3.1 TROUBLESHOOTING

To troubleshoot, follow all suggested remedies sequentially to determine source of the problem.

3.1.1 No power to furnace

A. The white MAIN POWER light on Control Console is out

1. Check main facility breaker is "on".
2. Check 3-phase disconnect switch mounted on furnace is "on" (Table 2-1).
3. Check EPO panel switches are pulled out or all furnace cover panels are in place (Table 2-1).
4. Check EMO switches are reset (Table 2-1).
5. Check fuse FA (neon light if blown) on Safety Enclosure panel per 802-101770 Power Control schematic.

B. The green or yellow FURNACE POWER light on Control Console is out

1. Check fuses FA & FB (neon light if blown) on Safety Enclosure panel per 802-101770 Power Control schematic.
6. Check K2 (located on Safety Enclosure panel per 802-101770 Power Control schematic) relay neon light "on" when FURNACE POWER ON button pressed.

C. The green or yellow FURNACE POWER light on Control Console is on, but the PLC has no power

1. Check fuse FB (neon light if blown) on Safety Enclosure panel per 802-101770 Power Control schematic.
7. Check Opto22 5 Vdc power supply fuses.
8. Check K6 (located on Safety Enclosure panel per 802-101770 Power Control schematic) relay light "on".
9. See section 3.6.2. items C) and D) below.

D. The green or yellow FURNACE POWER light on Control Console is on, but the belt doesn't move

1. Check K6 (located on Safety Enclosure panel per 802-101770 Power Control schematic) relay light "on".
10. Check that PLC has power.
11. Check fuses MA, MB, MC (neon light if blown) on Motor Control panel and on-board motor fuse on Motor Speed controller per 802-101771 Frame Wiring schematic.
12. See section 3.6.5 below.

3.1.2 Unable to log on:

A. The PLC control system does not have any power

1. Check fuses FA & FB (neon light if blown) on Safety Enclosure panel per 802-101770 Power Control schematic.
13. Check Opto22 5 Vdc power supply fuses.
14. Check the Ethernet cable between the PC and the Opto22 controller at the back of the PC and at the controller. (Ref: Frame Wiring Schematic in Documentation Section)
15. Check the setup of the installed Ethernet card. (Ref: Section 3)

3.1.3 Temperature

A. The furnace has been in "WARM UP" mode for more than 15 minutes.

On the Process screen, the zone temperature does not change. Perform the following procedures sequentially to determine cause.

1. Check K1 lamp contactor (located on Safety Enclosure panel) to be sure it is operational: on the Process screen, click on Cool Down and then click on Warm Up. You should easily hear the "snap" of the contactor points opening and then closing. If not, check:

   - Relay K5 (located on Safety Enclosure panel per 802-101770 Power Control schematic) light "on" when Warm Up mode selected. If not "on", check fuse FD (neon light if blown), then check fuses F6 and F7 on Power Distribution panel. If K5 is "on" and the fuses are okay, check:

   - K7 Lamp_Power_Cntl relay located on Opto22 panel (Ref: Channel Assignments 802-101570 in Section 5 and PLC Configuration 802-101710 in Section 6) looking for an illuminated LED, indicating an active output.

NOTE: K7 has diagnostic circuitry by allowing the user to manually control the status of the output

Set @ 3: Automatic (Factory set)
Set @ 2: Off (Bypass)
Set @ 1: Manual On/Off

B. The heat is in a runaway condition and cannot be shut off by changing the setpoint to a lower value.

1. The SCR needs calibration. See Maintenance ("Maint") screen for details. (Ref: Reference Manual)
2. The SCR has failed and shorted. Replace SCR.

NOTE: The following are factory typical settings:

Gain:	9
Integral:	45
Derivative:	0 or 1

3.1.4 Zone temperature fluctuates.

A. The SCR needs calibration

Calibrate SCR per section Calibrate SCRs3.9.1

B. Improper flowmeter setting(s)

Adjust flowmeters to improve furnace isolation and proper heat transfer. Generally gas flow should either be balanced or moving toward the entrance stack.

C. Adjacent zone temperature differentials are too large

Modify the adjacent temperature zones so setpoint differences are smaller to facilitate a stable furnace.

D. Improper PID setting(s)

See section 0 for initial recommendations. Also see section 3.9.1 to completely retune a zone.

3.1.5 Conveyor System

A. Transport Speed Error.

1. Check K6 (located on Safety Enclosure panel on 802-101770 Power Control schematic) relay light ON.
2. Check that PLC has power.
3. Check fuses MA, MB, MC (neon light if blown) on Motor Control panel and on-board motor fuse on Motor Speed controller per 802-101771 Frame Wiring schematic.
4. Inspect clutch for slippage.
5. Visually inspect for belt jam or snag.
6. Check the input signal on Motor Speed controller board (located in motor box); S1 is common, S2 is speed control. At maximum speed the voltage is approximately 10 Vdc.

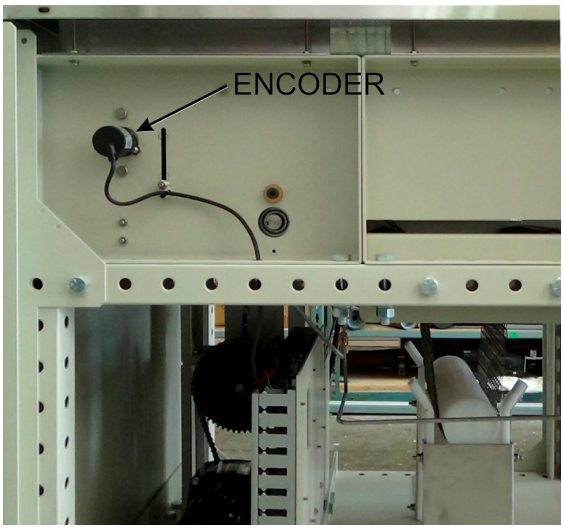

Figure 3-1 Encoder located behind furnace back exit panel

B. Transport Motion Fault.

In addition, items in 3.1.5A, the following items should be checked:

1. **Furnaces after 2002.** Check for wear and tear or loosening of the transport motion encoder mounted on the drive roller shaft at the exit end of the furnace.
2. **Furnaces prior to 2002** may have a chopper wheel instead of a rotary encoder. Check to make sure the wheel is still turning and the optical sensor is clean.

3.1.6 IPS Alarm Bypass

The furnace may be equipped with a manual ALARM BYPASS switch for each process gas pressure sensor. The switches are located on the PLC panel. Switch to Alarm Disable to manually close the pressure switch contact and bypass the alarm.

> Caution: in the bypass position the software will no longer detect and alarm for low process gas pressure.

IPS Bypass switches are useful for troubleshooting the system when gas pressure is not available.

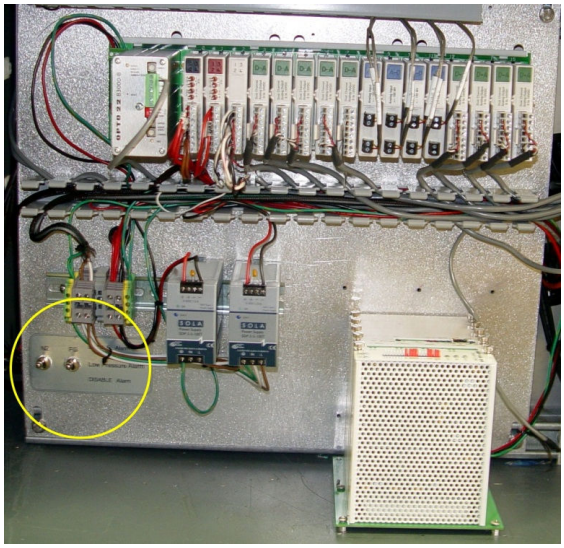

Figure 3-2 IPS Inlet Pressure Switch Location

3.2 Hardware COM Troubleshooting

3.2.1 Controller Communication

The most often seen problem is no communication between the computer and the controller and is characterized by pound signs "######" on the screen where you should have temperature or the date or any type of data.

Check the following things in this order:

Log Event Viewer: Any event happening between the computer and the controller is logged on this screen. You can access it by "ALT-TAB". The following are messages that are displayed:

- the normal message is "Attaching to Scanner"
- then a file download, such as the default recipe file.
- a message relating to the Ethernet card, make sure the coaxial cable is plugged in, and the controller IP address is correct.
- out of memory, switching to low scan mode; there is insufficient memory to run the software. Contact FurnacePros for additional memory.
- Incompatible gml file date/time; the source code has been changed, contact FurnacePros.

PLC: If you have communication, but it looks like some data is frozen, it may be a loss of communication between the PLC controller and the PLC modules. Check the PLC LCM4 controller module to be sure the LED's BATT, LINE AND STAT are green.

- Line "green" indicates 5VDC power status is good.
- BATT "green" indicates CMOS battery status is good.
- STAT "green" indicates the firmware is good.
- The LED's "TX" and "RX" indicate data is communicating between the controller and the modules.

Otherwise use the following table to troubleshoot communication problems:

Table 3-1 PLC Opto22 Troubleshooting Guide		
INDICATION	**EXPLANATION**	**REMEDY**
LINE LED is off	No Power.	Check fuses FA & FB (neon light if blown) on Safety Enclosure panel per 802-101770 Power Control schematic. Check wiring.
LIINE LED is red or Controller resets.	Power may be out of specification	Check/adjust 5V DC power supply to minimum 5.0 - 5.1 Vdc limits. Do not exceed 5.2 Vdc.
STAT LED is off	Controller is faulty	Call FurnacePros Technical Support.
STAT LED blinks red	Firmware problem	Call FurnacePros Technical Support
BATT LED is red	Backup battery is low	Replace LCM4 controller battery.
RX LED is stuck on	Wiring polarity problem	Call FurnacePros Technical Support.
Controller cannot transmit to PC	Configuration jumpers were changed without cycling power.	Cycle power off/on and retry transmission.
No communication to host PC.	Communication Problems	Check serial port. Check PC IP address (10.192.105.100)
No communication to host PC. RX LED is on, but TX LED is off	Communication Problems	Check controller address (10.192.105.102), baud rate, and ASCII/binary settings.
No communication to host PC. RX and TX LEDs are on	Communication Problems	Try a slower baud rate.
No communication to I/O modules. TX LED is off while trying to communicate.	Communication Problems	Check that I/O port software is configured for correct port. If RX LEDs on I/O modules are off while trying to communicate, check for loose connections, shorts or breakage. IF RX LEDs on I/O are on, check I/O address, baud rate, and protocol setting in software.
Furnace program fails to load with correct parameters, clock is wrong, or furnace controller fails to reset	Backup battery is low (battery has a 5 year life cycle)	Replace LCM4 controller battery.

If you have communication, but some variables appear as "###", this means the controller does not know what this particular variable is. Check the Event Log viewer for more details.

3.3 Computer Troubleshooting

The Furnace computer is equipped with indicating lights and sound to provide status information and troubleshooting diagnostics. See Figure **Error! Reference source not found.** for location of lights and ports.

3.3.1 Indicating Lights

The Furnace computer lights provide basic information about the system state..

Table 3-2 Computer Indication Lights

Controls and Lights - Front of the computer	
Power button (6)	push button
Power light (7)	blinking green — indicates that the computer is in sleep state solid green — indicates that the computer is in power-on state blinking amber — indicates a problem with the system board solid amber — indicates that the system board is unable to initialize
Drive activity light (4)	blinking green — indicates that the computer is reading data from or writing data to the hard drive
Network connectivity light (8)	green — indicates that a good connection exists between the network and the computer off (no light) — indicates that the computer is not detecting a physical connection to the network
Diagnostic lights (5)	four lights. For more information, see Diagnostics.
Controls and Lights - Back of the computer	
Link integrity light on integrated network adapter (7)	green — a good 10 Mbps connection exists between the network and the computer. orange — a good 100 Mbps connection exists between the network and the computer. yellow — a good 1000 Mbps connection exists between the network and the computer. off (no light) — the computer is not detecting a physical connection to the network.
Network activity light on integrated network adapter (6)	yellow light — A blinking yellow light indicates that network activity is present.

3.3.2 Power Button Light Codes

The diagnostic lights give much more information about the system state, but legacy power light states are also supported in your computer. The power light states are shown in following table.

Table 3-3 Computer Power Button Light Codes

Power Light State	Description
Off 	Power is off, light is blank.
Blinking Amber 	Initial state of light at power up. Indicates system has power, but the POWER_GOOD signal is not yet active. If the **Hard Drive light is off**, it is probable that the power supply needs to be replaced. If the **Hard Drive light on**, it is probable that an onboard regulator or VRM has failed. Look at the diagnostic lights for further information.
Solid Amber 	Second state of the light at power up. Indicates the POWER_GOOD signal is active and it is probable that the power supply is fine. Look at the diagnostic lights for further information.
Blinking Green 	System is in a low power state, either S1 or S3. Look at the diagnostic lights to determine which state the system is in.
Solid Green 	System is in S0 state, the normal power state of a functioning machine. The BIOS will turn the light to this state to indicate it has started fetching op-codes.

3.3.3 Computer Beep Codes

If the monitor cannot display error messages during the POST, the computer may emit a series of beeps that identifies the problem or that can help you identify a faulty component or assembly. The following table lists the beep codes that may be generated during the POST. Most beep codes indicate a fatal error that prevents the computer from completing the boot routine until the indicated condition is corrected.

Table 3-4 Computer Beep Codes

Code	Cause
1-1-2	Microprocessor register failure
1-1-3	NVRAM read/write failure
1-1-4	ROM BIOS checksum failure
1-2-1	Programmable interval timer failure
1-2-2	DMA initialization failure
1-2-3	DMA page register read/write failure
1-3	Video Memory Test failure
1-3-1 through 2-4-4	Memory not being properly identified or used
3-1-1	Slave DMA register failure
3-1-2	Master DMA register failure
3-1-3	Master interrupt mask register failure
3-1-4	Slave interrupt mask register failure
3-2-2	Interrupt vector loading failure
3-2-4	Keyboard Controller Test failure
3-3-1	NVRAM power loss
3-3-2	Invalid NVRAM configuration
3-3-4	Video Memory Test failure
3-4-1	Screen initialization failure
3-4-2	Screen retrace failure
3-4-3	Search for video ROM failure
4-2-1	No timer tick
4-2-2	Shutdown failure
4-2-3	Gate A20 failure
4-2-4	Unexpected interrupt in protected mode
4-3-1	Memory failure above address 0FFFFh
4-3-3	Timer-chip counter 2 failure
4-3-4	Time-of-day clock stopped
4-4-1	Serial or parallel port test failure
4-4-2	Failure to decompress code to shadowed memory
4-4-3	Math-coprocessor test failure
4-4-4	Cache test failure

3.3.4 Computer Diagnostic Lights

To help troubleshoot a problem, your computer has four lights labeled 1, 2, 3, and 4 on the bank panel. When the computer starts normally, the lights flash before turning off. If the computer malfunctions, the sequence of the lights help to identify the problem.

NOTE: After the computer completes POST, all four lights turn off before booting to the operating system.

Table 3-5 Computer Diagnostic Lights

Light Pattern	Problem Description	Suggested Resolution
	The computer is in a normal *off* condition or a possible pre-BIOS failure has occurred. The diagnostic lights are not lit after the computer successfully boots to the operating system.	• Plug the computer into a working electrical outlet. • If the problem persists, contact Dell.
	A possible processor failure has occurred.	• Reseat the processor (see Processor information for your computer). • If the problem persists, contact Dell.
	Memory modules are detected, but a memory failure has occurred.	• If two or more memory modules are installed, remove the modules, then reinstall one module and restart the computer. If the computer starts normally, continue to install additional memory modules (one at a time) until you have identified a faulty module or reinstalled all modules without error. • If available, install working memory of the same type into your computer. • If the problem persists, contact Dell.
	A possible graphics card failure has occurred.	• Reseat any installed graphics cards. • If available, install a working graphics card into your computer. • If the problem persists, contact Dell .
	A possible floppy drive or hard drive failure has occurred.	Reseat all power and data cables.
	A possible USB failure has occurred.	Reinstall all USB devices and check all cable connections.
	No memory modules are detected.	• If two or more memory modules are installed, remove the modules, then reinstall one module and restart the computer. If the computer starts normally, continue to install additional memory modules (one at a time) until you have identified a faulty module or reinstalled all modules without error. • If available, install working memory of the same type into your computer. • If the problem persists, contact Dell.

Table 3-5 Computer Diagnostic Lights		
Light Pattern	**Problem Description**	**Suggested Resolution**
	Memory modules are detected, but a memory configuration or compatibility error has occurred.	• Ensure that no special requirements for memory module/connector placement exist. • Ensure that the memory you are using is supported by your computer (see the "Specifications" section for your computer). • If the problem persists, contact Dell.
	A possible expansion card failure has occurred.	• Determine if a conflict exists by removing an expansion card (not a graphics card) and restarting the computer. • If the problem persists, reinstall the card you removed, then remove a different card and restart the computer. • Repeat this process for each expansion card installed. If the computer starts normally, troubleshoot the last card removed from the computer for resource conflicts. • If the problem persists, contact Dell.
	Another failure has occurred.	• Ensure that all hard drive and optical drive cables are properly connected to the system board . • If there is an error message on the screen identifying a problem with a device (such as the floppy drive or hard drive), check the device to make sure it is functioning properly. • If the operating system is attempting to boot from a device (such as the floppy drive or optical drive), check system setup to ensure the boot sequence is correct for the devices installed on your computer. • If the problem persists, contact Dell.

3.4 Remote Access

In order to allow for remote diagnostics of in-process furnace operations, a 2nd network interface card (NIC) is provided as well as a modem with communication software. The remote operator, in conjunction with on-site personnel, can simultaneously view the Process screen and have access to input and control features.

Remote access can be accomplished as follows:

- Broadband connection via internet access
- Wireless connection via internet access

3.4.1 Connect Using TeamViewer™

A good method of connecting to the furnace remotely is to use the TeamViewer internet service for remote diagnostics:

If the computer is TeamViewer enabled:

Make sure there is an internet connection to the local network connection 2 port.

Click on the blue TeamViewer icon in the menu or next to clock on desktop menu bar.

Provide Your ID and random generated Password to remote user (factory or service tech).

Partner (factory or service tech) must have Remote User ID and TeamViewer password as well as Furnace Computer password, if any to log on the furnace computer from a remote location.

Note: For security, each time TeamViewer is enabled on the Furnace Computer, TeamViewer will generate a new password that must be provided to the remote user.

If the computer is not TeamViewer enabled, contact factory for installation instructions.

3.5 Remote Diagnostics

Enable TeamViewer™ by clicking on blue icon on lower right of screen and enable.

Contact factory service tech and indicate system is on-line and available for troubleshooting

3.6 Element Failure Indication

3.6.1 Furnace Element Monitor screen

Press the Monitor button on the menu bar to view the lamp status. Use this screen to identify whether any lamp string have a problem. The element monitoring system only detects lamp status when lamp current is above a set value (default is 4%) and sometimes may report false failures if the current is too low at the power setting.

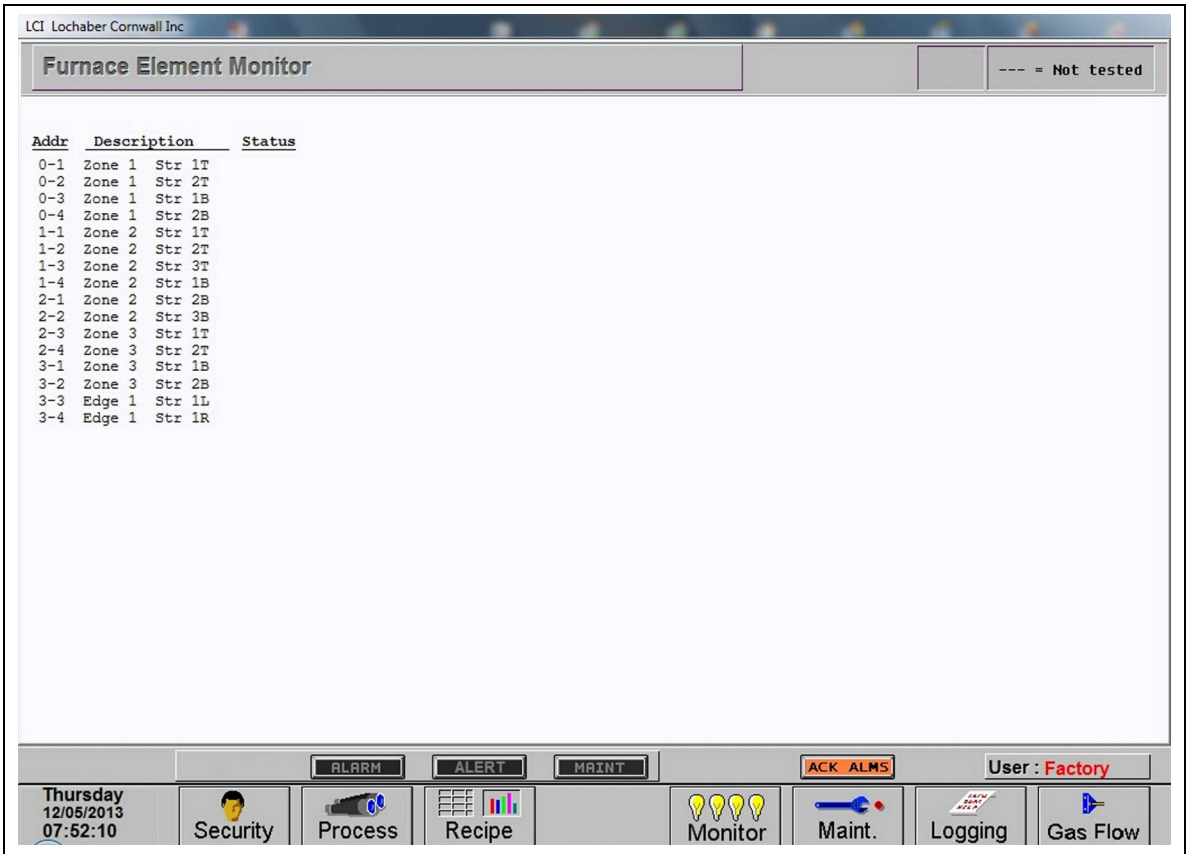

Figure 3-3 Lamp String Failure screen

Table 3-6 shows examples of EM screen readings and their meaning.

Table 3-6 Element Monitor Screen

Addr	Zone	Str# T/B	Status	Description and Location
0	Zone 1	Ele 1T	See Table 3-7	Element monitor 0 detected a possible failed top lamp in Zone 1in the first string from entrance.
1	Zone 1	Ele 2B	See Table 3-7	Element monitor 1 detected a possible failed bottom lamp in Zone 1 in the second string from entrance.
10	Edge 1	Ele 1 L	See Table 3-7	Element monitor 10 detected a possible failed Left Edge heater, in the first pair of edge heaters from the entrance.

Table 3-7 defines the EM screen possible Status values, description and recommended actions.

Table 3-7 Element Monitor Status

Status	Description	Action
- - - -	Not Tested	Lamp %power is too low to test current.
PASSED	Lamp string OK	None
FAIL	Lamp string reports faulty string	If a single string is shown as faulty, check lamp string using procedure in section 3.6.3. If all strings in a zone (top or bottom) are faulty, verify corresponding SCR is operating properly. If four strings fail, verify element monitor board is operating properly.

3.6.1 Discrete Indication (RTC retrofits and new furnaces, 2013 and after)

The Furnace controller contains a channel for each independent string of lamps. When power is applied to the lamps above a minimum value, the controller checks the status of all channels and reports any failures. When the lamps are ON, lights on the controller indicate which strings indicate current is flowing.

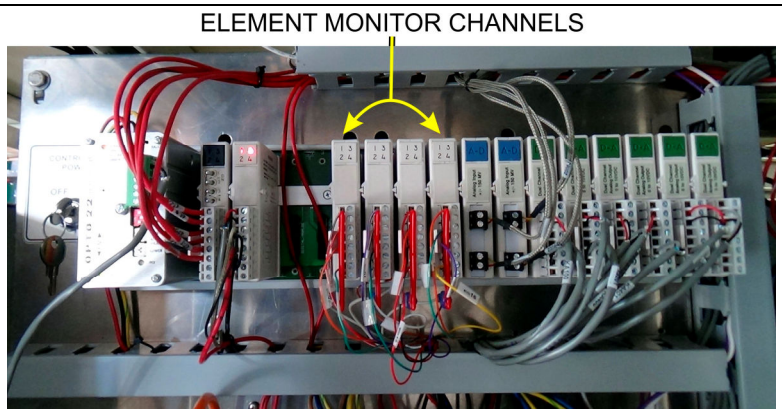

Figure 3-4 Furnace Controller EM I/O modules

3.6.2 Serial Polling (2001-2012 furnaces)

If the system returns a number of nuisance errors, from the monitor screen, you increase the minimum value below which the program will not poll the strings. To change this value, click on Serial EM Test button open the Serial Elemon Test screen (see Figure 3-5). This screen shows real time polling of the signal from the element monitor boards. Enter a higher value in the Min Value % box: Sometimes a value of 15% can provide better results if the system is falsely reporting string failures. The screen will also reveal if there is a wiring error of if there is no response from a polled system.

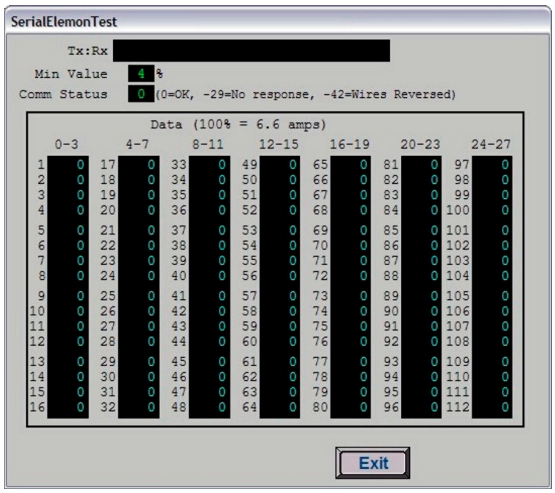

Figure 3-5 Serial Element Monitor Test screen (2001-2012 furnaces)

3.6.3 Heating Element Test Procedure

To simplify troubleshooting, the software displays the lamp strings by zone, top and bottom to indicate possible failures in each serial string of lamps. The furnace element screen displays the specific location of a suspected failed lamp string during operation. For a more reliable check, the user should perform the Testing Lamps process in this section.

Visual inspection of the lamps (either by looking down the entrance of the furnace or by removing the lamp covers) with the power on or off is not reliable. When adjacent lamps are on, reflected light will make a defective element appear okay. If the Testing Lamps process confirms that a string has failed, note the LAMP STRINGS indicator (EleT1, B1, etc.) that was OFF during the test, and use the following procedure to isolate which lamp in that identified string has failed.

This procedure is to be used to test for open heating or failed lamp heating elements.

A. Required Equipment

1. Ohmmeter (or Continuity Tester)

2. 3/8" Box or Open End Wrench

3. Control & Element Wiring Schematic 802-101814

B. Test Procedure

Remove all power from the furnace, and if a UPS or EPS is installed, locate and shut off the unit. Remove all side covers, completely exposing all lamp terminations.

Locate the identified failed string and the lamps in that string using the Element Wiring drawing.

Within each zone, the lowest numbered lamp (Ele 1) is nearest the entrance end of the furnace.

Disconnect one end of each of the 2 to 4 lamps in the suspect string and measure the resistance of each lamp. The resistance of a good lamp is <10 Ω. A higher reading identifies a defective lamp that should be replaced.

Refer to section 3.8.6 Heat Lamp Replacement for lamp replacement instructions.

Once the elements have been completely tested, replace the covers on the furnace. Turn on the EPS/UPS (if so equipped) and power to the furnace. Bring the furnace up to temperature, and, next, run a profile verifying that no leaks occurred around the lamps that were replaced.

The procedure is now complete.

3.6.4 Lamp Replacement

See furnace Reference Manual, Section 7.5.3 Heat Lamp Replacement.

3.7 Troubleshooting Process Problems

3.7.1 Belt speed

Measure the belt speed with a stopwatch. If it differs from the value on the process screen by more than 5% (1 IPM off for each 20 IPM of belt speed), re-calibrate the belt speed. Follow the Belt Speed Calibration procedure in the furnace Reference Manual, Chapter 7.

3.7.2 Resolving zone control issues

The calibration screen can be useful for use in troubleshooting and resolving zone control issues, testing lamps and checking for blown lamp fuses by isolating individual zones.

Zone Control. If heat in any zone increases rapidly into a "runaway" condition even if the zone controller OUT1 LED indicator is dark (the controller output is OFF), but the heat can be stopped by shutting off the affected zone top and bottom switches, the zone SCR probably has failed with a shorted output and needs to be replaced.

If the heat in any zone steadily stays above the setpoint value, but is not in a "runaway" condition, enter zero on the Process Screen for power for the affected zone top and bottom and see if the heat decreases. If it does not, the furnace has a process gas flow problem or the setpoint value in adjacent zones may need to be lowered.

Types of Energy. The ability to turn banks of lamps off and on via the % Power fields on the Process or Recipe Editor screens allows the user great flexibility in applying energy to each zone. Use just the top lamps in each zone for drying moisture or volatile organic compounds from the top surface of substrates or trays, or curing thermosetting compounds or coatings on wafers or polycarbonate materials. Use both top and bottom lamps in traditional furnace applications. Use just the bottom lamps to emphasize conduction heating of parts from the transport belt and from IR radiation on the bottom of metallic or ceramic parts carriers.

3.7.3 Temperature or large power fluctuations

If the temperature is slow to respond to large deviations from setpoint temperature, it may be a problem with the PID settings. If you need to modify a particular zone, see the procedures in section 0. Also see section 3.9.1 to completely retune a zone.

At low temperatures (<100°C) or near the maximum temperature, if there is an unacceptable deviation from setpoint, the SCR may need to be calibrated. If the SCR is out of calibration, most likely it will not be noticeable in the medium range of the temperature. If necessary, calibrate the SCR Calibration using the procedure in section 3-26 Calibrate SCRs.

NOTE: PID tuning should only be attempted by qualified personnel. Unreasonable PID parameters can stress the components of the system and cause premature failure of some electrical systems.

3.7.4 Unstable zone temperatures

If the temperature fluctuates by more than 5 degrees in less than 20 seconds after you reached ready state, it might be a problem with the PID settings. If you notice unstable behavior in a certain zone, you may need to modify the PID loop parameters for that particular zone. Follow the procedures in section 0 to retune the PID loop parameters. Also see section 3.9.1 to completely retune a zone.

If the SCR is out of calibration, most likely it will not be noticeable in the medium range of the temperature. Only at low temperature (<100°C) or near the maximum temperature, will there be deviation from the setpoint. See the SCR Calibration procedure in the Furnace Reference Manual.

NOTE: PID tuning should only be attempted by qualified personnel. Unreasonable PID parameters can stress the components of the system and cause premature failure of some electrical systems.

3.7.5 Abnormal sensor behavior

There are numerous sensors (standard and optional) on the furnace, from thermocouple to a board counter, gas analyzer, and so on. If one particular sensor seems to behave erratically, you will need to look into the value reported by the control subsystem.

The errors could be

1. • a temperature with a negative value,
2. • a gas analyzer readout that never changes value,
3. • a board counter that doesn't count.

For the digital sensors, first locate the relay module connected to that sensor on the OPTO panel, using the Channel Assignment configuration sheet. The red LED should toggle every time the sensor changes state. If it doesn't, the problem is with the sensor or the wiring. Most unlikely the relay module itself.

If the relay does toggle, make sure the module is talking to the controller; the TX LED should be flashing.

The analog inputs cannot be checked visually.

3.8 Control System Installation and Setup

3.8.1 LCM4 Furnace Controller Installation

Connect the various cables between the modules, the controller, the computer and the I/O racks. Newer systems have a surge protector on the network cable between the computer and the controller.

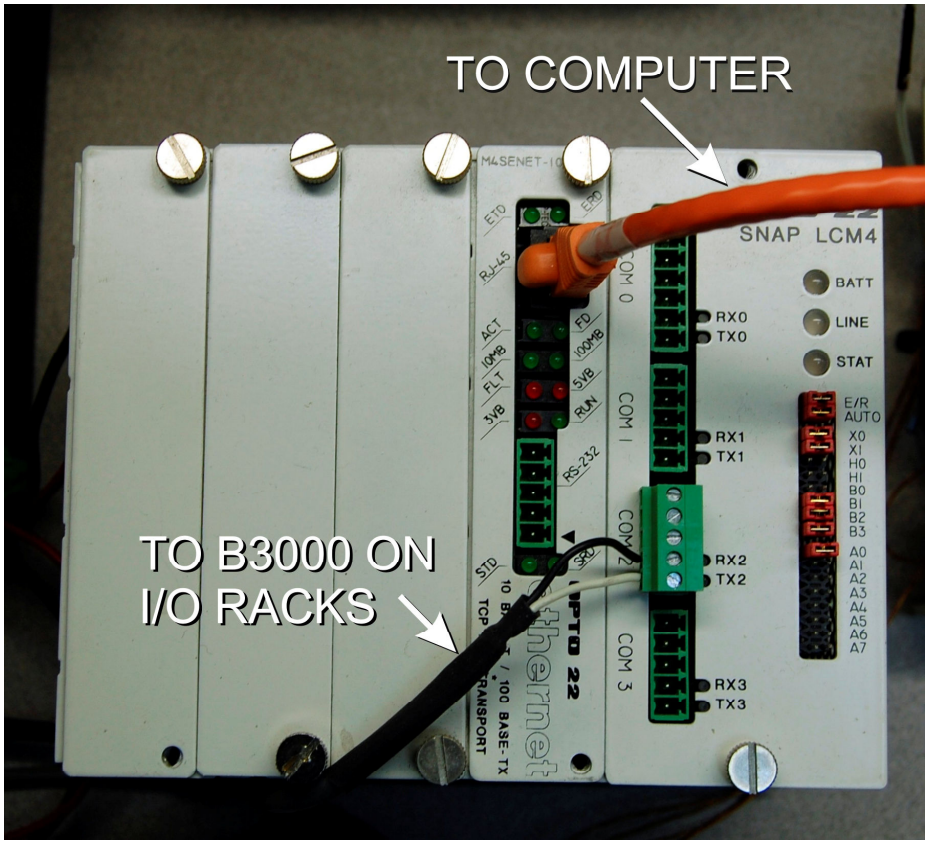

Figure 3-6 Furnace Controller connections

INITIALIZE: Open computer access door and turn ON the computer. When the WINDOWS® logo comes up, hold down the shift key to prevent the MMI from starting, since the controller is not ready yet. If it started, exit using ALT +F4.

The first time the controller is turned on, its memory is empty, and the software has to be downloaded. Double click on the download icon in the furnace group in Windows or the furnace icon on the desktop.

FURNACE SOFTWARE. The furnace icon or menu item will download the kernel (the Operation System for the controller) and the ProControl™ furnace software, and start running it.

You can now start the MMI software by double clicking on the Furnace icon. From now on, startup will be automatic.

You should see the correct date and day in the bottom left corner. If not, go to the Ethernet Installation and troubleshooting section.

LOG-IN. Check the log-in dialog box for one of the 3 proposed users: operator, tech and Factory (FPD). Enter appropriate password for the level selected.

3.8.2 Verify configuration of the external jumpers of the LCM4 Controller

Refer to Figure 3-6 for board jumper settings.

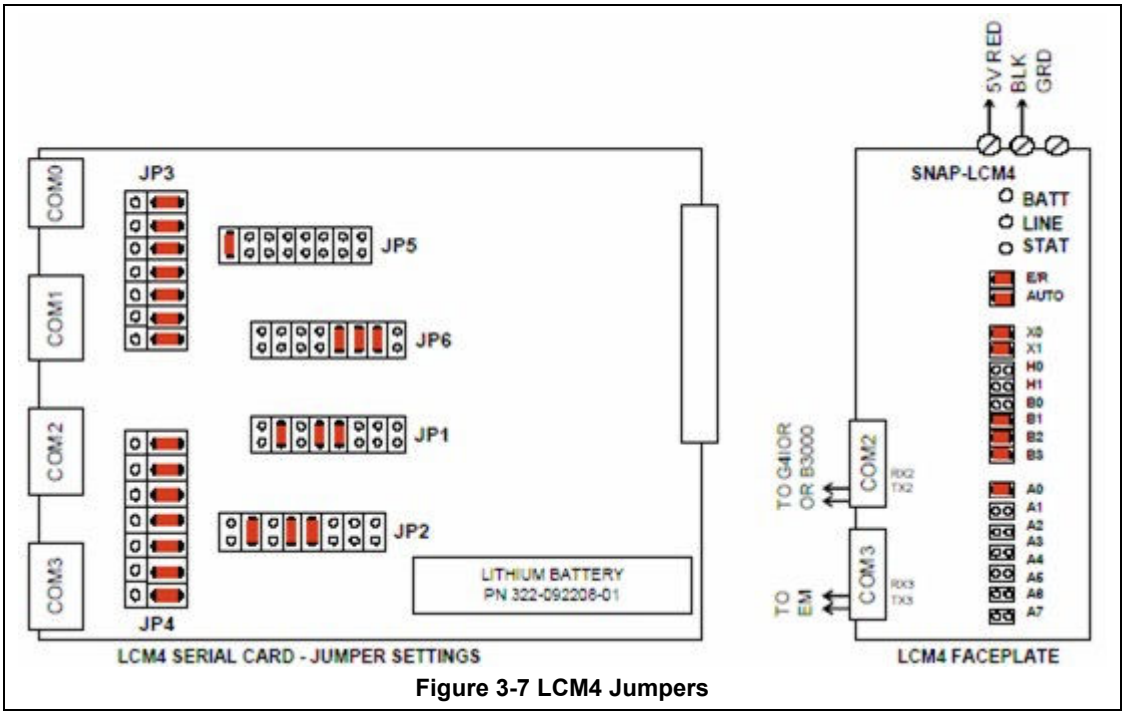

Figure 3-7 LCM4 Jumpers

3.8.3 Windows10® Setup of Furnace Computer Ethernet Connection

a. Open the Windows Start . Click on the Settings icon . Select Network & Internet. Then select Ethernet/Change adapter settings (Figure 3-9 Select Change adapter settings)

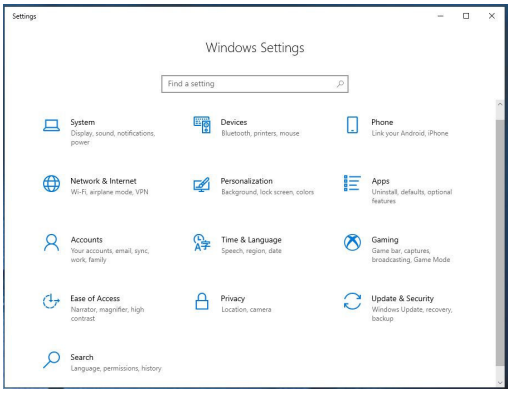

Figure 3-8 Open Network & Internet

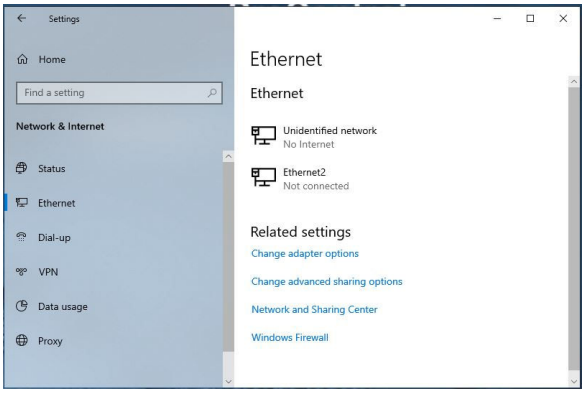

Figure 3-9 Select Change adapter settings

b. From Network Connections window, select Ethernet-Furnace, the connection that corresponds to the furnace network (it may say “Unidentified network, No Internet”), Figure 3-10.

c. Select Properties button from the Ethernet-Furnace Status window, Figure 3-11.

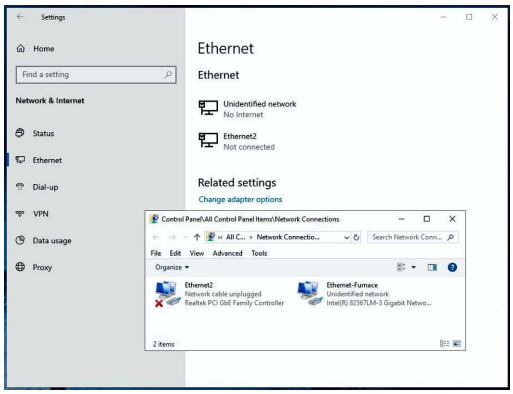

Figure 3-10 Select Select Ethernet-Furnace

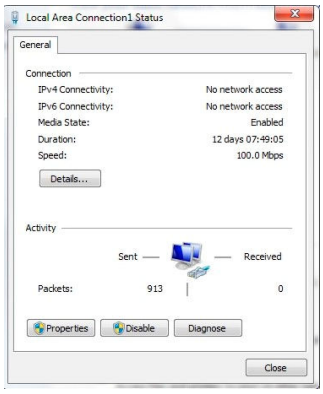

Figure 3-11 Select Properties

d. Double-click Internet Protocol Version 4 (TCP/IPv4) from the Properties screen Figure 3-12. Verify IP address 10.192.105.100 and subnet mask 255.255.255.0, Figure 3-13. Revise if incorrect.

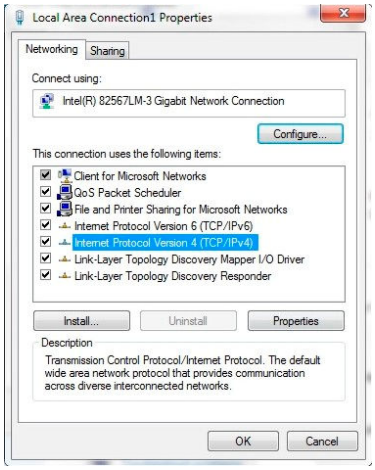

Figure 3-12 Select Internet Protocol 4

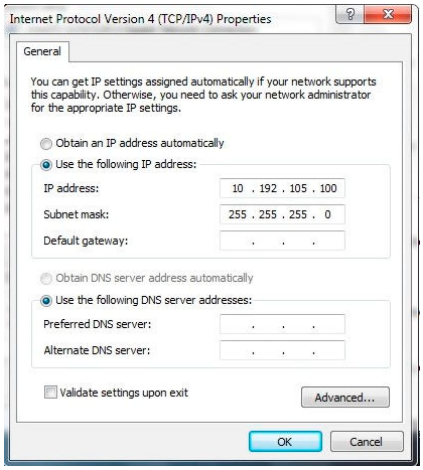

Figure 3-13 Verify IP Address

e. Click Ok. And close all windows.

3.8.4 Reset & Assign an IP Address to the Controller's Ethernet Adapter Card.

a. Remove power from the controller chassis box.

b. Remove the controller's Ethernet adapter card from the controller chassis.

Note: Follow standard anti-static dissipative procedures when removing and handling the card.

c. Remove Ethernet and RS-232 connectors

d. Release (4) front panel set screws and (2) covers

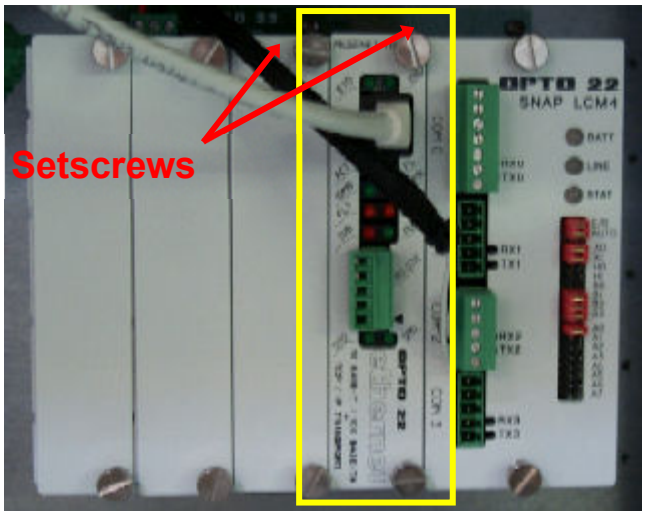

Figure 3-14 Remove Card from chassis. (See figure below)

e. Remove the Ethernet adapter card

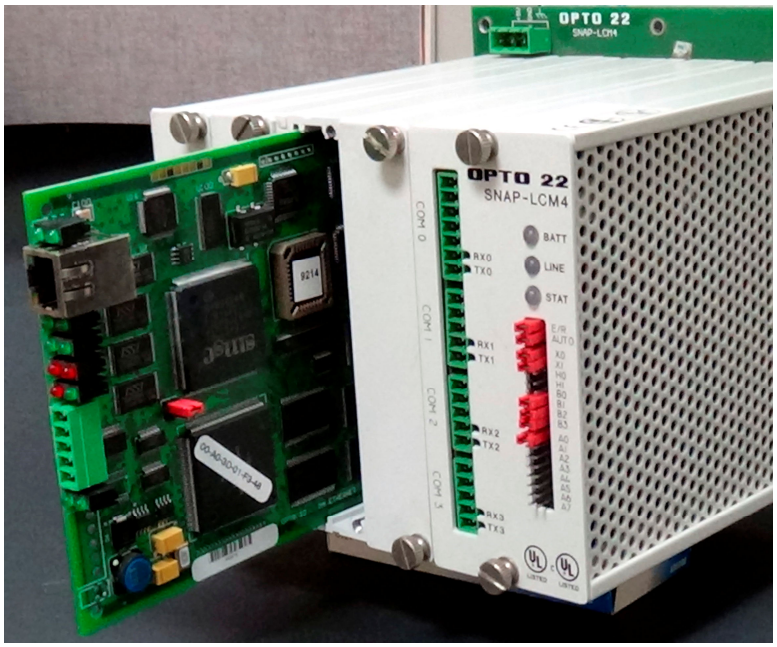

Figure 3-15 Removal of Ethernet Card

f. Move the J7 Jumper to the Module Reset Position as shown in the following pictures.

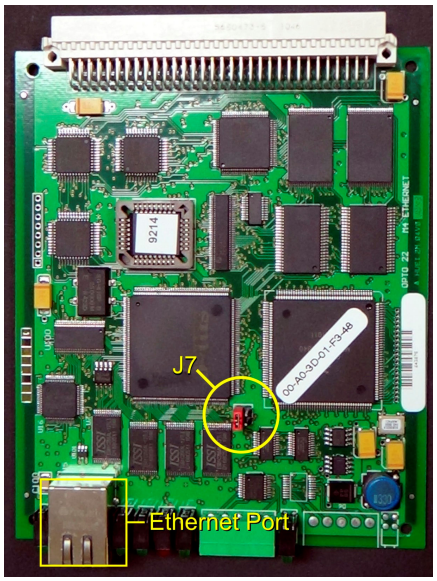

Figure 3-16 Location of J7 Jumper J7 in Normal RUN Position

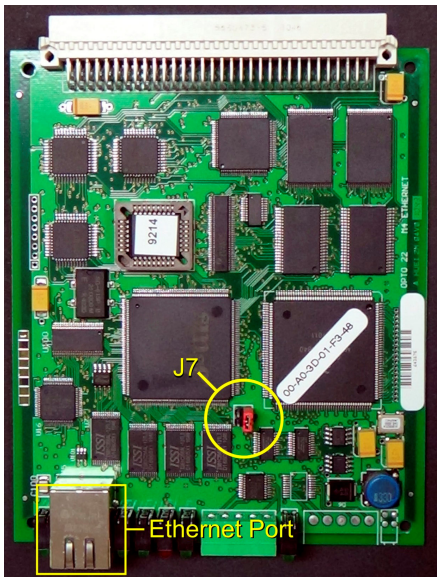

Figure 3-17 J7 Jumper at Module RESET

g. Reinstall the Ethernet adapter card into the Opto22 controller chassis box.

h. Wait for the STD LED on the Ethernet adapter card to stop blinking, and then turn off, or remove power from the system.

Note: The power switch on the PC may need to be initialized.

i. Apply power to the controller system.

Note: This procedure resets the Ethernet Adapter Card to its factory default settings.

j. After removing power from the controller system, again remove the Ethernet Adapter card and restore the J7 Jumper to its original position as shown at right

Figure 3-18 Original J7 Position

k. Reinstall the Ethernet Adapter card into the Opto22 controller chassis box making sure the covers and set screws are in place. Connect the network cable to the Ethernet port on the Ethernet adapter card. Make sure the green I/O connector is connected to COM2 port on the LCM4 (do not connect to the Ethernet card).

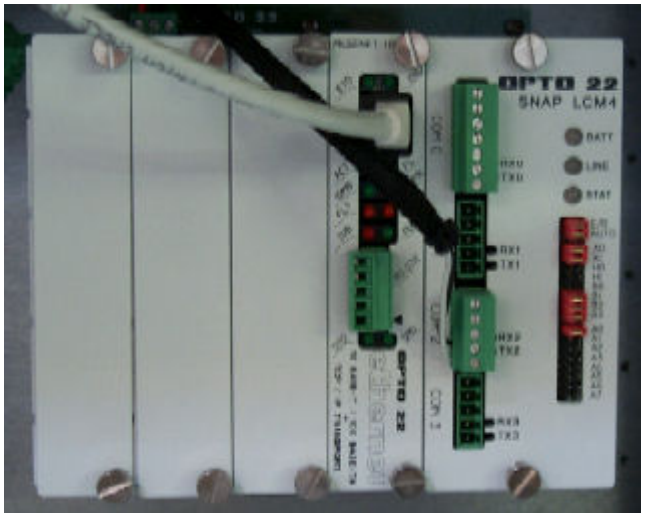

Figure 3-19 LCM4 Controller with Ethernet Adapter (on left)

l. From the Windows© Toolbar, Select <Start/Programs\Opto22\OptoUtil\OptoBootP Utility>

m. On the "OptoBoot Tool" dialog box, click the "Listen" pushbutton located at the upper right.

n. After a few seconds, in the dialog box's data window, a Mac address will be listed followed by 0.0.0.0 IP Address and a ?.?.?.?. Subnet Mask.

Double Click on the 0.0.0.0 field to assign an IP Address

Enter "**10.192.105.102**" for the IP Address and "**255.255.255.0**" for the Subnet Mask. Leave the Gateway field **0.0.0.0**.

Click the "Send" pushbutton to assign the entered address.

The data window should now be updated to display a "Yes" under the "Sent" Column.

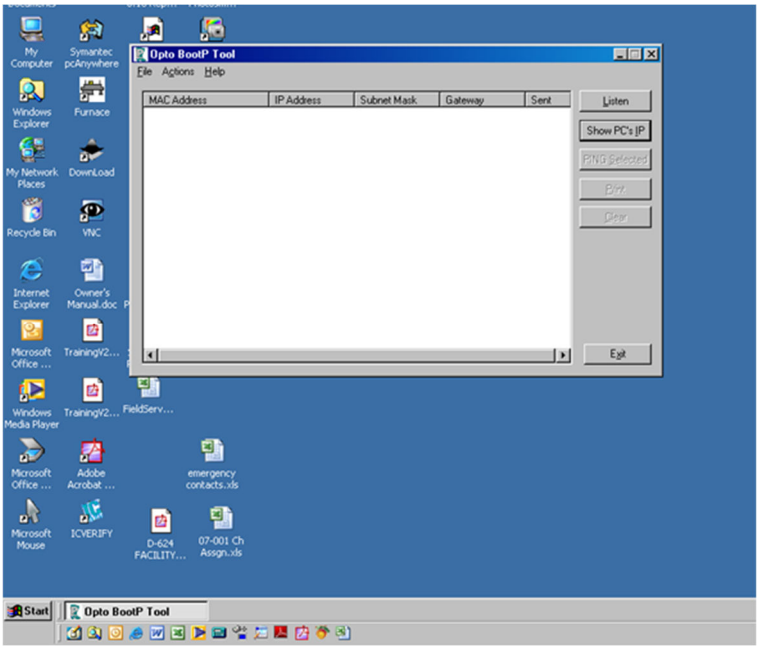

Figure 3-20 OptoBoot Screen

o. Click on "Exit" to leave the OptoBoot tool application.

3.8.5 Replacing SCR Control Modules

A. SCR REMOVAL

To remove the entire SCR assembly, disconnect the 10Vdc and the 24 Vac wire pairs. Unscrew the Line and Load wires. If you are only replacing the firing board, remove the (2) firing board screws. If you are removing the entire assembly, remove the (2) SCR Mounting screws. See **Figure 3-21 SCR installed**

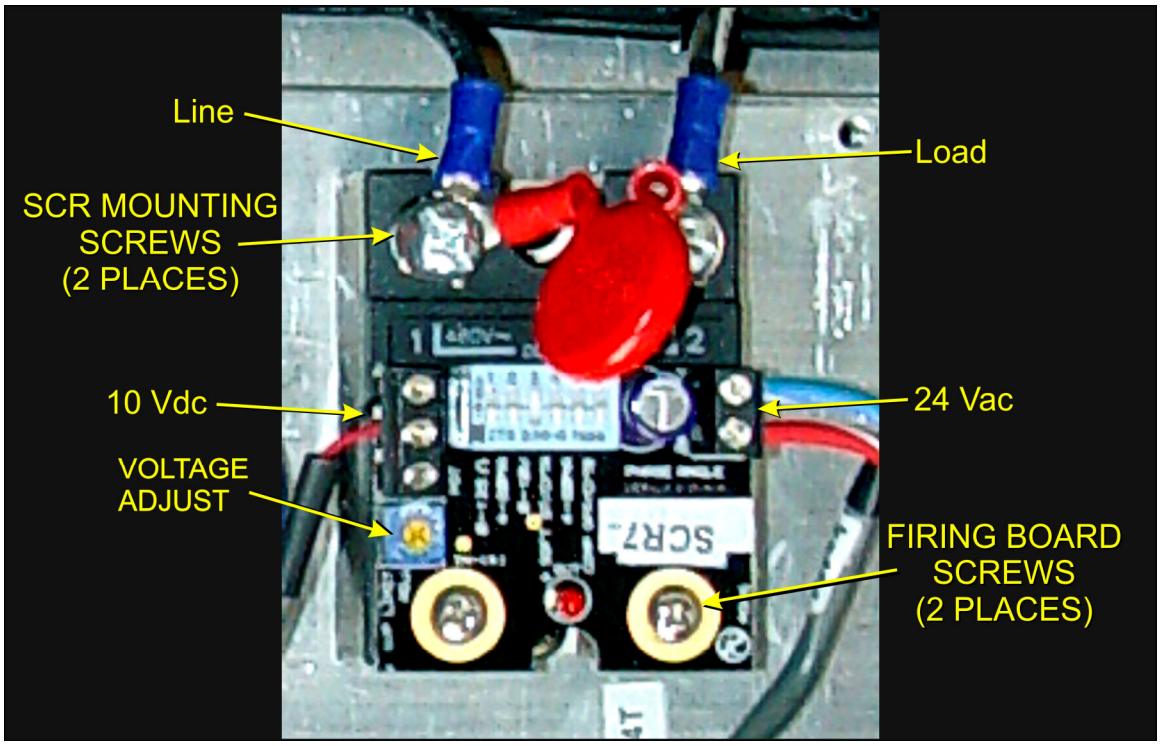

Figure 3-21 SCR installed

B. SCR INSTALLATION

Install an entire SCR assembly, by first checking that thermal paste is applied to the back of the SCR and the heat sink (aluminum plate) in the location where is will be mounted. Screw the assembly to the heat sink. Connect the 10 Vdc control wires, the 24 Vac control voltage wires and the Line and Load wires with red capacitor in place. Make sure the dip switch is set as shown in Table 3-10 . Then follow the procedure on page 3-26, section **3.9.1 Calibrate SCRs** to calibrate the SCR.

Table 3-8 SCR Firing Board DIP Switch Settings

Dip Switch	1	2	3	4	5	6
Position	OFF	OFF	ON	OFF	OFF	OFF

3.8.6 Heat Lamp Replacement

A. Tools Required:

Table 3-9 Tools needed for replacing Lamps	
(2) 3/8 in. open ended wrenches	Replacement Kaowool packing material
Allen wrench	Lint free cloth or protective gloves
Flashlight	

B. Handling Heating Lamps

Warning: Whenever handling furnace heat lamps, special care must be taken not to touch the surface of the lamp. Leftover salt from handling the lamps can cause hot spots which can reduce lamp performance or cause failure.

If the cleanliness of a heat lamp is suspect, clean the lamp with isopropyl alcohol and wipe with a lint-free cloth prior to use.

C. Lamp Removal

All power should be removed from the furnace before replacing lamps.

1. If Plenum covers are supplied, remove the setscrews securing the plenum clamps and carefully remove plenum covers. Care must be taken not to damage the rubber seal between the plenum chamber and the chamber cover.
16. Short one lamp from each zone to the furnace frame to remove any charge residing in the lamps.
17. Taking care not to disturb the ceramic insulating blocks, use one of the 3/8" wrenches to hold the base nut while you loosen the fastening nut.

Warning: If the furnace is equipped with the hermetic seal (Option ❒), any cracks to the insulating block will result in furnace chamber leaks and should be replaced if broken.

18. Disconnect the element lead from the insulating terminal block. Repeat this step for the opposite side.
19. Remove lamp and old packing material.

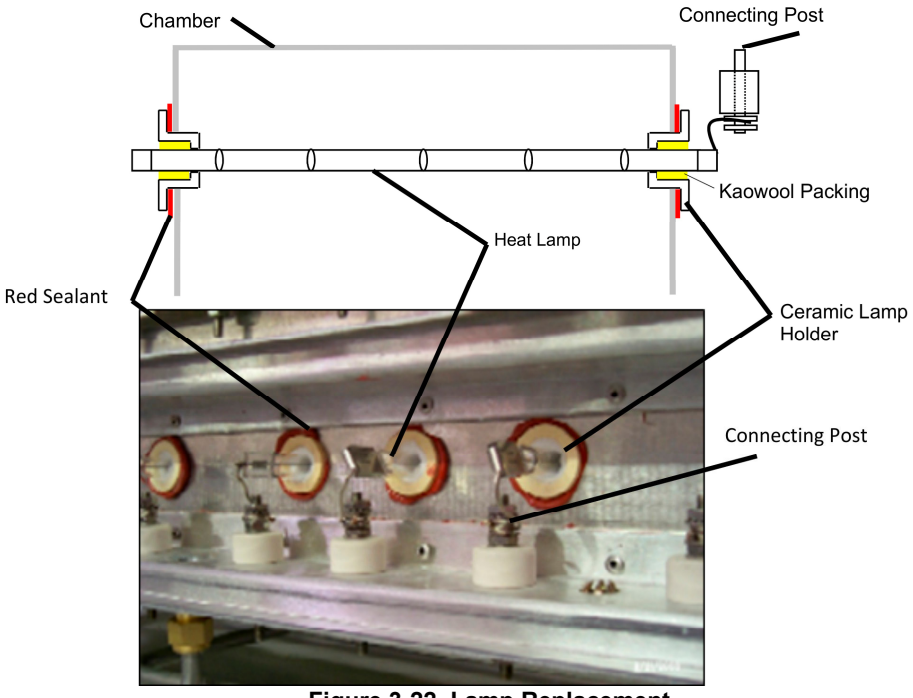

Figure 3-22 Lamp Replacement

Cross-section Across-the-Belt Diagram (top), End View Picture (bottom)

D. Lamp Installation

1. Make sure the red sealant securing the ceramic lamp holder is intact. Unsealed ceramic lamp holders may be resealed with Kaowool packing.
2. Using a lint free cloth or protective gloves, remove the lamp from its carton being very careful not to touch the glass with bare hands.
3. Straighten the connecting lead on one end of a new lamp and slide it into place. You may need the flashlight to locate the opposite side's ceramic holder. Once the lead appears from the ceramic holder, you may carefully pull the lamp through the furnace chamber.

   If threading the lamp is difficult. Thread a dowel or stiff wire through the furnace. Tape the lead to the dowel or wire and then pull the lamp into position.
5. Pack the ceramic holders on both sides with the Kaowool packing material.
6. Center the lamp to ±1/32-in. (±0.8-mm) and recheck the packing.
7. Wrap the connection leads around the connection terminals in the same direction as the nut will be tightened. Use two wrenches, as you did when removing the connection, to ensure the connection post is not disturbed.
8. Cut off excess connection wire.
9. Replace plenum covers being careful not to damage the rubber seal.

3.9 Calibration

Consult the Reference Manual Section 7.3 for most calibration procedures.

3.9.1 Calibrate SCRs

Follow the calibration procedure described in section 7.3 of the Reference Manual.

Calibration of the SCRs is usually necessary only if an SCR or SCR controller is replaced. Good maintenance practice, however, is to check SCR calibration every 6 months or so, or if the furnace seems to be slower than usual to reach operating temperature.

This calibration procedure will require use of an RMS responding voltmeter/multimeter and a thin blade screwdriver, and will require that the access cover to the control enclosure be opened.

3.9.2 PID tuning

PID parameters can be varied for each zone. Typical initial values for PID parameters in high temperature applications are shown in Table 3-10. Alternate values can be used for a low temperature application to provide more constant application if IR energy. Use the SuperTrends screen to evaluate performance in each zone for you process.

Table 3-10 Typical PID Initial Factory Settings

Symbol	Parameter	Initial Value	Alt Initial Value
P	Proportional Gain	9	18
I	Integral	45	45
D	Derivative	0	1

See Furnace Reference manual for theory and description of PID Tuning.

If you notice unstable behavior in a certain zone, use the following procedure to retune the PID:

NOTE: This procedure should only be attempted by qualified personnel. Unreasonable PID parameters can stress the components of the system and cause premature failure of some electrical systems.

First go the Process screen an open the Super Trends chart for the zone to be tuned (see section 2.6 Super Trends). Go to the recipe screen and select the PID tuning for the zone of interest. Write down the values of Gain and Integral before you start changing them! If all else fails, you can return to the factory default.

Set the integral to the maximum possible value (180), the Derivative to 0 and the Gain to 1. Wait until the temperature stabilizes. Increase the Gain by 10%. Repeat until the temperature starts oscillating. Always wait for at least 5 oscillations before changing any parameters again. The temperature will be oscillating at a value BELOW the setpoint. This is normal. The temperature will be anywhere between 5° and 50°C below the setpoint.

Now set the Integral to the period of previous oscillations (usually between 5 and 15 seconds). Round up to the nearest integer. The temperature will slowly drift to a new value. Reduce the Integral term for faster convergence.

At that point, the system may start oscillating again. Decrease the Gain by an additional 10% until stable.

If the heating process inside the chamber is a first order process with very little lag time. This means that the PID does not need a Derivative value to operate (D = 0).

Oscillations are caused by gain too high, integral too short, or rate too long. Never set rate to more than one-fourth of integral time. Sluggish response is caused by gain too low, integral too long, or rate too short.

The PID values will work over a rather wide range of temperature. However, on a High Temperature furnace, the PID might require tuning for the low range of temperature, around 200°C, and different set of parameters above 500°C. The machines are set up for one set of PID parameters at the factory. For furnace fine tuning, it is the responsibility of owner's process engineer to determine the final settings.

3.9.3 Belt Speed Measurement

The belt speed has been calibrated at the factory. The actual belt speed can be verified by the following procedure.

Tools Required: Tape Measure & Stop Watch.

❶ Measure the distance from the furnace entrance gate to the exit gate.

❷ Set the belt to the desired speed. (Set belt to the maximum speed if you plan to reprogram the Belt Speed Display meter.).

❸ Place an object on the belt to act as a marker

❹ Start the timer as the marker enters the entrance gate.

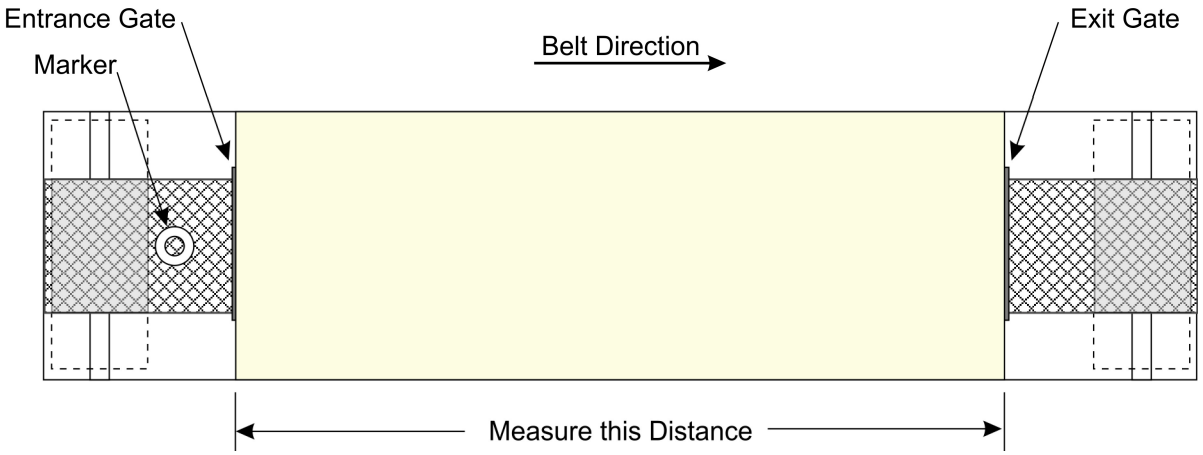

Figure 3-23 Belt Speed Calibration Diagram

❺ When the marker on the belt reaches the exit belt tray, stop the timer. Record the time in seconds.

CALCULATE ACTUAL BELT SPEED:

Convert the measured distance from **step ❶** above to inches.

Convert the time from **step ❺** to minutes.

Compute the actual belt speed according to the following equation:

$$\text{Speed} = \frac{\text{Distance (in.)}}{\text{Time (min.)}}$$

3.9.4 Belt speed Calibration

Go to the calibration screen. Check the box 50% output. Using a stopwatch, time the belt speed over a known distance, and calculate the actual belt speed. Enter the number in the Actual speed field. Un-check the 50% output box. See Reference Manual Chapter 7.3 for more detail.

3.9.5 Thermocouples

The thermocouples are pre-calibrated. They do not require any additional calibration.

3.9.6 IPS - Low Gas Pressure Switch Calibration (optional equipment-not installed)

Inlet Pressure Switches are installed on the process gas manifolds. These switches are normally open. They close when proper pressure is present in the process gas supply lines.

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

Table 3-11 Initial Alarm Settings

Port	Manifold	Pressure	
Gas 1	CDA or Nitrogen	55-60 psig	3.8-4 Bar
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.

Figure 3-24 IPS Inlet Pressure Switch

A. Gas Supply Low Pressure Switch Calibration

The process gas pressure switch is located on the gas supply manifold for each gas supplied.

If a reservoir tank is supplied, the pressure switch is located at or near the compressed air receiver. See drawing 802-101780-01.

B. Calibration

To calibrate each switch:

1) Verify that the Low Pressure Alarm switch is enabled.
2) Close all flowmeter valves.
3) Set inlet air pressure to desired set point pressure. Read pressure on supply gage.
4) Rotate the Adjusting Wheel: Clockwise to increase the pressure set point, counterclockwise to decrease. You can hear a faint click when the micro switch changes state. Below this point below which the switch will activate the alarm when enabled.7
5) Start the furnace system without power to the lamps. Close the facility process gas valve to the furnace. Open the flowmeter valves and verify that the alarm trips when the pressure drops below the new set point.
6) Readjust as necessary and retest.

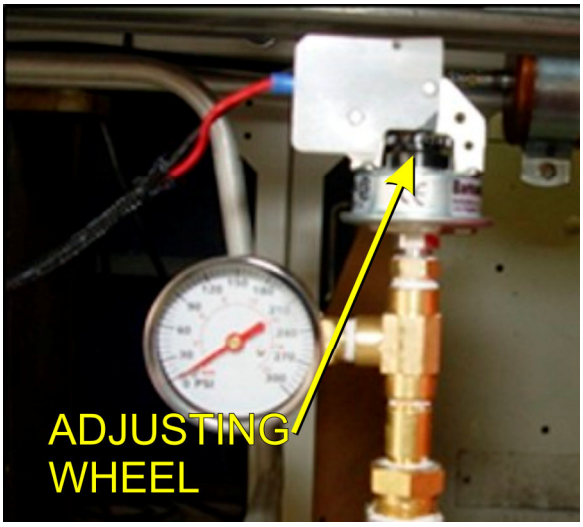

Figure 3-25 Air Pressure sensor