

## 2.1 Power Controls and Indicators

### 2.1.1 Power Status Indicators

#### A. MAIN POWER ON - White Indicator

This lamp burns continuously when power is available to the furnace. The 3-phase disconnect switch and facility circuit breaker (optional) must be turned on and the EMO buttons and Safety Interlocks must be closed.

#### B. FURNACE POWER ON – Yellow/Amber Indicator

This lamp burns continuously when the control circuits are energized, and indicates that power is available to actuate the control circuits.



Figure 2-1 Control Console  
Furnace Power ON and OFF & Indicator Lights



Figure 2-2 Control Console  
with keyboard & monitor.

#### C. ALARM HORN and Silence Switch

This horn provides audible feedback for furnace system alarm conditions. The silence switch lights when alarm horn is silenced.

#### D. BELT CLEANER - Fill, Run & Drain Indicating Lamps – (included option)

Lamps light to indicate status of Ultrasonic Cleaner Dry system. See logic table on drawing 802-101787.

#### E. COOLING – Fan Cooling Speed Control - (included option)

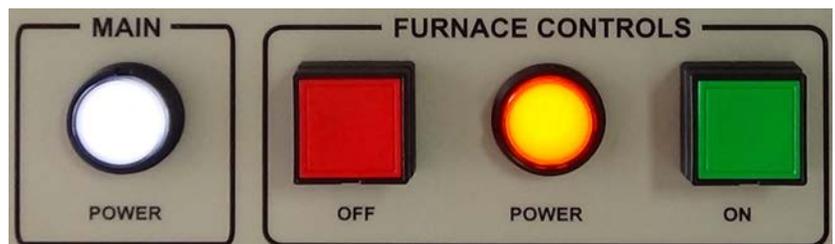
Turns on/off and adjusts the speed of the product/belt cooling fans at the furnace exit.

#### F. USB Ports

One (1) USB 2.0 port is provided on the back of the professional computer monitor to connect a jump drive or other device. USB 2.0 ports on the front of the furnace can be used for connecting profiling equipment.

### 2.1.2 Power Console

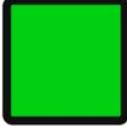
Figure 2-3 Power Buttons  
Main Power ON



## Section 2

### A. MAIN FURNACE POWER

Table 2-1 Main Furnace Power		
MODE	ON	OFF
MAIN FACILITY BREAKER	Power to TR0 only: 1. MAIN POWER light (white) on 2. PC-S1 and PC-S2 sockets live for PC and monitor	No power to furnace.
3-PHASE CIRCUIT BREAKER DISCONNECT 	Lockable circuit breaker furnace disconnect switch. Switch must be turned ON to provide power to furnace.	No power to furnace, computer or monitor
EMO SWITCHES  <b>Standard (Vertical Mount) EMO</b>  <b>Optional Horizontal mount EMO</b>		Operator activated Emergency Power Off switch located at furnace entrance and exit immediately cuts power to furnace. UPS keeps PLC, PC and monitor on for 5-6 minutes.  Rotate EMO knob to reset.  FURNACE POWER ON button must be pressed to re-introduce power.
EPO PANEL SWITCHES 	For maintenance purposes only, pulling out on all exposed interlock switches will allow operation of the furnace.  FURNACE POWER ON button must be pressed to re-introduce power.	If a lower panel is removed, emergency power interlocks will automatically cut power to furnace. UPS keeps PLC, PC and monitor on for 5-6 minutes. Replace panel or pull out exposed interlock switch to service position resume furnace operation.

Table 2-1 Main Furnace Power		
MODE	ON	OFF
<p>MAIN POWER ON</p>  <p style="text-align: center;">POWER</p>	<p>Lamp illuminates indicating that 3-phase power is connected to the furnace: facility main disconnect and the furnace circuit breaker are ON.</p>	<p>No power to furnace, computer or monitor</p>
<p>FURNACE CONTROLS ON</p>  <p style="text-align: center;">POWER</p>  <p style="text-align: center;">ON</p> <p>FURNACE CONTROLS OFF</p>  <p style="text-align: center;">OFF</p>  <p style="text-align: center;">POWER</p>	<p><b>Furnace Controls Power</b> lamp ON indicates power is supplied to the furnace control system.</p> <p>When <b>Furnace Controls Power</b> lamp is ON, pressing the red pushbutton instantly cuts power to the furnace control system, lamps and accessories, if the system has not been placed in Cool down.</p> <p>If the furnace has been placed in Cool down, pressing the red OFF button delays complete shutdown. IR lamps are turned off immediately. After all zones are below 100°C, the fans, transport belt, and other functions are shut down.</p> <p>In any event, the UPS will keep the PLC, PC and monitor on for 5-6 minutes after power is OFF to allow the user to properly shut down the furnace control software and PC.</p>	<p><b>Furnace Controls Power</b> lamp OFF indicates furnace controller is OFF or in cool down.</p> <p>When <b>Furnace Controls Power</b> lamp is OFF, pressing the green pushbutton will power up the furnace control system and accessories if:</p> <ol style="list-style-type: none"> <li>a) All EMO and EPO interlock switches are closed;</li> <li>b) The UPS, PLC, PC and monitor are ON.</li> </ol>
<p>POWER FAILURE</p>		<p>A power failure will instantly cut power to the lamps. The UPS will keep key parts of the control system (PLC, PC, monitor, belt motor, fans) ON for 5-6 minutes after power is OFF to allow user to properly shut down the furnace control software and PC, and to remove as many parts as possible being processed within the furnace.</p>

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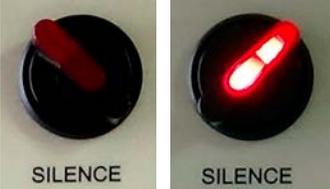
Table 2-2 Special Controls		
MODE	ON	OFF
<p>Cooling Fan Speed Control</p>  <p>Located on Control Console</p>	<p>Adjusts product/belt cooling fan speed. When furnace control system is ON, adjust switched knob clockwise to increase cooling section fan speed. To decrease cooling fan speed turn knob counterclockwise. Turn knob all the way counterclockwise to click at position 0 to turn OFF cooling fans completely.</p>	<p>Turn knob full counterclockwise to turn fans OFF.</p>
<p>SILENCE Switch</p>  <p>Inactive (OFF)    Active (ON)</p> <p>Located on Control Console</p>	<p>When active, Silence switch mutes audible alarms sound. Lights when active to indicate alarms are silenced. Software indicates alarm condition normally by flashing Alert or Alarm button and logs alarm.</p>	<p>DEFAULT. Audible alarms sound normally. Software indicates alarm condition by flashing Alert or Alarm button and logs alarm</p>
<p>UCD Indicating Lights</p>  <p>Located on Control Console</p>	<p>When UCD system is running, red lamp lights during UCD tank fill. Green lamp lights during UCD system recirculation. Green lamps blinks slowly during tank cool down (about 10 minutes). Yellow lamp lights during tank drain.</p>	<p>DEFAULT. All lights are off when UCD system is not active.</p>
<p>UPS POWER Switch</p>  <p>Service On/Off switch - located behind the computer door on the front of the UPS</p>	<p>DEFAULT. Controls AC power to Computer and PLC panel DC power supplies that supply power for Controller and control auxiliaries, including pressure alarms and element monitoring system. ON during all normal furnace operations.</p>	<p>Useful to cycle or service controller or control system analog and digital I/O devices. Shut down PLC after power disconnect of failure.</p>

Table 2-3 Software – Furnace Control		
SOFTWARE MODE	WARMUP	COOL DOWN
<p>PROCESS SCREEN</p> 	<p>If FURNACE POWER is ON, 1) energizes lamps and edge heaters via C1 lamp contactor,</p> <p>If FURNACE POWER is OFF, no effect</p>	<p>If furnace is in WARM UP or PROCESS READY modes, places furnace in COOL DOWN mode. Immediately shuts off lamps and edge heaters by opening C1 lamp contractor and furnace begins to cool. Unless the user enters AUTOMATIC SHUTDOWN mode, there is no other effect on the furnace, the furnace can be left in this standby mode indefinitely without harm.</p> <p>AUTOMATIC SHUT DOWN: When in COOL DOWN mode, user may enter AUTOMATIC SHUT DOWN mode by pressing the redo OFF pushbutton on the control console. In AUTOMATIC SHUT DOWN mode, when all furnace zones have called below 100C, power will be cut to the furnace control system and accessories. The user should properly shut down the PC via the Windows operating system before power is cut.</p>

## Section 2

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### **B. COMPUTER POWER**

COMPUTER SWITCHED (Default). The computer has been wired to be powered from a switched power source. Although protected momentarily by the UPS, the computer should always be shut down via the Windows operating system before the furnace is shutdown . Otherwise the computer shuts down when the red Furnace Control power OFF button is pressed or if Main Power is removed from the furnace.

The momentary power button on the front of the computer must be pressed to start the computer if the computer does not start when the green Furnace Control ON button is pressed.

Note: Pressing the red FURNACE CONTROLS OFF button on the Furnace Console will not cut power to the monitor.

## 2.2 Software – Main screens

This section describes the main screens with a description of their use and the information presented on each. Detail regarding changing setpoint values can be found in 2.6 Modifying Control Strategies. Changing setpoint values requires level 3 access or higher.

### 2.2.1 Screen Menu bar

Located at the bottom of the main screens, the Menu bar allows operator to select a desired screen by moving the cursor and clicking on the chosen screen button. Note: Items on the Menu bar will vary according to furnace features and user log-in level. Typical screens and their functions are:

**Lamps screen**– polls heating elements and provides failure indication during furnace operation.

**Log-On screen**– log on to the furnace program and to view user access and furnace information

**Process screen** – Main operating screen. Display setpoints and values in the furnace controller.

**Recipe screen** – set, name, edit, store and retrieve operating parameters for each desired process to be run. Access gas flowmeter screen.

**Alarm popup screen** – view and silence/reset alerts and alarms and recent history.

**Service screen** – furnace tuning and calibration.

**Profile shortcut** – access profiling software, if present.

**Auxiliary screens** – quick access to Windows™ Calculator and Notepad and:

**IO Status** – status of input and output signals for troubleshooting.

**Trends** – current and historical operating levels for zone top/bottom power, temperature, temperature deviation as a function of time.



Figure 2-4 Screen Menu bar

### 2.2.2 Top Status bar

The top Status bar displays process state, recipe running in the furnace controller and name of the user that is currently logged-on. Use the Select button on the Status bar to initiate or kill the furnace process.

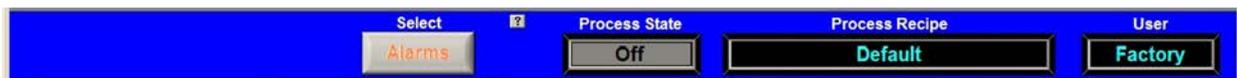
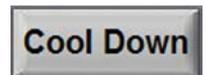


Figure 2-5 Top Status bar

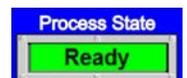
#### A. Select (Process Action) button

The Process choices include Warm Up, Cool Down. Press the Warm Up button to introduce power to the heating lamps. The furnace remains in Warm Up until all zones are  $\pm 2\%$  of setpoint for over 60 seconds, then the green Process Start indicator and green READY box will lite. Pressing the Cool Down button starts the cool down sequence.



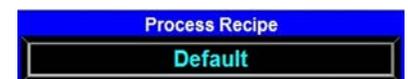
#### B. Process State indicator

Indicates the current state of the furnace: Warm Up, Process Ready, Cool Down, and Alarm.



#### C. Recipe indicator

The Recipe indicator displays the recipe currently in running in the furnace controller.



#### D. User indicator

The User indicator displays the name of the user currently logged on to the furnace software.



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### 2.2.3 Furnace Log-On screen

Log-On

From the Menu Bar, select Log-On button to access the Log-On & User Information screen.

#### A. User and Furnace Information

From the Log-On screen, select User name to log-on. You can also select log-off, and depending on access level, add or delete users, and modify password and access codes.

The Log-On screen also displays information about the furnace model and configuration.

#### B. Access Level Permissions

Operator, Level 1	Allows the operator to start, stop the furnace and load and run a recipe and initiate a process.
Maintenance Engineer, Level 2	Operator level plus calibration and test
Process Engineer, Level 3	Maintenance Engineer level plus operation Set-point, recipe changes.
Supervisor, Level 4	Process Engineer level plus User management
Factory, Level 5	Factory level. Restricted to Manufacturer's personnel only.

#### C. To Log-On, Select Access Level

Select Access Level by clicking on the User Name, click Log-On and enter the appropriate password and select Ok.

The system is shipped with five (5) access levels enabling the Supervisor to add User Names (with designated Access levels) each with its own password.

The screenshot displays the Log-On screen for the TP Solar SMD-615 furnace. At the top, the system identifies itself as 'SMD-615 Carsem (M)' and shows the date and time as 'Saturday 09/13/2014 11:55:15'. A navigation bar contains buttons for 'Select', 'Process State' (set to 'Off'), 'Process Recipe' (set to 'Default'), and 'User' (set to 'None').

The central part of the screen features a table of users:

User Name	Access Level	Last Log-On
Peter	Operator	04/07/2014 11:11:16
Process Alex	Process Engineer	04/07/2014 11:11:36
Maint Man	Maintenance Engineer	07/01/2013 09:02:35
Supervisor	Supervisor	07/01/2013 09:02:54
Factory	Factory	08/30/2014 11:50:41

Below the table, a 'Furnace Information' section provides detailed specifications:

- Company: Carsem (M)
- Furnace Model: SMD-615
- Specification Number: 14-005
- Serial Number: 1506151401
- Software Version: 14.06.19 Kernel: R8.5d
- Shipping Date: 09/05/2014
- Electrical: 415 VAC, 3 Phase, 50/60 HZ; Amps: 100; Power: 42 KW
- Mechanical: Process Gas: Nitrogen @ 70 PSI; Transport Speed Range: 4 to 80 (in/min); Maximum Temperature: 600 Deg C; Product Clearance: 2.0 in (50.8mm) above belt; Heating Length: 60 Inches; Zones: 6; Edge Heats: 1; Fans: 0
- Alarm Set Points: 80°C Cabinet Temp; 50 O2 ppm

The bottom of the screen has a menu bar with buttons for 'Lamps', 'Log-On', 'Process', 'Recipe', 'Alarm', 'Service', 'Profile', 'Notepad', and 'Calculator/Trends'.

Figure 2-6 Log-On screen

### D. Adding users (Supervisor level only)

Click on blank user name field. A User Edit window will open.

Click on **User Name** to add the name.

Click on **Access Level** to set the access level, Click on **OK** to close the window.

The password is set by logging in as the new user and entering the password. The password can be set by the supervisor or by the new user. Once set, it can only be changed by a supervisor. See Editing Users below.

### E. Editing users (Supervisor level only)

Click on the user name. A User Edit window will open.

Click on **Delete** to remove the user.

Click on **User Name** to change the name.

Click on **Access Level** to change the access level.

Click on **Reset Password** to erase the password. The password is set by logging in as the new user and entering the new password.

Click on **OK** to close the window.

2.2.4 Furnace Process Screen



A. Process screen overview

Select the Process button on the menu bar to view the Process screen. The Process screen displays the zone temperature, setpoint temperature, the Process Recipe, Process State, Belt speed and setpoints, and other information such as percentage of power to elements and edge heater settings. Status of optional equipment such as Nitrogen Pre-Purge system, Oxygen and/or Moisture sample levels, selected sampling system port, ultrasonic cleaner status is also displayed

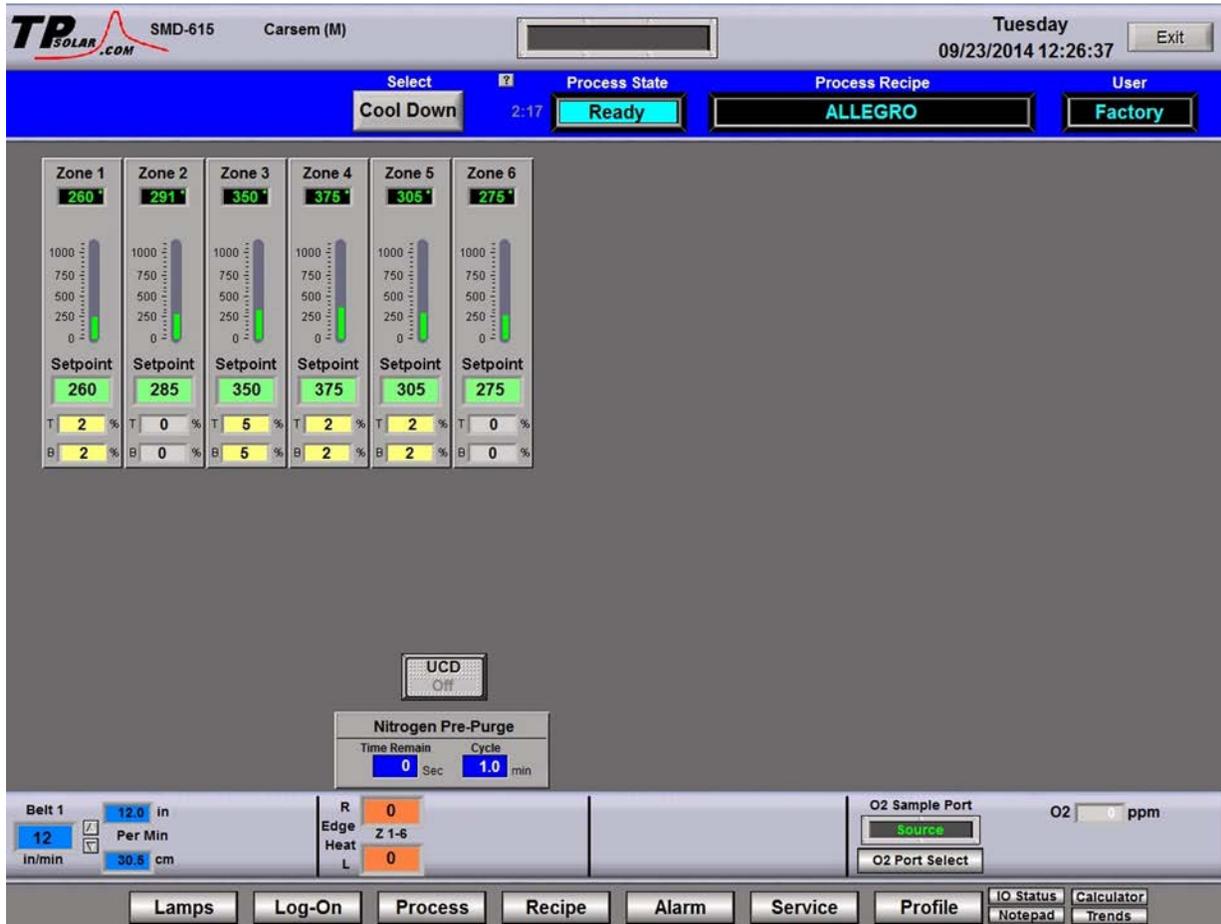


Figure 2-7 Process screen

B. Zone Temperature display

Temperatures measured in each zone are displayed below each zone title as shown in Figure 2-8.



Figure 2-8 Zone Temperature display

C. Zone Setpoint Temperature display

Setpoint Temperatures for each zone are displayed below the Setpoint label for each zone as shown in Figure 2-9. Click on the setpoint to enter a new setpoint temperature. It will change immediately.



Figure 2-9 Zone Temperature setpoint

## D. Temperature Deviation bar display

The actual zone temperature is displayed graphically using a vertical bar. The bar changes color based upon deviation from setpoint as set in the recipe running in the furnace. The bars are green for normal conditions, and change color independently as the deviation in a given zone changes. Scale is 0-1000 C of setpoint.

Color	Indicates zone is
Red	Hot
Yellow	Warm
Green	Normal
Light Blue	Cool
Blue	Cold

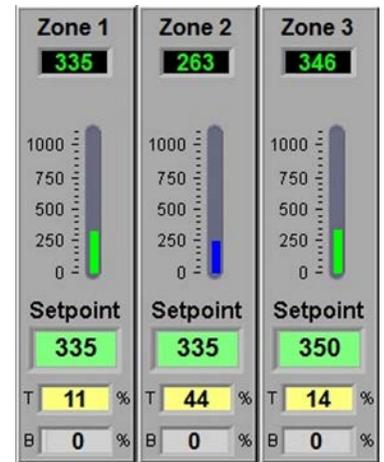


Figure 2-10 Zone Temperature display

## E. Top and Bottom Power display

Real time zone top and bottom power applied to each zone is displayed below the Setpoint Field labeled T and B respectively. Click on any power display field to change setpoint. Changes will be sent to furnace immediately.

## F. Belt Speed Display

The measured belt speed is displayed in English and metric units.



Figure 2-11 Belt Speed display

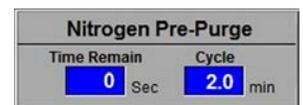
## G. Edge Heater Setpoint display

If equipped with Edge Heaters, the setpoint for each pair is displayed in the Right and Left fields as shown in the figure below. To change an edge heat value, click on the value and enter a new number from 0 – 100 percent. Changes will be sent to furnace immediately.



## H. Nitrogen Pre-Purge status display

Temperatures measured in each zone are displayed below each zone title as shown in the figure below. Click on the cycle time to change. Click on the Time remaining to reset to zero. Changes will be sent to furnace immediately.



## I. Oxygen Sampling System display

Selected sampling port and measured oxygen level are displayed. When system is off, O2 level will read zero. click on the O2 port select to select another port or change alert and alarm values. Changes will be sent to furnace immediately.



## J. UCD button and status indicator

The UCD button will indicate when the ultrasonic system is running. Click on the button to change start time and run duration.



## Section 2

### 2.2.5 Recipe screen

Recipe

#### A. Recipe screen overview

The Recipe screen is used to create, edit and load a recipe into the furnace. A recipe can be created for each process (level 3+ access) that can save temperature zone setpoints, alert and alarm levels, PID Gain and Integral parameters, and top and bottom power levels for reuse every time the process is run. Recipes stored on the furnace computer can be accessed and sent to the furnace from the Recipe screen.

**Editing.** The Editing box displays the recipe currently loaded into the Recipe editor.

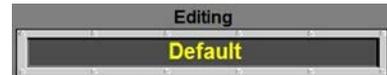


Figure 2-12 Recipe Editing box

The screenshot shows the 'Get Recipe from' screen. At the top, it displays 'TP SOLAR .COM', 'SMD-615', 'Carsem (M)', and the date/time 'Tuesday 09/23/2014 13:07:53'. Below this is a status bar with 'Select Warm Up', 'Process State 2:31 Off', 'Process Recipe ALLEGRO', and 'User Factory'. The main area features a table of recipe parameters for six zones.

Description	1	2	3	4	5	6
High Alarm	280	305	370	395	325	295
High Alert	270	295	360	385	315	285
Setpoint	260	285	350	375	305	275
Low Alert	250	275	340	365	295	265
Low Alarm	240	265	330	355	285	255
Top Power %	80	80	80	80	80	80
Bottom Power %	100	100	100	100	100	100
Bottom Track Top	<input checked="" type="checkbox"/>					
Gain	5	10	10	10	10	10
Integral	35	25	25	25	25	25
Voltage Control Btm						
Set Btm Volts						

Below the table are controls for 'Get Recipe From' (Disk, Process), 'Editing ALLEGRO', and 'Send Recipe To' (Process, Default). There are also sliders for 'Top Power Limit' (set to 80%) and 'Bottom Power' (set to 100%), and a 'Zone 1' temperature control panel with various alarm and setpoint values.

Figure 2-13 Get Recipe from Recipe screen

## 2.2.6 Recipe Gas Flow screen

Access the Gas Flow screen from the Recipe screen. Select Menu bar Recipe button and on the Recipe screen, select the Gas Flow button.



### A. Recipe Gas Flow screen overview

This screen is used to record and display the flowmeter settings for each recipe. The Gas Flow screen will be shown similar to Figure 2-14 . Values may vary for each recipe loaded.

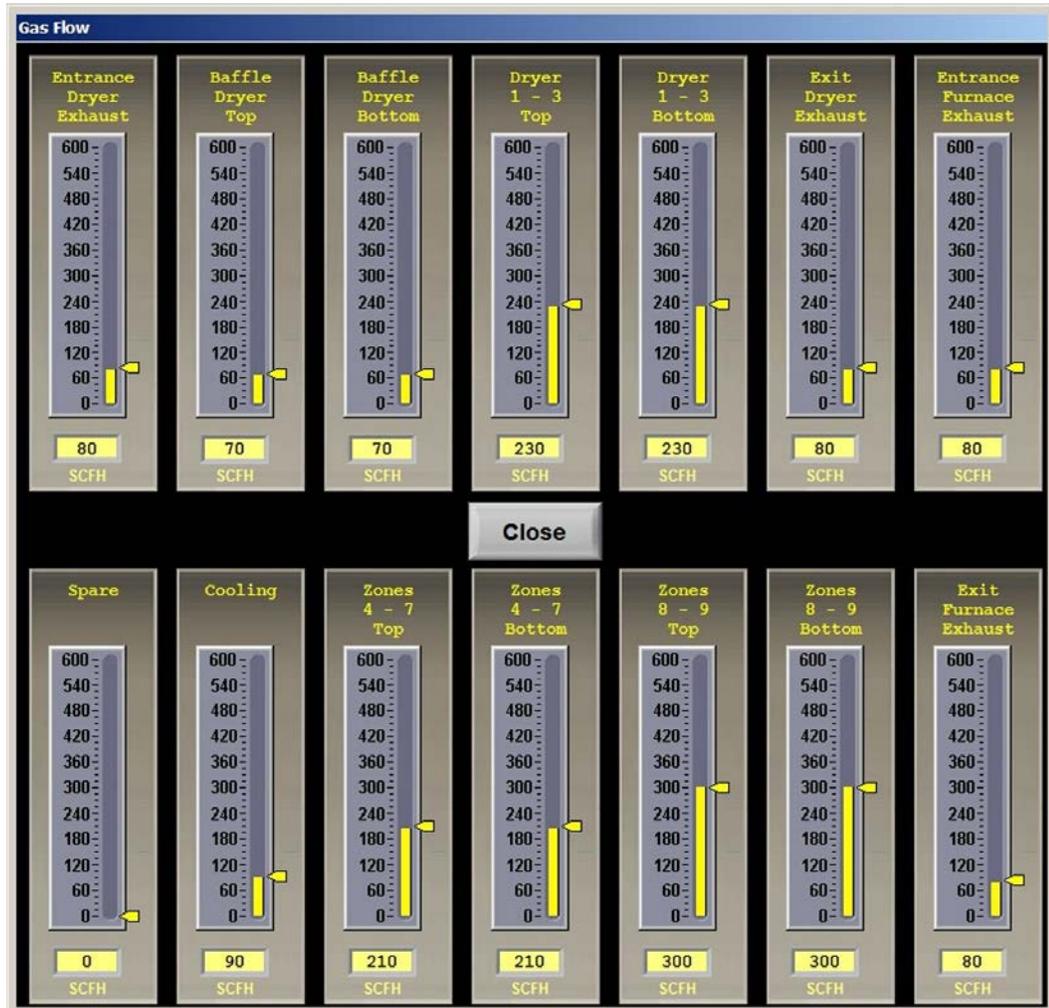


Figure 2-14 Recipe Gas Flow Screen

## Section 2

### 2.2.7 Service screen

Service

The Service screen is used to access furnace tuning and calibration features.

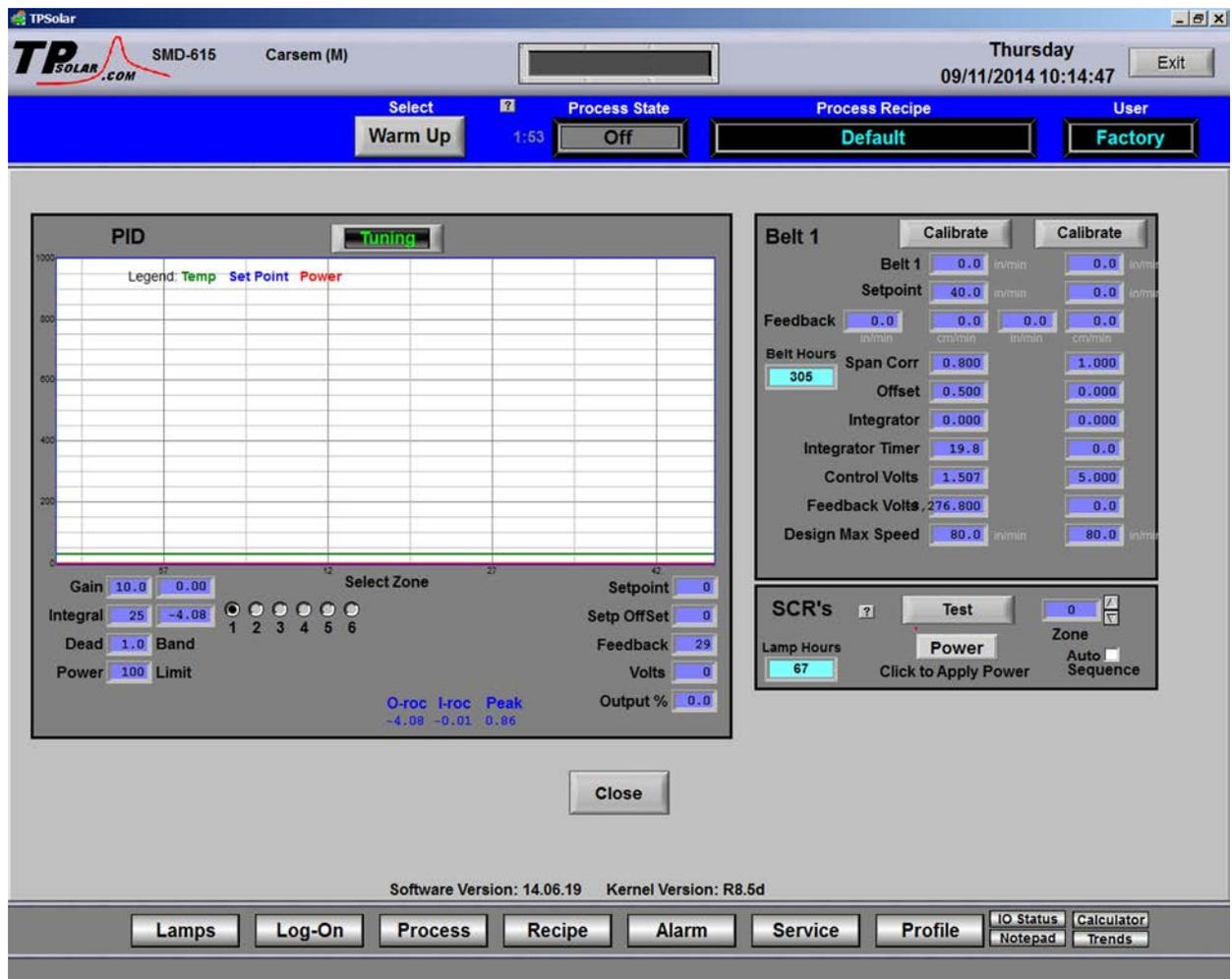


Figure 2-15 Service screen

### 2.2.8 Profile program

Profile

The Profile button is an optional feature that, if present, can be used to load a profiling program. The profiling program will run independently of the furnace program. Once activated the profiling program must be closed separately from the furnace program.

2.2.9 Lamps screen



The Lamps screen displays the status of the heating elements and lamp string failure indication.

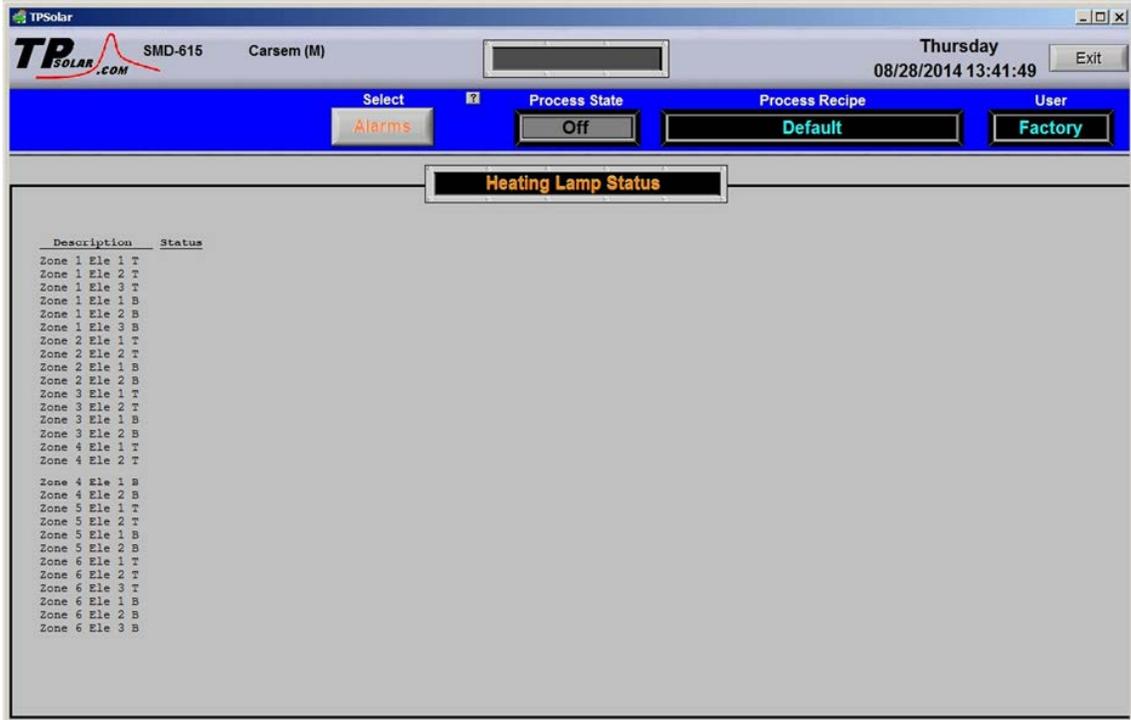


Figure 2-16 Lamps screen

2.2.10 Auxiliary screens and programs



Four quick access buttons are provided in the Menu bar:

**Windows™ Calculator** program

**Windows™ Notepad** text editor program

**IO Status popup screen:** status of input and output signals for troubleshooting.

**Trends screen:** current and historical operating levels for zone top/bottom power, temperature, temperature deviation as a function of time.



Figure 2-18 Trends screen



Figure 2-17 I/O Status popup

## Section 2

### 2.3 Starting the Furnace

#### 2.3.1 Main Power Indicator

The MAIN POWER indicator must be lit to make sure facility power is provided to the furnace.

#### 2.3.2 Process Gas Pressure

Assure that clean dry compressed process gas is supplied to the furnace at a minimum of 4.8 bar (70 psig). Compressed gas must be delivered to the furnace walls, exit stack venturi and belt tensioners for proper operation of the furnace. If furnace is supplied with Auto Gas Shutoff feature, process gas will flow when Furnace Power ON is pressed.

#### 2.3.3 Power On/Startup

Follow the steps per the STARTUP table to start the furnace. See section 0 if restarting from Auto Shutdown

<b>1. Main Power</b>	Verify the white Main Power ON button is lit. Furnace Disconnect switch should be ON, all panels in place and EMO switches reset.
<b>2. Furnace ON</b>	Press Furnace Controls ON button. Yellow Furnace Controls Power light illuminates. Power is provided to the furnace controller.
<b>3. Computer ON</b>	Open the computer enclosure door, press the Computer start button on the tower to start the computer. The computer boots up and the logo screen is displayed. Furnace software starts. Computer and PLC begin to communicate.
<b>4. Monitor ON</b>	Press the power button on the monitor if you do not see the logo screen.
<b>5. Start Program</b>	Press Furnace program icon to initialize communication with the PLC and start the furnace program.
<b>6. Log-In</b>	Log in to furnace software. Log-in is only possible when PLC and Computer are communicating.



**CAUTION:** Dangerous voltages are now present throughout the electrical systems of the furnace. Make sure that any probes in the furnace are placed on the belt surface only. Probes extending over the sides of the belt may contact high voltage terminals!

#### 2.3.4 Fans

Check that the cabinet cooling exhaust fans, and optional cooling tunnel exterior fans and product cooling fans are turning. If the exhaust for the furnace is located on the bottom of the machine, it is important to have the bottom impeller fan speed greater than or equal to the speed of the top fan to allow the cooling system to work properly.

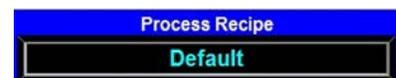
#### 2.3.5 Check for Alarms & Alerts

Check to assure that there are no active alarms or alerts. If needed, move cursor to and click on “ACK ALMS” to clear or silence an alarm/alert in order to proceed with furnace operation. If alarm/alert does not clear, see Troubleshooting in Section 3.

#### 2.3.6 Verify Process Parameters or Get Recipe

##### A. Verify correct recipe is loaded.

The Recipe indicator in the top status bar displays the recipe currently in running in the furnace controller. If the wrong recipe is displayed, either change the parameters on the process screen or load the correct recipe.



**To Change Process parameters:** On the Process screen enter desired process parameters including zone set point temperatures, power, edge heater and belt speed by clicking on respective the blue fields and typing the correct values.

**To Load a Recipe:** Click on the Menu bar RECIPE button to access the “Recipe” screen, Figure 2- and load the correct recipe. If the correct recipe is already displayed in the Recipe Editing box, click on Send Recipe To: **Process**. Otherwise get correct recipe per below:

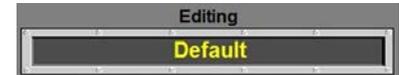


Figure 2-19 Recipe Editing box

**Get Recipe from Computer.** To load a different recipe into the Recipe editor, select Get Recipe From: **Disk**. A dialog box will open with a list of the furnace recipes stored on the furnace computer.

**Send Recipe to Furnace.** A recipe can be sent to the furnace to replace the parameters running in the furnace controller. Select Send Recipe To: **Process**. Furnace will start using the values just loaded and these values will be shown on the Process screen.

Description	1	2	3	4	5	6
High Alarm	355	500	335	445	465	490
High Alert	345	490	325	435	455	480
Setpoint	335	480	315	425	445	470
Low Alert	325	470	305	415	435	460
Low Alarm	315	460	295	405	425	450
Top Power %	100	100	100	100	100	100
Bottom Power %	100	100	100	100	100	100
Bottom Track Top	<input type="checkbox"/>					
Gain	10	10	10	10	10	10
Integral	25	25	25	25	25	25
Voltage Control Btm	<input type="checkbox"/>					
Set Btm Volts						

Figure 2-20 Get Recipe from Recipe screen

### 2.3.7 Process screen

Once correct recipe is loaded, gas flow settings are correct, and alarms are not present, go to the Process Screen to begin furnace Warmup.

## Section 2

### 2.4 Normal Furnace Operation

#### 2.4.1 Process screen

##### A. Select WARM UP

Click on Process **Select** button to start the furnace in Warm Up (Figure 2-21). Process State indicator will display **Warmup** (Figure 2-22). In the “WARM UP” mode, the heating elements are energized. After 20 minutes, check the system for instability or cycling, and correct if necessary.

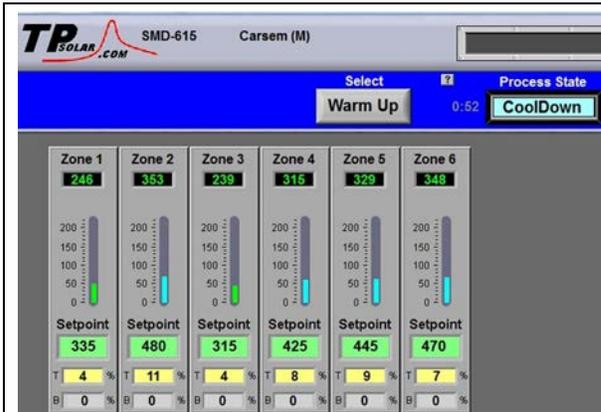


Figure 2-21 Select Warmup



Figure 2-22 In Warmup

##### B. Process Start

When the furnace has stabilized the Process State indicator will display **Ready**. Product may now be placed on the belt for processing (Figure 2-23).



Figure 2-23 Process Ready

NOTE: Allow the system to stabilize and to enter the Process READY mode as indicated by a Process State indicator on the screen before processing any product.

## 2.5 Furnace Shut Down

### 2.5.1 Shut Down Modes

There are five basic levels of shut down on the furnace:

1. EMO – Emergency Off
2. Control System Off
3. Cool Down
4. Auto Shut Down
5. Complete Shut Down

### 2.5.2 EMO Shut Down

For immediate shut down of the furnace:

1. EMO - Press any of the Emergency OFF (EMO) buttons.
2. All systems will immediately shut down, except for furnace computer and monitor.

### 2.5.3 Furnace Control System Shut Down

For immediate shut down of the furnace:

1. Press FURNACE POWER OFF button on Control Console .
2. All systems will immediately shut down, except for furnace computer and monitor.

### 2.5.4 Cool Down

To place the furnace in “standby” mode for quick restart (to load and run new recipe):

1. Using PC mouse, click the COOL DOWN button on the PROCESS screen to remove power from the heating elements. The heating elements turn off immediately. You will hear the K1 lamp power contactor release with a click. The furnace control system will continue to run the belt, cabinet cooling fans, product cooling fans, and keep process gas flowing during COOL DOWN.
2. When all zones are below 100°C, COOL DOWN is complete. The furnace may be left in this condition with belt running and process gas flowing indefinitely. You may manually turn off the process gas flow at this point without causing harm to the furnace, although you must remember to turn it back on prior to restarting the furnace.
3. To restart the furnace (after loading a new recipe or to run the current recipe again), click the WARM UP button on the Process screen , referring to item 5) in the Furnace Operation (Process Screen) section 2.3.

### 2.5.5 Shut Down Considerations

The furnace should be shut down when more than an hour or two will elapse between production runs. A shutdown conserves energy and prolongs the life of the furnace and elements. Follow the steps in sections 2.5.6 for short duration shutdowns.

The furnace computer is often left running if the furnace is to be down for less than 2-3 days. Leaving the computer on for longer period will not harm the system.

**NOTE: Before turning off furnace computer, you must “Log-Off” through the Log-On screen and shut down Windows OS via the START button on the computer Desktop display.**

### 2.5.6 Auto Shut Down

Auto Shut Down allows an operator to initiate the shutdown sequence and not have to be present when the furnace completes COOL DOWN to complete the sequence. After Auto Shut Down is complete, the furnace computer remains running, although the rest of the furnace is shut down completely and must be restarted to resume operation (see section 2.4.10).

To initiate the Auto Shut Down sequence while in PROCESS START or WARM UP mode on the PROCESS screen follow steps 1 and 2. If all furnace zones are below 100°C, go to step 2:

#### **AUTO SHUT-DOWN STEPS:**

1. Click COOL DOWN on Process screen
2. Press FURNACE POWER OFF button

**COOL DOWN.** Using the PC mouse, click the COOL DOWN button on the PROCESS screen to remove power from the heating elements. The heating elements turn off immediately. You will hear the K1 lamp power contactor release with a click. The furnace control system will continue to run the belt, cabinet cooling fans, product cooling fans, and keep process gas flowing during COOL DOWN.

You may move to Step 2) at any time after clicking COOL DOWN, or the furnace can be left in this condition without problem. However, until FURNACE POWER OFF is pressed, the belt and auxiliary systems will continue to run even after COOL DOWN is through.

**FURNACE POWER OFF.** Press the FURNACE POWER OFF button on the control console.

While still in COOL DOWN, the MAIN POWER light remains “on” and the FURNACE POWER OFF button light is “off”. All controls and accessories (belt motor, fans, light tower, etc.) remain “on”. When all zones are below 100°C, COOL DOWN is complete and the control system will stop the belt automatically and shut off any other automatic systems.

When both AUTO SHUT-DOWN steps have been initiated and are complete, the furnace will be completely shut down electrically, except for the furnace computer and monitor. If the furnace is not equipped with Auto Gas Valve Shutdown, the process gas will still be flowing to the furnace until the valve is manually closed. The furnace can be left in this state indefinitely without harm to the furnace. For complete shutdown of the furnace see section 2.5.7.

## 2.5.7 Complete Shut Down

For complete shutdown of all systems and power to the furnace follow steps 1-5:

1. Click COOL DOWN on Process screen
2. Press FURNACE POWER OFF button
3. Computer system OFF
4. Process Gas OFF
5. Main Power

**COOL DOWN.** See section 2.5.5, subsection 0.

**FURNACE POWER OFF.** See section 2.5.5, subsection 0.

**COMPUTER SYSTEM.** The computer system is normally left ON between short periods of furnace shut down. However, after COOL DOWN is finished, for Complete Shutdown, exit the Furnace program from the Process or Security screen. Then, click on Windows Start/Shut Down to turn the computer OFF. The computer will Power OFF after the operating system closes all files are closed.

**PROCESS GAS.** For furnaces equipped with the Auto Gas Shutoff feature, the process gas valves will close after COOL DOWN is finished. For complete shutdown, manually close process gas supply valves, but only after COOL DOWN is complete.

**MAIN POWER.** The main power is not automatically disconnected from the furnace. If you wish to disconnect the main power to the furnace, wait until steps 1-3 are complete before throwing the facility power breaker.

## 2.5.8 Turning Off Furnace PC and Monitor

Shutdown of Windows operating system and the furnace computer is only required if you are disconnecting facility power to the furnace.

1. **LOG OFF.** Using the PC mouse, go to the Security screen. Click your user name in the User List and click Log-Off. Clicking on the Exit button will take you out of furnace operation mode when all zones are below 100°C and the belt has stopped.
2. **SHUT DOWN.** From the Windows Desktop, select start, then select Shut Down. The computer will Power OFF after the operating system closes all files.

## 2.5.9 Exiting a Frozen Furnace Program

1. **EXIT FROZEN PROGRAM.** Using the PC keyboard, press ALT-F4 to exit the active program.
2. This method of closing the furnace program should only be used to exit a frozen program. It will not affect the program running in the furnace Controller. If still in Cool Down, the furnace will continue to run until the Cool Down sequence is complete.

Note: If communication is lost to the PLC LCM4 controller, the furnace program will freeze. To exit any frozen Windows® program, Press Alt-F4 on the keyboard.

## Section 2

### 2.5.10 Restarting the Furnace after Auto Shut Down

Auto shutdown turns off process gas and the Opto22 PLC after Cool Down. Since the computer remains on, the PLC must be re-initialized. Follow the steps per the RESTART table to start the furnace after Auto shutdown.

<b>Table 2-5 Restarting the Furnace after Auto Shut Down</b>	
<p>After Auto Shutdown, the furnace computer left ON, while furnace belt, lamps and all auxiliaries are OFF. In this state the furnace program will not be communicating with the PLC and, therefore, must be closed and reopened after the furnace is restarted to re-establish communication with the furnace.</p>	
<p><b>1. Close Furnace program</b></p>	<p>Click in the center of the furnace program screen and use Alt-F4 to close the furnace program.</p> <p>Note: Alt-F4 is a Windows command to close the active window. If Alt-F4 does not close the main furnace program, repeat the Alt-F4 command until you see the Exit OptoDisplay Runtime dialog box. Do not restart the furnace program until the furnace is ON.</p> <div style="text-align: right;">  </div>
<p><b>2. Main Power</b></p>	<p>Verify the Main Power ON button is lit. Disconnect switch should be on, all panels in place and EMO switches reset.</p>
<p><b>3. Furnace ON</b></p>	<p>Press Furnace Power ON button. Furnace ON light illuminates.</p> <p style="text-align: center;"><b>Wait 2-3 minutes for the Opto22 PLC to sync with the Furnace computer.</b></p>
<p><b>4. Start Furnace Program</b></p> <p><b>5. Log-in</b></p>	<p>Press Furnace program icon to initialize communication with the PLC and start the furnace program.</p> <p>Log in to the furnace software. Log-in is only possible when PLC and Computer are communicating.</p> <div style="text-align: right;">  </div>

**CAUTION:** Dangerous voltages are now present throughout the electrical systems of the furnace. Make sure that any probes in the furnace are placed on the belt surface only. Probes extending over the sides of the belt may contact high voltage terminals!

## 2.6 Modifying Control Strategies

Primary means of changing the way the furnace operates is covered in this section.



### 2.6.1 On-Line Changes to Setpoints via the Process screen

**On-Line Modifications.** The Process screen displays the primary operating parameters running in the furnace controller. Many of these parameters can be modified in real time by level 3 and above users. On-Line changes will not be saved. Go to section to change and store a recipe instead of making On-Line changes.

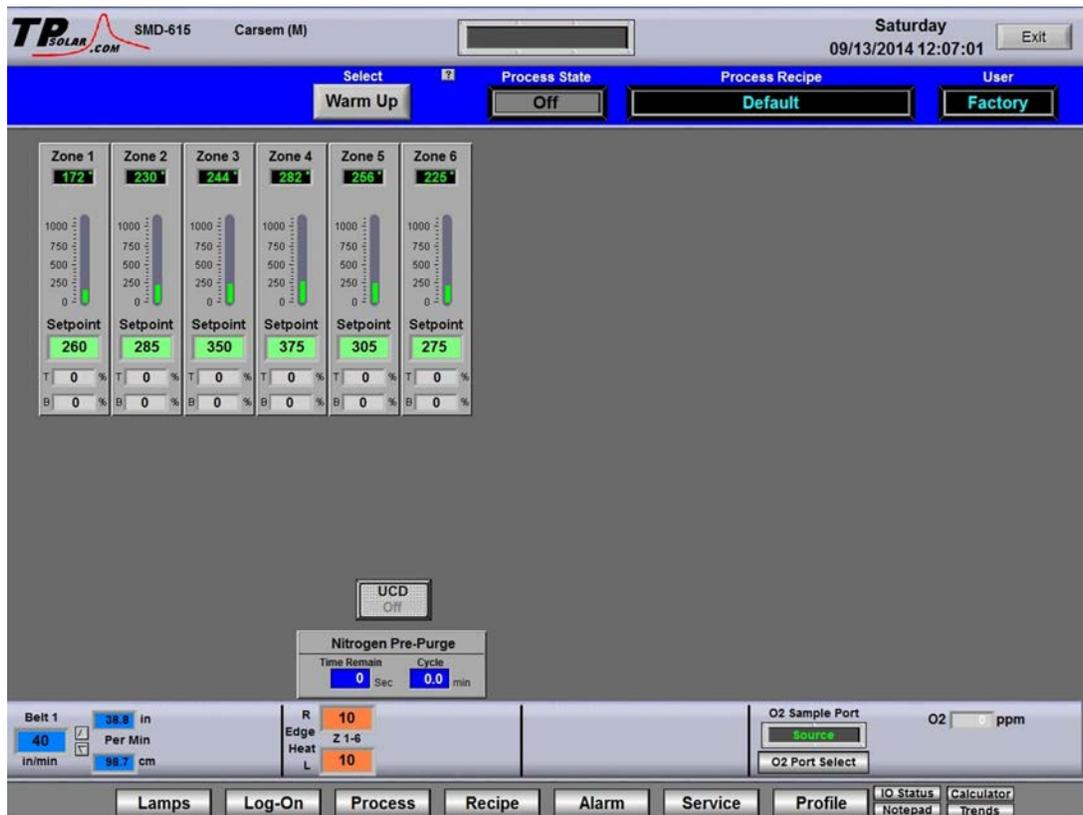


Figure 2-24 Process screen

#### A. Temperature Indicator and bar display

Measured Temperature, Top and Bottom Power (% applied) are displayed for each zone. Deviation of measured zone temperature from setpoint for each zone is displayed graphically using a colored vertical bar. Each bar changes color independently as the deviation in an individual zone changes. Temperature is in degrees C. Bar scale is 0-200% of setpoint. Power is in percent.

Color	Indicates zone is	Type
Red	Hot	Alarm
Yellow	Warm	Alert
Green	Normal	Setpoint
Light Blue	Cool	Alert
Blue	Cold	Alarm

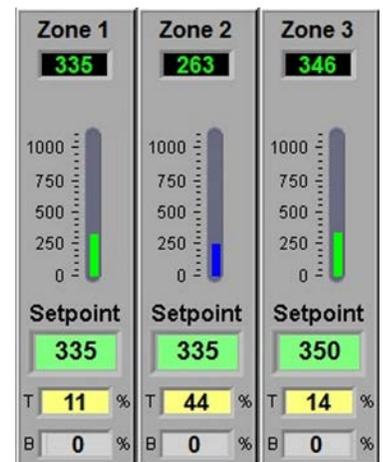


Figure 2-25 Zone Temperature & Power setpoints

To change the alarm and alert setpoints, go the Recipe screen and make the changes to Deviation values per section 2.6.2E Edit Recipe Zone Temperature 2.6.2E.

## Section 2

### B. Change Zone Temperature setpoint

To enter or change zone setpoint temperatures, click on the Setpoint field and enter the new temperature in degrees Celsius. Click Ok to send value to the furnace. The setpoint in the furnace will change immediately.



### C. Change Top and Bottom Power setpoints

Real time zone top and bottom power applied to each zone is displayed below the Setpoint field. The T% and B% are Power fields that display the percent power used by each zone by the lamps above (T) and below (B) the belt.

Change the maximum value by clicking on the field and entering a value from 1-100%. For values less than 100% the furnace program will multiply the entered percentage times the resulting PID control value. For example if 50% is entered into the Top Power field for Zone one, when the PID value calculates a value of 3.0% power, the actual power applied and displayed will be 1.5% for that location.

Changes will be sent to furnace immediately.



Figure 2-26 Zone Temperature & Power fields

**WARNING: A low power limit may prevent the machine from reaching the Process Ready state, since the user value may not be high enough to reach the desired temperature. For example, setting a maximum of 30 kW will most likely not be enough to reach a steady state in a high temperature furnace when trying to go to 900°C. In this case, the machine will just stay in the Warm Up mode.**

### D. Change Belt Speed setpoint

The measured belt speed is displayed in English and metric units.

Click on the small setpoint fields to enter a new belt speed in either English or metric units. The larger Belt field displays the current belt speed and its units as determined by feedback from the motor speed as calibrated.



Figure 2-27 Belt Speed fields

### E. Change Edge Heater setpoints

If equipped with Edge Heaters, the setpoint for each pair is displayed in the Right and Left fields as shown in the figure below. Edge heaters apply linear heat along the edge of the furnace belt.

To change an edge heat value, click on the value and enter a new number from 0 – 100 percent. Since edge heaters only apply the preset amount of heat to their entire length, the lowest acceptable value should be used to achieve even distribution of heat across the belt. Click on the field to change the value in the furnace. Changes will be sent to furnace immediately.



Figure 2-28 Edge Heater setpoints

## F. Change N2 Pre-Purge system setpoint

Temperatures measured in each zone are displayed below each zone title as shown in the figure below. Click on the cycle time to change. Click on the Time remaining to reset to zero???. Changes will be sent to furnace immediately.

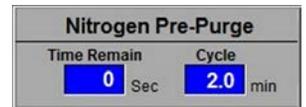


Figure 2-29 N<sub>2</sub> Pre-Purge setpoint

## G. Oxygen Sampling System alarm and zone select

Selected sampling port and measured oxygen level are displayed. When system is off, O<sub>2</sub> level will read zero. click on the O<sub>2</sub> change alert and alarm values. Click Close, changes will be sent to furnace immediately.



Figure 2-30 O<sub>2</sub> Sampling display and Port Select

Selected sampling port and measured oxygen level are displayed. When system is off, O<sub>2</sub> level will read zero. click on the O<sub>2</sub> change alert and alarm values. furnace immediately.

Click **O2 Port Select** to open O<sub>2</sub> Sampling popup.

If the process does not require gas sampling, click on the radio button until the label displays **Off**. Close popup.

If the recipe requires gas sampling, click on the radio button until the label displays **On**. Select sampling port.

To verify quality of sample line or to purge analyzer, select Source to sample the gas supply line. Otherwise, select Zone to be sampled during recipe processing.

Enter Recipe Oxygen Alert and Alarm limit values. While recipe is running in the furnace, an Alert or Alarm will sound if the Sample System Analyzer detects an Oxygen level above one of the setpoint limits.

Range of values is 10-1000 in ppmv.

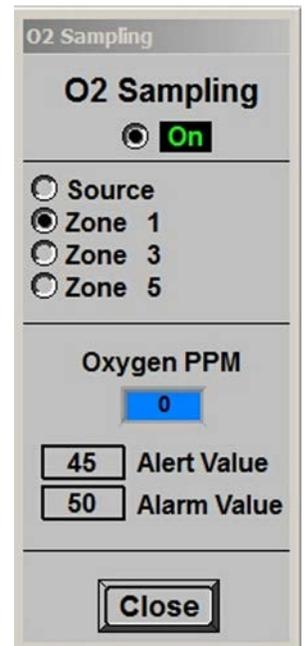


Figure 2-31 O<sub>2</sub> Sampling display and Port Select

## Section 2

### H. Managing the UCD System

The UCD button indicates the UCD status (**Wash, Cool, Off**). Click on the UCD button to access the UCD pop-up screen (Figure 2-32). Both scheduled automatic cleaning and manual cleaning are available. See table.



Table 2-6 Starting UCD System Cycles	
Automatic Cleaning	Manual Cleaning
<ol style="list-style-type: none"> <li>Click on UCD button on Process Screen.</li> <li>Enter up to 5 cleaning schedules with:               <ul style="list-style-type: none"> <li>-Start time (24 hr. format)</li> <li>-Wash duration (minutes)</li> <li>-Drain duration (minutes)</li> </ul> </li> <li>Click ENABLE box to activate desired schedule(s).</li> <li>Furnace will automatically start cleaning at the scheduled time(s).</li> </ol>	<ol style="list-style-type: none"> <li>Click on UCD button on Process Screen.</li> <li>Across from Manual row, Enter:               <ul style="list-style-type: none"> <li>-Wash duration (minutes)</li> <li>-Drain duration (minutes)</li> </ul> </li> <li>Click on Manual START box to start cleaning immediately.</li> </ol>
At any time while the UCD System is running you can click the Stop button to force the System into Cool Down.	

**Calculate Wash Duration** by determining the belt length and dividing by the belt speed. Run belt at low speed (10 ipm) to assure good cleaning.

**Example:**

**Calculate belt length:** If furnace is 160 inches long, belt is (160 inches x 2) + 72 inches = 392 inches.

**Calculate Wash time:** Belt length / Belt speed = 392 inches / 10 ipm = 39.2 minutes.

Set Wash Duration to 40 minutes.

**Drain duration** is a failsafe time to turn off pump. Set drain duration period of time. Normally pump should turn off when tank low level is reached.

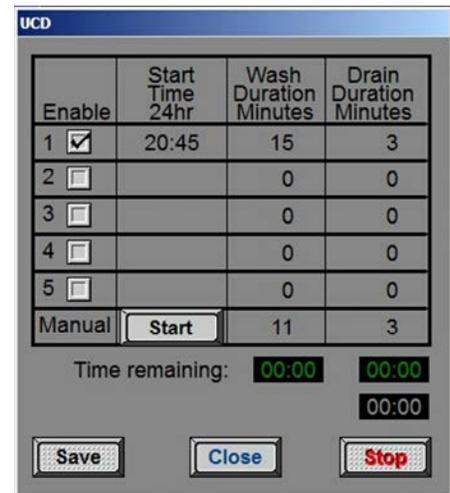


Figure 2-32 UCD System pop-up

**UCD System Cycle.** The UCD System cycles through 4 modes:

Table 2-7 UCD System Cycle Modes				
	FILL Mode	RUN Mode	COOL DOWN Mode	DRAIN Mode
Function	Fills tank until tank level sensor stops fill mode:	Cleans belt in tank for Wash Duration: Water recirculates through filter	Cools tank heaters for 10 minutes to prevent damage to tank:	Drains tank until tank low level sensor stops drain mode:
Console	Red lamp is on	Green lamp is on	Green lamp is flashing	Yellow lamp is on
Pump	Off	On	On	On
US generator	Off	On	Off	Off
Tank heater	Off	On	Off	Off
Belt dryer	On	On	On	On
Fill Valve	Open	Closed	Closed	Closed
Run Valve	Off	Open	Open	Closed
Drain Valve	Off	Closed	Closed	Open
Button display				

**UCD Tank Heaters and Cool Down.** To improve ultrasonic cleaning of the belt, the tank is equipped with heaters to heat the water after the tank is filled. To avoid warping the tank, the system automatically enters a timed cool down while the water continues to be recirculated and before the drain cycle starts. The cool down time is shown on the UCD pop-up (Figure 2-33 UCD Cool Down).

Enable	Start Time 24hr	Wash Duration Minutes	Drain Duration Minutes
<input checked="" type="checkbox"/>	20:45	20	3
<input type="checkbox"/>		0	0
<input type="checkbox"/>		0	0
<input type="checkbox"/>		0	0
<input type="checkbox"/>		0	0
Manual		11	3

Time remaining: 00:00 00:00  
 ? Cool Down Time remaining: 9:55

Save Close Stop

**Figure 2-33 UCD Cool Down**

**UCD Dryer.** The dryer consists of an electric heater, twin air blowers and compressed air rakes. The dryer is on during all 4 modes of UCD System and shuts down automatically when the drain cycle is complete.

To prevent damage, a mechanical switch will turn off the electric heater if twin blowers fail to turn on.

**CAUTION.** The UCD System leaves some water in the tank to assure that the pump is primed properly for the next use. If the pump is started without water in the pump casing (running dry), you may burn out the pump.

**WARNING: DO NOT RUN THE PUMP DRY. Running the pump without water in the pump casing will damage the pump and void the warranty.**

2.6.2 Managing Recipes



The Recipe screen is used to create, edit and load a recipe into the furnace. A recipe can be created for each process (level 3+ access) that can save temperature zone setpoints, alert and alarm levels, PID Gain and Integral parameters, and top and bottom power levels for reuse every time the process is run. Recipes stored on the furnace computer can be accessed and sent to the furnace from the Recipe screen.

**Editing.** The Editing box displays the recipe currently loaded into the Recipe editor.

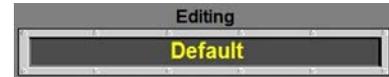


Figure 2-34 Recipe Editing box

**Get Recipe from Computer.** To load a different recipe into the Recipe editor, select Get Recipe From: **Disk**. A dialog box will open with a list of the furnace recipes stored on the furnace computer.

**Get Recipe from Furnace.** To load the recipe running in the furnace controller into the Recipe editor, select Get Recipe From: **Process**. The values from the recipe running in the furnace controller will be loaded into the editor.

**Save as a New Recipe.** Once edited the recipe in the editor can be saved on the computer as a new recipe. Select Send Recipe To: **Save AS**. Enter a new recipe name and file name and click OK. The new recipe will be stored in the RECIPES directory.

**Send Recipe to Computer.** To store a new or edited recipe from the Recipe editor to the computer hard disk, select Send Recipe To: **Disk**. A dialog box will open. Enter the recipe name and recipe file name, click OK.

**Send Recipe to Furnace.** Once edited a recipe can be sent to the furnace to replace the values running in the furnace controller. Select Send Recipe To: **Process**. Furnace will start using the values just loaded and these values will be shown on the Process screen.

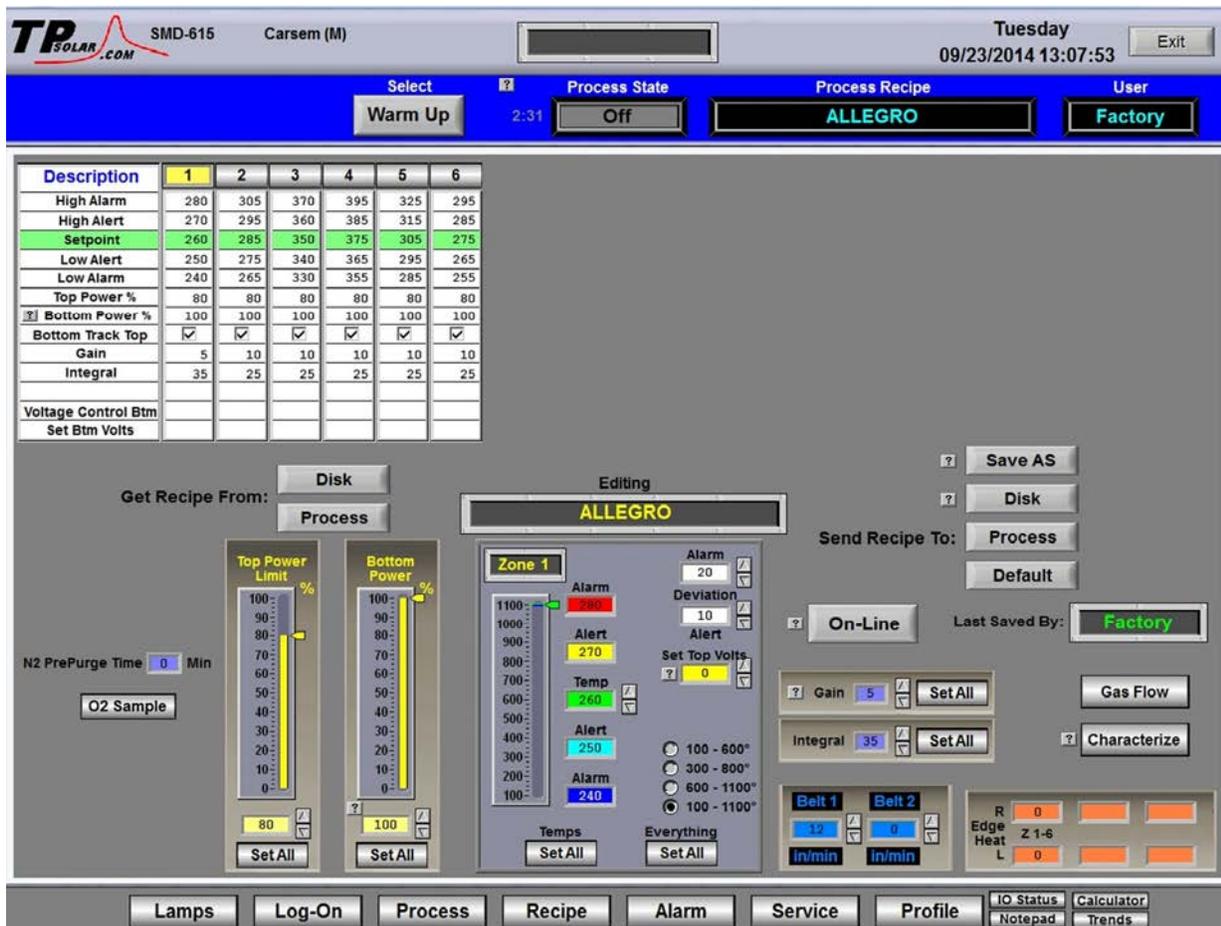


Figure 2-35 Get Recipe from Recipe screen

## A. Recipe Belt Speed Editor

Edit the values for the recipe belt speed.. Multiple pairs will appear if furnace is equipped with more than one belt. See Figure 2-36.

Range of values is minimum belt to maximum furnace belt speed in displayed units.



Figure 2-36 Recipe Belt Speed Editor

## B. Recipe N2 PrePurge Time

Upon initiating furnace warmup, the Nitrogen PrePurge system floods the furnace chambers with nitrogen for a period of time determined by each recipe. Enter the amount time for the purge in the prepurge time field. See Figure 2-37.

Range of values is 0-10 in minutes.



Figure 2-37 Recipe N<sub>2</sub> Purge Editor

## C. Recipe O2 Sampling Editor

Click **O2 Sample** to open O2 Sampling Recipe popup (Figure 2-38).

If the recipe does not require gas sampling, click on the radio button until the label displays **Off**. Close popup.

If the recipe requires gas sampling, click on the radio button until the label displays **On**. Select sampling port.

To verify quality of sample line or to purge analyzer, select Source to sample the gas supply line. Otherwise, select Zone to be sampled during recipe processing.

Enter Recipe Oxygen Alert and Alarm limit values. While recipe is running in the furnace, an Alert or Alarm will sound if the Sample System Analyzer detects an Oxygen level above one of the setpoint limits.

Range of values is 10-1000 in ppmv.

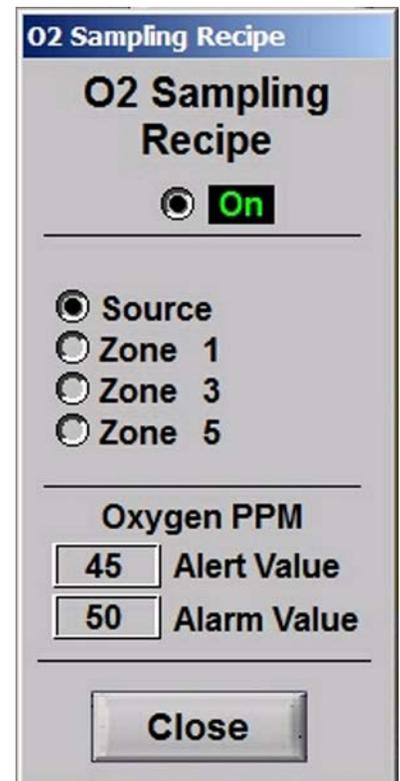


Figure 2-38 Recipe O<sub>2</sub> Sampling System Editor popup screen

## Section 2

### D. View Recipe and Zone Select

The Description box shows the recipe values for each zone. To make changes, click on the number of the Zone to be edited. In Figure 2-39 zone 2 is selected.

Description	1	2	3	4	5	6
High Alarm	280	305	370	395	325	295
High Alert	270	295	360	385	315	285
Setpoint	260	285	350	375	305	275
Low Alert	250	275	340	365	295	265
Low Alarm	240	265	330	355	285	255
Top Power %	80	80	80	80	80	80
? Bottom Power %	100	100	100	100	100	100
Bottom Track Top	<input checked="" type="checkbox"/>					
Gain	5	10	10	10	10	10
Integral	35	25	25	25	25	25
Voltage Control Btm						
Set Btm Volts						

Figure 2-39 Recipe Description & Zone Select

### E. Edit Recipe Zone Temperatures

Once a zone is selected, edit the values in the Recipe Zone Editor fields. Figure 2-40 shows an example of using the Recipe Zone Editor to edit parameters for Zone 1. Setpoint fields and colors are defined in Table 2-8.

Type	Color	Description
Alarm	Red	Hot, high temperature Alarm setpoint
Alert	Yellow	Warm, high temperature Alert setpoint
Setpoint	Green	Normal
Alert	Light Blue	Cool, low temperature Alert setpoint
Alarm	Blue	Cold, low temperature Alarm setpoint

Changes can be made to the setpoint temperature, alarm and alert levels, as follows:

- Enter the new zone temperature setpoint in the green Temp field.
- Adjust the top Deviation value to determine the Alarm bandwidth.
- Adjust the bottom Deviation value to set the Alert bandwidth.

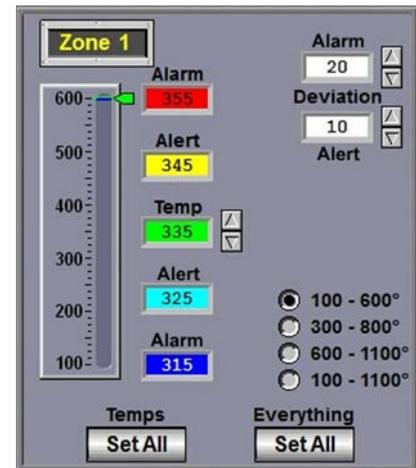


Figure 2-40 Recipe Zone Editor

The high and low colored Alert and Alarm fields will update automatically using the bandwidth settings for each. For example, setting top Deviation to 20 will cause the high and low temperature alarm fields to update to 20 C above and below the zone temperature setpoint (green). Similarly setting the Alert Deviation field to 10 changes the high and low Alert fields to 10 C above and below the zone temperature setpoint.

The vertical temperature bar will change color when the actual zone temperature deviates in excess of the deviation amounts from setpoint.

- Use Temps **Set All** button to enter the Recipe Zone Editor temperature setpoints in all zones in the recipe.
- Use Everything **Set All** button to enter the Recipe Zone Editor setpoints in all zones in the recipe.

## F. Edit Recipe PID values

Once a zone is selected, edit the PID Gain and Integral values using the Recipe PID.

Click on the spinner or enter a new value in the field next to the PID Editor value you want to change.



Figure 2-41 Recipe PID Editor

**Gain** values can range from 5 to 20 with 5 being slow to warm-up and slow to react to temperature setpoint changes. An aggressive value of 10 will warm-up quickly and respond quickly to changes. Values above 10 are increasingly aggressive with 20 being extremely aggressive. The amount of correction is proportional to the rate of change of temperature deviation from Setpoint. Gain is an independent parameter.

**Integral** values are calculated in the Recipe Editor based on the Gain. Integral values may adjust automatically during Warm-up and will be saved to the Recipe file after Warm-up changes to Ready. The function of the Integral is to slowly reduce steady state temperature deviations from Setpoint to zero. Integral input range is 5-55.

**Derivative** is not used.

Use Gain **Set All** button to enter the Recipe Gain value in all zones in the recipe.

Use Integral **Set All** button to enter the Recipe Integral value in all zones in the recipe.

## G. Apply Zone Characterization

Variations in Zone Chamber performance can be caused by thermocouple inaccuracies, thermocouple placement, insertion depth, gas flow, baffle placement/arrangement, etc. Although every effort is made to insure repeatability at the Factory, some minor variations can occur. Changes in performance over time due to maintenance activities are likely to occur as well.

To compensate for variations in the Zone Chamber environment, a characterization value can be introduced that will raise or lower the feedback temperature. This allows the same recipe to be used across Furnaces by 'normalizing' each Furnace with individual characteristic settings for each zone. A positive value of say 10 degrees will increase the Zone Temperature by 10 Deg (in the chamber) but will not affect the displayed temperature or the Zone Setpoint.

Click on Characterize button to access Zone Character pop-up. Click on the zone field to apply a characterization factor. These settings are stored in the Furnace Setup file and apply to all Recipes. Range of values is -25 to +25 in degrees C.

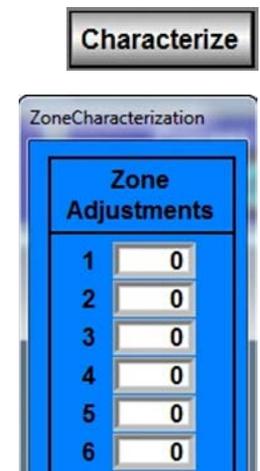


Figure 2-42 Zone Character pop-up

## H. Edit Recipe Top and Bottom Power

Once a zone is selected, edit the values in the Top Bottom Power fields. Figure 2-43 shows an example of using the Recipe Top Bottom Power Editor to edit change the recipe parameters for the selected zone.

Click on the spinner or enter a new value in the field below the Power bar you want to change.

Range of values is 0.5 to 100 in percent (%).

Use Top Power **Set All** button to enter the Recipe Top Power value in all zones in the recipe.

Use Bottom Power **Set All** button to enter the Recipe Bottom Power value in all zones in the recipe.

Range of values is 0.5 to 100 in percent (%).

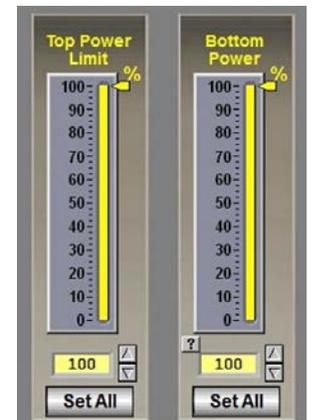


Figure 2-43 Recipe Top Bottom Power editor

## Section 2

### 2.6.3 Gas Flow screen (access from Recipe screen)

Record flowmeter settings and store for each recipe using the Gas Flow screen. If stored with the recipe file, when a recipe is later opened, the operator can verify and adjust the flow meters to match each recipe. Access the Gas Flow screen from the Recipe screen.



#### A. Recipe / Gas Flow screen

**Flow Meter Recipe Settings.** Select Recipe button and on the Recipe screen, select the Gas Flow button. The Gas Flow screen (Figure 2-45) will displayed. The Gas Flow screen is provided as a record of the settings required for the recipe only. This screen displays the flowmeter setpoint values stored for the recipe in the editor. The flowmeters must be adjusted manually for each recipe loaded.

The labels as flowmeter ranges are entered at the factory. To change the recipe value for a flowmeter location, click on the setpoint field (Figure 2-45) and enter a new value.

See Owner's Manual, Engineering section for recommended settings. See section 8.5.5 for information on setting the flow meters to balance the system gas flow.

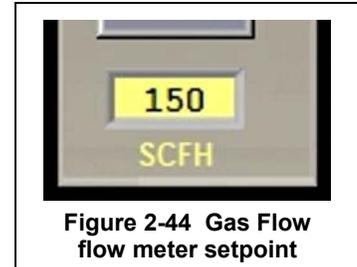


Figure 2-44 Gas Flow flow meter setpoint

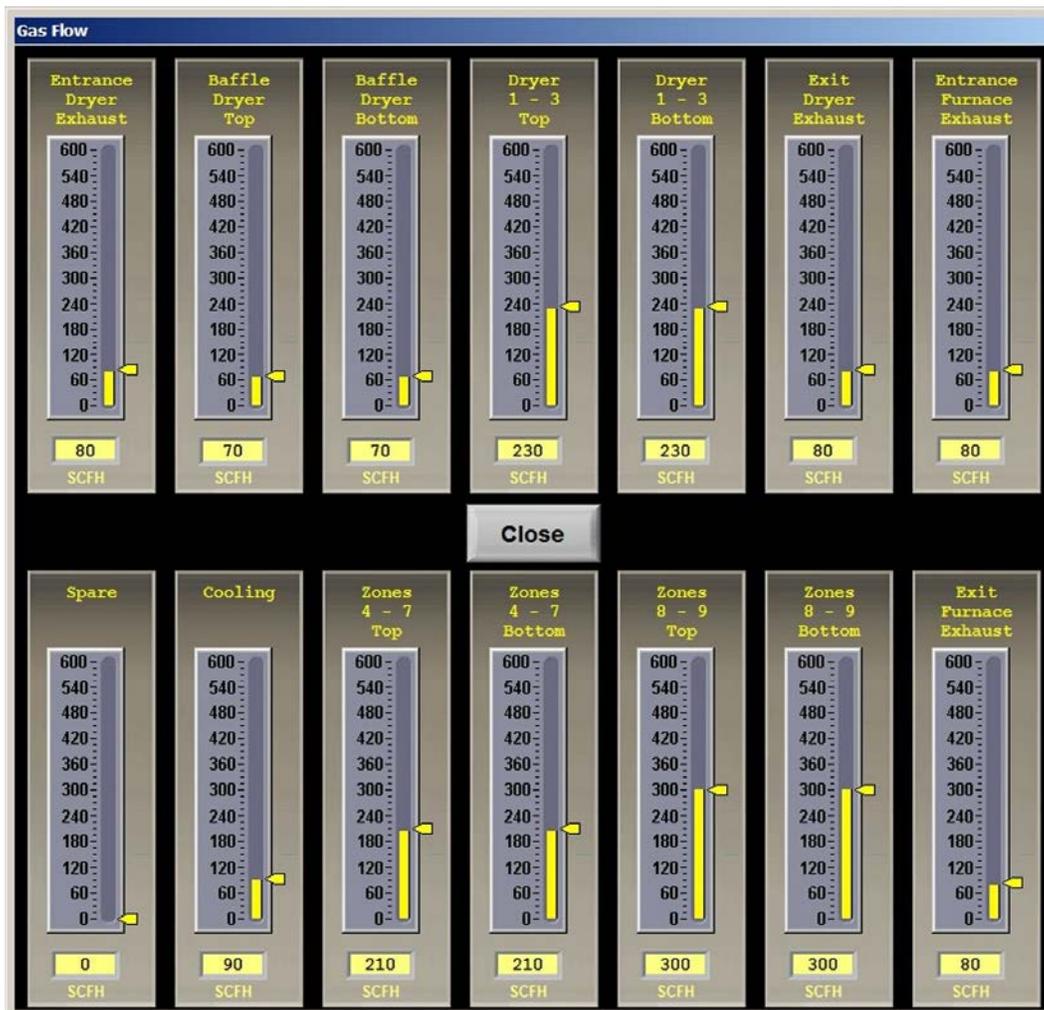


Figure 2-45 Gas Flow Screen

## 2.7 PID Zone Tuning

(Access Level 3+)

On the Service screen, click “Tuning” button to view the Tuning screen. Enter new values for Gain, Integral and Derivative and save in recipe file.

Parameter	Initial Values
Proportional Gain	10
Integral	25
Derivative	none

Click on the desired Zone radio button to monitor and Edit Zone PID Settings for that zone. Zone Tuning fields will display the PID parameters for that zone. Place the

cursor on the value to be modified and click. Type the new setting and press enter from the keyboard. See section 8-6 PID Tuning Concepts for Process Engineering considerations in establishing PID parameters. Also see section 3.12.1 to completely retune a zone.



Figure 2-46 Service Screen: Zone Tuning

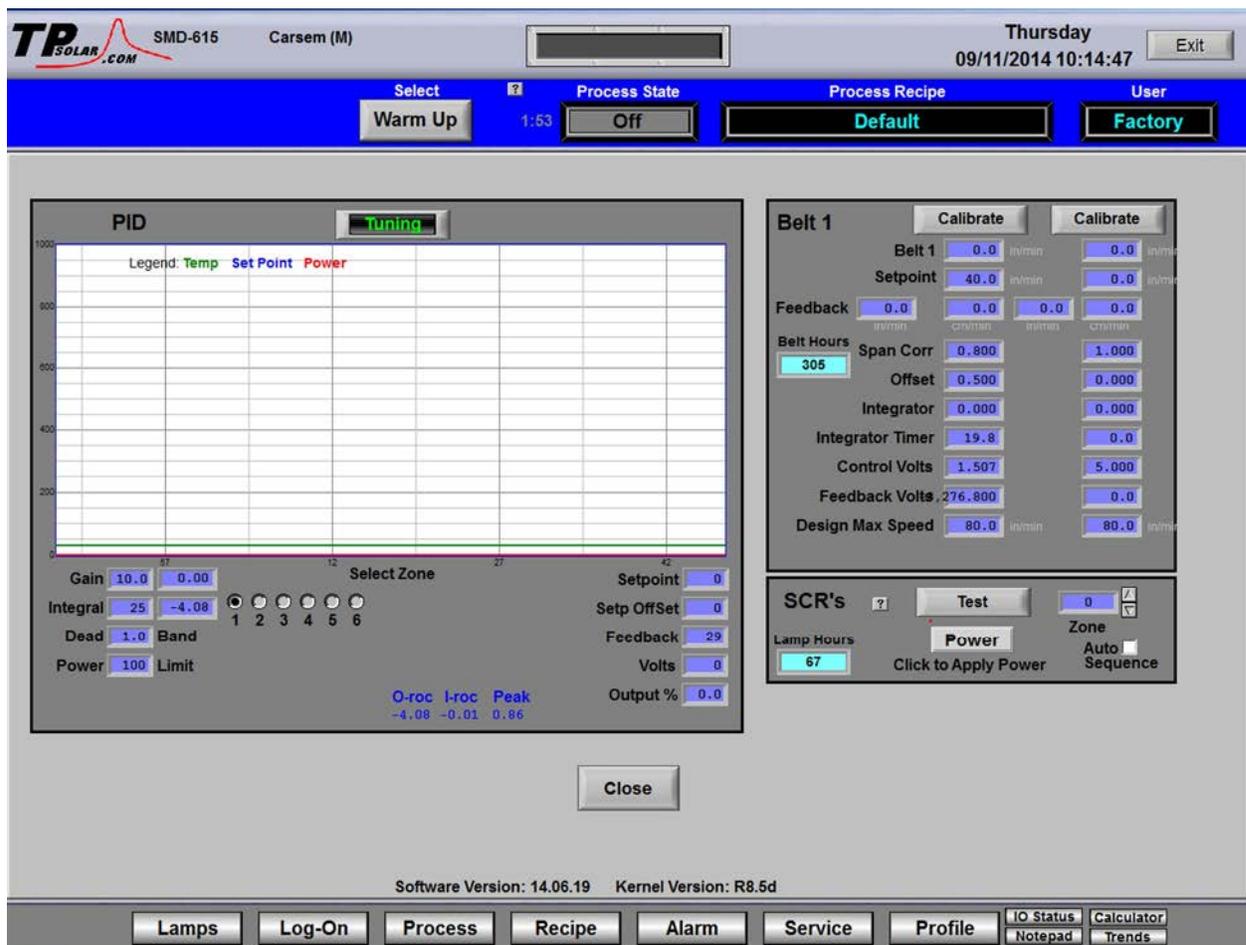


Figure 2-47 Service screen: Zone Tuning

### A. Gain (Proportional)

Gain influences the proportional response of the PID by amplifying the error between set point and actual temperature to establish an output level. The proportional band, in degrees Celsius, is defined as 100 divided by the gain. An increase in the gain reduces the amount of temperature deviation required to turn the heating

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elements on at full distributed power or decrease it. Too small a value will cause the system to be sluggish in response. Too high a value will cause the system to overshoot and be unstable.

### B. Integral

The integral (or Reset) function corrects temperature offset.

### C. Derivative

The derivative is not used.

## 2.8 Real-time and Historical Trends

To view current or historical performance by zone:

1. Press the Trends button at the top of the Process screen,
2. Select dropdown for the desired zone to view.

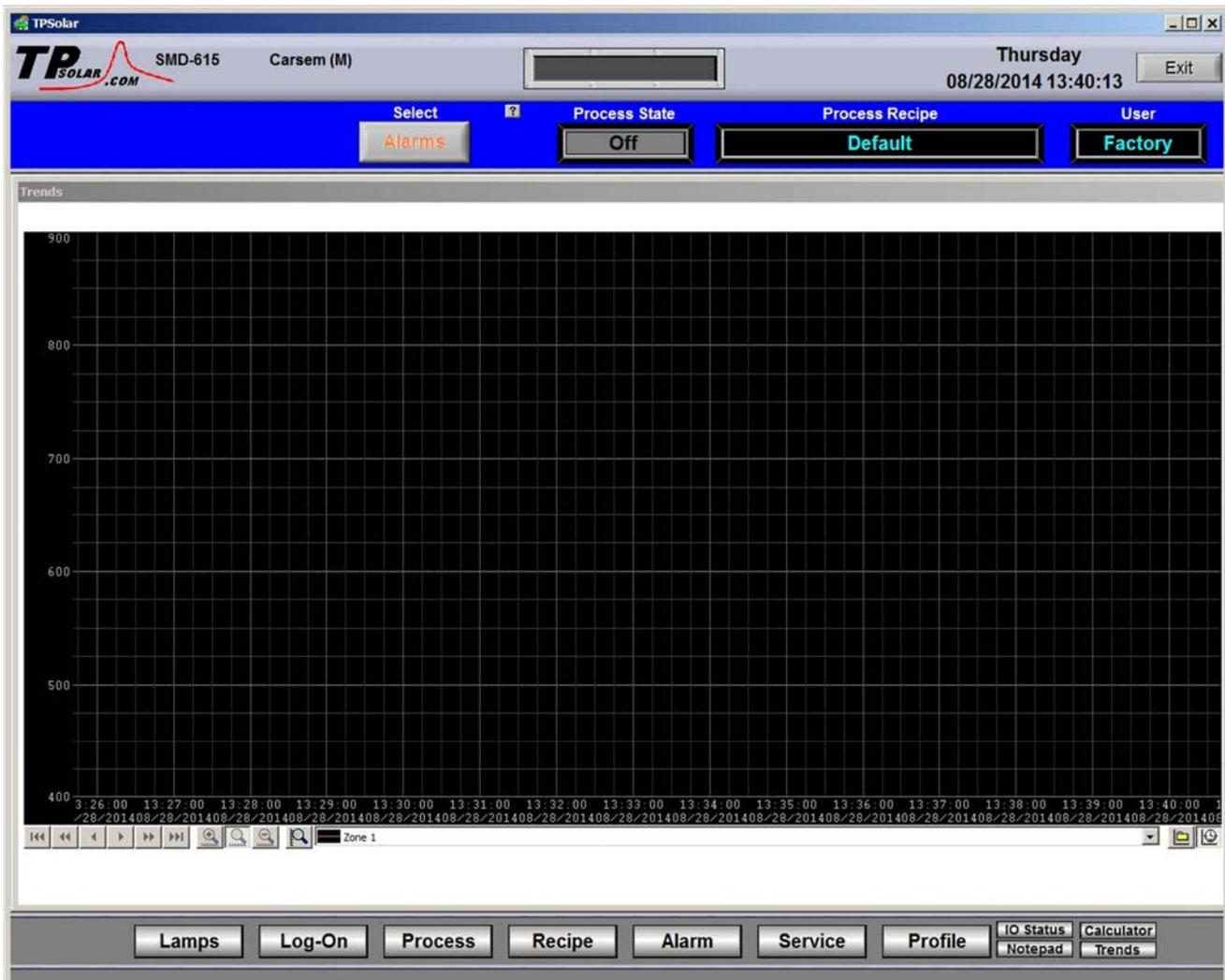


Figure 2-48 Trends graph

Once the trends graph appears you can select the parameter to view. Selecting a specific parameter changes the vertical axis for that parameter. Press the  button to change the scale for the selected parameter. (see Figure 2-). All parameters are shown on the screen at all times, although the scale is adjusted for the selected parameter.

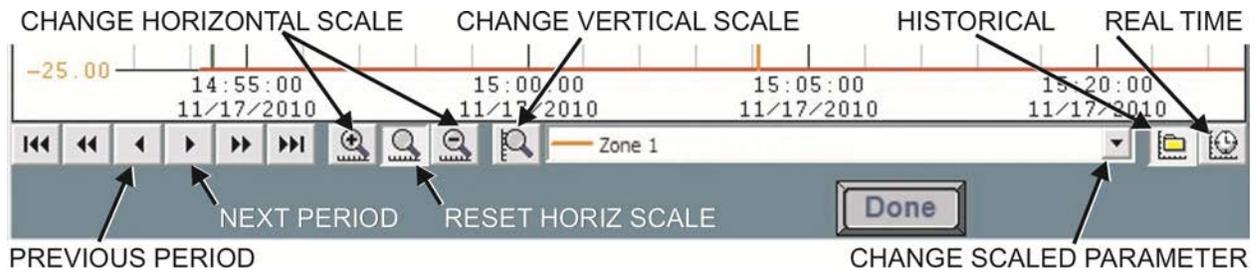


Figure 2-49 Trends Menu bar

Table 2-10 Trends Menu Buttons	
Button	Action
	<b>Real Time Mode</b> (default). Shows data currently being recorded for all 5 parameters.
	<b>Historical Mode</b> . Opens file from an earlier period. (See Figure 2-51). Activates Previous and Next buttons and Horiz scale buttons.
	<b>Select Zone</b> . Select the zone you want to track.
	<b>Zoom Pen</b> . Change vertical scale for selected parameter.
	<b>Zoom Normal</b> . Resets Horizontal scale to default (30 minutes per screen).
	<b>Zoom Hour</b> . Compresses horizontal scale (x-axis) to show more detail (one hour per screen).
	<b>Zoom Day</b> . Compresses horizontal scale (x-axis) to show longer time period in one view. (24 hours per screen)
	<b>Log Forward</b> (movement varies with Zoom) Zoom Normal: 5 minutes / 30 minutes / End of data Zoom In: 6 minutes / 1 hour / End of data Zoom Out: 30 minutes / 1 day / End of data
	<b>Log Back</b> (movement varies with Zoom) Zoom Normal: Start of data / 30 minutes / 5 minutes Zoom In: Start of data / 1 hour / 6 minutes Zoom Out: Start of data / 1 day / 30 minutes

Enter the Historical Log Mode by pressing . The Super Trend Historical Log file popup is shown in Figure 2-51. Once an historical file has been selected, the Zoom and Log Forward/Back buttons can be used to view different time periods of furnace activity.

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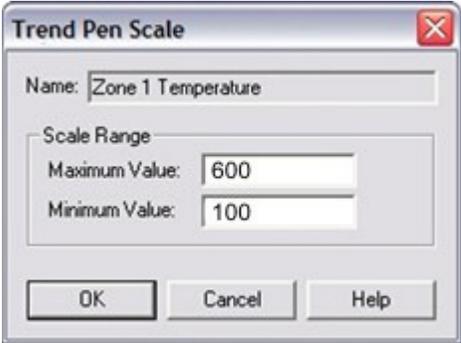


Figure 2-50 Change Vertical Scale

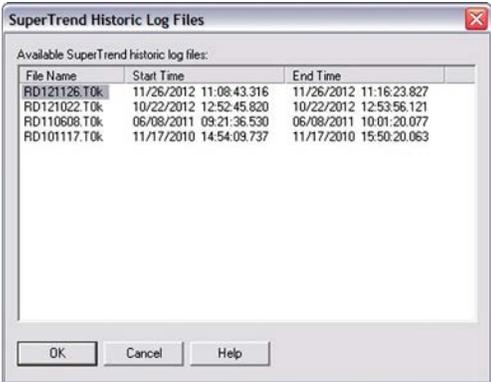


Figure 2-51 Load Historical Trend Data

## 2.9 Alarm Status (All Access Levels)

During an Alarm condition, the Menu bar Alarm button turns red. Any existing alarm conditions, such as transport speed error, can be viewed on the Alarm popup screen. Click on the Alarm button on the Menu bar to access the Alarm pop-up. To clear or silence an alarm/alert, move the cursor on the Alarm pop-up screen and click on “Silence Reset” See Section 3 SERVICE & MAINTENANCE for further information.



Figure 2-52 Alarm pop up screen

### A. Silence Reset button

Pressing the Silence Reset button will “Acknowledge” or reset the alarm. If the source of the alarm is still a problem, the ALARM button will continue to blink and the alarm continue to sound.

While the machine is heating, check for alerts and alarms and listen for the alarm buzzer. In particular, check for any exhaust fan failure alarms. Check for failed elements. The effect of an element failure is generally minimal unless two failed elements are adjacent to each other.

NOTE: Allow the system to stabilize and to enter the PROCESS READY or PROCESS START mode as indicated by a green light on the screen before processing any product.

You must be in “Process Off” condition to exit (indicated by a red light).

### B. Alarm Definitions

Message	Type	Description	Enabled
Zone Temps	Alarm/Alert	High or Low temperature after setpoint is reached	Yes
Cabinet Temperature	Alarm	High temperature in Furnace Enclosure	No
Water In Temperature	Alarm	High Inlet water temperature	No
Water Out Temperature	Alarm	High Outlet water temperature	No
Water Flow Switch	Alarm	No Cooling Water flow	No
Process Air Flow Switch	Alarm	No Process Air flow	No
Exhaust Air Flow Switch	Alarm	No Exhaust Air flow	No
Cooling Air Flow Switch	Alarm	No Cooling Air flow	No
Cooling Exhaust Flow Switch	Alarm	No Cooling Exhaust Air flow	No
Belt Speed	Alarm	High or Low Belt Speed feedback	Yes
Transport Motion	Alarm	Belt not moving.	Yes
I/O Rack Offline	Alarm	Communication failure to Acromag I/O module	Yes
Zone x Lamp Fail	Alert	Lamp Failure in specified Zone.	Yes
Nitrogen Pressure	Alarm	Low process gas supply pressure	Yes

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Table 2-11 Typical Alarms			
Message	Type	Description	Enabled
O2 Level	Alert	Oxygen level in furnace above Alert setpoint	Yes
O2 Level	Alarm	Oxygen level in furnace above Alarm setpoint	Yes

### 2.9.2 IPS Low Gas Pressure Alarms

An Inlet Pressure Switch is installed on the GAS 2 process gas manifold. These switches are normally open when gas is disconnected from the furnace. They close when proper pressure is present in the process gas supply line(s).

The current switches are set to open when pressure falls below set points in the following table:

Table 2-12 Initial Alarm Settings			
Port	Manifold	Pressure	
Gas 1	CDA or Nitrogen	No alarm	
Gas 2	Nitrogen Forming Gas, or other (Option)	55-60 psig	3.8-4 Bar

The pressure switch set points can be adjusted manually. Locate the switch in the process gas supply line. To increase the set point turn the wheel clockwise. Turn the top of the switch counter clockwise to decrease the pressure set point so the alarm will not occur until the pressure drops to a lower point. See section 3.12.6 for instructions on adjustment and calibration.



Figure 2-53 IPS Inlet Pressure Switch

### 2.9.3 Auto Gas Shutoff (option not supplied)

This furnace may be equipped with Auto Gas Shutoff. The Auto Gas Shutoff feature consists of solenoid valves on the process gas supply lines integrated with the furnace. These valves open and allow Process Gas to flow when Furnace ON is pressed. This feature is designed to conserve process gas. To shut down the furnace the operator need only put the system into Cool Down and press Furnace OFF. When all furnace zones reach 100°C or lower for at least one minute, the furnace shuts down and the process gas valves close.

The Auto Gas Shutoff valves fail in the closed position.

## 2.10 Element Monitoring System

The Element Monitoring system consists of single channel circuit boards installed on each string which detect the location of a failed heating element. The circuit boards monitor the current to the lamp string and activate an audible alarm and visible alarm upon sensing an element failure. The display shows the specific location of the lamp or lamp string (multiple lamps wired in series make up a string) containing the failed lamp. The audible alarm alerts the operator immediately if a lamp fails and allows him to discern its location and determine if process results will be appreciably affected.

Access the Monitor screen in the software to view the status of the heating element strings. Communication failure or individual lamp failure of itself will not shut down the process. The process will only shut down if a lamp failure adversely impacts the furnace ability to maintain set point temperatures.

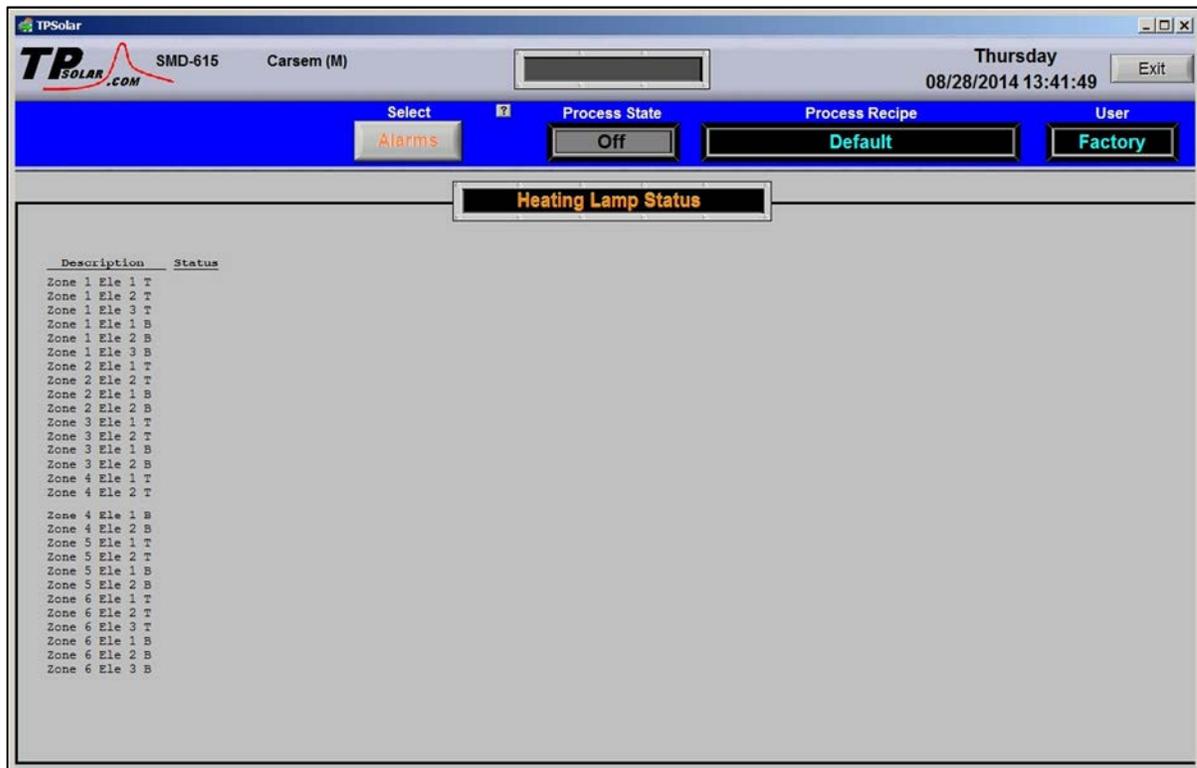


Figure 2-54 Element Monitor screen

### 2.10.1 EM Signal Polling

The software polls the element monitor cards via a serial string. The signal sent from each channel can be viewed on the Serial EM Test popup screen (Figure 2-55). Click on the Serial EM Test button to determine if all boards are communicating properly with the PLC controller. Each board contains a dip switch which determines the digital address of a given board and the software checks each board in sequence. Boards are addressed from 0 to nn.

On older retrofitted systems, the element monitor signals are collected from a current switch located each serial string and transmitted to the PLC.

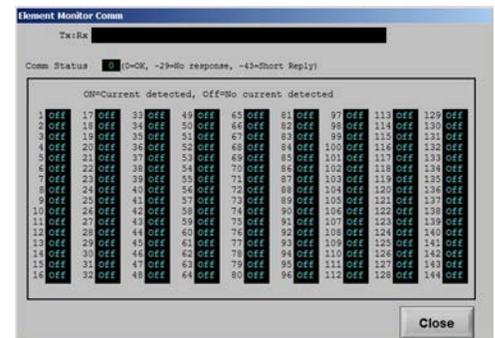


Figure 2-55 EM Serial Test screen

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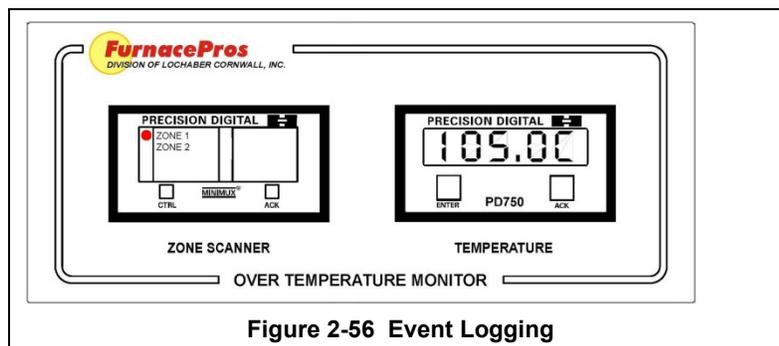
### 2.11 Over Temperature Alarm

#### 2.11.1 Over Temperature Option (option not supplied)

The Over Temperature Alarm system consists of redundant zone thermocouples, a scanner/annunciator and digital panel meter hardware integrated into the furnace software. The scanner/annunciator and digital panel meter are mounted on top of the furnace near the flowmeter controls.

**NORMAL OPERATION.** The system scans each zone and passes a temperature signal to the digital panel meter. The operator can view the temperature on the panel meter and the respective zone being monitored will be indicated on the scanner

**ALARM.** If the temperature in any zone reaches the alarm set point, an alarm will sound in the scanner/annunciator and the furnace will go into Cool Down, the heating elements will be shut off by the controller. To silence the alarm, press ACK on the scanner/annunciator. The furnace cannot be restarted until the zone temperature drops below the alarm set point.



### 2.12 View Alternate Programs

To switch the viewing window between ProControl™ Furnace Process Software and another application (the Mole, WinKIC or DataPac Windows Applications) press and hold down the ALT key, and then press TAB repeatedly. When the title of the desired Windows Application appears, release ALT. The new application will appear in the foreground. Repeat the procedure to return ProControl™ Furnace Process Software to the active window.

### 2.13 Exit Program in Windows

To exit an active program, click Alt-F4 and the program will either close immediately or present a dialog box asking if you are sure. Click yes to close the program.