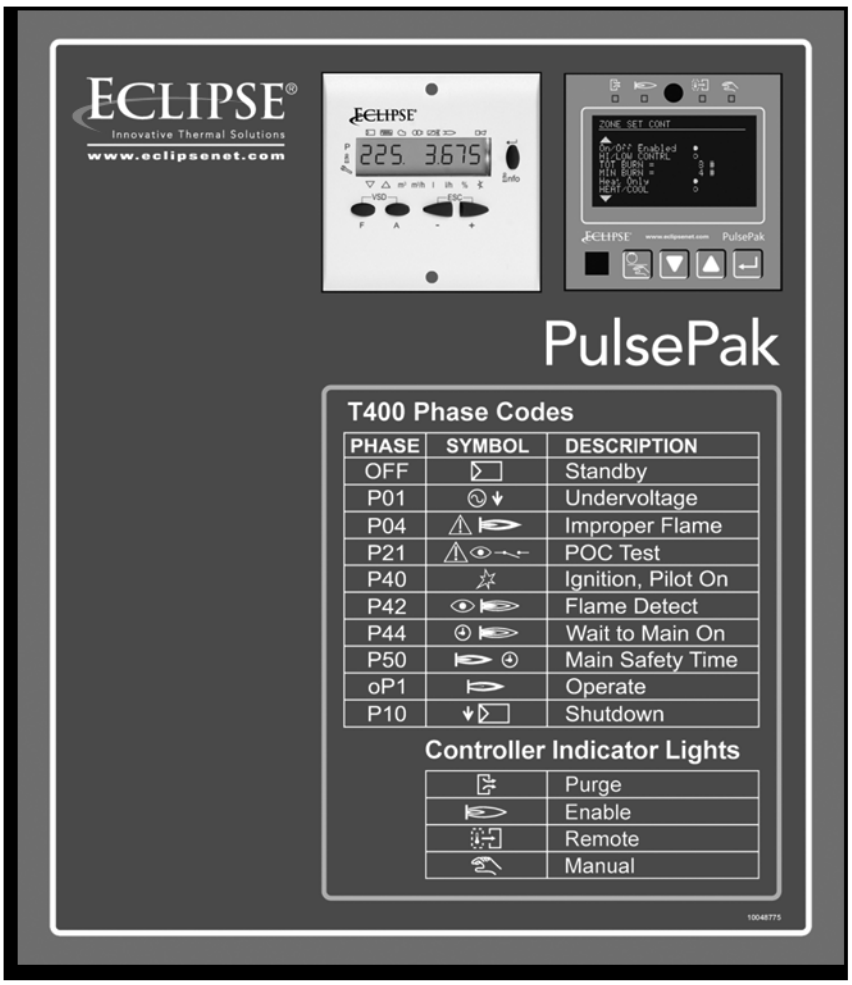
Installation Guide 862-1
3/25/2011

Eclipse PulsePak Zone

Models PZ

Version 1



ECLIPSE®
Innovative Thermal Solutions

Disclaimer Notice

In accordance with the manufacture's policy of continual product improvement, the product presented in this brochure is subject to change without notice or obligation.

The material in this manual is believed adequate for the intended use of the product. If the product is used for purposes other than those specified herein, confirmation of validity and suitability must be obtained. Eclipse warrants that the product itself does not infringe upon any United States patents. No further warranty is expressed or implied.

Liability & Warranty

We have made every effort to make this manual as accurate and complete as possible. Should you find errors or omissions, please bring them to our attention so that we may correct them. In this way we hope to improve our product documentation for the benefit of our customers. Please send your corrections and comments to our Marketing Communications Manager.

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Any operation expressly prohibited in this manual, any adjustment, or assembly procedures not recommended or authorized in these instructions shall void the warranty.

Document Conventions

There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows below. Please read it thoroughly.

	This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.
DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Is used to address practices not related to personal injury.
NOTE	Indicates an important part of text. Read thoroughly.

Table of Contents

Table of Contents

Introduction 1

Product Description

The Eclipse PulsePak offers a modular and scalable approach to pulse-fire control applications. With integrated flame safeguard, temperature control, and pulse-firing of burners in each zone; the PulsePak is the most complete and scalable pulse solution available for your application.

Each temperature zone on your furnace or oven is controlled by its own PulsePak Zone Controller. Each controller provides you with independent, closed-loop, auto-tuned PID temperature control with integrated pulse-firing for up to eight (8) burners per zone. No additional PLC or programming is required to achieve pulse control; the unit is ready “out of the box” to interface to your furnace control.

Multiple PulsePak Zone Controllers can communicate via Profibus® DP or Modbus to provide an integrated furnace control solution.

Each burner on your furnace is controlled by a PulsePak Burner Controller which interfaces to the PulsePak Zone Controller. The burner controller fires the burner per the prescribed pulse algorithm you select at the zone controller, plus it offers state-of-the-art flame safeguard protection with the Eclipse Trilogy T400 Flame Safeguard.

Figure 1.1. PulsePak Zone

Audience

This manual has been written for people who are already familiar with all aspects of a burner system and its add-on components, also referred to as “the burner system”.

These aspects are:

- Design/Selection
- Use
- Maintenance

The audience is expected to have previous experience with this type of equipment.

PulsePak Documents

Installation Guide No. 862

- This document

Datasheet, Series No. 862

- Available for individual PulsePak models
- Required to complete installation

Design Guide No. 862

- Used with Datasheet to complete installation

Worksheet No. 862

- Required to provide application information to Eclipse Engineering

Related Documents

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Info Guides:
  - Instruction Manual 830-1 (T400)
  - Quick Guide 830 (T400)
  - Data 841
  - Drawing 10050014

Purpose

The purpose of this manual is to ensure that you carry out the installation of a safe, effective, and trouble free combustion system.

Safety 2

Important notices about safe operation will be found in this section. Read this entire manual before attempting to start the system. If any part of the information in this manual is not understood, contact Eclipse before continuing.

Safety Warnings

DANGER

- **Read entire manual before attempting to start this system. If you do not understand any part of the information contained in this manual, contact Eclipse before continuing.**

- **The safety of this device is only ensured when the device is used correctly for its intended purpose within the limits and environmental conditions that have been specified. Any application beyond these limits is prohibited. Claims of any kind against the manufacturer, for damages resulting from misuse of the instrument are precluded, liability is limited to the user.**

- **The user is responsible for keeping the operating manual in the immediate vicinity of the instrument and always accessible for the operating personnel.**

- **All electrical wiring must conform to local standards. See the "Specifications" section for more details.**

Capabilities

Adjustment, maintenance and troubleshooting of the mechanical and the electrical parts of this system should be done by qualified personnel with good mechanical aptitude and experience with combustion equipment.

Operator Training

The best safety precaution is an alert and trained operator. Train new operators thoroughly and have them demonstrate an adequate understanding of the equipment, its operation and any related hazards. A regular retraining schedule should be administered to ensure operators maintain a high degree of proficiency.

Replacement Parts

Order replacement parts from Eclipse only.

Specifications 3

General Technical Data

Parameter	Specifications
Power Supply	120 or 230 VAC, 1PH, 50/60 Hz
Power Consumption	2A (Panel with Ignition Transformer On, Refer to Valve Datasheet for Valve Train current draw)
Ambient Temperature	32°F to 122°F (0°C to 50°C)
Enclosure Rating	NEMA 12
Dimensions	16" High x 14" Wide x 8" Deep (406 x 356 x 203 mm)
Weight	50 lbs (22 kg)
Flame Monitor	No Purge
Flame Sensor	Flame rod UV Scanner Self-Check UV Scanner (North America Only)
Ignition Transformer	Included
Start Signal	120 VAC or 230 VAC (same as power supply)
Annunciation	Equipped with HMI and Remote Display
Temperature Control	Included - PID with Heat Only or Heat/Cool modes
Remote Setpoint	4-20 mA or Host Communication
Remote Firing Rate (Load)	4-20 mA or Host Communication
Temperature High Limit Control	Selectable - FM or SIL
Host Communication	Profibus or Modbus
PulsePak Burner Communication	CANBUS Only
Standard Alarm Outputs	All Burners Off, Zone in Manual, Zone Fail, Burner Fail
Optional Alarm Outputs	Hi Temp, Lo Temp, Hi Deviation, Cycle Alarm

Installation 4

In this section you will find the information and instructions that you need to install the PulsePak Zone Packaged Burner Option.

Handling

- Make sure that the area is clean.
- Protect the components from the weather, damage, dirt and moisture.
- Protect the components from excessive temperatures and humidity.
- Take care not to drop or damage components.

Storage

- Make sure that the components are clean and free of damage.
- Store the components in a cool, clean, dry room.
- After you have made sure that everything is present and in good condition, keep the components in the original package as long as possible.

NOTICE

- **It is critical that the instructions for handling and storage are followed. The PulsePak Zone should be considered fragile; improper handling and storage will cause premature failure.**

Approval of Components

Limit Controls & Safety Equipment

All limit controls and safety equipment must comply with all applicable local codes and/or standards and must be listed for combustion safety by an independent testing agency. Typical application examples include:

- American: NFPA 86 with listing marks from UL, FM, CSA
- European: EN 746-2 with CE mark from TuV, Gastec, Advantica

Electrical Wiring

All the electrical wiring must comply with all applicable local codes and/or standards such as:

- NFPA Standard 70
- IEC60364
- CSA C22
- BS7671

Gas Piping

All the gas piping must comply with all applicable local codes and/or standards such as:

- NFPA Standard 54
- ANSI Z223
- EN 746-2

Where to Get the Standards:

The NFPA Standards are available from:
National Fire Protection Agency
Batterymarch Park
Quincy, MA 02269
www.nfpa.org

The ANSI Standards are available from:
American National Standard Institute
1430 Broadway
New York, NY 10018
www.ansi.org

The UL Standards are available from:
333 Pfingsten Road
Northbrook, IL 60062
www.ul.com

The FM Standards are available from:
1151 Boston-Providence Turnpike
PO Box 9102
Norwood, MA 02062
www.fmglobal.com/approvals

Information on the EN standards and where to get them is available from:
Comité Européen de Normalisation
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196811
Fax: +32-25196819
www.cen.eu

Comité Européen de Normalisation Electronique
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196871
Fax: +32-25196919
www.cenelec.org

PulsePak Zone Panel Mounting

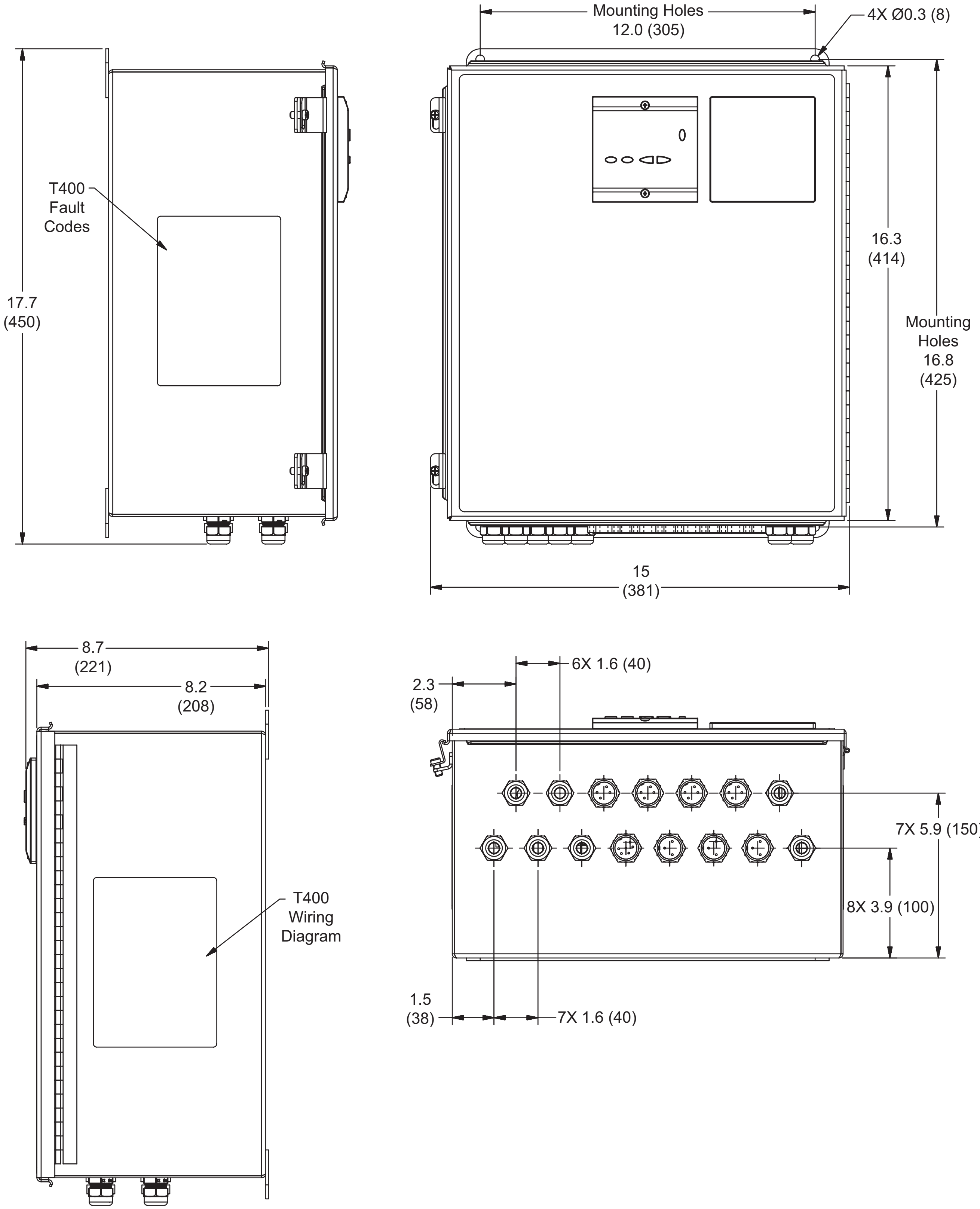


Figure 4.1.

PulsePak Zone Components

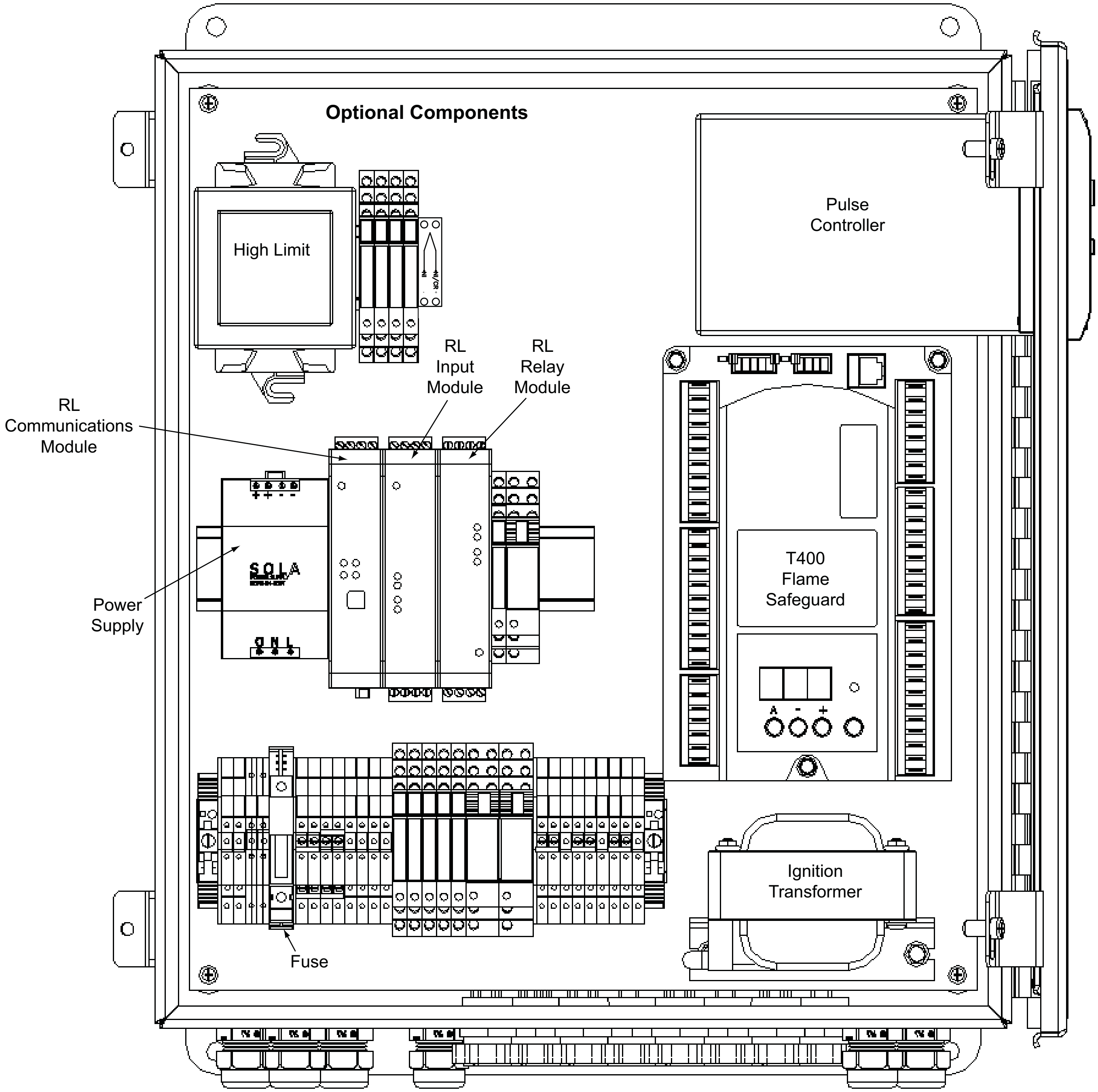


Figure 4.2.

Pulse Controller

Eclipse PN:
10049572 (Profibus)
10049573 (Modbus)
10050246 (No host communication)

For additional Product information, see:
http://www.pma-online.de/en/products/ks98-1.html

T400 Flame Safeguard

Eclipse PN:
10042540 (120V)
10042544 (230V)

For additional product information, see:
T410 Instruction Manual 830-1
Bulletin 830C
T400 Quick Guide 830

Ignition Transformer

Eclipse PN:
22967 (120V)
10005352 (230V)

For additional product information, see:
Data 841

RL Modules

Eclipse PN:
10049574 (Communications module)
10049575 (Input Module)
10049576 (Relay Module)

For additional product information, see:
http://www.pma-online.de/en/products/rl400.html

Power Supply

Eclipse PN:
10049577

For additional product information, see:
http://www.solahd.com/products/powersupplies/sdp.htm

High Limits (Optional)

Eclipse PN:
10049578 (FM approved, also with UR, cUR, CE, UL)

For additional product information, see:
http://www.west-cs.com/
ProductSpec.aspx?id=1018&taxonomyid=139

Eclipse PN:
10050226 (SIL approved - 120V, also with CE)
10050228 (SIL approved - 230V, also with CE)
For additional product information, see:
http://www3.jumo.de/pio/JUMO/en_UK/cat/
ee159f9b0a090a052d21932ae570ea02/temperature-monitors---limiters.html

For additional Part numbers, documentation or for replacement parts, contact Eclipse.

NOTE: To ensure correct product configuration, order replacement parts from Eclipse only.

PulsePak Zone & Burner Panel Wiring

There are a number of wiring connections required during installation. See supplied electrical drawings for additional details regarding wiring connections. Additional controls are required to provide the zone panel with a pulse enable signal. Interlocks and purge signals are also handled externally.

NOTE: Handling of Interlock and Purge signals is to be done in accordance to local codes. See the Approval of Components section for additional information on safety codes.

NOTE: General wiring "Best Practices" should be followed. For example low voltage wiring (signal, communications, etc.) should not be run in the same conduit as high voltage wiring (power, ignition cables, etc.).

A general overview of required wiring connections can be seen below.

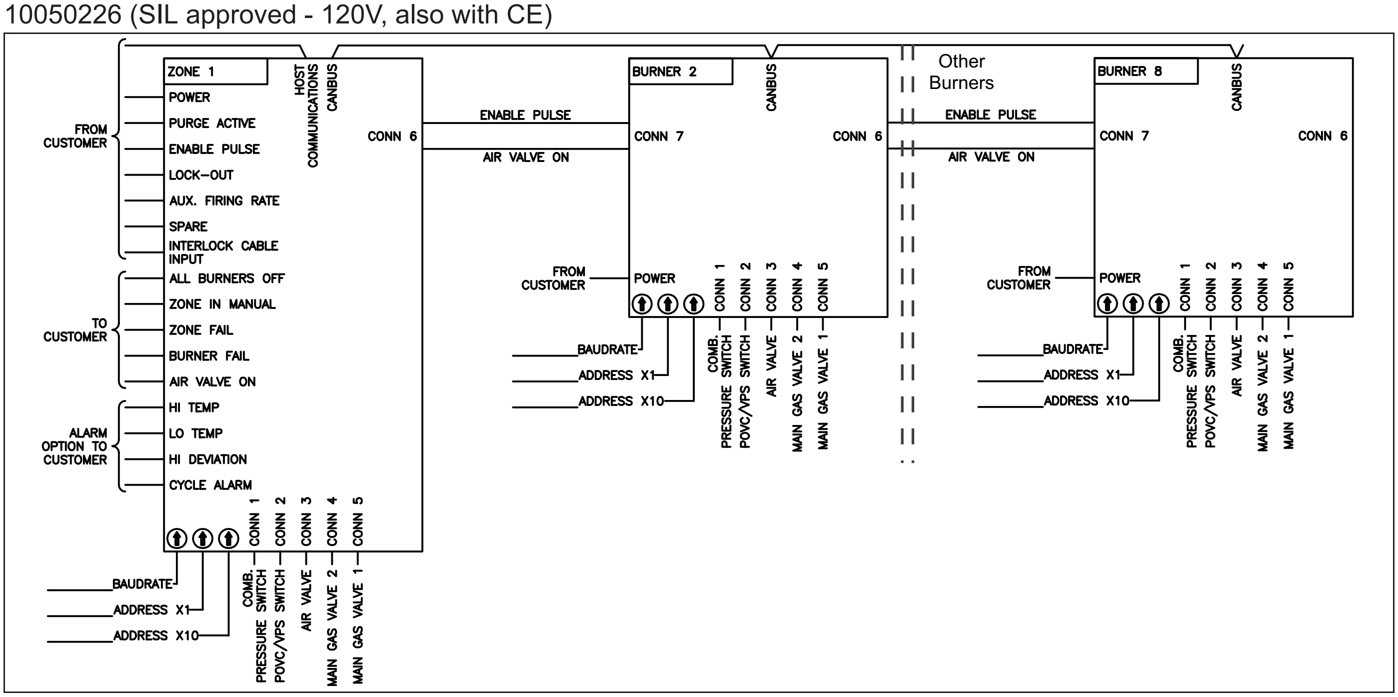


Figure 4.3.

Connections

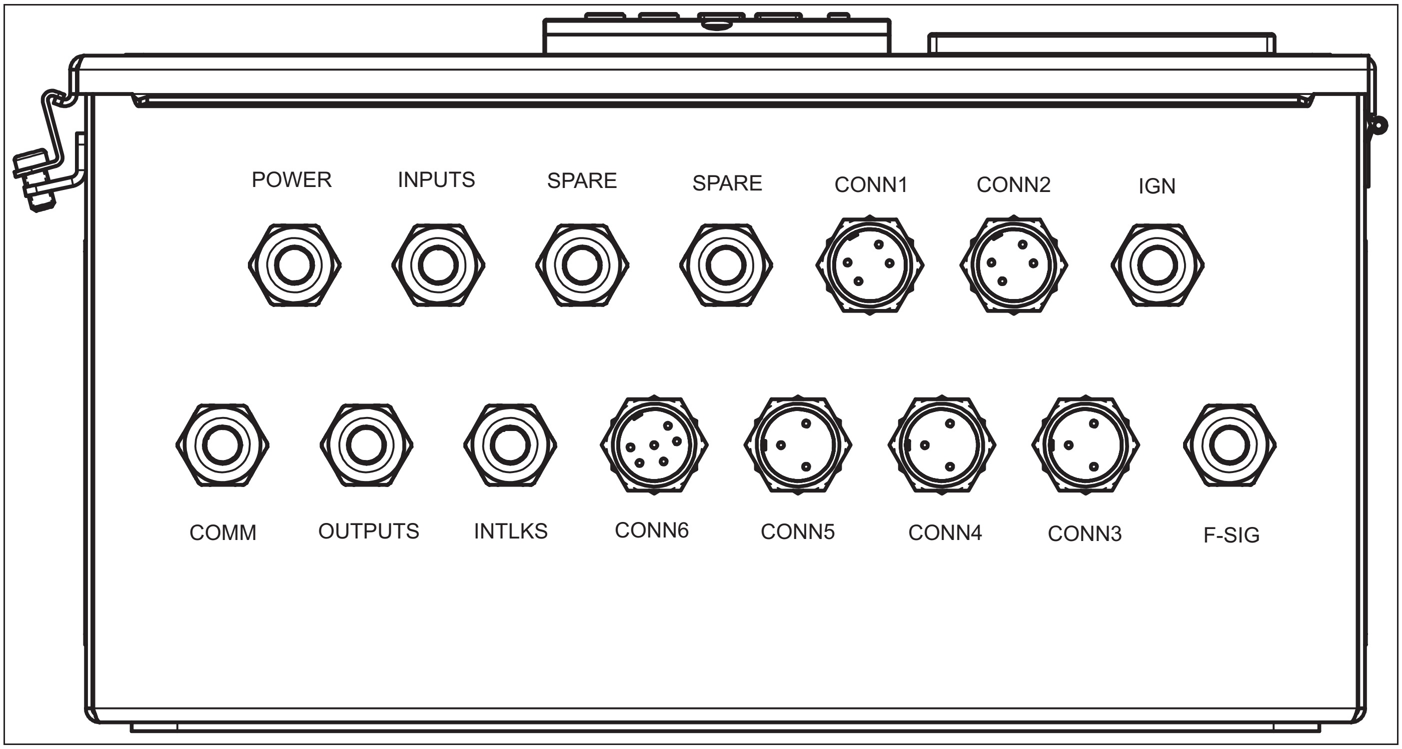


Figure 4.4.

All cable connections are located at the bottom of the panel. The diagram above identifies each cable connection location. CONN 1 through CONN 6 have connectors for Brad Harrison Cables. See Data Sheets 862-1 or 862-2 for cable ordering information. The remaining connections can be brought in to or out of the panel using the supplied cord grip connectors. If required the cord grip connectors may be replaced with conduit fittings.

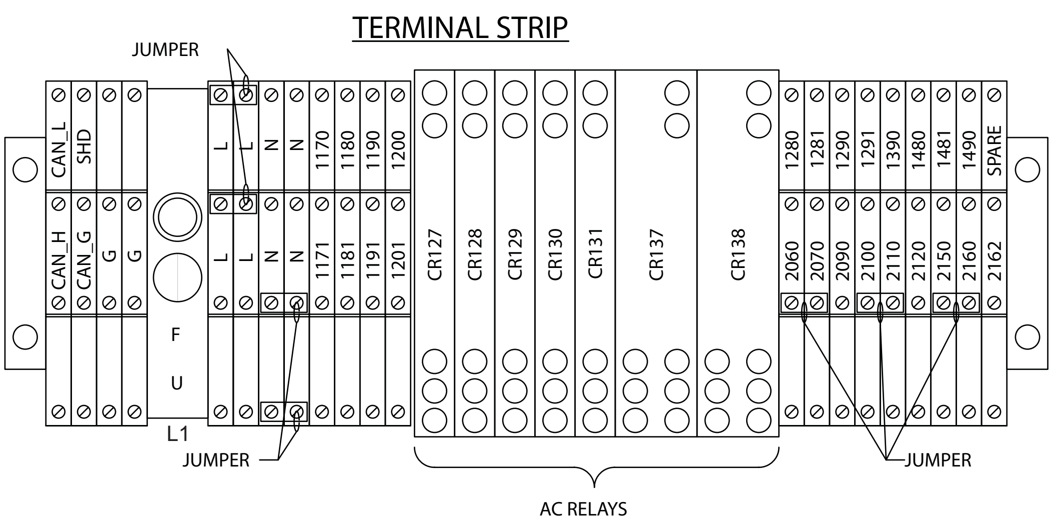


Figure 4.5.

Power Cable

Power is supplied to the G, L1 & N terminals and must be 120 or 230 VAC, 1 Phase, 50/60 Hz as specified when ordered.

Input Cable

There are several required input signals along with some optional signals. They are as follows:

Purge Active

The purge active input is controlled external to the zone pack. When the input goes high, all air valves are turned on and gas valves are locked out. This is a line voltage input (120 or 230VAC) that is wired to terminals A1 and A2 of CR127 (relay coil).

Pulse Enable

The pulse enable (start) signal is required to operate the burners. This signal could be fed directly from the users interlock circuit or there might be additional logic that controls the Pulse Enable signal. This is a line voltage input (120 or 230VAC) that is wired to terminals 1280 and A2 of CR128 (relay coil).

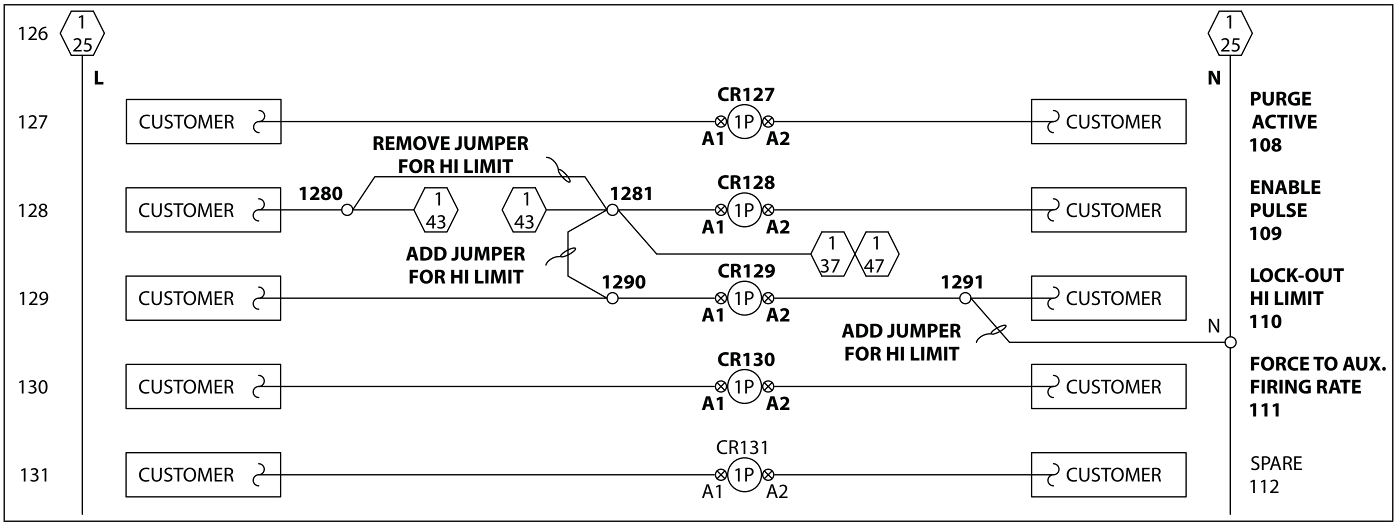


Figure 4.6.

If the panel was ordered with the internal high limit, the jumper between 1280 and 1281 has been removed and jumpers have been placed from 1281 to 1290, and from 1291 to Neutral. This will feed the pulse enable signal through the High limit device. See detail in Figure 4.6.

Lock Out/Hi Limit

The lockout signal must be high for the controller to operate. This is typically used with an external high limit and is not used when using the internal high limit. This is a line voltage input (120 or 230 VAC) that is wired to terminals 1290 and 1291.

Aux Firing Rate

A signal at this input will force all burners to the auxiliary rate. See Zone Settings. This is a line voltage input that is wired to terminals A1 and A2 of CR130 (relay coil).

CONN1 - COMB Air Switch

When using an air switch, a Brad Harrison cable is used to connect the panel (CONN1) to the switch. It will be necessary to remove the jumper between 2060 and 2070. See Figure 4.5.

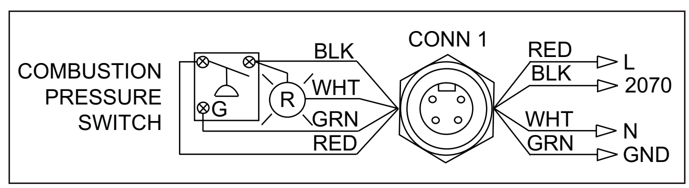


Figure 4.7.

CONN2 -POVC Switch

When using a Proof of Valve Closure Switch (POVC), remove the jumpers between 2090 and 2100 plus 2110 and 2120. Add a jumper between 2100 and 2110. See detail in Figure 4.8.

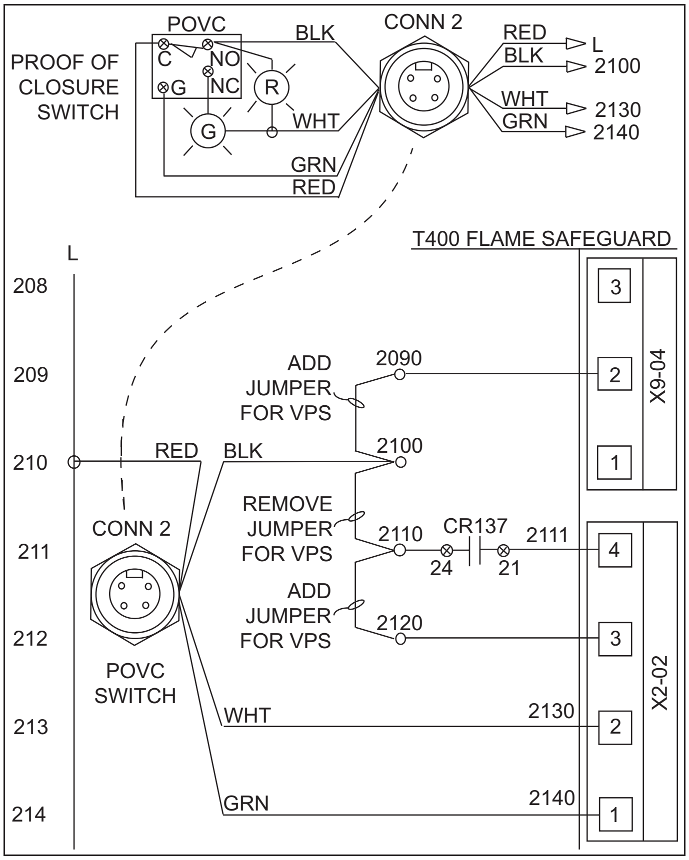


Figure 4.8.

IGN Cable

The IGN output connection is used to run the high voltage cable from the ignition transformer to the burner ignitor. The cable plugs directly into the ignition transformer.

F-SIG Cable

The flame rod or UV wires can be fed through the F-Sig cord grip. These are wired directly to the T410. A UV scanner is wired to X10-06 Terminals 1 & 2. A flame rod is wired to X10-5 Terminals 1 & 2. See Instruction manual 830-1 and Data 830-1 and 830-2 for additional info.

CONN3-Air Valve; CONN4-Gas Valve 2; CONN5-Gas Valve 1:

Air and gas valves are connected to CONN 3, CONN4 and CONN 5 using Brad Harrison Cables. CONN 3 goes to the Air Valve. CONN 4 goes to gas valve 2 and CONN 5 goes to gas valve 1.

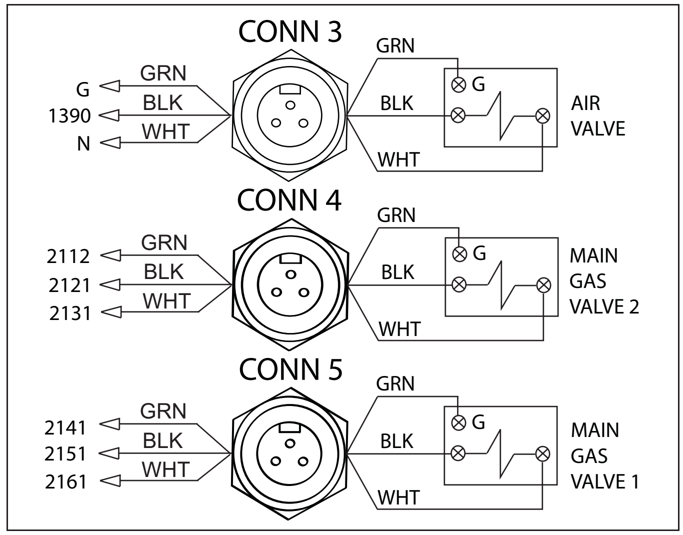


Figure 4.9.

INTLKS/CONN6:

Interlock Cable Input (Air Interlocks)

The air interlocks circuit gives the user the ability to monitor the air switches of all burners in the zone. The interlock loop from the customer panel should be wired directly to terminals 1480 and 1490. The zone panel outputs the signal (along with a hard wired pulse enable signal), to CONN6. The signals are brought into each burner panel through CONN7 and back out through CONN6, as shown in Figure 4.3. The last burner panel (Burner 8 for an 8 burner system) should include a jumper between 1481 and 1490 to complete the circuit. See Terminal Strip, Figure 4.5. This is one possible method used to verify purge.

Output Cable

There are four standard relay outputs along with four optional relay outputs. The standard outputs are "All Burners Off", "Zone in Manual", "Zone Fail" and "Burner Fail".

All Burners Off

The "All Burners Off" relay will close when the burners shut off due to either a High Temp or a High Deviation Alarm, or if the burners go into a cooling mode. This output can be used to determine if a purge is required before the burners restart. Terminals 1170 and 1171 are used for this output.

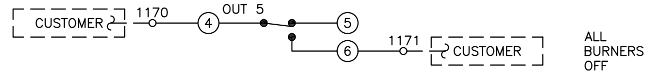


Figure 4.10.

Zone in Manual

The "Zone in manual" relay will close if the temperature controller is put into manual mode, thus overriding the temperature setpoint. Terminals 1180 and 1181 are used for this output.

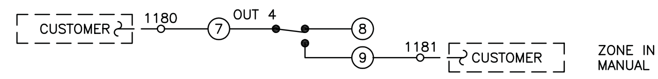


Figure 4.11.

Zone Fail

The "Zone Fail" relay contact closes in conjunction with the zone fail alarm. This is triggered when the active burner count falls below the minimum burner count. If desired, this can be wired to the interlocks or Pulse enable circuit to shut down all burners when the alarm is triggered. Terminals 1190 and 1191 are used for this output.

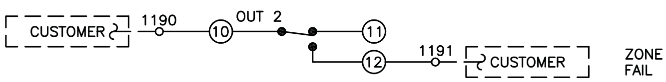


Figure 4.12.

Burner Fail

The "Burner Fail" relay contact closes when any of the enabled burners fail (T400 Alarm). Terminals 1200 and 1201 are used for this output.

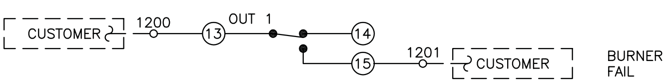


Figure 4.13.

Optional Outputs

The optional outputs are "High Temp", "Low Temp", "High Deviation" and "Cycle Alarm".

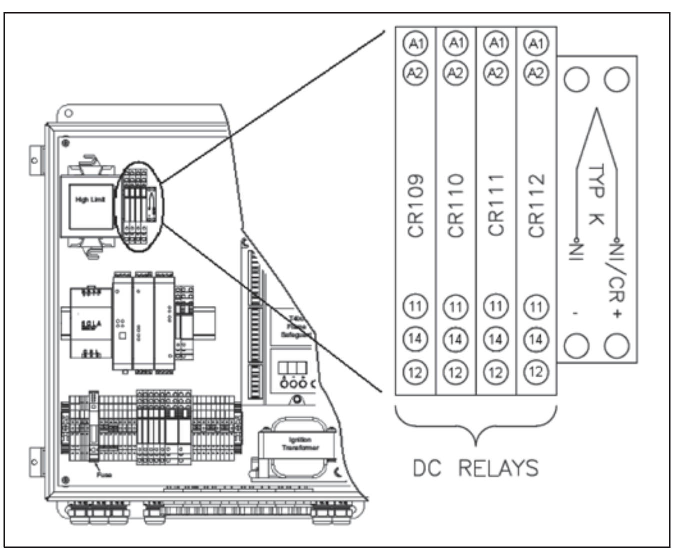


Figure 4.14.

High Temp

The "High Temp" relay contact is activated when a high temp alarm is triggered (See Alarms). The output can be wired directly to CR109, see Figure 4.14. For Normally Open, wire to terminals 11 and 14. For Normally Closed, wire to 11 and 12.

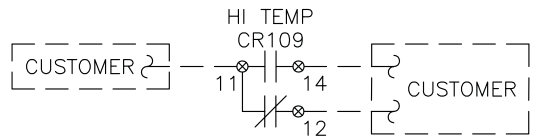


Figure 4.15.

Low Temp

The "Low Temp" relay contact is activated when a low temp alarm is triggered (See Alarms). The output can be wired directly to CR110, see Figure 4.14. For Normally Open, wire to terminals 11 and 14. For Normally Closed, wire to 11 and 12.

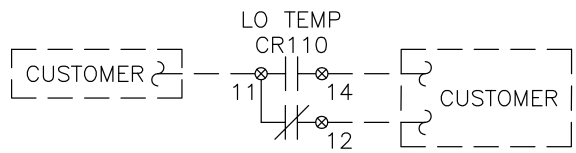


Figure 4.16.

High Deviation

The "High Dev" relay contact is activated when a high deviation alarm is triggered (See Alarms). The output can be wired directly to CR111, see Figure 4.14. For Normally Open, wire to terminals 11 and 14. For Normally Closed, wire to 11 and 12.

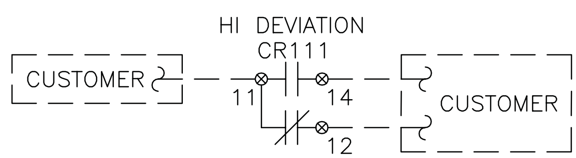


Figure 4.17.

Cycle Alarm

The "Cycle Alarm" relay contact is activated when a cycle alarm is triggered (See Alarms). The output can be wired directly to CR112, see Figure 4.14. For Normally Open, wire to terminals 11 and 14. For Normally Closed, wire to 11 and 12.

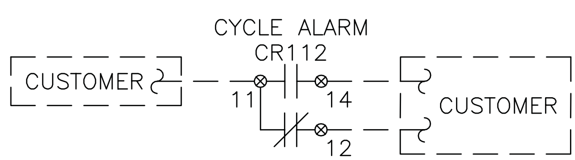


Figure 4.18.

Thermocouples:

Type K is the default thermocouple type. Contact Eclipse if another thermocouple type is required. When wiring thermocouples into the panel, it is very important that the correct thermocouple type is used and polarity is correct. Different regions of the world use different color codes for K type thermocouples. Below is a chart describing thermocouple color codes and polarity.

Type K Thermocouple Color Code			
Country	**Jacket Color**	**Lead Color**	**Lead Polarity**
USA Canada	Brown	Yellow	+
		Red	-
USA Canada	Yellow	Yellow	+
		Red	-
International	Green	Green	+
		White	-
International	Blue	Green	+
		White	-
Czech British	Red	Brown	+
		Blue	-
Netherlands German	Green	Red	+
		Green	-
Japanese	Blue	Red	+
		White	-
French	Yellow	Yellow	+
		Purple	-

Figure 4.19.

The control thermocouple can be wired directly to the pulse controller. The thermocouple is wired to terminals 15 (Negative lead) and 16 (Positive lead). See connection diagram below at the end of this section.

If the FM high limit option was selected, the thermocouple can be wired directly into a thermocouple terminal block next to the high limit. The terminals are labeled with positive and negative.

If the SIL high limit option was selected, there are two separate thermocouples that need to be wired in. Both thermocouples are wired directly into the high limit. The first thermocouple is wired into terminals 1 and 2. Terminal 1 is negative and terminal 2 is positive. The second thermocouple should be wired into terminals 3 and 4. Terminal 3 is negative and terminal 4 is positive.

WARNING

- **Thermocouple wires that make contact at any point other than the desired measurement location will result in a temperature reading at the point of contact. If this occurs outside the furnace, the temperature controller will essentially be disabled.**

REM SP / External Load %

A remote set point can be sent to the PulsePak Zone via an analog input. This is a 4-20 mA signal that is wired to terminals A5 and A6 on the pulse controller. Alternately, an external load % can be sent to the PulsePak zone controller via an analog input as well. This is also a 4-20 mA signal that is wired to terminals A9 and A10 on the pulse controller. Only one of these inputs can be used at any given time. See the Zone Settings section for more information.

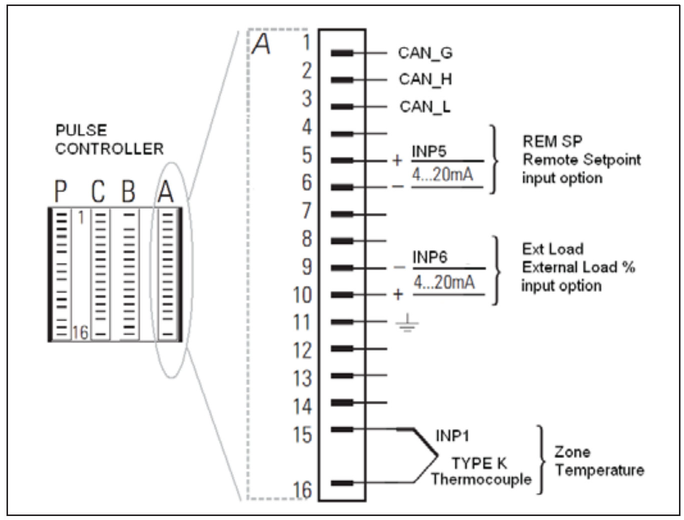


Figure 4.20.

COMM

The Comm input/output connection is used to run communication into and/or out of the panel. Canbus is used to communicate between the zone panel and the burner panels. The PulsePak Zone can also communicate with a Furnace Master PLC via PROFIBUS or MODBUS communication protocols (as ordered). Recommended Communication Cables are as follows:

CANBUS - BELDEN 7896A Multi-Conductor - DeviceBus® for ODVA DeviceNet™

PROFIBUS - BELDEN 3079A Multi-Conductor - DataBus® ISA/SP-50 PROFIBUS Cable

MODBUS - BELDEN 8777 Multi-Conductor - Shielded Twisted Pair Cable

The CANBUS cable that runs between the Zone and Burner panels can be connected to the CAN_H, CAN_L and CAN_G terminal blocks. See Terminal Strip on page 12. Profibus and Modbus cable from the PLC can be connected directly to terminals B12-16 on the pulse controller. RS422 and RS485 are used for Modbus. See detail below for wiring of the various types of protocols.

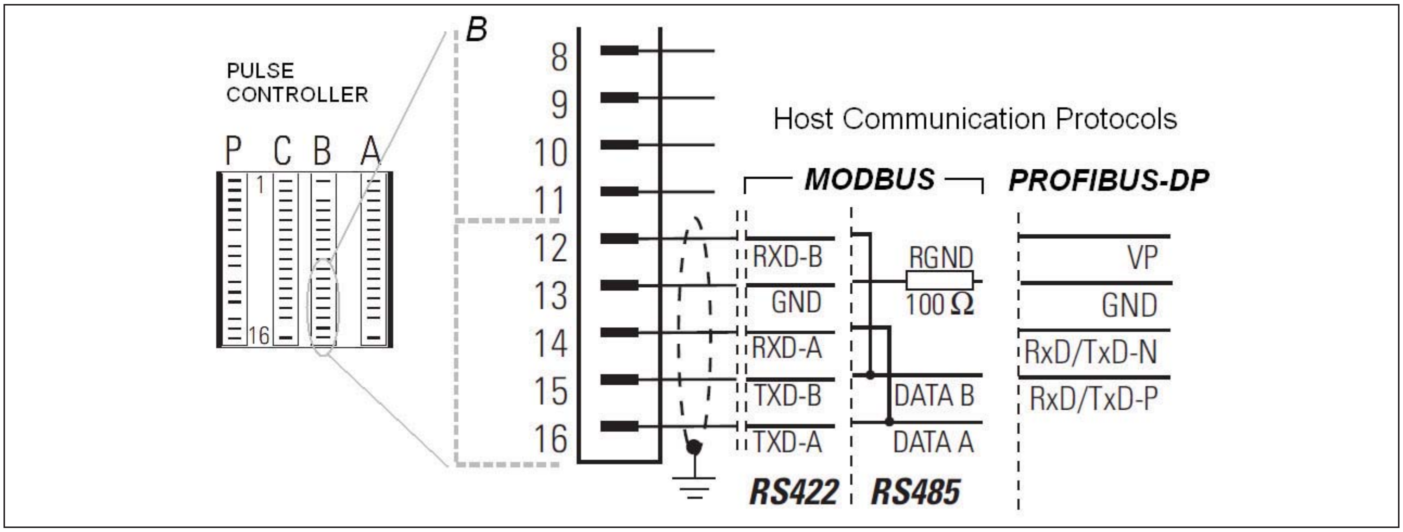


Figure 4.21.

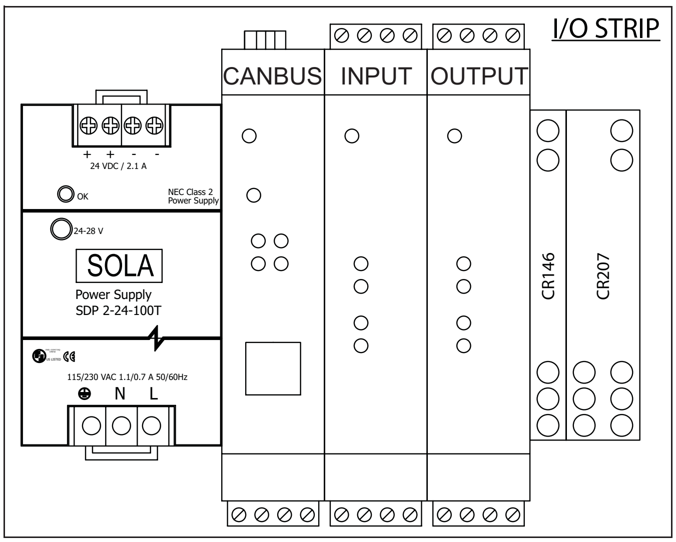


Figure 4.22.

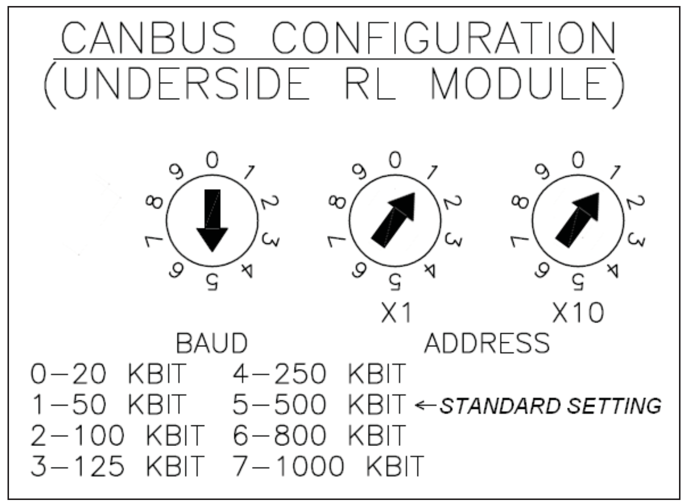


Figure 4.23.

Zone/Burner Pack Communcation, RL Modules (I/O)

Address

Communication between the Zone panel and Burner panels is done using Canbus. The PulsePak Zone Controller is the Master and is assigned to an Address (ID/Node) = 1. Burner 1 is assigned to an address of 11. Burner 2 is assigned to 12, and continuing up to Burner 8 should be assigned to 18. The burner address is set by adjustment of two rotary dip switches on the RL Communication Module. The switch with the “X10” indication should always be set to 1. The switch with the “X1” designation should range from 1 to 8 (1 for address 11, 2 for address 12, etc). If adjusted with power applied, power must be turned off and back on for the new settings to become active.

Baud Rate

The Baud rate by default is set to 500kBit in the pulse controller. The RL Communication modules should also be set to 500kBit by adjustment of the Baud rotary switch. A setting of 5 provides a Baud rate of 500kBit. The pulse controller baud rate can be verified by going to the Device Data screen in the Miscellaneous section. The controller Baud rate is referred to as CAN-Bd. If a baud rate other than 500kBit is desired, the controller Baud rate can be changed here. The RL Communication modules would then need to be adjusted so that the Baud rates match the controller.). If adjusted with power applied, power must be turned off and back on for the new settings to become active.

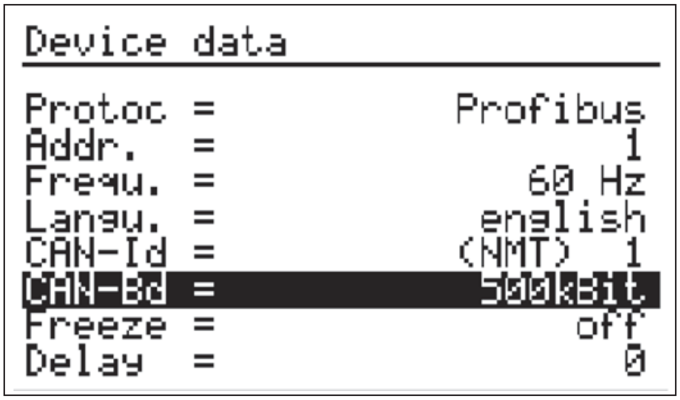
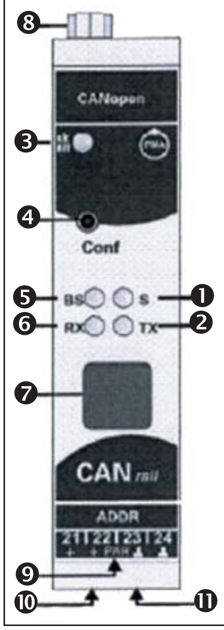


Figure 4.24.

I/O LEDs

There are several LED's on the RL Communication module that indicate proper communication and faults. When communication is taking place between the controller and the RL modules, OK/err (LED# 3) should be solid green. BS (LED#5) and S (LED #1) should be solid yellow. Rx (LED #6) and Tx (LED #2) should blink yellow. If communication is not occurring, BS will blink yellow and there will be nothing on Rx or Tx.

View



	Displays	
1 S	LED	System bus status
	off	off
	Flashing	module scan
	on	communication active
2 TX	LED	CAN - Bus
	on	transmit active
3	LED Device status	
	green	ok
	yellow	initializing
	yellow flashing	configuration mismatch
	red	no configuration
	red flashing	module failure
4	Configuration push button	
5 BS	LED	CAN - Bus status
	off	init
	flashing	Preoperational
	on	Operational
6 RX	LED	CAN-Bus
	on	Receive active
7	PC interface for the engineering tool	

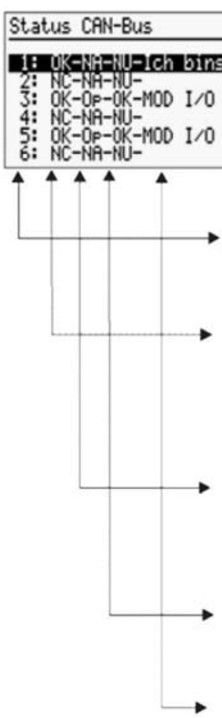
Figure 4.25.

Status

The status of the Can Bus network can be viewed by going to the Status CAN-Bus screen in the Miscellaneous section. Once all addresses and baud rates are set, each assigned address should indicate the following:

OK-Op-OK-RL40-CAN

See below for status indication meanings.



Value	Signification
1.42	Node number
NC	NoCheck: Node existence not checked so far / node not provided
Ck	Check: Node existence just being checked
NR	NoResponse: No reply from this node, but node is required
OK	Ready: Node has replied and is identified
ES	EMStart: Node has provided an emergency message
NA	NotAvailable: Node status is unknown
PO	PreOperation: Node is in the PreOperational status
Er	Error: Node is in error status
Op	Operational: Node is in Operational status
NU	NotUsed: Node is not required by an own lib function
Wa	Waiting: Lib function waits for identification of thise node
Pa	Parameterizing: Lib function just setting the node parameter
OK	Ready: Lib function has finished the parameter setting
String	determined node name

Figure 4.26.

CAN Troubleshooting

Problem	Possible Cause	Solution
No Communication	CAN Network not wired or incorrectly wired	Verify wiring. Ring out CAN high, CAN low, and CAN ground with multi-meter.
	Pulse Controller CAN switch open	Close CAN switch (see CAN switch location below).
	Wrong Model of Pulse Controller or RL Module. Not CANopen models.	Replace with correct parts.
	Baud Rates set incorrectly	Make sure Baud rate of Pulse Controller and RL modules match (500k default).
	Addresses set incorrectly	Make sure RL modules are set to an address of 11-18 and do not share an address with another module.

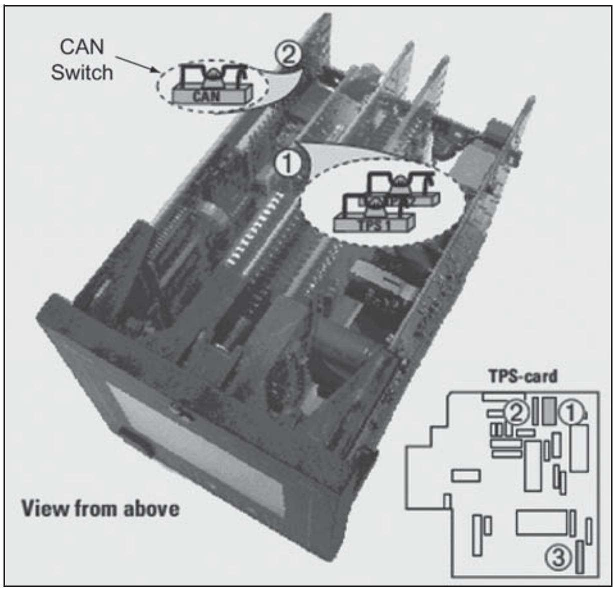


Figure 4.27. CAN Switch Location

Modbus

Before attempting to read or write data to and from the pulse controller, Verify the Protocol, Address and Baud rate are set correctly in the Device Data screen (see the Miscellaneous section).

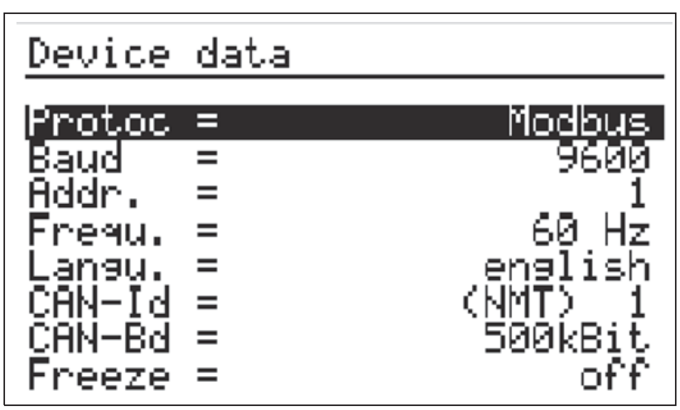


Figure 4.28.

For detailed Modbus information, refer to the following:

http://www.pma-online.de/en/pdf/sb_ks98-1_mod_e_9499-040-88711.pdf

A predefined set of data is available to read and write to from the pulse controller using the following addresses.

Address					
Hex	**Dec**	**Data**	**Range**	**R/W**	**Notes:**
0x0050	80	Gas Open Burners 1-6	0...63	R	* See notes blow
0x0051	81	Gas Open Burners 7-8	0...3	R	* See notes blow
0x0052	82	Temperature	-29999…999999	R	°F
0x0053	83	Effective Set Point	0…2000	R	°F, Local or remote
0x0054	84	Local Set Point	0…2000	R	°F
0x0055	85	Output %	0...100	R	% - Abs(Y Output %)
0x0056	86	Cycle Count	0...999999	R	x1000 Cycles
0x0057	87	Active Burner Count	0-8	R	Enabled/Not in Alarm
0x0058	88	Y Output %	-100...100	R	% , (Neg for Cooling)
0x0059	89	CAN Status D01-6	0...63	R	** See notes blow
0x005A	90	CAN Status D07-8, DI 1-8	0...63	R	** See notes blow
0x0062	98	Air Open Burners 1-6	0...63	R	*See notes below
0x0063	99	Air Open Burners 7-8	0...3	R	*See notes below
0x006B	107	Manual/Reset CNT	0...3	R/W	***See notes below
0x006C	108	Remote Set Point	0...2000	R/W	°F, See Zone settings 2
0x006D	109	External Load %	-100...100	R/W	% ,See Zone settings 2
0x0110	272	Burner 1 Step #	0-8	R/W	See Burner Setup
0x0111	273	Burner 2 Step #	0-8	R/W	See Burner Setup
0x0112	274	Burner 3 Step #	0-8	R/W	See Burner Setup
0x0113	275	Burner 4 Step #	0-8	R/W	See Burner Setup
0x0114	276	Burner 5 Step #	0-8	R/W	See Burner Setup
0x0115	277	Burner 6 Step #	0-8	R/W	See Burner Setup
0x0116	278	Burner 7 Step #	0-8	R/W	See Burner Setup
0x0117	279	Burner 8 Step #	0-8	R/W	See Burner Setup
0x011B	283	Minimum Burner Count	0-8	R/W	See Burner Setup

* Gas and Air open data is presented as an analog value that represents a binary string. If burner 1 Gas is open, it will return a 1. If burners 1, 2 and 4 gas valves are open, a value of 11 is returned (001011 → 0 x 32 + 0 x 16 + 1 x 8 + 0 x 4 + 1 x 2 + 1 x 1 = 11). A value of 63 indicates gas (or air) valves 1-6 are all open (111111 → 32 + 16 + 8 + 4 + 2 + 1 = 63).

** Can status is determined in a similar manner as air and gas valve status. Data is presented as an analog value that represents a binary string. Decimal address 89 gives the digital output status of pulse zone and burner packs 1-6. Decimal address 90 gives the digital output status for burner packs 7-8 along with digital input status for zone and burner packs 1-8. The digital inputs status is grouped for burners 1&2, 3&4, 5&6 and 7&8. A proper connection will return a value of 1 (high) for each input/output. For an 8 burner system, a value of 63 should be read by both Address 89 and 90. A 6 burner system should read 63 for Address 89 and 28 (011100 → 0 + 16 + 8 + 4 + 0 + 0) for address 90.

***Writing an analog value of 1 to decimal address 107 will put the controller in manual mode. A value of 2 will reset the counter. A value of 3 will do both.

MODBus Troubleshooting

Problem	Possible Cause	Solution
No Communication	Modbus Network not wired or Incorrect wiring	Verify Wiring
	Incorrect Protocol	Make sure Modbus was selected under Device Data
	Wrong Model Pulse Controller	Verify Model numbers for pulse controller is a Modbus versions(KS98-1 20-2XXXX-XXX)
	Baud Rates set Incorrectly	Make sure Baud rate of pulse controller and Host PLC Match
	Addresses set Incorrectly	Verify address settings
Incorrect information being sent to pulse controller	Wrong address for function block	Verify address of desired function is correct
	Wrong format of address or data	Verify address and data is in correct format
	Wrong address for function block	Verify address of desired function is correct
	Wrong format of address or data	Verify address and data is in correct format

Profibus

Before attempting to read or write data to and from the pulse controller, Verify the Protocol, Address and Baud rate is set correctly (see Device Data, Figure 4.29).

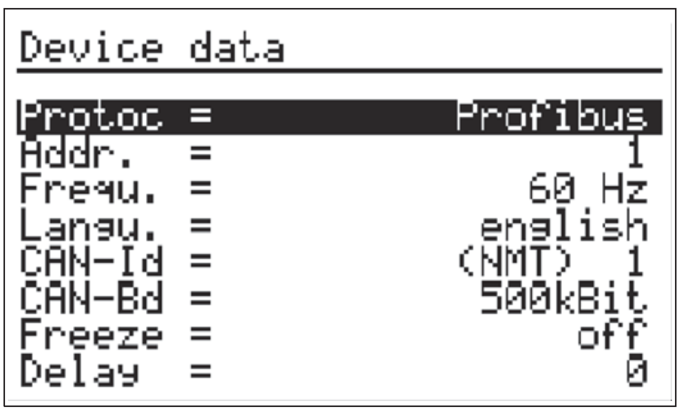


Figure 4.29.

Also verify the DP wire hook switches are closed. This can be done by removing locking screw on the front display panel and pulling the instrument out of the housing. The two wire hook switches are located on the bottom of the instrument.

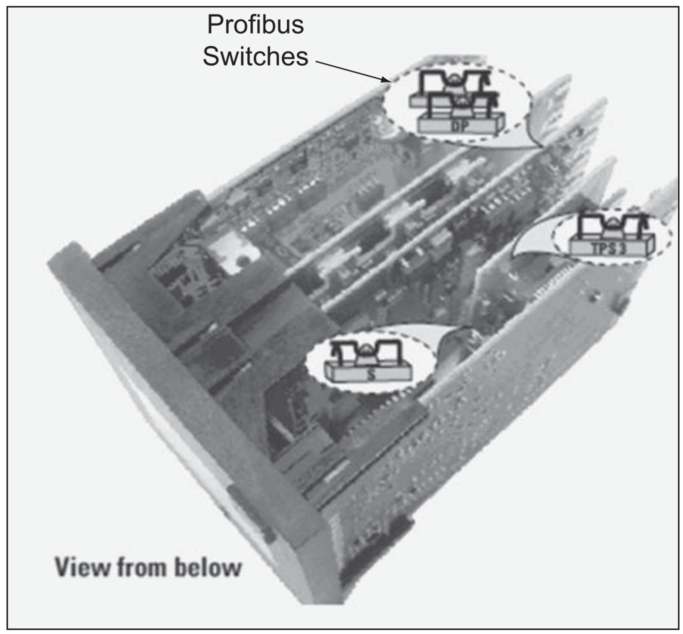


Figure 4.30.

For detailed Profibus information, refer to the following:

http://www.pma-online.de/en/pdf/sb_ks98-1_profibus-dp_e-9499-040-82811.pdf

A GSD file (KS 98 GSD) is also available to download at:

http://www.pma-online.de/en/products/download.html

The GSD file can be used for cyclically transmitted data. Module C should be used to ensure the correct data is transferred.

The data being transferred will be in the following order:

Data	Range	R/W	Notes:
Gas Open Burners 1-8	0...255	R	* See notes blow
Air Open Burners 1-8	0...255	R	* See notes blow
Temperature	-29999…999999	R	°F
Effective Set Point	0…2000	R	°F, Local or remote
Local Set Point	0…2000	R	°F
Output %	-100...100	R	%, (Neg for Cooling)
Cycle Count	0...999999	R	x1000 Cycles
Active Burner Count	0-8	R	Enabled/Not in Alarm
CAN Status D01-8	0...255	R	** See notes blow
CAN Status DI 1-8	0...15	R	** See notes blow
Empty String			
Empty String			
Empty String			
Empty String			
Empty String			
Empty String			
Manual/Reset CNT			***See notes below
External Load %	-100...100	W	% ,See Zone settings 2
Remote Set Point	0...2000	W	°F, See Zone settings 2

* Gas and Air open data is presented as an analog value that represents a binary string. If burner 1 Gas is open, it will return a 1. If burners 1, 2 and 4 gas valves are open, a value of 11 is returned (001011 → 0 x 32 + 0 x 16 + 1 x 8 + 0 x 4 + 1 x 2 + 1 x 1 = 11). A value of 63 indicates gas (or air) valves 1-6 are all open (1111111 → 32 + 16 + 8 + 4 + 2 + 1 = 63).

** Can status is determined in a similar manner as air and gas valve status. Data is presented as an analog value that represents a binary string. The digital output status of pulse zone and burner packs 1-8 are represented by an analog value up to 255. The digital input status for burner packs 1-8 is grouped for burners 1&2, 3&4, 5&6 and 7&8 and is represented by an analog value up to 15. A proper connection will return a value of 1 (high) for each input/output. For an 8 burner system, a value of 15 should be read for digital input status (1+2+4+8=15) and a value of 255 should be returned for the digital output status (1+2+4+8+16+32+64+128=255).

***Writing an analog value of 1 will put the controller in manual mode. A value of 2 will reset the counter. A value of 3 will do both.

Profibus dP Troubleshooting

Problem	Possible Cause	Solution
No Communication	Profibus network not wired or incorrect wiring	Verify wiring
	Wire hook switches open	Verify that switches are closed.
	Wrong Model Pulse Controller Not Profibus models.	Verify Model numbers for pulse controller is a Profibus versions(KS98-1 20-3XXXX-XXX)
	Incorrect Protocol	Make sure Profibus was selected under Device Data
	Baud Rates set Incorrectly	Make sure Baud rate of pulse controller and Host PLC match
	Addresses set Incorrectly	Verify address settings
Incorrect information being sent to pulse controller	Wrong address for function block	Verify address of desired function is correct
	Wrong format of address or data	Verify address and data is in correct format
Incorrect information being sent from pulse controller	Wrong address for function block	Verify address of desired function is correct
	Wrong format of address or data	Verify address and data is in correct format
	Wrong GSD file	Verify correct GSD File is being used

Valve Train Installation

For Valve Train installation, please see Installation Guide 791-2.

WARNING

- **Certain safety features are designed into the complete PulsePak system. Failure to use Eclipse PulsePak Valve Train Segments (dual valves with ratio regulator) and an upstream containment removal system (drip leg, filter, stainer) increases the risk of explosion.**

Operation 5

PulsePak Controller

The operation of the PulsePak Controller is menu-guided and divided into several levels including: Operator Level, Service Level, and Parameter Level (the Parameter Level requires Eclipse Engineering support for access).

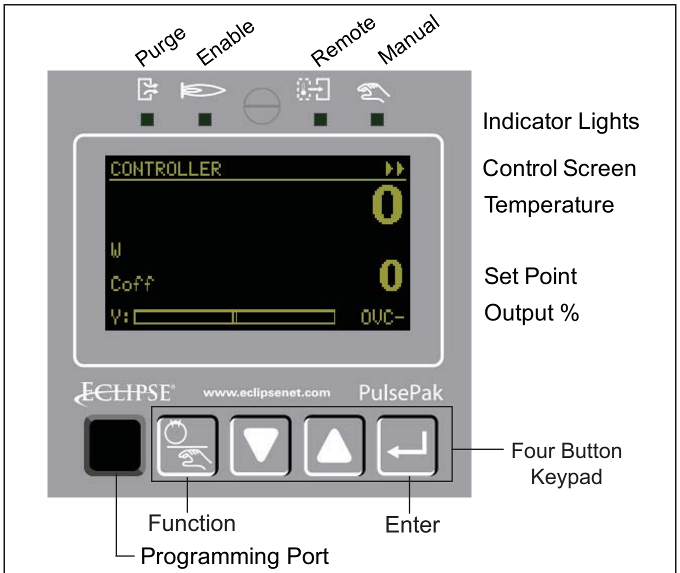


Figure 5.1.

Navigation of the PulsePak controller is done using the Four Button Keypad shown in Figure 5.1.

Button	Function
	**Function / Manual** Auto/Manual Switchover Selection of options
	**Down** One menu level down Decrease an input value
	**Up** One menu level up Increase an input value
	**Enter** Menu selection Input value confirmation

Navigation

Navigation of the controller is done by pressing the Up or Down buttons to select the input field or the desired line. (The selected item will be shown highlighted.)

Confirm selection by pressing the Enter button. This will either select the next menu level or menu item that is highlighted. If the selection is an on-off switch, push button, or selection list the Function button must be used to select the field.

- If the selected item is a menu level, the next menu will open and navigation can be continued by using the Up and Down keys.
- If an input field was selected, the field will begin blinking.
- If a selection list is selected, the selected item will show a highlighted circle.
- If an on-off switch or push button is selected, the selected item will change the text display.

Continuation or previous menu pages are marked by an arrow at the top or bottom of the menu and can be activated by navigating to the arrow and pressing the Enter key.

Items marked with two arrows pointing to the right opens another menu page when selected.

To exit a page, scroll to the menu item **End** at the bottom of the list or scroll until no input field is highlighted and then press the Enter key.

Adjusting Values

The menu operating pages include several types of fields for adjustment of values. These fields include:

- numerical value
- times
- selection lists
- on/off switches
- push-buttons

Numerical Values and Times

Navigate to the value to be altered using the Up and Down keys. Press the Enter key to select the input field. The field will begin blinking and the required change can be entered using both the Up and Down arrows. As the Up and Down keys are held, the change in value will accelerate faster, the longer the keys are pressed. Confirm the new value by pressing the Enter key. The input field will stop blinking and the alteration is saved.

Selection Lists

Use the up and down arrows and the Function key to pick a selection list option. Selection of the desired field will fill in the adjacent circle and will automatically deselect any other option.

On/Off Switches or Push-Buttons

Use the Function key to activate an on-off switch or push button.

Operating Pages

When the unit is powered on for the first time, the operating pages screen is displayed. The operator has access to the Burner Setup screens, the Controller, the Trend screen, and the Alarm screen.

Burner Setup

The BURNER menus are divided into two groups:

- Burners 1 - 4 (selecting goes to burner 1 setup)
- Burners 5 - 8 (selecting goes to burner 5 setup)

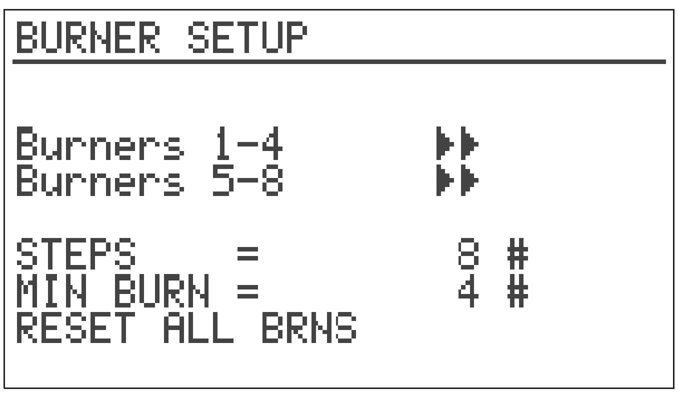


Figure 5.2.

Selecting the up-arrow (▲) changes the screen to the next burner setup screen. There is a total of 8 burner setup screens. If the ▲ is selected in Burner 8 Setup it will cycle back to Burner 1 Setup.

Enable/Disable Burner

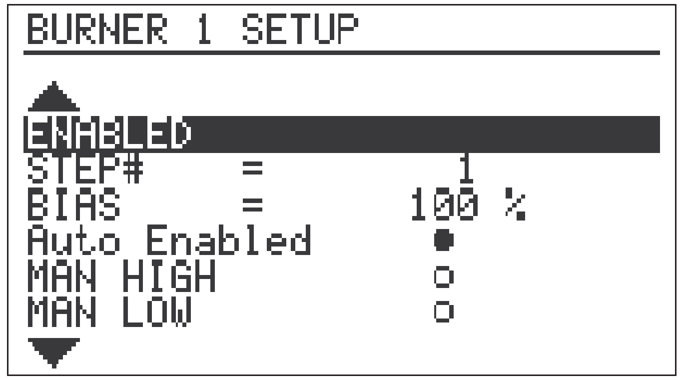


Figure 5.3.

A burner that is enabled is indicated by displaying ENABLED. In order to disable or enable a burner, the option must be selected by pressed the function key. If the burner is disabled, it will display DISABLED. If a zone has less than 8 burners, one or more burners should be disabled. Burner 8 should be disabled first, then burner 7, etc. depending on the number of burners required. When disabling a burner, a step alarm will be displayed if the STEPS # is set higher than the number of enabled burners. If the step alarm is displayed, it might be necessary to change the STEPS# or several of the step assignments.

Step Assignment

The order which burners are fired is determined by the step assignment. The program starts by firing all burners assigned to step 1. It then moves to step 2 and fires all burners assigned to step 2. This continues until it reaches the STEPS # assigned on this screen and then goes back to step 1, where the sequence starts over. The STEPS number set here is the total number of steps required.

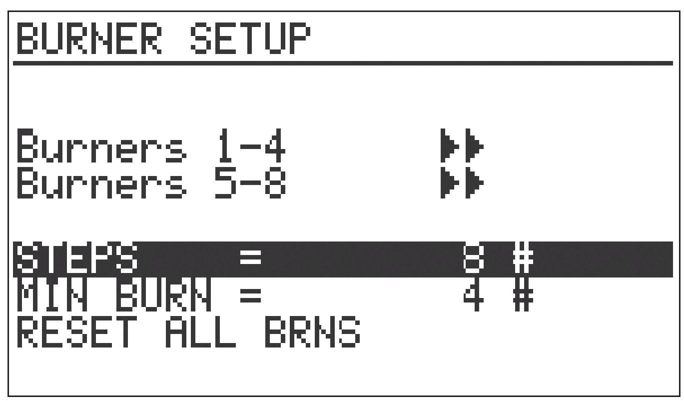


Figure 5.4.

The Number of Steps should be between 2 and 8, as 8 is the maximum number of burners that can be controlled by a zone controller. The number of steps selected is typically the number of burners that are installed in a furnace. However, this can be less than the number of burners installed if more than one burner shares a step.

Example: If the zone has 6 burners and each is set to its own step #, the STEPS should be set to 6. However, suppose the zone has 6 burners and burners 1 and 4 are set to step 1; Burners 2 and 6 are set to step 2; Burner 3 is set to step 3; and burner 5 is set to step 4.

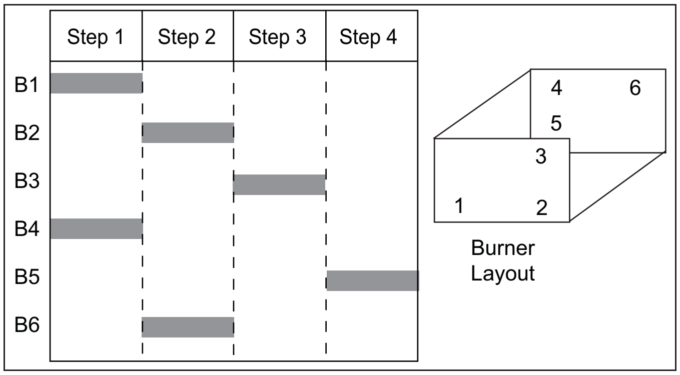


Figure 5.5.

In the example, STEPS # should be set to 4 and burners 7 and 8 should be disabled and their STEP assignment should be set to 0.

A step alarm will occur when the number of steps is greater than active burner count or a burner is assigned to a step # that is greater than the number of steps.

Burners that are not considered active are either in an alarm state or have been disabled.

Minimum Burner Setting

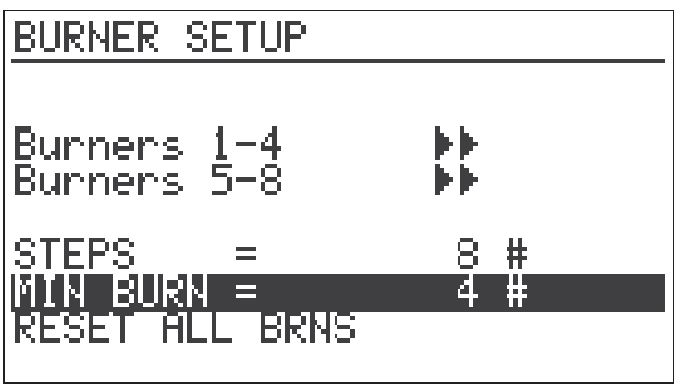


Figure 5.6.

This setting is the minimum number of burners that are required to be active in order to keep a zone functioning. If the zone has 6 burners and the Min. Burn is set to 4. It will operate normally as long as 4 or more burners are active (Enabled and not in alarm). However, if the number of active burners falls below 4, an alarm will display and a relay contact will close (Zone Fail). If desired, this can be wired to the interlocks or the Pulse enable (start signal) circuit to shut down all burners when the alarm is triggered.

Burner Bias Adjustment

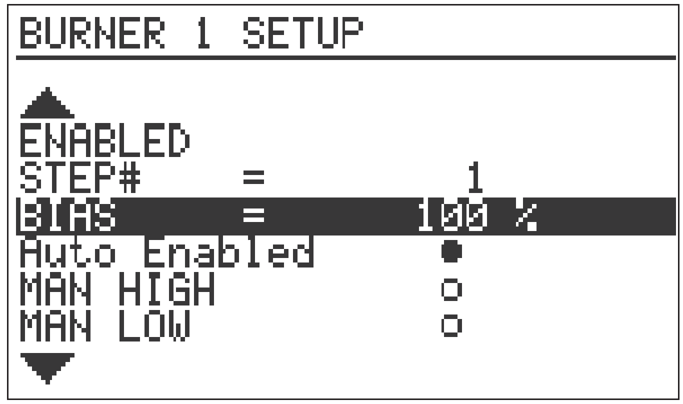


Figure 5.7.

A Burner Bias will allow a particular burner to run longer or shorter than other burners in the zone. A setting of 100% is nominal, while 125% would mean that burner would have an ON time that is 25% longer than nominal. For example if an ON time of 10 seconds is calculated, a setting of 125% would cause the burner to stay on for 12.5 seconds.

If the Bias is less than 100%, the burner will be on for a shorter period of time than what was calculated. For example, with an ON time of 20 seconds, and a bias of 75%, the ON time would be 15 seconds.

In the example, burner two has a bias greater than 100% and Burner 4 has a bias less than 100%.

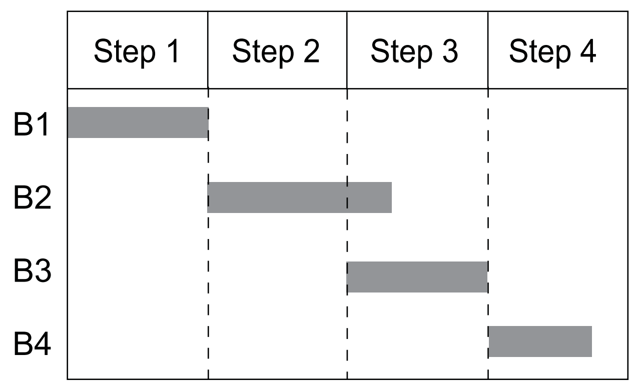


Figure 5.8.

NOTICE

- **When setting minimum On and Off times (see Zone Settings), Bias settings should be considered. The Min. On time will is enforced and a bias (less than 100%) that takes the time below the minimum will be held at the minimum. However, a bias above 100% could cause the minimum off time to fall below the set minimum.**

Burner Mode Setting

Each burner has a selection between Auto, Manual High and Manual Low. Only one of the three states can be selected. The selection is made using the function key.

In auto mode, the pulses are controlled by the controller. This is the default setting.

In MAN HI, the burner is held on regardless of the controller output. This is typically used for tuning a burner at startup, or to provide additional heat to one portion of the zone. It can also be used in some cases as a means to avoid having to purge the furnace if all other burners are off for a long period due to a low demand for heat. Check applicable codes.

NOTICE

- **Setting a burner to MAN HI could cause the furnace to hit a high temp/high limit condition.**

In MAN LOW, the burner is either held off or held low depending on the control method (See “Zone Settings” on page 32.). In Hi/Low mode, the burner is held at low fire. In On/Off Mode, the burner is held off. (Burner remains active.)

Reset all Burners

By selecting the Reset All Brns setting with the function button the controller sends an input to all the T400 flame safety devices in the zone to remove any T400 alarms and restart a burner. This is typically used when a burner fails due to a flame failure. All T400's in alarm will be reset. However, T400's that are not in an alarm state ignore this input.

Controller

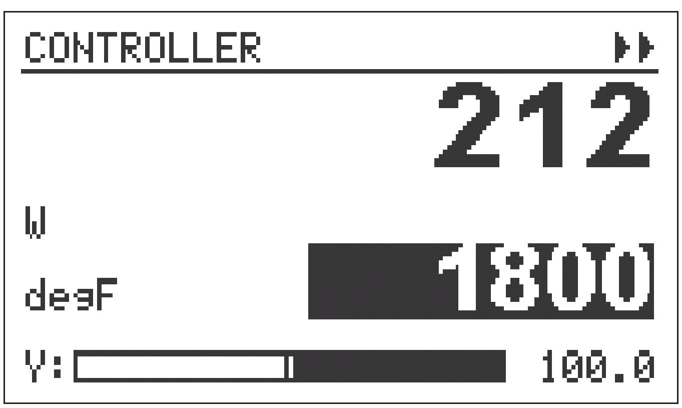


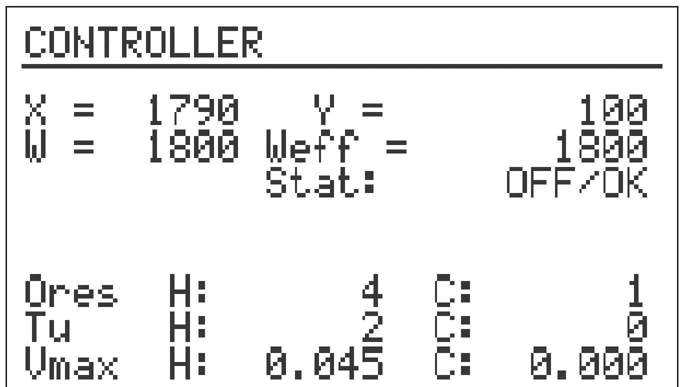
Figure 5.9.

The **Default Screen** is the master temperature controller for the zone and displays the Temperature, Set Point, Output, and Manual Set Point. The Output value can range from 0 to 100 when in heat only mode and -100 to 100 when in heat/cool mode. The default screen is where the temperature is read and a set point is entered (temperature or manual). The top number (212°) is the current temperature. The number below that is the set point (1800°). Below that is the controller output display. The manual set point can be set here. The manual set point value can range from 0 to 100 when in heat only mode and -100 to 100 when in heat/cool mode (See “Zone Settings” on page 32.).

The function key is used to toggle between a temperature set point and a manual set point. When in manual mode, "Man" is displayed on the controller. When in temperature set point mode, the output display can only be viewed and not be accessed.

Auto Tuning

The **Auto Tuning** screen can be accessed by pressing the Enter key when the arrows on the top line of the default screen are highlighted. Details of the auto tuning screen are shown below. Return to the default controller screen by pressing the Enter key when nothing is highlighted. Auto-tuning provides automatic optimization of the controller by calculating and setting the control tuning parameters for fast response while minimizing temperature overshoot and oscillation.



LEGEND:

X	Temperature
Y	Output %
Weff	Set Point
Stat	Start/Stop Status
Ores	Auto Tune Result
Tu/Vmax	Tu/Vmax = Response should be H: / C: = Heating / Cooling

Figure 5.10.

When auto-tuning is started, the controller makes a step-change at the output and monitors the resulting change in temperature. The final status of the optimization result is displayed (Ores). The temperature response characteristics for both heating and cooling are displayed (Tu, Vmax) and are used to calculate the tuning parameters for PID control. The tuning parameters can be observed in the SCALING/PID screen.

The time to complete auto-tuning depends on the furnace response. Careful consideration must be taken for any loads in the furnace since the temperature will change greatly during the auto-tuning period.

Any tuning parameters can be disabled from auto-tuning by pre-setting its value to 0.0:

Type	Symbol	INT TI (Integral, Tn)	DER TI (Derivative, Tv)
Proportional only	P	0.0	0.0
Proportional + Derivative (Rate)	PD	0.0	> 0
Proportional + Integral (Reset)	PI	> 0	0.0
Proportional + Integral + Derivative	PID	> 0	> 0

The process characteristics of the furnace dictate which type should be used and is discussed in the See "Manual Tuning" on page 29.

Auto-tuning should be started with the furnace at a low stable temperature to avoid a long waiting time. The set point (W) should be at a value high enough to allow the heating tuning sequence to finish without overshooting the set point value. Before initiating auto-tuning, switch the output to manual at a low% output value that maintains the stable furnace temperature. To start the optimization, navigate to the "Stat: OFF/OK" field, change to "Start" and enter. The auto-tune sequence can be stopped by selecting Stop in the Stat field or by switching to the manual mode with the function key. The following are the sequences during auto-tune optimization:

- **PIR_H:** The output (Y) will go to 0% if starting from the automatic mode or it will stay at the manual set point. The Stat field will change to PIR_H (process in rest - heating). The temperature must stabilize within 10 degrees for 60 seconds before it advances to the next sequence, "Step".
- **Step:** The output (Y) will then change to 100 and the controller will register the delay (Tu) before the temperature starts to rise. Then it will register the maximum rate of rise in temperature (Vmax). If the furnace responds well, then the next sequence for determining the cooling parameters is started.
- **PIR_K:** The Stat field will change to PIR_K (process in rest - cooling) and the output (Y) will adjust to stabilize the temperature at the set point (W/Weff). The temperature must stabilize within 10 degrees for 60 seconds before it advances to the next sequence, "Step".
- **Step:** The output (Y) will then change to -100 and the controller will register the delay (Tu) before the temperature starts to fall. Then it will register the maximum rate of fall in temperature (Vmax). If the furnace responds well, the optimization will be completed. The registered values will be used to calculate and update the tuning parameters and the Stat field will change to Off/Ok.

Auto-tuning Sequence Diagram

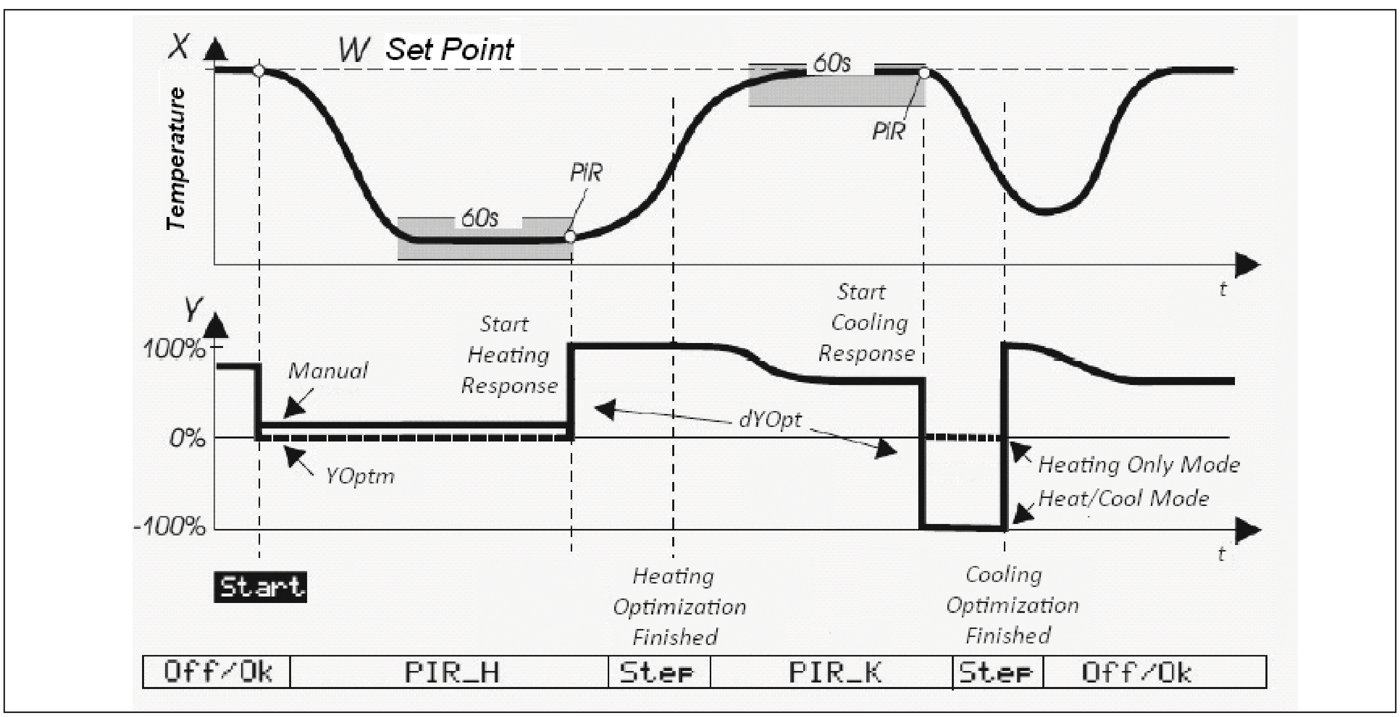


Figure 5.11.

If the furnace does not respond well, the optimization stops and reports errors in the status field and a numeric code in the Ores fields. The significance of the numeric code is explained in Table 5.1.

Table 5.1

Ores	Description	Possible Cause
0	No attempt initiated, or attempt cancelled by Stat: Stop, or cancelled by switching to manual	Auto-tune optimization not started or not needed
1	CANCELLATION: The temperature (X) is responding in the opposite direction of the set point (W) and output (Y)	Sensor connection is reversed
2	COMPLETED: Auto-tuning was successful	No problem, tuning accomplished
3	CANCELLATION: The process does not respond or changes too slowly (temperature change is less than 1% in 1 hour)	Bad sensor location, Burners are not enabled
4	COMPLETED, without AdaErr: Auto-tuning was successful, but the tuning constants are based on a low step change in temperature	Optimum tuning for small changes, it may need further adjustment if larger step changes are normal in the process
	CANCELLATION, with AdaErr: Attempt failed, process change is too small	Bad sensor location, Too many burners disabled
5	CANCELLATION: Risk of temperature exceeding the set point	The set point was too low when auto-tuning was started
6	COMPLETED - CANCELLED: Attempt successful, but auto-tuning cancelled due to risk of exceeding the set point	The step sequence did not complete but the data was valid for calculating the tuning constants
7	CANCELLATION: Output step change too small, $\Delta Y < 5\%$	Factory set parameter has changed (Ymax set too low, YOptm set too high, or dYopt set too small)
8	CANCELLATION: During PiR: the difference between temperature and set point is too small (< 10% of span), or the temperature exceeded set point	The set point was too low when auto-tuning was started, factory set parameter has changed (YOptm set too high)

Most furnaces can be auto-tuned if there is not too much dead time (Tu) and the change in temperature (Vmax) is not too quick. These factors are influenced by sensor location, the sizing of the burners, furnace heat losses, heat absorbers in the furnace and the type and size of the product load. Problems in maintaining a steady temperature can be addressed by looking for ways to improve the furnace characteristics, the sensor location, and any items that require maintenance.

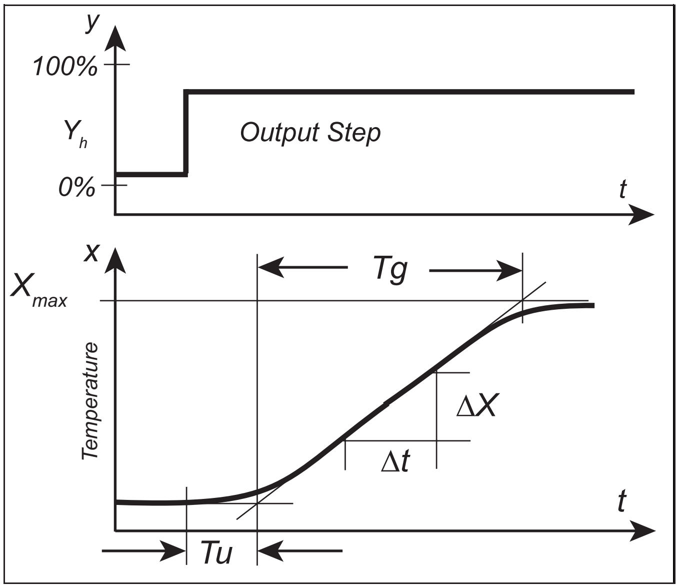
Manual Tuning

Sometimes a furnace system may have excessive lag or dead time or the temperature response is too quick for auto-tuning to complete successfully. At other times, the auto-tuning results may not be satisfactory or may cause too much action on the control equipment. Then a manual tuning process will be necessary. This section gives one method for determining the process characteristics and calculating the tuning constants.

CAUTION

- **During manual tuning, the controller will not regulate according to normal process temperature. Care must be taken to prevent dangerous excursions of the temperature and output.**

For this method, the system is subjected to a step change as shown in Figure 1. The controller is put into manual mode at some low output (Y) and held until the temperature (X) is stable. Next, a step change is made to the output (Y) and the response of the temperature (X) is recorded.



y = output variable

Yh = output step range

Tu = delay (lag) time (s)

Tg = recovery time (s)

Xh = controller range (span)

Xmax = maximum line-out temperature

Figure 5.12.

To calculate the tuning constants, the following values must be obtained from the plot:

- Process characteristic: K = (Vmax/Xh)*Tu*100%
- Maximum rate of increase: Vmax = Xmax/Tg = Δx/Δt
- Delay (lag) time: Tu

Usually, it is not possible to plot the complete response curve until the temperature stabilizes at Xmax, because the process must be kept within certain limits. Rather than waiting for the complete recovery time (Tg), the process only needs to run long enough to achieve the linear portion of the rise in temperature. Then a smaller change in temperature (Δx) is divided by the corresponding elapsed time (Δt) to get a value for the rate of temperature rise (Vmax).

Different types of control actions should be used depending on the process characteristic, as shown in Table 5.2.

Table 5.2 Recommended Controller Type

Process Characteristic	Controllability	Recommended Type
K < 10%	Good	PD
K = 10 to 22%	Medium	PID
K > 22%	Bad	PI

The tuning constants can be calculated from the values of delay time Tu, and process characteristic value K according to the formulas.

Table 5.3 Tuning Formulas

Type	PB (Proportion Band, Xp)%	INT TI (Integral, Tn) seconds	DER TI (Derivative, Tv) seconds
PID	1.7 * K	2 * Tu	2 * Tu
PD	0.5 * K	0.0 (infinity)	Tu
PI	2.6 * K	6 * Tu	0.0
P	K	0.0 (infinity)	0.0

To refine the response with further manual adjustment, see the guidelines given in Table “Parameter Adjustment Effects”. Increase the proportion band (Xp) if the temperature line-out oscillates.

Table 5.4 Parameter Adjustment Effects

Parameter	Setting Adjustment	Control Dampening	Start-Up Reduction of Energy Near Set Point	Recovery from Disturbance
PB	Xp Higher	Increased	Earlier and Slower	Slower
	Xp Lower	Reduced	Later and Faster	Faster
INT TI	Tn Higher	Increased	Slower	Slower
	Tn Lower	Reduced	Faster	Faster
DER TI	Tv Higher	Reduced	Earlier	Faster
	Tv Lower	Increased	Later	Slower

Manual Tuning with Empirical Optimization

Sometimes the tuning constants must be further refined while the controller is in automatic mode. A trial and observation method should follow the steps in this section.

NOTE: The time needed for empirical tuning can be very long. The trend screen or an external recorder will help identify the response to each trial attempt. Each trial attempt after adjustment of a tuning parameter should start with the same initial conditions (starting temperature, set point, furnace load, etc.) to get results that can be appropriately compared. Only one parameter should be adjusted at each attempt.

1. Disable the integral and derivative by adjusting Tn=Tv=0.0. Adjust the proportion band to a large value, such as Xp=100% (P-controller). Reduce Xp at each attempt until the temperature becomes unstable and oscillates around the set point. Then increase Xp back to the stable value and proceed to step 2.
2. Observe the lasting offset. If it is sufficiently small, then the optimization is completed (P-controller). If it is too large, then the controlled system is better regulated with a PD-controller. Adjust Tv relatively large and proceed to step 3.
3. Reduce Xp from attempt to attempt, as long as the control is sufficiently stable. If it becomes too unstable, then the next step is 4.
4. Make Tv smaller at each attempt to determine whether the regulation can be sufficiently stabilized again. If stable, then go back to step is 3 (iterations to determine the smallest values of Xp and Tv for stable control). If not, then increase Xp back to its stable value and the next step is 5.
5. Did the procedures 3 and 4 make Xp substantially smaller? If so, then the next step is 6, if not, then the system is better regulated with a PI-controller. Set Tv to 0 and go to step 7.
6. Observe the lasting offset. If it is sufficiently small, then the optimization is completed (PD-controller). If it is too large, then the system is better regulated with a PID-controller. Leave the settings of Xp and Tv and go to step 7.
7. Tn is adjusted largely and reduced from attempt to attempt, as long as the control is sufficiently stable. If it becomes too unstable, then increase Xp, and the optimization is completed (PID- or PI-controller).

Trend

The trend screen is used to view current and past temperature measurements. The Y scale (degrees F) can be adjusted by selecting the UP/Down arrows and changing the resolution. The resolution can either be set to 500° or 2000°. The minimum value on the Y scale can also be selected to move the scale up or down in increments of 250°. The X scale (seconds) can also be scrolled by selecting the time on the right (0.0 s default) and changing its value.

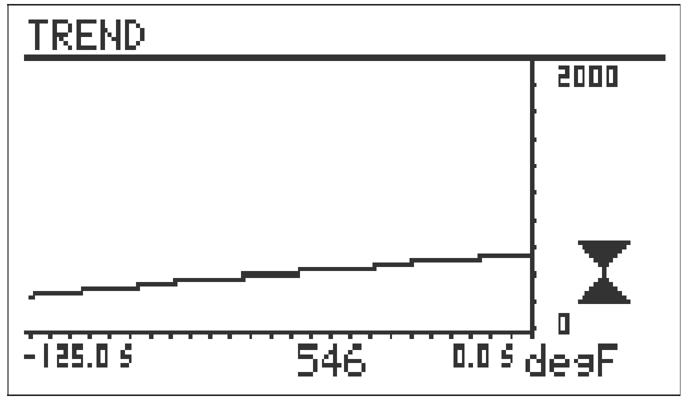


Figure 5.13. Trend with 2000° Resolution

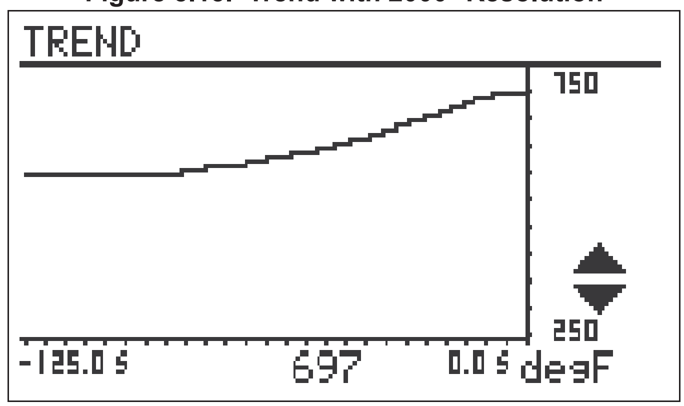


Figure 5.14. Trend with 500° Resolution

Alarms

There are several alarms that can be viewed and acknowledged (not all alarms are acknowledgeable) on the alarm screen. When an alarm event occurs, the screen contrast will inverse. In the case of a burner failure, zone failure (below min) or a cycle alarm, the screen will also go red. Also, multiple alarms can be displayed at one time. A more comprehensive list of alarms can be seen below:

Table 5.5

Alarm Type	Display	Acknowledgeable
Burner Failure	Inverse/Red	Yes
High Temp	Inverse	No
High Deviation	Inverse	No
Low Temp	Inverse	No
Cycle Alarm	Inverse/Red	Yes
Step Alarm	Inverse	Yes
Zone Fail	Inverse/Red	Yes

When an alarm is triggered, the screen will flash and may or may not change to red depending on the alarm type.

Some alarms are acknowledgeable, which requires the operator to acknowledge. For those alarms that require acknowledgement, the display will continue to flash until acknowledged, even if it is no longer in an alarm state. The alarm can be acknowledged while the alarm state is still present. If that is the case, the screen will stop flashing but the alarm will still be indicated on the alarm screen.

Once the alarm state is gone, the alarm will have arrows pointing to the right. Once acknowledged, the screen will stop flashing, and the alarm will be removed.

Several alarms are non acknowledgeable. For this type of alarm, the screen will flash and the alarm type can be viewed, however once the alarm state is gone, the screen will stop flashing and the alarm type will be removed from the alarm screen automatically.

Alarm Troubleshooting

Table 5.6

Alarm Type	Reason
Burner Failure	T400 Alarm - Failure to Ignite, Loss of Flame, No Flame Signal
High Temp	Zone temperature above high limit set point (See Limits)
High Deviation	Zone temperature greater than set point by deviation specified (See Limits)
Low Temp	Zone temperature below low limit set point (See Limits)
Cycle Alarm	Cycle count exceeded cycle alarm set point (see Zone settings - Cycle Alarm)
Step Alarm	Number of steps is greater than active burner count. A burner is assigned a step that is greater than the steps # (See STEPS or STEP #)
Zone Fail	Zone failure, active burner count is below minimum number

Service Level

The service level screen provides a place to enter a password to access two additional levels of screens. The correct password to the service level provides access to additional zone settings, limits, Scaling, PID, and the Misc screens. A second password provides access to parameters, configuration data and I/O data, along with everything in the service level. This screen also provides a means to disable the service level and displays the software version. The password will be reset after 10 minutes of being idle (no screen changes).

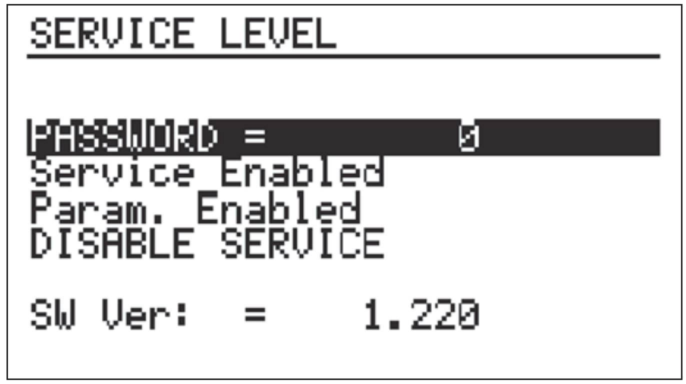


Figure 5.15.

CAUTION

- **Any changes to the Parameter Level requires Eclipse engineering support. These settings are critical and any changes can result in equipment damage and possibly unsafe conditions.**

Once the correct password is entered the Service Disabled status below PASSWORD will display Service Enabled, the number will go back to 0 after several seconds, and the user can exit the screen to gain access to the additional levels.

DISABLE SERVICE can be selected using the FUNCTION button. This will disable all service and parameter level screens. The service and parameter level will also become disabled after 10 minutes.

Operating Pages - Service Level

Zone Settings

Zone settings includes four screens titled zone settings, zone set cont, zone set cont2, and zone set cont3. The first screen sets minimum and maximum On and Off times. It also displays the current on and off times.

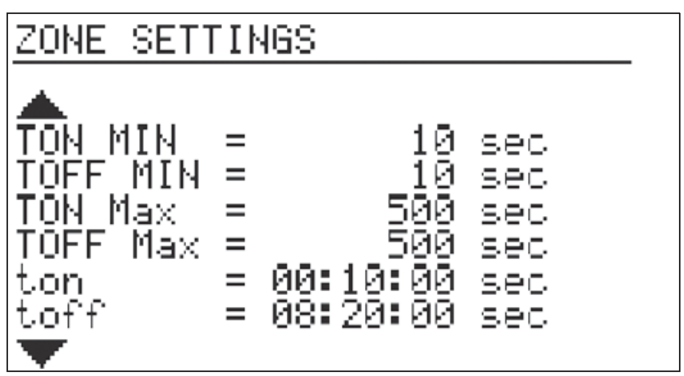


Figure 5.16.

WARNING

- **When setting TON MIN and TOFF MIN, the sum of the TON MIN and TOFF MIN should be greater than the cycle rate of the valves used.**

TON MIN

When a burner is fired, the TON MIN sets the minimum amount of time the burner stays on. When setting this value, things that should be considered are as follows:

- On/Off vs. High/low
- Valve opening time
- Ignition Time: T400 Default = 5 sec
- Flame Fail Response Time (FFRT or Reaction Time): T400 Default = 1 sec
- Ignition Delay: T400 = 2.5 sec
- Gas Wait (See ZONE SET CONT): Default = 0 sec
- Bias (see BURNER SETUP): Default = 100%

For High/Low control, Ignition time, FFRT, Ignition delay and Gas Wait are irrelevant as the burner is only lit at start up and these do not come into play during pulsing. Therefore, with the exception of the Bias, TON MIN will be a preference as to how fast or slow the end user wants to cycle. At 50% controller output, the On time will be at the TON MIN setting.

TOFF MIN

TOFF Min sets the minimum amount of time the burner stays off. When setting this value, things that should be considered are as follows:

- On/Off vs High/low
- Bias (see BURNER SETUP): Default = 100%
- Post Air Time (See ZONE SET CONT): Default = 0 sec
- Valve Closing time
- Burner type and flame extinguish time
- Location of valves with respect to burner

For High/low control, Bias and Valve closing times are the only factors that need to be considered. After that, it is mostly preference as to how fast the user wants to cycle. At 50% controller output, the Off time will be at the TOFF MIN setting.

TOFF MIN is used to calculate timings, but is not enforced. Therefore, it is possible to have a lower off time than desired. For example if the Min off time is set for 10 seconds, and the controller is at 50% output, a bias greater than 100% will force the burner to be off for less than 10 seconds.

During on/off operation, If the off time is too low, it could cause a T400 alarm as flame might still be present in the burner when the ignition sequence starts.

TON MAX

TON MAX sets the maximum amount of time the burner can stay on for a given pulse when firing at a controller output less than 99%. This is entirely user preference. All burners are held on indefinitely with a controller output above 99%.

TOFF MAX

TOFF MAX sets the maximum amount of time the burner can stay off between pulses. This can be either user preference or might be required by code when firing ON/OFF.

Cycle Time Calculation

The total Cycle time is the sum of TON + TOFF. The calculated values for TON and TOFF are held within the limits set by TON MIN&MAX and TOFF MIN&MAX.

$$\text{TOFF} = \frac{\text{TON MIN (100-LOAD\%)}}{\text{LOAD\%}}$$

$$\text{TON} = \frac{\text{TOFF MIN x LOAD\%}}{\text{100-LOAD\%}}$$

Example:

If TON MIN is set to 15 Sec and TOFF MIN is also set to 15 Sec, with a controller output of 75%, the calculated values for TON and TOFF would be 45 sec and 5 sec respectively. However since TOFF MIN is 15 sec, TOFF would be held at 15 sec. Therefore, the total cycle time would be 60 sec (45sec + 15 sec).

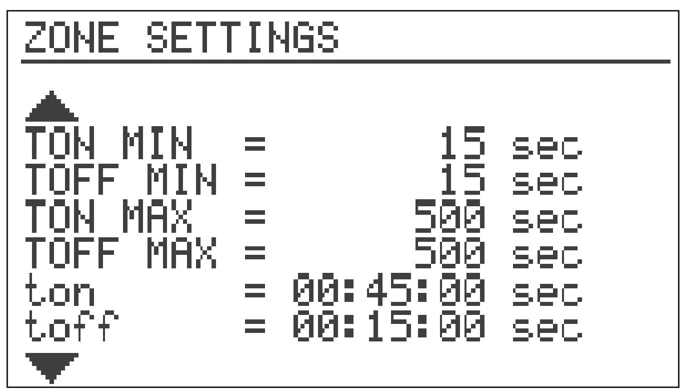


Figure 5.17.

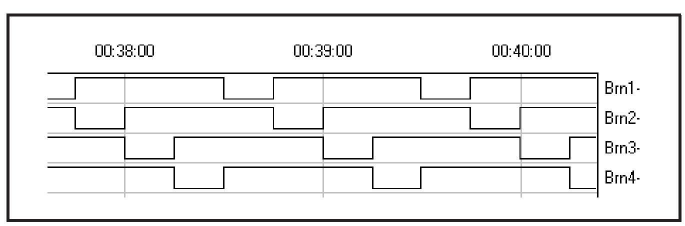


Figure 5.18.

Some examples of the effects of TON and TOFF settings can be seen in the table and graphs below.

Table 5.7. Cycle and Pulse Times at Various Firing Rates												
MIN TON	10			10			20			20		
MIN TOFF		10			20			10			20	
OUT %	TON	TOFF	Total	TON	TOFF	Total	TON	TOFF	Total	TON	TOFF	Total
4	10	240	250	10	240	250	20	480	500	20	480	500
10	10	90	100	10	90	100	20	180	200	20	180	200
20	10	40	50	10	40	50	20	80	100	20	80	100
30	10	23	33	10	23	33	20	47	67	20	47	67
40	10	15	25	13	20	33	20	30	50	20	30	50
50	10	10	20	20	20	40	20	20	40	20	20	40
60	15	10	25	30	20	50	20	13	33	30	20	50
70	23	10	33	47	20	67	23	10	33	47	20	67
80	40	10	50	80	20	100	40	10	50	80	20	100
90	90	10	100	180	20	200	90	10	100	180	20	200
96	240	10	250	480	20	500	240	10	250	480	20	500

Cycle Time vs. % Heat Demand
MIN Times Equal

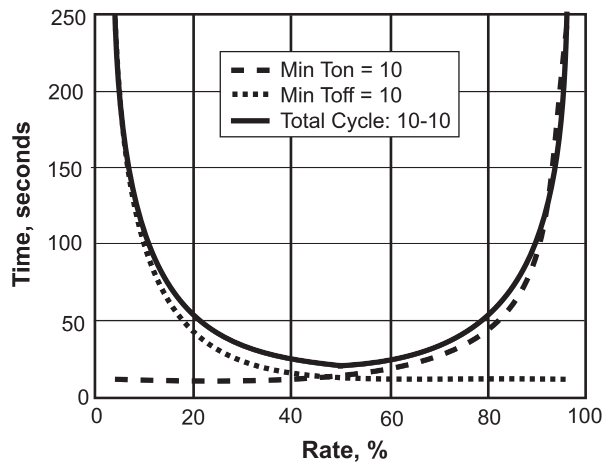


Figure 5.19.

Cycle Time vs. % Heat Demand
MIN Times Not Equal

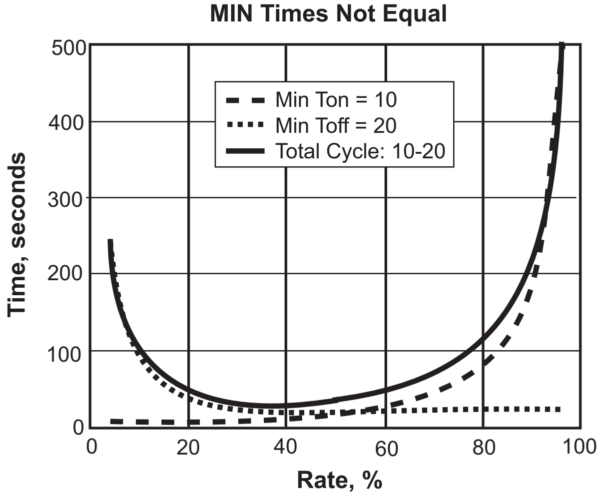


Figure 5.20.

ON/OFF - HI/LOW Switch

The top two items in the ZONE SET CONT screen is a switch between high/low and on/off control. When Hi/Low is selected, it will read Hi/Low Enabled. If On/Off is selected, it will read On/Off Enabled. Only one can be selected at any time. Default is High/Low Control.

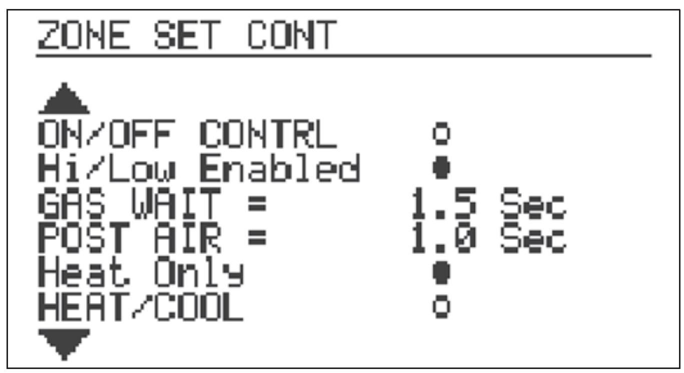


Figure 5.21.

Gas Wait

The gas wait feature only affects ON/Off firing. The setting delays ignition for an additional amount of time. There is a 2.5 sec delay built into the T400, which is essentially the delay between when the air valve opens and the burner ignites. Adding a delay here will add onto the T400 delay. For example, if set to 1.5 sec, the delay between the air valve opening and ignition would be 4 sec (2.5 + 1.5). This feature is typically used to help resolve ignition problems and is disabled during Hi/Low operation. Default is 0.0 sec.

Post Air

The post air feature only affects ON/Off firing. The setting holds the air valve open for an additional amount of time when the burner is shut down. This feature can be used to resolve carbon problems and clean up flame appearance on shutdown. In some cases, depending on burner type and valve location, excess gas may burn inside the burner for several seconds after shutdown. It is possible that this could lead to carbon deposits and future ignition problems. The feature is disabled during Hi/Low operation and the default is 0.0 sec.

HEAT ONLY - HEAT/COOL Switch

The bottom two items in the ZONE SET CONT screen is a switch between Heat only and Heat/Cool. If Heat only is selected, the display will read Heat Only, the circle to the right of Heat Only will be Highlighted and the controller is limited to an output between 0 and 100%. If Heat/Cool is selected, the display will read Heat/Cool, the circle to the right will be highlighted and the controller output will range from -100% to 100%.

In Heat/Cool mode, when the controller output drops below 0%, the air valves are cycled on with the same time base as if the burner was firing. For example with a controller output of -50%, and TON MIN and TOFF MIN set to 15 sec, the air valve will be on for 15 sec, then off for 15 sec.

If using Heat/Cool in High/Low mode, all gas will be shut off when the controller output falls below 0%. The burners will then reignite when the output signal rises above 0%. If this occurs, code may require that the furnace be purged prior to ignition (Check applicable codes).

If the internal high limit or high deviation is reached when in heat/cool mode, all gas valves will be shut off and all air valves will be turned on until the temperature falls below the alarm set point minus the hysteresis. Again, if this occurs, code may require that the furnace be purged prior to ignition (Check applicable codes)

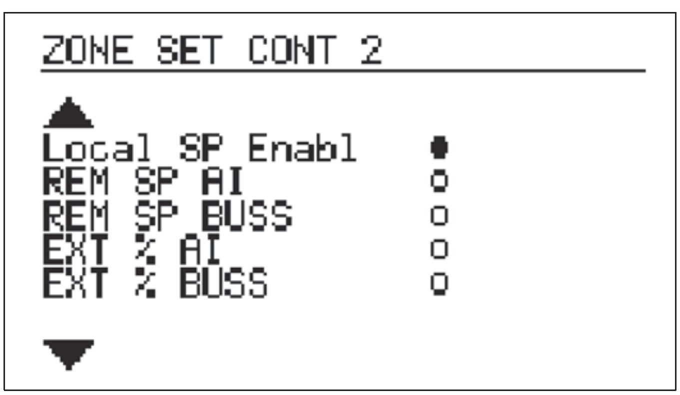


Figure 5.22.

The ZONE SET CONT 2 screen allows the user to select the input type. Only one can be selected at a time. The input that is selected will have the circle to the right highlighted.

Local Set Point

Temperature is controlled via the built in temperature controller. All remote inputs are ignored.

Remote Set Point Analog Input

The temperature set point is being output by an external device and is read by the pulse controller via a 4-20 mA input. Scaling for the input is set in the SCALING/PID Screen (see Scaling / PID section). For example, if scaling is set such that 0°F is equal to 4 mA and 2000°F is equal to 20 mA, then an input signal of 12 mA would give a temperature set point of 1000°F.

Remote Set Point Buss

Temperature set point is being sent to the pulse controller via a Modbus or Profibus network. See Modbus or Profibus.

External% Analog Input

The temperature controller output is being driven by an external device and is read by the pulse controller via a 4-20 mA input. If this option is selected, the internal controller is bypassed along with all tuning parameters that have been previously set. Therefore, the external device is responsible for all temperature control parameters. An input of 4 mA = -100%, an input of 12 mA = 0% and an input of 20 mA = 100%. For Heat only mode, inputs below 12 mA = 0%.

External% Buss

Temperature controller output is being sent to the pulse controller via a Modbus or Profibus network. See Modbus or Profibus. If this option is selected, the internal controller is bypassed along with all tuning parameters that have been previously set. Therefore, the external device is responsible for all temperature control parameters. Acceptable values range between -100% to 100%. Values below 0% will be set to 0% output when in heat only mode.

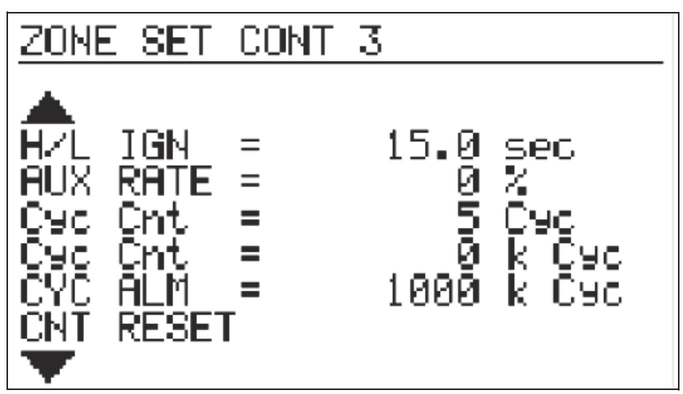


Figure 5.23.

High/Low Ignition

The High/Low ignition time holds the burner at low fire for the set time during ignition. This prevents the burners from lighting at high fire. After the burners are ignited, their air valves will not go high until after the H/L ignition period has passed. At that point, the burner will drive high if required by the pulse signal. Default is 15 sec.

The 2.5 sec T400 delay should be subtracted from this value to give your true delay. For example, if the H/L IGN is set to 15 sec, the true delay between the gas valve first opening and the potential to drive to high fire would be 12.5 sec (15 - 2.5).

Auxiliary Rate

The auxiliary rate drives the controller output to this setting when the Aux Firing Rate input is present (see wiring section). For example, this input could be wired to a door switch so that the controller drives to 0% when the door is opened. Default is 0%.

Cycle Counter 1

Cycle counter 1 counts the pulses of step 1. This counter resets at 1000 at which point Cycle counter 2 is increased by 1. The value in Cycle Counter 1 is stored in volatile RAM so the value may be lost if the PulsePak is powered down for an extended period of time (several days).

Cycle Counter 2

Cycle counter 2 counts the number of times that cycle counter 1 reached 1000 cycles. The value in cycle counter 2 is stored in non-volatile EEPROM, which will not be lost when powered down for extended periods of time.

Cycle Alarm

The cycle alarm is triggered when cycle counter 2 exceeds this setting. Expected cycle life of components should be considered when setting this value. For example, if a particular valve in the system is rated for 1 million cycles, setting this to 1000 (1000 Cycle Counter 1 x 1000 Cycle Counter 2 = 1,000,000 Total Cycles) will trigger an alarm when cycle counter 2 exceeds 1000 counts (1 million cycles total).

Counter Reset

This button resets both cycle counters to zero.

LIMITS

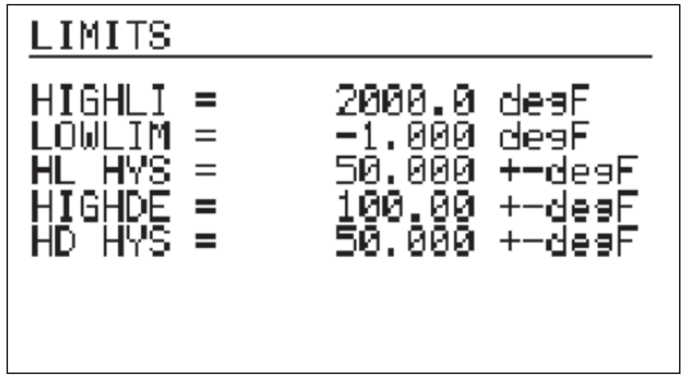


Figure 5.24.

High Limit (HIGHLI)

The high limit setting is an internal high limit that shuts off all burners when the set point is reached. If in Heat/Cool mode, air valves are opened when the limit is reached. Once the set point is reached, the burners will not restart until the temperature is below the high limit set point minus the high limit hysteresis (HIGHLI - HL HYS).

This is separate from the external high limit which is often required (check applicable codes) and typically set below the external high limit set point. When the temperature exceeds the High limit setpoint, a non acknowledgeable alarm is triggered and code may require that the furnace be purged prior to ignition. Default is 2000°F.

Low Limit (LOWLIM)

The low limit setpoint triggers a non acknowledgeable alarm if the temperature falls below the setpoint. Default is -1°F.

High Limit Hysteresis (HL HYS)

The high limit hysteresis controls how far the temperature must drop before the burners can be restarted when a high limit condition is reached. For example if the HIGHLI is set to 2000°F, and the HL HYS is set for 50°F, the temperature must drop below 1950°F before the burners will restart. Default is 50°F.

High Deviation (HIGHDE)

The high deviation works much like the High limit. When the temperature exceeds the setpoint plus the high deviation, the burners will shut off. If in Heat/Cool mode, air valves are opened when the limit is reached. Once the set point is reached, the burners will not restart until the temperature is below the High Deviation set point minus the High Deviation Hysteresis (HIGHDE - HD HYS).

When the temperature exceeds the Setpoint plus the High Deviation setting, a non acknowledgeable alarm is triggered and code may require that the furnace be purged prior to ignition (check applicable codes). This is not applicable when External% Analog Input or External% Buss is selected. Default is 100°F.

High Deviation Hysteresis (HDHYS)

The high deviation hysteresis controls how far the temperature must drop below the setpoint plus the deviation before the burners can be restarted. For example if the HIGHDE is set to 100°F, and the setpoint is 1600°F. The alarm will occur at 1700° and will not turn off until below the High deviation minus the High Deviation Hysteresis. If the High Deviation Hysteresis is set to 50°F, the burners will not restart until the temperature falls below 1650°F. This is not applicable when External% Analog Input or External% Buss is selected. Default is 50°F.

Scaling / PID

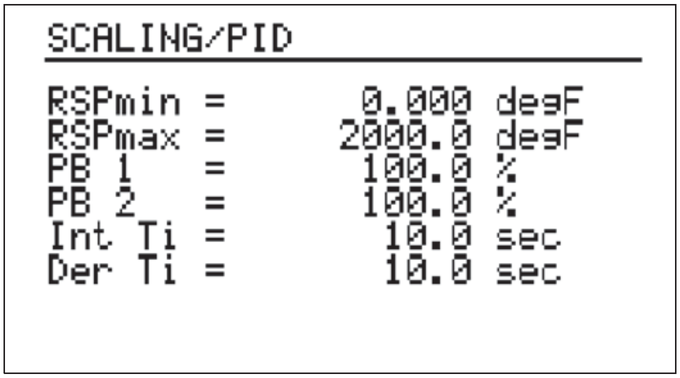


Figure 5.25.

Remote Set Point Minimum (RSPmin)

The Remote set point minimum value sets the temperature value at 4 mA for a 4-20 mA input. See “Remote Set Point Analog Input” on page 35.

Remote Set Point Maximum (RSPmax)

The Remote set point minimum value sets the temperature value at 20 mA for a 4-20 mA input. See “Remote Set Point Analog Input” on page 35.

For example, if scaling is set such that 0°F is equal to 4 mA (RSPMIN) and 2000°F is equal to 20 mA (RSPMAX), then an input signal of 12 mA would give a temperature set point of 1000°F.

Proportional Band 1

Proportional Band 1 sets the PID proportional band for Heating as a percentage. This value can be manually set when self tune is not used. Any value set here will be changed with a successful self tune. See “Manual Tuning” on page 29.

Proportional Band 2

Proportional Band 2 sets the PID proportional band for Cooling as a percentage. This value can be manually set when self tune is not used. Any value set here will be changed with a successful self tune. See “Manual Tuning” on page 29.

Integral Time

Integral Time sets the PID Integral in seconds. This value can be manually set when self tune is not used. Any value set here will be changed with a successful self tune. See “Manual Tuning” on page 29.

Derivative Time

Derivative Time sets the PID Derivative in seconds. This value can be manually set when self tune is not used. Any value set here will be changed with a successful self tune. See “Manual Tuning” on page 29.

MISCELLANEOUS

The Miscellaneous screen provides access to several additional screens related to the controller operation and communications. Specific details regarding these parameters are addressed in the applicable sections (Canbus, Host communications, etc.) The miscellaneous screen is accessed by selecting END at the bottom of the operating pages screen list. For additional information on these screens, please refer to: http://www.pma-online.de/en/products/ks98-1.html.

High Limit

There are three options for a high limit control in the zone panel: none, FM type, or SIL type.

WARNING

- **The high limit control is a critical safety device for protecting the furnace. The temperature limit value shall be set according to recommendation from the furnace manufacturer. Improper adjustment can result in equipment damage, injury, or death to persons near the furnace.**

If the SIL high limit option was selected, the high limit can be set by simply adjusting the knob to the correct set point.

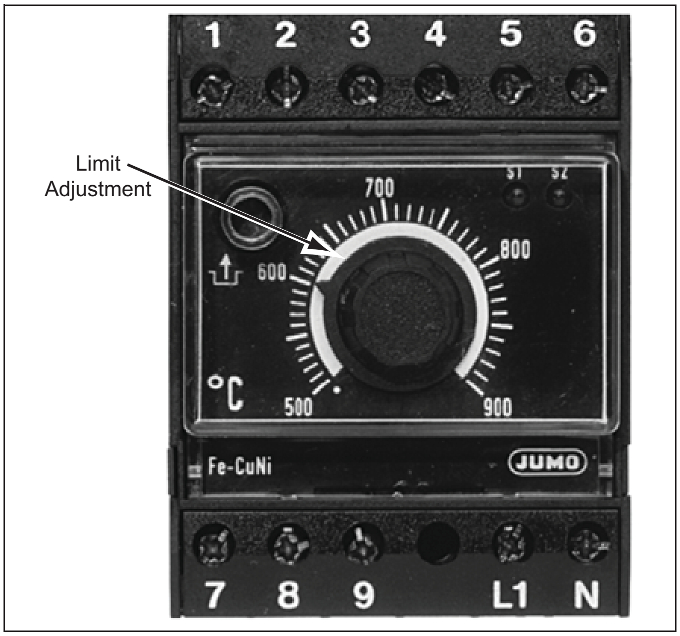


Figure 5.26.

If the FM high limit option was selected, the high limit can be set in the set up mode. To access the setup mode, follow the directions in Figure 5.27.

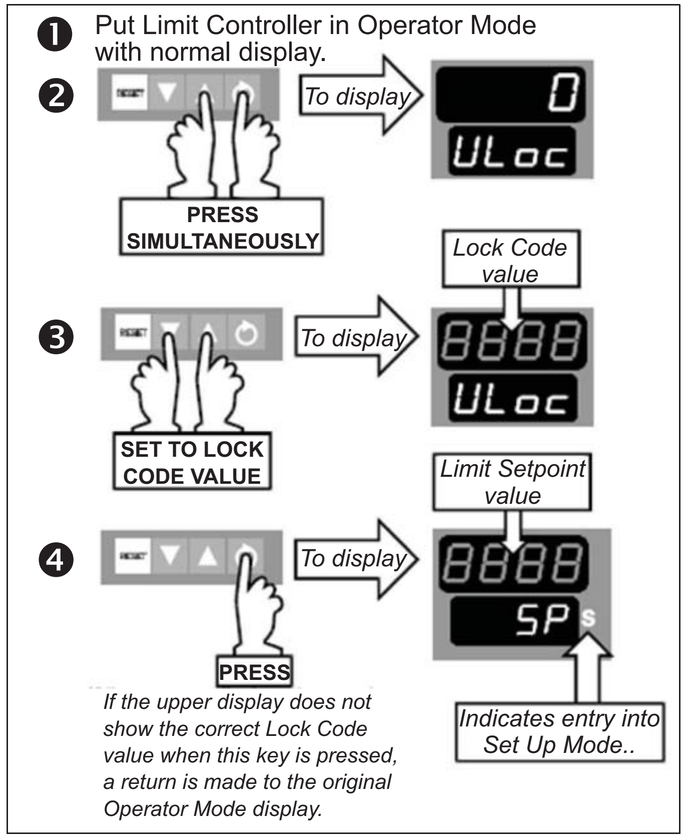


Figure 5.27.

The parameters that can be set in this level are as follows:

Table 5.8			
Parameter	**Legend**	**Adjustment Range**	**Default Value**
Limit Setpoint	SP	Range Max. To Range Min.	Range Max. (High Limit) Range Min. (Low Limit)
Digital Filter Time Constant	F.Lt	OFF, 0.5 to 100.0 secs. in 0.5 sec. increments	2.0 seconds
Hysteresis	HySt	0% to 10% of input span	1 unit
Process High Alarm 1 value[1]	h_Al	Range Min. To Range Max.	Range Max.
Process Low Alarm 1 value[1]	L_Al	Range Min. to Range Max.	Range Min.
Band Alarm 1 value[1]	b_Al	0 to span from Limit SP	5 units
Deviation Alarm 1 value[1]	d_Al	± Span from Limit SP	5 units
Process High Alarm 2 value[1]	h_A2	Range Min. to Range Max.	Range Max.
Process Low Alarm 2 value[1]	L_A2	Range Min. to Range Max.	Range Min.
Band Alarm 2 value[1]	b_A2	0 to span from Limit SP	5 units
Deviation Alarm 2 value[1]	d_A2	± Span from Limit SP	5 units
Scale Range Maximum[2]	rhi	-1999 to 9999	1000
Scale Range Minimum[2]	rLo	-1999 to 9999	0000
Scale Range Decimal Point[2]	rPnt	0, 1, 2 or 3	1
Recorder Output Scale Maximum[4]	roPH	-1999 to 9999	Range Max.
Recorder Output Scale Minimum[4]	roPL	-1999 to 9999	Range Min.
Communications Enable[3]	CoEn	0 (Disabled) or 1 (Enabled)	1 (Enabled)
Display Enable	d.SP	0 (Disabled) or 1 (Enabled)	1 (Enabled)
Set Up Lock Code	Loc	0 to 9999	10
Operator Mode Parameters (accessible in Set Up Mode):			
Process Variable		Read Only	-
Alarm Status	ALSt	Read Only (see Subsection)	-

To exit the setup mode, select the process variable operator mode display then depress the up and function keys simultaneously. The S indicator will go off and the controller will return to the operator mode.

NOTE: The controller will return to the operator mode if there is no key activity for two minutes.

Start Up 6

Before applying power to the panel, ensure the following points have been taken into account.

Verify Wiring/Connections

Verify the supply voltage corresponds to the specifications on the label(s); all wiring is correct. At a minimum, the zone pack needs to have power and an external pulse enable signal. (This is a 120/230 VAC input that is wired to terminals A1 and A2 of CR128 (relay coil)).

Many systems will also include a purge signal, air interlock wiring, an external lockout or high limit signal. There are additional inputs or alarm outputs that may also require connection. If host communications are being used (Profibus or Modbus), verify communications wiring.

If burner packs are being used with the zone pack, verify the burner packs have power supplied to them, the CAN wiring is correct and all address and baud rates on the I/O modules have been properly set. (See CANbus section).

Verify all gas and air valves are connected properly Using the Brad Harrison connectors.

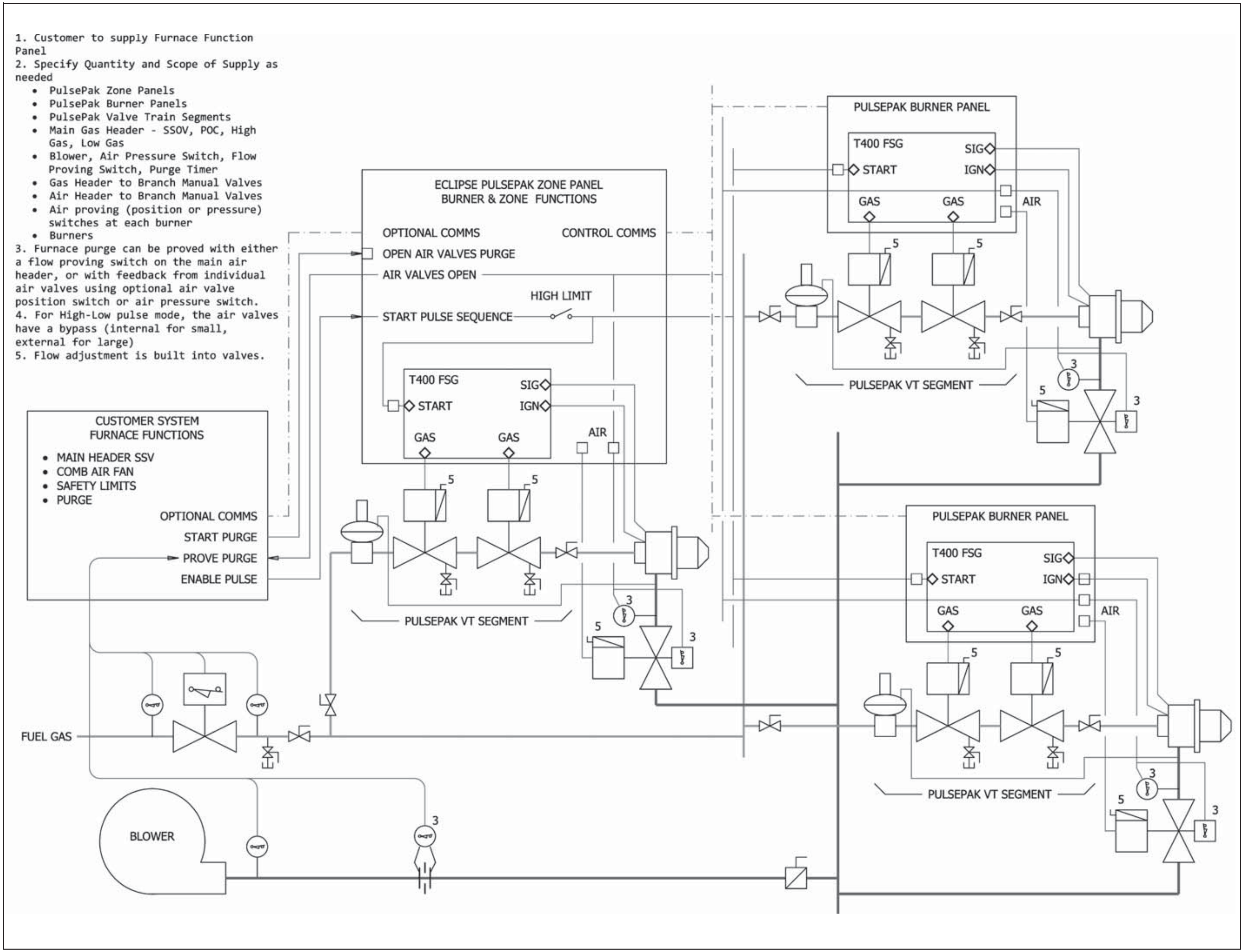
Also verify a Brad Harrison cable is connected between connector 6 from the zone panel to connector 7 on the first burner panel. An additional Brad Harrison cable should then be connected to each additional burner pack between connectors 6 of the previous panel and connector 7 of the next panel. These supply a hard wired pulse enable and air interlock signal between all panels in the zone.

Verify the pulse controller thermocouple is connected and installed correctly.

WARNING

- **Thermocouple wires that make contact at any point other than the desired measurement location will result in a temperature reading at the point of contact. If this occurs outside the furnace, the temperature controller will essentially be disabled.**

An example of a typical zone wiring diagram can be seen in the diagram on the next page.


1. Customer to supply Furnace Function Panel
2. Specify Quantity and Scope of Supply as needed
• PulsePak Zone Panels
• PulsePak Burner Panels
• PulsePak Valve Train Segments
• Main Gas Header - SSOV, POC, High Gas, Low Gas
• Blower, Air Pressure Switch, Flow Proving Switch, Purge Timer
• Gas Header to Branch Manual Valves
• Air Header to Branch Manual Valves
• Air proving (position or pressure) switches at each burner
• Burners
3. Furnace purge can be proved with either a flow proving switch on the main air header, or with feedback from individual air valves using optional air valve position switch or air pressure switch.
4. For High-Low pulse mode, the air valves have a bypass (internal for small, external for large)
5. Flow adjustment is built into valves.
CUSTOMER SYSTEM
FURNACE FUNCTIONS
• MAIN HEADER SSV
• COMB AIR FAN
• SAFETY LIMITS
• PURGE
OPTIONAL COMMS
START PURGE
PROVE PURGE
ENABLE PULSE
ECLIPSE PULSEPAK ZONE PANEL
BURNER & ZONE FUNCTIONS
OPTIONAL COMMS
CONTROL COMMS
OPEN AIR VALVES PURGE
AIR VALVES OPEN
HIGH LIMIT
START PULSE SEQUENCE
T400 FSG
SIG
START
IGN
GAS
GAS
AIR
PULSEPAK VT SEGMENT
PULSEPAK BURNER PANEL
PULSEPAK VT SEGMENT
PULSEPAK BURNER PANEL
PULSEPAK VT SEGMENT
FUEL GAS
BLOWER
3
5

Verify Communications

Once wiring has been verified, apply power to the zone and burner panels. Verify communication between panels is taking place by LEDs or by going to CAN status screen. See Canbus section for additional details.

Setup Flame Safeties

In each zone and/or burner panel, verify flame safety settings are correct. Typically, the settings of concern are trial for ignition and flame failure response time. See Instruction Manual 830-1 for detailed information on initial settings for the flame safety.

Set Burner Settings

Go to the burner setup screens and Set up the zone for the appropriate number of burners by disabling any burners that are not being used. Set step numbers for disabled burners to zero, and the remaining step numbers to the desired assignments. Set the total number of steps, and the min burner count to the desired values (See burner setup).

Set Zone Settings

Go to zone settings (via service level) and set desired ON/Off min and maximum timings. When setting Min/Max On and Off times, refer to the zone settings section for proper adjustment.

Set any additional desired settings such as remote/local/external set point, on/off or high/low, Heat only or heat/cool, HL ign time, etc.

Go to limits and set internal high/low limits, deviation and hysteresis to desired settings. Under Scaling/PID, set RSPMIN and RSPMAX if a 4-20mA input is being used to send a remote set point signal.

Go to misc and verify date and time is correct (not included with Profibus versions) and all communication settings are correct and proper communication is occurring for all wired burner packs See COMM section for additional information.

Verify Purge

Once the system is ready to start, verify the purge timer is set to the appropriate amount of time for the furnace. Purge time is typically determined by the volume of the furnace and the flow rate through the air valves. Four or five volume changes are often required to complete a full purge, but it is necessary to verify purge requirements from all applicable codes and regulations.

Close all burner manual gas valves and initiate the startup sequence. Verify the purge signal comes on before the start signal and the start signal is not triggered until the purge has completed. Once the purge has been triggered, verify that all air valves are open and flowing the correct amount of air. If flow meters are not available, this can be done using differential or static pressures supplied with the burner setup data.

Depending on the purge time and number of burners, it might be best to set the purge time longer than required to ensure enough time is allowed for verification. Otherwise, it might be necessary to restart the purge sequence several times to verify the correct amount of air is flowing through each burner.

Adjust Burners

Once all wiring, settings and communications have been verified, adjust burner valves so that they start safely. See the setup guides for that particular burner for proper guidelines.

Set the main panel to start up and open all manual gas valves. At this point, the pulse enable signal can be sent to the pulse pak. If using the pulse controller for set points, (local set point), go to the controller and put in manual mode and zero percent output if using the controller. If a remote output or external load is being used, make sure the output is set such that all burners remain off or at low fire. If running in High/Low mode, all burners should light and remain at low fire. Verify low fire settings for each burner and ensure all burners are operating in a safe condition. If running on On/Off mode, all burners should be off.

To properly setup each burner, the MAN HIGH feature (see burner setup) can be used to drive a specific burner to high fire regardless of controller output. Best practice is to set up each burners high fire one at a time using this feature.

CAUTION

- **Setting a burner to MAN HI could cause the furnace to hit a high temp/high limit condition.**

Please note that depending on the type of burner, the control scheme, piping practices, etc, adjustments of individual burners might change when running multiple burners. All adjustments should later be verified when the furnace is fully operational. For a hi/Low system, Once high fire is set for each burners in the zone, go back to low fire and verify low fire adjustments.

Set High Limit

If the high limit option was selected, set high limit to appropriate setting. This is typically set 50° - 100°F above the maximum setpoint and as far below the point where damage will occur to the furnace as possible.

Also, verify all thermocouples are reading correctly and are not shorted anywhere outside the furnace. If the High limit has a display, make sure the temperature increases with the furnace temperature.

For either type of high limit, heat the furnace up to a safe temperature well below the typical setpoint. Then decrease the high limit setting until the limit trips and the zone shuts down. Make sure the point at which the limit tripped was close to the furnace temperature.

WARNING

- **Thermocouple wires that make contact at any point other than the desired measurement location will result in a temperature reading at the point of contact. If this occurs outside the furnace, the high limit will essentially be disabled.**

Start Furnace Operation

Once all burners have been properly adjusted and all burners have been returned back to auto, the controller can be set to automatic mode and the desired setpoint can be entered or sent to the pulsepak by the appropriate means. At this point, the furnace should be functional and care should be taken to ensure all burners in the furnace are operating safely and correctly. If any burners failed to ignite at any point, the burner failure can be viewed and acknowledged in the alarms screen and the burner can be reset in the burner setup screen.

Startup Checklist

Verify wiring / connections	Verify supply voltage matches unit voltage.
	Verify host communications wiring (if applicable).
	Verify purge signal wiring.
	Verify interlock / start signal wiring.
	Verify optional wiring (external lockouts, alarm outputs, etc.).
	Verify CANbus wiring is correct (between zone and burner packs).
	Verify I/O module baud rates and addresses are set correctly.
	Verify gas and air valves are connected to zone / burner panel correctly.
	Verify pulse enabled / air interlock cable is connected between all zone and burner packs.
	Verify pulse controller thermocouple is installed correctly.
	Verify high limit thermocouple is installed correctly (if applicable).
Verify CANbus communications	Verify communication between zone and all burner packs.
Setup flame safeties	Set each zone and burner flame safety parameters.
Set burner settings	Disable unused burners. Set step number of unused burners to 0.
	Set active burner step assignments to desired values.
	Set total number of steps.
	Set min burner count.
Set zone settings	Set desired ON/OFF MIN/MAX timings.
	Set to ON/OFF or High/Low.
	Select desired control settings (local, external, etc.).
	Select heat only or heat/cool.
	Set additional desired zone settings (HL ign time, Post Air, Gas Wait, etc.).
Set limits	Set desired internal high/low limits, deviations and hysteresis.
Set scaling / PID settings	Set RSPMIN / RSPMAX (if remote set point being used).
	Set PID to initial values if desired.
Verify misc settings	Verify date, time settings are correct (not included with Profibus models).
	Verify communication protocol is correct.
	Verify baud rate is correct
	Verify address settings are correct
Verify purge	Verify purge timer is set correctly.
	Start purge sequence, verify (and adjust if necessary) air flow through each air valve.
Adjust burners	Adjust burner gas valves to ensure safe start.
	Set controller to manual and 0% output.
	Provide start signal to PulsePak Zone Panel.
	Make sure all burners ignite safely (High/Low only).
	Adjust low fire settings on each burner (High/Low only).
	Put burners in Manual High one at a time. Verify ignition (On/Off only). Adjust high fire settings for each burner.
	Place each burner back in auto and verify low fire settings again (High/Low only).
Set high limit	Verify high limit is reading correctly.
	Test high limit by lowering setpoint to furnace temperature.
	Set high limit device to desired temperature.
Start furnace operation	Provide start signal to PulsePak Zone Panel.
	Place controller in auto and enter or send desired setpoint.
	Make sure all burners ignite safely.
	Verify burner high and low fire settings. Readjust if necessary.

PulsePak Parameter Configuration

Parameter	Set Value	Factory Default
BURNER SETUP		
STEPS =		8
MIN BURN =		4
BURNER 1 SETUP		
ENABLED / DISABLED		ENABLED
STEP#=		1
BIAS=		100%
Auto Enabled	[ ]	[x]
MAN HIGH	[ ]	[ ]
MAN LOW	[ ]	[ ]
BURNER 2 SETUP		
ENABLED / DISABLED		ENABLED
STEP#=		2
BIAS=		100%
Auto Enabled	[ ]	[x]
MAN HIGH	[ ]	[ ]
MAN LOW	[ ]	[ ]
BURNER 3 SETUP		
ENABLED / DISABLED		ENABLED
STEP#=		3
BIAS=		100%
Auto Enabled	[ ]	[x]
MAN HIGH	[ ]	[ ]
MAN LOW	[ ]	[ ]
BURNER 4 SETUP		
ENABLED / DISABLED		ENABLED
STEP#=		4
BIAS=		100%
Auto Enabled	[ ]	[x]
MAN HIGH	[ ]	[ ]
MAN LOW	[ ]	[ ]
BURNER 5 SETUP		
ENABLED / DISABLED		ENABLED
STEP#=		5
BIAS=		100%
Auto Enabled	[ ]	[x]
MAN HIGH	[ ]	[ ]
MAN LOW	[ ]	[ ]
BURNER 6 SETUP		
ENABLED / DISABLED		ENABLED
STEP#=		6
BIAS=		100%
Auto Enabled	[ ]	[x]
MAN HIGH	[ ]	[ ]
MAN LOW	[ ]	[ ]
BURNER 7 SETUP		
ENABLED / DISABLED		ENABLED
STEP#=		7
BIAS=		100%
Auto Enabled	[ ]	[x]
MAN HIGH	[ ]	[ ]
MAN LOW	[ ]	[ ]
BURNER 8 SETUP		
ENABLED / DISABLED		ENABLED
STEP#=		8
BIAS=		100%
Auto Enabled	[ ]	[x]
MAN HIGH	[ ]	[ ]
MAN LOW	[ ]	[ ]

Parameter	Set Value	Factory Default
ZONE SETTINGS		
TON MIN=		10 sec
TOFF MIN=		10 sec
TON MAX=		500 sec
TOFF MAX=		500 sec
ZONE SET CONT		
ON/OFF	[ ]	[x]
HI/LOW	[ ]	[ ]
GAS WAIT=		0.0 Sec
POST AIR=		0.0 Sec
HEAT ONLY	[ ]	[x]
HEAT/COOL	[ ]	[ ]
ZONE SET CONT 2		
LOC SP	[ ]	[x]
REM SP AI	[ ]	[ ]
REM SP BUSS	[ ]	[ ]
EXT % AI	[ ]	[ ]
EXT % BUSS	[ ]	[ ]
ZONE SET CONT 3		
H/L IGN=		15.0 sec
AUX RATE=		0%
CycCnt1		0 Cyc
CycCnt2		0 k Cyc
CYC ALM=		1000 k Cyc
LIMITS		
HIGHLI=		2000.0 DegF
LOWLIM=		-1.000 DegF
HL HYS=		50.000 +-DegF
HIGHDE=		100.00 +-DegF
HD HYS=		50.000 +-DegF
SCALING/PID		
RSPMIN=		0.000 deg
RSPMAX=		2000.0 deg
PB 1=		100.00%
PB 2=		100.00%
INT TI=		10.0 sec
DER TI=		10.0 sec
Miscell.-Device Data		
Protoc=		(As Ordered)
Baud=		9600
Addr.=		1
Frequ.=		60 Hz
Langu.=		english
CAN-Id=		(NMT) 1
CAN-Bd=		500kBit
Freeze=		off
Delay=		0
PulsePak Controller		
Thermocouple Type		K
Units		degF
Range		0-2000 degF
External High Limit		
Thermocouple Type		K
Units		degF
Set-Point		0 degF
T410 Flame Safeguard		
140 (Display Mode)		2
230 (Stabilize)		3.234
231 (Interrupt)		9.996
239 (24Hr Restart)		0
240 (Repitition)		0
247 (Pilot Stays On)		0
254 (Flame Response)		0
257 (Ignition Time)		4.116

Maintenance & Troubleshooting

7

This chapter is divided into two sections:

- Maintenance procedures
- Troubleshooting guide

Maintenance

Preventive maintenance is the key to a reliable, safe and efficient system. The core of any preventive maintenance system is a list of periodic tasks.

The following are suggestions for a monthly list and a yearly list.

NOTE: The monthly list and yearly lists are an average interval. If your environment is dirty, the intervals may be shorter.

Monthly Checklist

- Inspect and tighten loose mechanical or electrical components.
- Look for signs of damage and repair as needed.
- Clean the external surfaces.

Yearly Checklist

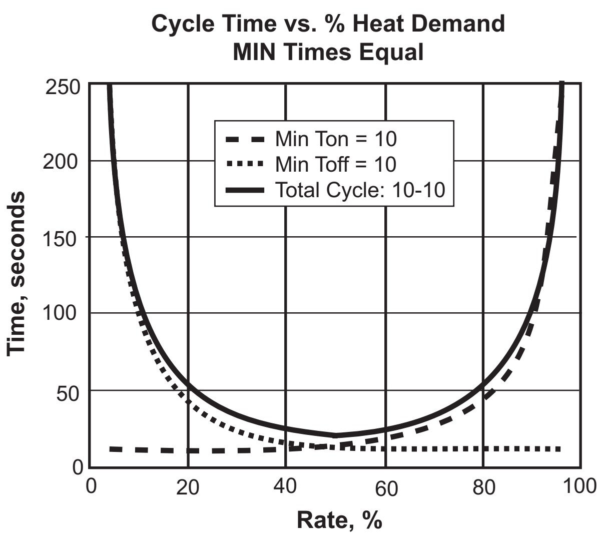
- Perform all monthly checklists plus;
- Check tightness of wiring connections.
- Check for gas pipe leaks.

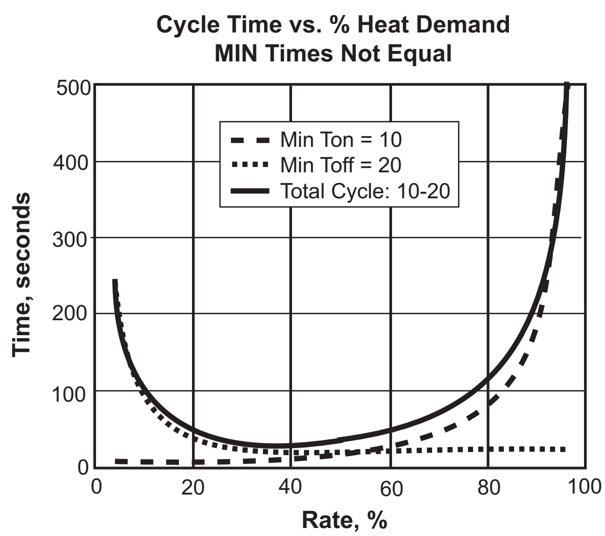
See Valve Train Installation Guide 791-2 for details regarding valve train maintenance and troubleshooting. Gas valves in the On/Off mode and air valves in either pulse mode will accumulate cycles according to the chart below. The maintenance interval (years) is based on a valve life rating of 1 million cycles.

Table 7.1 Maintenance for On-Off Pulse Mode

Operating Conditions				Results	
Pulse Timings		Furnace Operation		Accumulated	Repair/Replace
Cycles / Hour	Seconds / Cycle	Hours / Day	Days / Year	Cycles / Year	Years
600	6	16	300	2,880,000	0.3
300	12			1,440,000	0.7
100	36			480,000	2
60	60			288,000	3
600	6	10	300	1,800,000	0.5
300	12			900,000	1
100	36			300,000	3
60	60			180,000	5

Table 7.2 Cycle & Pulse Times at Various Firing Rates												
MIN TON	**10**			**10**			**20**			**20**		
MIN TOFF		**10**			**20**			**10**			**20**	
Out%	**TON**	**TOFF**	**Total**	**TON**	**TOFF**	**Total**	**TON**	**TOFF**	**Total**	**TON**	**TOFF**	**Total**
4	10	240	250	10	240	250	20	480	500	20	480	500
10	10	90	100	10	90	100	20	180	200	20	180	200
20	10	40	50	10	40	50	20	80	100	20	80	100
30	10	23	33	10	23	33	20	47	67	20	47	67
40	10	15	25	13	20	33	20	30	50	20	30	50
50	10	10	20	20	20	40	20	20	40	20	20	40
60	15	10	25	30	20	50	20	13	33	30	20	50
70	23	10	33	47	20	67	23	10	33	47	20	67
80	40	10	50	80	20	100	40	10	50	80	20	100
90	90	10	100	180	20	200	90	10	100	180	20	200
96	240	10	250	480	20	500	240	10	250	480	20	500





Troubleshooting Guide

Problem	Possible Cause	Solution
Dead, no power	No voltage to panel	Check power is being supplied and verify wiring
	No fuse / blown fuse	Add or replace fuse
Pulse sequence won't start	No start signal	Purge in progress; interlocks not made; main panel not calling for startup; Hi-Limit alarm; Incorrect wiring
	No call for heat	Controller in manual mode; set point not correct; incorrect input type selected; control signal wiring errors; Buss communication error
Starts without purge	No purge	Purge timer not set; incorrect wiring

Problem	Possible Cause	Solution
Burner does not ignite	No communication between zone and burner packs	Incorrect wiring; incorrect RL address or baud rate settings: Can switch not closed
	Burner ignition failure	Incorrect burner settings; bad/wrong igniter; incorrect flame signal wiring; Ignition transformer not connected; air and gas valves not connected correctly; flame safety error
	Burner disabled	Enable burner
	Burner set to Man Low	Set burner to Auto
	Step alarm - burner set to step # that is higher than steps setting	Set burner to correct step #
	Wrong mode selected	Verify correct high/low or on/off setting
	Flame safety errors	Incorrect flame safety settings; flame safety alarm
Temperature overshoot	Set point set too high	Correct set point
	Incorrect tuning parameters	Adjust tuning parameters (Manual or Auto tune)
	Low fire set too high	Adjust burner low fire settings
	Internal high limit or deviation alarm not set/ set too high	Set internal high limit or deviation alarm to desired value
	External high limit not set / set too high	Set external high limit to desired value
	Controller in manual mode	Put controller in auto mode
	Burner set to manual high	Set burners to auto
	Max off cycle time set too low	Increase Max Off cycle time
	Air valve stuck open	Clean or replace air valve

Appendix

Conversion Factors

Metric to English

From	To	Multiply By
actual cubic meter/hr (am^3/h)	actual cubic foot/hr (acfh)	35.31
normal cubic meter/hr (Nm^3/h)	standard cubic foot /hr (scfh)	38.04
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 9/5) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	BTU/hr	3415
meter (m)	foot (ft)	3.281
millibar (mbar)	inches water column ("w.c.)	0.402
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}
MJ/Nm^3	BTU/ft^3 (standard)	26.86

Metric to Metric

From	To	Multiply By
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

English to Metric

From	To	Multiply By
actual cubic foot/hr (acfh)	actual cubic meter/hr (am^3/h)	2.832×10^{-2}
standard cubic foot /hr (scfh)	normal cubic meter/hr (Nm^3/h)	2.629×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F - 32) x 5/9
pound (lb)	kilogram (kg)	0.454
BTU/hr	kilowatt (kW)	0.293×10^{-3}
foot (ft)	meter (m)	0.3048
inches water column ("w.c.)	millibar (mbar)	2.489
pounds/sq in (psi)	millibar (mbar)	68.95
inch (in)	millimeter (mm)	25.4
BTU/ft^3 (standard)	MJ/Nm^3	37.2×10^{-3}

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