



# **CONTINUOUS BELT IR FURNACE**

*Model AG-1524  
Controls Upgrade*

*Owner's Manual*



MODEL: AG-1524  
SERIAL NUMBER: 1824159102  
FACTORY ORDER NUMBER: 08-002(32180 orig)

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# Continuous Belt IR Furnace

## Owner's Manual

Rev. 0

Part No. 08-002 - 675-121524-01 CD

Part No. 08-002 - 675-1201524-02 Loose Leaf

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## WHAT IS IN THIS MANUAL

This Owner's Manual contains your product information and warranty as well as installation, startup, operating instructions specific to the equipment purchased. The Owner's Manual is to be used in conjunction with the Continuous Belt IR Furnace Reference Manual and Dell Computer Product Information Guide to assure the equipment is installed and operated according to manufacturer's instructions.

*Note that throughout this Owner's Manual and the furnace Reference Manual the equipment is generally referred to as a furnace. A dryer is a furnace with only the top lamp elements installed.*

## EQUIPMENT LIST

Verify that the following equipment was received.

Qty	Unit	Description	Part Number
(1)	ea	AG-1524 Furnace Control and Lower Electrical System consisting of the following equipment	08-002
(1)	ea	Furnace Computer, Dell Optiplex GX330	S/N 9QSO1G1
(1)	ea	Monitor, Dell E178FP 17" LCD Flat Panel Monitor	320-5576
(1)	ea	Mouse, USB Optical	2MOUSEU2L
(1)	ea	Panel, PLC Control	08-002-322-092219-01
(1)	ea	Panel, Element Monitor	
(2)	ea	Panel, Lower Electrical Safety Panel	08-002-101770-01/-02
(3)	ea	Panel, SCR	08-002-101899-01
(1)	ea	Console, Control, Keyboard Platform	090781-04
(1)	ea	Tower, Light	190-092255-102
(1)	Lot	Motor Components	-

In addition verify that you received the following, shipped separately.

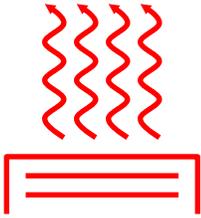
Qty	Unit	Description	Part Number
(2)	ea	Manual, AG-1524 Owner's, 3-Ring Bound	08-002-675-121524-02
(1)	ea	Manual, Reference, Perfect Bound	675-110000-02
(1)	ea	CD Media, Reinstallation, ProControl™ Furnace software, including - Owner's Manual, P/N 08-002-675-121524-01 - Reference Manual, P/N 675-110000-01	08-002-675-131524-01
(1)	ea	CD Media, Owner's Manual, including - Reference Manual, P/N 675-110000-01	08-002-675-121524-01
(1)	ea	CD Media, Reinstallation, WindowsXP™ SP2 operating system	0RX073
(1)	ea	CD, Reinstallation, Cyberlink PowerDVD 7.0	N0JW351
(1)	ea	CD, Drivers and Utilities, Dell Optiplex 330	XW/726 August 2007
(1)	ea	CD, Dell E178FP LCD Monitor drivers and user Documentation	HU370 REV.A01
(1)	ea	CD, Linksys, User Guide and Drivers, 10/100/1000 Gigabit Network Adapter v3.0	EG1032
(1)	ea	Product Information Guide, Dell Computers and Monitors	YK181

## GENERAL SAFETY GUIDELINES

The following set of guidelines is intended to create awareness of potential health and safety hazards.

### Normal Good Laboratory Practice

Normal good laboratory practices apply to the operation of IR furnaces. Do not use the space above the furnace as storage. Do not block the cabinet doors preventing the cooling of the electronic equipment inside. Do not operate with side covers off as this will prevent normal cooling of the electronic equipment thus voiding the warranty. Tuck electrical cords out of the way. Do not store flammables in the vicinity of the furnace and especially while operating the furnace with an oxygen atmosphere.

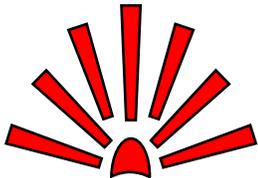


**HIGH TEMPERATURES.** In general, the operation of any furnace may expose operators or maintenance technicians to the risk of burns. After being processed in a FurnacePros furnace, customer product may still be dangerous to handle. Each owner is responsible for providing a safe work environment and proper training in the handling of material being processed in a furnace.



**ELECTRICAL SHOCK HAZARD.** IR furnaces operate at high voltages. Operation with side covers off constitutes a safety hazard. Ensure that main power is off while side covers are removed.

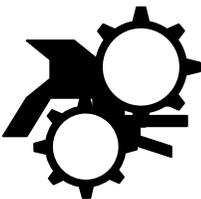
Electrical shock hazards exist for those technicians who service the furnace. High voltages are required to operate the furnace and precautions must be taken to reduce the exposure to these elements. Again, it is the responsibility of the furnace owner to assure that only properly trained service technicians, familiar with high voltage operations be allowed to service the equipment



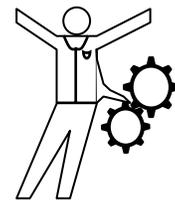
**EXPLOSION** Explosive dangers may exist in the high temperature process environment of the furnace. If the furnace operates with process gas containing hydrogen, measures must be taken to avoid the dangers of explosion. Furthermore, improper gas flow balance may draw oxygen rich air into the furnace, mixing with effluent gases and material from products, also creating a hazardous environment.



**HAZARDOUS MATERIALS.** Persons performing maintenance tasks such as replacement of lamps may become exposed to silica fiber compounds. Such tasks should be performed by qualified persons wearing gloves, eye protection and a facemask to prevent inhalation of particulates.



**ROTATING EQUIPMENT.** Roller dangers exist when working around the conveyor belt of the furnace. Care should be taken not to place hands on or near the belt drive mechanisms when the conveyor system is operating as roller crush may occur. Operators should avoid walking near the open ends of the conveyor belt. Those who must be near the moving parts should wear close fitting clothing.



# LIMITED WARRANTY

PURCHASER: AMKOR TECHNOLOGY

MODEL: AG-1524

SHIPMENT DATE: JULY 28, 2008

SERIAL NUMBER: 1824159102

INSTALLATION DATE: AUGUST 8, 2008

EQUIPMENT	WARRANTY PERIOD
IR Continuous Belt Furnaces & Dryers	Fifteen months (15) months from date of shipment or twelve (12) months after startup, whichever occurs first.
Aftermarket Parts	Sixty (60) days from date of shipment.
Refurbished Equipment	Twelve months (12) months from date of shipment or ten (10) months after startup, whichever occurs first.

FURNACEPROS warrants the Equipment sold to PURCHASER to conform to its specifications and to be free from defects in workmanship and material under normal use and service, excluding chemical attack, wear and tear from abrasion or corrosion, during the Warranty Period. Minor deviations from FURNACEPROS' specifications shall not constitute defects in workmanship or materials or failure to comply with said specifications. Consumables such as fuses, filters, lamps, thermocouples and lubricants are expressly excluded from this warranty.

PURCHASER shall promptly report all asserted defects in the Equipment to FURNACEPROS and shall afford FURNACEPROS a reasonable opportunity to inspect all asserted defects to determine cause and conditions of failure. FURNACEPROS' liability is limited to the repair or replacement of the equipment found to be defective in workmanship or material at such location as may be determined in the sole discretion of FURNACEPROS and excludes travel and removal and re-installation labor. Shipping costs for return to FURNACEPROS of any materials, components and equipment are at PURCHASER's expense. FURNACEPROS shall bear cost of non-expedited shipping to PURCHASER parts and materials replaced under this warranty.

Unless otherwise specifically authorized in advance, payment of charges incurred by others shall not be borne by FURNACEPROS. In any event, approved charges shall be limited to the cost FURNACEPROS would have reasonably incurred had the equipment been returned to its plant for correction. FURNACEPROS will not accept any backcharges for field corrections made without its prior written approval and instructions.

No parts shall be received by FURNACEPROS without FURNACEPROS' prior written authorization. Upon return and inspection of defective parts, FURNACEPROS will determine if the remedy is the responsibility of FURNACEPROS. If the warranty does not apply, the PURCHASER will be responsible for the repair or replacement costs and all associated freight charges.

These warranties will not apply if the articles or any components thereof have been subject to: (1) maintenance, overhaul, installation, storage, operation or use which is improper or not in accordance with FURNACEPROS' instructions; (2) any alteration modification, or repair by anyone other than FURNACEPROS or its authorized representative; (3) any accident, misuse, neglect, or negligence after shipment, or (4) damage due to uncontrollable external events or acts of God. These warranties will not apply if the PURCHASER fails to make payments to FURNACEPROS in accordance with the contract Terms and Conditions. Warranties will resume in accordance with the Terms stated herein upon payment of any monies due FURNACEPROS.

THERE ARE NO OTHER WARRANTIES, EXPRESS, STATUTORY OR IMPLIED, INCLUDING THOSE OF MERCHANTABILITY AND OF FITNESS FOR PARTICULAR PURPOSE, NOR ANY AFFIRMATION OF FACT NOR REPRESENTATION WHICH EXTENDS BEYOND THE DESCRIPTION ON THE FACE HEREOF. FURNACEPROS' WARRANTY WILL BE STRICTLY LIMITED TO THE PERFORMANCE SET FORTH IN HEREIN. IN NO EVENT SHALL LOCHABER CORNWALL, INC. OR ANY OF ITS SUBSIDERARIES BE LIABLE FOR ANY CONSEQUENTIAL DAMAGES (SUCH AS SPECIAL OR INDIRECT) NOR FOR ANY LOSS OF PRODUCTION OR OTHER LOSSES arising out of, resulting from, or in any way connected with the Work, the performance of the Equipment, any failure of the Equipment or any breach of the Agreement.



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**DOCUMENT LIST**

DOC NBR:	08-002	802-101000-01	R 0
MODEL NBR:	AG-1524	APVL	
SERIAL NBR:	1824159102	JCLARK	
DATE:	27-Jul-08	SHT	1 of 1

Job/Master	Drawing Nbr.	Title	Location
STD	675-110000-02	REFERENCE MANUAL	-
08-002	675-121524-02	OWNER'S MANUAL	-
STD	802-101000-01	DOCUMENT LIST	-
08-002	802-101400-01	FURNACE SPECIFICATIONS	Section 4
08-002	802-101420	COMPUTER EQUIPMENT LIST	Section 4
08-002	802-101600-01	SCR POWER AND CURRENT	Section 5
08-002	802-101610-01	FLOW	Section 5
08-002	802-101700-01	CHANNEL ASSIGNMENTS	Section 5
STD	802-101701-1524	PLC CONFIGURATION	Section 6
08-002	802-101710-01	TERMINAL BLOCK TB1 ASSIGNMENTS BY ZONE	Section 6
08-002	802-101710-02	TERMINAL BLOCK TB1 ASSIGNMENTS BY LINE	Section 6
08-002	802-101750-01	ELEMENT MONITOR SWITCH SETTINGS	Section 6
STD	802-101770-01	POWER CONTROL SCHEMATIC	Section 6
STD	802-101771	SCHEM, FRAME WIRING	Section 6



## 1.1 Unpacking the Equipment

### 1.1.1 Machine Placement

Remove the banding from the shipping container and carefully disassemble. Refer to the Equipment List in this manual and verify the model of your furnace system and good receipt of all options, accessories, and special configurations, which were ordered according to the original purchase order or specification. If any item listed is unaccounted for, immediately notify the carrier and the FurnacePros Technical Support.

## 1.2 Installation Requirements

### 1.2.1 Machine Placement

The machine should be located on an unyielding floor in the final installation position so that the access panels along the length of the furnace can be removed for the upgrade work, service and maintenance. If lifting is required, lift the machine at the approximate locations shown on the original installation drawing. Do not attempt to lift the machine at one point or at points other than recommended; failure to follow these instructions invites frame damage and will void the warranty.

**NOTE:** The lifting device must extend under the machine and support both sides of the frame structure.

Remove the base covers and adjust the leveling screws to level the frame within 0.06 inch overall. Each of the leveling screws should support an equal amount of weight.

After the frame is level. Adjust the chamber leveling screws to 0.06 inch overall.



Figure 1.2.1 Leveling Feet



Figure 1.2.2 Leveling Chamber Supports

### 1.2.2 Machine Inspection

Whenever, the furnace has been moved, remove the upper and lower side covers from both sides of the machine and inspect all lamp connections for soundness and for loose hardware that may have become dislodged during the move or shipment. Inspect the lower electrical compartment for shipping damage, loose connections, or components. Finally, inspect the furnace interior, checking for broken lamps, foreign

## Section 1

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objects, or any components that may have come loose during shipment. Report any shipping damage immediately to the FurnacePros Technical Support Department.

### 1.2.3 Providing Power

These machines are shipped wired for the voltage specified on the nameplate located adjacent to the power entrance hole in the lower electrical compartment.

Electrical power, matching the specifications on the nameplate shall be connected to the contactor or circuit breaker located directly above the entrance hole. A ground terminal is provided for a safety ground. All city and local codes should be followed when wiring this system for power. See Engineering and Specifications sections of this manual for power requirements.



Figure 1.2.3 Power Port and Elapsed Time Meter

### 1.2.4 Providing Gas and Air

Oil-free dry shop air, at a maximum recommended dew point of 15°C (59°F), shall be brought to the machine through a customer supplied line with a minimum inside diameter of 3/4 inch.

In addition to a supply line filter and condensate trap, a regulator limiting the supply pressure to 70-110 psig is required. The supply temperature of both gas and air should be above the dew point of the room air to prevent condensation from forming on the feed lines and dripping into the furnace.



Figure 1.2.4 Air Connection

**WARNING:** The flowmeters on these furnaces are rated at 70 psi maximum. Operating above 70 psi exposes the operator to possible injury

The air filters installed in the furnace as shipped are new, except for use in testing and product curing. The furnace is shipped with a spare air filter kit to be installed during startup, or as required. Open the lower panel below the flowmeters to access the furnace filter and regulator.

### 1.2.5 Process Exhaust Requirements

In most applications, process exhaust and heat should be vented to the outside atmosphere. It is the customer's responsibility to review the process, local laws, and facility in deciding on an exhaust system. Insulated exhaust tubing and a collector hood with a 4 inch inside diameter, or larger, is routinely used. Do not make any direct connections to the chamber exhaust stacks. A minimum 8.0 inch clearance between the exhaust stacks and venting device is required.

### 1.2.6 Installation of the Transport Belt

A portion of the transport belt which goes through the furnace chamber is intentionally removed to protect the furnace interior during shipment. When reinstalling the belt, it will be helpful to have an assistant available to help guide the belt into the furnace entrance.

The portion of the belt which goes through the furnace is rolled up and secured at the entrance end of the furnace. Unroll the belt and attach it securely to the pull wire that was left in the furnace chamber.

Pull the belt through the chamber from the exit end of the furnace, while an assistant guides the belt into the entrance.

Once the belt has been pulled completely through the chamber, remove and discard the pull wire. Splice as shown in Figure 1.2.5 Belt Splice.

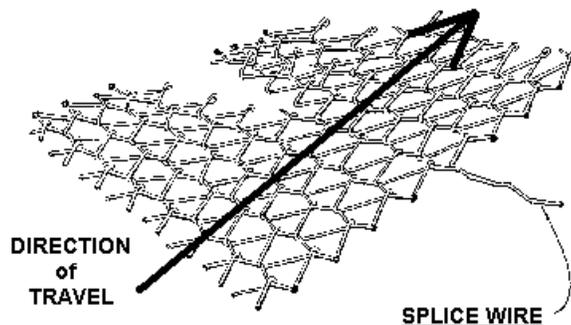


Figure 1.2.5 Belt Splice

### 1.2.7 Removal of Shipping Restraint Screws

Large furnaces operating at high temperatures experience considerable growth from thermal expansion. All models are equipped with support slides which allow stress free expansion to take place. To secure the process chamber during shipment, restraining brackets (painted red) attach directly between the chamber and frame. The screws which secure these brackets to the frame must be removed before bringing the furnace up to operating temperature.



Figure 1.2.6 Shipping Brackets

**WARNING:** Failure to remove slide restraint screws invites structural damage and will void the warranty.

### 1.2.8 Installation of Owner Supplied UPS

The furnace is shipped with the computer powered through an unswitched connection. If desired a uniform power supply (UPS) can be installed by FurnacePros, or the Owner. See Sections 4 and 5 for information on computer power requirements necessary for sizing the UPS.

To install the UPS, locate the lower access panel located near the entrance of the furnace on the side opposite the Control Console. Install the UPS in this area on the furnace floor panel so that it is well supported. Provide power to the UPS through the standard 110 VAC socket labeled “COMPUTER UNSWITCHED”. Plug the UPS serial or USB connector into the rear panel of the computer tower.

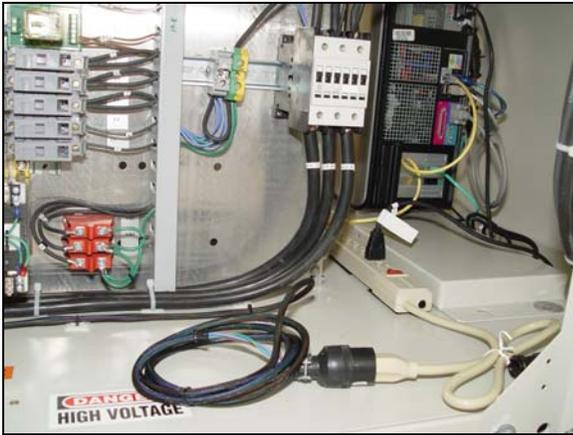


Figure 1.2.7 Computer “Unswitched” (default)



Figure 1.2.8 Computer Power Options

To install the manufacturer’s software, insert the UPS Installation Disk in the optical drive accessed through the computer access opening below and left of the control console. Follow UPS manufacturer’s instructions for proper installation and configuration of the UPS to allow normal computer system shutdown in the event power is removed from the furnace system.

To install the UPS in WindowsXP, start the computer and insert the UPS Installation Disk in the optical drive accessed through the computer access opening below and left of the control console.

To setup the UPS in WindowsXP:

- 1) Click on Start/Control Panel
- 2) Select Power Options
- 3) Select the UPS tab.
- 4) Select manufacture and model buttons and enter preferences to allow normal computer system shutdown in the event power is removed from the furnace system.

### 1.3 Controls Upgrade Installation Tasks

The following tasks shall be performed by FurnacePros. When Service technicians visit the user's plant, the technicians may require the part to full-time help of at least one customer representative who will be responsible for the operation and maintenance of the furnace system.

- 1) Remove existing panels
- 2) Install new panels:
  - a. Safety panel, change transformer taps to local voltage, and install relay clips
  - b. SCR panel; connect TB1 to lamps and edge heats

- c. Element monitor panel; connect to lamps, connect returns to SCR panel fuse line returns, and connect power supply to 117VAC strip fed by TR0
- d. Opto22 (PLC) panel
- e. Mount control panel onto cabinet (left-to-right operation)
- 3) Connect PC, monitor, keyboard, and mouse
- 4) Connect hour meter through TR0
- 5) Install new belt motor and drive (sprocket gears, chain, motor, clutch, tensioner/idler, special fuse holder, and isolation transformer)
- 6) Install new motor speed controller, transport motion sensor, and signal booster board
- 7) Install new T/C in all zones w/ new wire, check height
- 8) Install new lamps (as required)
- 9) Install 3-color light tower
- 10) Check and install additional hardware (2 x 0.6 kVA transformers, rheostat/variatic, knob & dial) for blowers
- 11) Test/verify PC software
- 12) Test/verify PLC software
- 13) Calibrate SCRs for local line voltage
- 14) Calibrate belt speed
- 15) Integration Test
- 16) Verify PROCESS READY
- 17) Startup furnace

### 1.4 Startup Tasks

Startup services are to be performed by FurnacePros. Tasks typically performed during startup by the Service technician include:

- 1) Prepare the machine for operation.
- 2) Apply power and bring up the machine to a fully operational state.
- 3) Run through the installation test and checkout procedure.
- 4) Report to the customer any deficiencies noted in the installation of the machine.
- 5) Instruct the appropriate personnel in the customer's plant how to set up and run the furnace system.
- 6) If training has been included, a manufacturer's representative shall train the appropriate personnel in the customer's plant on furnace operation and necessary preventive maintenance.
- 7) Replace Covers. Before operation for production, install any covers that were removed during the functional checkout.

**NOTE:** All functions must operate properly before proceeding. Refer to the Service Information section and correct any malfunctions before proceeding.

- 8) Turn over the machine and documentation to the customer.



## 2.1 Power Controls and Indicators

### 2.1.1 Power Status Indicators

#### MAIN (Yellow Indicator)

This lamp burns continuously whenever power is available to the furnace and the main circuit breaker (optional) is turned on.

#### ON (Green Indicator)

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

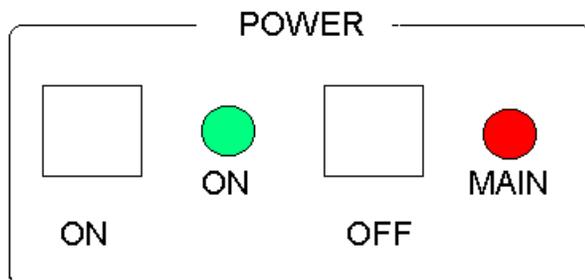


Figure 2.1.1 Control Panel showing Main Power ON and OFF and Indicator Lights



Figure 2.1.2 Control Panel, Rear showing monitor and USB ports.

### 2.1.2 Controls



MAIN POWER CONTROLS and INDICATORS

Figure 2.1.3 Control Panel

## Section 2

### MAIN FURNACE POWER

MODE	COMPUTER UNSWITCHED	COMPUTER SWITCHED
MAIN POWER ON	Power to furnace, controller and computer monitor. Pressing this switch causes the furnace to go through its power up sequence, providing the MAIN lamp is lit and the EPO's (Emergency Power Off switches) and interlocks located in the doors are released. The ON indicator will illuminate.	Power to furnace, computer, controller and computer monitor. Pressing this switch causes the furnace to go through its power up sequence, providing the MAIN lamp is lit and the EPO's (Emergency Power Off switches) and interlocks located in the doors are released. The ON indicator will illuminate.
MAIN POWER OFF	Cuts power to furnace, controller and computer monitor. Before pressing POWER OFF, the furnace must be in COOL DOWN mode. Pressing this button causes the furnace to begin a timed power shutdown sequence. The heaters are shut down immediately, and after a cool-down (to 100°C) period, the fans, transport belt, and other functions are shut down.	Cuts power to furnace, computer, controller and computer monitor. Before pressing POWER OFF, the furnace must be in COOL DOWN mode. Pressing this button causes the furnace to begin a timed power shutdown sequence. The heaters are shut down immediately, and after a cool-down (to 100°C) period, the fans, transport belt, and computer other functions are shut down.
EPO PANEL SWITCHES 	If an lower panel is removed, emergency power interlocks will automatically cut power to furnace, controller and computer monitor.	If an lower panel is removed, emergency power interlocks will automatically cut power to furnace, computer, controller and computer monitor.
EMO SWITCHES  Entrance EMO  Exit EMO	Operator activated Emergency Power Off switch located at furnace entrance and exit immediately cuts power to furnace, controller and computer monitor. Rotate knob to reset. Main Power button be pressed to re-introduce power.	Operator activated Emergency Power Off switch located at furnace entrance and exit immediately cuts power to furnace, computer, controller and computer monitor. Rotate knob to reset. Main Power button be pressed to re-introduce power.
POWER FAILURE	Cuts power to furnace, controller and computer monitor.	Cuts power to furnace, computer, controller and computer monitor..

### COMPUTER POWER

The computer can be powered from either a switched or unswitched power source. However, the computer monitor is switched with the furnace MAIN POWER BUTTONS in any case.

**COMPUTER UNSWITCHED (Default).** In this mode the computer remains ON unless either shut down or power is removed from the furnace. This mode offers the best protection for the computer operating system, files and hard drives. The momentary power button on the front of the computer must be pressed to start the computer. Pressing MAIN POWER OFF will not cut power to the computer.

**COMPUTER SWITCHED.** If the computer is powered through the switched power source, pressing MAIN POWER ON will start the computer with the furnace. Pressing MAIN POWER OFF will cut power to the computer and furnace. In normal operation the computer should be always shut down through WindowsXP™ or by pressing the computer momentary switch before pressing the furnace MAIN POWER OFF. This mode is not recommended as power can be cut to the computer before the WindowsXP operating system can close files and power down the hard drives. Improper operation in this mode may result in corruption of files and premature hard drive failure.

## 2.2 Starting the Furnace

### 2.2.1 Main Power Indicator

The MAIN indicator must be lit before pressing the MAIN POWER ON button.

### 2.2.2 CDA Pressure

Assure that CDA, clean dry compressed air is supplied to the furnace at a minimum of 70 psig. Compressed air must be delivered to the furnace walls, exit stack venturi and belt tensioners for proper operation of the furnace.

**LOW PRESSURE ALARM.** The furnace is equipped with a sensor that sends a contact closure to the controller when air pressure drops below its set point. Assure that compressed air is supplied to the furnace at the minimum required pressure. When the furnace computer and main power are on, an alarm will sound when the pressure is below the set point.

### 2.2.3 Power On/Startup

**COMPUTER UNSWITCHED.** Start computer or assure computer is ON. You can immediately press the MAIN POWER ON button. The ON indicator illuminates. The computer boots up and the logo screen is displayed. Press the power button on the monitor if you do not see the logo screen.

**COMPUTER SWITCHED.** Press the MAIN POWER ON button. The ON indicator illuminates. The computer boots up and the logo screen is displayed. Press the power button on the monitor if you do not see the logo screen.

**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!

### 2.2.4 Fans

Check that the control enclosure fans, the cabinet cooling exhaust fans, and the turbulent 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 fan at greater than or equal to the power of the top fan. If this is not done the cooling system will not work properly.

### 2.2.5 Screen Button Menu (Located at bottom of screen)

The Screen Button Menu allows operator to select the desired screen by moving the cursor and clicking on the chosen screen.



Figure 2.2.1 Screen Button Menu

## 2.2.6 Furnace Log-on and Initial Operation

Select “Security” button to access the “Security and User Information” screen.

### 1) Security and User Information

The Security and User Information screen allows the operator to select access level, log-on or log-off, add or delete users, and modify password and access codes.

### 2) Access Level

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

The system is shipped with three (3) access levels, each with its own password. See the Furnace Reference Manual, Chapter 5 Software, for information on managing users and passwords.

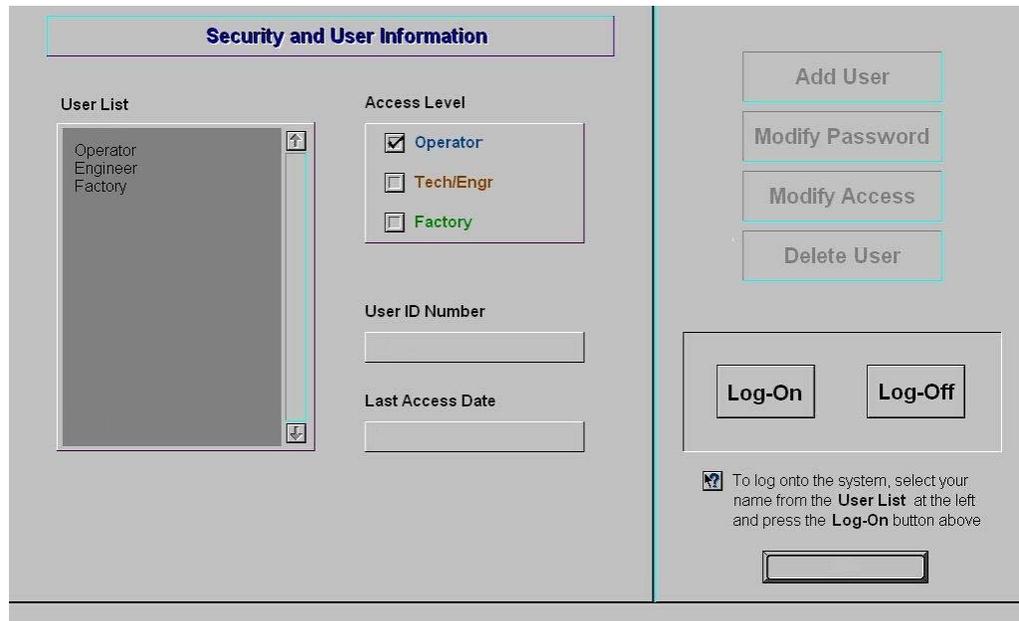


Figure 2.2.2 Security Screen, Log-on

- |                          |  |
|--------------------------|--|
| Access Level 1 password: | 1. Operator level, and allows the operator to load and run a recipe and initiate a process. (Initial password is set to “1”.)  |
| Access Level 2 password: | 2. Tech/Engr level. It allows the Technician or Engineer to do all of the above, as well as changing parameters such as temperature setpoints, power distribution, and belt speed. (Initial password is set to “2”.) |
| Access Level 3           | restricted to Manufacturer’s personnel only.   |

**NOTE:** Before turning off system, you must “Log-Off” through the Security screen and Shutdown Windows.

## Section 2

### 2.2.7 Atmosphere Supply Gas - CDA

#### FURNACE AIR SYSTEM

Plant instrument air is regulated in the furnace by a check valve to preserve furnace pressure, an internal ASME air receiver with pressure switch and a pressure regulator to regulate pressure to the flowmeters. An air reservoir with check valve is dedicated to the belt tensioners. The pressure switch provides an alarm contact closure to the furnace controller if the furnace air pressure drops below its set point.

When operating the furnace, the system will not enter Warm Up while the low air pressure alarm is engaged.

If the furnace air pressure drops below the set point during operation, the system will automatically enter Cool Down. The operator can reset the system to Warm Up when air pressure is again over set point.

Location	Default Setting
Plant air	70-110 psig
Furnace Regulator	70 psig
Low Pressure Alarm Switch	60 psig

You can verify the atmosphere supply gas pressure and adjust the inlet regulator to 70 psi by opening the lower panel under the flowmeters. See Section 3 for information calibration and service of the CDA system.

**WARNING:** The flowmeters on these furnaces are rated at 70 psi maximum. Operating above 70 psi exposes the operator to possible injury.

#### Flow Meter Default Settings

Select the Gas Flow button. The Gas Flow screen will be shown. Open the furnace flowmeter access panel and adjust the gas flow to the default flows indicated on the screen or per process recipe requirements. See Owner's Manual, Engineering section for default settings. See Reference Manual, Chapter 9, Balancing Gas Flow for information on setting the flow meters to balance the system gas flow.

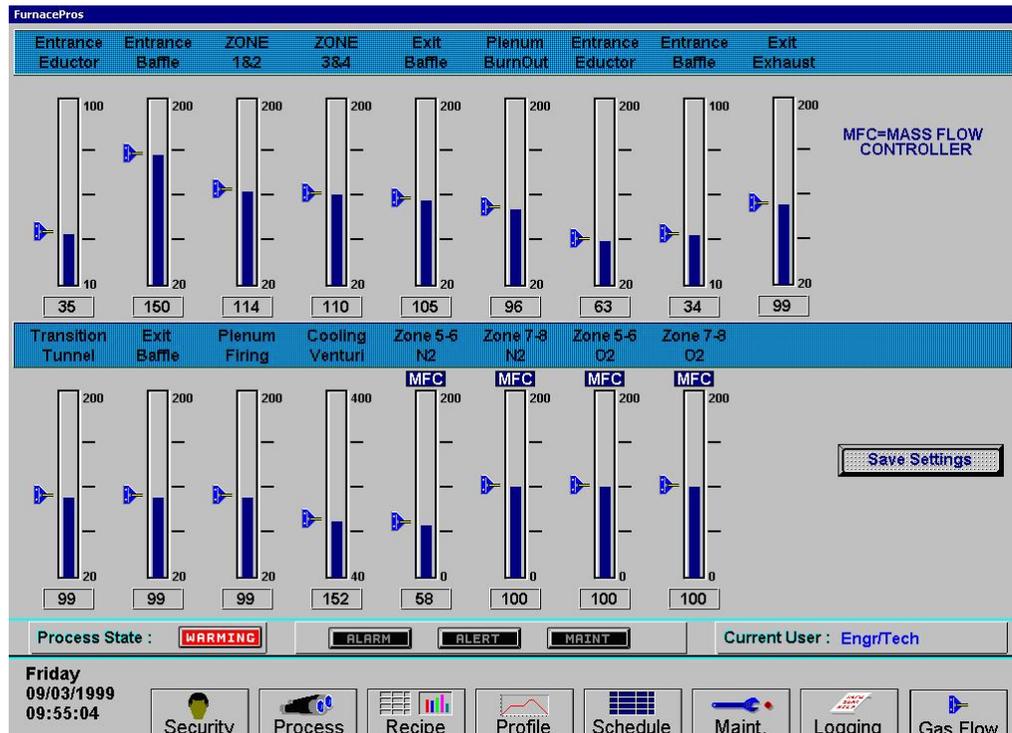


Figure 2.2.3 Gas Flow Screen

## 2.3 Furnace Operation (Process Screen)

The Process Monitor Screen displays the setpoint temperature, the current recipe, process state and status, transport speed, and other information such as percentage of power to elements and edge heaters. Alarm and alert dialog box also is displayed here along with event status.

- 1) Select the Process button on the menu bar view the process screen.



Figure 2.3.1 Process Screen

- 2) Check to assure that there are no active alarms or alerts.

If appropriate, 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.

- 3) Verify correct recipe is loaded.

Verify correct recipe is loaded. If not, click on RECIPE button for “Recipe” screen or enter the zone set point temperatures and belt speed by clicking on respective the blue fields and typing the correct number.

- 4) In Process field, select “WARM UP” to initiate the process selected.

In the “WARM UP” mode, the heating elements will come on. After 10 minutes, check the system for instability or cycling, and correct if necessary.

While the machine is heating, check for 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 "READY" mode before processing any product.

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

## Section 2

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### 2.3.2 Power Saving Feature

The actual power number reflects the actual power being used by the machine. This number is based on the % power applied to the zone and the lamp power of the zone. This number can be limited by the “Maximum power” value set up in the SCR Calibration screen. If this value is set at 0, no power is calculated and no limit is set on the power used by the machine. Any non-zero value will cause the system to calculate the power and limit it to this value.

Default maximum power is set to 50%

**NOTE:** The edge heaters are not part of the calculation.

The total power will then always stay below the number set by the user.

**WARNING:** This may cause the machine to never reach the 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 degrees C. In this case, the machine will just stay in the warm-up mode.

### 2.3.3 Transport Speed

Move the cursor to the Belt Speed field. Enter the desired transport speed. Vary the conveyor speed from minimum to maximum, checking for smooth operation at all speeds. To check for belt speed accuracy, set the speed at its midrange setting. Place a coin or metal ruler on the moving belt and time through two fixed points while the furnace is in the off or COOL DOWN mode.

## **2.4 Furnace Shut Down**

### **2.4.1 Power Off**

Before pressing POWER OFF, the furnace must be in COOL DOWN mode.

Go to the Security screen. Click your user name in the user list and Log-Off. The “Exit” field will terminate and take you out of furnace operation mode when a safe preset temperature is reached.

COMPUTER UNSWITCHED (default).	Shutdown WindowsXP is only required if you are disconnecting power to the furnace. In this mode YOU MAY PRESS MAIN POWER OFF WITHOUT SHUTTING DOWN THE COMPUTER.
COMPUTER SWITCHED.	Shutdown WindowsXP from the Start button before pressing MAIN POWER OFF. In this mode YOU MUST SHUTDOWN WINDOWS BEFORE PRESSING MAIN POWER OFF.

Press the MAIN POWER OFF button. Under normal conditions, the furnace will turn off when all zones cool below 100°C.

If MAIN POWER OFF is pressed while the furnace is in the WARM UP or ready mode, the furnace will remain in normal operation until the COOL DOWN mode is selected.

### **2.4.2 Shutdown Sequence**

The furnace should be shut down when more than an hour will elapse between production runs. A shutdown conserves energy and prolongs the life of the furnace and elements. From the Process screen, press Cool Down. The furnace will enter the “COOL DOWN” mode. Once the zones have cooled sufficiently and the furnace is in the “off” mode, the atmosphere supply can be shut off at the source.

### **2.4.3 Auto Shutdown Sequence.**

The furnace must be in COOL DOWN mode.

Press the POWER OFF button. The ON power indicator will turn off. Once the temperature falls below 100°C, all functions will automatically shut down. See section 2.1.2 for proper Computer operation and shutdown.

### **2.4.4 Gas Shut Off**

Turn the supply gas off. Shutdown of the furnace is now complete.

## Section 2

### 2.5 Recipe Screen (Off Line Edit)

#### 1) Go to Recipe Screen

NOTE: When editing this screen the process is not changed.

Level 1 access will allow the operator to inquire, select, and run preset parameters and recipes. Level 2 access will allow the operator to edit and save recipe data.

When initializing the “Load & Run” field, the process screen is updated and the Recipe Setup screen is changed to On Line Edit.

**Recipe Editor** Recipe Name: **LOWTEMP** **Off Line Edit**

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	
SETPOINT	298.00	184.00	167.00	167.00	170.00	160.00	224.00	275.00	°C
GAIN	20.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	
INTEGRAL	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	
DERIVATIVE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TOP POWER LIMIT	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	
BOTTOM POWER LIMIT	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	
HIGH ALARM DEV SETPOINT	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	
HIGH ALERT DEV SETPOINT	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	
LOW ALERT DEV SETPOINT	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	
LOW ALARM DEV SETPOINT	-20.00	-20.00	-20.00	-20.00	-20.00	-20.00	-20.00	-20.00	

Left Edge Heat Power: 0.0 0.0 0.0 %      Belt Speed: 14.5 IPM  
 Right Edge Heat Power: 0.0 0.0 0.0 %  
 O2 Alarm Level: 75 PPM      Boat Length: 10.0 In.  
 Atmosphere Purge Time: 5 Min.      1 2 3 Water Temps: 15 °C 80 °C  
 H2 Gas Fill Time: 5 Min.      Lanes Active: ●●●

Recipe in Furnace: **LOWTEMP**

Process State: **OFF**    ALARM    ALERT    MAINT    Current User: **TECHENGR**

Tuesday 06/05/07 15:34:02

Security Process Recipe Profile Schedule Maint. Logging Gas Flow

Figure 2.5.1 Recipe Screen

#### 2) Load Recipe (Access Levels 1 and 2)

#### 3) Delete Recipe (Access Level 2)

#### 4) Edit Stored Recipe, Save Stored Recipe (Access Level 2)

NOTE: Do not use this feature on the current recipe while in ready mode and while processing parts.

## 2.6 Recipe Modification

### 2.6.1 Setpoint Modification (Access Level 2)

#### 1) Change Temperature (Access Level 2)

Place the cursor on the temperature setting to be modified. Type the new setting and press enter from the keyboard.

NOTE: Temperature display is in degrees Celsius.

#### 2) Change Power Distribution (Access Level 2)

##### a) Heating Element Power distribution

Default value is 50% top and bottom.

Place the cursor on the power distribution setting to be changed. Type in the new setting and press enter from the keyboard. This can be between 0% and 100%.

Power distribution is a scaled percentage of maximum power output to the top and bottom heating elements.

The maximum power is typically set at 1.5 times the actual percentage of power used when the furnace is in the “Ready” mode.

##### b) Edge Heater Power Distribution (Access Level 2)

The edge heaters are located at the outer edges of the belt and run the entire length of the heated chamber. They can be used to improve the temperature uniformity across the width of the belt.

Click on the blue cell to modify the percentage on. The range is 0-100% and can be set in increments of 1%. See the Reference Manual for more on using the edge heaters.

### 2.6.2 PID Zone Tuning (Access Level 2)

On the recipe screen, click on the desired “Edit Zone PID Setting” pushbutton. A Zone Tuning dialog box will appear with default values for proportional gain, integral, and derivative, if not already shown on the screen. Place the cursor on the value to be modified and click. Type the new setting and press enter from the keyboard. See Reference Manual, Chapter 9 for Process Engineering considerations in establishing PID parameters.

#### 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 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.

Parameter	Initial Values
Proportional Gain	9
Integral	45
Derivative	0

#### Integral

The integral (or Reset) function corrects temperature offset.

#### Derivative

Derivative is a rate function that clamps temperature overshoot/oscillation. The maximum set point for the derivative function should be ¼ of the integral value.

## Section 2

### 2.6.3 Change Transport Speed (Access Level 2)

Place the cursor on the Belt Speed field, click, type in the new value and press enter from the keyboard.

NOTE: Transport speed is displayed in inches per minute.

### 2.6.4 Change Gas Flow Settings

This screen represents flowmeter settings stored for selected recipe. The flowmeters must be manually adjusted for the desired flow. Click on each respective cell to record new values for the recipe being edited. See section 2.2.7 for more information.

## 2.7 Alarm Status (All Access Levels)

This is a display only feature. Any existing alarm conditions, such as transport speed error, are highlighted on the Process screen. To clear or silence an alarm/alert, move the cursor to and click on “Acknowledge Events.” See Troubleshooting, Section 4.2 for further information.

## 2.8 Data Log/Alarms and Alerts

### 2.8.1 Occurrence and Timed Logging Control (Access Levels 1 and 2)

Move the cursor to and click on “Logging” to see any occurrence.

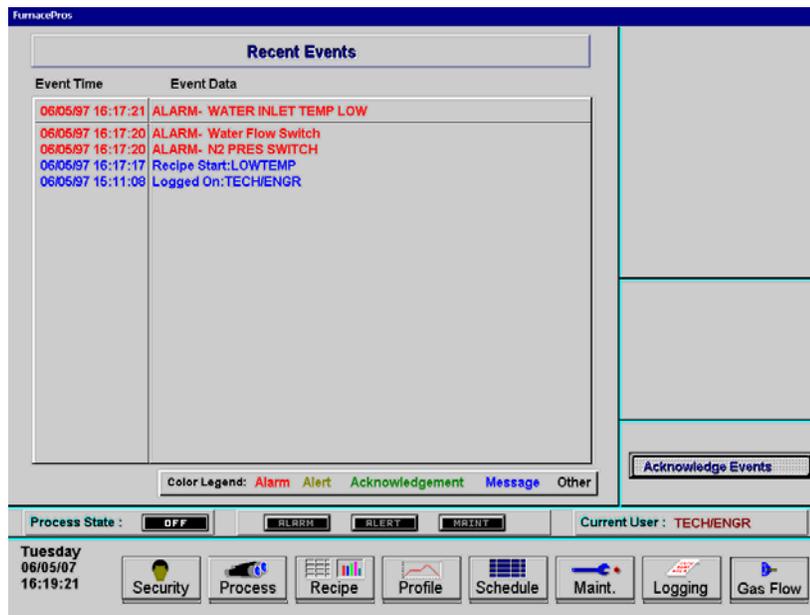


Figure 2.8.1 Event Logging

### 2.9 Over Temperature Alarm Operation

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 in the lower panel below the Main Control Console.

**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.

### 2.10 Remote Access

In order to allow for remote diagnostics of in-process furnace operations, a 2<sup>nd</sup> 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 in one of two ways:

- Broadband connection via internet access
- Dial-up connection directly via analog telephone line (PSTN)

To connect furnace to the network:

**Wired:** Connect a Cat5 or higher TCP/P Cable to the RJ45 port below the entrance of the furnace. Set LAN Connection 2 to receive network signals.

Note LAN Connection 1 must be reserved for the furnace control system.

**Wireless:** Connect a USB wireless transmitter such as D-Link DWA-140 RangeBooster Wireless-N network adapter to the control console USB port (behind the keyboard). Setup connections to receive network signal.

**Remote Desktop.** To use WindowsXP in desktop mode, verify furnace computer is enabled for remote connection. On remote WindowsXP computer use Remote Desktop Connection to interface with the furnace.

**pcAnywhere:** The pcAnywhere™ communications software application must be installed and running in the background set to Host Mode, waiting to receive call from the factory. Provide either the IP address or the direct dial-in telephone number to the factory in order to access the furnace computer. Also required will be any Login name and Password customer has configured in pcAnywhere.

For a more detailed explanation of the configuration when using pcAnywhere utility for remote access of the furnace computer refer to the pcAnywhere documentation and the furnace Reference Manual, Chapter 9.

**WARNING:** Do not use a digital phone line, as found in most modern telephone installations. A digital phone line will damage the modem. The customer must provide FurnacePros with the phone number for that particular phone line to obtain service.

### 2.11 View Alternate Programs

To switch the viewing window between ProControl™ Furnace Process Software and another application (the WinKIC or DataPaq 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.

### 2.12 Element Monitors

The Element Monitoring system consists of a panel of twenty (20) 4-channel circuit boards which detect the location of a failed heating element. The circuit boards monitor the current to the lamps 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. 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 19. The address switch settings are depicted on drawing 08-002-802-101750-01. 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.

## SERVICE & TROUBLESHOOTING

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### 3.1 Routine Maintenance

#### 3.1.1 General

Generally external cleaning is all that is required. The chambers are not to be touched or removed. If chamber cleaning is required, contact FurnacePros.

**WARNING. DO NOT ATTEMPT TO OPEN OR MANUALLY CLEAN THE CHAMBERS OR THE FURNACE MAY BE INOPERABLE DUE TO DAMAGE TO THE INSULATION. Contact the manufacturer if cleaning is required.**

### 3.2 Service and Maintenance Access

Observe extreme caution when the furnace power is engaged while the access panels are removed. Dangerous levels of AC and DC voltages will be present.

**LOWER PANELS.** Gain access to the lower sections of the furnace by turning the quick release screws and removing the panels. For convenience, lower panels can be hung from the slots in the upper panels during service. Make sure the EPO switches on lower panels are pulled out if the furnace is to be energized while these lower panels are off.

**UPPER PANELS.** Once the lower panels have been removed. The upper panels can be lifted and removed. When replacing the upper panels carefully lower the top of the panel into the slot provided and insert the bottom of the panel so it is resting on the stainless steel shoulder screws.

**COMPUTER ENCLOSURE PANELS.** These panels are located on either side of the furnace near the entrance and are not interlocked. These panels can be removed to gain access to the computer enclosure. Remove lower pedestal panel to service an owner-installed UPS (if so equipped).

**DRIVE ENLOSURE.** Remove Panels at entrance and exit of the furnace to adjust the belt tracking.

**HEATING ELEMENTS.** Remove upper side panels to access lamp elements.

### 3.3 Daily Maintenance

Daily maintenance consists of a simple series of functional checks that will alert maintenance personnel to any signs of developing problems. The importance of regularly checking the machine cannot be overstressed to prevent not only damage to the machine, but also loss of productive time and product. Whenever the furnace is started up the failure alarms should be checked for signs of trouble. An intermittent exhaust failure indicates that something is wrong and that the alarm mechanism, system exhaust fan, and possibly exhaust ductwork must be checked and corrected as necessary. Other alarm functions should be monitored, such as the lamp failure indicator, to see if corrective action is required. As the machine is being started up, each control and switch should be briefly checked to ensure that all functions are working properly. Any controls that do not respond as expected, or alarms that do not clear should be checked out and corrected before putting the machine into operation.

### 3.4 Monthly Maintenance

Monthly maintenance, in general, means four weeks of operation for one eight-hour shift per day. This period of operation is not an absolute number, and it is possible that some of the tasks are needed more often. Experience with the machine and process being performed should dictate the need.

**Run a temperature profile, no less often than monthly, on machines that are used for sensitive processes.**

On machines that are used for a variety of products, it is advisable to set up a profiling schedule so that each process can be checked periodically. The most sensitive profiles should be checked at least monthly, while less sensitive profiles could be checked every 2-6 months.

### 3.5 Other Scheduled Maintenance

#### 3.5.1 Preventive Maintenance Screen

The Preventive Maintenance Screen is used to list maintenance and their preferred frequency of occurrence. Consult the Reference Manual, Chapter 7 for a description of the use of this screen.

The Remaining Time Status Bar on the Maintenance Screen will provide a graphical representation of the time remaining before maintenance is required. When any Maintenance Item has timed out/reached the maintenance required date, the MAINT status box on the Process Screen will Flash.

As Maintenance Items are completed, click on the appropriate "Completed" pushbutton the Maintenance Screen in order to set a new maintenance required date that is based upon the #days field.

#### 3.5.2 Recommended Maintenance and Frequency

Equipment	Recommended Maintenance	Recommended Interval
Air Filters, Door	Remove the foam sponge air filters from the lower electrical compartment (base doors); clean or replace them. These filters can be washed out with a mild detergent and water, but must be completely dry before being replaced.	Annually, or as required.

Equipment	Recommended Maintenance	Recommended Interval
Air Filters, compressed air	<p>Remove the door panel below the flowmeters and replace filter set in the compressed air line to assure furnace receives clean dry air.</p> 	6 months or as required.
Compressed Air Tank	<p>With air pressure still on the furnace system, remove the door panel below and to the left of the flowmeters. Open the small valve for the air compressor reservoir drain. Purge the tank until the condensate has been removed.</p> 	Monthly or as required.
Belt Shaft Bearings-perm	<p>To gain access to the belt shaft bearings remove the end covers from both ends of the machine. Located at both ends of each belt shaft are permanently-lubricated bearings. These bearings should not be lubricated.</p>	None
Belt Shaft Bearings with grease fittings	<p>Bearings with grease fittings should be lubricated with a general multipurpose bearing grease. Apply enough grease to the bearing block so that excess grease can be visually seen squirting out along the shaft of the device. Wipe off all excess grease that has squirted out to avoid dirt accumulation.</p>	6 months
Belt Shaft Rollers	<p>The belt shaft rollers should be inspected periodically to make sure that they are centered on their respective shafts. Remove the end covers to gain full access to the belt shaft rollers. If a roller is misaligned, loosen the setscrews that hold the roller onto the shaft and use a rubber mallet to move the roller on its shaft. Use a scale to make sure the rollers are centered to within 0.125 inches on the belt shaft.</p> 	After first 30 days, annually thereafter

## Section 3

Equipment	Recommended Maintenance	Recommended Interval
Belt Tracking Adjustment	<p>The belt should be checked periodically to make sure that it is tracking through the center of the oven. Belt tracking can be checked visually at the entrance and exit ends of the oven. The belt should be centered between the belt guides at the entrance and exit ends of the oven. If the belt tracks off-center this problem can be rectified by realigning the belt shafts. First, set the belt speed to zero and remove the end covers at the entrance and exit end of the machine to expose the frame ends and the belt shaft bearing mounts at the end of the belt shafts. The following procedure can be used to correct tracking problems at either end of the furnace.</p> <p>Loosen the belt shaft bearing mount bolts at one end of the furnace (entrance or exit). While facing the end (entrance or exit) of the furnace, use the following procedure. If the belt is tracking to your left, pull the left side of the belt shaft forward and/or move the right side of the belt shaft rearward. If the belt is tracking to your right, pull the right side of the belt shaft forward and/or move the left side of the belt shaft rearward. Repeat this procedure at the other end of the furnace. It is best to make these adjustments in small increments. Adjustments that are too large will cause a belt tracking problem in the other direction. At the exit end of the furnace, the transport motion sensor will also have to be loosened and moved with the belt shaft to maintain engagement with the gear on the belt shaft. Now run the belt at its highest speed and observe how the belt is tracking. Repeat the adjustment procedure until the belt tracking is centered.</p> 	Weekly
Chamber	<p>The chamber normally does not require maintenance. If a problem with the chamber is suspected, the manufacturer should be consulted. Because the process gas is inserted through the insulation, the gas flow away from the insulation prevents contamination from building up on the chamber walls. To help reduce flux residue buildup in the chamber, the zones can be set at 400°C and the furnace can be put into a self-cleaning cycle for about an hour to burn out these organic residues.</p>	Process dependent
Cooling Fans	<p>Inspect all system cooling fans and flow switches, for freedom of movement and proper operation.</p>	6 months
Drip Trays	<p>Remove and clean the drip trays, located under the process exhaust stacks. Access to the trays is through the top removable section of the furnace chamber, located above the trays, or at the furnace entrance, behind the cosmetic entrance molding. For procedure on removal and cleaning of the trays, consult the furnace Reference Manual, Section 7.5.1. Depending on the process, if very little buildup is found, cleaning may not be necessary more than once a year.</p>	After the first 6 months of operation,
Drive Chain	<p>The chain drive system is contained in the motor enclosure at the exit end of the oven. Lubricate the drive chain with FurnacePros #100523 chain lube or a commercial quality non-dripping chain lube.</p> 	Every 6 months of operation

Equipment	Recommended Maintenance	Recommended Interval
Drive Chain Tensioner	The chain tensioner is equipped with a grease fitting for lubrication. The chain tensioner should be lubricated every 6 months with a general multipurpose bearing grease. Apply enough grease to the tensioner so that excess grease can be visually seen squirting out along the shaft of the device. Wipe off all excess grease that has squirted out to avoid dirt accumulation.	6 months
Drive Motor Mounts	The drive motor is contained in the enclosure at the exit end of the oven. The motor mount bolts must be checked periodically and tightened if necessary.	Annually, or as required.
Exhaust Stacks	Check the exhaust stacks, after 6 months of operation, for possible buildup of materials generated from firing processes.  The stacks should be cleaned, as necessary, with a brush and solvent to remove the buildup. A periodic inspection of the stacks is essential to establish a sensible maintenance cycle, since some processes will require frequent cleaning, and others require none at all.	After the first 6 months, and thereafter as required.
Lamp Heating Elements	No maintenance is required for the heating elements other than replacement when one burns out. Note that with low temperature operations, the lifetime of the heating element is in excess of 100,000 hours. It is only at temperatures in the 900°C to 1000°C range that the expected lifetime begins to shorten. Also, the heating elements do not degrade over time. Should failure occur, it will be sudden and catastrophic. Use ohmmeter for best results visual inspection is unreliable. Refer to the Reference Manual for changing heating elements.	Inspect regularly, replace lamps as required.
Lamp Seals	Inspect the lamp seals for loose, cracked or missing packing material. Once the side covers are removed, the lamp seals can be visually inspected.	6 months
Sprocket Alignment	The sprockets are contained in the motor enclosure at the exit end of the oven. Visually verify that the sprockets are aligned. Adjust according to the furnace Reference Manual, Chapter 7.	After first 30 days and annually thereafter.
Sprocket Shaft Bearing Block	The sprockets are contained in the motor enclosure at the exit end of the oven. The sprocket shaft bearing block is equipped with a grease fitting for lubrication. The bearing block should be lubricated with a general multipurpose bearing grease. Apply enough grease to the bearing block so that excess grease can be visually seen squirting out along the shaft of the device. Wipe off all excess grease that has squirted out to avoid dirt accumulation.	6 months
Transport Belt Length	Check the length of the transport belt and shorten it if the gravity loop comes within 6 inches of the floor. A properly shortened belt should hang between 2 and 3 inches below the main frame.	Annually, or as required.
Transport Clutch	The clutch should be inspected periodically to insure proper tension on the belt. To adjust, a large hex nut at the chain sprocket end of the drive drum must be tightened until the drum turns. If the drum cannot be stopped by firm pressure with your hands, the clutch is too tight. Do not over tighten the clutch, as it is there for safety reasons.	Annually, or as required

### 3.6 Troubleshooting

To troubleshoot, follow all suggestions sequentially to determine cause of problem.

#### 3.6.1 Unable to log on:

The PLC control system does not have any power

- A) Check fuse “FB” in safety enclosure box. (Ref: Power Control Schematic in Section 6)
- B) 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)
- C) Check the setup of the installed Ethernet card. (Ref: Section 3)

#### 3.6.2 Temperature

1) 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.

- A) Check K1 main contactor (located in safety enclosure) to be sure it is operational. If not, check fuse “FD”. (Ref: Power Control Schematic in Section 6)
- B) Check K3 and K6 relays (located in safety enclosure) to be sure they are operational. If not, check interlock switches (located on frame) to be sure they are engaged. (Ref: Power Control Schematic in Section 6.)
- C) Check K4 relay (located on OPTO22 PLC panel. (Ref: Channel Assignment Sheet in Sections 5 and 6)
- 6) Check for illuminated LED, indicating an active output.

NOTE: K4 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

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

- A) The SCR needs calibration. See Maintenance (“Maint”) screen for details. (Ref: Reference Manual)
- B) The SCR has failed and shorted. Replace SCR.

NOTE: The following are factory typical settings:

- |             |    |
|-------------|----|
| Gain:       | 30 |
| Integral:   | 90 |
| Derivative: | 8  |

### 3.6.3 Zone temperature fluctuates.

- 1) The SCR needs calibration
- 2) Improper flowmeter setting(s)
- 3) Adjacent zone temperature differentials are too large
- 4) Improper PID setting(s)

### 3.6.4 Conveyor System

#### 1) A Transport Speed Error occurred.

- A) Check fuse “FB” (located in safety enclosure box). (Ref: Power Control Schematic in Section 6)
- B) Check fuses “F1” and “F2” on Motor Speed Control PCB (located in the motor box). (Ref: Frame Wiring Schematic in Section 6)
- C) Inspect clutch for slippage.
- D) Visually inspect for belt jam or snag.
- E) Check the input signal on Motor Speed Control PCB (located in motor box);S1 is common, S2 is speed control. (Ref: Frame Wiring Schematic in Section 6)

At maximum speed the voltage is approximately 10 VDC.

#### 2) Transport Motion Fault has occurred.

In addition to Section 0.0.0, the following items should be checked:

- A) Check for wear and tear on the small gear present on the transport motion sensor, and the gear located on the drive shaft at the exit end of the furnace.
- B) The optical coupler mounted on the sensor must be kept clean and positioned properly. The timing wheel must be adjusted so the edge of the wheel and the face of the wheel have the same spacing, with respect to the optical coupler.

### 3.6.5 Jerking or vibrating of transport system

See Recommended Maintenance and Frequency table 3.5.2 for transport system alignment and maintenance.

### 3.7 Hardware Communication and Software Troubleshooting

#### 3.7.1 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:

INDICATION	EXPLANATION	REMEDY
LINE LED is off	No Power.	Check wiring.
LIINE LED is red or Controller resets.	Power may be out of specification	Check the power supply for 5V DC power.
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 backup 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.

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.

### 3.8 Remote Diagnostics

To setup the remote control on the furnace for troubleshooting by FurnacePros from the factory, start PcAnywhere, click on “Be a Host” and “Wait for Call”. The computer should be connected to an ANALOG phone line. See section 2.9 for Remote Access options.

### 3.9 Process Problems

#### 3.9.1 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.

#### 3.9.2 Temperature or large power fluctuation

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. Go to the PID tuning screen for that particular 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 Documentation Section.

### 3.10 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

- a temperature with a negative value,
- a gas analyzer readout that never changes value,
- 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.

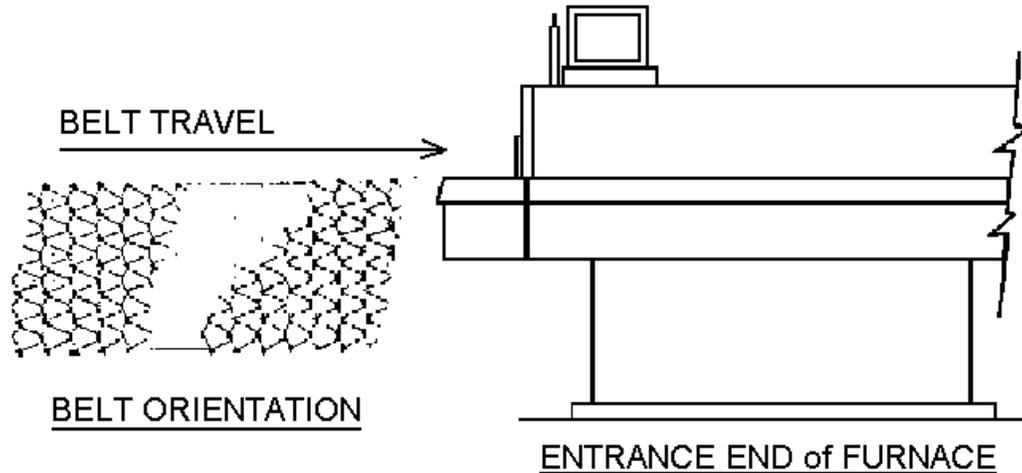
If the relay does toggle, make sure the module is talking to the controller; the TX LED should be flashing.

The analog inputs cannot be checked visually.

### 3.11 Transport Belt Replacement

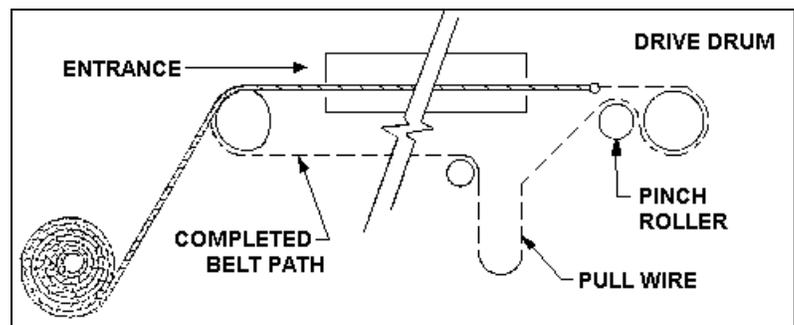
When replacing the transport belt, it will be helpful to have an assistant for the task.

- 1) Place the rolled up belt at the entrance end of the furnace and orient, as shown in the figure below.



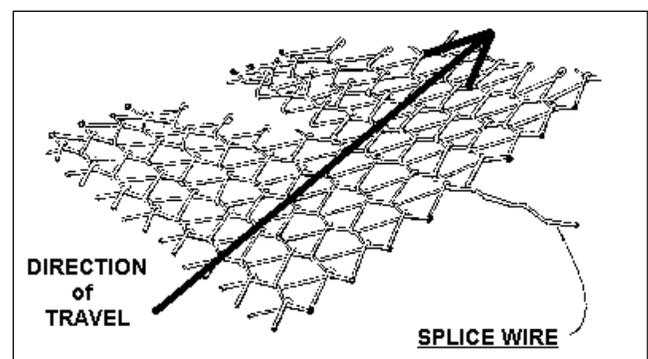
- 2) Extend a long rod or stick through the furnace chamber, being careful not to damage the lamps or insulation. If possible, use the old belt to draw a pull wire through the chamber during its removal. Securely attach the leading edge of the belt to the rod. Carefully pull the belt through the furnace from the exit end, while an assistant unrolls and guides the belt into the furnace.
- 3) When the belt has been pulled through the furnace chamber, remove the rod and thread a pull wire through the rollers and drive drum, as shown below. Attach the wire to the leading edge of the belt and pull the belt through.

Figure 3.11.1 Belt Installation



- 4) Continue pulling the belt through the drive system using the wire, and then by hand, until the belt path is complete.
- 5) Splice the belt, as shown below.

Figure 3.11.2 Inserting the Belt Splice



### 3.12 Heating Element Test Procedure

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

#### 3.12.1 Required Equipment

1. Continuity Tester (Ohmmeter preferred)
2. 3/8" Box or Open End Wrench
3. Control & Element Wiring Schematic

#### 3.12.2 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.

Using the schematic as a reference, locate the bus bars linking the elements in each zone. The bus bars are made from aluminum, and are connected to the lamp terminal screws.

Starting at the front of the furnace, remove the bus bars for only zone 1 (top & bottom), taking note of which terminals the bus bars were connected to. Using the multimeter on ohms scale, and a technician on either side of the furnace, check each lamp by measuring the resistance across the terminations of the lamp. If the resistance is less than 10 ohms, the element is good. If resistance is greater, replace the element following the procedure in Section **Error! Reference source not found.** of the manual. Next, check the bottom half of the zone in the same manner. After verifying the top and bottom lamps, replace the bus bars on the proper terminals, and securely tighten all hardware.

Following the same procedure, check the other zones, one at a time, throughout the furnace.

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.

### 3.13 Lamp Replacement

See furnace Reference Manual, Section 7.5.3 Heat Lamp Replacement.

### 3.14 Controller Installation

Connect the various cables between the modules, the controller and the computer.

INITIALIZE: Turn the computer on. When the WIN XP 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 furnace ProControl2007™ 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.

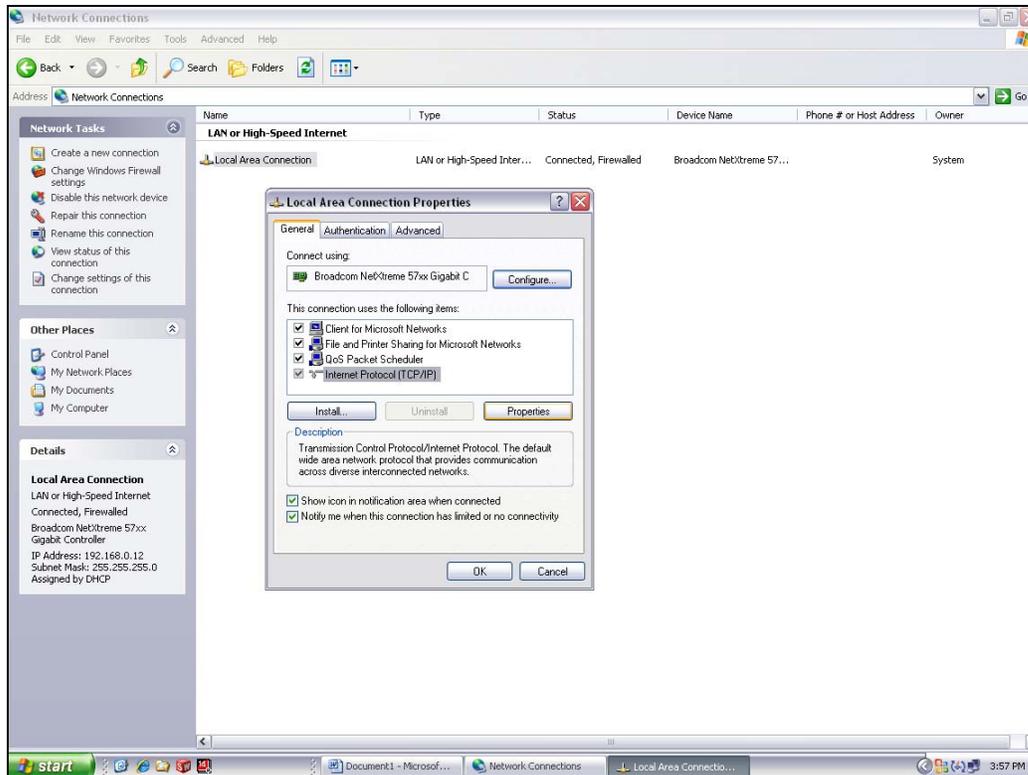
You should see the correct date and day in the bottom left corner. If not, go to the Ethernet Installation and troubleshooting section.

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.

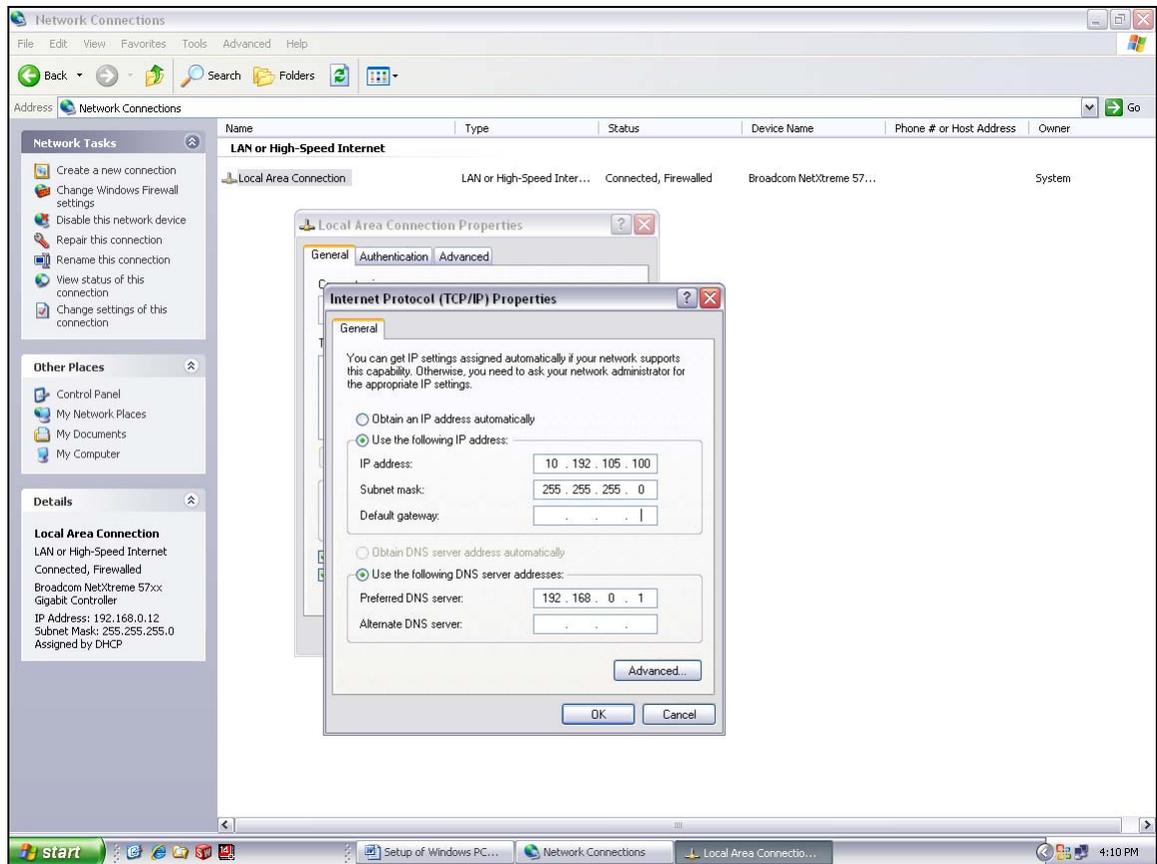
### 3.15 Ethernet Installation and Troubleshooting

#### 3.15.1 Setup of Windows® PC Ethernet Interface

- Open Windows Control Panel<start\settings\control panel
- Double click on the “Network Connections” icon.
- Choose “Local Area Connection”, right click, “Properties”.
- Highlight “Internet Protocol (TCP/IP)”, make sure the box is checked.
- “Client for Microsoft Networks”, and “File and Printer Sharing for Microsoft Networks” should be checked.
- Click the pushbutton labeled “Properties”.



- A dialog box called “Internet Protocol (TCP/IP) Properties” will appear.
- On the “General” tab look for the following available two choices:  
“Obtain an IP address automatically”  
“Use the following IP address:”



## IP Addresses

- i. For the case of setting up the communication link between the PC and the Opto22 Controller use the following information. (Setup of the communication link using the second Ethernet card on the PC will be shown afterward.)
- j. Select "Use the following IP address:"  
Enter the following in the fields:  
IP address: 10.192.105.100  
Subnet mask: 255.255.255.0

Clear the Default gateway: fields, and the DNS server addresses fields.

- k. When the furnace PC computer contains two Ethernet cards, configure the "Local Area Connection2" communication link for the second Ethernet card as done above, however, with the following modification shown below:
  - l. Select "Obtain an IP address automatically"; Click "OK", "OK".
  - m. Close "Network Connections".

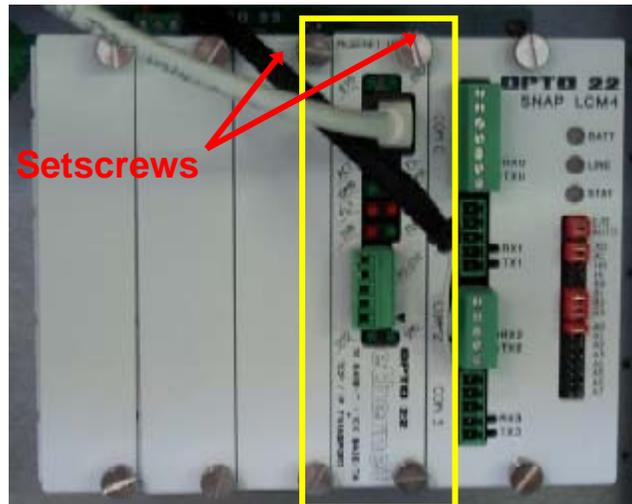
## Section 3

### 3.15.2 Reset and 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.

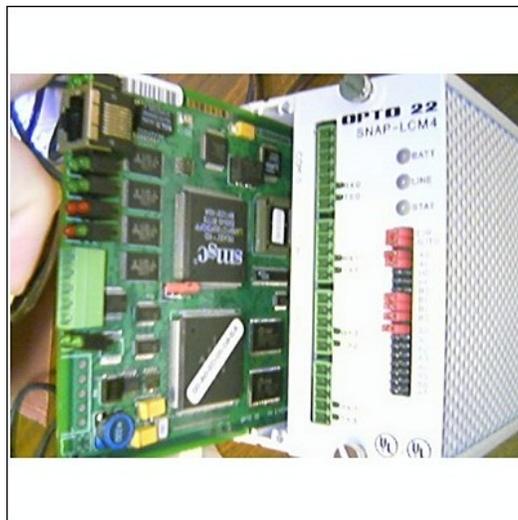
**Note: Follow standard anti-static dissipative procedures when removing and handling the card.**

- c. Remove Ethernet and RS-232 connectors
- d. Release (4) front panel set screws and (2) covers



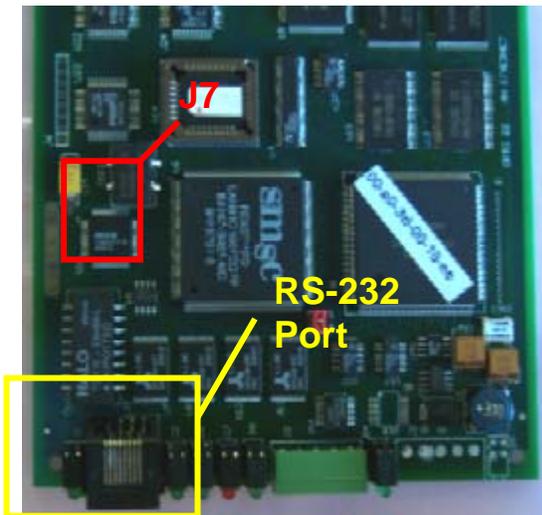
**Remove Card from chassis. (See figure below)**

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

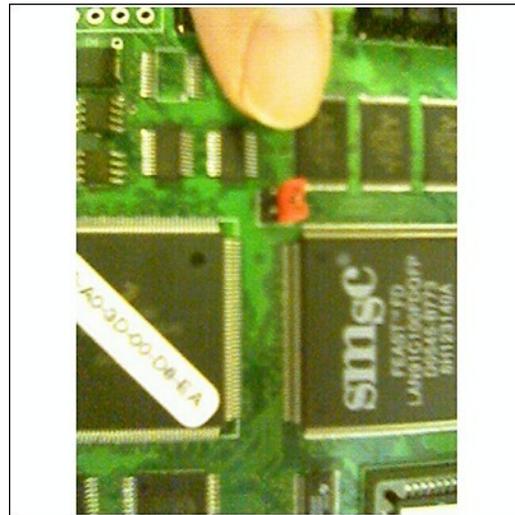


**Removal of Ethernet Card**

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



Location of Port and J7 Jumper



Move J7 Jumper to Module Reset

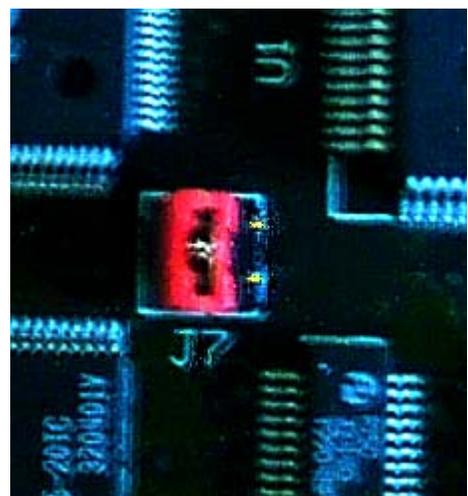
- g. Reinstall the Ethernet adapter card into the Opto22 controller chassis box.
- h. Wait for the STD LED on the Ethernet adapter card to stop blinking, and then turn off, or remove power from the system.

**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.**

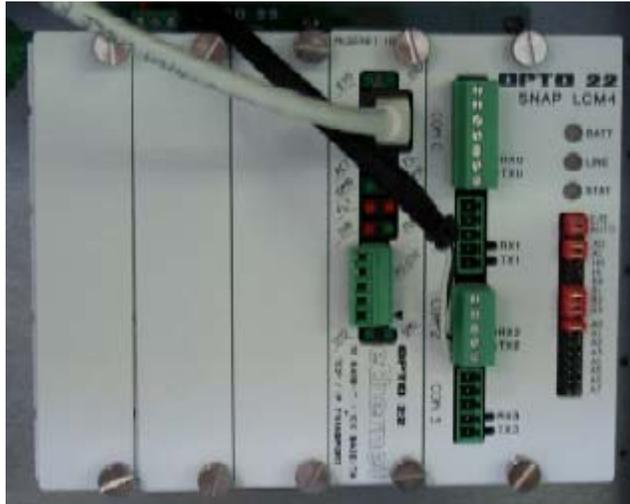
- j. After removing power from the controller system, again remove the Ethernet Adapter card and restore the J7 Jumper to its original position as shown at right



Original J7 Position

## Section 3

- k. Reinstall the Ethernet Adapter card into the Opto22 controller chassis box making sure the covers and set screws are in place.



**Ethernet Adapter**

- 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.

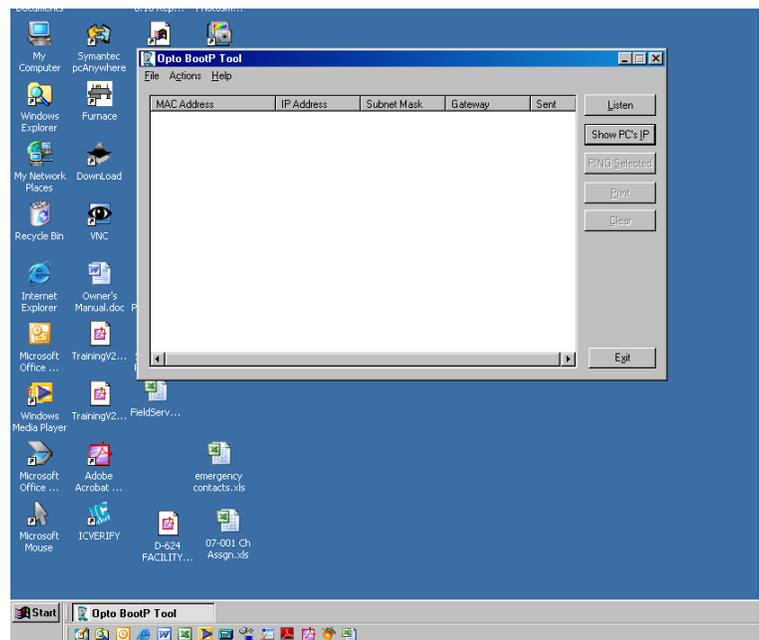
Double Click on the 0.0.0.0 field to assign an IP Address

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.

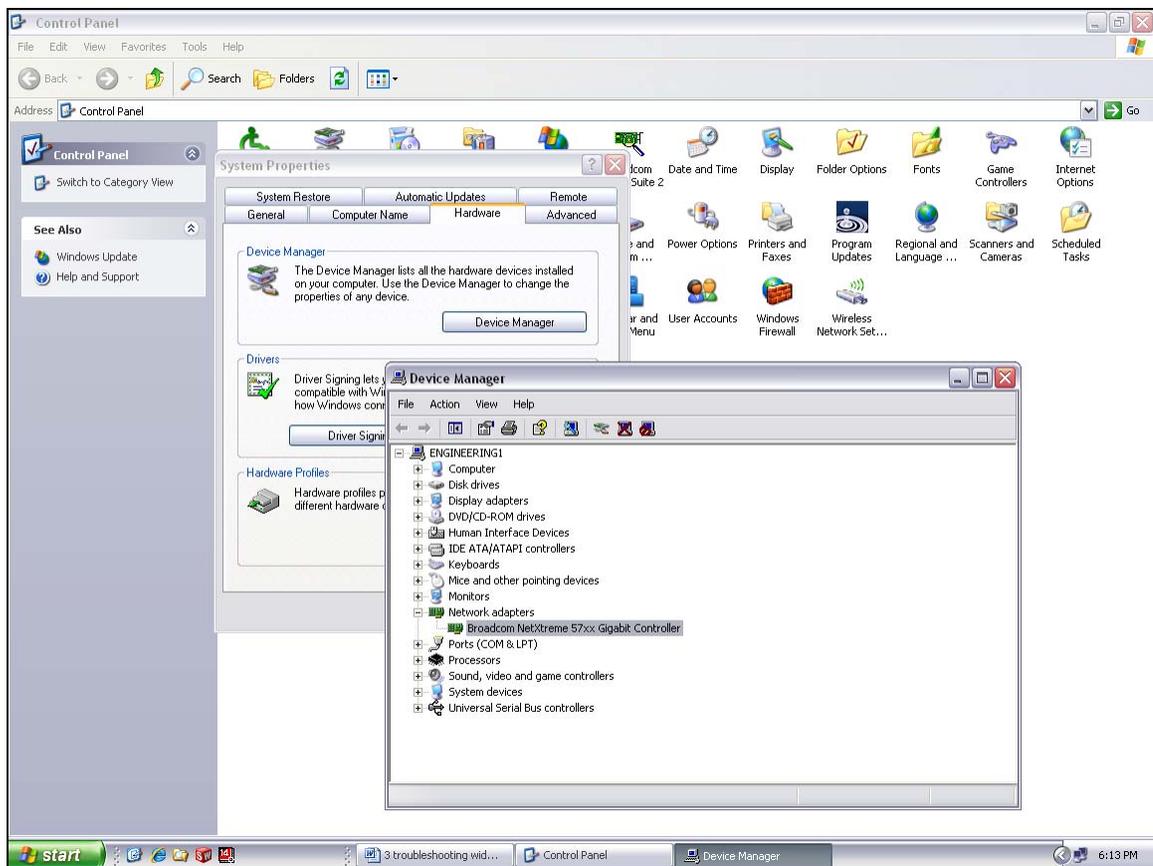
- o. Click on “Exit” to leave the OptoBoot tool application.



**OptoBoot Screen**

### 3.15.3 Troubleshooting Windows® Setup of Ethernet Connection

- a. Open Windows Control Panel<start\settings\control panel>
- b. Double click on the “System” icon.
- c. A dialog box called “System Properties” will appear.
- d. On the “Hardware” tab look for the pushbutton called “Device Manager”.
- e. Click on “Device Manager”. A listing will appear showing the hardware devices installed on the computer. Verify the Ethernet card(s) are shown in this list.
- f. Exit “Device Manager”, “OK”, close Control Panel.



- g. Open Windows Control Panel<start\settings\control panel>
- h. Double click on the “Network Connections” icon.
- i. Check to see that the network connection for the communication link between the PC and the Opto22 Controller (Local Area Connection) appears under the listing Name “LAN or High-Speed Internet”.

## Section 3

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- j. Choose “Local Area Connection”, right click, “Properties”.
- k. Highlight “Internet Protocol (TCP/IP)”, make sure the box is checked.
- l. Click the pushbutton labeled “Properties”.
- m. Within the dialog box, “Internet Protocol (TCP/IP) Properties”, in the “General” tab, verify that “Use the following IP address:” is selected and the following address information is entered:
  - IP address: 10.192.105.100
  - Subnet mask: 255.255.255.0
- n. Click “OK”, “OK”.
- o. Close “Network Connections”

### **3.15.4 Verify configuration of the external jumpers of Opto22 Controller**

See Section 7, PLC I/O CONFIGURATION drawing for jumper settings.

### 3.16 Calibration

Consult the Reference Manual for most calibration procedures.

#### 3.16.1 SCR

Follow the calibration procedure described in the Reference Manual.

#### 3.16.2 Belt speed

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 for more detail.

#### 3.16.3 Thermocouples

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

#### 3.16.4 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.

Go to the recipe screen and select the PID tuning for the zone you're interested in. 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 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.

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.

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.



### 3.17 Over Temperature Alarm Setpoints (optional)

The Over Temperature Alarm system is factory set to 200°C for each zone. The system consists of a microprocessor-based eight channel analog input scanner/multiplexer and annunciator that provides automatic switching for multi-point display and alarm of the furnace zone temperatures. Signals received from redundant type K thermocouples in each zone of the furnace are scanned and alternately displayed on the digital temperature panel meter mounted below the Main Control Console of the furnace. See drawing 802-101915-03 Over Temperature Monitor wiring schematic.

**DIGITAL PANEL METER SCALE (F or C).** F or C can be switched to indicate Fahrenheit or Celcius.

1. Press ENTER, when F or C appears press ENTER again.
2. The meter will display F or C alternatively. Press ENTER when desired character is flashing. Meter will then return to indication mode and display the temperature in either Fahrenheit or Celcius.

**DIGITAL PANEL METER ALARM SET AND RESET PROGRAMMING.** The panel meter alarm set and reset point is performed in the ALAr5 routine.

1. To enter the ALAr5 routine, press ENTER and when ALAr5 appears, press ENTER again. This starts a scan of the system set and reset points. The scan sequence begins with a flashing display of alarm #1 set point. The “1” LED and “S” LED are illuminated to indicate the meter is flashing alarm #1 set point value.
2. All digits flash for 3 seconds. If this is the desired display for this alarm point, press ENTER. Pressing ENTER completes this alarm point programming. Proceed to step 8 for next alarm point programming.

If this is not the desired display, wait for the first digit to flash. It will flash for 3 seconds before it starts to scroll.

3. If the first flashing digit is OK, press ENTER before it starts to scroll to accept it, the next digit flashes – go to step 6. If not OK, wait for first digit to scroll.
4. When the first digit is OK, press ENTER and the next digit flashes for 3 seconds before it starts to scroll.
5. If the flashing digit is OK, press ENTER before it scrolls. If not OK, wait for digit to scroll
6. When digit is OK, press ENTER. Program remaining digits in same fashion.
7. When the last digit is OK, press ENTER. The entire display flashes for 3 seconds. Press ENTER if OK to complete alarm point programming and proceed to step 8. If not OK, wait, first digit flashes. Repeat steps 3-7.
8. When an alarm set or reset point has been programmed the scan moves to the next alarm set or reset point. To program the remaining alarm set and reset points, repeat steps 2-8.

**SCANNER/ANNUNCIATOR.** The scanner/annunciator is programmed for scanning and alarm functions using the CTRL button and a four-position DIP switch (S1). The CTRL button is used to set the dwell time for each channel (if using internal scanning) and DIP switch S1 is used to program the following:

S1 Switch	Function
S1-1	Sequence A or F2A alarm operation (if needed)
S1-2	Stopping-on-alarm or continuous scan-on-alarm (if needed)
S1-3	Internal or external scanning
S1-4	RUN or SETUP mode

## Section 3

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The scanner/annunciator's front cover is held in place by 6 latches that snap into notches on the cover. To remove the cover grasp it firmly on its top and bottom edges and pull it forward. The latch plate remains around the case. DIP switch S1 is located below the right bank of LEDs.

**PRPROGRAMING DWELL TIME (INTERNAL SCAN ONLY).** The default dwell time is four seconds per channel. It can be adjusted for any time between 0.6 and 30 seconds per channel. A channel can be disabled from the scan sequence by programming that channel's dwell time for less than 0.5 seconds during setup.

To program a dwell time for other than the four second default or to disable a channel:

1. Set the switch S1-4 to the SETUP (off/up) position.
2. Unit will beep and channel 1 will illuminate, indicating it is ready to be programmed.
3. Dwell times are programmed with the CTRL button, either
  - a) Press and release CTRL button within 0.5 seconds to disable a selected channel,
  - b) Press and release CTRL button after the 0.5 second beep to program channel for minimum dwell time, or
  - c) Press and hold CTRL button for desired length of dwell time up to 30 seconds maximum.
4. After the CTRL button is released the unit will beep and go to the next channel.
5. Program the remaining channels in a similar fashion.
6. When the dwell times for all eight channels have been programmed, a red LED will light up next to channels that have been disabled (default: channels 4-8 are disabled).
7. To make sure the dwell times have been programmed as desired, set switch S1-4 back to the RUN (on/down) position and scanner will begin scanning.
8. To make any corrections to the dwell times, set switch S1-4 back to the SETUP (off/up) position and press the ACK button to advance to the desired channel.
9. When the dwell times have been programmed as desired set switch S1-4 to the RUN (on/down) position.

**4.1 Furnace Specifications**

**4.2 Computer**



Customer: <b>Amkor</b> Equipment: <b>AG-1524</b>	<b>FACILITY REQUIREMENTS</b>	Job/Proposal Nbr: <b>08-002</b> Date: <b>28-Jul-08</b>
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**EQUIPMENT SPECIFICATIONS**

NUMBER OF LAMPS	140 TOTAL
FURNACE HEATING CHAMBER LENGTH	150 INCHES
FURNACE NOMINAL WIDTH (LAMP LENGTH)	24 INCHES
ENTRANCE INTERFACE ROLLER	NONE
EXIT INTERFACE ROLLER	NONE
EDGE HEAT	Dual (zones 1-7 & 8-11)
LINE VOLTAGE	480 VAC, 60 Hz, 3 Ph
APPROX NET WEIGHT	2300 LB

<b>EQUIPMENT RATING</b>	<b>MAX</b>	<b>NORMAL</b>
TEMPERATURE	1000 °C	300-400 °C
BELT SPEED	2-20 IPM	6 IPM
POWER (PEAK & OPERATING)	148 kW	55 kW
CURRENT (UNBALANCED)	178 A	65 A

**PROCESS GAS SPECIFICATIONS: NITROGEN or NITROGEN/HYDROGEN MIX**

TOTAL HYDROCARBONS, MAXIMUM	PPM
MOISTURE, MAXIMUM	PPM

<b>PROCESS GAS: CDA OR NITROGEN</b>		<b>MAX</b>	<b>NORMAL</b>
PURGE RATE	GAS PURGE/MIN	7.9	2.0
GAS SUPPLY	FLOWRATE	130 SCFM	33 SCFM
	PRESSURE	90 PSIG	70 PSIG
PROCESS EXHAUST	FLOWRATE	130 SCFM	33 SCFM
	TEMPERATURE	300 °C	100 °C

CABINET EXHAUST - HEATING CHAMBER	FLOWRATE	1500 SCFM
	TEMPERATURE	LESS THAN 40°C
CABINET EXHAUST - CONTROLLED ATMOSPHERE	FLOWRATE	1500 SCFM
	TEMPERATURE	LESS THAN 40°C
CABINET EXHAUST - TURBULENT AIR COOLING	FLOWRATE	750 SCFM
	TEMPERATURE	LESS THAN 40°C
STANDARD CONDITION	PRESSURE	14.7 PSIA
	TEMPERATURE	294 K

NOTES:

1. FOR COMPLETE INSTALLATION INSTRUCTIONS CONSULT FURNACE OPERATING MANUAL.





**EQUIPMENT LIST,  
COMPUTER**

DOC NBR: 08-002 802-101420 R 0

MODEL NBR: AG-1524

APVL

SERIAL NBR: 1824159102

JCLARK

DATE: 27-Jul-08

SHT 1 of 1

Qty	Part Number	Description
1	802-101420-01	Computer System, Dell Optiplex 330, 1.6GHz cpu, 800MHz front side bus, 1GB memory, dual 80GB hard drives/RAID array, 2 TC/IP network interface cards, 1 modem, 1 USB optical mouse, 1 USB keyboard, 1 CD R/RW/DVD Optical drive, 1 3.5' floppy drive, each consisting of the following components:

Qty	Part Number	Description
1	223-1449	OptiPlex 330 Minitower,PentiumDual Core E2140/1.6GHz,1M 800FSB
1	420-3699	NTFS File System
1	311-7420	1.0GB,Non-ECC,667MHz DDR2 1x1GB,OptiPlex 330 Memory
1	310-8010	Dell USB Keyboard,No Hot Keys English,Black,Optiplex
1	320-5576	Dell E178FP,17 Inch Flat Panel17.0 Inch Viewable Image Size
1	341-4985	80GB RAID1 (2x80GB) SATA 3.0Gb/s and 8MB Data Burst Cache,Dell OptiPlex Minitower
1	341-4005	3.5 inch,1.44MB,Floppy Drive Dell OptiPlex 330
1	467-0811	Windows XP Professional Service Pack 2,with Media,DellOptiPlex,English
1	2MOUSEU2L	Dell USB-Optical Mouse with Scroll,Black,OptiPlex
1	313-5559	V.92, PCI, Data/Fax Modem,FullHeight
1	313-5550	48X32 CDRW/DVD Combo,Dell
1	420-7964	Cyberlink Power DVD
1	420-7965	Compact Diskette for CyberlinkPower DVD,Dell OptiPlex
1	310-9460	Resource CD contains Diagnostics and Drivers for Dell OptiPlex 330
1	989-2707	Dell Hardware Limited Warranty Plus Onsite Service Initial Year
1	989-2708	Dell Hardware Limited Warranty Plus Onsite Service Extended Year(s)
1	985-8070	Basic Support: Next Business Day Parts and Labor Onsite Response Initial Year
1	985-2792	Basic Support: Next Business Day Parts and Labor Onsite Response 2 Year Extended
1	A0136556	Gigabit Instant Network Adapter, Linksys 10/100/1000

# DELL™ OPTIPLEX™ 330



## AN ESSENTIAL MANAGED DESKTOP SOLUTION DESIGNED FOR GROWING BUSINESSES



The Dell OptiPlex 330 provides a stable, configurable solution with basic manageability and processor performance that can suit the needs of growing businesses. With this platform, Dell is raising the bar in the entry-level desktop category with Intel® Core™ 2 Duo processors and a next-generation chipset, plus optional DirectX® 10 graphics technology. In addition, the Broadcom® Gigabit<sup>1</sup> NIC (network interface card) can deliver advanced networking capabilities and enhanced performance.

To help you conserve energy and overhead, the OptiPlex 330 features Dell Energy Smart configurations defaulted out of the factory. The platform is also available with 80% efficient power supplies. Manageability is provided via ASF (Alert Standard Format) 2.0 standards-based technology, and data security can be reinforced with optional RAID 1 (Redundant Array of Independent Disks) support.

### ESSENTIAL REMOTE MANAGEMENT: New capabilities that allow IT to have greater control

- ASF 2.0 delivers enhanced security measures over the previous generation
- Dell Client Manager provides centralized remote control and automation of common tasks associated with owning client systems

### POWER EFFICIENCY: Productivity and power savings in a proven, reliable design

- Intel® Core™ 2 Duo processors can deliver more performance with less power
- Pre-configured Energy Smart settings help enable immediate energy savings
- Dell's Online Energy Calculator helps you measure and manage energy consumption for your unique environment
- ENERGY STAR® 4.0 compliant options are designed to meet the internationally recognized standards set by the U.S. Environmental Protection Agency

### SMART SECURITY: Strategic, comprehensive endpoint solutions for all types of businesses

- RAID 1 support helps keep data intact and accessible via real-time redundancy
- CompuTrace® tracking capability incorporated into the BIOS can help reduce losses from theft

### DELL DEPLOYMENT SERVICES: Image management, customization and deployment made easy

- Dell Advanced Configuration Services speed deployment via pre-configuration of your custom settings
- Dell ImageDirect service allows you to build custom images spanning multiple Dell client systems
- Microsoft® Windows Vista® Assessment and Migration options help streamline and optimize your deployment processes



# DELL™ OPTIPLEX™ 330

## SYSTEM

<b>Processor Type</b>	- Intel® Core™ 2 Duo - 1066MHz FSB, 4MB L2 cache, Enhanced Intel SpeedStep® Technology (Up to E6700 series) - Intel® Core™ 2 Duo - 800MHz FSB, 2MB L2 cache, Enhanced Intel SpeedStep® Technology (E4000 series) - Intel® Pentium® - 800MHz FSB, 1MB L2 cache, Enhanced Intel SpeedStep® Technology (E2000 series) - Intel® Celeron® - 800MHz FSB, 512MB L2 cache
<b>Chipset</b>	Intel® G31 Express Chipset
<b>Operating Systems</b>	Dell recommends Microsoft® Windows® XP Professional; Microsoft Windows XP Home Edition; Microsoft® Windows Vista® Home Basic; Microsoft® Windows Vista® Business; Microsoft® Windows Vista® Ultimate
<b>Video</b>	Integrated Intel Graphics Media Accelerator 3100 <sup>2</sup> ; 256MB ATI Radeon™ HD 2400 PRO with DVI and/or TV-out
<b>Memory</b>	2 DIMM Slots; Non-ECC shared dual channel <sup>3</sup> DDR2 SDRAM <sup>4</sup> - Supports up to 4GB <sup>5</sup> ; 667MHz and 800MHz
<b>Networking</b>	Integrated Broadcom® BCM5787 Gigabit <sup>1</sup> LOM 10/100/1000
<b>Standard I/O Ports</b>	8 USB 2.0 (2 front, 6 rear), 1 Ethernet (RJ45), 1 serial (9-pin)(16550 compatible), 1 parallel (25-hole, bi-directional), 1 VGA out (15-hole), optional add-in PS2 card with second serial port, 1 stereo line-in, 1 microphone-in, 1 speakers/line-out, 1 headphone (front)
<b>Hard Drive</b>	40GB, 80GB, 160GB and 250GB <sup>6</sup> 7200RPM SATA II, 3.0GB/s and 80GB <sup>6</sup> 10K RPM SATA II 3.0GB/s

## CHASSIS

Dimensions (H x W x D)	Minitower:	Desktop:
	16.10" x 7.36" x 17.52" (40.89cm x 18.69cm x 44.50cm)	15.65" x 4.59" x 14.25" (39.75cm x 11.66cm x 36.19cm)
<b>Number of Bays</b>	2 internal 3.5" 1 external 3.5" 2 external 5.25"	1 internal 3.5" 1 external 3.5" 1 external 5.25"
<b>Expansion Slots</b>	2 full-height PCI 1 PCIe x16 full-height graphics	2 low-profile PCIe x16 graphics
<b>Power Supply</b>	Minitower 305W; Desktop 280W	

## PERIPHERALS

<b>Monitors</b>	<b>CRT:</b> Dell 17" E773 CRT, analog; Dell 17" E773 CRT, analog, speakers <b>Flat Panel Analog:</b> Dell 15" E157FP Flat Panel, analog; Dell 17" E177FP Flat Panel, analog; Dell 17" E178FP Flat Panel, analog; Dell 19" E197FP Flat Panel, analog; Dell 19" E198FP Flat Panel, analog; Dell 22" E228WFP Widescreen Flat Panel, analog <b>Widescreen Flat Panel Analog:</b> Dell 17" E178WFP Widescreen Flat Panel, analog; Dell 19" E198WFP Widescreen Flat Panel, analog; Dell 20" E207WFP Widescreen Flat Panel, analog; Dell 22" E228WFP Widescreen Flat Panel, analog <b>UltraSharp Digital Flat Panel:</b> Dell 17" UltraSharp 1708FP Flat Panel, adjustable stand, VGA/DVI; Dell 19" UltraSharp 1908FP Flat Panel, adjustable stand, VGA/DVI; Dell 20" UltraSharp 2007FP Flat Panel, adjustable stand, VGA/DVI UltraSharp Widescreen digital; Dell 20" UltraSharp 2007WFP Widescreen, adjustable stand, VGA/DVI; Dell 24" UltraSharp 2407WFP Widescreen, adjustable stand, VGA/DVI; Dell 24" UltraSharp 2407FPW-HC Widescreen, adjustable stand, VGA/DVI
<b>Keyboard</b>	Dell USB keyboard, no hot keys; Dell USB Enhanced Multimedia keyboard; Smart Card Reader USB keyboard; Bluetooth® keyboard and mouse
<b>Mouse</b>	Dell USB two-button and Dell USB optical two-button scroll, Dell USB Premium five-button
<b>Speakers</b>	Internal Dell Business audio speaker, Dell A225, Dell A525, AS501 and AS501PA sound bar available with select FP monitors

## STORAGE DEVICES

<b>Removeable Media Storage Devices</b>	Floppy drive, CD-ROM, CD-RW/DVD combo, DVD-ROM <sup>7</sup> and DVD+/-RW <sup>6</sup>
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## SECURITY

<b>Security</b>	Chassis loop lock support (with cable locks available), Setup/BIOS Password, I/O Interface Security, Smart Card reader keyboard
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## SYSTEMS MANAGEMENT

<b>Hardware Management Options</b>	ASF 2.0, PXE, WOL
<b>Dell Client Manager Standard</b>	<b>Dell Client Manager Standard:</b> A no-charge download of a single hardware management console allows you to identify, inventory, monitor health and troubleshoot, and manage the BIOS version and configuration of Dell client systems across your entire organization. <b>Dell Client Manager Upgrades:</b> Fee-based modules available to add imaging, software inventory, software delivery, PC migration (Dell Client Manager Plus), as well as advanced capabilities including security assessment, asset management, service desk applications and more (Management Suites for Dell Clients). For more information, visit <a href="http://www.dell.com/openmanage">www.dell.com/openmanage</a>

## ENVIRONMENTAL, ERGONOMICS AND REGULATORY, SERVICE AND SUPPORT

<b>Standards</b>	Blue Angel, CECP, ENERGY STAR® 4.0, TCO 05, WEEE, Japan Energy Law, CES, Japan Green PC, FEMP, South Korea Eco-label, EU RoHS <sup>9</sup> , China RoHS, Japan RoHS, EPEAT
<b>Base Service</b>	Three-Year Limited Warranty <sup>10</sup> and Next Business Day On-Site Service <sup>11</sup> (U.S. Only)
<b>Optional Service</b>	Three-Year Same Day Four-Hour On-Site Response Service, <sup>11</sup> 5 days x 10 hours a day; Three-Year Same Day Four-Hour On-Site Response Service, <sup>11</sup> 7 days x 24 hours a day

1. This term does not connote an actual operating speed of 1 GB/s. For high-speed transmission, connection to a Gigabit Ethernet server and network infrastructure is required.

2. Up to 256 MB of system memory may be allocated to support integrated graphics, depending on system memory size and other factors.

3. Dual-channel memory requires two each of the same capacity memory DIMMs.

4. Your graphics solution may use a portion of your system memory to support graphics depending on your operating system, system memory size and other factors.

5. The total amount of usable memory available will be less than 4GB, depending on the actual system configuration.

6. For hard drives, GB means 1 billion bytes; actual capacity varies with preloaded material and operating system and will be less.

7. DVD-ROM drives may have write-capable hardware that has been disabled via firmware modifications.

8. Discs burned with this drive may not be compatible with some existing drives and players; using DVD+R media provides maximum compatibility.

9. Meets the requirements of the EU Directive on the restriction of the use of certain Hazardous Substances dated January 27, 2003.

10. For a copy of our guarantees or limited warranties, please write Dell USA L.P., Attn: Warranties, One Dell Way, Round Rock, TX 78682.

11. Service may be provided by third party. Technician will be dispatched if necessary following phone-based troubleshooting. Subject to parts availability, geographical restrictions and terms of service contract. Service timing dependent upon time of day call placed to Dell. U.S. only.





**5.1 SCR Power and Current**

**5.2 Flowmeters, 2 exchanges/min**

**5.3 Channel Assignments**



Customer: Amkor	<b>IR FURNACE SYSTEM</b> <b>SCR Lamp Power &amp; Current</b>	Job/Proposal Nbr: 08-002
Equipment: AG-1524		Date: 7/28/2008

INPUT TABLE		Entry OK?
3-phase Line Voltage (208/240/380/400/415/480/500)	480 VAC	TRUE
Lamps wired to Neutral? (Y/N)	N	TRUE
Line Frequency (50/60)	60 Hz	TRUE
Lamp Length (9/14/24/36)	24 inches	TRUE
Typical Operating %	35 %	TRUE

SUMMARY OF RESULTS	
<b>Max Power</b>	<b>147.4 kW</b>
<b>Max Current</b>	<b>177.4 A</b>
<b>Typical Power</b>	<b>54.5 kW</b>
<b>Typical Current</b>	<b>65.5 A</b>

HARDWARE	
<b>Lamps</b>	<b>140</b>
<b>SCRs</b>	<b>26</b>
<b>EMs</b>	<b>20</b>

Phase	1	1	2	2	2	2	3	3	3	3	Totals	
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	Zone 11	
Length (7.5/10/15/20/30) in inches	10	20	20	10	7.5	15	7.5	10	20	20	10	150 in.
Length Entry OK?	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	
Furnace(f) or Dryer(d)?	F	F	F	F	F	F	F	F	F	F	F	
Furnace/Dryer Entry OK?	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	
No. Lamps in Series/String	1	2	2	2	2	2	2	2	2	2	2	
Rated Lamp Voltage	461	461	461	461	461	461	461	461	461	461	461	
Max. Lamp Wired Voltage	480	240	240	240	240	240	240	240	240	240	240	
Rated Lamp Power (W)	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	
Max. Lamp Wired Power (W)	2554	878	878	878	878	878	878	878	878	878	878	
No. Strings per SCR	6	4	4	3	2	3	2	3	4	4	3	
Max. Current per String (A)	5.3	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	41.9
No. Lamps in Zone	12	16	16	12	8	12	8	12	16	16	12	140
No. Lamp SCRs in Zone	2	2	2	2	2	2	2	2	2	2	2	22
No. Strings in Furnace Zones	12	8	8	6	4	6	4	6	8	8	6	76
No. Furnace Element Monitors												19
Power Required/SCR (kW)	15.3	7.0	7.0	5.3	3.5	5.3	3.5	5.3	7.0	7.0	5.3	
Total Power/Zone (kW)	30.6	14.1	14.1	10.5	7.0	10.5	7.0	10.5	14.1	14.1	10.5	143.1
Current Required/SCR (A)	0.0	14.6	14.6	11.0	7.3	11.0	7.3	11.0	14.6	14.6	11.0	
Color Temp (K) (target:2300-2700)	2538	1964	1964	1964	1964	1964	1964	1964	1964	1964	1964	
Peak Wavelength (µm) (target:<2)	1.14	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	
Estimated Lamp Life (hrs)	3674 hr	Long	Long									
Light Output vs. Rated (%)	114	12	12	12	12	12	12	12	12	12	12	

Furnace Total	Number of Item?	Voltage	Current	Max Power 147.4 kW	Max Current 177.4 A	Typical Power 54.5 kW	Typical Current 65.5 A
Lamps	140	480 VAC		143.1 kW		50.1 kW	
Motor, Belt	1	24 VDC	8.0 A	0.2 kW		0.2 kW	
Computer	1	115 VAC	3.0 A	0.3 kW		0.3 kW	
Edge Heaters	4	480 VAC	2.0 A	3.8 kW		3.8 kW	
UCD		115 VAC	8.4 A	0.0 kW		0.0 kW	
UCD Recirc Pump		115 VAC	12.0 A	0.0 kW		0.0 kW	
Other:		115 VAC	A	0.0 kW		0.0 kW	
			A	0.0 kW		0.0 kW	
			A	0.0 kW		0.0 kW	

PHASE	PHASE BALANCING			TOTAL
	1	2	3	ALL
LAMP PWR, kW	45	49	49	143.1
EH/OTHER	3.8	0.0	0.0	3.8
TOTAL	48.5	49.2	49.2	146.9



<b>Customer:</b> Amkor	<b>IR FURNACE FLOWMETER SCALE CORRECTION, PURGE AIR AND EXHAUST</b>	<b>Job/Ppsl Nbr:</b>
<b>Equipment:</b> AG-1524		<b>Date:</b>

<b>STANDARD CONDITIONS</b>			<b>Gage</b>	<b>Absolute</b>	
Ts	Standard Temperature, F	70 F	530 R	Dwyer flowmeter std	
Ps	Standard Pressure, psig	0.0 psig	14.7 psia	Dwyer flowmeter std	
<b>COMPRESSED AIR SUPPLY</b>					
T1	Actual Temperature, F	100 F	560 R	max normal temperature at flowmeter exit	
P1	Pressure after Furnace Regulator, psig	60 psig	74.7 psia	furnace pressure regulator setting	
<b>REPLENISH RATE</b>					
	Number of Replenishes/minute	2 rep/min	120 rep/H	furnace replenishes per hour	
	Time it takes to evacuate Furnace		30 sec	time to refresh gas in furnace	

**CALCULATE INTERNAL VOLUME OF THE FURNACE**

	Interface Roller Assy	Load Station	Zone											Transition Tunnel w exhaust	Plenum	Cooling	Unload Interface Station Roller Assy		
			Entrance Baffle	1	2	3	4	5	6	7	8	9	10				11	13.2	241.4
Length, inches		13.2	15	10	20	20	10	7.5	15	7.5	10	20	20	10	15	20	15	13.2	241.4
Width, inches			25	25	25	25	25	25	25	25	25	25	25	25	25	25		chambe	
Height, inches			6	12	12	12	12	12	12	12	12	12	12	12	6	6		chambe	
Temperature, °C			150	204	243	294	330	350	360	353	345	322	293	200	150	100		lowest rx	
Pressure, in H2O			2	2	2	2	2	2	2	2	2	2	2	2	2	2		highest rx	
Volume, CF			1.3	1.7	3.5	3.5	1.7	2.6	1.3	1.7	3.5	3.5	1.7	2.6	1.7	1.3		33.0	
Std Volume, SCF			0.9	1.1	2.0	1.8	0.9	1.2	0.6	0.8	1.7	1.7	0.9	1.6	1.2	1.0		18.1	

**REPLENISH GAS FLOW**

Q1	BALANCING GAS FLOW, ACTUAL CUBIC FEET PER HOUR	33.0 x 120 =	3958 ACFH
	BALANCING GAS FLOW, STANDARD CUBIC FEET PER HOUR	18.1 x 120 =	2171 SCFH

**ESTABLISH FURNACE FLOW BY ZONE**

**CALCULATE FLOW TO EDUCTORS**

Eductor multiplier

TOTAL  
EXHAUST  
1981.7  
SCFH

	Entrance Eductor X	Z2-3 Eductor X					Z3-4 Eductor X		Z6-7 Eductor X		Z8-9 Eductor X		Z10-11 Eductor X		Exit Eductor X	Total
		1	2	3	4	5	6	7	8	9	10	11	180.2			
Temperature, deg F	130	130	130	130	130	130	130	130	130	130	130	130	130	130	max ten	
Pressure, in H2O	5	5	5	5	5	5	5	5	5	5	5	5	5	5	min pres	
Flowmeter setting	27	27	27	27	27	27	27	27	27	27	27	27	27	27	189 Flowmetr	
Flow, Max (size)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	700 Flowmetr	
Calc Reqd Flow, SCFH	109.2	129.1	238.8	217.3	102.2	74.2	148.3	73.0	110.0	110.0	110.0	110.0	110.0	145.6	123.8	1801.6 SCFH st
Temperature, °F	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	@ flown
Pressure, PSIG	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	@ flown
Flowmeter setting	52.0	61.5	113.7	103.5	48.7	35.3	70.6	31.2	52.4	52.4	52.4	52.4	52.4	69.3	59.0	854 Flowmetr
Flow, Max (size)	400	400	400	400	400	400	400	400	400	400	400	400	400	400	200	3400 Flowmetr

**SUMMARY, TOTAL FLOW**

	Normal	Max (all flowmeters open)
Required standard flow	1982 Total SCFH reqd	
Observed flow, flowmeter settings	1043 Flowmeter Grad SCFH	4100 Flowmeter Grad SCFH

**PROCESS EXHAUST**

	Normal	per Stack	Max (all flowmeters open)
Qs	Standard Flow to plant exhaust	1982 SCFH	283 SCFH
T3	Temperature at exhaust	200 F	200 F
P3	Pressure at exhaust	5 in H2O	5 in H2O
Q3	Actual total exhaust flow	41 ACFM	6 ACFM
	Velocity in each stack	1.0 fps	1.0 fps
			4.1 fps

**REQUIRED COMPRESSED AIR OR NITROGEN**

	Normal	Max (all flowmeters open)
Qs	Actual Flow to Plant Exhaust Syst	33.0 SCFM
	<b>Air compressor size</b>	43 SCFM
	Air Compressor pressure rating	60 psig
	Air compressor size, ACFM	8.4 ACFM
	Air Compressor pressure rating	90 psig
	Air compressor size, ACFM	6.0 ACFM



 <b>FurnacePros</b> DIVISION OF LOCHABER CORNWALL, INC.	<b>CHANNEL ASSIGNMENTS</b>		DOC NBR: 08-002	802-101700-01	R 0
			MODEL NBR: AG-1524	APVL	
			SERIAL NBR: 1824159102	JCLARK 07/20/08	
			DATE: 07/20/08	SHT 1 of 1	
<b>Controller Module</b> BASE 0,4 Power Supply Processor, B3000 Processor, LCM4 NIC, Ethernet	<b>Part Number</b> 322-094408-01 322-094410-01 322-092246.03 322-092246-04	<b>Electrical</b> Power: 480 VAC Phase: 3 Freq: 60 Hz			
<b>Digital Address 0:</b>					
<b>Channel</b>	<b>Signal</b>	<b>Type</b>	<b>Part Number</b>	<b>Range</b>	<b>Signal Description</b>
CH0	MAIN_POWER_LATCH	DO	322-094401-01	12-140 VAC w/sw	K4 Delay Power OFF, Ref: 802-101770-01
CH1	LAMP_POWER_CTRL				K7 Process Power ON, Ref: 802-101770-01
CH2	spare				
CH3	spare				
CH4	RED_LAMP	DO	322-094401-02	12-140 VAC w/o sw	K15 Light Tower Control, Ref: 802-101775
CH5	YEL_LAMP				K16 Light Tower Control, Ref: 802-101775
CH6	GRN_LAMP				K17 Light Tower Control, Ref: 802-101775
CH7	spare				
CH8	ALARM_HORN	DO	322-094412-01	5-60 VDC	K14 Alarm Horn
CH9	spare				
CH10	spare				
CH11	spare				
CH12	TRANSPORT_MOTION_FAULT	DI	322-094406-01	2.5-16 VDC	K8 Transport Motion Sensor, Ref: 802-101771
CH13	SPEED_FEEDBACK				K11 Transport Motor Tach Feedback, Ref: 802-101771
CH14	PRESSURE_SW_AIR_MANIFOLD				
CH15	spare				
<b>Analog 3: ANALOG I/O</b>					
CH0	T/C TEMPERATURE_ZONE_1	AI	322-094405-01	Thermocouple Input	KA103 Thermocouple Inputs TC1
CH1	T/C TEMPERATURE_ZONE_2				KA203 Thermocouple Inputs TC2
CH2	T/C TEMPERATURE_ZONE_3	AI	322-094405-01	Thermocouple Input	KA303 Thermocouple Inputs TC3
CH3	T/C TEMPERATURE_ZONE_4				KA403 Thermocouple Inputs TC4
CH4	T/C TEMPERATURE_ZONE_5	AI	322-094405-01	Thermocouple Input	KA503 Thermocouple Inputs TC5
CH5	T/C TEMPERATURE_ZONE_6				KA603 Thermocouple Inputs TC6
CH6	T/C TEMPERATURE_ZONE_7	AI	322-094405-01	Thermocouple Input	KA703 Thermocouple Inputs TC7
CH7	T/C TEMPERATURE_ZONE_8				KA803 Thermocouple Inputs TC8
CH8	T/C TEMPERATURE_ZONE_9	AI	322-094405-01	Thermocouple Input	KA903 Thermocouple Inputs TC9
CH9	T/C TEMPERATURE_ZONE_10				KA1003 Thermocouple Inputs TC10
CH10	T/C TEMPERATURE_ZONE_11	AI	322-094405-01	Thermocouple Input	KA1103 Thermocouple Inputs TC11
CH11	T/C TEMPERATURE_ZONE_12				KA1203 Thermocouple Inputs TC12
CH12	ZONE_1_TOP	AO	322-094402-01	0-10 VDC	KA100 Top SCR Signal Control
CH13	ZONE_1_BOT				KA101 Bot SCR Signal Control
CH14	ZONE_2_TOP	AO	322-094402-01	0-10 VDC	KA200 Top SCR Signal Control
CH15	ZONE_2_BOT				KA201 Botop SCR Signal Control
<b>Analog 6: ANALOG I/O</b>					
CH0	ZONE_3_TOP	AO	322-094402-01	0-10 VDC	KA300 Top SCR Signal Control
CH1	ZONE_3_BOT				KA301 Bot SCR Signal Control
CH2	ZONE_4_TOP	AO	322-094402-01	0-10 VDC	KA400 Top SCR Signal Control
CH3	ZONE_4_BOT				KA401 Bot SCR Signal Control
CH4	ZONE_5_TOP	AO	322-094402-01	0-10 VDC	KA500 Top SCR Signal Control
CH5	ZONE_5_BOT				KA501 Bot SCR Signal Control
CH6	ZONE_6_TOP	AO	322-094402-01	0-10 VDC	KA600 Top SCR Signal Control
CH7	ZONE_6_BOT				KA601 Bot SCR Signal Control
CH8	ZONE_7_TOP	AO	322-094402-01	0-10 VDC	KA700 Top SCR Signal Control
CH9	ZONE_7_BOT				KA701 Bot SCR Signal Control
CH10	ZONE_8_TOP	AO	322-094402-01	0-10 VDC	KA800 Top SCR Signal Control
CH11	ZONE_8_BOT				KA801 Bot SCR Signal Control
CH12	ZONE_9_TOP	AO	322-094402-01	0-10 VDC	KA900 Top SCR Signal Control
CH13	ZONE_9_BOT				KA901 Bot SCR Signal Control
CH14	ZONE_10_TOP	AO	322-094402-01	0-10 VDC	KA1000 Top SCR Signal Control
CH15	ZONE_10_BOT				KA1001 Bot SCR Signal Control
<b>Analog 7: ANALOG I/O</b>					
CH0	ZONE_11_TOP	AO	322-094402-01	0-10 VDC	KA1100 Top SCR Signal Control
CH1	ZONE_11_BOT				KA1101 Bot SCR Signal Control
CH2	RIGHT_EDGE_HEAT_1	AO	322-094402-01	0-10 VDC	KA111 Edge Heat 1 Right SCR Signal Control
CH3	LEFT_EDGE_HEAT_1				KA112 Edge Heat 1 Left SCR Signal Control
CH4	RIGHT_EDGE_HEAT_2	AO	322-094402-01	0-10 VDC	KA211 Edge Heat 1 Right SCR Signal Control
CH5	LEFT_EDGE_HEAT_2				KA312 Edge Heat 1 Left SCR Signal Control
CH6	BELT_SPEED_OUTPUT	AO	322-094402-01	0-10 VDC	KA2 Motor Speed Control Signal
CH7	spare				
CH8	not used				
CH9	not used				
CH10	not used				
CH11	not used				
CH12	not used				
CH13	not used				
CH14	not used				
CH15	not used				



**Section 6**  
**DRAWINGS & SCHEMATICS**

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<b>Job/Master</b>	<b>Drawing Nbr.</b>	<b>Title</b>
STD	802-101701-1524	PLC CONFIGURATION
08-002	802-101710-01	TERMINAL BLOCK TB1 ASSIGNMENTS BY ZONE
08-002	802-101710-02	TERMINAL BLOCK TB1 ASSIGNMENTS BY LINE
08-002	802-101750-01	ELEMENT MONITOR SWITCH SETTINGS
STD	802-101770-01	POWER CONTROL SCHEMATIC
STD	802-101771	SCHEM, FRAME WIRING
STD	802-101772	SCH SIGNAL CONTROL WIRING
STD	802-101775	LIGHT TOWER SCHEMATIC
STD	802-101889-01	ELEMENT WIRING



## **7.1 MATERIAL DATA SAFETY SHEETS**

1. Fiberfrax Cements MSDS 042006
2. Fiberfrax Duraboard MSDS 042006
3. Fiberfrax Fibers MSDS 042006
4. Fiberfrax Papers MSDS 042006
5. Magnaform MSDS 050406
6. RTU Silicone Red Hi Temp 042006
7. Kaowool Insulation MSDS 050406

## **1. Fiberfrax Cements MSDS 042006**

## 2. Fiberfrax Duraboard MSDS 042006

## **2. Fiberfrax Duraboard MSDS 042006**

### **3. Fiberfrax Fibers MSDS 042006**

### **3. Fiberfrax Fibers MSDS 042006**

## 4. Fiberfrax Papers MSDS 042006

## **4. Fiberfrax Papers MSDS 042006**

## 5. Magnaform MSDS 050406

## **5. Magnaform MSDS 050406**

## 6. RTU Silicone Red Hi Temp 042006

## **6. RTU Silicone Red Hi Temp 042006**

## 7. Kaowool Insulation MSDS 050406

## **7. Kaowool Insulation MSDS 050406**





**8.1 ORIGINAL RTC OWNERS MANUAL**

Owner's Manual, AG-1500 Infrared Furnace Series, February 1991

**8.2 ORIGINAL RTC SPECIFICATION**

Product Specification, Series AG-1500X Controlled Atmosphere Infrared FurnacePros  
Specification No. RTC-STD-S1511-176 Rev C, August 1990

