for the vent cycle. The second line also explains all alarm conditions along with status.

## Quick Start Guide: Hot Oil TCUs

This Quick Start Guide can be used only if the controller has been properly installed and wired. All operators must be familiar with the Operation and Installation Manual before proceeding.

### Turning the Power On

When AC power is first applied to the unit, the following sequence of events will occur:

1. The LCD backlight lights up.
2. The LCD displays dashes: LEDs have all segments on.
3. The LCD displays the PROM Rev/Date.
4. The LCD displays "SelfTest in Progress."
5. If the 'Debug' parameter is enabled, the following messages about Option Cards can be displayed:
  - Re-Transmit Detected
  - Cool Analog Detected
  - Heat Analog Detected
  - Serial Comm Detected
  - None Installed
6. The LED segments turn off.
7. The LCD backlight turns off.
8. The LCD displays "Power Available/System OFF."

At this point a Manual Vent Operation can be initialized for 8 seconds by pressing the Vent button.

The unit is now in a standby mode of operation. System will not occur until the Start button is pressed.

### Starting the Unit

Press the Start button to begin the following sequence of events:

1. The green LED inside the Start button lights up.
2. The LCD backlight lights up.
3. The Pump Output turns on.
4. The LCD displays the setpoint value, process temperature, return temperature, and delta temperature.
5. If the Auto Vent Cycle parameter is enabled, the Vent Output turns on, the green LED blinks, and the LCD alternates between "Mode is OFF," "Press START to Run," and "Vent Time = mm:ss."
6. When the Auto Vent timer expires or if the Auto Vent Cycle parameter is disabled, the LCD alternates between "Mode is Off" and "Press START to Run."
7. Press the Start button. The display reads "Vent Time = mm:ss."
8. When the vent time expires, the LCD displays "RUNNING," and system control begins.

### Stopping the Unit

While the system is running, press the Stop button to shut down the system. If the current process temperature is above 150°F, pressing the Stop button will begin the following sequence of events:

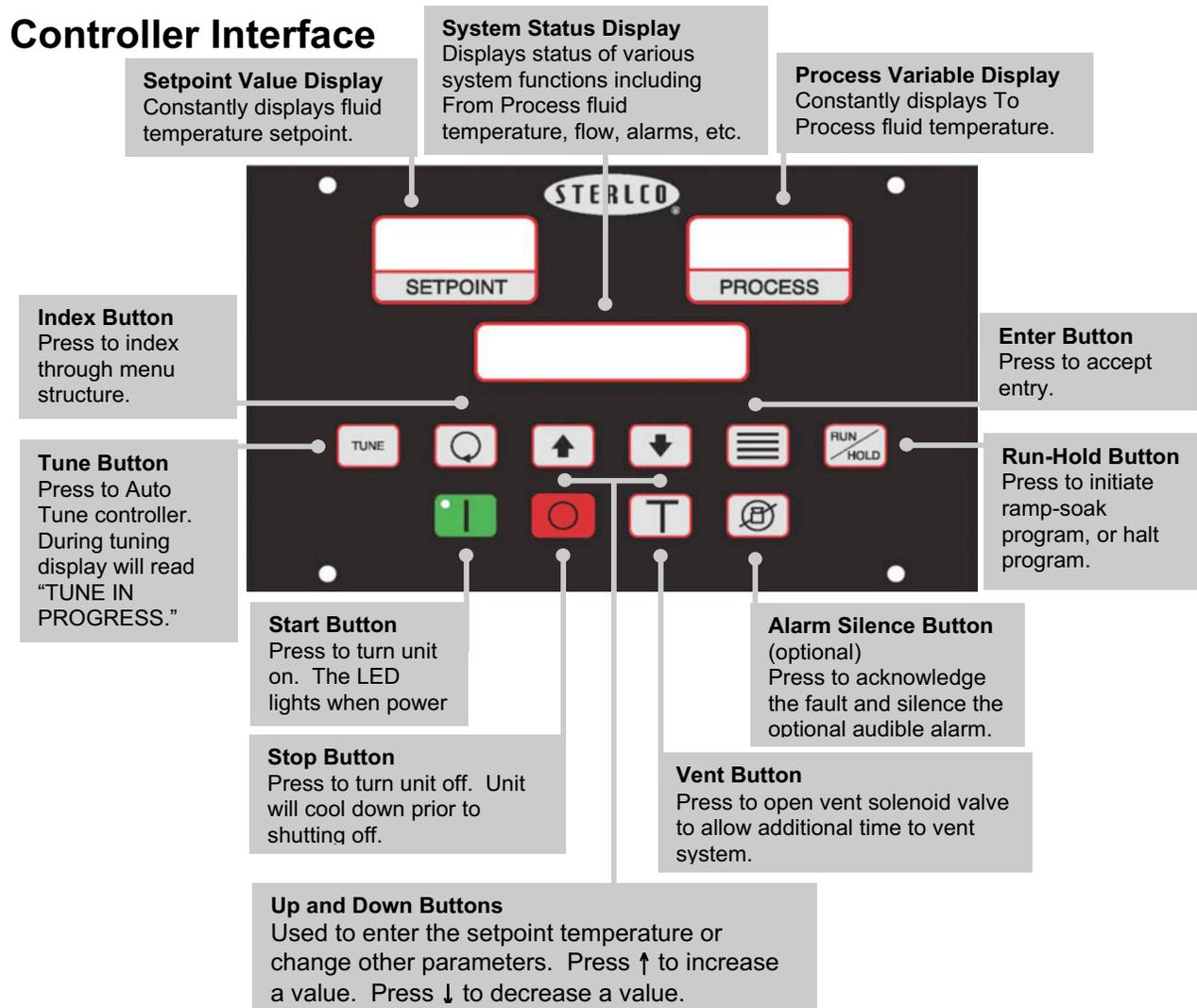
1. The LCD displays "SHUTDOWN [Cool Down]."
2. The setpoint changes to 150°F.
3. The Heat Outputs will turn off.
4. The Cool Output will turn on.
5. The system waits for the process temperature to drop down to 150°F.
6. At 150°F, the LCD displays "SHUTTING DOWN."
7. All outputs immediately turn off.
8. The system recycles to the "Power Available/System OFF" state.

Note: Pressing the Stop button a second time while the controller is in the "SHUTDOWN [Cool Down]" mode will abort this cool down operation and the system will immediately go into the "SHUTTING DOWN" phase of the operation.

If the process temperature is below 150°F, all outputs will turn off, and the controller will begin Pump Reverse mode. The LCD will display "Shutdown [PmpRevOff]" for 30 seconds before the system recycles to the "Power Available/System OFF" state.

During the 30-second "Shutdown[PmpRevOff] mode, press the Up button to reverse the pump and purge oil from the mold. During pump reverse, the Vent Output and Pump Reverse outputs will turn on. The LCD will display "Shutdown[PmpRevON]" until the Up button is released, at which time the 30-second time-out will restart. After 30-seconds, the system will recycle to the "Power Available/System OFF" state.

## Controller Interface



### LED Displays

**Setpoint LED.** The setpoint LED display has four digits. The desired control setpoint is shown as temperature, in either °F or °C. The setpoint can be displayed as either an integer or as a decimal.

**Process LED.** The process LED display has four digits. The "To Process" temperature is shown in either °F or °C. The To Process temperature can be displayed as either an integer or as a decimal.

### LED Indicator Lights

The M2B+ Controller has one LED that will light up to indicate the control process has been started. This LED is located inside the Start button of the controller's front panel. When power is applied, the LED will remain off until the Start button is pushed. The LED will then illuminate green.

### LCD Display

A 2-line by 20-character liquid crystal display (LCD) will show operational status, alarms and programming menus.

**1st Line.** The first line of the LCD continuously displays the "From Process" temperature (the delta temperature of the "To Process" and the "From Process"), and the flow in GPM or LPM if applicable.

**2nd Line.** The second line displays all menu items used in the controller setup. This line also displays the status of the pump, outputs for the heater, as well as cooling and elapsed time for the vent cycle. The second line also explains all alarm conditions along with status.