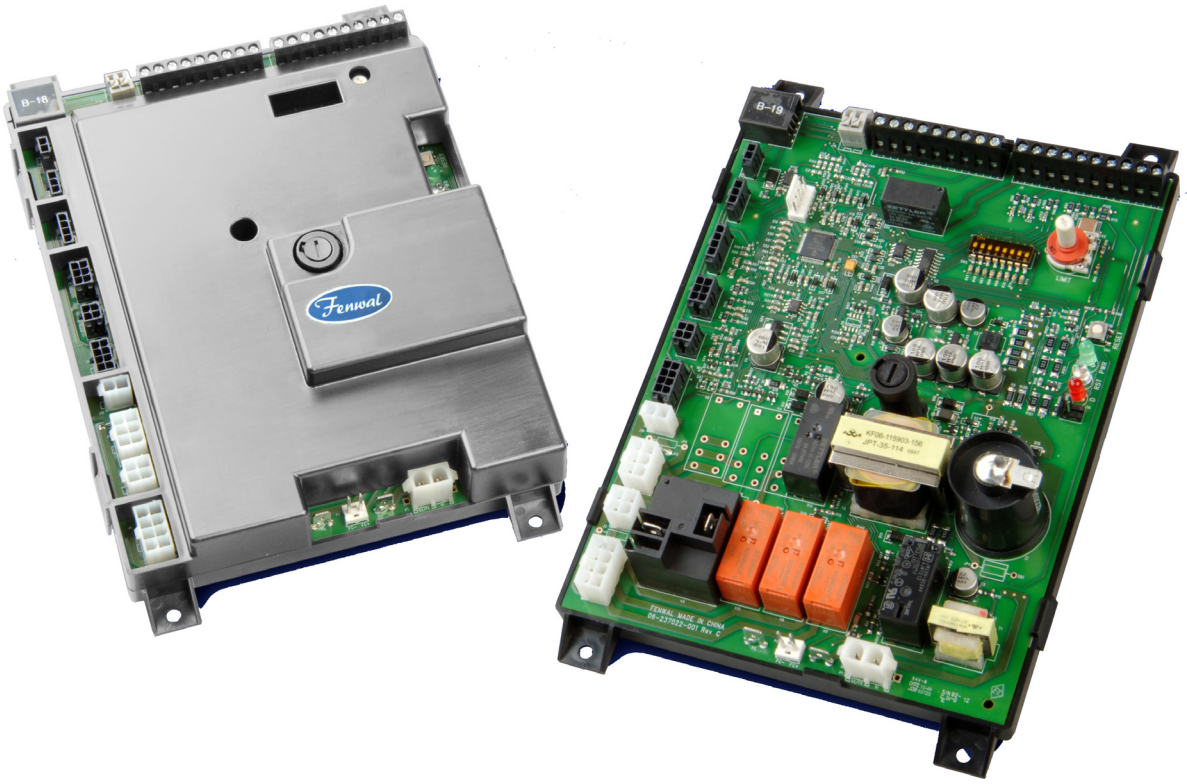
P/N 06-237157-001
June 2012

Platform Ignition Module



Installation and Operation Manual

FOREWORD

This manual is intended to provide a general overview of The Fenwal Controls® Platform Ignition Module (PIM) and its functions within a hydronic heating system when paired with a tekmar BTC_II control. This manual details wiring and connection information, product specifications, and functional characteristics to facilitate product integration by an OEM gas appliance manufacturer.

This manual also provides general operating, configuration, and troubleshooting sections which are intended to help field service personnel maintain the system when used to supplement the primary operation and maintenance documents provided by the appliance manufacturer.

The chosen set of operating parameters MUST be functionally tested for correct operation by the OEM gas heating appliance manufacturer. The corresponding ID card which reflects the parameters assigned to an appliance model must remain in the appliance at all times.

TERMS AND ABBREVIATIONS

BTC	Boiler Temperature Control	LED	Light Emitting Diode
DHW	Domestic Hot Water	LWCO	Low Water Cut-off
DSI	Direct Spark Ignition	PIM	Platform Ignition Module
EMS	Energy Management System	PWM	Pulse Width Modulation
Ft-bus	Fenwal/tekmar communications bus (RS-485)	RPM	Revolutions per Minute
HSI	Hot Surface Ignition	TFI	Trial for Ignition
IP	Intermittent Pilot	tN4	tekmar Networking

CAUTIONS AND WARNINGS

CAUTION

A caution identifies a procedure, practice, or statement, which, if not strictly followed, could result in programming errors, impairment of equipment operation, or equipment damage.

WARNING

A warning identifies an operating or maintenance procedure, practice, condition or statement, which, if not strictly followed, could result in personal injury or death.

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CHAPTER 1
PRODUCT AND COMPONENT DESCRIPTIONS

1-1 INTRODUCTION

The Fenwal Controls® Platform Ignition Module (PIM) integrates the functions of Automatic Ignition Control with temperature regulating and control functions. The PIM is designed for a range of hydronic boilers including both staged systems and modulating types. The PIM can be configured as a direct spark ignition (DSI), intermittent pilot (IP) or Hot Surface Ignition (HSI) to provide safe lighting and supervision of the burners in an appliance. The PIM is also designed to connect to and receive commands from the tekmar® Boiler Temperature Control (BTC_II). When connected to a BTC_II, the PIM offers expanded control functionality to include Domestic Hot Water (DHW), outdoor reset, diagnostic messages, and other system capabilities.

The PIM connected together with the BTC_II form a Hydronic Control System developed jointly by tekmar and Fenwal, offering a scalable modular based system to cover a wide range of boiler needs. They communicate using a proprietary protocol on the Fenwal tekmar bus (Ft-bus). The tekmar control offerings also allow for integration with other protocols (including tekmar tN4).

Figure 1-1. PIM and Associated Components

1-2 APPLICATIONS

The PIM and BTC_II control system is suited to a wide variety of residential and commercial gas-fired hydronic heating systems including:

- High-efficiency Modulating Condensing Boilers
- Fan-assisted single and multi-staged Boilers
- Multiple Boiler Installations using intelligent sequencing
- Intermittent Pilot based Hydronic appliances
- Water Heaters
- Pool and Spa Heaters

1-3 OPERATION WITH TEKMAR BTC_II

The Fenwal PIM is designed to directly interface to the tekmar® BTC_II series of boiler temperature controls to provide advanced control and energy efficiency features and support for a wide range of boiler system configurations.

The tekmar BTC_II serves as the system display, operator interface, temperature controller, and diagnostic center. Complete details on operations and features are provided in the *tekmar®- Installation and Operation Manual (BTCII-2)*

1-4 FEATURES

The PIM provides the following features:

- Integrated UL353 High Limit using Thermistor Sensor
- Configuration parameters selected through a unique Identification Card
- Communicates via (RS485) with tekmar (BTC_II) using the Ft-bus protocol
- Supports tN4 signals when using BTC_II
- Measures Inlet, Outlet, Limit, and Vent temperatures using NTC curve J Thermistors, 10 KΩ (β3892) at 25°C (12 KΩ Thermistors optional).
- Optional signals from DHW, System, and Outdoor Air sensors to BTC_II for Outdoor Reset and DHW functions.
- Supports external input (0-10 VDC or 4-20 mA) from an Energy Management System
- Controls the Boiler, System, and DHW pumps
- Controls the gas ignition sequence in response to space heating or DHW demand
- Hall-effect Water Flow sensor input for optimizing DHW performance
- Modulates the boiler firing rate using combustion blower speed control, providing a PWM output or a 4-20 mA signal.
- Closed-loop control of blower speed (RPM) through tachometer signal monitoring
- Optional support for two-stage blowers by re-assigning the DHW pump relay
- Low-voltage detection and safe shutdown below 18.0VAC supply input
- Hot Surface or Direct Spark Ignition (also allows for external HV transformer)
- Intermittent Pilot Ignition (single stage only)
- Fail-safe Control for one or two stages of gas valves
- 24 VAC or Isolated Contact Gas Valve operation
- Airflow, water flow and gas pressure switch monitoring and diagnostics
- Optional automatic reset after ignition lockout (one hour or as defined)
- Safe-Start and full-time Flame sensing
- Local (through the HSI or DSI element) or Remote Flame sensing
- Configurable as needed to meet CSD-1 applications
- System and Control Diagnostics through use of on-board or remote LED
- Communication of Diagnostic status to BTC_II through Ft-bus
- Manual Reset for Ignition Lockout or Hi-Limit (on-board or remote)
- Field Test/pump exercise capability
- Dry contact relay output for Alarm and Alert conditions
- Capability of two PIM operation to support up to 4 gas valve stages using a master/member configuration

1-5 SPECIFICATIONS

WARNING	Operation outside specifications could result in failure of the Fenwal product and other equipment with injury to people and property.

Table 1-1. Specifications

Specification	Value
Input Power	Control: 18-30 VAC 50/60 Hz (Class 2 Transformer)
Input Current Drain	400 mA @ 24 VAC with gas and blower relays energized (Control only)
Gas Valve Relays	5.0A max (continuous)
Combustion Blower	5.0 A max for standard (J2) connection 15.0 A max for heavy-duty (K5 relay) terminals
Hot Surface Igniter	5.0 A max, 120/240 VAC
Pump Relays	5.0 A max (continuous)
Alarm Relay	2.0 A, 30 VDC or 30 VAC max
Operating Temperature	-40°F to + 165°F (-40°C to +74°C)
Storage Temperature	-40°F to + 185°F (-40°C to +85°C)
Sensor Temperature Range	-22°F to + 260°F (-30°C to +126°C)
Flame Sensitivity	0.7 µA minimum
Flame Failure Response or Reignition Time	0.8 seconds minimum
Flame Detector Self-check Rate	Once per second minimum
Flame Failure Lockout Time	Varies by model
Types of Gas	Natural, LP, or manufactured
Spark Rate	Remote sense (50/60 Hz) Local sense (25/30 Hz)
Size (LxWxH)	8.50 x 6.50 x 2.50 inches (21.59 x 16.51 x 6.35 cm)
Moisture Resistance	Conformal coated to operate non-condensing to 95% R.H.
Tries for Ignition	One or three try versions available
Trial for Ignition Period	1 to 30 seconds, up to 300 seconds (IP)
Pre-purge Timings	1 to 255 seconds
Inter-purge Timings	1 to 255 seconds

1-6 AGENCY APPROVALS

C US

CSA Design certified to ANSI Z21.20, CAN/CSA C22.2 No. 199-M99

1-7 REFERENCE DOCUMENTS

The PIM complies with the documents listed below and any applicable materials referenced in the documents listed.

Table 1-2. Reference Documentation

Document Number	Name
ANSI Z21.20-2005	Thermostats and Automatic Gas Ignition Systems and Components
CAN C22.2 #199	Combustion Safety Controls and Solid State Igniters for Gas and Oil Burning Equipment
UL 372	Primary safety Controls for Gas and Oil Fire Appliances (Harmonized version)
UL 1998	Software in Programmable Components, 2nd edition
UL 353	Limit Controls
ASME CSD-1-2009	Requirements CF-200, CF-300 and CW-400

1-8 SENSORS

The PIM provides standard support for 10K ohm @ 77°F NTC curve J Thermistor probes (β=3892). Special OEM models may support other sensor types as outlined in the specific appliance manuals.

The Inlet, Outlet, Hi-Limit, and Vent (exhaust stack) sensors are directly processed by the PIM. The optional System, Outdoor, and DHW tank sensors are also connected to the PIM but passed through to the BTC_II which is required to provide those additional features.

1-9 ID CARD

The PIM determines its operating parameters by reading the identification code of an external plug-in ID card.

Note: This ID card must be present for the PIM and appliance to operate.

A total of up to 127 unique codes shall be supported. This card selects the proper settings in the PIM's memory for appliance models. These parameters include ignition timings and operation, system configuration, and OEM configuration settings. Appendix C details the parameters that are configurable for each unique ID code.

Fenwal supplies the PIM with its internal ID card settings blank. The first time a PIM is powered-up attached to an ID card, the PIM stores the ID card setting in non-volatile memory. Once set, the PIM only operates with the correct ID card installed that matches the PIM’s internal ID settings. The PIM verifies the ID card at power-up and on each call for heat cycle.

WARNING	The ID card must remain with the appliance for its entire service life. In the event of an ID Card failure, replacement must be performed by a qualified technician and must be replaced with an ID card of the same number. ID Cards cannot be interchanged between appliances.

If a PIM needs to be re-configured for another ID card, such as during service or replacement, its internal ID card settings must be cleared. To clear these settings, follow the procedure in Appendix D, Resetting the PIM to Accept a New ID Card.

CHAPTER 2
INSTALLATION AND CONFIGURATION

2-1 SYSTEM OVERVIEW

Generally, Figure 2-1 shows a typical system layout for a PIM appliance.

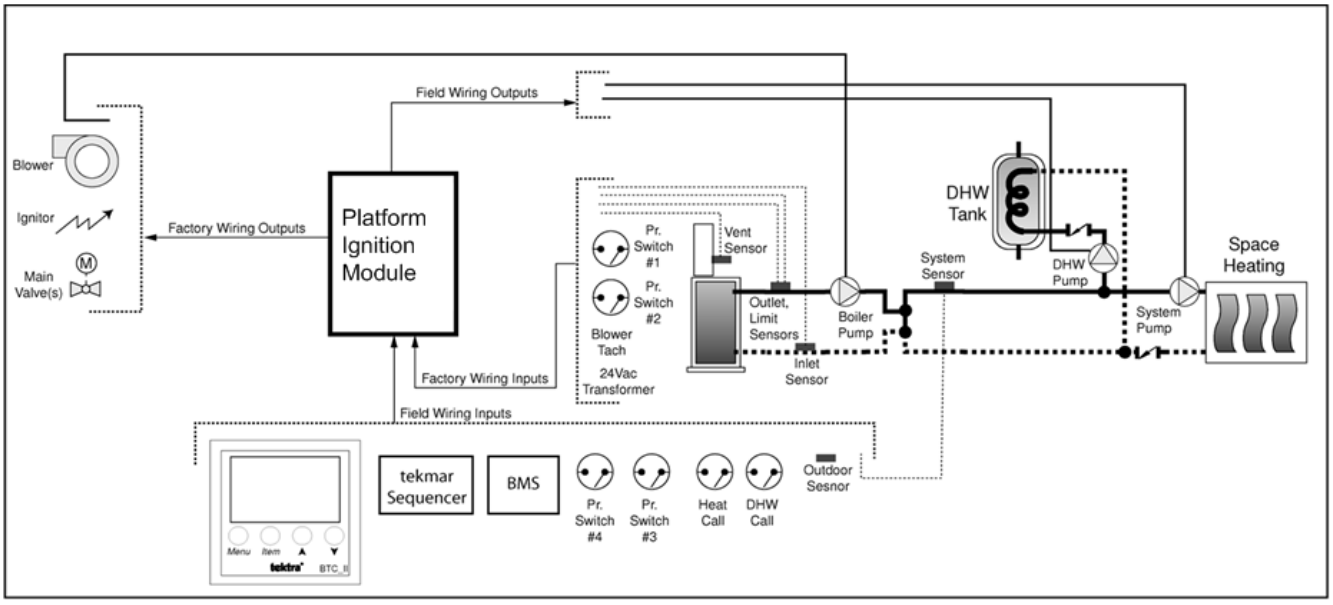

Figure 2-1. PIM Hydronic System Layout

2-2 MOUNTING

The PIM enclosure is designed to facilitate mounting within a control box by the appliance OEM.

The PIM is not position sensitive and can be mounted vertically or horizontally. The case may be mounted on any surface using four standard #8 sheet metal screws.

WARNING	The PIM must be mounted and located in a manner which protects components from exposure to water (dripping, condensate, spraying, rain). Any control that has been exposed to water must be replaced.

WARNING	All wiring must be done in accordance with both local and national electrical code. Wiring must be at least #18 AWG rated for 105°C or higher.

WARNING	The PIM uses voltages of shock hazard potential. Wiring and initial operation must be done by qualified service technician.

2-3 IGNITER LOCATIONS

Regardless of the type of ignition method, proper placement of the igniter is necessary for optimal system performance.

2-3.1 Proper Electrode Location

For DSI, the electrode assembly should be located so that the tips are inside the flame envelope and about 1/2 inch (1.2 cm) above the base of the flame.

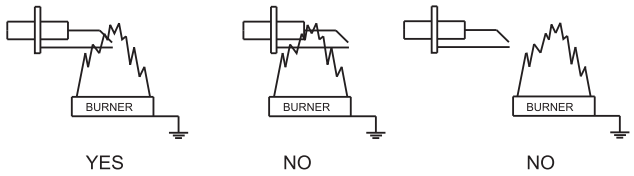

Figure 2-2. DSI Electrode Location Guideline

- Ceramic insulators should not be in or close to the flame.
- Electrode assemblies should not be adjusted or disassembled. Electrodes should have a gap spacing of 0.125± 0.031 inch (3.12± 0.81 mm), unless otherwise specified by the appliance manufacturer. If this spacing is not correct, the assembly must be replaced. Electrodes are NOT field-adjustable.
- Exceeding the temperature limits can cause nuisance lockouts and premature electrode failure.
- Electrodes must be placed where they are not exposed to the appliance user in normal operation.

2-3.2 Hot Surface Igniter

For HSI, the assembly should be located so that the hot surface element is inside the flame envelope and about 1/2 inch (1.2 cm) above the base of the flame.

Note: The temperature of the ceramic holder should not exceed the manufacturer's specifications.

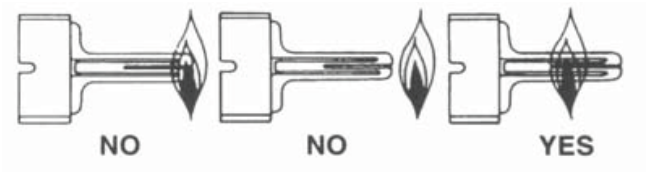

Figure 2-3. HSI Electrode Location Guideline

2-4 OEM FACTORY WIRING

2-4.1 Supplying Power

The PIM requires 24 VAC on Connector J11 to operate its microprocessor circuits, the safety switch connections, and the field demand inputs. An onboard fuse protects the 24 VAC circuits and the 24 VAC relay outputs to the gas valves.

2-4.2 Sensor Inputs

The PIM requires an outlet thermistor sensor for burner control and a high-limit thermistor sensor for the integrated UL353 high-limit function. These two thermistors must be independent but co-located so they provide similar readings. The vent sensor and inlet sensor are optional and if used should be enabled by the parameter table settings.

2-4.3 Isolated Valve Contacts

If the optional isolated valve configuration is used, the valve power and return must be separately supplied to J12 and the valve outputs are not protected.

2-4.4 Combustion Blower Connections

The blower motor is connected to J13 operating off the power supplied to L1, which can be 120VAC or 240VAC. If a modulating blower is used, PWM or 4-20 mA signals are provided by connection to J10. The blower motor tachometer signal is required when configured for closed-loop fan speed control.

2-4.5 High-Current Blower Option

If provided, the relay contacts of K5 must be used to connect the blower. The QC dry-contact terminals on top of the relay are used for the blower output and supply voltage, which may be 120VAC or 240VAC. The maximum current rating is 15.0A.

2-4.6 Pump Outputs

The pump circuits are operated off the power supplied to L1 and L1-S, which can be 120VAC or 240VAC. The boiler pump and DHW pump are sourced from L1, while the supply pump (if used) must be powered by L1-S.

2-4.7 Ignition Outputs

The PIM is capable of DSI, IP, or HSI ignition depending on configuration. For spark ignition (DSI or IP) the electrode is connected to the T3 ignition coil. For HSI the igniter element connects to P1 and is driven off the L1 supply voltage.

If configured, an external spark ignition transformer can be used by connecting it to P1. It is powered by L1 and the spark output on T3 will be disabled.

2-5 SYSTEM CONNECTIONS (FIELD WIRING)

If used, the tekmar BTC_II must be connected to J4. The RJ-45 style 8-pin jack provides power, communications, and sensor information to the BTC_II.

The PIM also acts as the central wiring point of a hydronic system. Field wiring terminals on J1 and J2 allow connection of optional DHW, outdoor, and system sensors, tN4, EMS analog demand signal, LWCO, remote reset, water flow switch, and the space thermostat and DHW demand inputs. Section 5 details these optional system level features.

2-6 WIRING DIAGRAMS

Figure 2-4 and Figure 2-5 illustrate standard wiring diagrams for the PIM.

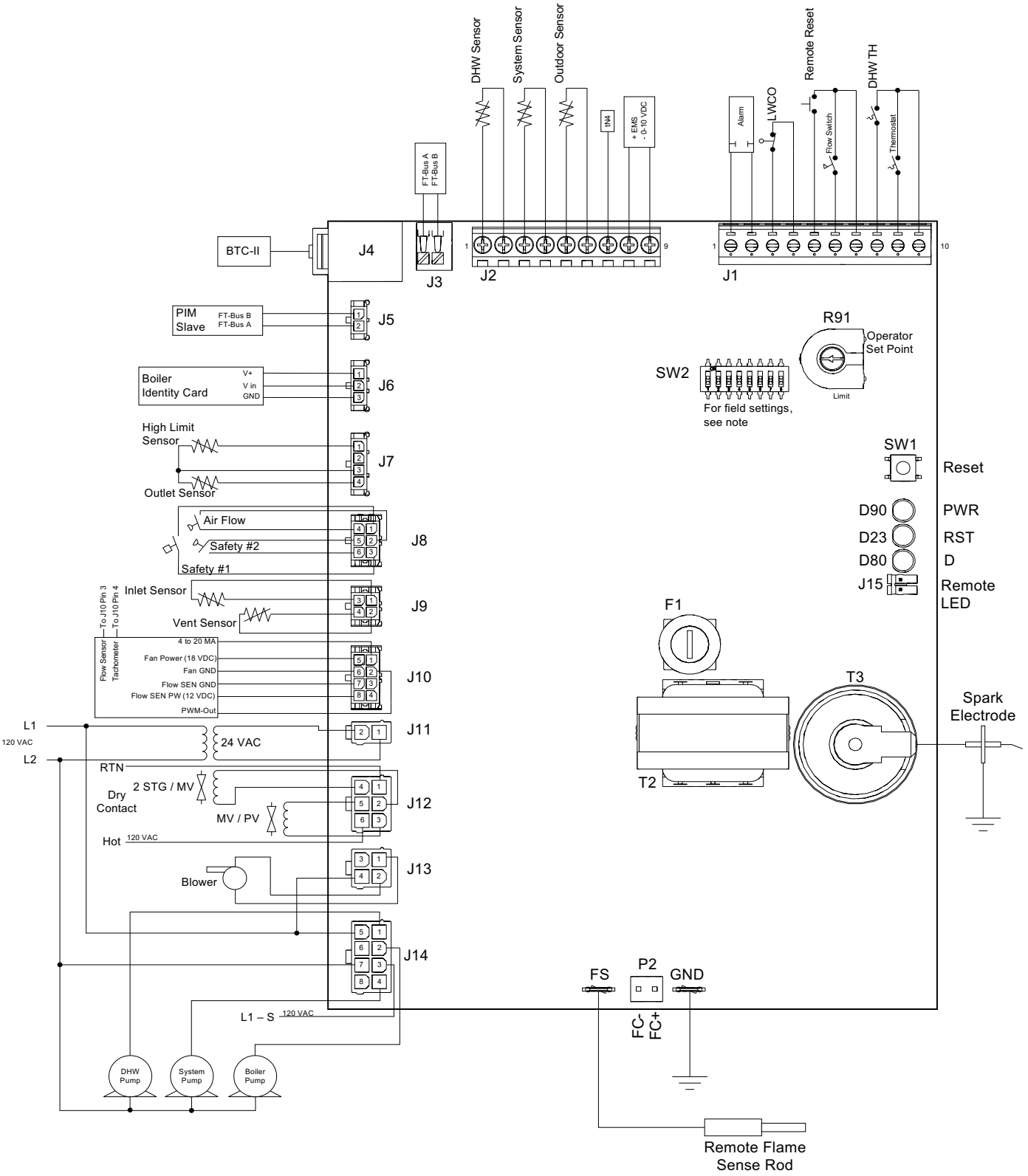

Figure 2-4. DSI Wiring Diagram

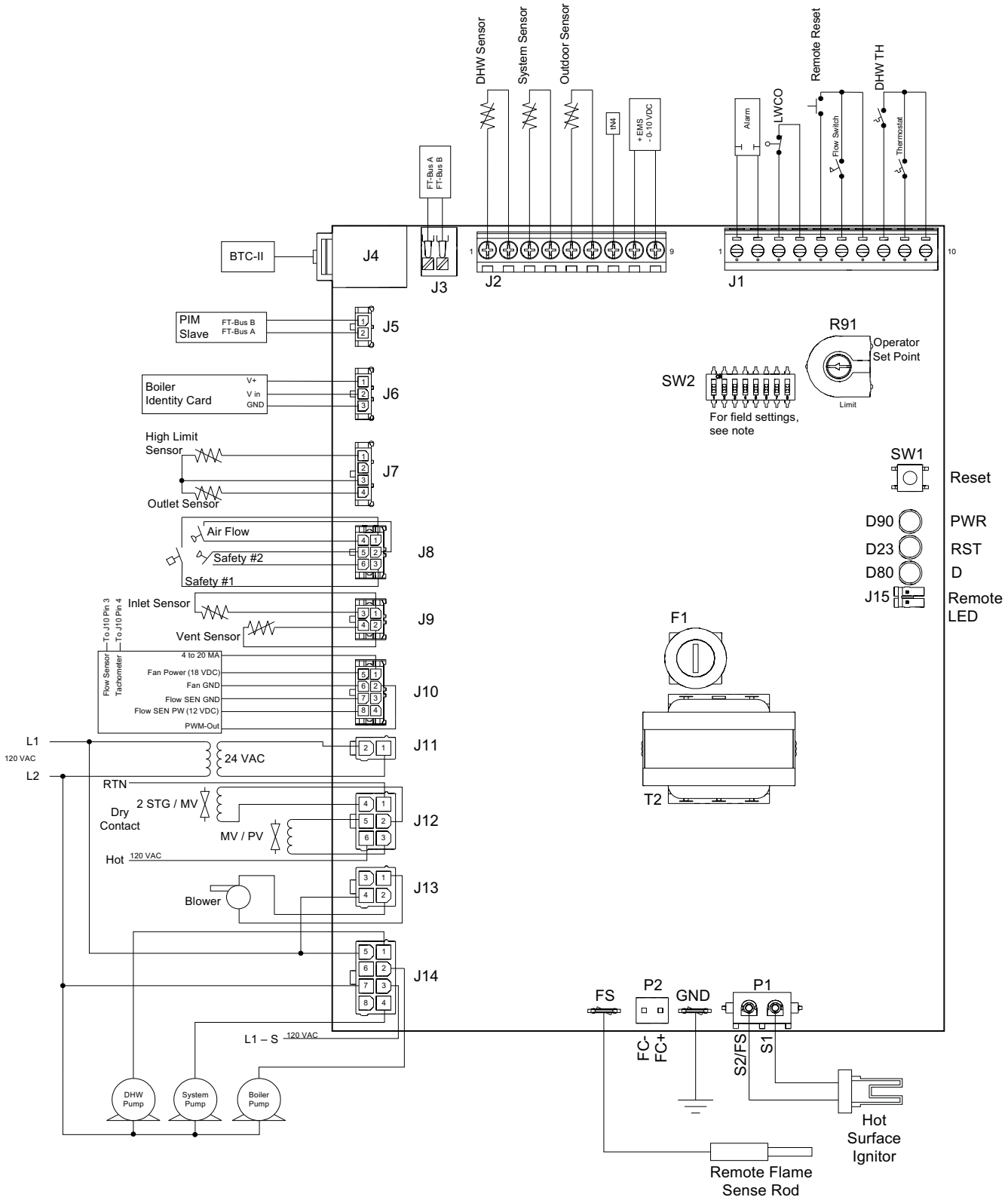

Figure 2-5. HSI Wiring Diagram

2-7 WIRING TABLES

2-7.1 OEM Factory Low-Voltage Wiring Connections (30 VAC Max)

Connector	Pin	Function	Type and Rating
J5	1	Ft-bus B (PIM to PIM)	Molex Micro-Fit, 20-30AWG, 2.0A
J5	2	Ft-bus A (PIM to PIM)	Molex Micro-Fit, 20-30AWG, 2.0A
J6	1	ID Card Power (3.3Vdc)	Molex Micro-Fit, 20-30AWG, 2.0A
J6	2	ID Card Signal	Molex Micro-Fit, 20-30AWG, 2.0A
J6	3	ID Card Ground	Molex Micro-Fit, 20-30AWG, 2.0A
J7	1	Hi-Limit Sensor	Molex Micro-Fit, 10K Thermistor J curve
J7	2	Sensor Common	Molex Micro-Fit, 10K Thermistor J curve
J7	3	Sensor Common	Molex Micro-Fit, 10K Thermistor J curve
J7	4	Outlet Sensor	Molex Micro-Fit, 10K Thermistor J curve
J8	1	Safety #1 switch	Molex Micro-Fit, 20-30AWG, 2.0A
J8	2	Airflow switch	Molex Micro-Fit, 20-30AWG, 2.0A
J8	3	Safety #1 return	Molex Micro-Fit, 20-30AWG, 2.0A
J8	4	Airflow return	Molex Micro-Fit, 20-30AWG, 2.0A
J8	5	Safety #2 switch	Molex Micro-Fit, 20-30AWG, 2.0A
J8	6	Safety #2 return	Molex Micro-Fit, 20-30AWG, 2.0A
J9	1	Inlet Sensor	Molex Micro-Fit, 10K Thermistor J curve
J9	2	Vent Sensor	Molex Micro-Fit, 10K Thermistor J curve
J9	3	Sensor Common	Molex Micro-Fit, 10K Thermistor J curve
J9	4	Sensor Common	Molex Micro-Fit, 10K Thermistor J curve
J10	1	4-20 mA Out (modulation %)	Molex Micro-Fit, 20-30AWG, 2.0A
J10	2	PWM Out (modulation %)	Molex Micro-Fit, 20-30AWG, 2.0A
J10	3	Flow Sensor Signal	Molex Micro-Fit, 20-30AWG, 2.0A
J10	4	Tachometer Input	Molex Micro-Fit, 20-30AWG, 2.0A
J10	5	Fan Power (18VDC)	Molex Micro-Fit, 20-30AWG, 2.0A
J10	6	Fan Ground	Molex Micro-Fit, 20-30AWG, 2.0A
J10	7	Flow Sensor Ground	Molex Micro-Fit, 20-30AWG, 2.0A
J10	8	Flow Sensor Power (12VDC)	Molex Micro-Fit, 20-30AWG, 2.0A
J11	1	24VAC Power (R)	Molex Mini-Fit Jr. 30VAC, 8A
J11	2	24VAC Common	Molex Mini-Fit Jr. 30VAC, 8A

2-7.2 OEM Factory Line-Voltage Wiring Connections

Connector	Pin	Function	Type and Rating
J12	1	Valve common (isolated contact)	Molex Mini-Fit Jr. 120/240VAC, 8A
J12	2	2nd stage Valve	Molex Mini-Fit Jr. 120/240VAC, 5A
J12	3	Gas Valve Return	Molex Mini-Fit Jr. 120/240VAC, 5A
J12	4	2nd Stage Valve Return	Molex Mini-Fit Jr. 120/240VAC, 5A
J12	5	Gas Valve (MV/PV)	Molex Mini-Fit Jr. 120/240VAC, 5A
J12	6	Valve Power (isolated contact)	Molex Mini-Fit Jr. 120/240VAC, 8A
J13	1	Blower Output (L1)	Molex Mini-Fit Jr. 120/240VAC, 5A
J13	2	Blower Return (L2)	Molex Mini-Fit Jr. 120/240VAC, 5A
J13	3	Blower Ground	Molex Mini-Fit Jr. 120/240VAC, 8A
J13	4	L1 supply input	Molex Mini-Fit Jr. 120/240VAC, 8A
K5 Relay		F1 and F2 terminals	.250” QC terminals, 120/240VAC, 15A
J14	1	DHW Pump	Molex Mini-Fit Jr. 120/240VAC, 5A
J14	2	Boiler Pump	Molex Mini-Fit Jr. 120/240VAC, 5A
J14	3	L1s – System Pump Supply	Molex Mini-Fit Jr. 120/240VAC, 8A
J14	4	System Pump	Molex Mini-Fit Jr. 120/240VAC, 5A
J14	5	L1 Supply power	Molex Mini-Fit Jr. 120/240VAC, 8A
J14	6	Not used	Molex Mini-Fit Jr.
J14	7	L2 (neutral)	Molex Mini-Fit Jr. 120/240VAC, 8A
J14	8	Pumps GND	Molex Mini-Fit Jr. 120/240VAC, 8A
HV		Spark Output (T3 coil)	.250” QC terminal, 25kV
GND		Burner Ground	.250” QC terminal
S1		Hot Surface Element	.250” QC terminal, 5.0A Max
S1/FS		Hot Surface Element	.250” QC terminal, 5.0A Max
FS		Flame Sense Rod	.250” QC terminal
P2	FC+	Flame Current Measurement	.156” pin header
P2	FC-	Flame Current Measurement	.156” pin header

2-7.3 Low-Voltage Field Wiring Connections (30 VAC Max)

Connector	Pin	Function	Type and Rating
J4	1	DHW sensor (to BTC)	RJ45
J4	2	System sensor (to BTC)	RJ45
J4	3	Outdoor sensor (to BTC)	RJ45
J4	4	Ft-bus B	RJ45
J4	5	Ft-bus A	RJ45
J4	6	tn4	RJ45
J4	7	24VAC Common	RJ45
J4	8	24VAC Power (to BTC)	RJ45
J3	1	Ft-bus B	22AWG twisted pair
J3	2	Ft-bus A	22AWG twisted pair
J2	1	DHW Sensor	10K Thermistor J curve
J2	2	DHW Sensor Common	10K Thermistor J curve
J2	3	System Supply Sensor	10K Thermistor J curve
J2	4	System Sensor Common	10K Thermistor J curve
J2	5	Outdoor Sensor	10K Thermistor J curve
J2	6	Outdoor Sensor Common	10K Thermistor J curve
J2	7	tN4 Communications	tekmar Network signal
J2	8	0-10Vdc Analog EMS Input	0-10 VDC or 4-20mA
J2	9	Common	GND
J1	1	Alarm Contacts	0-30VAC, 2.0A Max Dry contact
J1	2	Alarm Contacts	0-30VAC, 2.0A Max Dry contact
J1	3	Low Water Switch (LWCO)	0-30VAC, 2.0A Max
J1	4	24VAC out (R)	18-30VAC, 2.0A Max
J1	5	Remote Reset	0-30VAC, 2.0A Max
J1	6	Water Pressure Switch	0-30VAC, 2.0A Max
J1	7	24VAC out (R)	18-30VAC, 2.0A Max
J1	8	DHW Call (DHW)	0-30VAC, 2.0A Max
J1	9	Heat Call (TH)	0-30VAC, 2.0A Max
J1	10	24VAC out (R)	18-30VAC, 2.0A Max

2-8 INSTALL THE ID CARD

The PIM must always have the proper ID card attached for operation. The ID card is connected to J6 and determines the correct configuration parameters and system timings for a particular application. The ID card must always remain with the appliance, even if the PIM needs to be replaced.

2-9 POTENTIOMETER (OPERATOR SETPOINT)

The operating setpoint for PIM stand-alone mode is selected by manually adjusting a potentiometer. The operating point for outlet water temperature is settable from 110°F to 210°F.

Note: The operating setting used by the software limits the maximum setpoint to the configured operator safeguard (delta below the configured high limit setpoint) to avoid nuisance trips regardless of the potentiometer position.

2-10 CONFIGURATION (DIP SWITCH SETTINGS)

The PIM includes an 8-position DIP switch, located near the field wiring terminals. Use this DIP switch to set field configurable items when commissioning. The switch positions are listed in the following table.

Table 2-1. DIP Switch Settings

Position	Switch	Description
1	Operator Differential	(Manual/tekmar Auto Differential)
2	Analog Input Type	(Direct Drive/Target Temperature)
3	Pump Post Purge	(On/Off)
4	Pump Exercise Enable	(On/Off)
5	EMS/Demands	(PIM uses analog input only/BTC_II or PIM demands)
6	EMS Signal Type	(4-20mA/0-10Vdc) * * 4-20mA setting requires use of external 500Ω, 1/2W resistor.
7	Freeze Protection	(On/Off)
8	Commission Test	(On/Off)

The default factory setting for each switch is the second selection (off position).

Note: When a BTC_II is connected, higher level functions for these options must be enabled first using the DIP switch settings.

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CHAPTER 3
STARTUP

3-1 SYSTEM CHECKOUT

WARNING	**Risk of Explosion or Fire** Verify there are no gas leaks by using a rich soap and water solution on all joints and pipe connections. Never use a match or lighter to test for the presence of gas. Failure to test properly before operation can lead to explosion or fire and may result in severe injury or death.

Use the following method to test the gas control system after any service or component changes to the appliance:

1. Perform a visual check of all piping, burners, and venting.
2. Check all wiring for integrity and proper electrical and ground connections.
3. Verify the burner is properly grounded.
4. With the gas supply and thermostat off, turn on power to the appliance.
5. Turn the thermostat to a setting high enough to initiate a call for heat.
6. Verify the ignition control proceeds through the operating sequence to a safety shutoff (lockout) condition. (The burner will not light because the gas is shut off)
7. Turn off the thermostat.
8. Turn on the gas supply, and purge the gas lines of air.
9. Check for gas leaks on all joints upstream of the gas valve with a soap solution.
10. Turn the thermostat to a setting high enough to initiate a call for heat.
11. Verify the ignition control proceeds through the operating sequence to a normal run (burner lit) condition.
12. Confirm there are no gas leaks downstream of the gas valve using a soap solution.
13. Turn the thermostat setting down below the room temperature.
14. Verify the burner flame goes out.

3-2 FIELD TEST

Whenever the boiler is not firing or in lockout, pressing and holding the test/reset button for a period of 5 seconds shall initiate a field test. The PIM will light the Test LED indicator and sequentially turn on the Pump outputs for a minimum of 10 seconds each. Pressing and holding the test button for at least one second will cancel the field test and the Test LED shall be turned off. The remote reset input may also be activated for 5 seconds to initiate a field test whenever the PIM is not in Lockout Mode.

3-3 COMMISSION TEST MODE

When the DIP switch is set to the Commission Test position, the PIM lights the Amber LED. This mode activates certain functions to assist initial commission testing of the boiler system.

In this mode the configured high limit temperature is overridden to match the setpoint potentiometer position. The high limit can then be adjusted by the potentiometer to assist commission testing and verification. The operating setpoint is automatically set to 20°F above the high-limit (stand alone mode), or it can be controlled by the BTC_II.

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CHAPTER 4
OPERATIONAL SEQUENCE

4-1 NORMAL OPERATION

This section outlines the normal operation for the PIM.

4-1.1 Start-Up

1. Upon application of 24 VAC power, the PIM resets with all outputs in the off state.
2. The PIM performs a processor and memory self-test to insure proper operation.
3. The PIM confirms the presence of a valid ID card which matches the configuration previously stored in memory. If the valid ID card is not present, the PIM generates a diagnostic fault.
4. The PIM reads the DIP switch settings and configures itself for the desired operation.
5. The Ft-bus communications are scanned to determine if a BTC_II device is present. If found, system operation is controlled by the BTC_II.
6. The non-volatile memory is checked for an active lockout condition. A lockout indicates the previous attempt to light was unsuccessful, or a hi-limit or other system fault occurred. The PIM stays in lockout until a manual reset is performed.

4-1.2 Standby/Call for Heat

1. The PIM continuously monitors the flame status to verify no flame is present during Standby. If an erroneous flame is detected, the PIM generates a flame error fault.
2. The PIM verifies that the optional exhaust vent sensor below the vent temperature limit before burner operation can occur. If the vent temperature exceeds the limit, the PIM performs a Post-purge and proceeds to a Hard Lockout.
3. A Call for Heat is initiated by the presence of any one or more of the four sources below:
   - A heat demand (contact closure) on the TH field wiring terminals
   - A voltage greater than 0.5Vdc on the analog 0-10Vdc EMS signal input
   - A heat demand present on the DHW field wiring terminals
   - A heat demand from the BTC_II based on the DHW sensor temperature
4. The PIM initializes the Trial for Ignition (TFI) counter to the programmed number of trials and proceeds to Pump Purge mode.

4-1.3 Pump Purging

Note: If a BTC_II is present, the PIM responds to pump commands via the Ft-bus. When the BTC_II determines the boiler needs to fire, it sends a firing rate command to the PIM and operation proceeds to Blower Pre-purge.

If the PIM is in stand-alone mode, the pumps operate as follows:

1. A call for space heating energizes the boiler and system pump outputs.
2. The heat exchanger is purged providing flow past the water pressure switch.
3. The pump pre-purge time begins after the water pressure switch is proven.
4. If burner operation is required to meet the operating setpoint, the PIM proceeds to Blower Pre-purge.

4-1.4 Blower Prepurge

1. The Gas Pressure switch(es) are verified closed.
2. The Airflow switch is verified open (shorted switch detection).
3. The Combustion Blower is energized, and set to the purge speed (if modulating).
4. The Airflow switch is verified to close within 60 seconds to prove flow.
5. The configured ignition pre-purge delay takes place.
6. The voltage level of the 24 VAC supply input is confirmed to be above 18.0 VAC.
7. If all checks are passed, the PIM proceeds to Ignition.

4-1.5 Ignition (DSI Models)

1. The PIM re-initializes the ignition counter to the configured number of trials.
2. The High Limit sensor is confirmed to read below the High Limit Set Point.
3. The blower light-off RPM speed is verified (modulating type only).
4. The gas valve relay contacts are verified open (except isolated valve models).
5. The Combustion Blower is set to the Ignition light-off speed (if modulating).
6. The gas valve output is enabled for the trial for ignition time to light the burner.
7. The HV spark output is enabled for the configured trial-for-ignition time.
8. The flame sense is checked for successful lighting of the burner. When a valid flame is detected during the TFI period, sparking is terminated and the main gas valve, operating pumps, and blower relay remain energized and the PIM proceeds to the Heating mode.
9. If flame is not detected during the TFI period see "Failure to Light - Lockout".

4-1.6 Ignition (HSI Models)

1. The PIM re-initializes the ignition counter to the configured number of trials.
2. The High Limit sensor is confirmed to read below the High Limit Set Point.
3. The blower light-off RPM speed is verified (modulating type only).
4. The gas valve relay contacts are verified open (except isolated valve models).
5. The HSI Element proving current is verified to be above the configured value. (proven hot-surface models only)
6. The configured heat-up delay takes place to allow the hot surface element to reach ignition temperature.
7. The gas valve output is enabled for the trial-for-ignition time to light the burner.
8. The hot surface element is de-energized during the last second of the TFI period.
9. The flame sense is checked for successful lighting of the burner. If a valid flame is detected during the TFI period, the main gas valve, operating pumps, and blower relay remain energized and the PIM proceeds to the Heating mode.
10. If flame is not detected during the TFI period see "Failure to Light - Lockout".

4-1.7 Ignition (IP Models)

1. The PIM re-initializes the ignition counter to the configured number of trials.
2. The High Limit sensor is confirmed to read below the High Limit Set Point.
3. The blower light-off RPM speed is verified (modulating type only).
4. The gas valve relay contacts are verified open (except isolated valve models).
5. The Combustion Blower is set to the Ignition light-off speed (if modulating).
6. The Pilot gas valve output is enabled for the trial for ignition time.
7. The HV spark output is enabled for the configured trial-for-ignition time.

8. The flame sense is checked for successful lighting of the burner. When a valid Pilot flame is detected during the TFI period, sparking is terminated and the main gas valve is energized. The Pilot valve, operating pumps, and blower relay remain energized and the PIM proceeds to the Heating mode.
9. If flame is not detected during the TFI period see "Failure to Light - Lockout".

4-1.8 Heating

1. The flame status, airflow switch, LWCO switch, water pressure switch and other safety switches are continually monitored for proper state.
2. The High Limit sensor is confirmed to read below the High Limit setpoint.
3. The boiler operating water temperature is monitored against the target temperature to determine the proper firing rate or staging level.
4. The PIM remains in heating mode until the staging reaches 0% or the firing rate drops below the configured minimum value for the burner.
5. A Blower Post-purge is completed and the control proceeds to Standby mode.

4-1.9 Heat Demand Satisfied

1. The thermostat signal becomes inactive indicating the call for heat is satisfied.
2. The gas valve(s) are immediately disabled.
3. A Blower and Pump Post-purge is completed before returning to Standby mode.

4-2 FAILURE TO LIGHT - LOCKOUT

4-2.1 Single Trial Model

Should the burner fail to light, or if flame is not detected during the trial for ignition period, the control performs the following actions:

1. The control enters ignition lockout.
2. The gas valve(s) are de-energized immediately.
3. The LED indicates the fault code for ignition lockout.

4-2.2 Multi Trial Model

Should the burner fail to light, or if flame is not detected during the first trial for ignition period, the control performs the following actions:

1. The gas valve(s) are de-energized.
2. The control then goes through an interpurge delay before another ignition attempt.
3. The control attempts two additional ignition trials before going into lockout and the gas valve relay(s) are de-energized immediately.
4. The LED indicates the fault code for ignition lockout.

4-2.3 Lockout Reset

4-2.3.1 VOLATILE RESET MODELS

Recovery from lockout requires either pressing manual reset, recycling the call for heat, or removing 24 volts for a period of 5 seconds. On models with automatic reset, if the call for heat is still present after the configured reset time, the control will automatically reset and attempt to start a new heating cycle.

4-2.3.2 MANUAL RESET MODELS

Recovery from lockout requires activation of the manual reset switch or remote reset input.

4-2.4 High Limit Fault Reset

If the High Limit sensor detects a temperature above the High Limit setpoint, the PIM will enter lockout. Recovery from a High Limit fault requires activation of the manual reset switch or remote reset input.

4-3 FLAME FAILURE RESPONSE

4-3.1 Recycle Mode

With "recycle after loss of flame", upon loss of flame, the gas valve is de-energized within 0.8 seconds. After the flame recycle delay, the control attempts to relight the burner. Multi-try models allow three tries for ignition including inter-purges. If the pilot burner relights, normal operation resumes. If the burner does not relight, the control will go into lockout as described in “Failure to Light - Lockout”.

4-3.2 Re-ignition Mode (Spark Models Only)

If the established flame signal is lost while the burner is operating, the control responds within 0.8 seconds by energizing the HV spark for the TFI period in an attempt to relight the burner. If the flame is re-established, normal operation resumes. If the burner does not light within the TFI, the gas valve is de-energized immediately and on multi-try models a new TFI sequence begins. Multi-try models will make 2 more attempts to light the burner.

If the burner does not relight, the control will lockout as previously described in “Failure to Light - Lockout”.

CHAPTER 5
OPTIONAL FEATURES

5-1 SYSTEM SENSOR

If an optional system sensor is connected to J2-3 and J2-4 the PIM will pass this signal to the BTC_II and it will use the system sensor in place of the outlet sensor as the primary control point for the temperature algorithms.

5-2 OUTDOOR RESET

If an optional outdoor sensor is connected to J2-5 and J2-6 the PIM will pass this signal to the BTC_II. The heating demand will be optimized for energy efficiency based on tekmar's outdoor reset algorithm when enabled by the BTC_II.

5-3 DOMESTIC HOT WATER CONTROL

When the DHW call for heat is active, the PIM communicates this to the BTC_II. The BTC_II calculates the optimal operation and sends the firing rate and pump output requests to the PIM so it can activate the DHW pump and Boiler pump if needed.

If an optional DHW sensor is connected to J2-1 and J2-2 the PIM will pass this signal to the BTC_II. This allows the BTC_II to optimize the DHW demand to maintain the DHW setpoint. The DHW thermostat switch closure is not required when using the DHW sensor.

If a BTC_II is not present the PIM shall activate the DHW pump whenever the DHW call is active. The Boiler pump may also be activated based on the DHW piping configuration setting.

5-4 PUMP CONTROL

The PIM supports direct control of the boiler, system and DHW pumps including optimization when a BTC_II is connected. The boiler pump and the optional system pump will run whenever there is a demand for space heating. The DHW pump will run whenever there is a DHW demand. Depending on the system configuration and DHW piping, the boiler pump may be required to turn off during DHW pump operation.

Pump Postpurge, when enabled (DIP switch position 3), is controlled by the BTC_II or using fixed timings in stand-alone mode.

Pump Exercising, when enabled (DIP switch position 4), will cycle the pumps for 10 seconds every 72 hours, even with no heat demand, to help extend the life of the pumps.

5-5 FREEZE PROTECTION

Freeze protection is normally controlled by the BTC_II. When connected and freeze protection enabled (DIP switch position 7), the BTC_II provides the pump enable commands and/or boiler firing rate to prevent freezing.

In stand alone mode, the following method is used whenever the freeze protection DIP switch is enabled:

1. If either the Outlet or Inlet temperature drops below 45°F, the Boiler and System pumps shall be enabled. The pumps shall be turned off when both the Inlet and Outlet temperatures rise above 50°F.

2. If either the Outlet or Inlet temperature drops below 38°F, the Burner shall start at the minimum firing rate. The Burner cycle will terminate when both the Inlet and Outlet temperatures rise above 42°F.

5-6 ENERGY MANAGEMENT SYSTEM (CUSTOMER PROVIDED)

An external EMS system can provide direct control of the PIM through the analog 0-10 VDC input. To enable this configuration DIP switch position 5 must be set to EMS. BTC_II commands for firing rate will then be ignored.

Once a valid call for heat is detected on the Analog EMS input, the PIM will operate to maintain a target temperature or accept a direct drive demand request as determined by the system configuration. DIP switch position 2 is enabled to select direct drive; otherwise target temperature control will be used.

The PIM normally expects the signal on the analog EMS input to be 0-10VDC. For flexibility, the PIM can also accept a 4-20mA EMS input provided a 500Ω, 1/2W resistor is placed across the EMS terminals. DIP switch position 6 must also be enabled to select 4-20mA as the EMS signal type.

CHAPTER 6
TROUBLESHOOTING

6-1 TROUBLESHOOTING PROCEDURE

WARNING	**Risk of Explosion or Fire** The PIM cannot be serviced by the user. If any control faults are detected, the PIM must be replaced by qualified service personnel. Risk of explosion or fire can result if the control module has been opened or with any attempts to repair it, and the warranty is void.

Before troubleshooting the system, check the following items:

- Verify all mechanical and electrical connections are secure and tight.
- Verify all system wiring is correct.
- Verify there is a proper system ground. The igniter, flame sensor, and ignition module must share a common ground with the burner. *Nuisance shutdowns are often caused by a poor or erratic ground.*
- Perform the instructions in "System Checkout" on page 3-1, as the first step in any troubleshooting.
- Verify that the system is powered and that the thermostat is calling for heat.
- If the control displays an error code on the red diagnostic LED, troubleshoot per Table 6-2.

The LED will flash on for 1/10 second, then off for 2/5 second during a fault condition. The pause between fault codes is 8 seconds.

If the problem is not addressed in this chapter or, if after performing the suggested actions, the problem persists, contact the manufacturer of the heating appliance for support.

6-2 GENERAL TROUBLESHOOTING

Table 6-1. General Troubleshooting Guide

Symptom	Probable Cause
1. Control does not start	A. Mis-wired B. 24 VAC Transformer bad C. Fuse/Circuit breaker bad (no power) D. Bad control, check LED for steady on or flashing codes.
2. Thermostat on - no spark	A. Mis-wired B. Bad thermostat, no voltage at thermostat terminal C. Bad control, check LED for steady on or flashing codes.
3. Valve on - no spark during TFI	A. Shorted electrode B. Verify 1/8th inch spark gap. C. Check high voltage cable.
4. Spark on - valve off	A. Gas Valve coil open B. Valve wire disconnected C. Bad control, check voltage between gas valve terminals and GND.
5. Flame okay during TFI - no flame sense after TFI	A. Check electrode position B. Check high voltage wire C. Poor ground at burner D. Poor flame, check flame current

6-3 INDICATORS

The PIM has three LED indicators to display operational status and to help diagnose system error conditions.

- **Power**: Green LED indicating the PIM module is receiving 24 VAC power.
- **Alarm/Test**: Amber LED which indicates the PIM is in Commission Test Mode or that a diagnostic alarm (fault) is present.
- **Diagnostic Code**: Red LED that is normally off. During a control or system fault condition, this LED flashes the error codes. For more information, see "LED Error Code Listing" on page 6-2.

6-4 LED ERROR CODE LISTING

The following table lists the errors detected by the control and the associated LED indications

Table 6-2. LED Diagnostic Indications

Error Mode	LED Code	Recommended Troubleshooting
Normal Operation	Off	
ID Card Fault	Red LED Steady ON, Green Power LED OFF	Check that the proper ID card is securely connected. Perform a power and system reset.
Internal Control Failure	Steady ON	Perform a power and system reset. If fault remains, replace the PIM.
Airflow Fault	1 flash	Check Blower operation and airflow switch.
False Flame Error	2 flashes	Check for proper gas valve closure. Clean burner and electrodes.
Ignition Lockout Fault	3 flashes	Check the gas supply. See Table 6-1 for more information.
Ignition Proving Current Fault	4 flashes	Check HSI element. Replace with a new element of the proper rating.
Low Voltage Fault	5 flashes	Check the 24 VAC input voltage. The voltage must be above 18.0 VAC
Vent Temperature Fault	6 flashes	Check for a blocked flue. Check the vent sensor and connections.
Hi-Limit Fault	7 flashes	Check for proper water flow. Check hi-limit and outlet sensors.
Sensor Fault	8 flashes	See BTC_II for fault identification. Check sensors and wiring.
Safety #1 Fault	9 flashes	Check gas pressure. Verify proper safety switch operation.
Water Pressure Fault	10 flashes	Check piping for leaks. Check pressure switch and connections.
Blower Speed Fault	11 flashes	Verify tachometer signal and connection on J5.
LWCO Fault	12 flashes	Check LWCO switch and connections. Check the water level.
Hi-Temperature Delta Fault	13 flashes	Check pump operation. Confirm proper water flow across heat exchanger.
Ft-bus Communications Fault	14 flashes	Verify BTC_II is connected and operating. Check the cable between the BTC_II and J1.
Safety #2 Fault	15 flashes	Check gas pressure. Verify proper safety switch operation.

6-5 REPLACING THE FUSE

The 24 VAC input and output circuits of the PIM are protected by a fuse. The current rating will vary between 3.0 and 8.0 A depending on the application.

CAUTION	Always replace with a fuse of the same rating as originally installed.

6-6 INTERNAL CONTROL FAILURE

If the control detects an error in its software or hardware, all outputs are turned off and the LED displays a steady ON condition. If this condition persists after an attempt to restart then the control must be replaced.

6-7 FLAME CURRENT MEASUREMENTS

The PIM supports direct measurement of flame signal strength using the flame current test pins (FC+,FC-) on connector P2. Flame current may be measured by a micro-ammeter, or alternately by using a standard digital voltmeter. The signal on P2 is calibrated to 1 micro-amp/volt, so flame current in micro-amps can be directly read on the volts scale.

If a BTC_II is connected an approximation of flame current is displayed, with a maximum limit of 5 micro-amps.

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APPENDIX A
STAND ALONE OPERATION

A-1 STAND-ALONE TEMPERATURE CONTROL

The Fenwal PIM is fully capable of stand-alone operation of a hydronic heating system in applications where a BTC_II or other higher-level control is not required. This section details the features and limitations when operating in this configuration.

Note: The PIM also reverts to Stand-alone operation mode whenever communication with a BTC_II control is lost for more than 30 seconds.

A-2 OPERATING SETPOINT

The Potentiometer on the PIM is used to control the Operating Setpoint. This is the target outlet temperature used in the firing rate calculations. The maximum target setpoint will be limited to the high-limit setting less the operator safeguard, regardless of the potentiometer position.

A-3 TEMPERATURE CONTROL

The PIM calculates the required firing rate or stage demand using a PID-based algorithm. This algorithm uses the boiler inlet and outlet sensor inputs and the target setpoint from the operator potentiometer setting.

The algorithm uses the boiler mass and other parameter settings to refine the firing rate for optimal setpoint control. Full auto-differential capability is retained when enabled using the DIP switch.

A-4 DHW OPERATION

The PIM will respond to a DHW call signal on the field wiring terminals. The DHW pump is activated and the temperature is controlled to the operating setpoint of the potentiometer. The Boiler pump may also be activated based on the DHW piping configuration DIP switch setting.

A-5 LIMITATIONS DURING STAND-ALONE OPERATION

1. Diagnostic information is limited to the Alarm relay and LED flash codes.
2. System Sensor operation is not supported.
3. DHW sensor operation is not supported.
4. Outdoor Sensor and Outdoor Reset functions are not supported.
5. tN4 networking support is disabled.
6. Pump purge timings are controlled by parameter settings.

APPENDIX B
PART NUMBER BREAKDOWN

B-1 PIM PART NUMBER

The following image explains the meaning of the various digits in the part number. Use this information to order the correct board.

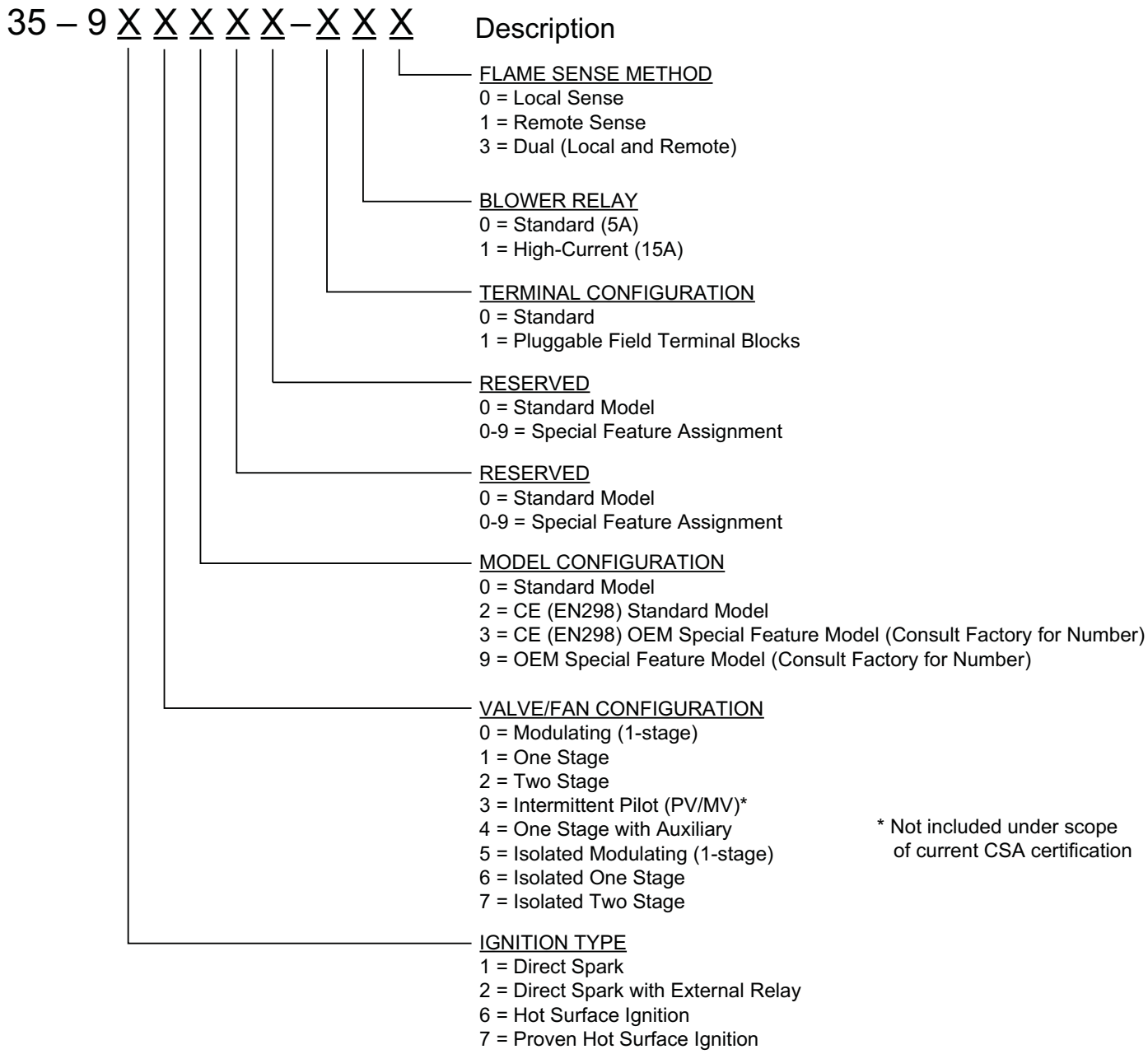

Figure B-1. Part Number Breakdown

B-2 ID CARD PART NUMBER

The ID card has part number:

05-990000-XXX

XXX is the ID card number from 001 to 127.

APPENDIX C
PIM PARAMETER DESCRIPTIONS

C-1 PIM PARAMETERS

The following tables list the parameters available for the PIM.

Table C-1. PIM Parameters

Name	Description	Allowed Range
Ignition Settings		
Type	Ignition Type	DSI, HSI, Proven HSI, IP
Ext_Spark	External spark transformer	Yes or No
TFI	Trial for Ignition (seconds)	1 to 300 (limit 25 if not IP)
Trials	Number of ignition tries	1 to 3
Heatup	HSI Heat-up period (seconds)	0 to 255
HSI Current	Ignitor Proving Current (amps)	0.5 to 4.0
Prepurge	Ignition Prepurge (seconds)	0 to 255
Interpurge	Ignition Interpurge (seconds)	0 to 255
Postpurge	Blower Postpurge (seconds)	0 to 255
Sense	Flame Sense Method	Local or Remote
Recycle/Re-ignition	Flame Loss Retry Method (re-ignition N/A with HSI)	Recycle or Re-ignition
Lockout on Loss of Flame	Locks-out on loss of flame or airflow in TFI and burn (CSD-1)	Yes or No
Reset Method	Lockout Reset Method	Volatile or Manual
Automatic Reset	Automatic Reset Delay after Lockout (seconds)	0 - Off 60 - 3600 (enabled)
Gas Stages	Number of Gas Valve Stages	One Stage, Two stage, Three Stage, or Four Stage
Blower Type	Blower Configuration	One Stage, Two-stage, Modulating, None
Flame Period Ignition	Flame Integration Period during Ignition and first 5 seconds after	10 to 30 (25mS periods)
Flame Period Burn	Flame Integration Period during Burner On Cycle	4 to 30 (25mS periods)
System Settings		
Type	Selects order of 's for Multi stage boilers	Master or Member
Hi-Limit	Hi-Limit setpoint	100-240 (°F)
Operator Safeguard	Maximum allowed Operating setpoint below Hi-Limit Setting	0 to 30 (°F)
Manual Differential	Operator setpoint differential when Manual Differential DIP switch enabled	5 to 30 (°F)
Tachometer Type	Tach signal (pulses/revolution) 0 indicates Tach not present.	0,1,2 or 3 0 uses open loop control

Table C-1. PIM Parameters

Name	Description	Allowed Range
Inlet Sensor	Inlet Sensor Present	Yes or No
Vent Sensor	Vent Sensor Present	Yes or No
Water flow Rate Sensor	Water flow Rate Sensor Present	Yes or No
Airflow Switch	Airflow Switch Monitoring	Normal, Ignore Open switch test, or Ignore All
Water flow Switch	Water flow Switch Monitoring	Normal, Ignore Open switch test, or Ignore All
Safety #1 Input	Safety Switch Input Monitoring	Normally Open, Normally Closed, or Ignore
Safety #2 Input	Additional Safety Input Monitoring	Normally Open, Normally Closed, or Ignore
Pump Prepurge	Pump Prepurge Period (seconds)	0 to 255
Pump Postpurge	Pump Postpurge Period (seconds) (stand-alone mode only)	0 to 255
DHW Pump Piping	Activate Boiler pump when DHW Pump is active (stand-alone only)	Yes or No
Boiler Configuration Settings		
Boiler Mass	Boiler Construction (thermal mass)	Low, Medium, High or Proportional
Application Type	Designates application settings for BTC_II to follow	Boiler, Water Heater or Pool Heater
Hi-Delta T Threshold	Difference between outlet and inlet temperatures for Delta T limiting	20 to 200 (°F)
Vent Temperature Limit	Threshold setting for High Vent temperature shutdown	100 to 300 (°F)
Turndown	Minimum Modulation Rate (% of full fire)	5% -50%
Closed Loop Modulating Blower Settings (tach required)		
Maximum Blower Speed	Blower RPM at Maximum Modulation Rate (100% full-fire)	0 - 16000
Purge Blower Speed	Blower RPM during Prepurge and Interpurge periods	0 - 16000
Light off Blower Speed	Blower RPM during Ignition period	0 - 16000
Minimum Blower Speed	Blower RPM at Minimum Modulation Rate (Turndown)	0 - 16000
Postpurge Blower Spee	Blower RPM during Postpurge	0 - 16000
Open Loop Modulating Blower Settings		
Maximum PWM Rate	Blower Modulation Rate (PWM output % at 100% full-fire)	0 - 100%
Purge Blower Rate	Modulation of Blower during Purge periods (% of full fire)	20% - 100%
Light off Blower Rate	Modulation of Blower during Ignition period (% of full fire)	10% - 100%
Postpurge Blower Speed	Modulation of Blower during Postpurge (% of full fire)	20% - 100%

APPENDIX D
RESETTING THE PIM TO ACCEPT A NEW ID CARD

When connecting a new ID Card to a PIM that already has a different set of ID Card parameters loaded into memory, you must perform a hard reset of the PIM to clear the saved ID card.

Follow these steps to perform a hard reset:

1. Remove power from the control.
2. Set all DIP switches on the board to their OFF position.
3. Unplug the current ID card from Connector J12 on the PIM control.
4. Power up the board while holding the reset/test button for 5 seconds.
5. The Red diagnostic LED flashes indicating a successful reset. The board's memory is now clear of any ID card parameters.
6. Release the test/reset button.
7. Remove power from the control.
8. Connect the new ID card to Connector J12 on the PIM control.
9. Set the DIP switches to their correct position for your application.
10. Power up the control.
11. If the reset was successful, the Green LED shows steady on.

If the Red and Yellow LEDs are on, and the Green LED is off, the reset was not successful. Repeat the process again.

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P/N 06-237157-001 Rev. AA