Preferred Instruments

BurnerMate Universal

Burner Management and Combustion Control

Instruction Manual

Book 1

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Instruction Manual
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PREFERRED UTILITIES MANUFACTURING CORPORATION
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<u>Warning</u>

The **BurnerMate Universal** is used to control potentially dangerous Boiler, Burner, and Combustion processes.

Only qualified Instrument Engineers or Senior Technicians that have read this entire manual, and are familiar with all aspects of the processes being controlled should attempt to install and commission this control.

FAILURE TO DO SO CAN RESULT IN EQUIPMENT DAMAGE, INJURY, OR DEATH.

This space reserved for revision notes.

BurnerMate Universal Controller

Book 1

Operation & Maintenance Manual

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Book 2 – Appendix

SECTION 1 INDEX

Introduction to BurnerMate Universal

Preferred Instruments' **BurnerMate Universal** is true industry advancement in boiler room automation and control. It is designed for application to any single-burner firetube or watertube steam or hot water boiler.

The **BurnerMate Universal** is a UL-recognized product having both fuel/air ratio and flame safeguard control capabilities. It is designed to allow commissioning using its own LCD Display. NFPA 85 compliance is met by having total separation of the fuel/air ratio and flame safeguard control hardware.

Drum Level and Furnace Draft control are available with the addition of an option board. The **BurnerMate Universal** is offered with a complete package of its own field devices, or it can be used with compatible existing equipment.

The operation of any fuel-fired equipment is generally governed by three separate control systems (and the **BurnerMate Universal** includes all three):

- **Burner Management System** (also referred to as a Combustion Safeguard or Flame Safeguard System)
- **Combustion Control System**
- **Auxiliary Control Systems**

The **Burner Management System** (BMS) governs the step-by-step starting sequence for the fired equipment. At the Release to Modulate State, control is turned over to the Combustion Control System until the operator elects to shut down the system or an abnormality results in a BMS-directed shutdown of the equipment. The BMS also provides flame supervision, system status indication, system or self-diagnostics and troubleshooting features.

The **Combustion Control System** (CCS) is responsible for Burner fuel/air ratio control. Three types of systems can be selected for use in the **BurnerMate Universal**: Jackshaft (also known as Single Point) Positioning, Parallel Positioning and Predictive Metering. Oxygen trim is a common addition to each of these systems to maintain combustion efficiency.

The use of Flue Gas Recirculation (FGR) to reduce NOx coincidentally influences effective fuel/air ratios and burner stability. FGR control is an important consideration in the design of the CCS and the BMS. With the addition of a separate oxygen analyzer mounted in the windbox, a more accurate control of FGR flow can be obtained.

During the startup and shutdown sequences, fuel, combustion air, FGR and O2 trim control elements (dampers, valves, VFDs, etc.) are directed to specific positions by the BMS. In the Release to Modulate state, their positions are governed by the CCS.

The **Auxiliary Control Systems** (ACS) are provided as option(s) in the **BurnerMate Universal**. These include Draft Control, Atomizing Steam Control, and Boiler Drum Level control. Draft control (furnace or boiler outlet) is an extremely important function as it helps to maintain consistent fuel/air ratios and FGR flow. Draft control elements are also directed to prescribed positions by the BMS during the start and shutdown sequences. Drum level control is separate from the fuel/air ratio control functions, working to maintain proper feedwater flow and drum level during all load conditions.

Glossary of Terms and Abbreviations Used in this Manual

Term or Abbreviation	Description
BMU	BurnerMate Universal
BMS	Burner Management System
CCS	Combustion Control System
ACS	Auxiliary Control Systems
States	Defined steps in the FSG sequence of operation
PTFI	Pilot Trial for Ignition
MTFI	Main Trial for Ignition
ALFCO	Assured Low Fire Cutout
Interlocks	BMU control or limit inputs (divided into 10 groups)
Px.x.x	Designates a BMU parameter number
Txxx	Designates a BMU wiring terminal number
CFH	Call for Heat
SSOV	Safety Shutoff Valve
POCS	SSOV Proof of Closure Switch
LWC	Low Water Cutout
FGR	Flue Gas Recirculation
VSD	Variable Speed Drive
MAF	Minimum Air Flow
PAF	Purge Air Flow
mA	Milliamp, usually ranging from 4 to 20 mA
OAT	Outdoor Air Temperature
DHW	Domestic Hot Water
HOP	High Oil Pressure
LOP	Low Oil Pressure
LGP	Low Gas Pressure
HGP	High Gas Pressure
LG3P	Low Gas Pressure Fuel 3
HG3P	High Gas Pressure Fuel 3
VAC	Volts AC
VDC	Volts DC

Safety Cautions and Warnings

Throughout this manual, numerous **"Cautions"** and **"Warnings"** are highlighted in bold print. Before attempting to install, commission, or operate this equipment, the reader is obligated to read all sections of this manual and to adhere to the precautions and warnings herein to ensure the safety of all personnel and to maintain the integrity of the operating equipment and systems to which this equipment is applied. If the reader has any doubt about any of the requirements, it is his/her obligation to consult the supplier. The installation and commissioning of this product MUST be carried out by suitably trained personnel who are experienced with the intended functions of this product and the operation of the equipment and systems to which it is applied.

The manufacturer of this equipment accepts no liability for any consequences resulting from the inappropriate, negligent or incorrect installation, commissioning or adjustment of operating parameters of this equipment.

Warning:

The equipment covered in this manual is capable of causing property damage, severe injury, or death. It is the responsibility of the owner or user to ensure that the equipment described herein is installed and commissioned in compliance with the requirements of all national and local legislation, whichever may prevail.

Required BurnerMate Universal System Components

BurnerMate Designations

BurnerMate Universal Chassis Model Number Description BMU - __ __ __ 0

0	Basic controller supports up to six independent servo-actuators. (3 air, 2 fuel, 1 FGR)
1	Expanded controller supports up to eight independent servo-actuators. (3 air, 2 fuel, 1 FGR) plus servos or 4-20 mA outputs for feedwater valve and draft damper.
2	Predictive Metering plus all the features of the Expanded Controller

0	Controller does not support optional oxygen trim
Z	Controller supports optional oxygen trim

H	LCD touch pad is flush-mounted on the BMU controller chassis cover for landscape chassis mounting.
V	LCD touch pad is flush-mounted on the BMU controller chassis cover for portrait chassis mounting.
N	LCD touch pad is shipped loose.

0	(Additional options for future use)

Catalog Number	Delivery	Description
BMU-00N0	1-2 weeks	Basic control chassis with ship loose LCD touch pad.
BMU-00H0 or BMU-00V0	1-2 weeks	Basic control chassis with LCD touch pad flush-mounted in the chassis cover.
BMU-0ZN0	1-2 weeks	Basic control chassis with oxygen trim and ship loose LCD touch pad. (In situ detector & probe assembly not included)
BMU-0ZH0 or BMU-0ZV0	1-2 weeks	Basic control chassis with oxygen trim and LCD touch pad flush-mounted in the chassis cover. (In situ detector & probe assembly not included)
BMU-10N0	1-2 weeks	Expanded control chassis with ship loose LCD touch pad.
BMU-10H0 or BMU-10V0	1-2 weeks	Expanded control chassis with LCD touch pad flush-mounted in the chassis cover.
BMU-1ZN0	1-2 weeks	Expanded control chassis with oxygen trim and ship loose LCD touch pad. (In situ detector & probe assembly not included)
BMU-1ZH0 or BMU-1ZV0	1-2 weeks	Expanded control chassis with oxygen trim and LCD touch pad flush-mounted in the chassis cover. (In situ detector & probe assembly not included)
BMU-2ZN0	1-2 weeks	Predictive Metering options plus the Expanded control chassis with oxygen trim and LCD touch pad shipped loose. (In situ detector & probe assembly required but not included.)

Required BurnerMate Universal Field Devices

Catalog Number	Delivery	Description
BMU-CABLE-XX	1 week	BurnerMate Universal to LCD to Servo Communications Cable (xx= cable length in feet)

Note: To assure that the integrity of system communications is maintained and that the adverse influence of "electrical noise" is minimized, it is recommended that the "BMU-CABLE-XX" be utilized.
The interconnection of the BurnerMate Universal (BMU) to the LCD and Servos utilizes the BMU-Cable. The interconnection of the BMU to the ZP Oxygen Analyzer utilizes 190130 connecting cable.
Preferred Utilities will not warranty the operation of the **BurnerMate Universal** system if wired in any other form.
Refer to the discussion on "Wiring Practices and the Suppression of Electrical Noise" in the **"BurnerMate Universal Installation – Wiring",** Section 4 of this Manual.

Actuators

Catalog Number	Delivery	Description
BMU-SM-03	1-2 weeks	3 ft-lb torque servo actuator
BMU-SM-15	1-2 weeks	15 ft-lb torque servo actuator
BMU-SM-37	1-2 weeks	37 ft-lb torque servo actuator
BMU-UM-072-FS	1-2 weeks	72 ft-lb torque servo actuator
BMU-UM-140-FS	1-2 weeks	140 ft-lb torque servo actuator
BMU-UM-280-FS	1-2 weeks	280 ft-lb torque servo actuator
BMU-UM-420-FS	1-2 weeks	420 ft-lb torque servo actuator
BMU-UM-720-FS	1-2 weeks	720 ft-lb torque servo actuator

Optional BurnerMate Universal System Components

Color Touch Screens and Communication Hardware

Catalog Number	Delivery	Description
BMU-OIT-10	1 week	10.4" Operator Interface Terminal color touch screen display with pre-configured operation and commissioning displays, built-in one Ethernet, one RS-485 and two RS232 communications ports. Graphics screens are pre-engineered.
BMU-OIT-15	1 week	15" Operator Interface Terminal color touch screen display with pre-configured operation & commissioning displays, built-in one Ethernet, two RS-485 and two RS232 communications ports. Graphics screens are pre-engineered.
BMU-OIT-Setup	1 week	Touch Screen "Application Setup" Note: the "Touch Screen Application Setup Questionnaire" (Section 8) must be completed and submitted with the Purchase Order
190777	1 week	BMU-OIT Terminal Wiring Adapter Kit
92443	1 week	BMU-OIT-10 Power Supply, 2.5 Amp, 120VAC/24 VDC

Communication Hardware

BMU-OIT-BRIDGE	1-2 weeks	Optional web browser remote communication module with pre-configured operation and commission displays visible from a standard web browser. One Ethernet, one RS-485, and two RS-232 communication ports are built-in. Pre-configured to the BMU.
90283	1-2 weeks	Historical memory 2 GB compact flash card for extended historical memory collection and export to MS Excel.
90284	1-2 weeks	Optional communications expansion card for BMU-OIT-10.

Factory Options

Catalog Number	Delivery	Description
BMU-Panel243010	1-2 weeks	NEMA 12, wall mount enclosure (24"H x 30"W x 10"D) with (2) slotted quarter-turn latches. Door hinge is on the left hand side. Panel face mounted devices, including LCD touch pad, Burner Off-On Selector Switch, Emergency Stop Pushbutton, Fuel Selector Switch, Gas / Oil Valves energized and Low Water Pilot Lights, are mounted on the door. Internally a circuit breaker, surge protector, fuses and a selective number of 120 VAC terminals will be provided. A Beacon & Alarm Horn will also be provided. Other than the power supply to the BurnerMate Universal and interconnection of the touch screen (if purchased) there is no wiring. Standard Drawings showing the panel arrangement and the internal wiring schematic are presented in the BurnerMate Universal Instruction Manual, Section 4. Application-specific wiring drawings (if required) are to be prepared by others – not by PUMC.
BMU-Panel243010-OIT	1-2 weeks	NEMA 12, wall mount enclosure (24"H x 30"W x 10"D) – includes same items outlined in BMU-Panel-LCD. Additional panel mounted devices include 10.4" Touch screen Monitor (BMU-OIT-10), 24 VDC power supply and terminal adapter kit for OIT interfacing. Other than the power supply to the BurnerMate Universal and interconnection of the touch screen, there is no wiring. Standard Drawings showing the panel arrangement and the internal wiring schematic are presented in the BurnerMate Universal Instruction Manual, Section 4. Application-specific wiring drawings (if required) are to be prepared by others – not by PUMC.
BMU-Wiring	1-2 weeks	For the "Stock" Panel mount BMU Option only, an application-specific wiring diagram can be generated indicating field device to BMU connector wiring. Note: direct wiring from the field device to the connector is presumed (i.e. no intermediate terminals are required or recommended).

Optional BurnerMate Universal Field Devices

Flame Scanners

Catalog Number	Delivery	Description
BMU-UVSC-10C	1 week	Ultraviolet self-check scanner (incl. 10 ' cable)
BMU-UV-10C	1 week	Ultraviolet non-self-check scanner (incl. 10 ' cable)
BMU-IR-10C	1 week	Infrared non-self-check scanner (incl. 10 ' cable)

Oxygen Probes and Accessories

Catalog Number	Delivery	Description
ZP-20	1 week	In situ detector & probe assembly 20”
ZP-30	1 week	In situ detector & probe assembly 30”
ZP-45	1 week	In situ detector & probe assembly 45”
ZP-65	1 week	In situ detector & probe assembly 65”
ZP-90	1 week	In situ detector & probe assembly 90”
190130	1 week	ZP probe connecting cable – seven wire Specify length required (Maximum is 500 feet.)
190680	1 week	ZP probe mounting kit, includes: • (1) 3” 125# cast iron threaded flange • (1) 3” pipe, half-coupling, threaded • (1) 3” x 8” long pipe nipple, threaded • (1) 3” gasket • (50) feet copper tubing, ¼” OD • (8) Hex head screw, 5/8-11 x 2 ½ • (2) Straight fitting, brass • (8) Hex nut, 5/8-11 • (8) Washer, 5/8 • (2) 1/8” ball valve – brass
92168	1 week	8% calibration gas cylinder (21”H x 4” diameter)
92169	1 week	0.4% calibration gas cylinder (21”H x 4” diameter)
92297	1 week	Flow meter assembly, 0-5 SCFH, 2” flow meter, ½” NPT valve

Optional BurnerMate Universal Field Devices

Gas Control Valves

All Gas Control Valves are shipped factory mounted to BMU-SM Servos and pre-stroked for 90 degrees.

Catalog Number	Delivery	Description
VBF2.00T-M-BB-SOUS37	1-2 weeks	2” NPT bronze 175# butterfly valve, Maximum Cv = 180
VBF1.50T-M-BB-SOUS15	1-2 weeks	1-1/2” NPT bronze 175# butterfly valve, Maximum Cv = 112
VBF1.25T-M-BB-SOUS15	1-2 weeks	1-1/4” NPT bronze 175# butterfly valve, Maximum Cv = 85
VBF1.00T-M-BB-SOUS15	1-2 weeks	1” NPT bronze 175# butterfly valve, Maximum Cv = 43
VBL0.75T-F-B90V-EOUS15	1-2 weeks	3/4” NPT bronze 175# butterfly valve, Maximum Cv = 25
VBL0.50T-F-60V-EOUS15	1-2 weeks	1/2” NPT bronze 175# Butterfly Valve, Maximum Cv = 13

Natural Gas Capacity – SCFH (Based on a gas-specific gravity of 0.5543 and gas temperature of 60 deg. F)									
Valve Size	Valve Cv	Pinlet:	2.5" w.c.	5" w.c.	10" w.c.	80" w.c.	5 PSIG	10 PSIG	25 PSIG
		DP:	0.5" w.c.	1" w.c.	4" w.c.	16" w.c.	1 PSI	2 PSI	5 PSI
8.00	4200		173471	245996	494072	1061325			
6.00	2600		107387	152283	305854	657011			
4.00	819		33827	47969	96344	206958	287474		
3.00	457		18875	26767	53760	115482	160410		
2.50	322		13299	18860	37879	81368	113024		
2.00	180		7434	10543	21175	45485	63181	99272	196650
1.50	112		4626	6560	13175	28302	39313	61769	122360
1.25	85		3511	4978	9999	21479	29836	46878	92862
1.00	43		1776	2519	5058	10866	15093	23715	46977
0.75	25		1033	1464	2941	6317	8775	13788	27312
0.50	13		537	761	1529	3285	4563	7170	14202

For a complete listing of valve alternatives and a more in-depth valve-capacity calculation procedure, consult the factory. The maximum pressure rating of the 6" & 8" valves is 3 PSIG, of the 2-1/2 through 4" is 5 PSIG, and of valves 2" and smaller is 175 PSIG.

Optional BurnerMate Universal Field Devices

Oil Control Valves

All Oil Control Valves are shipped factory mounted to BMU-SM Servos and pre-stroked for 90 degrees.

Catalog Number	Delivery	Description
VMC0.50T-H-F1/224-EOUS15	1-2 weeks	1/2” NPT alloy steel 300# micro valve, Maximum Cv = 1.74
VMC0.50T-H-F1/220-EOUS15	1-2 weeks	1/2” NPT alloy steel 300# micro valve, Maximum Cv = 1.14
VMC0.50T-H-F1/218-EOUS15	1-2 weeks	1/2” NPT alloy steel 300# micro valve, Maximum Cv = 0.706
VMC0.50T-H-B1/224-EOUS15	1-2 weeks	1/2” NPT alloy steel 300# micro valve, Maximum Cv = 0.522
VMC0.50T-H-F1/216-EOUS15	1-2 weeks	1/2” NPT alloy steel 300# micro valve, Maximum Cv = 0.430
VMC0.50T-H-B1/220-EOUS15	1-2 weeks	1/2” NPT alloy steel 300# micro valve, Maximum Cv = 0.381
VMC0.50T-H-B1/218-EOUS15	1-2 weeks	1/2” NPT alloy steel 300# micro valve, Maximum Cv = 0.289
VMC0.50T-H-B1/216-EOUS15	1-2 weeks	1/2” NPT alloy steel 300# micro valve, Maximum Cv = 0.227
VMC0.50T-H-B1/212-EOUS15	1-2 weeks	1/2” NPT alloy steel 300# micro valve, Maximum Cv = 0.154

Fuel Oil Capacity – GPH
(Based on 0.8654 specific gravity #2 fuel oil at a temperature of 60 deg. F)

Valve Size	Valve Cv	DP:	1 PSI	5 PSI	10 PSI	15 PSI	20 PSI	25 PSI	30 PSI
½” F0.5/24	1.740		112	251	355	435	502	561	615
½” F0.5/20	1.140		74	164	233	285	329	368	403
½” F0.5/18	0.706		46	102	144	176	204	228	249
½” B0.5/24	0.522		34	75	106	130	151	168	184
½” F0.5/16	0.430		28	62	88	107	124	139	152
½” B0.5/20	0.381		25	55	78	95	110	123	135
½” B0.5/18	0.289		19	42	59	72	83	93	102
½” B0.5/16	0.227		15	33	46	57	65	73	80
½” B0.5/12	0.154		10	22	31	38	44	50	54

For a complete listing of valve alternatives and a more in-depth valve-capacity calculation procedure, consult the factory. The maximum pressure rating of all listed valves is 300 PSIG. Capacities given are based on a 90-degree valve rotation.

Optional BurnerMate Universal Field Devices

Pressure & Differential Pressure Switches

Catalog Number	Delivery	Description
DP-ANT-.07/1.7-IWC-FG	4-5 weeks	Combustion air pressure switch, 0.07 to 1.70 in. W.C., FM/UL/CSA
DP-ANT-.10/10-IWC-FG	4-5 weeks	Combustion air pressure switch, 0.10 to 10.0 in. W.C., FM/UL/CSA
DP-ANT-.10/24-IWC-FG	4-5 weeks	Combustion air pressure switch, 0.10 to 24.0 in. W.C., FM/UL/CSA
DP-ANT-5.0/35.0-IWC-FG	Consult Factory	Combustion air pressure switch, 5.0 to 35.0 in. W.C., FM/UL/CSA
P-ASH-0/15-PSI-AGO	4-5 weeks	Atomizing air/fuel oil/steam pressure switch, 0 to 15 PSIG, narrow deadband, FM
P-ASH-0/30-PSI-AGO	4-5 weeks	Atomizing air/fuel oil/steam pressure switch, 0 to 30 PSIG, narrow deadband, FM
P-ASH-0/200-PSI-AGO	4-5 weeks	Atomizing air/fuel oil/steam pressure switch, 0 to 200 PSIG, narrow deadband, FM
P-ANT-0.8/4.0-IWC-GAS	4-5 weeks	Gas pressure switch, 0.8 to 4.0 in. W.C., FM/UL/CSA, w/pilot light
P-ANT-2.0/20.0-IWC-GAS	4-5 weeks	Gas pressure switch, 2.0 to 20.0 in. W.C., FM/UL/CSA, w/pilot light
P-ANT-1.0/4.0-PSI-GAS	4-5 weeks	Gas pressure switch, 1.0 to 4.0 PSI, FM/UL/CSA, w/pilot light
P-ANT-1.0/7.0-PSI-GAS	4-5 weeks	Gas pressure switch, 1.0 to 7.0 PSI, FM/UL/CSA, w/pilot light
P-ANT-6.0/15.0-PSI-GAS	4-5 weeks	Gas pressure switch, 6.0 to 15.0 PSI, FM/UL/CSA, w/pilot light
12477	4-5 weeks	Pressuretrol, 2 to 15 PSI
12435	4-5 weeks	Pressuretrol, 5 to 50 PSI
12471	4-5 weeks	Pressuretrol, 10 to 150 PSI

Temperature Switches

Catalog Number	Delivery	Description
T-ASH-420-75/205F-ALL	4-5 weeks	Temperature switch, all fluids, 75 to 205 deg. F., w/Thermowell, U = 2.5”, remote mount w/10’ capillary
T-ASH-420-150/260F-ALL	4-5 weeks	Temperature switch, all fluids, 150 to 260 deg. F., w/Thermowell, U = 2.5”, remote mount w/10’ capillary
T-ASH-420-350/525F-ALL	4-5 weeks	Temperature switch, all fluids, 350 to 525 deg. F., w/Thermowell, U = 2.5”, remote mount w/10’ capillary
12482	4-5 weeks	Aquastat, 110 to 290 deg. F
12482	1 week	Thermowell Assembly, ½” NPT

Optional BurnerMate Universal Field Devices

Transmitters

Catalog Number	Delivery	Description
JC-22XMTR-HPCO	1 week	Draft Transmitter with High Pressure Cut-out
JC-22XMTR-LDCO	1 week	Draft Transmitter with Low Pressure Cut-out
70600	3-5 days	0-25 psig / 4-20 mA pressure transmitter SS sensor & body, 1/2” MNPT, c/w steam siphon loop
70601	3-5 days	0-200 psig / 4-20 mA pressure transmitter SS sensor & body, 1/4” MNPT, c/w steam siphon loop
70602	3-5 days	0-500 psig / 4-20 mA pressure transmitter SS sensor & body, 1/4” MNPT, c/w steam siphon loop
70610	3-5 days	-50 to +300 F temperature sensor Thermistor type, 5.5” x 0.25” SS probe, 1/2” MNPT, weatherproof enclosure
70610W	3-5 days	Thermowell 4.5” immersion, SS, 1/2” MNPT (for 70610)
70611	3-5 days	-50 to +300 F temperature sensor Thermistor type, 8.5” x 0.25” SS probe, 1/2” MNPT, weatherproof enclosure
70611W	3-5 days	Thermowell 7.5” immersion, SS, 1/2” MNPT (for 70611)
70612	3-5 days	Outside air temperature sensor -30 to +120 F, Thermistor type, weatherproof enclosure with sunlight shield

BMU Quick Disconnect System Selection

Catalog Number	Delivery	Description
BMU-JBOX	1-2 weeks	BMU Quick Disconnect Termination Box
PWR-CABLE-ASSEMBLY-2	1-2 weeks	Quick Disconnect Cable, 4 wire, 2 ft.
PWR-CABLE-ASSEMBLY-6	1-2 weeks	Quick Disconnect Cable, 4 wire, 6 ft.
PWR-CABLE-ASSEMBLY-12	1-2 weeks	Quick Disconnect Cable, 4 wire, 12 ft.
COM-CABLE-ASSEMBLY-2	1-2 weeks	Quick Disconnect Cable, 8 wire, 2 ft.
COM-CABLE-ASSEMBLY-6	1-2 weeks	Quick Disconnect Cable, 8 wire, 6 ft.
COM-CABLE-ASSEMBLY-12	1-2 weeks	Quick Disconnect Cable, 8 wire, 12 ft.

SECTION 2 INDEX

BurnerMate Universal Overview

Safety Features and Optional Functions

Emergency Stop and Safety Relays (All BMU models)

The Safety Relay (K17) contacts and the Emergency Stop Relay (K16) contacts provide 120 VAC to the contacts of the fuel bus relays (all ignition source and fuel valve relays). When either the Safety Relay or the Emergency Stop Relay is de-energized, the 120 VAC is removed from the Fuel Bus Relay outputs. The Fuel Bus Relay output contacts are individually monitored, and the safety relay coil de-energizes if any Fuel Bus Relay malfunctions. See drawing on page 12.

Servo Tests (All BMU models)

Fuel, Air and FGR servos are stroke tested from minimum to maximum position during every burner start-up. A detailed message will be displayed to facilitate servo troubleshooting. Servos such as Feedwater, Atomizing Steam and Draft do not stroke during the Servo Test. Parameter **P2.1.2** allows the set up engineer to choose the desired action of the FGR damper servo during the Servo Test, Close then Open or Open then Closed.

Fuel Selection (All BMU models)

The desired fuel is selectable via the LCD display, field contact inputs or Modbus. The burner will light off only if a single fuel is requested. If the requested fuel is changed, the burner will be forced back to Standby and then directed to restart with the new selected fuel without the required assistance of the boiler operator.

Low Fire Fuel Transfer (All BMU models)

This option implements NFPA 85 Section 5.7 procedures for Single Burner Simultaneous Firing of Two Fuels for Fuel Transfer Only. A New Fuel can be selected while the burner is operating in the Release to Modulate mode. The Fuel Transfer method is selected in **P1.12.1** as either Restart or Low Fire. The **BurnerMate Universal** will automatically sequence the burner through a safe fuel changeover, oil to gas, or gas to oil.

Fuel Firing Flexibility (All BMU models)

Light oil, heavy oil, natural gas and/or waste gas fuel firing are supported in the following combinations: one gas; one oil; one oil and one gas; two gases; and one oil and two gases. Fuel firing flexibility offers the opportunity to save fuel cost by firing that fuel which is the most economical. A single command to the BMS (local or remote) will initiate a controlled fuel transfer to the desired fuel.

FD Fan Variable Speed Changeover to Fixed Speed Bypass (ALL BMU models)

There are two separate and very different sets of combustion curves for 60 Hz fixed speed Forced Draft (FD) Fan operation versus Variable Speed Drive (VSD) operation. The operator simply shuts down the burner, selects VSD or VSD Bypass (fixed speed), and then restarts the burner.

Safety Features and Optional Functions

Run/Test Hold Dipswitch (All BMU models)

The Run/Test Hold Dipswitch 1 can be turned on before the pilot flame has been proven so a "Pilot Turndown Test" can be performed. Enabling **P1.2.1** will also turn on this feature**.**

Single or Dual Flame Scanners (All BMU models)

The **BurnerMate Universal** can be configured for a second scanner that can be used to provide redundant flame safety and allow for individual scanner maintenance without tripping the burner. There are three Preferred Instruments Unitized Scanners to choose from: IR, UV and UV self-checking. The scanners provide a contact closure to the **BurnerMate Universal** to prove the flame and also a 4-20mA signal for the display of flame intensity (0-100% scale).

Third-party scanners can be used in lieu of the Preferred Instruments scanners. The **BurnerMate Universal** provides 120VAC or 24VDC terminals for a power supply. The analog inputs for the flame intensity display can be 4-20mA, 0-20mA, 0-5VDC, 0-3VDC, or 0-1VDC. Dipswitches 5 & 6 provide a 250-ohm resistor across the input terminals to convert the mA signals to DC volts. The dipswitches remain off if a DC volt signal is supplied.

Individual Limit Annunciation (All BMU models)

The **BurnerMate Universal** monitors and annunciates up to 6 recycling limit inputs and up to 33 non-recycling limit inputs. All boiler limits are 120 VAC contacts, wired in parallel for easy troubleshooting and individualized annunciation.

Lockout and Alarm History (All BMU models)

When the **BurnerMate Universal** initiates a lockout, it saves a "snapshot" of more than 140 boiler/burner variables. This data can be viewed for the previous 10 burner lockouts by accessing the Lockout History via the LCD touch pad. The past 50 alarms (including lockouts) are time/date stamped and can also be displayed using the LCD display.

Automatic Gas SSOV Leak Test (All BMU models)

Gas safety shutoff valve leak testing can be performed automatically. This feature can be used with or without a vent valve between the two SSOVs. If there is no vent used, enable parameter **P1.8.2.** It should be noted that when the Automatic Gas SSOV Leak Test is enabled (for Fuel 2), the **BurnerMate Universal** cannot be configured to fire a second gas fuel (Fuel 3).

MAF and PAF Safe Start Check (All BMU models)

Unless the FD Fan is in the manual run mode, terminals **T35** and **T34** must be de-energized at the start of a cycle indicating that the fan is off. Likewise, **T33** (Minimum Air Flow) and **T46** (Purge Air Flow) must be de-energized to indicate that these switches are operable and not bypassed. A nuisance delay timer is 60 seconds before Lock Out.

Safety Features and Optional Functions

Automatic Oil Gun Post Purge (All BMU models)
Oil gun purging helps minimize the admission of unburned oil into the furnace after burner shutdown. The **BurnerMate Universal** supports two methods of oil gun purge: safely purging oil into the furnace with the pilot flame on (“BlowThru”); or energizing a scavenging pump to pull the oil back out of the oil gun (“Pumpback”). Automatic Oil Gun Post Purge is functional during the Low Fire Fuel Changeover when the New Fuel selected is gas.

Nuisance Trip Protection (All BMU models)
To prevent nuisance shutdowns, the technician can enable time delays of up to four seconds for the following external limits: minimum airflow, low fuel pressure, low atomizing steam flow, etc. Similar to the flame failure response time of a flame scanner, these adjustable time delays will allow the BMS to “ride through” intermittent “opening” of these external limits. The fuel specific limit delays (HOP, LOP, LGP, HGP, LG3P, and HG3P) are only in effect immediately after opening the SSOVs.

High Flue Gas Temperature Shutdown (All BMU models)
The **BurnerMate Universal** can monitor flue gas temperature, and if it exceeds a user-defined set point, the BMS initiates a trip. This serves as an additional protection against firing a “dry” boiler.

Fuel/Air Position “Pacing Logic” (All BMU models)
The key to efficient boiler operation is accurate, repeatable positioning of the fuel, air and FGR servos and VSDs. When the firing rate is changing, the **BurnerMate Universal** moves all servos and VSDs simultaneously, each at its own speed. Due to fuel valve and air damper non-linearity, a 10 degree air damper change might correlate to a 5 degree fuel valve change. In this example, the fuel servo has to run at one-half the speed of the air servo to remain "on the curve" during a load change. The **BurnerMate Universal** automatically compensates as the curves change with firing rate and as the servo speeds change with load. Every 500 ms, the **BurnerMate Universal** measures the current position of each servo and VSD, calculates a new target position/speed for each servo and VSD based on the curves, and then moves all outputs simultaneously. This feedback measurement compensates for output position or speed deviations. When the fuel valve is not changing, all outputs (servos and VSDs) will settle to within +/- one deadband of each output’s curve value.

Additional information on the “Pacing Logic” is provided in the Commissioning Section.

Five Configurable Auxiliary Relays (All BMU models)
Up to five auxiliary relays can be configured for a variety of uses. Common alarm, auxiliary fan start, oil auxiliaries, gas auxiliaries, common auxiliaries, hot water pump start, LWC blowdown valve, flame on, limits made, fuel valves open, etc.

Safety Features and Optional Functions

The **BurnerMate Universal** can accommodate up to ten control servos and four Variable Speed Drives depending on the model selected and application requirements.

Typical servo applications:
1. Oil valve servo
2. Gas valve servo
3. Fuel #3 valve servo (landfill gas, digester gas, etc.)
4. Tandem fuel valves (single servo for linked fuel valves)
5. Jackshaft Firing Rate servo
6. Link Trim Actuator (LTA) O2 trim servo
7. Combustion Air FD damper servo
8. Auxiliary servo 1 (burner air sleeve control, fresh air damper, etc.)
9. Auxiliary servo 2 (inner/outer spud control, steam valve for NOx control, etc.)
10. FGR damper servo
11. Atomizing Steam control servo (BMU-1xx0 or BMU-2xx0 only)
12. Boiler Outlet Damper for draft control (BMU-1xx0 or BMU-2xx0 only)
13. Boiler Feedwater servo for drum level control *** (BMU-1xx0 or BMU-2xx0 only)

Servo Actuators from 3 to 720 ft-lbs are available.

The **BurnerMate Universal** can also accommodate the following variable speed drives (VSDs):
1. FD Fan
2. Auxiliary 2 (FGR for example)
3. Draft ID Fan (BMU-1xx0 or BMU-2xx0 only)
4. Feedwater pump *** (BMU-1xx0 or BMU-2xx0 only)

*** Note that a Feedwater valve servo and a Pump VSD cannot both be configured.

Tandem Oil/Gas Valve Servo
This option allows a single actuator to be mechanically linked to both the Oil (Fuel 1) and Gas (Fuel 2) Control Valves. A separate actuator is required for Fuel 3. The **BurnerMate Universal** maintains separate curves for Standby, Purge, and Ignition positions along with separate fuel/air ratio curves for Oil and Gas.

Analog Inputs and Outputs
The Basic **BurnerMate Universal** (BMU-0xx0) provides five analog inputs for a variety of uses (steam pressure, hot water temperature, remote set point, etc.) plus two analog outputs with paired feedback analog inputs typically used for VSD control. The Expanded **BurnerMate Universal** (BMU-1xx0 and BMU-2xx0) provides an additional eleven analog inputs and four analog outputs to accommodate the optional Fully Metered Combustion Control, Draft, Feedwater, and Windbox O2 Trim Control.

Safety Features and Optional Functions

Flue Gas Oxygen Trim (BMU-0Zx0, BMU-1Zx0 and BMU-2Zx0)
Flue gas oxygen measurement is used to continuously adjust (trim) the fuel/air ratio. Oxygen trim saves fuel by fine-tuning the burner to operate safely and reliably at reduced excess air levels throughout the burner firing range. It also allows the controller to compensate for external environmental changes that affect burner stoichiometry (i.e. ambient temperature, fuel heating value, viscosity, etc.). Low flue gas oxygen can be elected to shutdown the burner after an adjustable time delay.

Jackshaft "Link Trim Actuator" Oxygen Trim Servo (BMU-0Zx0 and BMU-1Zx0)
For Jackshaft Positioning applications, one of the Actuators can be designated as the Oxygen Trim Actuator. This actuator will be integrated into the mechanical fan damper linkage system connecting the FD Damper and the jackshaft. The **BurnerMate Universal** "LTA" limits the amount of +/- trim. This option can only be configured for a Jackshaft Positioning Combustion Control cases.

Windbox Oxygen FGR Trim (BMU-1xx0 and BMU-2xx0)
Flue Gas Recirculation (FGR) reduces NOx emissions by mixing flue gas with fresh air, usually at the FD Fan inlet. This blend results in a reduction in the oxygen level from a normal 20.9% to a typical range of 15-18%. The FGR mass flow rate can vary based on flue gas temperature, outlet draft conditions and other factors. The **BurnerMate Universal** Windbox O2 Trim option allows for corrective action to maintain the windbox O2 at the same levels as the "commissioned" level.

Variable Speed Drive FD Fan Control (All BMU models)
The **BurnerMate Universal** maximizes VSD electrical energy savings by allowing the user to maintain the FD Fan Damper at 100% open from high fire down to approximately 40% (field adjustable). From 40% firing rate down to minimum fire, the FD Fan damper ramps from full open to partially closed to assure the maximum burner turndown is achieved.

The **BurnerMate Universal** allows an operator to select between constant speed and variable speed combustion air flow control for either fuel oil, fuel gas and/or fuel 3 (waste gas) firing. Two sets of fuel/air ratio curves can be stored for each fuel.

Atomizing Media Pressure Control (BMU-1xx0 and BMU-2xx0)
The Atomizing Media Pressure Control option compares current atomizing pressure versus the "commissioned" atomizing pressure curve (Atomizing Pressure vs. Fuel Valve Position) and PID control will modulate the control servo. An external Atomizing Pressure Transmitter is required for use of this option.

Safety Features and Optional Functions

Combustion Efficiency Calculation and Display
(BMU-0Zx0, BMU-1Zx0 and BMU-2Zx0)
A "Combustion Efficiency by Losses" computation based on Flue Gas Oxygen and Flue Gas Temperature is implemented and the results displayed on the LCD. This is available for Oil (Fuel 1) and Gas (Fuel 2). Fuel 3 calculation is based on #2 oil only. Parameter **P2.4.13** allows selection of either a #2 Fuel Oil or #6 Fuel Oil for the calculation.

Firing Rate Set Point (All BMU models)
The **BurnerMate Universal** can operate in the "Manual" mode, in which the firing rate is determined by the operator, or the operator can input a steam pressure or water temperature set point, and the **BurnerMate Universal** will "automatically" use PID control to maintain that set point. A firing rate or set point signal can also be input remotely – either through a wired contact or Modbus.

Firing Rate Control (All BMU models)
Firing rate demand is the result of the firing rate controller PID demand or a remote firing rate demand (4-20mAdc or Modbus). The firing rate PID is only active when Local mode is selected with the "Local/Remote" push button and the "Auto" mode is selected with the "Auto/Manual" push button.

The firing rate PID controller compares the firing rate set point to the actual measured boiler outlet temperature (or pressure) and, based on the deviation, creates a firing rate demand. When "Manual" mode is selected with the "Auto/Manual" push button, the firing rate is an operator-selected value. The remote firing rate demand choice is determined by a parameter selection.

Call for Heat (All BMU models)
The CFH start and stop command is determined either by local set point deviation or a remote input. When set point deviation is selected, the **BurnerMate Universal** will generate a CFH when the fired equipment is a user-defined temperature (or pressure) below the firing rate set point. Alternatively, the CFH is removed when the boiler outlet conditions are a user-defined value above the firing rate set point. The remote start/stop command choice is determined by a parameter selection.

Outdoor Air Temperature Reset (All BMU models)
The **BurnerMate Universal** saves energy by lowering a Hot Water Boiler's exit temperature set point when the outside air temperature increases. Operating cost is greatly reduced during warmer days. When desired, the operator can also set the boiler water temperature set point manually.

Safety Features and Optional Functions

Domestic Hot Water Override (All BMU models)
Some boilers are used primarily for building space heating, but they also provide heat for domestic hot water (DHW) tanks. When the outdoor weather is warm, there may be no space-heating load, and the boilers will shut down.

Another possible scenario is that the outdoor reset set point has dropped so low (due to warm weather) that the DHW cannot be heated sufficiently. The DHW override feature forces the exit water temperature set point to be greater than or equal to the DHW set point.

The DHW start logic overrides the remote CFH, the OAT cutoff set point, and the Building Automation System disable input.

Warm Standby Option (All BMU models)
Some boiler installations, such as those for manufacturing plants, research facilities and medical facilities, cannot tolerate a sustained low header pressure (or temperature). Larger boilers require a long slow warm-up cycle. Therefore, some facilities require that one or more boilers be kept on "Warm Standby."

Warm Standby boilers are periodically fired at low fire until their pressure (or temperature) is almost as high as the operating pressure, and then the boilers are shut down. When the pressure drops to a lower threshold, the cycle repeats. If a boiler is kept warm, it can rapidly be brought up in firing rate as needed.

When this option is selected, the Warm Standby logic starts and stops the boilers using a boiler shell temperature (or pressure) switch or the boiler outlet temperature (or pressure) sensor by comparing this signal against user-determined start and stop set points.

Cold Start Warm-Up Cycle Option (All BMU models)
Because of the stress created by thermal expansion, some boilers require a slow warm-up if the boiler is cold. The firing rate Cold Start Warm-up Cycle Option steps the firing rate up in stages in response to the boiler outlet temperature (or pressure). An override timer can cause the firing rate to increase to the next firing rate step, even if the boiler outlet temperature (or pressure) has not yet reached the step set point. Consult the boiler manufacturer for the proper firing rate and set point step sizes and the proper override time for your particular boiler.

An in-progress warm-up cycle can be cancelled by placing the firing rate “Auto/Manual” push button in “Manual”. This cycle occurs only once per boiler start-up.

The cold start warm-up cycle ends automatically, and the PID logic begins modulating the burner if the boiler outlet conditions exceed a field selectable value or are equal to the firing rate set point.

Safety Features and Optional Functions

Burner Light-off Low Fire Hold (All BMU models)
To minimize thermal stresses, some boilers require that the burner hold at low fire (0%) after light off. The **BurnerMate Universal** will release the burner to modulate when the boiler shell temperature (or pressure) increases to set point or the Low Fire Hold Override Timer times out. This cycle occurs only once per boiler start-up. The Cold Start Warm-up Cycle Option overrides the Burner Light-off Low Fire Hold. If the Warm Standby Option is the only CFH, the firing rate demand will remain at low fire. The temperature is measured by a boiler shell temperature (or pressure) sensor or a boiler water temperature (or pressure) switch, depending on the option selected.

Integrated Draft Control (BMU-1xx0 and BMU-2xx0)
The **BurnerMate Universal** can perform simple proportional floating draft control, or PID draft control with firing rate feedforward. It also supports field selectable boiler outlet damper Servo or 4-20 mA actuator control, ID Fan Variable Speed Drive (VSD) control, or combined damper and VSD control. Open damper or adjustable starting draft options are also selectable.

Drum Level -- Feedwater Control (BMU-1xx0 and BMU-2xx0)
User-configurable one, two, or three-element drum level control can be accomplished using a servo feedwater valve, 4-20 mA control valve, or feedwater pump VSD control.

Automatic Low Water Cutout Blowdown (All BMU models)
The user can select the time of day for automatic blowdown, the duration, and a minimum steam drum pressure required to perform automatic blowdown. An alarm or a lockout can also be configured to occur if a low water cutout doesn't open during the blowdown.

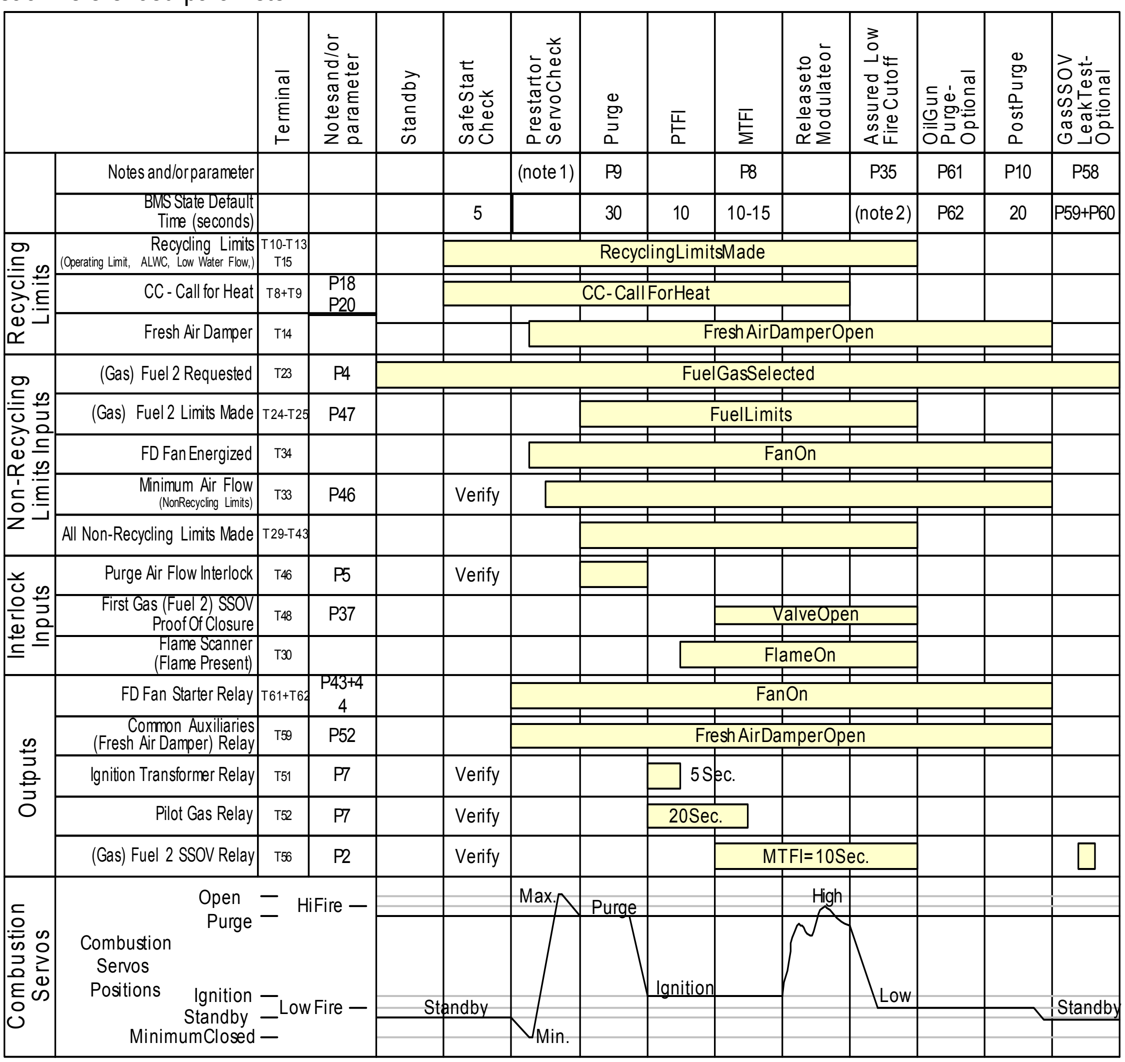
RS485 Modulating Lead/Lag Interface (All BMU models)
This option allows communication via a Modbus network to an optional Chief Dispatcher modulating lead/lag controller or to a building automation system and thereby eliminates the need for individual firing rate and CFH signal wiring.

Burner Management System Overview

The Burner Management System logic provides automatic burner sequencing, flame supervision, system status information, system and self-diagnostics and troubleshooting information.

The sequence governed by the BMS follows the general guidelines of NFPA 85. The following is a typical BMS Start-up Sequence:

The below sequence is a typical Fuel 2 application based on the factory default values set in each referenced parameter.



Note 1: The time for PrePurge depends on the slowest stroke time of any of the servos.
Note 2: The time for ALFCO depends on the firing rate the burner is at when the CFH is de-energized.

Burner Management System Overview
The BMS sequence is divided into 13 separate states. Four of these 13 states are optional operations: ALFCO, Low Fire Fuel Transfer, Oil Gun Purge and Gas Valve Leak Test. The 13 states are as follows and are shown in standard sequential order:

Standby
Safe Start Check
Prestart
Purge
Pilot Trial for Ignition (PTFI)
Main Trial for Ignition (MTFI)
Release to Modulate
Low Fire Fuel Transfer
Assured Low Fire Cutout (ALFCO)
Oil Gun Purge
Post Purge
Gas Valve Leak Test
Lockout

Descriptions of BMS States
<u>Note: The descriptions of each state can change slightly depending on how particular parameters are set. The following are descriptions based on parameter default values.</u>

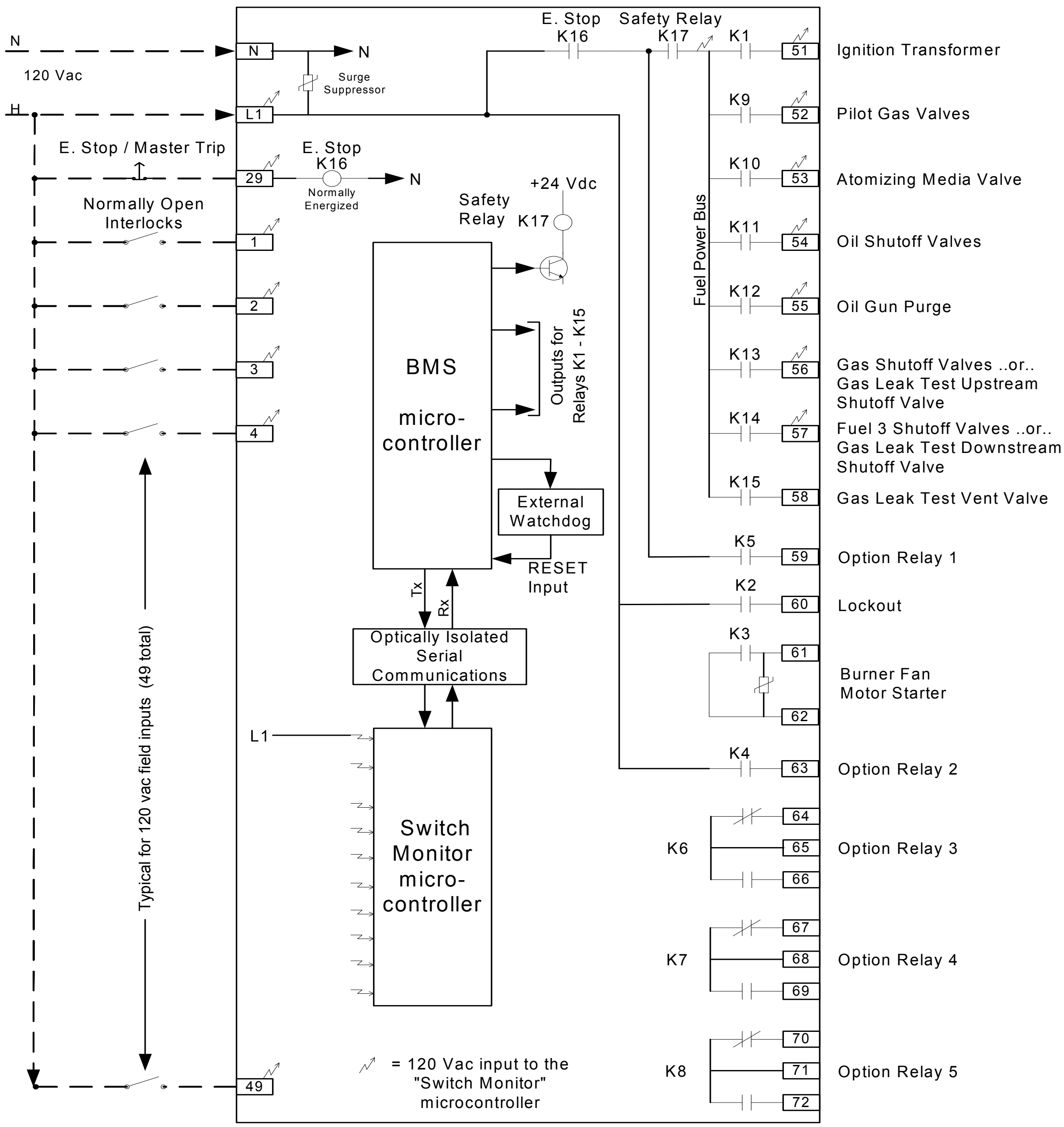
Standby
Standby is the state from which the BMS starts an operating sequence following a Call for Heat when all the following interlock inputs are energized:
Burner off-on switch -- **T10**
Operating limit -- **T11**
Auxiliary low water level cutout -- **T12** (steam boilers)
Low water flow -- **T13** (hot water boilers)
Spare recycling limit -- **T15**
During the Standby state, the BMS will command all fuel/air devices to their standby positions. The Emergency Stop and the Fuel Valve Proof of Closure switches are monitored. Should either of these inputs open – the BMS will lockout.
During the Standby state, a technician or engineer is allowed to change restricted and non-restricted parameters.

Burner Management System Overview

Safe Start Check

During Safe Start Check, the fuel/air ratio curve data are verified, parameter values are checked for conflicts, and minimum/maximum limits are checked. If all fans are off, the Minimum Air Flow **T33** and Purge Air Flow **T46** switches are verified to be "open".

The BMS will also test the Safety Relay by de-energizing the K17 coil and insuring there is no power detected on any of the fuel terminals **T51** thru **T58**. The following diagram illustrates the power flow through the **BurnerMate Universal**.



BurnerMate Universal Power Flow Diagram

Burner Management System Overview

Safe Start Check – continued
The BMS initiates a Lockout if any of these items fail; the Emergency Stop is "open", any of the Fuel Valve POCS are detected as "open", or if a false flame is detected. If a Lockout has not occurred, the start sequence is continued.

From this point on, restricted parameters may not be changed until the BMS has returned to the Standby or Lockout state. The programming of non-restricted parameters is not allowed during Safe Start Check and Prestart.

Prestart
During Prestart, all combustion servo calibration data, parameters and feedback potentiometer alignments are checked by forcing the servos first to their full closed and then to their full open positions.

If Auxiliary Relays are being used, they are now energized (terminals **T59** to **T72**).
The FD fan is started by contacts **T61** and **T62.**
The Atomizing Steam (Air) valve **T53** is directed to open after the FD fan starts (if oil is selected).

When the above items have been proven, the combustion servos are sent to the Purge position. The start sequence is now on hold until all Recycling Limits (including the Fresh Air Damper) and applicable Non-recycling Limits and Fuel Limits are made.

If the servo for the unselected fuel fails the Servo Check, a message will alert the operator that the standby fuel may not be available for use. However, if **P1.12.1** is selected to Low Fire, the **BurnerMate Universal** will Lock Out if the unselected fuel servo fails the Servo Check.

Purge
Once all the purge interlocks are satisfied, the purge timer is started. During Purge, the purge interlocks are allowed to open intermittently but for no more than 30 seconds (cumulative). The purge timer stops counting when a purge interlock is open. If the purge interlocks are open for more than 30 seconds, the **BurnerMate Universal** will Lockout.

After the purge time is complete, the **BurnerMate Universal** will drive the servos to their ignition positions.

Pilot Trial for Ignition, PTFI
After the servos are proven in their ignition positions, the ignition transformer and Pilot valve outputs **T51 and T52** are energized (according to **P1.1.7**). A Pilot flame must be proven present before the PTFI times out (10 seconds), or a Lockout will result (does not apply to direct spark ignition mode).

The Run/Test Hold Dipswitch 1 can be turned on before the flame has been proven so a pilot turndown test can be performed. Also, the servos can be positioned to allow air or fuel adjustments for proper light-off.

Burner Management System Overview

Main Trial for Ignition, MTFI
If a pilot flame is proven **T30,** the **BurnerMate Universal** energizes the SSOVs (terminals **T54** to **T58,** depending on the selected fuel). The Pilot valves and ignition transformer de-energize 10 seconds after the main SSOVs are energized. From this point forward, the Main Flame must be proven continuously, or a Lockout will occur.

Note: If you are in the Commission Mode, the **BurnerMate Universal** holds at the light-off position so that the technician can make adjustments to the fuel and air servos.

The sequence proceeds to the Release to Modulate state.

Release to Modulate
The **BurnerMate Universal** releases control of the combustion servos to fuel/air ratio control. The fuel remains at the ignition position while all other air and FGR devices must move to their corresponding "On Curve" positions within 20 seconds, or a Lockout will occur. “Servo Pacing” is now enabled. Any servos that are not being used are commanded to the Standby position. Based on the process variable (steam PSI or water temperature) to set point comparison, a firing rate demand signal is generated that positions the appropriate servos to their proper positions.

The **BurnerMate Universal** continually monitors all Recycling and Non-recycling interlocks, fuel request changes and the Call for Heat inputs.

Low Fire Fuel Transfer
There are two ways in which an operator can change from the current fuel being fired to a new fuel, Restart or Low Fire Fuel Transfer. See **P1.12.1.** If the burner is in the Standby state when a new fuel is selected, the **BurnerMate Universal** will fire that new fuel upon a command to start.

When Restart is selected in **P1.12.1**, the operator can select a new fuel while the burner is running. The **BurnerMate Universal** will safely shut down the current fuel and restart the burner using the new fuel selected.

WARNING

LOW FIRE TRANSFER CAN BE HAZARDOUS AND CAN RESULT IN EQUIPMENT DAMAGE, INJURY OR DEATH. Low Fire Transfer should only be used if a Competent Authority (the burner manufacturer or field tests performed by a combustion engineer) determines that the burner, pilot/igniter, scanners, and other equipment are compatible with the selected sequence and are in compliance with NFPA 85, or other applicable code. Burner Low Fire Transfer should be thoroughly tested during initial start-up for flame stability, scanner sighting, pilot turndown, and overall Safe operation.

The ‘With Pilot’ option should NOT be selected unless the Competent Authority has determined that the burner and the pilot/igniter comply with the NFPA 85 Fuel Transfer Standard.

If Low Fire is chosen in **P1.12.1** and a New Fuel is selected during the Release to Modulate state, the **BurnerMate Universal** will perform the following sequence:

- The New Fuel Curve data is checked for errors and any Auxiliary Option Relays are energized. The Atomizing Media valve is opened if the New Fuel is oil.
- The sequence Holds until all of the New Fuel limits are made.
- The Firing Rate travels to the ignition curve point of the Old Fuel while all other devices stay on curve relative to the fuel servo. The New Fuel servo is sent to the ignition position. During a fuel transfer, the Atomizing Media will go to the curve point and not the ignition point.
- The Air Damper/VSD is biased up to provide extra air to accommodate the addition of the New Fuel. **P1.12.4**
- The fuel valves for the New Fuel are opened after the air reaches the bias position.
- Both fuels are fired simultaneously for **P1.12.3** seconds.
- The Old Fuel valves are closed.
- The Air Bias is removed followed by a 20 second delay to the air to get back on curve.
- Normal operation resumes.

Both Restart and Low Fire Fuel Transfer can be selected with any of the three Combustion Control choices: Jackshaft (JS), Parallel Positioning (PP), and Predictive Metering (FM).

The Oil Gun Purge option will still be allowed during an automatic fuel transfer. When the fuel has changed from oil to gas and once the oil valve is determined to be closed, the Oil Gun Purge will take place. The release back to modulate is delayed by the gun purge timing **P1.9.2.**

Parameter **P1.12.2** allows the **BurnerMate Universal** to energize the pilot during the fuel transfer operation.

WARNING

ENABLING THIS OPTION ON A BURNER WITH AN INADEQUATE PILOT AND/OR SCANNER ARRANGEMENT IS EXTREMELY DANGEROUS!

This option can only be enabled after an Activation Code has been entered into the BurnerMate Universal. Consult the burner manufacturer to determine if this feature can be safely used with the burner. A written statement of approval from the burner manufacturer must be provided to Preferred Instruments in order to obtain the activation code.

Assured Low Fire Cutout (ALFCO) (Optional) (All BMU models)

When the **BurnerMate Universal** detects that there is no longer a Call for Heat and the ALFCO is enabled, all combustion servos are commanded to the Low Fire position before the SSOVs are de-energized. If the ALFCO is disabled, the SSOVs close immediately when there is no longer a Call for Heat.

Oil Gun Purge (Optional) (All BMU models)
Two Oil Gun Purge options are available: Blow Thru and Pump Back.

> **Warning: Do not use either of these options unless approved by the burner manufacturer and unless the proper pilot and piping have been installed.**

Blow Thru Option - The **BurnerMate Universal** commands the combustion servos to their Low Fire positions. The Pilot is turned on and is allowed 10 seconds to stabilize. The Atomizing Media Purge Valve **T55** is energized as the fuel SSOVs **T54** are de-energized. The Atomizing Media now purges the oil out of the gun and this discharge is safely burned with the assistance of the Pilot Flame. After the programmed Oil Gun Purge timer is completed, both the Atomizing Media Valve **T53** and the Atomizing Media Purge Valve are de-energized. The sequence proceeds to Post Purge.

Pump Back Option - The **BurnerMate Universal** holds all servos at each one's last position. **T55** is energized, and the evacuation pump removes oil from the gun and sends it back to the return line. The sequence proceeds to Post Purge.

Post Purge
After the fuel valves have de-energized and the Oil Gun Purge has completed, the fans continue to operate until the Post Purge time has elapsed. All combustion devices remain at their last position. All fans and auxiliary outputs are de-energized.

Gas Valve Leak Test Option (All BMU models)
The Gas Valve Proof of Closure switches (POCS) prove the valves are in their closed positions. However, a valve's POCS does not prove that the valve seats are not leaking. The **BurnerMate Universal** provides an optional Automatic Gas Valve Leak Test (Fuel 2 only). Most gas trains incorporate two Safety Shut Off Valves (SSOVs) with a Normally Open Vent Valve arranged so that the area between the two SSOVs is vented to atmosphere when the burner is off. (Refer to the drawing on page 24) However, many of the gas trains in the field today no longer use a vent valve and depend entirely on the Gas Leak Test procedure to prove the integrity of the SSOV seats. If there is no vent valve used, enable **P1.8.2.**

Lockout
The **BurnerMate Universal** reverts to the Lockout state whenever an unsafe or undesirable condition has been detected. The operator must reset the **BurnerMate Universal** before a burner restart can be attempted. Refer to **Troubleshooting Guide** (Section 6) for an overview of the Lockout messages and their meanings.

The following are some of the most common causes for a Lockout:

- Flame failure
- A fuel valve POCS opened at the wrong time during the sequence
- A Non-recycling limit has opened
- A Low Flue Gas Oxygen level has been detected
- High Flue Gas Temperature
- The Emergency Stop switch has opened
- Loss of communications with any of the servos has been detected
- The position of a combustion servo or VSD is "off-curve"

Interlock Groups

The following are the **BurnerMate Universal** Interlock Groups:

Stop Burner
Call for Heat (CFH)
Recycling Limits
Emergency Stop
Fan Speed
Non-recycling Limits
False Flame
Flame Failure
Fuel Valve "Proof of Closure" (POCS)
Fuel Limits

Descriptions of Interlock Groups

Stop Burner
The operator has manually turned off the burner on/off switch **T10**.

Call for Heat (CFH)
A burner start request has been made by a remote source **T9**, a local source **T8**, through Modbus communication or from a set point deviation.

Recycle Limits
Should a recycle limit open at any time during a normal sequence, the **BurnerMate Universal** will conduct an orderly shutdown and revert to the Standby state. The burner will automatically restart when the recycle limit closes. Recycle limits are:

- Operating Limits **T11**
- Auxiliary Low Water Level Cutout **T12**
- Low Water Flow **T13**
- Fresh Air Damper Open **T14**
- Auxiliary Recycle Limit **T15**

Emergency Stop
If the Emergency Stop input **T29** opens in any of the **BurnerMate Universal** states, a Lockout will occur.

Fan Speed
If the operator changes the fixed fan speed versus variable fan speed input **T3** in any of the **BurnerMate Universal** states (except Standby or Lockout), the burner will Lockout.

Interlock Groups

Common Non-recycle Limits
Should any of the common Non-recycle limits open from the end of the Prestart state to the end of the Oil Gun Purge state, a Lockout will result. The following are Non-recycle limits common to all fuels:

- Fuel specific limits are listed on Page 19
- High-High Limit Shutdown **T32** (pressure or temperature)
- Minimum Air Flow **T33**
- FD Fan Energized **T34** (as applicable, **T3**)
- FD Fan VSD Energized **T35** (as applicable, **T3**)
- Low Water Level Cutout **T36**
- High Water Level Cutout **T37**
- Low Draft Pressure **T38**
- ID Fan Energized **T39** (as applicable, **P1.1.6**)
- FGR Fan Energized **T40**
- Spare Limit 1 **T41**
- Spare Limit 2 **T42** (as applicable, **P1.8.1**)
- Spare Limit 3 **T43** (as applicable, **P1.8.1**)

False Flame
A false flame is a flame that is detected during the Standby, Safe Start, PreStart, or Purge States. If a flame is detected during these states a Lockout will result.

A False Flame is ignored for 90 seconds after the fuel valves close and for the first 30 seconds during Prestart.

Flame Failure
A Lockout occurs if no flame is detected during PTFI, MTFI, Release to Modulate, ALFCO, or Oil Gun Purge.

Fuel Valve Proof of Closure Switches (POCS)
The POCS indicate to the BMS that the fuel valves are closed. There are three terminal inputs for POCS, one for each fuel. If allowed by code, POCS can be disabled for smaller burners.

- Oil Valve Proof of Closure **T47** (as applicable **P1.3.3**)
- Gas Valve Proof of Closure **T48** (as applicable **P1.3.4**)
- Fuel 3 Proof of Closure **T49** (as applicable **P1.3.5**)

Interlock Groups

Fuel Limits

Non-recycling fuel limits:

- Fuel 1 -- Oil:
    1. High Oil Pressure **T17**
    2. Low Oil Pressure **T18**
    3. Low Atom. Media Pressure **T19**
    4. Low Atom. Media Flow **T20**
    5. High/Low Oil Temperature **T21**
    6. Oil Gun in Position **T22**
- Fuel 2 -- Gas:
    1. High Gas Pressure **T24**
    2. Low Gas Pressure **T25**
- Fuel 3 – Alternative Gas Fuel
    1. High Fuel 3 Pressure **T27**
    2. Low Fuel 3 Pressure **T28**

The selected fuel's Limits must remain closed from the end of Prestart to the end of ALFCO.

Interlock Group Monitoring Summary Table

This table identifies monitored interlocks and the actions taken during each BMS state. There are a total of six actions the **BurnerMate Universal** can take: Lockout, Standby, Post Purge, Hold, ALFCO, and Ignore.

Codes:	**Interlock Groups**									
Lockout- **L** Standby- **S** Post Purge- **P** Hold- **H** ALFCO- **A** Ignore- **Blank** **State**	Stop Burner	Call for Heat	Recycle Limits	Emergency Stop	Fan Speed	Common Non-recycle Limits	False Flame	Flame Failure	Fuel Valve Proof of Closure	Selected Fuel Limits
Standby				**L**			**L (1)**		**L**	
Safe Start Check	**S**	**S**	**S**	**L**	**L**		**L**		**L**	
Prestart	**S**	**S**	**S (3)**	**L**	**L**	**H**	**L**		**L**	**H**
Purge	**S**	**S**	**S**	**L**	**L**	**L**	**L**		**L**	**L**
PTFI	**S**	**P**	**S**	**L**	**L**	**L**		**L**	**L**	**L**
MTFI	**P**	**P**	**P**	**L**	**L**	**L**		**L**	**L (2)**	**L**
Release to Modulate	**P**	**P**	**P**	**L**	**L**	**L**		**L**	**L (2)**	**L**
ALFCO	**P**	**A**	**P**	**L**	**L**	**L**		**L**	**L (2)**	**L**
Oil Gun Purge	**P**		**P**	**L**	**L**	**L**		**L**	**L (2)**	**L**
Post Purge				**L**	**L**		**L (1)**		**L**	
Gas Valve Leak Test				**L**			**L (1)**		**L (2)**	

Notes: (1) - More than 30 seconds after the SSOVs close.
(2) – Non-selected fuels
(3) - Fresh air damper causes a "Hold."

Timers

Shutdown Flame Bypass Timer

Oil guns and long gas pipes can vent fuel after the safety shutoff valves close. This can result in a small, lingering flame that can trigger the flame scanner. This flame is ignored for the first 30 seconds (not adjustable) after shutdown to prevent nuisance false flame lockouts.

Trip Delay Timers

These adjustable timers prevent a nuisance burner trip due to momentary pressure or flow disturbances.

- Minimum Air Flow **T33, P1.6.1**
- Low Draft Cutout **T38, P1.6.4**
- Low Atomizing Media Flow **T20, P1.6.3**
- MTFI Fuel Pressure Switches **P41.6.2, T17, T18, T24, T25, T27 and T28**

Combustion Timers

These adjustable timers customize the **BurnerMate Universal** to suit a variety of applications. Refer to the detailed parameter listing for programming information. The following are some of the available timers:

- FD Fan Start Delay **P1.5.2**
- Aux Fan Start Delay **P1.5.3**
- Purge Time **P1.1.9**
- Pilot Trial for Ignition (10 seconds -- not adjustable)
- Gas Main Trial for Ignition (10 seconds)
- Oil Main Trial for Ignition Extended Timer **P1.1.8**
- Oil Gun Purge **P1.9.2**
- Post Purge **P1.1.10**
- Hold Time Before Alarm **P1.6.5**
- Hold Time Before Lockout **P1.6.6**

Low Water Cutout

Low Water Cutout (LWC) Blowdown Bypass Push Button

On a regular basis, the operator of a steam boiler will open drain valves on the low water level cutout float switches to blowdown any accumulated sludge. This can be conducted manually and/or automatically (the automatic blowdown option is described below).

LWC blowdown will cause the Low Water Level Cutout **T12** or Low Low Water Level Cutout **T36** to open. Typically, a LWC bypass push button **T4** is located next to the manual drain valve. This allows the operator to depress it during blowdown and thereby avoid a boiler trip. If the LWC Bypass **T4** is made for more than 120 seconds, it is assumed to be jumpered or defective and is ignored by the **BurnerMate Universal**.

During blowdown, the operator is usually not standing next to the **BurnerMate Universal** and therefore is unable to read the displayed message. When the operator first pushes the Bypass Push Button, the common alarm will pulse 3 times to let the operator know that the bypass has been activated. When the **T12** or **T36** terminals de-energize, the common alarm will stay on continuously. If the bypass is still activated after 90 seconds, the common alarm will pulse 5 times to alert the operator that bypass timer is about to expire.

The **BurnerMate Universal** logs an event message to the LCD Alarm History when the bypass button is pressed and states that one of the low water cutout inputs had opened. This gives the user a time/date stamped record of a successful LWC or LLWC operation.

Automatic Low Water Cutout Blowdown Test
The **BurnerMate Universal** offers an automatic LWC blowdown test option. The LWC blowdown test is conducted once per day at a pre-selected time. The test will not start unless the boiler steam pressure is above a minimum set point **P1.11.3.**

The **BurnerMate Universal** conducts the automatic LWC blowdown test procedure as follows:

- Waits until the steam pressure is high enough and the time is after the **P1.11.4** start time.
- Bypasses both the LWC and LLWC Limits for [(2* **P1.11.5**) + **P1.11.6**] seconds.
- Opens the blowdown valve.
- Waits for **P1.11.5** seconds.
- Verifies that at least one of the LWC limits was “opened”. If “opened”, records a successful blowdown in the historical data. If neither the LWC nor LLWC “opens”, an alarm and/or a trip results.
- Closes the blowdown valve.
- Waits for **P1.11.5** seconds.
- When the LWC bypass release delay **P1.11.6** is over, removes the LWC bypasses.

Gas Valve Leakage Test

Description

Many codes require that the burner Safety Shutoff Valves (SSOVs) incorporate “Proof of Closure Switches” indicating to the flame safeguard control that the valves are indeed in the closed position when they are de-energized. However, proof of position does not prove that the valve seat is not leaking. The **BurnerMate Universal** provides an optional Gas Valve Leak Test procedure. The procedure and referenced tables have been prepared based on the objective of detecting a valve leakage rate of 5.0 cubic feet per hour or more for natural gas. Note that the gas valve leak test option is only available for Fuel 2 and can only be elected if Fuel 3 is disabled.

If **P1.8.1 is** enabled, the Gas Valve Leak Test occurs after every normal shutdown Post Purge or after every Lockout reset.

The Gas Valve Leakage Test option can be used on piping train with or without the normally open vent valve. If there is no vent valve used, enable **P1.8.2**. When **P1.8.2** is disabled, the N.O. vent valve is used to vent the pressure from the Upstream SSOV test. When **P1.8.2** is enabled, the Downstream SSOV opens to vent pressure for the Upstream SSOV test.

Two pressure switches are installed between the SSOVs; one is set at 30% of the inlet pressure, and the other is set at 70% of the inlet pressure. The test is conducted automatically in two stages. First, the space between the SSOVs is vented and then sealed. If the pressure rises above 30% of the inlet pressure after **P1.8.3** seconds, the upstream valve is determined to be leaking. Next, the upstream valve is opened and then closed to pressurize the area between the SSOVs. If the pressure drops below 70% of the inlet pressure after **P1.8.4** seconds, then the downstream valve or vent valve (or both) are leaking.

If a leak is detected, the **BurnerMate Universal** will Lockout.

Timing Calculations

Tables I and II are used to determine the required leak test times for **P1.8.3** and **P1.8.4** based on a maximum leakage rate of 5.0 SCFH and a natural gas density of 0.04154 #/cu ft. The first step is to calculate the volume of the pipe section being tested. Using Table I, calculate the total volume of the valve train between the two SSOVs. Include the branch piping up to the vent valve. Include one-half of each valve in the pipe length measurement.

Example

A fuel train includes 2 feet of 3-inch pipe between two 1 ft. long SSOVs (3 feet total) and 3.75 feet of 1.5-inch pipe on the branch to the 6 inch long vent valve (4 feet total). From Table I, we find that the volume of these pipe trains are 0.154 and 0.057 cubic feet, respectively. Add those two together for a total volume of 0.211 cubic feet.

Gas Valve Leakage Test

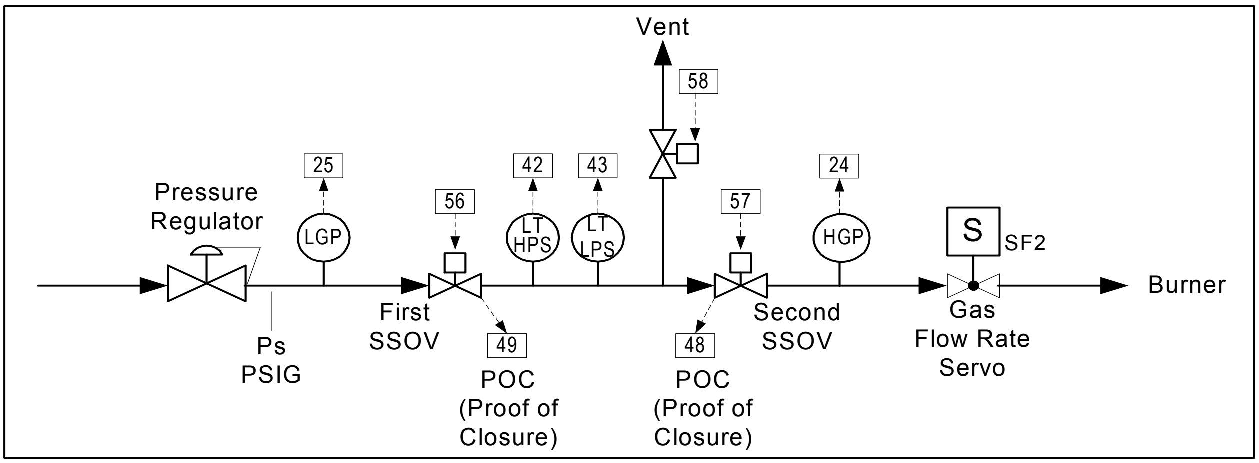
Determine the Test Timing in Seconds

Referencing Table II, find the volume that represents the next highest volume than the one calculated above. In this case, that will be 0.30 cubic feet. Drop down the column until you reach the row that matches the available inlet pressure. Assuming an inlet pressure of 7.0 PSI, the test time is 32 seconds. Enter this value into **P1.8.3** and **P1.8.4**. Note that the smaller the pipe volume, the shorter the time for the test. Keep the pipe between the two SSOVs and the vent valve as short as possible.

Warning
Explosion Hazard
A leak can cause severe injury, death or property damage

A leaking gas valve can result in an explosion or fire. The Gas Valve Leak Test is intended to detect a leak at a rate of 5.0 SCFH or more, provided that the recommended time for the test is programmed into parameters P1.8.3 and P1.8.4. If the programmed time is less than that determined from Table II, a dangerous leak can go undetected.

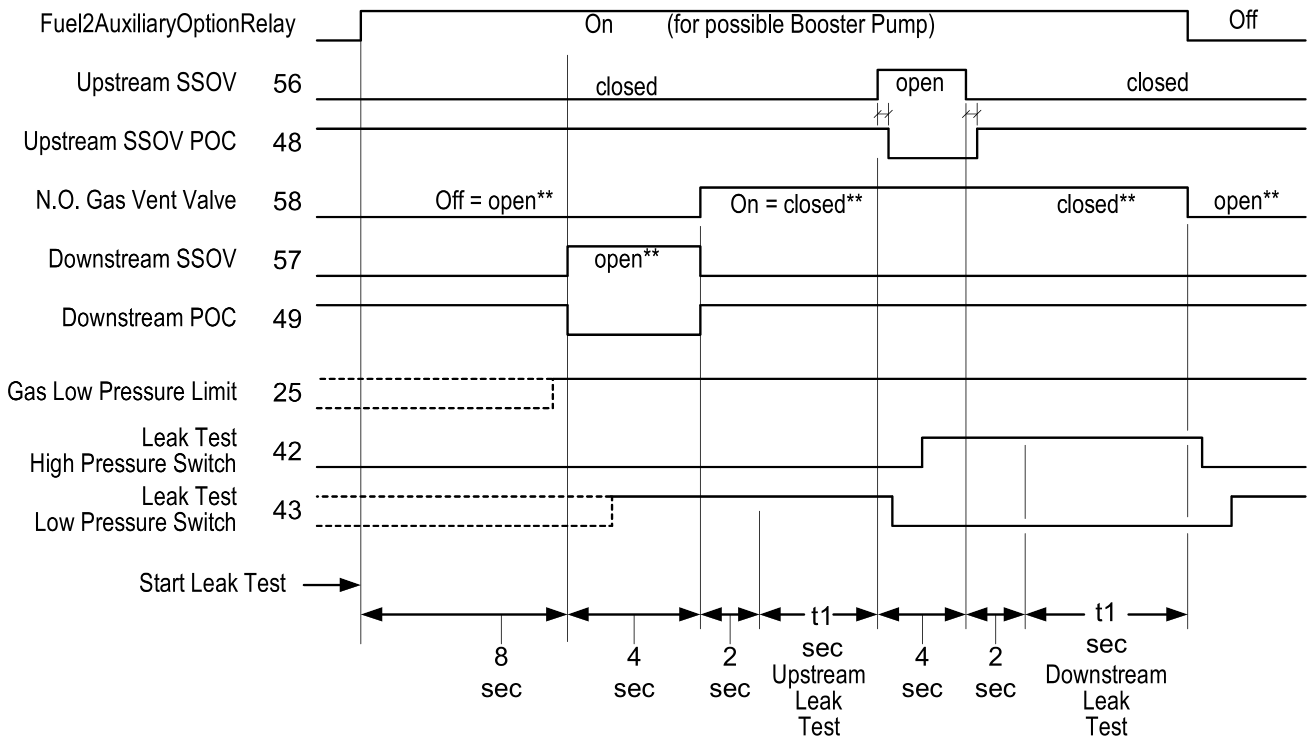
Typical Gas Train Layout



The above illustrates a typical NFPA-approved gas train. The components consist of a main supply Pressure Regulator, two Safety Shutoff Valves (SSOVs), each with Proof of Closure switches, one normally open Vent Valve, one Low Gas Pressure switch (LGP), one High Gas Pressure switch (HGP), and a gas flow rate control valve (SF2). For the purpose of the gas valve leak test, two additional switches (LT-LPS and LT-HPS) are installed between the two SSOVs.

Gas Valve Leakage Test

Gas Valve Leak Test Sequence of Operation



** Notes: If P1.8.2 = Enabled
Vent Valve is not installed.
Downstream SSOV opens to vent pressure for Upstream Leak Test

If P1.8.2 = Disabled
Vent Valve closes to build pressure for Downstream Leak test.
Downstream SSOV does NOT open to vent pressure for Upstream Leak Test

If parameter **P1.8.1** is enabled, the Gas Valve Leak Test will start after the completion of the Post Purge. The Safety Relay K17 remains energized and if applicable, the Fuel2 Auxiliary Option Relay is energized for the start of a possible Gas Booster Fan. This is followed by an 8 second delay to allow the gas pressure to stabilize. If **T25** (Low Gas Pressure Switch) is open, the Leak Test is aborted.

Gas Valve Leakage Test

The Gas Valve Leakage Test is performed in two steps.

Step 1:
- Both SSOVs are proven closed by the valve POCS.
- The area between the two main SSOVs is vented for the Upstream SSOV test. If **P1.8.2** is Disabled, the N.O. vent valve has already vented this area and is now energized to close. If **P1.8.2** is Enabled, the Downstream SSOV will energize for 4 seconds to vent the pressure into the furnace.
- After a 2-second delay, the LT-LPS must stay closed for **P1.8.3** seconds. The LT-HPS is verified as open.
- If the LT-LPS stayed closed, the test proceeds to Stage 2.
- If the LT-LPS opens during the test time, the BMU will default to the Lockout state.

Step 2:
- With the N.O. vent valve still closed, the Upstream SSOV is energized for 4 seconds to pressurize the test section. The LT-HPS closes.
- After a 2 second delay, the LT-HPS must stay closed for **P1.8.4** seconds. The LT-LPS is verified as open.
- If the LT-HPS stayed closed during the test time, the valves have passed the test.
- The N.O. vent valve is de-energized.
- The Safety Relay and the Fuel2 Auxiliary Option Relay are de-energized.
- The **BurnerMate Universal** proceeds to the Standby state.

If the POCS do not prove that the SSOVs are closed during the duration of the test (except for the 4 seconds between Stages 1 and 2), the **BurnerMate Universal** will Lockout. Upon a system reset, the Gas Valve Leak Test will again initiate, and the test must pass before the burner will be allowed to start.

Table 1 – Total Pipe Volume

Calculate the volume of the pipe to be leak tested										
Pipe Diam. inches	Area Sq. in.	Length in feet								
		1	2	3	4	5	6	7	8	10
1	0.864	0.006	0.012	0.018	0.024	0.030	0.036	0.042	0.048	0.060
1.25	1.498	0.010	0.021	0.031	0.042	0.052	0.062	0.073	0.083	0.104
1.5	2.036	0.014	0.028	0.042	0.057	0.071	0.085	0.099	0.113	0.141
2	3.356	0.023	0.047	0.070	0.093	0.117	0.140	0.163	0.186	0.233
2.5	4.788	0.033	0.067	0.100	0.133	0.166	0.200	0.233	0.266	0.333
3	7.396	0.051	0.103	0.154	0.205	0.257	0.308	0.360	0.411	0.514
4	12.73	0.088	0.177	0.265	0.354	0.442	0.530	0.619	0.707	0.884
5	19.63	0.136	0.273	0.409	0.545	0.682	0.818	0.954	1.091	1.363
6	28.28	0.196	0.393	0.589	0.786	0.982	1.178	1.375	1.571	1.964

Table II – Test Duration

Pressure		Total Pipe Volume between the SSOVs and the Vent Valve								
		0.025	0.05	0.075	0.1	0.2	0.3	0.4	0.5	0.6
inches w.c.	PSI	Test Duration - seconds								
5	0.181	10	10	10	10	10	10	10	10	10
10	0.361	10	10	10	10	10	10	10	10	10
15	0.54	10	10	10	10	10	10	10	10	10
20	0.722	10	10	10	10	10	10	10	10	10
27.7	1	10	10	10	10	10	10	10	10	10
41.6	1.5	10	10	10	10	10	10	10	12	14
55.4	2	10	10	10	10	10	10	12	15	19
69.3	2.5	10	10	10	10	10	12	15	19	23
83.1	3	10	10	10	10	10	14	18	23	28
	4	10	10	10	10	12	18	24	30	37
	5	10	10	10	10	15	23	30	38	46
	7	10	10	10	11	21	32	42	53	64
	10	10	10	12	15	30	45	60	75	91
	15	10	12	17	23	45	68	90	113	137
	20	10	15	23	30	60	90	120	150	182
	25	10	19	28	38	75	112	150	188	228
	30	12	23	34	45	90	135	180	225	273

Pressure		Total Pipe Volume between the SSOVs and the Vent Valve								
		0.7	0.8	0.9	1	1.2	1.4	1.6	1.8	2
inches w.c.	PSI	Test Duration - seconds								
5	0.181	10	10	10	10	10	10	10	10	10
10	0.361	10	10	10	10	10	10	10	10	11
15	0.54	10	10	10	10	10	12	13	15	17
20	0.722	10	10	10	11	13	16	18	20	22
27.7	1	11	12	14	15	18	22	24	28	30
41.6	1.5	16	18	21	23	27	33	36	41	45
55.4	2	21	24	28	30	36	43	48	55	60
69.3	2.5	26	30	35	38	45	54	60	69	75
83.1	3	31	36	41	45	54	65	72	82	90
	4	42	48	55	60	72	86	96	109	120
	5	52	60	69	75	90	108	120	137	150
	7	73	84	96	105	126	150	168	191	210
	10	104	120	137	150	180	215	240	273	300
	15	155	180	205	225	270	322	360	409	450
	20	207	240	273	300	360	429	480	546	600
	25	259	300	341	375	450	536	600	682	750
	30	311	360	410	450	539	643	720	819	900

Combustion Control Systems

Objective

The primary objective of a Combustion Control System is to always insure that the fuel/air/FGR ratio of the burner is maintained at the commissioned levels. This objective can be obtained a number of different ways:

1. Jackshaft Positioning: All fuel valves and air dampers are mechanically linked to one control actuator.
2. Parallel Positioning: All servos, actuators, VSDs, control valves and air dampers are maintained at a predetermined position based on curves set up during commissioning.
3. Predictive Metering (Fully Metered): The airflow and fuel flow are measured (metered) during the control process. The servos, actuators, VSDs, control valves and air dampers are positioned to maintain predetermined flow valves based on curves set up during commissioning.

The correct type of control system is determined by many variables; boiler type and size, burner design, fuel fired, and emission requirements. Before choosing the control system for any given application, it is always recommended that the boiler or burner manufacturer be consulted. The advantages and disadvantages of each type of system are discussed elsewhere in this section.

Other **BurnerMate Universal** options available that can be used to enhance the performance of the Combustion Control System are:

1. Outlet Flue Gas Oxygen Trim- compares the oxygen levels in the flue gas to a value determined during the commissioning and will implement control actions to correct the error.
2. LTA (Link Trim Actuator) allows for the use of Flue Gas Oxygen Trim with a Single Point Positioning System.
3. Windbox Oxygen FGR Trim- compares the oxygen levels in the windbox to a value determined during the commissioning and will adjust the FGR control to correct the error.
4. Gas Pressure Compensation- provides corrective action to the gas flow meter based on supply line pressure changes.
5. Combustion Air Temperature Compensation- provides corrective action to the air flow meter based on changes in the combustion air temperature.
6. Atomizing Pressure Control.
7. Draft Control.

The secondary objective of a Combustion Control System is to modulate the firing rate to provide a continuous supply of steam or hot water at the desired pressure or temperature. Based on PID control action or a remote firing rate demand signal, the **BurnerMate Universal** can modulate the burner to maintain the Process Variable at a predetermined Set Point.

Jackshaft Positioning

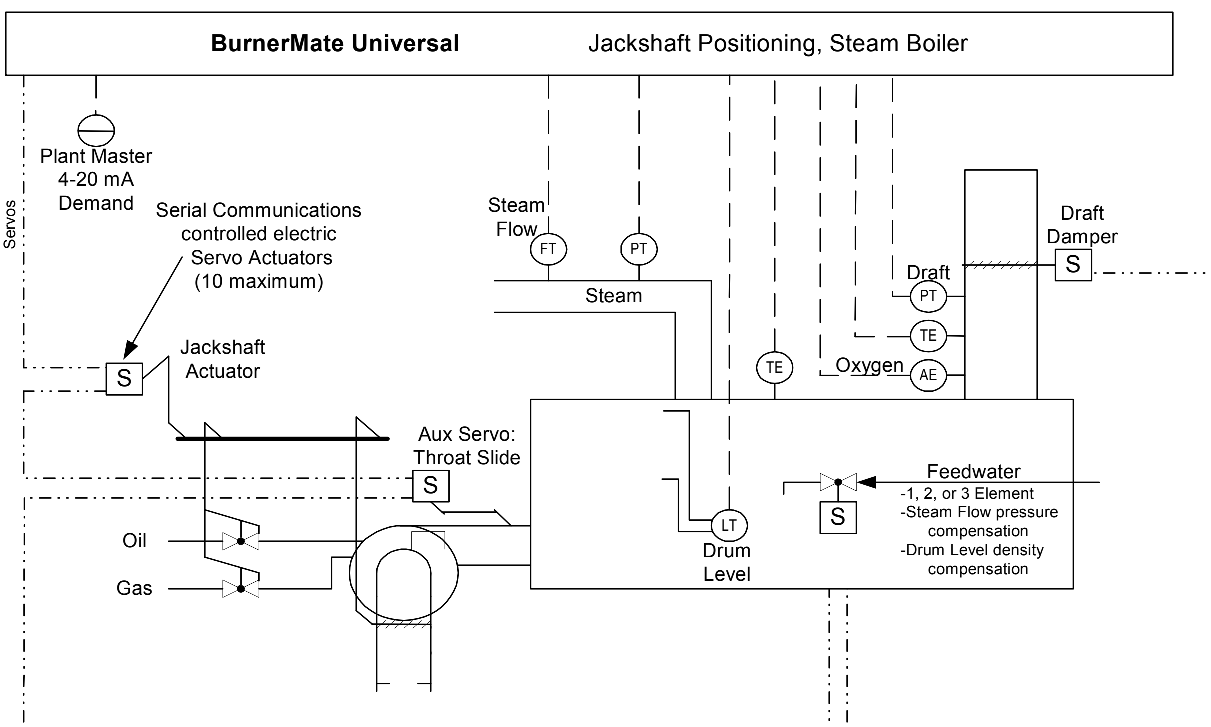
The simplest of the three basic combustion control systems is one in which the fuel control valves and air control dampers are mechanically linked through a jackshaft and linkage arms. One actuator or servo simultaneously moves both the fuel and air in order to maintain the desired system Process Variable. For every particular firing rate demand, there is only one position for the fuel valve and a corresponding position for the air damper. The fuel/air ratio is tuned by mechanically adjusting the fuel valve and air damper linkage during the initial commissioning.

The jackshaft actuator is wired to the **BurnerMate Universal,** which will cause the jackshaft and all interconnecting devises to stroke to the purge and light off positions. Following a safe light off, the actuator will modulate the firing rate based on a command from the **BurnerMate Universal** PID control or a remote demand signal.

The advantages of this system are its simplicity and low initial cost. This system is suitable for firetube and small watertube boilers and applications where the annual fuel expense is too small to justify a more elaborate system.

Typically, a burner using Jackshaft Positioning will have to operate with higher than required excess air levels due to linkage hysteresis (non-repeatability) and worn damper mechanisms. Other factors requiring higher excess air levels are changes in the fuel viscosity and pressure and changes in the air density, temperature and barometric pressures. Another disadvantage is that an FD Fan VSD cannot be utilized to save energy cost.

The use of an LTA can reduce the need to operate at a higher excess air level by compensating the airflow to overcome some of the factors noted above.



Parallel Position

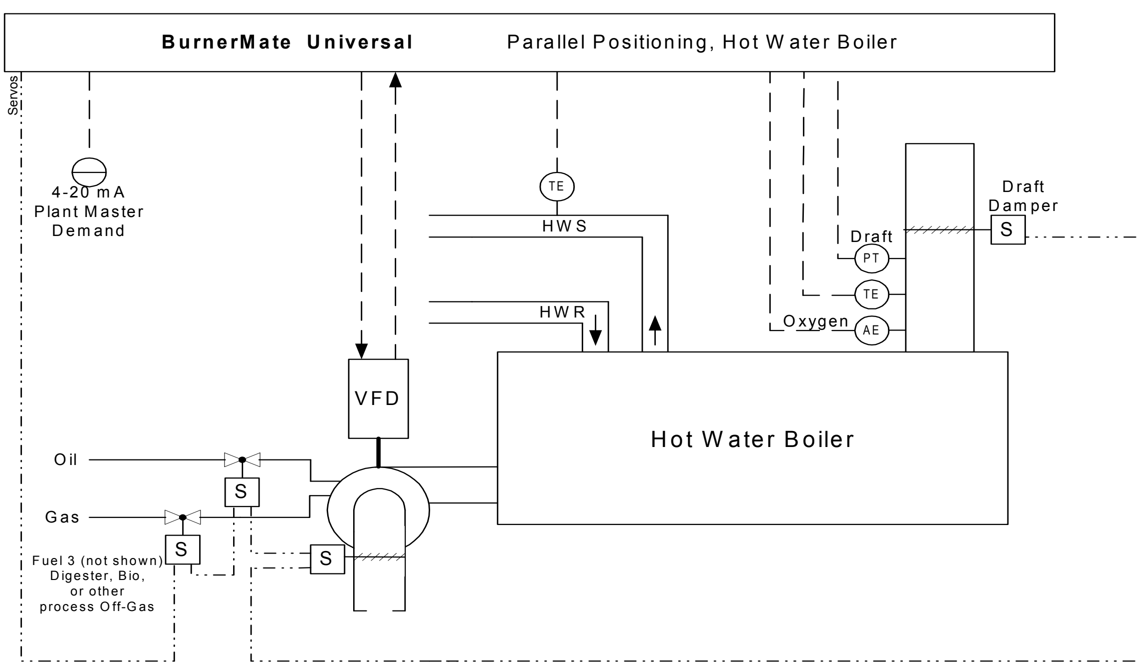
In this system, both the fuel valve(s) and the air damper each have their own actuator(s). Each actuator is equipped with a position feedback potentiometer. Unlike a Jackshaft Position system where every devise is mechanically linked, the individual actuators can be electronically characterized for a greater degree of fuel/air ratio control accuracy.

The Parallel Positioning system is also safer as the **BurnerMate Universal** continually monitors the demand to the actuator versus the feedback potentiometer input and will trip the burner should discrepancies be detected.

Like the Jackshaft Positioning system, the same factors that require higher excess air levels are the same; changes in the fuel viscosity, fuel pressure, changes in the air density, temperature and barometric pressures. However, with a Parallel Positioning system, the adaptation of Flue Gas Oxygen Trim becomes an easier task. Instead of the added cost of an LTA, the compensation for oxygen trim is performed by manipulation of the demand signal to the air damper actuator.

Other advantages of Parallel Positioning over Jackshaft Positioning are that a Variable Speed Drive can be used to save energy, as well as provide another means of oxygen trim.

Parallel Positioning is more suitable for larger boilers as all of the control devices no longer have to be in close proximity to a common jackshaft. Fans, VSDs and dampers can now be located remotely.



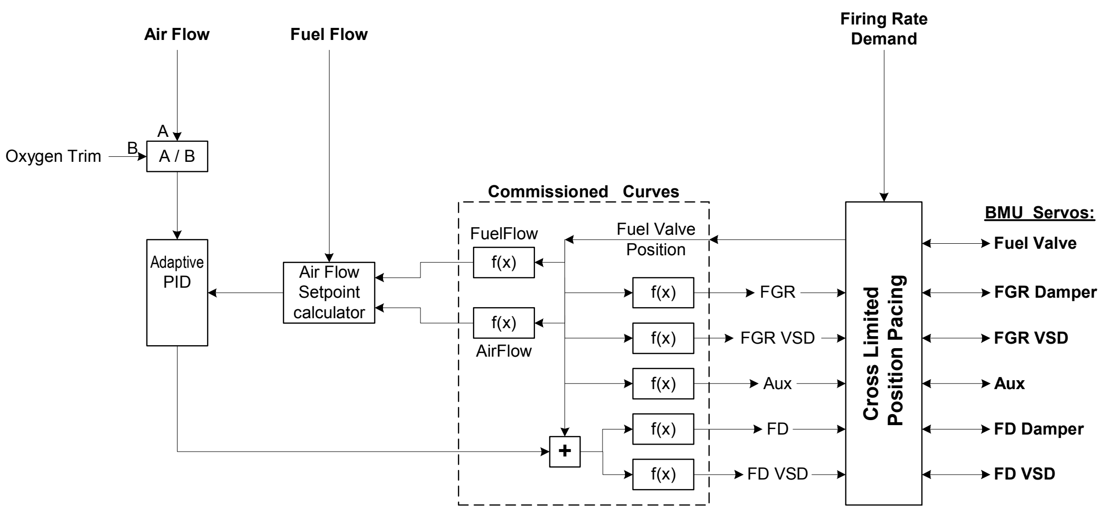
Predictive Metering (i.e. Full Metered)

Predictive Metering compares current Oxygen, Fuel Flow Rate, and Air Flow Rate versus Commissioned Oxygen, Fuel Flow Rate, and Air Flow Rate and corrects the damper and VSD curves in order to maintain the previously established fuel/air ratio. External Fuel and Air Flow Rate transmitters are required for Full Metered Trim.

Predictive Metering combines Full Metering, Parallel Positioning, and Oxygen Trim, and results in a much faster firing rate load response time than traditional approaches.

BMU Position Pacing assures that neither air nor fuel 'leads' or 'lags' during load changes. Position pacing assures that fuel, air, and FGR all move simultaneously, and always 'on curve', during load changes. This approach is much smoother than traditional full-metered 'Cross Limiting', and is actually safer for burners that operate close to their stability limitations.

In the event of a flow meter failure, the operator, by parameter **P2.1.1** selection of PositionedServo mode can retain full automatic operation until the flow meter is repaired or replaced. With typical Fully Metered controls, only manual operation would be allowed if one of the flow meters failed.



BMU Predictive Metering Fuel - Air Ratio Control

Combines the best features of Fully Metered and Positioning Combustion Control

BMU Predictive Metering:
- Accuracy and Efficiency
- Easy to Tune: Single PID

BMU Positioning:
- Rapid Load Change Response
- Cross Limited Position Pacing
- No Air Lead or Fuel Lag, Eliminates Air Rich Load Changes
- Burner Turndown is not Limited by Flow Meter Limitations

Predictive Metering

BurnerMate Universal systems have fuel and air flow rate sensors in addition to the fuel and air servo/VSD position feedback sensors. During Commission mode fuel flow and airflow data are stored for each curve point in addition to the normal position and Oxygen Set Point data.

Therefore, the fuel flow / airflow ratio for each fuel valve position can be calculated from the curve data. During operation, the measured fuel flow for a given fuel position is typically close to, but different from, the commissioned fuel flow. The **BurnerMate Universal** trims the air in order to maintain the same fuel flow / airflow Ratio that was established for that fuel valve position during Commission Mode.

The airflow trim PID output is range limited to prevent unsafe operation in the event of an Airflow Transmitter or Fuel Flow Transmitter failure. In addition, the PID output is scaled from “% of flow” to “Full scale flow %” which further reduces the trim range as the burner modulates toward low fire (Adaptive Gain). The commissioning technician determines the acceptable trim range allowed.

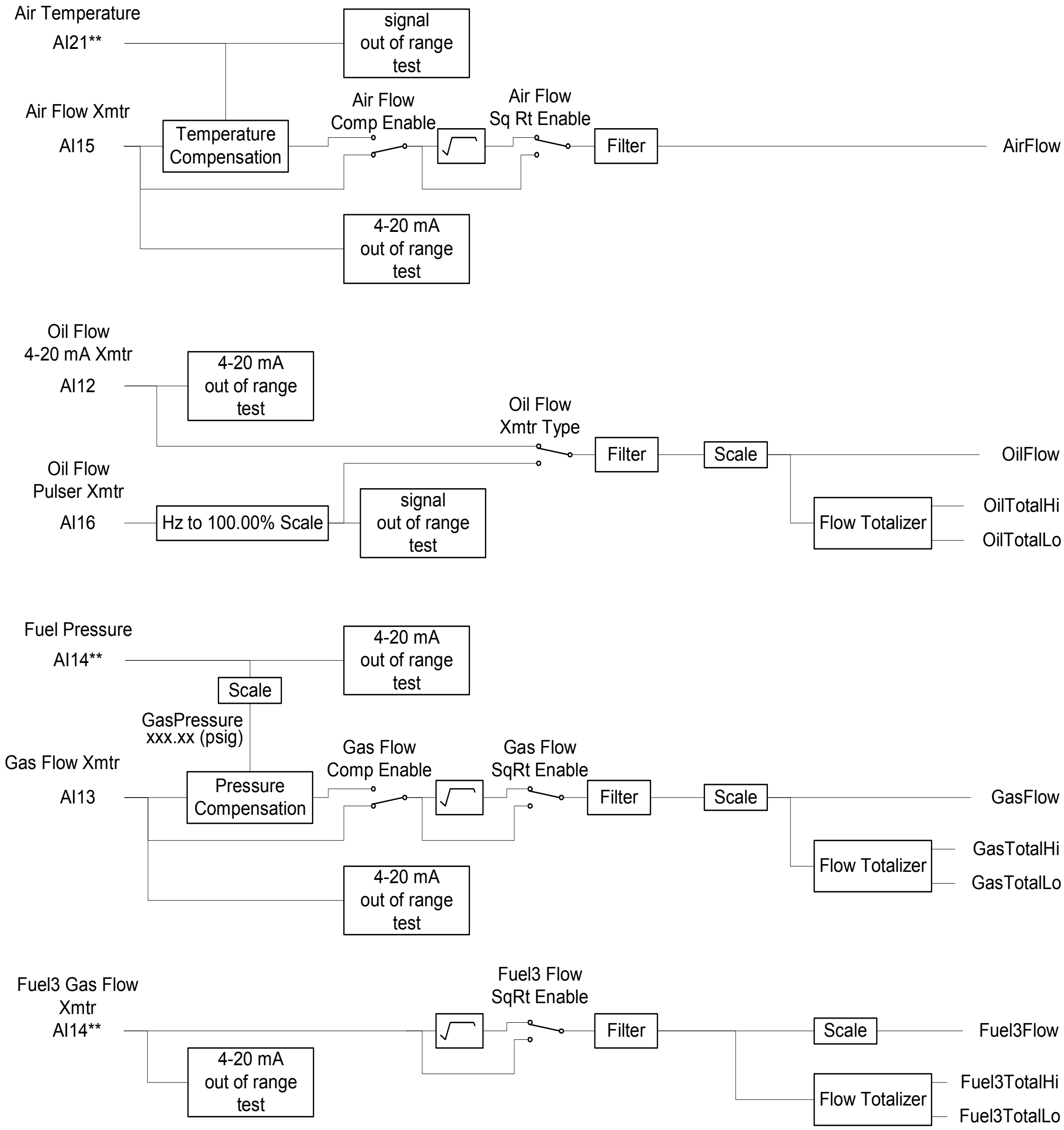
Oxygen Trim:
When in MeteredServo mode, the **BurnerMate Universal** will use the existing Oxygen Trim signal to modify the signal-conditioned airflow signal. This will increase/decrease the airflow by a percentage of the current value, which provides an automatic ‘adaptive gain’ effect. That is, if the trim is -5% and airflow is 40%, the trimmed airflow would be 42.1% whereas a 60% airflow results in a 63.15% trimmed airflow.

Since the air flow set point will be constant for a given fuel flow / fuel position combination, an increase in the trimmed air flow will cause the PID to decrease the air flow Trim until the set point and Trimmed Air Flow are again equal.

The Oxygen Trim PID is setup to react more slowly than the Air Flow Trim PID.

Predictive Metering

Field selectable gas flow pressure compensation, air flow temperature compensation, and an oil flow meter pulse input or a 4-20 mA input are provided. Fuel flows and Steam flows can be totalized. See below:



Note: ** = Multiple Use Input

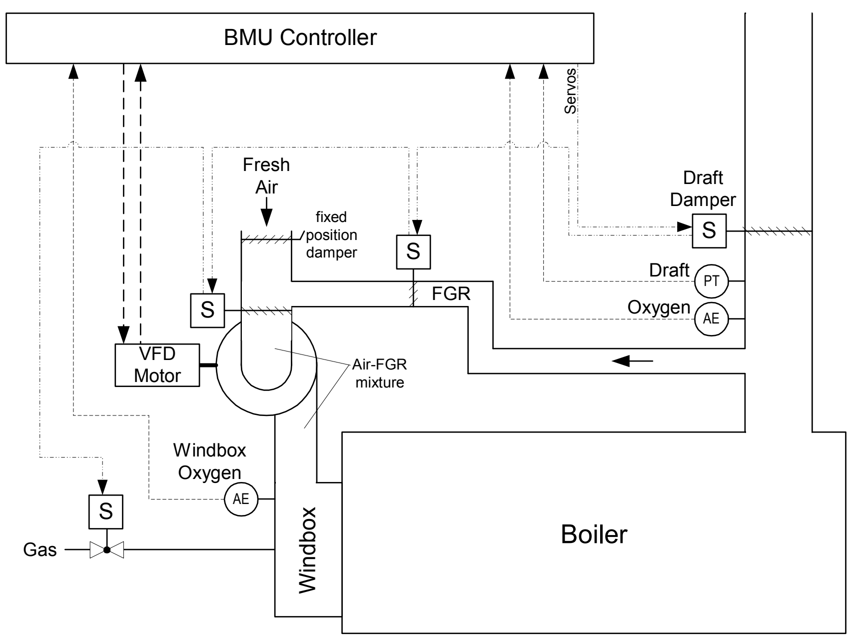
Windbox Oxygen FGR Trim

A common method used to reduce burner flue gas NOx is to mix flue gas with fresh air at the FD Fan inlet. This is called Flue Gas Recirculation (FGR). Typically, the suction at the FD Fan inlet is used to move the Flue Gas into the burner, this is called 'Induced FGR'.

The FGR reduces the Oxygen level from the normal ~20.6% in fresh air down to somewhere in the 15 – 18% range, and correspondingly increases the percentage of non-combustible gases entering the burner. The extra non-combustible gases reduce the flame temperature and thus the formation of NOx.

For most installations, the FGR damper position is simply positioned based on a fuel valve verses FGR damper curve that is established during burner startup. After that the FGR flow rate is 'Open Loop' and is not monitored or adjusted. For installations operating at very low NOx levels (typically < 10 ppm), or that have strict EPA emissions restrictions, a closed loop system can be used to insure that the FGR mass flow rate stays at the desired levels.

The **BurnerMate Universal** will be able to accept a 4-20 mA input that represents burner windbox oxygen. The **BurnerMate Universal** will have a curve for Windbox Oxygen versus Fuel Valve Position established during burner commissioning. PID logic will compare the commissioned windbox oxygen to the actual windbox oxygen and trim the FGR damper / FGR Fan VSD as required to maintain the FGR mass flow rate at the initially commissioned value.



Typical Watertube or <10ppm NOx Induced FGR layout

Auxiliary Control Systems

Atomizing Media Pressure Control

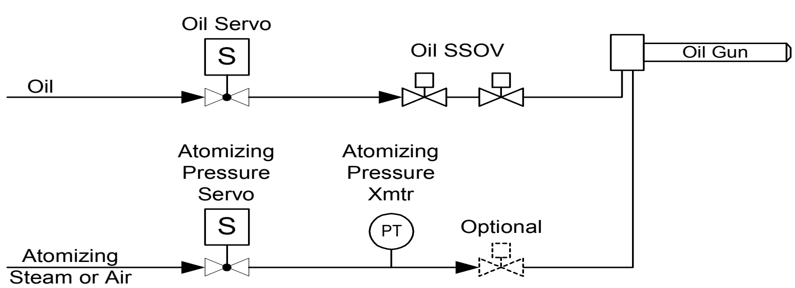
This feature will modulate a servo control valve in order to maintain the burner atomizing pressure at the desired set point. The pressure set point is a characterized curve based on the fuel servo position when the burner is firing. Fixed pressure set points are used during Purge and Ignition.

In some cases the atomizing pressure, and in others, oil to atomizing differential pressure is measured. The measurement method is based on the design of the oil gun and will be selected by the burner manufacturer. The **BurnerMate Universal** control logic is the same for either measurement methods. The only difference will be the Zero and Span data for the 4-20 mA (**P6.1.2** and **P6.1.3**) input from the Atomizing Pressure Transmitter.

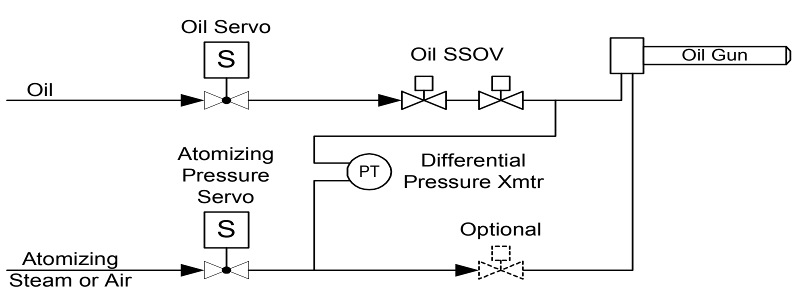
The atomizing pressure is only controlled when the BMS has commanded the Atomizing Shutoff Valve to open. The Atomizing Pressure PID is always controlling the servo valve. Manual control of the atomizing valve is not allowed when **P6.1.1** is Enabled.

In Commission Mode, the technician can manually manipulate the atomizing pressure set point; however, the PID is always controlling the servo.

The Atomizing Servo will be driven to its Closed Limit Switch position whenever the BMS has commanded the Atomizing Shutoff Valve to close. In many cases the Atomizing Control Valve will be used as the Atomizing Shutoff Valve as well as the atomizing pressure modulation valve.



Atomizing Pressure Control



Oil vs Atomizing Differential Pressure Control

Draft Control

Draft is the term used to describe the movement of gases, usually the products of combustion, through a flue or chimney. The measurement of draft is expressed in inches water column and represents the difference in weight of a column of flue gas and a corresponding column of outside air.

The objective of draft control is to maintain a constant furnace or boiler outlet draft pressure (positive or negative) as the boiler firing rate modulates from low to high fire and as outdoor weather conditions change the draft effect.

The **BurnerMate Universal** can accomplish draft control a number of ways. Positioning a boiler outlet damper (also referred to as a stack damper) or a damper at either the inlet or outlet of an Induced Draft Fan, controlling the speed of an ID Fan VSD or controlling both a damper and ID Fan VSD.

Typically, the draft pressure is sensed and controlled at either the boiler outlet or in the furnace. A high-quality draft range transmitter is used to provide reliable measurement of the draft. Because draft signals are inherently noisy (constantly moving), it is common to filter the draft signal before it goes to the PID block within the controller, however, caution must be exercised, as too much filtering will result in sluggish control. The draft transmitter should always be located above the sensing point and the sensor lines sloped so that condensation in the tubing runs back to the boiler. If the transmitter must be located below the sensing point, a drip leg, condensation pot, and drain valve should be provided. Reference the Appendix Section 10 for transmitter piping details.

Draft Control Strategies
The **BurnerMate Universal** has eight possible draft control configurations, as selected by the parameter **P4.1.1** Draft Control Option**.** The **BurnerMate Universal** allows for <u>three types of draft control strategies and three output control options</u>.

The eight possible **P4.1.1** Draft Control Option selections are:

Disable	Draft control is disabled
FloatingServo	Floating draft control; damper w/servo Actuator
Floating420	Floating draft control; damper w/4-20 mA Actuator
FloatingVSD	Floating draft control; ID fan w/VSD (Variable Speed Drive no damper)
PIDServo	PID draft control; damper w/servo Actuator
PID420	PID draft control; damper w/4-20 mA Actuator
PIDVSD	PID draft control; ID fan w/VSD (Variable Speed Drive no damper)
PIDVSDandServo	Dual Output; simultaneous ID Fan VSD and damper control. PID control of the VSD; floating control of the Damper w/servo Actuator
PIDVSDand420	Dual Output; simultaneous ID Fan VSD and damper control. PID control of the VSD; floating control of the Damper w/4-20mA Actuator

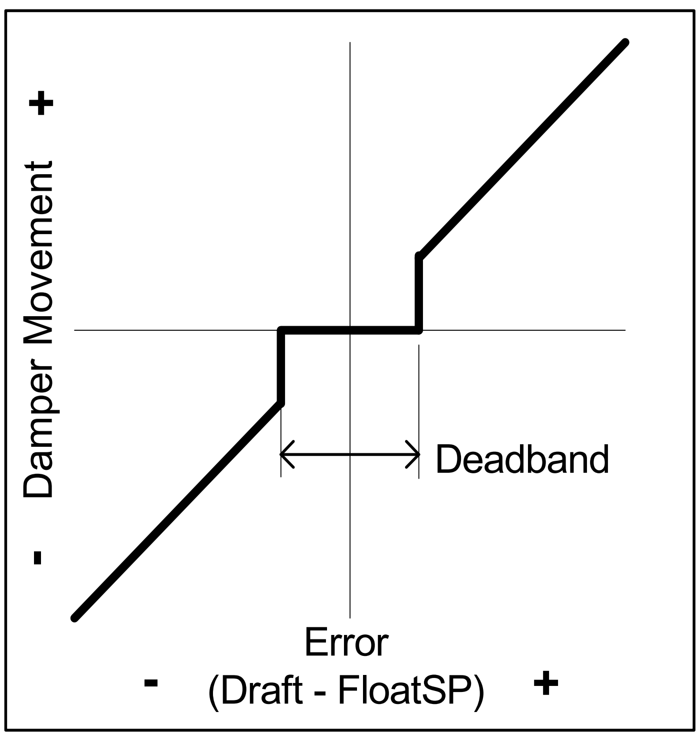
Draft Control Strategies
The following is an explanation of the possible draft control strategies for the **P4.1.1** Draft Control Option: Floating Control, Gap PID Control and Gap PID Firing Rate Feedforward.

Floating Control (Proportional with Deadband)

Floating control can only be used with either a stack damper or VSD output, but not both. It is the simplest form of draft control and requires the fewest user adjustments.

- If the draft error (draft minus set point) is inside the deadband, the draft damper/VSD output doesn't change.
- If the draft error is outside the deadband, the stack damper/VSD position is adjusted proportional to the draft error until the actual draft has returned to within the deadband. .

P4.5.1 Proportional Band, Floating Draft determines the floating control proportional band, and **P4.5.2** Deadband, Floating Draft determines the deadband.



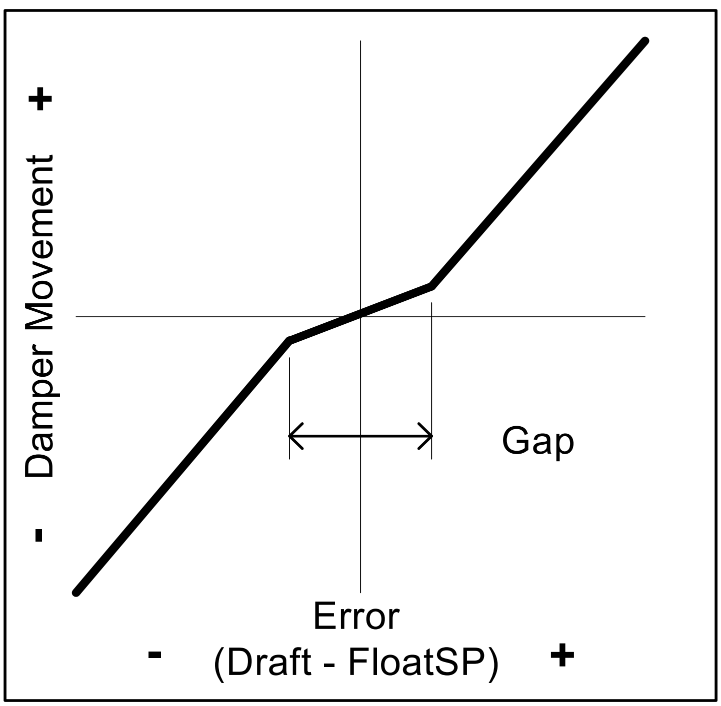
Gap PID Control

As noted earlier, draft signals are inherently noisy (constantly moving), usually due to normal combustion pulsation and changing weather conditions. To prevent oscillation of the draft actuator near the set point, a draft control technique called “gap” PID is used. Where the Floating Control system has a +/- deadband at the set point where no control action is performed, the Gap PID has a +/- “gap” at the set point where the PID proportional action is reduced to prevent over controlling.

P4.7.4 Gap Gain, Draft PID, sets the proportional response when the draft is within the gap. The width of the gap is determined by **P4.7.3** Gap, Draft PID.

Outside the gap, **P4.7.1** Proportional Band, Draft PID and **P4.7.2** Minutes per Repeat, Draft PID, determine PID control action.

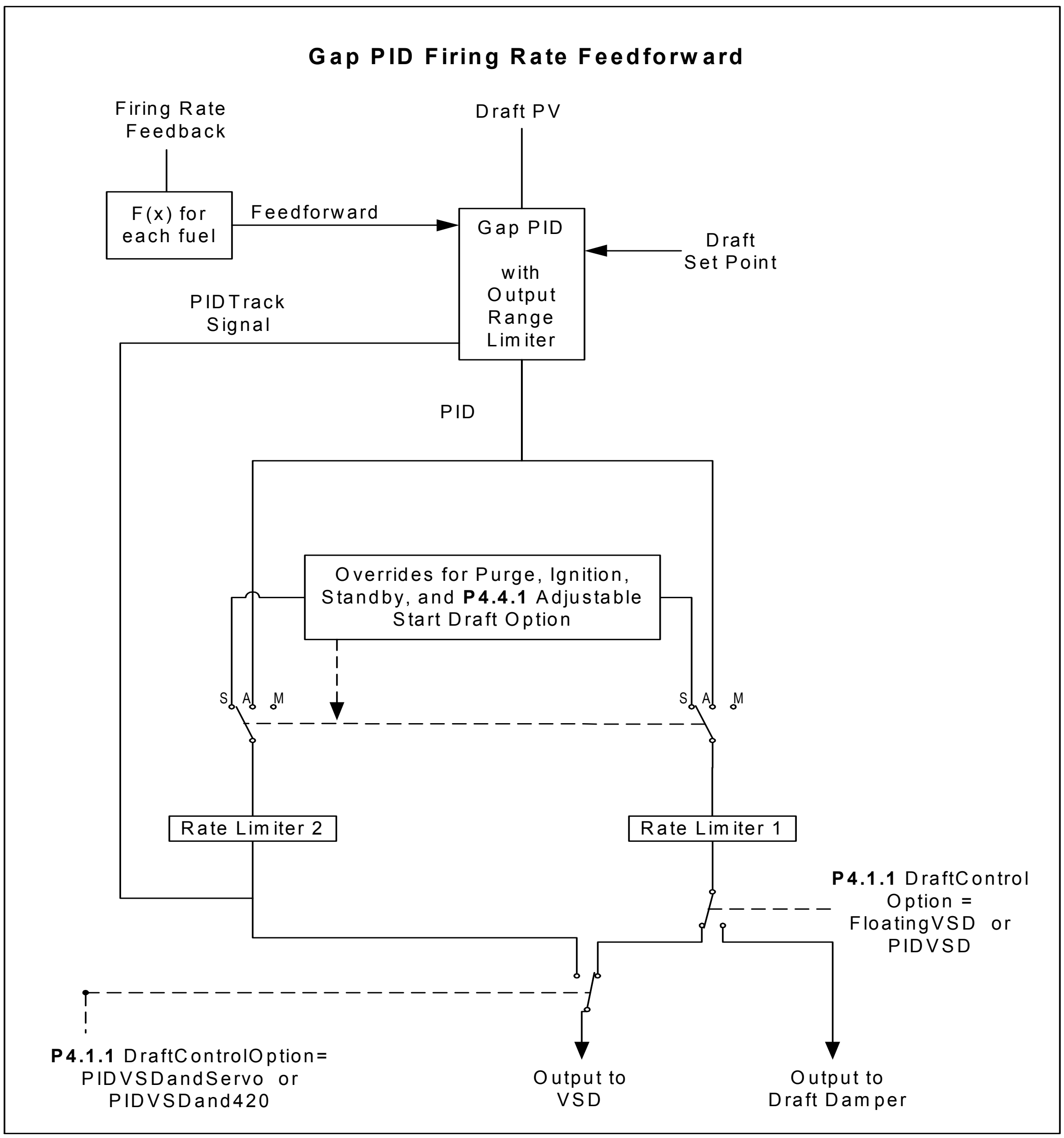
P4.6.3 Min Damper Position in Auto, and **P4.6.2** Max Damper Position in Auto, limit the PID control output range and can be used to prevent oscillation near fully closed and reset windup near fully open. Similarly, **P4.11.2** Min VSD Hz in Auto**,** Draft, and **P4.11.1** Max VSD Hz in Auto, Draft, are used to determine the minimum and maximum ID fan VSD speeds.



Gap PID Firing Rate Feedforward

Gap PID Firing Rate Feedforward provides rapid draft damper response to burner load changes by moving the damper to predetermined positions based on firing rate. Feedforward can only be used when the draft control mode is set to PID. It is cannot be used with Floating Control.

Separate F(x) curves can be input for each fuel. The X values correspond to boiler firing rate and are preset at 0%, 10%, 20%, 30%, 40%, 60%, 80%, and 100%. The Y values correspond to damper position and are input during commissioning. The Y values are entered in the engineering units appropriate to the device (0-90 degrees for a servo, 0-100% for a 4-20 mA output, and 0-60 Hz for a VSD). The damper position at each firing rate should be tested to ensure there is sufficient draft for safe boiler operation. Unlike the fuel-air ratio curves, the same curve is used for FD Fan fixed and variable speed modes.



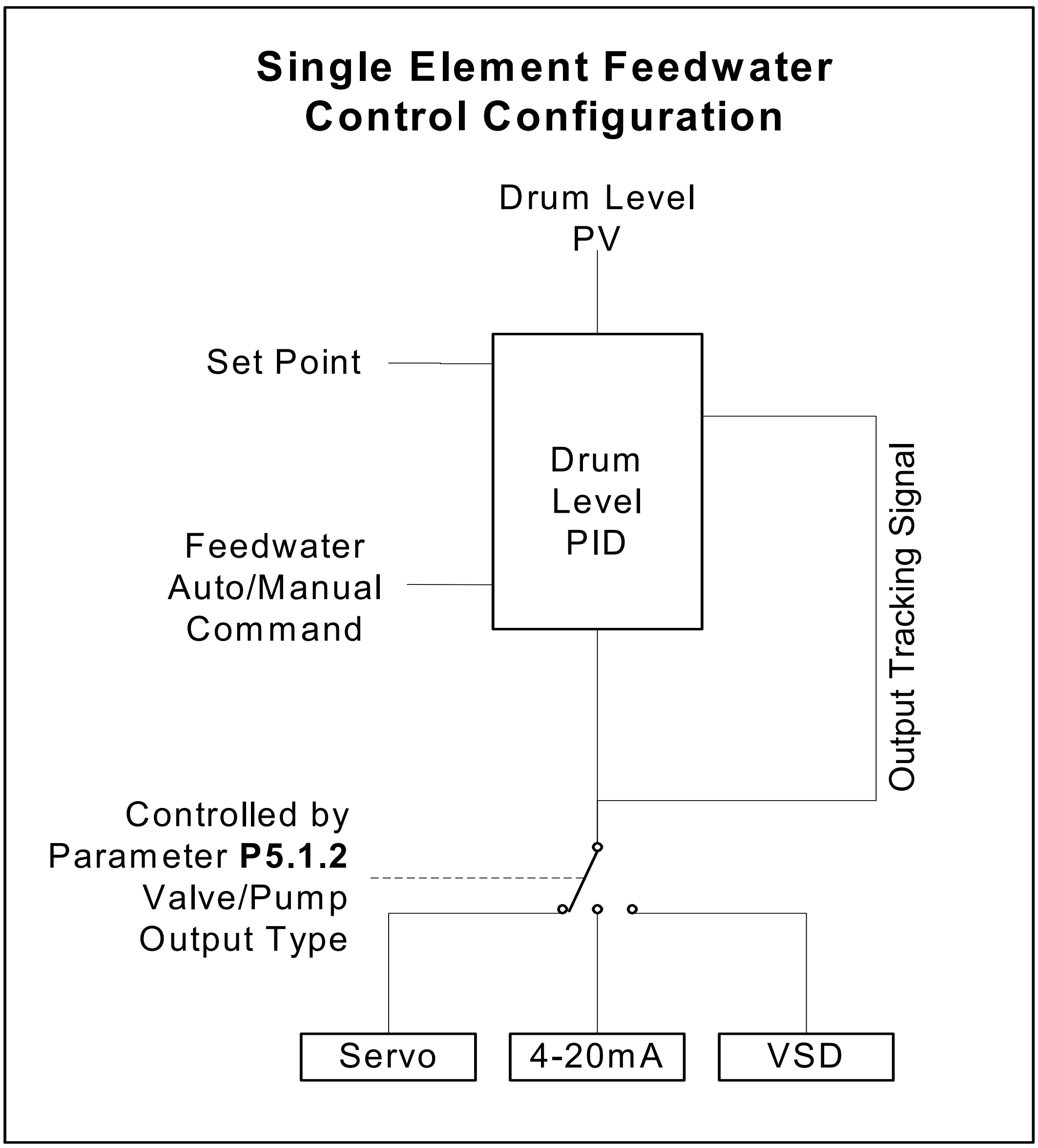
Additional Draft Control Features

1) Adjustable Purge Positions- **P4.1.4** Outlet Damper Purge Position, and **P4.1.5** ID Fan VSD Purge Hz, allow the user to set the outlet damper position and ID fan VSD speed, respectively, for boiler purge.
2) Adjustable Start Draft Option- On installations with excessively negative draft levels (very tall stack, oversized ID fan, badly leaking stack damper) that are preventing the burner from lighting off, **P4.4.1** Adjustable Start Draft Option allows the user to set different draft damper positions (or VSD) speeds at the Pilot Trial for Ignition and Main Trial for Ignition states for each fuel. When using this feature, the user must also set **P4.4.2** Adjustable Start Draft Set Point. To prevent lighting off under unsafe draft conditions, the BMU will initially position the draft damper or VSD to the values determined by **P4.4.3 to P4.4.5**, depending on which fuel is being fired. If, after this step, the measured draft still exceeds **P4.4.2** Adjustable Start Draft Set Point, the **BurnerMate Universal** will jog the draft damper/VSD open until the draft drops below the set point of **P4.4.2**.
Once the burner is lit off, the BMU holds the draft damper/VSD at this position for a period of time as determined by **P4.3.1** Modulate Delay Sec, and then control reverts back to normal, as determined by **P4.1.1** Draft Control Option.
Note: This option can only be enabled when **P4.1.1** Draft Control Option is selected to FloatingServo or PIDServo.
3) Modulate Delay- P4.3.1 Modulate Delay Sec, Draft can be used to hold the draft damper/VSD at the purge position (adjustable start set point) for a set amount of time after the burner is released to modulate.
4) Draft Cool-Down Delay- P4.3.2 Draft Cool Down Delay can be used to hold the damper at the purge position for an extended period of time after the burner has shut down. Some refractory-lined furnaces require extra cool-down after the end of post purge.
5) Draft Servo Check Option- This option is controlled by **P4.3.3** Draft Servo Check Option and is normally enabled. It directs the BurnerMate Universal to drive the draft damper servo from fully closed to fully open during PreStart to check for proper servo operation; this allows the servo feedback to be used as the draft damper open interlock. If this parameter is disabled, an additional external open damper proving switch must instead be wired to BMU terminal T46, and **P4.4.1** Adjustable Start Draft Option must be disabled.
6) Low Draft Alarm- A low draft (high pressure) alarm can be configured by **P4.2.1** Low Alarm SP, Draft. This parameter determines the set point of the low draft alarm. Setting this parameter to +25.000 disables this alarm. To avoid nuisance trips, **P4.2.2** Alarm Delay Sec, Draft configures a time delay that must be exceeded before the BurnerMate Universal trips the burner.
7) Rate Limiters- P4.6.4 Sec/90 deg Damper Rate Limit, Draft, limits the speed of the draft damper (in seconds per 90° travel) to prevent over controlling. For electric actuators or servos, this value should be set to the same speed as the servo, or slower. A similar slow value should be used to limit the speed of a pneumatic actuator when driving a draft damper. Similarly, **P4.11.3** Sec/60Hz VSD Rate Limit, Draft is used to limit the change in ID fan VSD speed. These rate limiters are active whether the firing rate is in automatic or manual control.

Drum Level and Feedwater Control

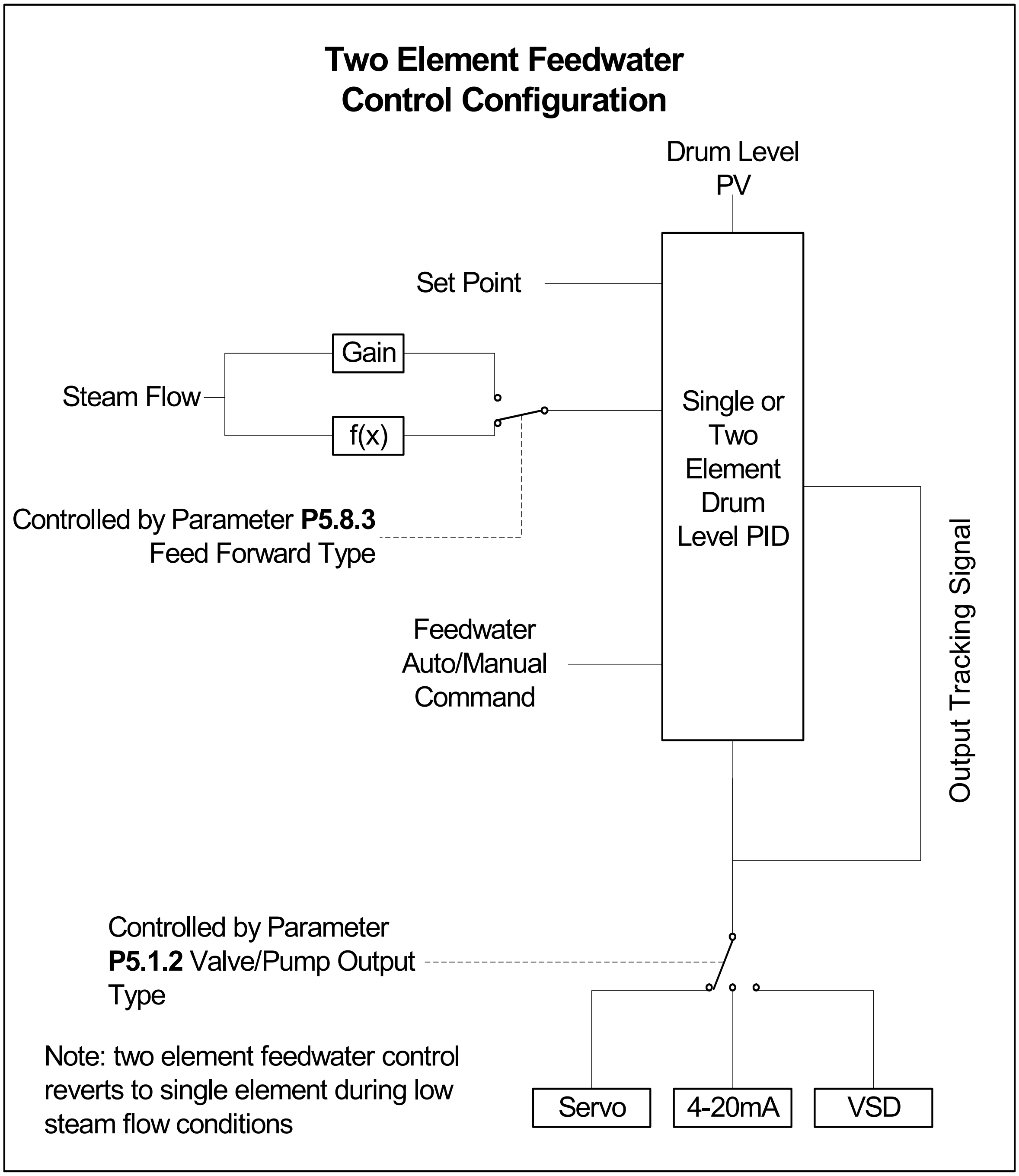
The objective of boiler feedwater control is to maintain a constant water level in the boiler (i.e. steam generator) during all load conditions. The **BurnerMate Universal** is capable of providing either single-element, two-element, or three-element drum level control. Output options can be selected for either a servo-operated feedwater valve (in the servo daisy chain) or an analog output for either a feedwater flow control valve, or a feedwater pump VSD.

Single Element Feedwater Control
Single-element feedwater control uses a single input (drum level) and PID control to position the feedwater control device. This control strategy is the simplest to implement; however, it will not effectively correct for shrink and swell caused by rapid load changes.



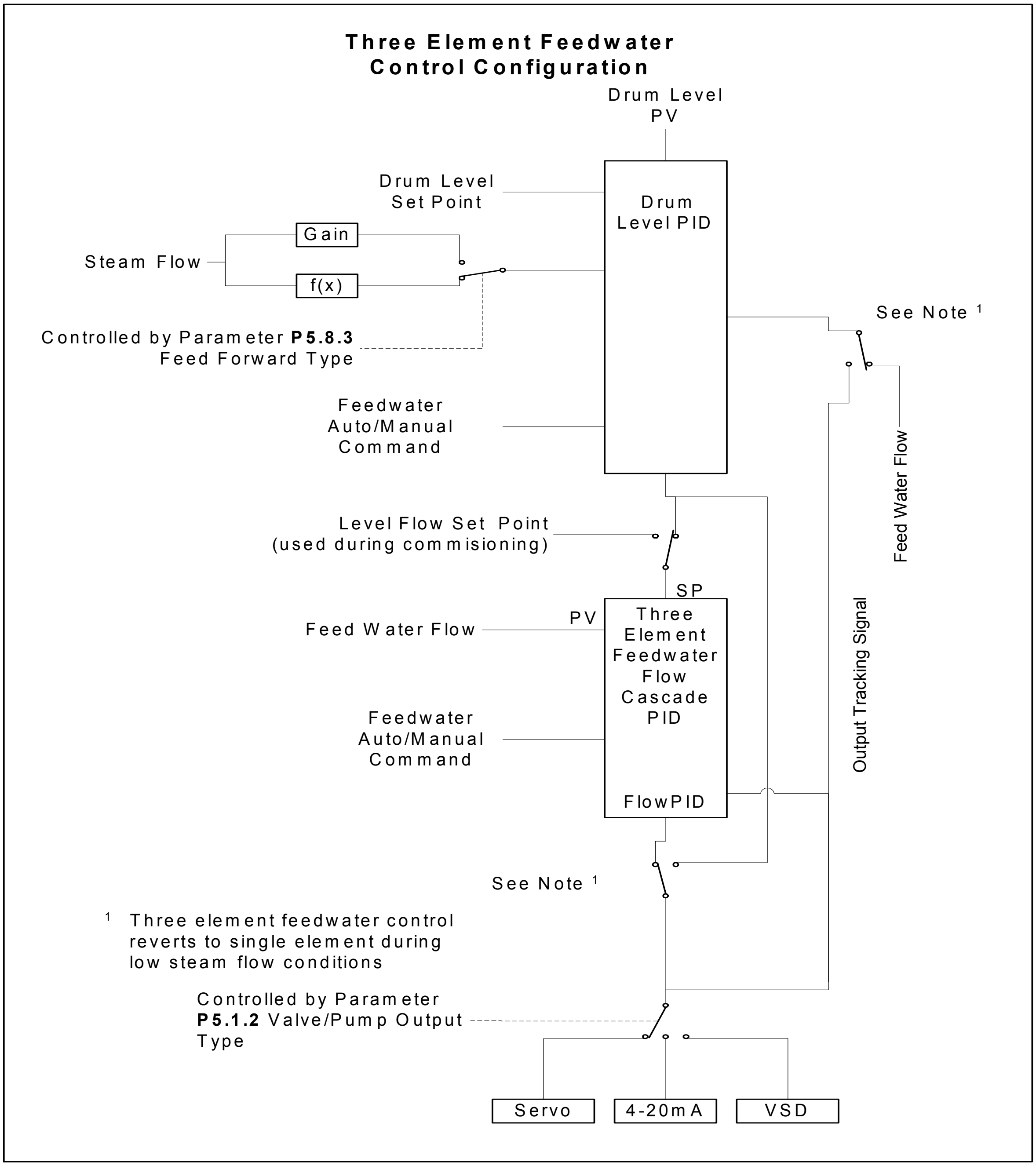
Two-Element Feedwater Control

In addition to monitoring drum level, two-element feedwater control uses steam flow as a “feedforward” to anticipate shrink and swell due to changes in boiler firing rate. When tuned correctly, two-element feedwater control can maintain constant drum level despite rapid/significant changes in firing rate.



Three-Element Feedwater Control

Three-element feedwater control has two cascaded PID loops. The outer Drum Level PID loop generates a desired feedwater flow signal that becomes the set point for the cascaded inner Flow PID loop. The Drum Level PID loop functions similarly to the primary PID loop in a two-element feedwater control configuration. The inner Flow PID loop compares actual feedwater flow to the feedwater flow set point generated by the outer control loop and positions the output-controlled device to maintain this set point. The BMU contains a screen dedicated to the tuning of the inner feedwater Flow PID loop.



SECTION 3 INDEX

BurnerMate Universal Parameters and Application Setup

Parameter Introduction

The **BurnerMate Universal** is a robust controller capable of Burner Management (Flame Safe Guard), Combustion Control and Auxiliary Control system functions. Further, it has many additional features such as Dual Flame Scanner (redundant), Gas Valve Leak Test, Automatic Atomizer Post Purge, etc. capabilities that allow flexibility in its application to various Fired Equipment services and Burner configurations.

This flexibility is afforded by designing the **BurnerMate Universal** to a Parameter-based setup procedure. The total number of available Parameters is in excess of 280. Though this will be needed on an application that involves all of the BMS, CCS and ACS functions that the **BurnerMate Universal** was designed to accommodate. However, on a very simple system … gas-fired only Hot Water Heater, no Drum Level control, no Draft or FGR control, no VSDs and no O2 monitoring or trim … the number of applicable Parameters is far less.

We believe any uneasiness over the number of Parameters can be overcome by breaking down the overall Parameter entry procedure into a “pre-commissioning Application Setup function” and a “during commissioning Servo setup and tuning function”. The use of any available Parameter is highly dependent on the Application specifics.

The Application Setup Questionnaire found in Section 5- Commissioning, was developed to identify the key information needed to facilitate completion of the “pre-commissioning Application Setup function”. We encourage the commissioning engineer to complete the Questionnaire well in advance of startup as doing so simplifies and abbreviates the Parameter entry process at the time of commissioning. In many cases the default values are acceptable and/or applicable as starting points for initial commissioning. Obviously those Parameters related to “tuning” will have to be optimized once the initial commissioning effort has been completed and operation in automatic control has been observed.

In the tables showing Parameters default setting, some Parameter numbers are **Bold** and have an asterisk (*) next to them. These Parameters are selected for the commissioning engineer as a minimum to confirm that the default settings are correct for the intended application. Although the total number of Parameters is just over 280, we hope that this table and these selections will help to ease the initial apprehension.

Although certain Parameters have been selected to get the commissioning engineer started, it is not intended to imply that the unselected Parameters are any less important in the final commissioning of the **BurnerMate Universal**. All Parameters must be reviewed and the final values recorded before completing the commissioning process. See Section 5 for Parameter documentation forms.

> Note: The **BurnerMate Universal** is shipped with fuel select Parameters **P1.1.1**, **P1.1.2** & **P1.1.3** set to **DISABLE** to prevent boiler operation until the controller is configured. In the event the **BurnerMate Universal** program is corrupted, Parameters **P1.1.1**, **P1.1.2** & **P1.1.3** default back to **DISABLE** to prevent unsafe firing.

Parameters are used to configure the **BurnerMate Universal** to match the boiler/burner type, field devices, and required operating characteristics of the fired equipment. The Parameters are organized into functional groups, which are easily accessed through the LCD touch pad, the optional color Touch screen, or by using BMU Edit software from a Laptop computer.

A complete and detailed explanation of each Parameter, including the associated terminals, ratings and example wiring, value options, Parameter location path, password level requirements and helpful notes can be found later in this section.

Also in this section is a quick overview of the Parameters, their default settings and a cross-reference to parameter numbers used in an earlier release of **BurnerMate Universal**.

Passwords and User Access

Parameters, options, and servo setup can be viewed at all times, regardless of the current Password Level. However, in order to modify the Parameters, options, fuel/air curves and servo setup the user must enter the appropriate password.

Each Parameter is assigned a required Privilege Level in order to modify that parameter. Reference the Parameter Guide Tutorial (Page 24) in this manual section. The Parameter Privilege Levels are as follows:

“O”	Operator, lowest security level. The "O" password requirement can be disabled by setting the password to: 9999. The Operator Password is set to 9999 at the factory.
“T”	Technician, this security level is intended for the combustion technicians that have been trained on the proper **BurnerMate Universal** operating, configuration, and fuel-air ratio curve commissioning techniques. Access is granted to functions required to commission the Fuel-Air curves, operational tuning parameters, and Servo configuration Menus. The "T" level password requirement cannot be disabled.
“E”	Engineer, this security level is intended for combustion engineers that have the experience and training required to design combustion equipment, and combustion control systems. In addition, users of this password level must have the knowledge and experience to interpret and implement safe combustion systems based on UL372, CSD-1, NFPA-85, IRI, and other appropriate Safety Codes. The "E" level password requirement cannot be disabled.
“R”	Restricted, this designation denotes items that can only be changed when the Flame Safeguard is in Standby or Lockout. These parameters cannot be changed during Burner operation.

The required Password for each Privilege Level is explained in the Commissioning Section of this manual.

BMU-LCD Display Menu Navigation

Button Functions:

BACK returns to the previous Menu.

NEXT activates the selected Menu.

Pressing **BACK** and **NEXT** at the same time displays the Home screen in the Operating display loop.

Pressing **BACK** and **NEXT** a second time makes the LCD jump back to the Menu or Screen that was being viewed just before jumping to the Home screen.

Since any Operating screen can be the Home screen, this provides a quick way to jump back and forth between any Operating screen and any Menu screen. To make one of the Operating screens the Home screen: display the screen, and then press and hold **BACK** and **NEXT** until the screen blinks.

RESET will reset the burner after a Lockout.

ALARM SILENCE de-energizes the Alarm relay and makes the LCD stop blinking.
Press and hold Alarm Silence for 5 seconds to cause the LCD to jump to the Alarm History screen.

ESC cancels the current editing operation and returns back into the Select Mode.

UP and DOWN buttons
In Select Mode, these buttons move the cursor around the screen from editable to editable item.
In Edit Mode, these buttons increase or decrease the value being Edited.

ENTER
Press to change from Select Mode into Edit Mode in order to change a number.
Press to toggle a ‘soft pushbutton’ on the LCD display.
In Edit Mode, pressing **ENTER** saves the value that was just changed into memory and then the display changes back into Select Mode.

SELECT MODE VS. EDIT MODE

Select mode is identified by a blinking solid cursor (█).
The cursor is moved around the screen by the **UP** and **DOWN** buttons.

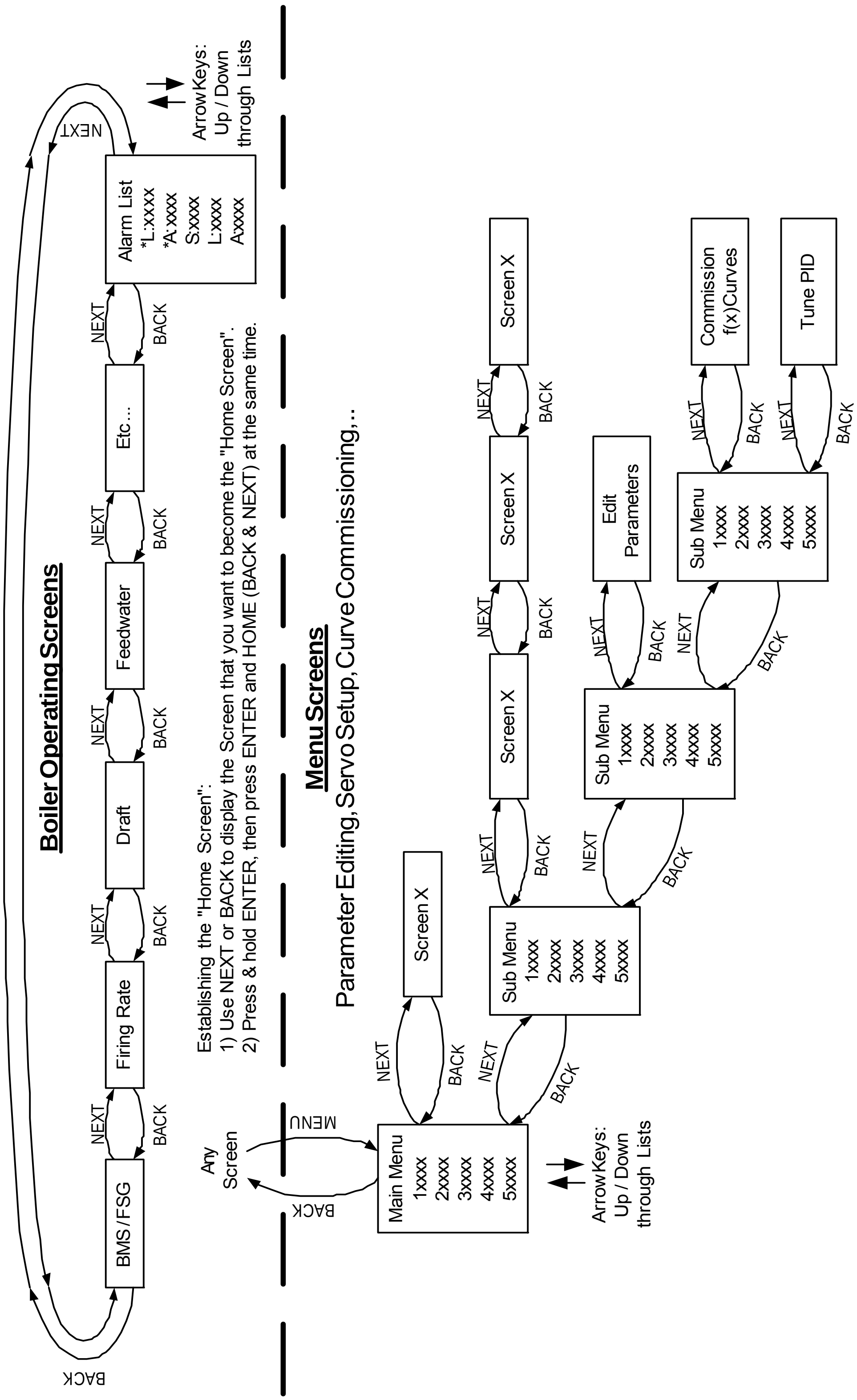
Edit Mode is identified by a blinking underline cursor (_).
The **UP** and **DOWN** buttons change the value, or selection, of the item being edited.

L, **A**, AND **C** INDICATORS CAN APPEAR ON ANY MENU OR OPERATING SCREEN IN THE RIGHT HAND COLUMN.

L indicates that the Flame Safeguard is in Lockout and has shutdown the burner until RESET is pressed.
A indicates that there is an Alarm that is active. View the Alarm message on the Alarm History screen.
C indicates that the BMU is in Commission Mode. The **L** (Lockout) indicator overrides the **C** indicator.

▲ and ▼ arrows in the right hand column of the LCD display
Indicates that there is more information above or below the 4 lines that are being displayed.
Use the **UP** and **DOWN** buttons to scroll the displayed lines to see the additional information.

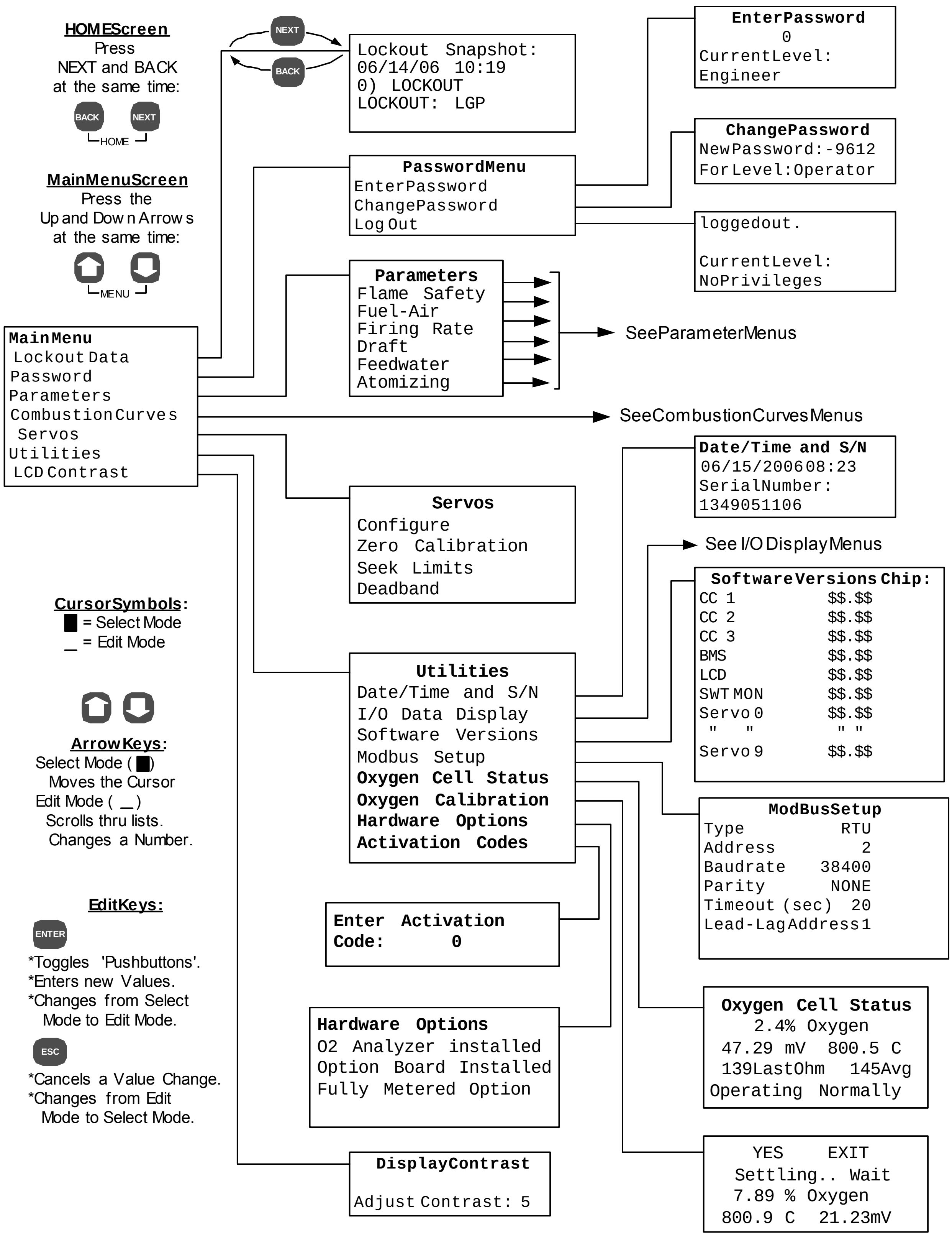
BMU-LCD Display Navigation Map



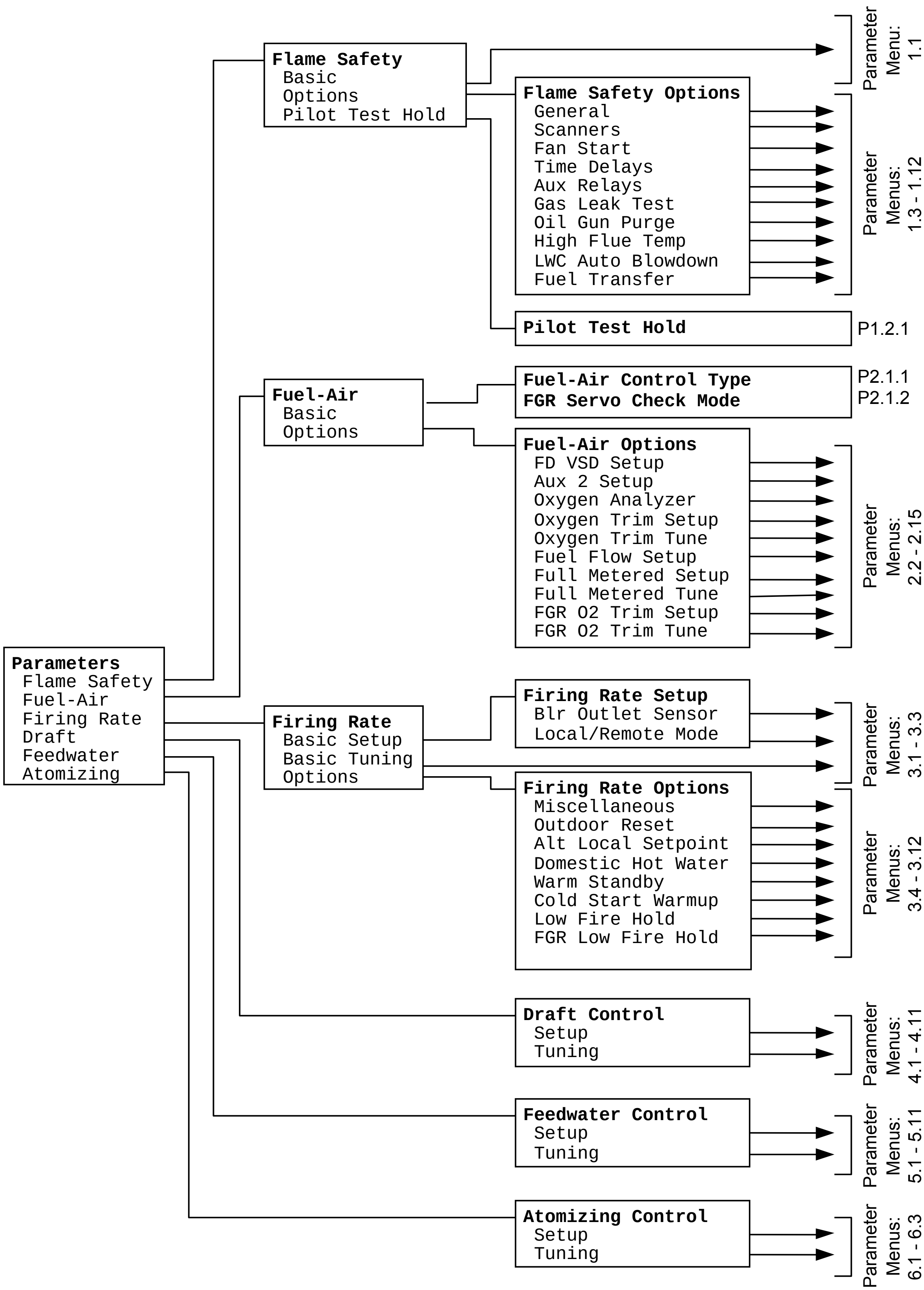
Hot Keys / Shortcuts (applies to ALL Screens and Menu Screens):
1) Press ALARM SILENCE for 2 seconds. Silences Alarm Relay, and then jumps from any screen to the Alarm History Screen.
2) Press HOME (BACK and NEXT). Jumps from any screen to the "Home Screen".
3) Press MENU (ENTER and ESC). Jumps from any screen to the Main Menu.

BMU-LCD Menu Trees

Main Menu



Main Parameter Menu



Flame Safeguard Parameters

Main Parameter Menu

Flame Safety
- Basic
- Options
- Pilot Test Hold

Pilot Test Hold
P1.2.1

Flame Safety Basic	
Fuel 1 Enable	P1.1.1
Fuel 2 Enable	P1.1.2
Fuel 3 Enable	P1.1.3
Fuel Request Source	P1.1.4
PAF Switch Installed	P1.1.5
ID Fan Installed	P1.1.6
Ignition Xfmr Mode	P1.1.7
Oil MTFI Sec	P1.1.8
Purge Sec	P1.1.9
Post Purge Sec	P1.1.10

FlameSafety Options
- General
- Scanners
- Fan Start
- Time Delays
- Aux Relays
- Gas Leak Test
- Oil Gun Purge
- High Flue Temp
- LWC Auto Blowdown
- Fuel Transfer

FSG General	
Power Fail Response	P1.3.1
Assured Low Fire Cut Off	P1.3.2
Fuel1 Proof of Closure Installed	P1.3.3
Fuel2 Proof of Closure Installed	P1.3.4
Fuel3 Proof of Closure Installed	P1.3.5

FSG Scanners	
Dual Flame Scanners	P1.4.1
Scanner 1 Signal	P1.4.2
Scanner 2 Signal	P1.4.3
Scanner Alarm SP	P1.4.4

FSG Fan Start	
FD Fan Start Mode	P1.5.1
FD Fan Start Delay	P1.5.2
Aux Fan Start Delay	P1.5.3

FSG Time Delays	
Min Air Flow Delay	P1.6.1
Low Fuel Pressure Delay	P1.6.2
Low Atomizing Flow Delay	P1.6.3
Low Draft Cutout Delay	P1.6.4
HOLD Alarm Delay	P1.6.5
HOLD Lockout Delay	P1.6.6

FSG Aux Relays	
Aux Relay Func. 1	P1.7.1
Aux Relay Func. 2	P1.7.2
Aux Relay Func. 3	P1.7.3
Aux Relay Func. 4	P1.7.4
Aux Relay Func. 5	P1.7.5
Hot Water pump/Valve Stop Delay	P1.7.6

FSG Gas Leak Test	
Gas (Fuel 2) Leak Test option	P1.8.1
Leak Test W/O Vent Valve Option	P1.8.2
Upstream Test Sec	P1.8.3
Downstream Test Sec	P1.8.4

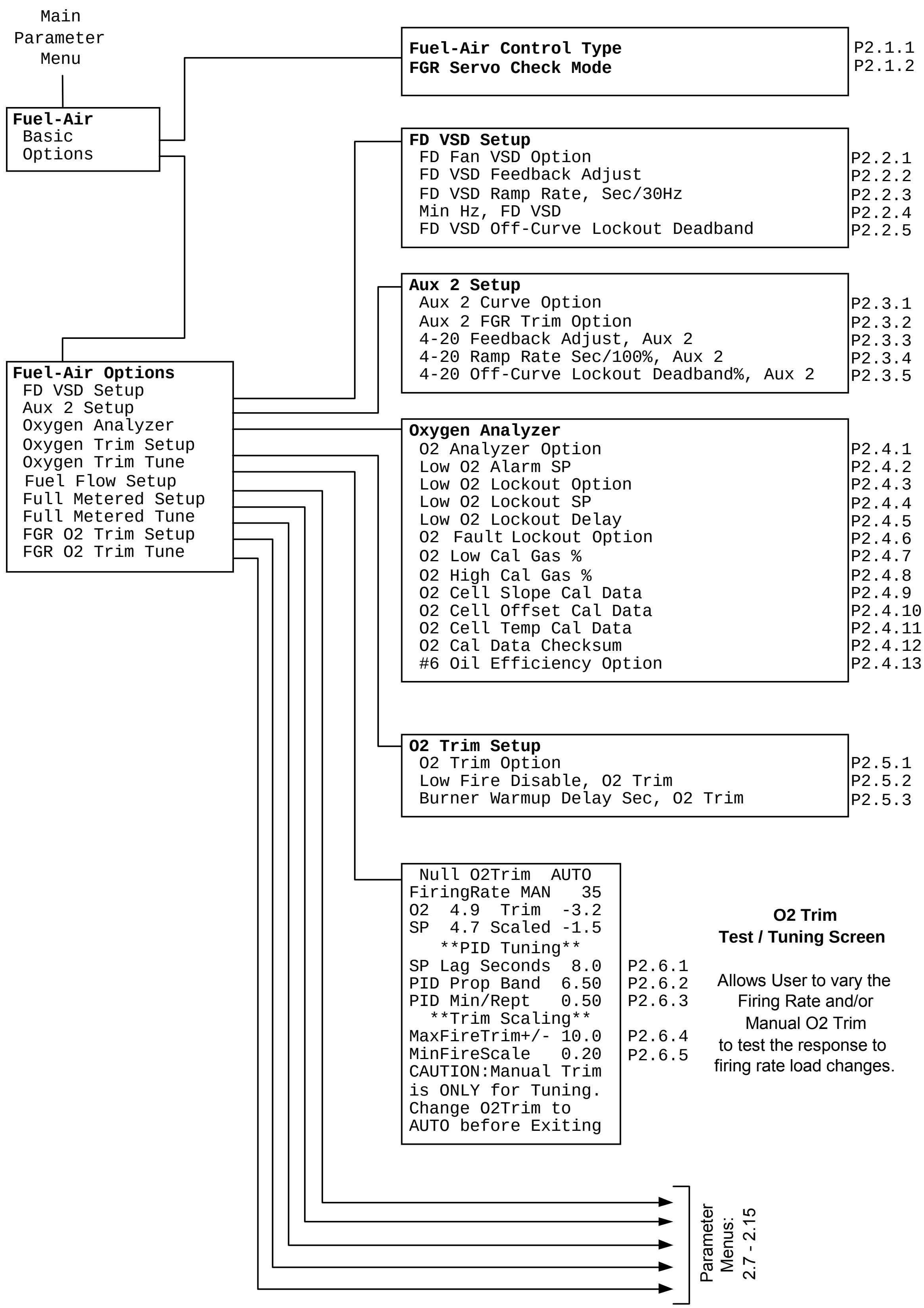
FSG Oil Gun Purge	
Oil Gun Purge Option	P1.9.1
Oil Gun Purge Sec	P1.9.2

FSG High Flue Temp	
Flue Gas T/C Type	P1.10.1
Alarm SP, Flue Temp	P1.10.2
Lockout SP, Flue Temp	P1.10.3

LWC Auto Blowdown	
LWC Auto Blowdown Option	P1.11.1
Failed Test Response, Blowdown	P1.11.2
Min Steam Pressure, Blowdown	P1.11.3
Time of Day, Blowdown	P1.11.4
Blowdown Seconds	P1.11.5
LWC Bypass Release Delay	P1.11.6

Fuel Transfer	
Fuel Transfer Method	P1.12.1
Low Fire Xfer Pilot Option	P1.12.2
Dual Fuel Time Limit, Sec	P1.12.3
Low Fire Xfer Air Bias %	P1.12.4

Fuel-Air-FGR Ratio Parameters



Fuel Flow and Full Metered Parameters

Main Parameter Menu

Fuel-Air Menu

Fuel-Air Options
- FD VSD Setup
- Aux 2 Setup
- Oxygen Analyzer
- Oxygen Trim Setup
- Oxygen Trim Tune
- Fuel Flow Setup
- Full Metered Setup
- Full Metered Tune
- FGR O2 Trim Setup
- FGR O2 Trim Tune

Fuel Flow Setup
- Oil Flow Meter
- Gas Flow Meter
- Fuel 3 Flow Meter
- Totalizers

Oil Flow Meter

Xmtr Signal, Oil Flow	P2.7.1
Decimal Point, Oil Flow	P2.7.2
GPH Span, Oil Flow	P2.7.3
Decimal Point, Oil Flow Pulser Freq	P2.7.4
Pulser Frequency Span, Oil Flow	P2.7.5

Gas Flow Meter

Decimal Point, Gas Flow	P2.8.1
Flow @ 20 mA, Gas Flow	P2.8.2
Sq Root Option, Gas Flow	P2.8.3
Pressure Comp Option, Gas Flow	P2.8.4
Gas PSIG Xmtr Span	P2.8.5
Flow Comp Design PSIG, Gas Flow	P2.8.6

Fuel 3 Flow Meter

Decimal Point, Fuel 3 Flow	P2.9.1
Flow @ 20 mA, Fuel 3 Flow	P2.9.2
Sq Root Option, Fuel 3 Flow	P2.9.3

Totalizers

Flow Totalizer Option	P2.10.1

Full Metered Setup
- Air Flow Meter
- Miscellaneous

Air Flow Meter

Sq Root Option, Air Flow	P2.11.1
Temp Comp Option, Air Flow	P2.11.2

Misc Metered Setup

Air Flow %, Disable Full	P2.12.1
% Air Flow, Lo Fire Deviation	P2.12.2
% Air Flow, Hi Fire Deviation	P2.12.3
% Fuel Flow, Deviation	P2.12.4
Sec, Flow Deviation Lockout	P2.12.5

Full Metered Tune

$$$$$ AFTrim MANUAL	
FiringRate AUTO 100	
Air Flow xxx.xx	
Air Flow SP xxx.xx	
AF Deviation x.x	
UnScaledTrim xx.xx	
Scaled Trim xx.xx	
PID Tuning	
Gap Band +/- x.x	P2.13.1
PropBand x.x	P2.13.2
Min/Repeat x.xx	P2.13.3
Trim Scaling	
MaxFireTrim+/- xx.x	P2.13.4
MinFireScale xx.x	P2.6.5
Trim Null AF% xx	P2.12.1
Xmtr Filter Sec x.x	P2.13.7
Flow SP Lag Sec x.x	P2.13.8

CAUTION:
Manual Trim
is ONLY for Tuning.
Change AFTrim to
AUTO before Exiting

FGR Windbox O2 Trim Parameters

Main Parameter Menu

Fuel-Air Menu

Fuel-Air Options
FD VSD Setup
Aux 2 Setup
Oxygen Analyzer
Oxygen Trim Setup
Oxygen Trim Tune
Fuel Flow Setup
Full Metered Setup
Full Metered Tune
FGR O2 Trim Setup
FGR O2 Trim Tune

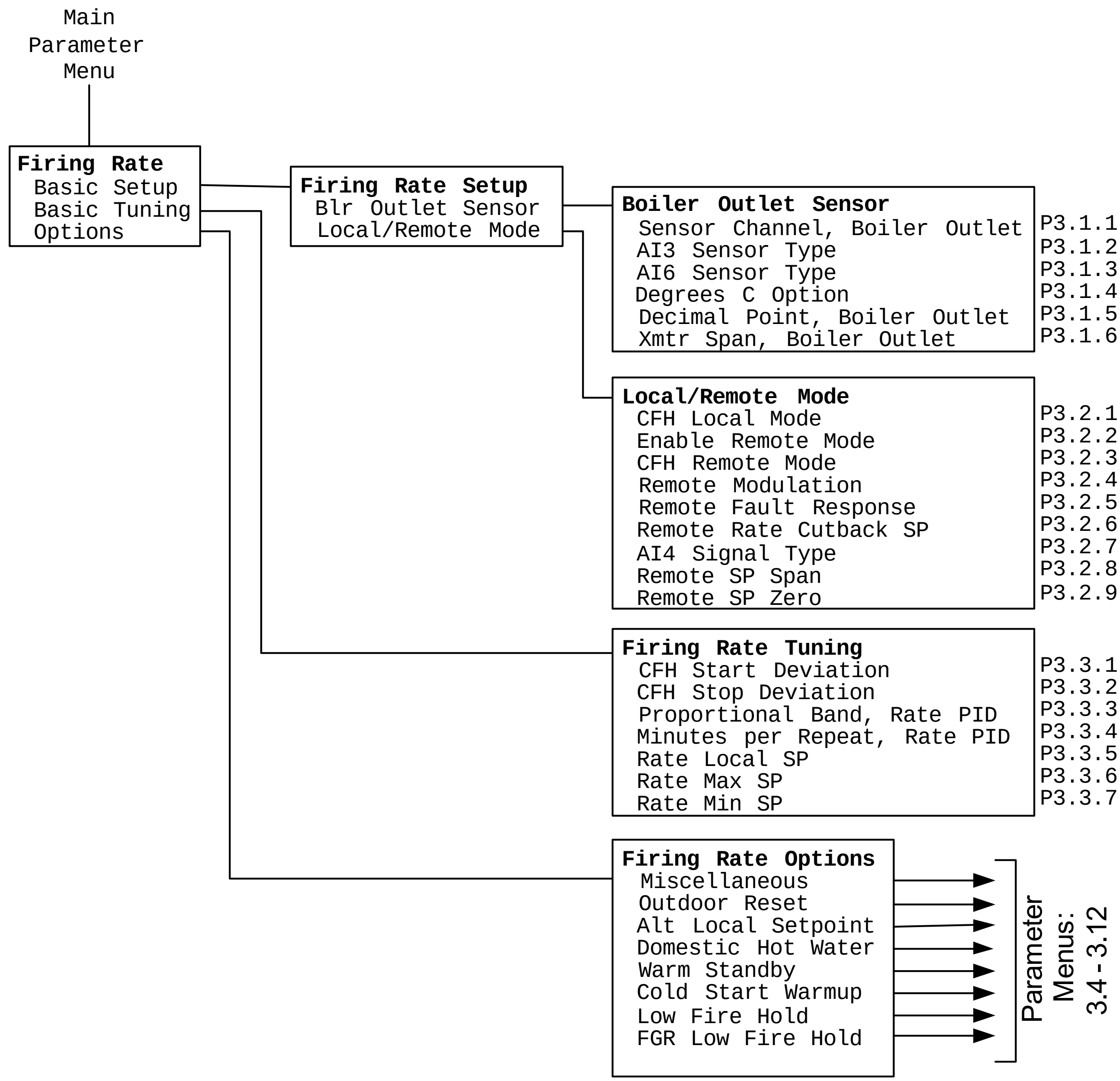
FGR O2 Trim Setup

Windbox Oxygen FGR Trim Option	P2.14.1
Windbox Oxygen @ 20 mA, Xmtr Cal	P2.14.2

FGR O2 Trim Tune

Null FGRTrim MANUAL	
FiringRate AUTO 100	
O2 xx.xx Trim-xx.x	
SP xx.xx Scale-xx.x	
PIDTuning	
SP Lag Seconds xx.x	P2.15.1
PID Prop Band x.xx	P2.15.2
PID Min/Rep't x.xx	P2.15.3
Trim Scaling	
MaxFireTrim+/- xx.x	P2.15.4
MinFireScale xx.x	P2.15.5
CAUTION:Manual Trim is ONLY for Tuning. Change FGR Trim to AUTO before Exiting	

Firing Rate Control Basic and Tuning Parameters



Firing Rate Control Options Parameters

Main Parameter Menu

Firing Rate Menu

Firing Rate Options
- Miscellaneous
- Outdoor Reset
- Alt Local Setpoint
- Domestic Hot Water
- Warm Standby
- Cold Start Warmup
- Low Fire Hold
- FGR Low Fire Hold

Misc. Firing Rate

Sec/100% Rate Limit, Firing Rate	P3.4.1
+/- Avoid Gap, Firing Rate	P3.4.2
Output Channel, Firing Rate	P3.4.3

Outdoor Reset
- Sensor Setup
- Reset Curve

OutdoorSensor Setup

Sensor Channel, Outside Air	P3.5.1
AI5 Sensor Type	P3.5.2
AI5 Xmtr Span, Outdoor Temp	P3.5.3
AI5 Xmtr Zero, Outdoor Temp	P3.5.4

Outdoor Reset Curve

Outdoor Cutoff Deg	P3.6.1
Low OAT Deg	P3.6.2
High OAT Deg	P3.6.3
Normal SP at Low OAT	P3.6.4
Normal SP at High OAT	P3.6.5
Setback SP at Low OAT	P3.6.6
Setback SP at High OAT	P3.6.7

Alternate Local SP

Alt Local SP Option	P3.7.1
Alt Local Setpoint	P3.7.2

Domestic Hot Water

DHW Override Option	P3.8.1
DHW Setpoint	P3.8.2

Warm Standby

Warm Standby Option	P3.9.1
Start SP, Warm Standby	P3.9.2
Stop SP, Warm Standby	P3.9.3
Sensor Channel, Warmup	P3.9.4
AI5 Sensor Type	P3.9.5
AI5 Xmtr Span, Warmup Temp	P3.9.6
AI6 Sensor Type	P3.9.7

Cold Start Warmup

Cold Start Warmup Option	P3.10.1
Activate SP, Cold Start	P3.10.2
Deactivate SP, Cold Start	P3.10.3
Setpoint Step, Cold Start	P3.10.4
Firing Rate Step, Cold Start	P3.10.5
Firing Step Override Minutes, Cold Start	P3.10.6

Low Fire Hold

Low Fire Hold Option	P3.11.1
Override Seconds, Low Fire Hold	P3.11.2
Low Fire Hold SP	P3.11.3

FGR Low Fire Hold

FGR Temp Low Fire Hold Option	P3.12.1
Release Temp., FGR LFH	P3.12.2
Min Temp., FGR Cutback	P3.12.3
Fuel 1 Cutback %, FGR Min Temp	P3.12.4
Fuel 2 Cutback %, FGR Min Temp	P3.12.5
Fuel 3 Cutback %, FGR Min Temp	P3.12.6

Draft Control Parameters

Main Parameter Menu

Draft Control
- Setup
- Tuning

Draft Setup
- Basic
- Alarm
- Miscellaneous
- Adj Start Option

Draft Basic Setup

Draft Control Option	P4.1.1
Draft @ 4 mA, Xmtr Cal	P4.1.2
Draft @ 20 mA, Xmtr Cal	P4.1.3
Outlet Damper Purge Position	P4.1.4
ID Fan VSD Purge Hz	P4.1.5

Draft Alarm Setup

Low Alarm SP, Draft	P4.2.1
Alarm Delay Sec, Draft	P4.2.2

Draft Misc Setup

Modulate Delay Sec, Draft	P4.3.1
Cooldown Delay Sec, Draft	P4.3.2
Draft Servo Check Option	P4.3.3

Draft Adj Start

Adjustable Start Draft Option	P4.4.1
Adj Start Draft SP	P4.4.2
Fuel 1(Oil) Adj Start Position	P4.4.3
Fuel 2(Gas) Adj Start Position	P4.4.4
Fuel 3 Adj Start Position	P4.4.5

Draft Tuning
- Floating Draft Tune
- Floating & PID Tune
- PID Draft Tune
- PID Feedfwd Curves
- ID Fan VSD Tune

Floating Draft Tune

Proportional Band, Floating Draft	P4.5.1
Deadband, Floating Draft	P4.5.2

Floating & PID Tune

Filter Sec, Draft Xmtr	P4.6.1
Max Damper Position in Auto, Draft	P4.6.2
Min Damper Position in Auto, Draft	P4.6.3
sec/90 deg Damper Rate Limit, Draft	P4.6.4

PID Draft Tune

Proportional Band, Draft PID	P4.7.1
Minutes per Repeat, Draft PID	P4.7.2
Gap, Draft PID	P4.7.3
Gap Gain, Draft PID	P4.7.4

DraftPID FeedForward Fuel(Oil)

For the Current Fuel Selection

Firing Rate	Damper or VSD	Oil **P4.8.x**	Gas **P4.9.x**	Fuel3 **P4.10.x**
0%	xxx.x	P4.8.1	P4.9.1	P4.10.1
10%	xxx.x	P4.8.2	P4.9.2	P4.10.2
20%	xxx.x	P4.8.3	P4.9.3	P4.10.3
30%	xxx.x	P4.8.4	P4.9.4	P4.10.4
40%	xxx.x	P4.8.5	P4.9.5	P4.10.5
60%	xxx.x	P4.8.6	P4.9.6	P4.10.6
80%	xxx.x	P4.8.7	P4.9.7	P4.10.7
100%	xxx.x	P4.8.8	P4.9.8	P4.10.8

ID Fan VSD Tune

Max VSD Hz in Auto, Draft	P4.11.1
Min VSD Hz in Auto, Draft	P4.11.2
sec/60Hz VSD Rate Limit, Draft	P4.11.3
SP Offset, Draft VSD/Damper Dual Output Mode	P4.11.4

Feedwater Control Parameters

Main Parameter Menu

Feedwater Control
- Setup
- Tuning

Feedwater Setup
- Basic
- Alarm
- Steam Flow
- Feedwater Flow
- Press Compensation

Feedwtr Basic Setup	
Feedwater Control Option	P5.1.1
Valve/pump Output Type	P5.1.2
Drum Level @ 4 mA, Xmtr Cal	P5.1.3
Drum Level @ 20 mA, Xmtr Cal	P5.1.4

Feedwtr Alarm Setup	
Low Alarm SP, Drum Level	P5.2.1
High Alarm SP, Drum Level	P5.2.2
Alarm Delay Sec, Drum Level	P5.2.3

Steam Flow Setup	
Decimal Point, Steam Flow	P5.3.1
Flow @ 20 mA, Steam Flow	P5.3.2
Sq Root Option, Steam Flow	P5.3.3
Filter Sec, Steam Flow	P5.3.4
Low Flow Cutout %, Steam	P5.3.5

Feedwtr Flow Setup	
Decimal Point, Feedwater	P5.4.1
Flow @ 20 mA, Feedwater Flow	P5.4.2
Sq Root Option, Feedwater	P5.4.3
Filter Sec, Feedwater Flow	P5.4.4
Low Flow Cutout %, Feedwater	P5.4.5

Pressure Compensate	
Pressure Units, Boiler Outlet	P5.5.1
Drum Level Press Comp Option	P5.5.2
Steam Flow Press Comp Option	P5.5.3
Steam Flow Design Pressure	P5.5.4

Feedwater Tuning
- Level Xmtr
- 1 Element PID
- 2 or 3 Element PID
- Feedforward Curve
- 3 Element Flow PID
- Pump VSD

Level Xmtr Tune	
Filter Sec, Drum Level	P5.6.1
Drum Level Adjust (Increase to Raise	P5.6.2

1 Element Level PID	
Proportional Band, 1 Elem FW	P5.7.1
Minutes per Repeat, 1 Elem	P5.7.2

2/3 Elem Level PID	
Proportional Band, 2/3 Elem	P5.8.1
Minutes per Repeat, 2/3 Elem	P5.8.2
Feedforward Type, FW	P5.8.3
Feedforward Gain, FW	P5.8.4
Steam Flow %, 1 Elem	P5.8.5
Fallback ON Delay Sec, FW	P5.8.6
Fallback OFF Delay Sec, FW	P5.8.7

FW FeedFwd Curve

Steam Flow	Valve	**P5.9.x**
0%	xxx.x	P5.9.1
10%	xxx.x	P5.9.2
20%	xxx.x	P5.9.3
30%	xxx.x	P5.9.4
40%	xxx.x	P5.9.5
60%	xxx.x	P5.9.6
80%	xxx.x	P5.9.7
100%	xxx.x	P5.9.8

****3 Elem FW Flow****		
LEVEL FlowSP	47.3	
FeedwaterFlow	50.2	
Flow Prop Band	150%	P5.10.1
Flow Min/Rept	0.20	P5.10.2

FW Pump VSD Curve	
No Flow VSD Hz, FW	P5.11.1
No Flow PID %, FW	P5.11.2

Atomizing Pressure Control Parameters

Main
Parameter
Menu

Atomizing Control
Setup
Tuning

Atomizing Setup
Atomizing Pressure Control Option P6.1.1
Pressure @ 4 mA, Xmtr Cal P6.1.2
Pressure @ 20 mA, Xmtr Cal P6.1.3

Atomize Tuning
PID Control
PID Feedfwd Curves

Atomizing PID Tune
Proportional Band, Atomizing P6.2.1
Minutes per Repeat, Atomizing P6.2.2
Gap Band, Atomizing Pressure P6.2.3
Minimum Modulation, Valve Degrees P6.2.4

Atomizing Valve Feedforward Curve
Low Oil deg xxx.x P6.3.1
Low Atom deg xxx.x P6.3.2
High Oil deg xxx.x P6.3.3
High Atom deg xxx.x P6.3.4

Parameter Guide Tutorial

Parameter Number

Parameter Name

Associated Terminal Reference

Factory Default Setting

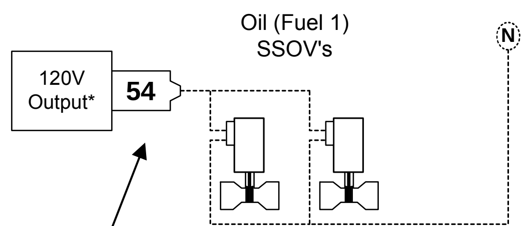
Parameter Location Path

Required Password Level

Menu Location:	Menu<Parameters<Flame Safety<Basic			P:	1.1.1
Password Level:	E, R	**Default Setting:**	**Disable**		**Fuel 1 Enable**
P1.1.1 Enables Fuel 1 (Oil Firing).				T:	**54**
			Rating	Terminal	Example Wiring

Options:

DISABLE Fuel 1 cannot be selected.
OIL BMU displays "OIL".
FUEL1 BMU displays "OIL".



*120Vac, 2A pilot duty or 65 VA pilot duty plus 1250 VA opening / 500 VA holding motorized valve

Note: The BMU screen will display the oil label selected here when Fuel 1 is selected.
Fuel 1 is the only fuel that can be associated with oil firing. Enabling Fuel 1 (OIL) enables all other parameters/terminals associated with oil firing.

Parameter Setting Options

Pertinent Parameter Notes

Wiring Information

Terminal Electrical Rating

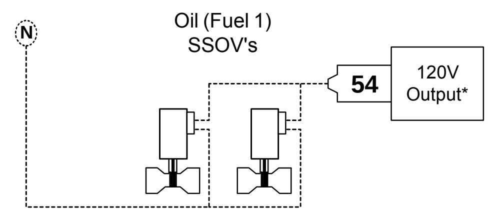
*Note: A ** before a parameter means that parameter is shown in 2 or more places.*
*A *** before a parameter means that parameter is one of the primary parameters that must be set before operating the **BurnerMate Universal,** regardless of the options utilized.*

1. FLAME SAFETY

1.1 – Basic

1.1.1 – Fuel 1 Enable***

Menu Location:	Menu<Parameters<Flame Safety<Basic			P:	1.1.1
Password Level:	E, R	Default Setting:	Disable		**Fuel 1 Enable**
P1.1.1 Enables Fuel 1 (Oil Firing).				T:	54
		Rating	Terminal	Example Wiring	



*120Vac, 2A pilot duty or 65 VA pilot duty plus 1250 VA opening / 500 VA holding motorized valve

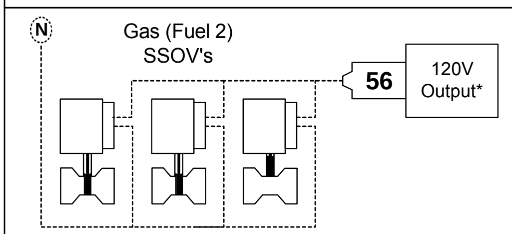
Options:

DISABLE	Fuel 1 cannot be selected.
OIL	BMU displays "OIL".
FUEL1	BMU displays "OIL".

Note: The BMU screen will display the oil label selected here when Fuel 1 is selected.
Fuel 1 is the only fuel that can be associated with oil firing. Enabling Fuel 1 (OIL) enables all other parameters/terminals associated with oil firing.

1.1.2 – Fuel 2 Enable***

Menu Location:	Menu<Parameters<Flame Safety<Basic			P:	1.1.2
Password Level:	E, R	Default Setting:	Disable		**Fuel 2 Enable**
P1.1.2 Enables Fuel 2 (Gas Firing).				T:	56
		Rating	Terminal	Example Wiring	



*120Vac, 2A pilot duty or 65 VA pilot duty plus 1250 VA opening / 500 VA holding motorized valve

Options:

DISABLE	Fuel 2 cannot be selected.
GAS	BMU displays "GAS".
bGAS	BMU displays "bGAS" (Bio Gas).
dGAS	BMU displays "dGAS" (Digester Gas).
oGAS	BMU displays "oGAS" (Off Gas).
FUEL2	BMU displays "FUEL2".

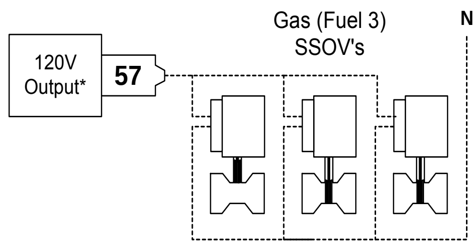
Note: The BMU screen will display the gas label selected here when Fuel 2 is selected.
If gas leak test is required see parameter P1.8.1.

1.1.3 – Fuel 3 Enable***

Menu Location:	Menu<Parameters<Flame Safety<Basic			**P:**	**1.1.3**
Password Level:	E, R	**Default Setting:**	**Disable**	**Fuel 3 Enable**	
P1.1.3 Enables Fuel 3 (Gas Firing).				**T:**	**57**
				Rating / Terminal / Example Wiring	

Options:

DISABLE Fuel 3 cannot be selected.
GAS BMU displays "GAS".
bGAS BMU displays "bGAS" (Bio Gas).
dGAS BMU displays "dGAS" (Digester Gas).
oGAS BMU displays "oGAS" (Off Gas).
FUEL3 BMU displays "FUEL3".



*120VAC, 2A pilot duty or 65 VA pilot duty plus 1250 VA opening / 500 VA holding motorized valve

Note: The BMU screen will display the gas label selected here when Fuel 3 is selected.
If gas (Fuel 2) leak test is enabled **P1.1.3** must be disabled. See **P1.8.1** for more information.

1.1.4 – Fuel Request Source***

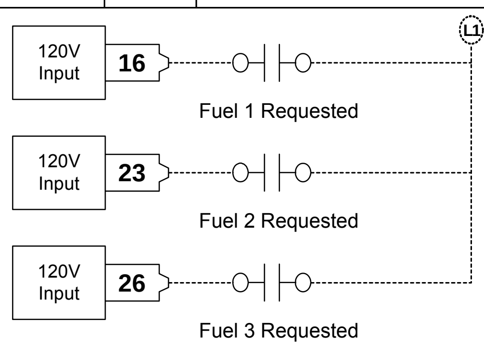
Menu Location:	Menu<Parameters<Flame Safety<Basic			**P:**	**1.1.4**
Password Level:	E, R	**Default Setting:**	**Contacts**	**Fuel Request Source**	
P1.1.4 Determines how the BMU selects a fuel curve for firing.				**T:**	**16, 23, 26**
				Rating / Terminal / Example Wiring	

Options:

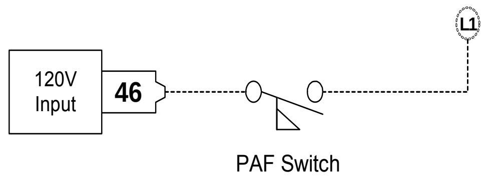
Contacts: An external switch or relay contact applies 120 VAC to T16, T23, or T26 to request the fuel.

Display: The BMU fuel request screen requests the fuel.

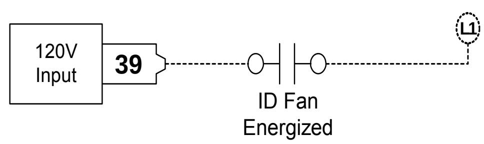
Display Or Modbus: When the BMU is in remote mode the BMU fuel request screen or Modbus can request the fuel. When the BMU is in local mode Only the BMU fuel request screen can request the fuel.



1.1.5 – PAF Switch Installed***

Menu Location:	Menu<Parameters<Flame Safety<Basic				**P:**	**1.1.5**
Password Level:	E, R	**Default Setting:**	**Yes**			**PAF Switch Installed**
P1.1.5 Determines if a Purge Air Flow (PAF) switch is installed.					**T:**	**46**
				Rating	Terminal	Example Wiring
Options: **Yes** A Purge Air Flow (PAF) interlock IS wired to T46. PAF is tested during Safe Start Check and is required for Purge. **No** A Purge Air Flow (PAF) interlock is NOT wired to T46. PAF is NOT tested during Safe Start Check and is NOT required for Purge.						
WARNING: "No" bypasses the Purge Air Flow (PAF) safety interlock. Use of a PAF interlock depends on system design and code requirements.						

1.1.6 – ID Fan Installed***

Menu Location:	Menu<Parameters<Flame Safety<Basic				**P:**	**1.1.6**
Password Level:	E, R	**Default Setting:**	**Yes**			**ID Fan Installed**
P1.1.6 Determines if an ID Fan energized input is used.					**T:**	**39**
				Rating	Terminal	Example Wiring
Options: **Yes** ID Fan Energized, input T39 is a non-recycling Limit. **No** ID Fan Energized, input T39 is not a nonrecycling limit.						
WARNING: "No" bypasses the ID Fan Energized safety interlock. If an ID fan is installed, this parameter must be set to "Yes".						

1.1.7 – Ignition Xfmr Mode***

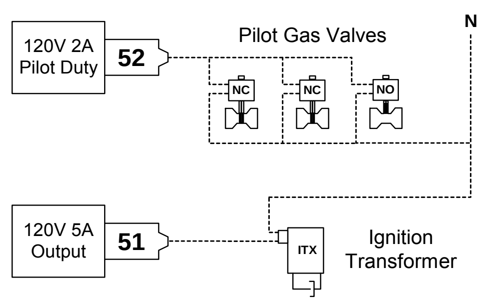
Menu Location:	Menu<Parameters<Flame Safety<Basic			**P:**	**1.1.7**
Password Level:	E, R	**Default Setting:**	**Early Terminate**	**Ignition Xfmr Mode**	
P1.1.7 Determines the ignition transformers mode of operation during Pilot Trial for Ignition or Direct Spark Ignition.				**T:**	**51, 52**
				Rating / Terminal / Example Wiring	

Options:

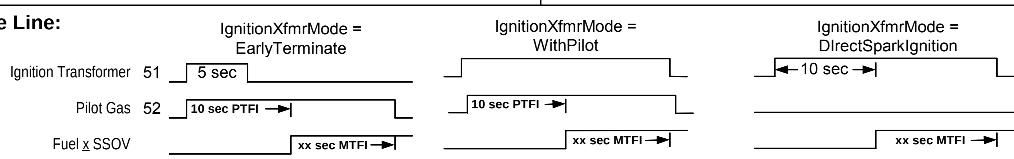
EarlyTerminate
T51 and T52 are both energized for the first 5 seconds of Pilot Trial For Ignition (PTFI). T51 is de-energized for the last 5 seconds of PTFI.

WithPilot
T51 and T52 are both energized throughout PTFI and Main Trial For Ignition (MTFI).

DirectSparkIgnition
T51 is energized throughout PTFI and MTFI. T52 is never energized.



Time Line:



WARNING: Verify that the ignition spark does not cause the scanner to detect a false flame (without fuel). Select EarlyTerminate if false flame is detected.

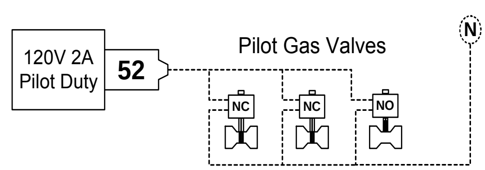
Note: The Run/Hold switch(dipswitch 1) can be turned on after flame has been proven so a pilot turn-down test can be performed. See also **P1.6.6** for hold lockout delay.

1.1.8 – Oil MTFI Sec***

Menu Location:	Menu<Parameters<Flame Safety<Basic			**P:**	**1.1.8**
Password Level:	E, R	**Default Setting:**	**10 Seconds**	**Oil MTFI Sec**	
P1.1.8 Extends the operation of the pilot during Fuel 1, oil Main Trial For Ignition.				**T:**	**52**
				Rating / Terminal / Example Wiring	

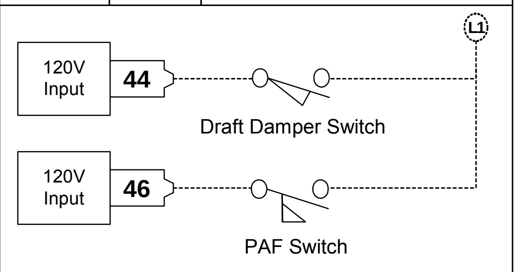
Options:

10 to 15 Seconds



WARNING: Any extension of the pilot during oil MTFI should be approved by the burner manufacturer prior to adjusting.

1.1.9 – Purge Time***

Menu Location:	Menu<Parameters<Flame Safety<Basic			P:	1.1.9
Password Level:	E, R	**Default Setting:**	**30 Seconds**		**Purge Time**
P1.1.9 Determines the purge time in seconds.				T:	**44, 46**
			Rating	Terminal	Example Wiring
Options: **15 to 1800 Seconds** Once the Purge interlocks; Purge Air Flow T46, Draft Damper Open T44 and combustion servos are at Purge position, the Purge timer is initiated (based on **P1.1.9**). During Purge, the Purge interlocks can be open for no more than 30 sec (cumulative). After the end of Purge, the BurnerMate Universal will initiate the Ignition command.					
WARNING: Consult the burner manufacturer for proper Purge time to be entered prior to firing burner.					

1.1.10 – Post Purge Time***

Menu Location:	Menu<Parameters<Flame Safety<Basic			P:	1.1.10
Password Level:	E, R	**Default Setting:**	**20 Seconds**		**Post Purge Time**
P1.1.10 Determines the post purge time in seconds.				T:	**44, 46**
Options: **15 to 1800 Seconds** Once Post Purge is initiated all servos will maintain their positions and fans will continue for this period.					
WARNING: Consult the burner manufacture for proper Post Purge time to be entered prior to firing burner.					

1.2.1 – Pilot Test Hold

Menu Location:	Menu<Parameters<Flame Safety			P:	1.2.1
Password Level:	T	**Default Setting:**	**Off**		**Pilot Test Hold**
P1.2.1 holds the burner at PTFI.				T:	**51, 52**
Options: **On:** BMU will hold at PTFI until operator turns Pilot Test Hold Off. **Off:** BMU follows normal ignition sequence.					
Notes: This parameter allows the technician to hold the burner at PTFI so a pilot turndown test can be performed or a flame scanner sight adjustments can be made. This parameter is automatically reset to Off after every burner cycle and during power-up. This parameter cannot be accessed from the BMU Edit Software. It is considered Operator Interface Logic.					

1.2.2 – FGR Servo Check Mode

Menu Location:	Menu<Parameters<Fuel Air<Basic			**P:**	**1.2.2**
Password Level:	E, R	**Default Setting:**	**Closed then Open**		**FGR Servo Check Mode**
P2.1.2 determines the action of the FGR Servo during Servo Check.				**T:**	

Options: **Closed then Open:** The Servo will drive closed then open during the Servo Check Mode.
Open then Closed: The Servo will drive open then closed during the Servo Check Mode.

Notes: The action of the FGR damper during purge is usually defined by the burner manufacturer.

If the FGR damper is to be closed during Purge, ensured that **P1.5.1** is set to "Purge Position" and the Purge Position Curve Point for the FGR Servo is closed.

1.3 – General

1.3.1 – Power Fail Response***

Menu Location:	Menu<Parameters<Flame Safety<Options<General			**P:**	**1.3.1**
Password Level:	E, R	**Default Setting:**	**Recycle**		**Power Fail Response**
P1.3.1 Determines operation of the BMU after a power failure.				**T:**	**L1**

Options:
Recycle: When power is restored, a call for heat starts the burner.
Lockout: When power is restored, the BMU goes into Lockout. Requires manual reset.

1.3.2 – Assured Low Fire Cut Off

Menu Location:	Menu<Parameters<Flame Safety<Options<General			**P:**	**1.3.2**
Password Level:	E, R	**Default Setting:**	**Disable**		**Assured Low Fire Cut Off**
P1.3.2 Determines if the burner; after a loss of Call For Heat will drive to low fire before shutdown.				**T:**	

Options:
Disable Assured Low Fire Cut Off is not used
Enable Assured Low Fire Cut Off is enabled

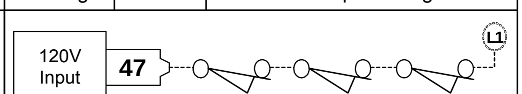
When the burner is doing an orderly shutdown due to call for heat loss or during a restart fuel transfer, the BMU drives the burner to low fire. The SSOV's close after Oil Gun Purge (if enabled) and when the burner reaches the minimum firing rate position.

1.3.3 – Fuel 1 POC Installed

Menu Location:	Menu<Parameters<Flame Safety<Options<General			**P:**	**1.3.3**
Password Level:	E, R	**Default Setting:**	**Yes**		**Fuel1 Proof of Closure Installed**
P1.3.3 Determines if Fuel 1 has a Proof Of Closure (POC) switch(s) installed.				**T:**	**47**
		Rating	Terminal	Example Wiring	

Options:
Yes Fuel 1 Safety Shut Off Valve SSOV has Proof of Closure (POC) switches installed.

No POC not used and not required by code.



All Fuel 1 POC's wired in series

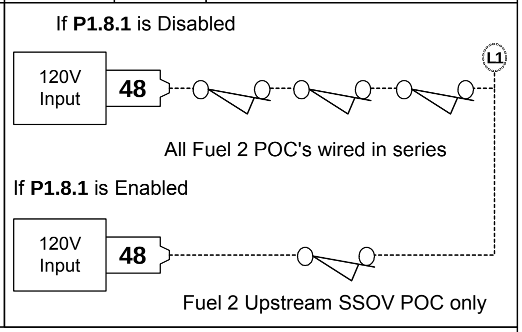
1.3.4 – Fuel 2 POC Installed

Menu Location:	Menu<Parameters<Flame Safety<Options<General			**P:**	**1.3.4**
Password Level:	E, R	**Default Setting:**	**Yes**	**Fuel2 Proof of Closure Installed**	
P1.3.4 Determines if Fuel 2 has Proof Of Closure (POC) switch(s) installed.				**T:**	**48**
				Rating / Terminal / Example Wiring	

Options:

Yes Fuel 2 Safety Shut Off Valve SSOV has Proof of Closure (POC) switches installed.

No POC not used and not required by code.



Note: See **P1.8.1** Gas Leak Test for more information.

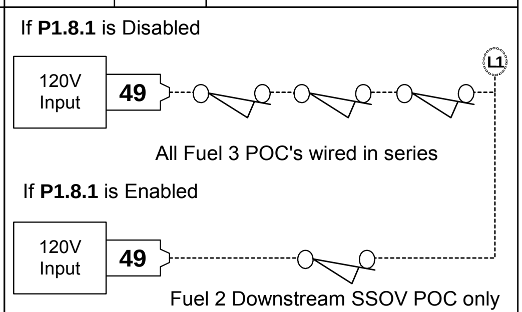
1.3.5 – Fuel 3 POC Installed

Menu Location:	Menu<Parameters<Flame Safety<Options<General			**P:**	**1.3.5**
Password Level:	E, R	**Default Setting:**	**Yes**	**Fuel3 Proof of Closure Installed**	
P1.3.5 Determines if Fuel 3 has Proof Of Closure (POC) switch(s) installed.				**T:**	**49**
				Rating / Terminal / Example Wiring	

Options:

Yes Fuel 3 Safety Shut Off Valve SSOV has Proof of Closure (POC) switches installed.

No POC not used and not required by code.



Note: See **P1.8.1** Gas Leak Test for more information.

1.4 – Scanner

1.4.1 – Dual Flame Scanners

Menu Location:	Menu<Parameters<Flame Safety<Options<Scanner			**P:**	**1.4.1**
Password Level:	E, R	**Default Setting:**	**Disable**	**Dual Flame Scanners**	
P1.4.1 Determines if one or two scanners are used.				**T:**	**30 - 31, 100-105**

Options:

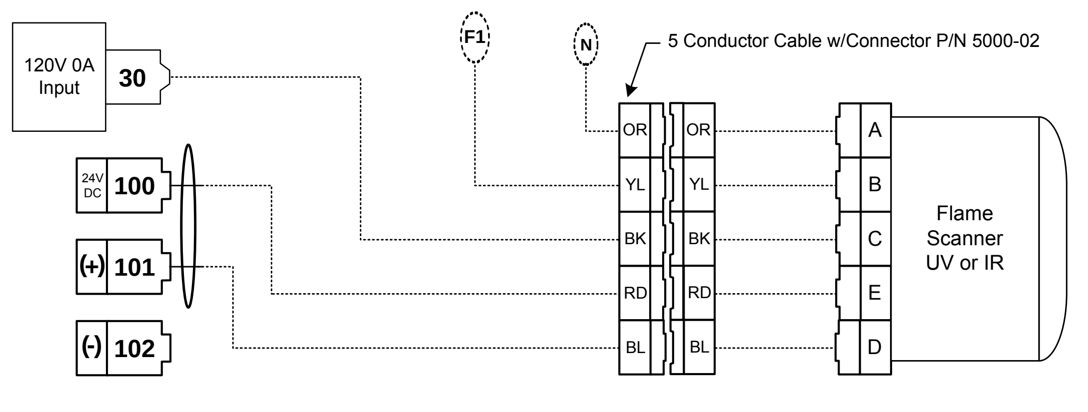
Disable Dual flame scanners are not used

Enable Dual flame scanners are enabled. In dual mode the BMU considers a flame to be present if either scanner contact is closed.

Note: For single scaner setup/wiring see **P1.4.2**.
For dual scanner setups see **P1.4.3** for scanner two setup/wiring details.

1.4.2 – Scanner 1 Signal

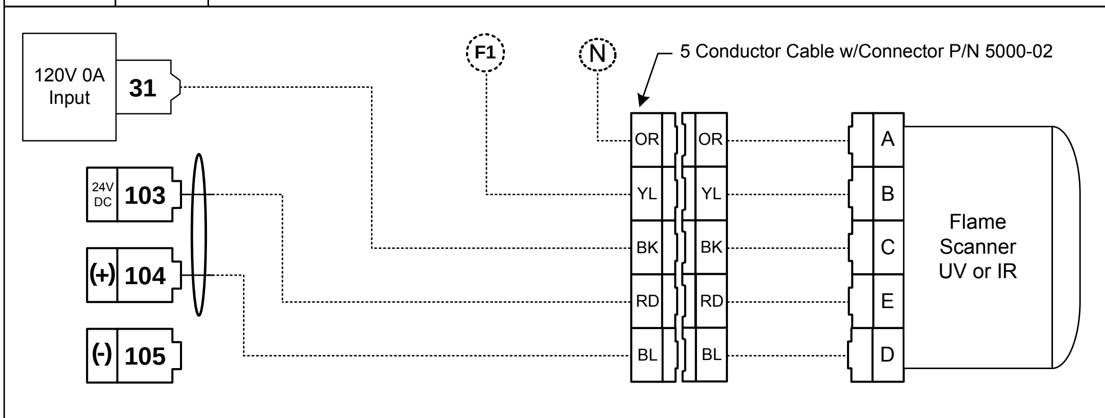
Menu Location:	Menu<Parameters<Flame Safety<Options<Scanner			**P:**	**1.4.2**
Password Level:	T	**Default Setting:**	**4-20mA**	**Scanner 1 Signal**	
P1.4.2 Scales Scanner 1 Signal 0-100% to the selected option.				**T:**	**30, 100 - 102**
Options:	**4-20mA**	**0-20mA**	**0-5VDC**	**0-3VDC**	**0-1VDC**
Rating	Terminal	Example Wiring			



Note: Dipswitch 5 must be ON for mA ranges; this installs an internal 250ohm resistor across T101 and T102. Dipswitch 5 must remain in the off position for VDC input selections.
There is no polarity on the 4-20 mA signal circuit. The 120 VAC positive must be connected to the yellow wire or the black wire will not have 120 VAC when a flame is detected.

1.4.3 – Scanner 2 Signal

Menu Location:	Menu<Parameters<Flame Safety<Options<Scanner			**P:**	**1.4.3**
Password Level:	T	**Default Setting:**	**4-20mA**	**Scanner 2 Signal**	
P1.4.3 Scales Scanner 2 Signal 0-100% to the selected option.				**T:**	**31, 103 - 105**
Options:	**4-20mA**	**0-20mA**	**0-5VDC**	**0-3VDC**	**0-1VDC**
Rating	Terminal	Example Wiring			



Note: Dipswitch 6 must be ON for mA ranges; this installs an internal 250ohm resistor across T104 and T105. Dipswitch 6 must remain in the off position for VDC input selections.
There is no polarity on the 4-20 mA signal circuit. The 120 VAC positive must be connected to the yellow wire or the black wire will not have 120 VAC when a flame is detected.

1.4.4 – Scanner Alarm SP

Menu Location:	Menu<Parameters<Flame Safety<Options<Scanner			**P:**	**1.4.4**
Password Level:	T	**Default Setting:**	**0%**		**Scanner Alarm SP**
P1.4.4 Determines the lowest flame signal allowed before sounding an alarm.				**T:**	
Options: 0% to 90% The BMU triggers an alarm when the flame signal is below **P1.4.4** after five seconds without shutting down the burner. This provides an early warning that combustion is abnormal or the scanner lens is dirty. Individual alarms are generated for dual scanner systems. On dual scanner systems the dirty scanner can be removed for cleaning without shutting down the burner.					
Note: 0% = alarm is disabled					

1.5 – Fan Start

1.5.1 – FD Fan Start Mode

Menu Location:	Menu<Parameters<Flame Safety<Options<Fan Start			**P:**	**1.5.1**
Password Level:	T, R	**Default Setting:**	**Pre Start**		**FD Fan Start Mode**
P1.5.1 Determines when the FD Fan will start.				**T:**	**61 - 62**

Options:

PreStart: Fan(s) start **P1.5.2** seconds after the Safe Start Check.

FADLimit: Fan(s) start **P1.5.2** seconds after fresh air damper is proven open.

PurgePosition:
Fan(s) start **P1.5.2** seconds after the servos are at the Purge position. This option prevents fan motor overload during the servo open limit switch check.

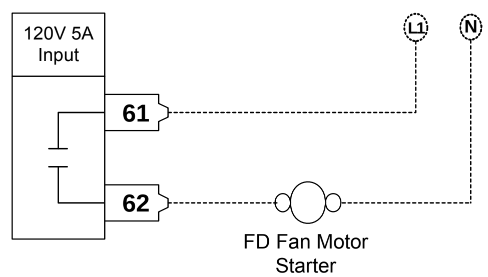
1.5.2 – FD Fan Start Delay

Menu Location:	Menu<Parameters<Flame Safety<Options<Fan Start			**P:**	**1.5.2**
Password Level:	T	**Default Setting:**	**1**		**FD Fan Start Delay**
P1.5.2 Determines the FD Fan Start Delay time.				**T:**	**61 - 62**

Rating	Terminal	Example Wiring

Options:
1 to 120 seconds

The FD fan start is delayed **P1.5.2** seconds after the event chosen in **P1.5.1.**



Note: This time delay can be used to allow an outlet/draft Control damper to partially open before the FD fan starts, or to stage the FD and the auxiliary fan (ID or FGR) starts.
See also **P1.5.3.**

1.5.3 – Aux Fan Start Delay

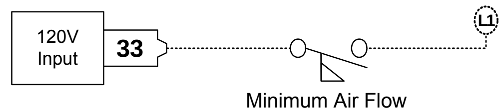
Menu Location:	Menu<Parameters<Flame Safety<Options<Fan Start			**P:**	**1.5.3**
Password Level:	T	**Default Setting:**	**1**		**Aux Fan Start Delay**
P1.5.3 Determines the Aux Fan Start Delay time.				**T:**	**59, 63 - 72**

Options: **1 to 120 seconds**
The aux fan start is delayed **P1.5.3** seconds after the event chosen in **P1.5.1.**

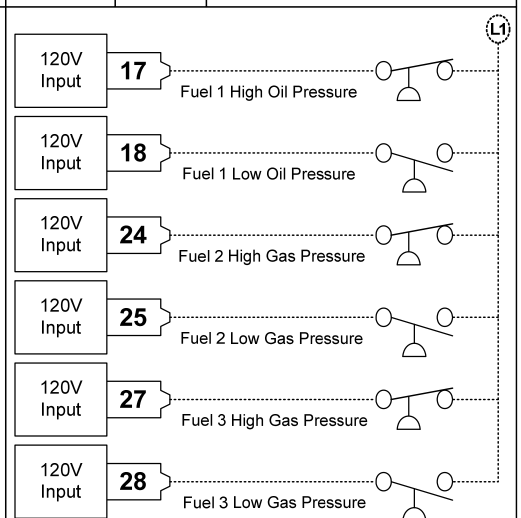
Note: This time delay can be used to allow an outlet/draft control damper to partially open before the FD Fan starts, or to stage the FD and the auxiliary fan (ID or FGR) starts.
See also **P1.7.1-P1.7.5** for aux relay functions.

1.6 – Time Delay

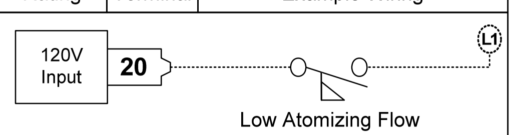
1.6.1 – Min Air Flow Trip Delay

Menu Location:	Menu<Parameters<Flame Safety<Options<Time Delays			**P:**	**1.6.1**
Password Level:	E, R	**Default Setting:**	**0**	**Min Air Flow Trip Delay**	
P1.6.1 Determines the delay time prior to a minimum air flow lockout.				**T:**	**33**
				Rating / Terminal	Example Wiring
Options: 0 to 4 seconds Delays burner shutdown for **P1.6.1** seconds after the Low Atomizing Flow limit opens.					
Note: Prevents trips due to momentary flow/pressure fluctuations.					

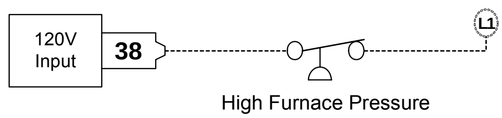
1.6.2 – Low Fuel Pressure Delay

Menu Location:	Menu<Parameters<Flame Safety<Options<Time Delays			**P:**	**1.6.2**
Password Level:	E, R	**Default Setting:**	**0**	**Low Fuel Pressure Delay**	
P1.6.2 Determines the time delay proir to a Low Fuel Pressure lockout.				**T:**	**17,18,24,25,27,28**
				Rating / Terminal	Example Wiring
Options: 0 - 4 seconds The Low Fuel Pressure Delay is only in effect immediately after the associated fuel Safety Shutoff Valve (SSOV) opens for the following fuel limits: - T17 High Oil Pressure or T18 Low Oil Pressure for oil/ Fuel1 - T24 High Gas Pressure or T25 Low Gas Pressure for gas/Fuel2, - T27 High Fuel Pressure or T28 Low Fuel Pressure for Fuel3.					
Note: This delay prevents trips due to a momentary pressure drop caused by opening an SSOV. During any other part of the sequence, these fuel limits drop out immediately.					

1.6.3 – Low Atomizing Flow Delay

Menu Location:	Menu<Parameters<Flame Safety<Options<Time Delays			**P:**	**1.6.3**
Password Level:	E, R	**Default Setting:**	**0**	**Low Atomizing Flow Delay**	
P1.6.3 Determines the delay time prior to a low atomizing flow lockout.				**T:**	**20**
				Rating / Terminal	Example Wiring
Options: 0 - 4 seconds Allows the burner to "ride through" the Low Atomizing Flow switch opening for 0-4 seconds.					
Note: This delay prevents trips due to momentary pressure fluctuations.					

1.6.4 – Low Draft Cutout Delay

Menu Location:	Menu<Parameters<Flame Safety<Options<Time Delays			**P:**	**1.6.4**
Password Level:	E, R	**Default Setting:**	**0**	**Low Draft Cutout Delay**	
P1.6.4 Determines the delay time prior to a Low draft Lockout.				**T:**	**38**
				Rating / Terminal / Example Wiring	
Options: 0 to 8 seconds Allows the burner to "ride through" a momentary opening of the high furnace pressure switch for 0-8 seconds.					
Note: This delay prevents trips due to momentary pressure fluctuations. If Low Draft Cutout (T38) is not needed jumper T38 to 120 VAC.					

1.6.5 – HOLD Alarm Delay

Menu Location:	Menu<Parameters<Flame Safety<Options<Time Delays			**P:**	**1.6.5**
Password Level:	T	**Default Setting:**	**45**	**Hold Alarm Delay**	
P1.6.5 Determines time BMU is allowed to Hold before the common alarm is triggered.				**T:**	
Options: 10 to 601 seconds The common alarm is triggered if the BMU is in Hold for more than **P1.6.5** seconds.					

1.6.6 – HOLD Lockout Delay

Menu Location:	Menu<Parameters<Flame Safety<Options<Time Delays			**P:**	**1.6.6**
Password Level:	E, R	**Default Setting:**	**120**	**Hold Lockout Delay**	
P1.6.6 Determines time BMU is allowed to Hold before lockout.				**T:**	
Options: 30 to 600 seconds Lockout occurs if the BMU is in Hold for more than **P1.6.6** seconds.					

1.7 – Auxiliary Relays

1.7.1 – Aux Relay 1 Function

Menu Location:	Menu<Parameters<Flame Safety<Options<Auxiliary Relays			P:	1.7.1 - 1.7.5
Password Level:	T	**Default Setting:**	**Disable**		**Aux Relay 1 Function**
P1.7.1 - 1.7.5 Determines the function of aux relays 1, 2, 3, 4 and 5.				T:	**59, 63 - 72**

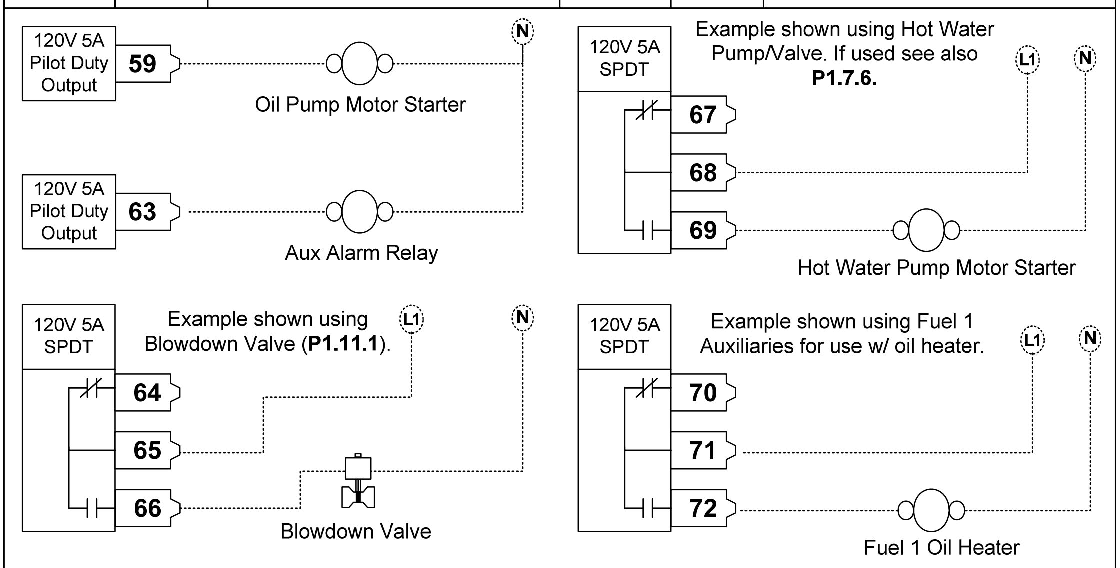
Options:

Disabled	Output is not used.
CommonAlarm	Common alarm with alarm silence.
AuxFanStarter	Start auxiliary fan (ID and/or FGR fans).
Fuel1Auxiliaries	Start oil pumps, oil heaters, etc.
Fuel2Auxiliaries	Start gas booster pumps, etc.
Fuel3Auxiliaries	Start bio gas compressors, etc.
CommonAuxiliaries	Call for heat, start fresh air dampers, make-up air fans, feedwater pumps, hot water pumps, hot water valves, etc.

Options:

HotWaterPump/Valve	Start hot water boiler pump or isolation valve.
BlowdownValve	Open/close low water cutout blowdown valve(s).
FlameOn	Flame is on.
Fuel1Open	Fuel 1 SSOV(s) are commanded to open.
Fuel2Open	Fuel 2 SSOV(s) are commanded to open.
Fuel3Open	Fuel 3 SSOV(s) are commanded to open.
LimitsMade	All Recycling and Non-Recycling Limits are Made

Rating	Terminal	Example Wiring	Rating	Terminal	Example Wiring



Note: T59 and T63 are BMU powered terminals. However, in the event of an Emergency Stop situation T59 will no longer be a powered output.
Aux Relay Default setting is Common Alarm as shown in the electrical schematic.

1.7.2 – Aux Relay 2 Function

1.7.3 – Aux Relay 3 Function

1.7.4 – Aux Relay 4 Function

1.7.5 – Aux Relay 5 Function

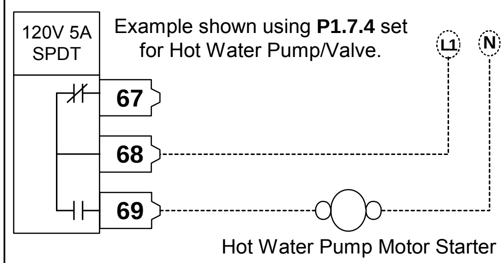
For Aux Relays 2, 3, 4 & 5, see Parameter **P1.7.1**

1.7.6 – Hot Water Pump / Valve Stop Delay

Menu Location:	Menu<Parameters<Flame Safety<Options<Auxiliary Relays	**P:**	**1.7.6**
Password Level: T	**Default Setting:** 300	**Hot Water Pump/Valve Stop Delay**	
P1.7.6 Determines the Hot Water Pump/Valve Stop delay time.		**T:**	**59, 63 - 72**
	Rating	Terminal	Example Wiring

Options: **1 to 1200 seconds**

The hot water pump/valve option relay energizes during Prestart and normally de-energizes **P1.7.6** seconds after completing Post Purge.



Note: If a burner recycle or lockout occurs before release to modulate, this relay de-energizes without a delay.

1.8 – Gas Leak Test

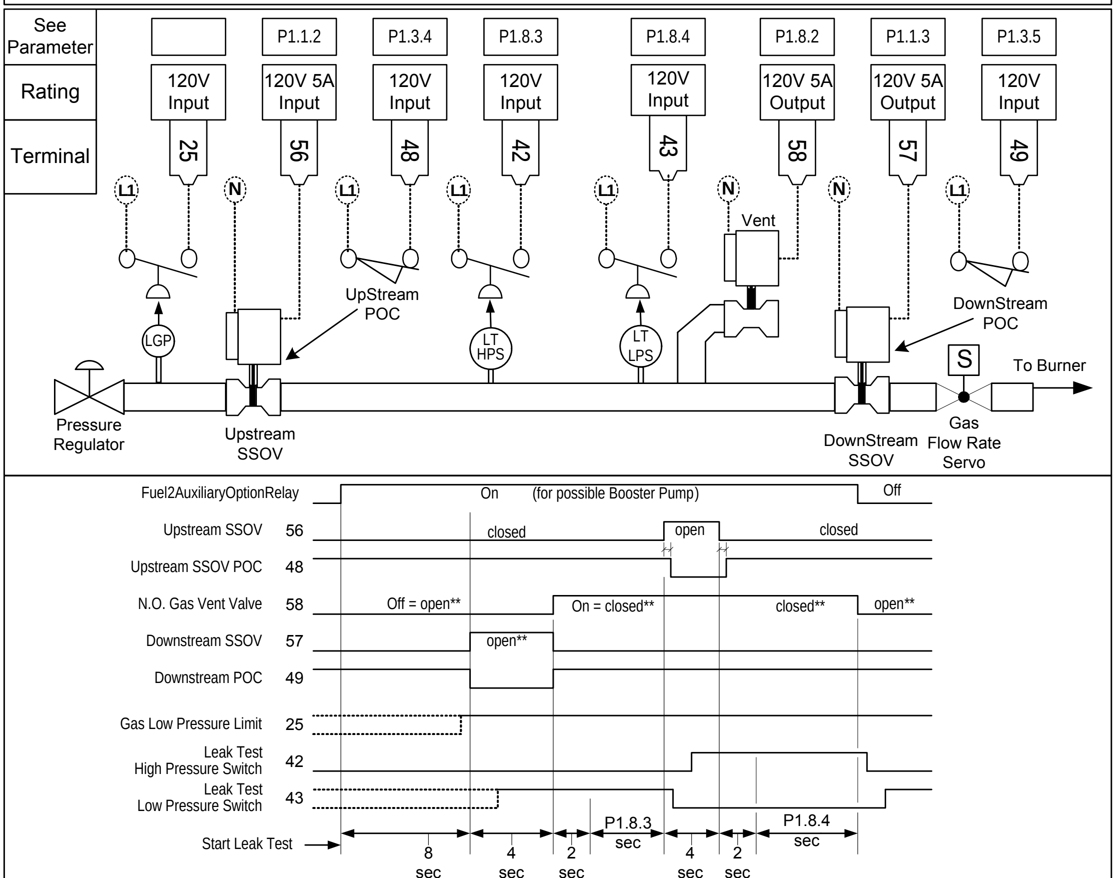
1.8.1 – Gas (Fuel 2) Leak Test Option

Menu Location:	Menu<Parameters<Flame Safety<Options<Gas Leak Test			P:	1.8.1
Password Level:	E, R	Default Setting:	Disable	**Gas (Fuel 2) Leak Test Option**	
P1.8.1 is enabled when gas valve leak testing is required.				T:	25, 42, 43 48, 49, 56 - 58

Options: **Enable** Leak Test is enabled **Disable** Leak Test is disabled

Operation:

The Low Gas Pressure T25 is verified closed. The vent valve is open (i.e. de-energized) and waits 4 seconds to allow the pressure to reach atmospheric. The vent valve closes for 2 seconds and verifies the High Leak Test Pressure T42 input is open. The Upstream Leak Test Timer, **P1.8.3**, is started and verifies the Low Leak Test Pressure T43 is input is made throughout the test period. The safety relay is energized, the vent valve is closed, and the upstream valve is opened for 4 seconds to pressurize the test section. After 2 seconds the Low Leak Test Pressure T43 is verified open and the Downstream Leak Test Timer, set by **P1.8.4**, will start and wait to time out. The High Leak Test Pressure T42 input is made throughout the test period. See **P1.8.2** for systems without a vent valve.



** Notes: If P1.8.2 Leak Test Without Vent Valve Option = Enabled
Vent Valve is not installed. Downstream SSOV opens to vent pressure for Upstream Leak Test
If P1.8.2 Leak Test Without Vent Valve Option == Disabled
Vent Valve is installed. Downstream SSOV does NOT open to vent pressure for Upstream Leak Test

Note: The gas (Fuel 2) leak test option must be disabled if Fuel 3 is enabled (see **P1.1.3**).
See Section 2 for gas pressure switch and time settings.

1.8.2 – Leak Test W/O Vent Valve Option

Menu Location:	Menu<Parameters<Flame Safety<Options<Gas Leak Test			**P:**	**1.8.2**
Password Level:	E, R	**Default Setting:**	**Disable**	**Leak Test Without Vent Valve Option**	
P1.8.2 is Enabled when gas train does not have a vent valve.				**T:**	**25, 42, 43 48, 49, 56 - 58**

Options:
Disable Vent valve is used in gas train leak test sequence.
Enable Vent valve is not used in gas train leak test sequence.
Operation:
The sequence of events is the same as in **P1.8.1;** However, the downstream SSOV opens to vent the pressure for upstream leak test (instead of the Vent Valve).

Note: The Gas (Fuel 2) Leak Test option must be Disabled if Fuel 3 is Enabled (See **P1.1.3**).
See Section 2 for gas pressure switch and time settings.
P1.8.1 must be enabled.

1.8.3 –Upstream Test Sec

Menu Location:	Menu<Parameters<Flame Safety<Options<Gas Leak Test			**P:**	**1.8.3**
Password Level:	E, R	**Default Setting:**	**60**	**Upstream Test Sec**	
P1.8.3 Determines the upstream leak test duration.				**T:**	**42**

Options: **10 to 90 seconds**
After venting the test section, the time delay to detect a pressure rise due to an upstream SSOV leak.

Note: Calculate the test time per the procedure in Section 2.
See also **P1.8.1.**

1.8.4 –Downstream Test Sec

Menu Location:	Menu<Parameters<Flame Safety<Options<Gas Leak Test			**P:**	**1.8.4**
Password Level:	E, R	**Default Setting:**	**60**	**Downstream Test Sec**	
P1.8.4 Determines the downstream leak test duration.				**T:**	**43**

Options: **10 to 90 seconds**
After pressurizing the test section, the time delay to detect a pressure fall due to a downstream SSOV or vent valve leak.

Note: Calculate the test time per the procedure in Section 2.
See also **P1.8.1.**

1.9 – Oil Gun Purge

1.9.1 – Oil Gun Purge Option

Menu Location:	Menu<Parameters<Flame Safety<Options<Oil Gun Purge		**P:**	**1.9.1**
Password Level: E, R	**Default Setting:**	**Disable**		**Oil Gun Purge Option**
P1.9.1 is used to enable or disable Oil Gun Purge.			**T:**	**55**

Options:

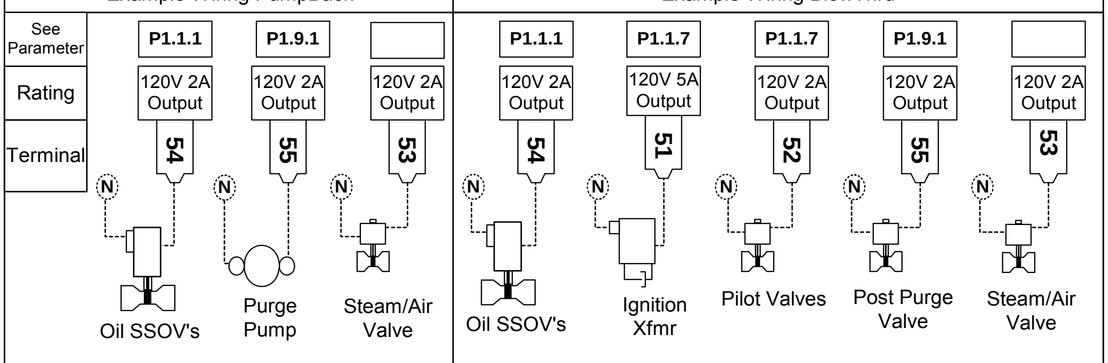
Disable Oil Gun Purge not used.
BlowThru Turn on pilot, blow oil thru gun and burn it in the furnace
PumpBack Turn on a scavenging pump to suck the oil out of the gun.

Operation:

Pump Back
The BMU closes Fuel 1 SSOV's and holds the fuel valves and dampers at their last positions. T55 is energized for **P1.9.2** Oil Gun Purge Seconds and Post Purge (**P1.1.10**) is started. After the Post Purge timer has timed out, all fans and auxiliary outputs are stopped and the servos are sent to their Standby positions.

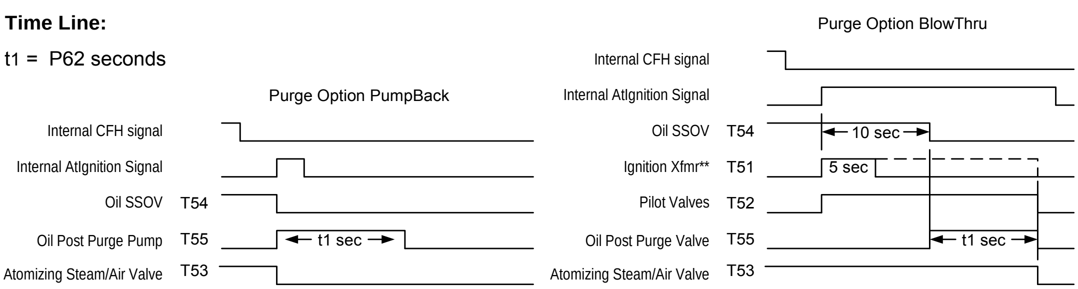
Blow Thru
The BMU sends all servos to their low fire positions and turns on the pilot; the BMU will wait 10 seconds for the pilot to stablize. After pilot stablization the Fuel 1 SSOV's are closed and T55 is energized for **P1.9.2** Oil Gun Purge Seconds. When Oil Gun Purge is completed, T55 and the pilot are turned off and Post Purge (**P1.1.10**) is started.

Example Wiring PumpBack | Example Wiring BlowThru



Time Line:

t1 = P62 seconds



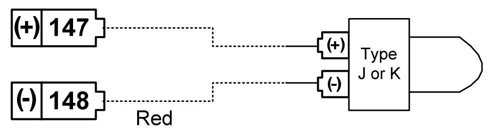
Note: **T51 is determind by **P1.1.7**.
See also **P1.9.2**.

1.9.2 – Oil Gun Purge Sec

Menu Location:	Menu<Parameters<Flame Safety<Options<Oil Gun Purge		**P:**	**1.9.2**
Password Level: E, R	**Default Setting:**	**10**		**Oil Gun Purge Sec**
P1.9.2 Determines Oil Gun Purge time.			**T:**	**55**
Options: **5 to 45 seconds**				
Note: **P1.9.2** Oil Gun Purge Sec determines the duration of both Blow Thru or Pump Back.				

1.10 – High Flue Temperature

1.10.1 – Flue Gas T / C Type

Menu Location:	Menu<Parameters<Flame Safety<Options<High Flue Temp			**P:**	**1.10.1**
Password Level:	E, R	**Default Setting:**	**J T/C**	**Flue Gas T/C Type**	
P1.10.1	Determines the type of thermocouple used to measure flue gas temperature.			**T:**	**147 - 148**
				Rating / Terminal / Example Wiring	
Options: **J T/C** **K T/C**					
Note: See also, **P1.10.2** and **P1.10.3**.					

1.10.2 – Alarm SP, Flue Temperature

Menu Location:	Menu<Parameters<Flame Safety<Options<High Flue Temp			**P:**	**1.10.2**
Password Level:	T	**Default Setting:**	**1000**	**Alarm SP, Flue Temp**	
P1.10.2 Determines at what temperature a high flue gas temperature alarm will sound.				**T:**	**147 - 148**
Options: **100 to 1000** If the actual flue gas temperature is greater than **P1.10.2** for more than 10 seconds, the common alarm will be triggered, and an alarm message will be entered in the event history.					
Note: 1000 will disable the high flue temperature alarm.					

1.10.3 – Lockout SP, Flue Temperature

Menu Location:	Menu<Parameters<Flame Safety<Options<High Flue Temp			**P:**	**1.10.3**
Password Level:	E, R	**Default Setting:**	**1000**	**Lockout SP, Flue Temp**	
P1.10.3 Determines at what temperature the BMU will Lockout.				**T:**	**147 - 148**
Options: **100 to 1000** If the actual flue gas temperature is greater than **P1.10.3** Lockout SP, Flue Temp for more than 30 seconds, the common alarm will be triggered and the BMU will Lockout and shutdown the burner.					
Note: 1000 will disable the high flue gas temperature lockout.					

1.11 – LWC Auto Blowdown Option

1.11.1 – LWC Auto Blowdown Option

Menu Location:	Menu<Parameters<Flame Safety<Options<LWC Auto Blowdown			P:	1.11.1
Password Level:	E, R	**Default Setting:**	**Disable**	**LWC Auto Blowdown Option**	
P1.11.1 is enabled if the Low Water Cutout (LWC) Automatic Blowdown w/limit testing option is desired.				**T:**	**12, 36, 59, 63 - 72**
				Rating / Terminal / Example Wiring	

Options:

Disable LWC Auto Blow-down is not used

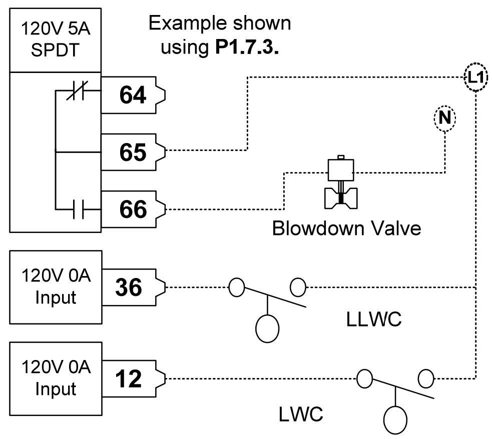
Enable LWC Auto Blow-down is enabled

Operation:

The Boiler Outlet Pressure (T110) input (as selected by **P3.1.1**) is required for this option.

The LWC blowdown test is conducted once per day, at or within 12 hours after **P1.11.4** Time of Day, Blowdown.The boiler outlet pressure must be greater than **P1.11.3** in order to start a low water cutout automatic blowdown test. The boiler outlet pressure can drop below **P1.11.3** without aborting the test. For initial test purposes, ignore the actual steam pressure (boiler outlet pressure input) and use the Release to Modulate state as the condition upon which the start of the test is initiated.

P1.11.5 (valve opening) + **P1.11.5** (valve closing) + **P1.11.6** LWC Bypass Release Delay = total LWC bypass time.

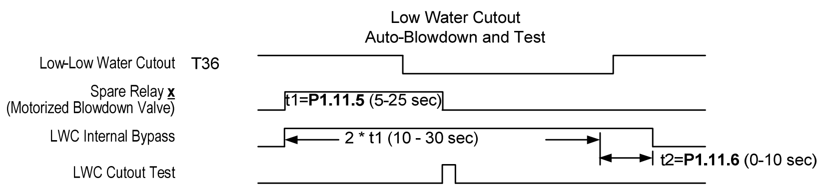


Test procedure:

1) Start LWC bypass timer.
2) Bypass both the LLWC and LWC limits.
3) Open the blowdown valve.
4) Wait for **P1.11.5** Blowdown Seconds.
5) Close the blowdown valve.
6) Verify that at least one of the LLWC or LWC (Low Water Cutout) limits was open. If open, record a successful blowdown test in the historical data. If neither open, either alarm only or alarm and Lockout based on **P1.11.2** Failed Test Response, Blowdown.
7) When **P1.11.6** LWC Bypass Release Delay is over, remove the LLWC and LWC bypasses.

Time Line:

Note: t = Time



Note: See **P1.7.1- P1.7.5** for assignment of an auxiliary relay to LWC Blowdown1.
If T12 is not used jumper to 120 VAC.

1.11.2 – Failed Test Response, Blowdown

Menu Location:	Menu<Parameters<Flame Safety<Options<LWC Auto Blowdown			P:	1.11.2
Password Level:	O	**Default Setting:**	**Lockout**	**Failed Test Response, Blowdown**	
P1.11.2 Determines what the BMU will do after a failed automated blowdown test.				**T:**	**12, 36, 59, 63 - 72**

Options:

Lockout If neither low water cutout opens, the BMU will alarm and lockout. This will require manual reset of the control.

Alarm If neither low water cutout opens, the BMU will alarm and the burner will continue to run.

1.11.3 – Min Steam Pressure, Blowdown

Menu Location:	Menu<Parameters<Flame Safety<Options<LWC Auto Blowdown			**P:**	**1.11.3**
Password Level:	T	**Default Setting:**	**50.0**	**Min Steam Pressure, Blowdown**	
P1.11.3 Determines the minimum pressure required for an automatic blowdown test.				**T:**	**12, 36, 59, 63 - 72**

Options: **0.3 to 1500.0 psi**
Input steam pressure must be greater than **P1.11.3** for the blowdown test to occur.

1.11.4 – Time of Day, Blowdown

Menu Location:	Menu<Parameters<Flame Safety<Options<LWC Auto Blowdown			**P:**	**1.11.4**
Password Level:	O	**Default Setting:**	**8:00**	**Time of Day, Blowdown**	
P1.11.4 Determines the time of day when the BMU first attempts to start automatic blow-down.				**T:**	**59, 63 - 72**

Options: **0:00 to 23:00hrs military time**
The auto blowdown test will occur everyday at **P1.11.4** hours.

Note: Time is set in one hour increments.
If the pressure is lower than **P1.11.3** the blowdown will occur within the next 12 hours once the pressure rises above **P1.11.3**.

1.11.5 – Blowdown Seconds

Menu Location:	Menu<Parameters<Flame Safety<Options<LWC Auto Blowdown			**P:**	**1.11.5**
Password Level:	T	**Default Setting:**	**10**	**Blowdown Seconds**	
P1.11.5 Determines the time needed for blowdown valve open time.				**T:**	**59, 63 - 72**

Options: **2 to 30 Seconds**

Note: **P1.11.5** should equal time needed to initiate a low water condition once the open blowdown valve command is given.
Blow-down test total time is **P1.11.5** (valve opening) + **P1.11.5** (valve closing) + **P1.11.6** LWC Bypass Release Delay.

1.11.6 – LWC Bypass Release Delay

Menu Location:	Menu<Parameters<Flame Safety<Options<LWC Auto Blowdown			**P:**	**1.11.6**
Password Level:	T	**Default Setting:**	**5**	**LWC Bypass Release Delay**	
1.11.6				**T:**	

Options: **0 to 10 Seconds**
This time is added at the end of the test to allow for water level stabilization.

Note: Blow-down test total time is **P1.11.5** (valve opening) + **P1.11.5** (valve closing) + **P1.11.6** LWC Bypass Release Delay.

1.12 – Fuel Transfer

1.12.1 – Fuel Transfer Method

Menu Location:	Menu<Parameters<Flame Safety<Options<Fuel Transfer			**P:**	**1.12.1**
Password Level:	E, R	**Default Setting:**	**Restart**		**Fuel Transfer Method**
P1.12.1 Determines the automatic fuel transfer sequence.				**T:**	

Options: Restart or Low Fire

Restart: BMU performs a controlled shut down of current fuel and then restarts with the selected new fuel.

Low Fire: BMU sends the burner to Ignition position, Biases the Air flow up, burns two fuels simultaneously at the ignition position for **P1.12.3** seconds, shuts down the 'old fuel', removes the Air Bias, and transfers to the new fuel, and then resumes modulating. All without shutting down.

Note: Burner manufacturer must be consulted prior to selecting the **Low Fire** option.
See also **P1.12.3 - P1.12.4** when Low Fire is selected.

1.12.2 – Low Fire Xfer Pilot Option

Menu Location:	Menu<Parameters<Flame Safety<Options<Fuel Transfer			**P:**	**1.12.2**
Password Level:	E, R	**Default Setting:**	**Disabled**		**Low Fire Xfer Pilot Option**
P1.12.2 Determines if the pilot is used during a low fire fuel transfer.				**T:**	

Options:

Disabled Pilot is not used during low fire fuel transfer (typical for most burner designs).

Enabled: Pilot is used during low fire fuel transfer.

Warning: Enabling this feature on a burner with an inadequate Pilot and/or Scanner arrangement is extremely dangerous!

Note: This option can only be enabled after an Activation Code has been entered into the BMU. Consult the burner manufacturer to determine if this feature can be Safely used with the burner. A written statement of approval from the burner manufacturer must be provided to Preferred Instruments in order to obtain the Activation Code.

1.12.3 – Dual Fuel Time Limit, Sec

Menu Location:	Menu<Parameters<Flame Safety<Options<Fuel Transfer			**P:**	**1.12.3**
Password Level:	T	**Default Setting:**	**20**		**Dual Fuel Time Limit, Sec**
Options: 10 to 90 Seconds				**T:**	

P1.12.3 Determines the length of time that the burner is allowed to simultaneously fire two fuels during low fire transfer. If this time expires the new fuel SSOV's close and the burner continues to fire the old fuel.

Note: Low Fire must be selected in **P1.12.1**.

1.12.4 – Low Fire Xfer Air Bias %

Menu Location:	Menu<Parameters<Flame Safety<Options<Fuel Transfer			**P:**	**1.12.4**
Password Level:	T	**Default Setting:**	**10.0**		**Low Fire Xfer Air Bias %**
P1.12.4 Determines the Air Bias that is applied during low fire fuel transfer firing.				**T:**	

Options: 2.0 to 50.0 %

Notes: Air Bias is a percentage of the (max fire - min fire) curve range. Set the Air Bias % to provide enough extra air flow to safely fire two fuels simultaneously with each fuel at it's Ignition position. For best results both fuel valve Ignition positions should be at nearly the same Btu Input, and both fuel curves should have similar high fire to low fire Btu turndown ratios.

Jackshaft controlled burners can not be Air Biased and must be setup with sufficient excess air at Ignition to allow simultaneous firing.

FGR is not Biased.

Low Fire must be selected in **P1.12.1**.

2. FUEL – AIR

2.1 – Basic

2.1.1 – Fuel – Air Control Type***

Menu Location:	Menu<Parameters<Fuel-Air<Basic			**P:**	**2.1.1**
Password Level:	E, R	**Default Setting:**	**Positioned Servo**		**Fuel-Air Control Type**
P2.1.1 Determines the type of fuel/air control system used .				**T:**	

Options:

JackshaftServo: One servo actuator is mechanically linked to all fuel valves and the FD damper. A BMU-SM-LTA link trim servo can be used for O2 Trim. FGR, Aux 1, and Aux 2 servos can be configured. FD fan VSD control can NOT be configured.

PositionedServo: Separate servo actuators for fuel valves, FD damper, and FGR damper. An FD fan VSD can be configured with full speed bypass if desired. Aux 1, and Aux 2 servos can be configured.

MeteredServo: Flow meters measure fuel and air flow and a PID maintains the commissioned fuel-air ratio. MeteredServo also includes all of the PositionedServo features.

Note: MeteredServo can only be enabled with BMU-2Zxx hardware.

2.1.2 – FGR Servo Check Mode

Menu Location:	Menu<Parameters<Fuel Air<Basic			P:	**2.1.2**
Password Level:	E, R	Default Setting:	Closed then Open		**FGR Servo Check Mode**
P2.1.2 determines the action of the FGR Servo during Servo Check.				T:	

Options: Closed then Open: The Servo will drive closed then open during the Servo Check Mode.
Open then Closed: The Servo will drive open then closed during the Servo Check Mode.

Notes: The action of the FGR damper during purge is usually defined by the burner manufacturer.

If the FGR damper is to be closed during Purge, ensured that **P1.5.1** is set to “Purge Position” and the Purge Position Curve Point for the FGR Servo is closed.

2.2 – FD VSD Setup***

2.2.1 – FD Fan VSD Option

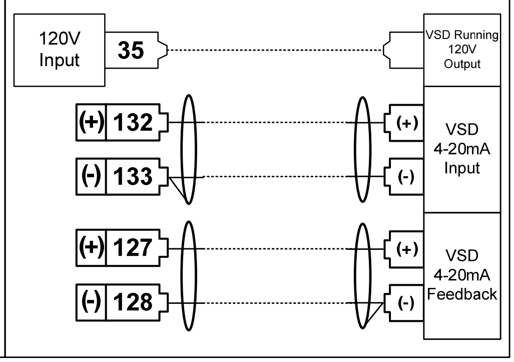
Menu Location:	Menu<Parameters<Fuel-Air<Options<FD VSD Setup			**P:**	**2.2.1**
Password Level:	E, R	**Default Setting:**	**Disable**	**FD Fan VSD Option**	
P2.2.1 Is enabled if a VSD is controlling the FD fan speed.				**T:**	**35, 127 - 128, 132 - 133**

Options: **Disable:** FD fan VSD not being used.
Enable: FD fan VSD is used.

The FD fan VSD speed command is based on a curve determined by the fuel valve position. There are three curves possible--one for each fuel.

Notes:
FD fan VSD speed output is T132 - T133.
4-20mA = 0-60 Hz.
FD fan VSD speed feedback is T127 - T128.
4-20 mA = 0-60 Hz.

Rating	Terminal	Example Wiring



2.2.2 – FD VSD Feedback Adjust

Menu Location:	Menu<Parameters<Fuel-Air<Options<FD VSD Setup			**P:**	**2.2.2**
Password Level:	T, R	**Default Setting:**	**1.000**	**FD VSD Feedback Adjust**	
P2.2.2 Adjusts the the VSD feedback to the BMU.				**T:**	**127 - 128**

Options: **0.970 to 1.030**
A VSD speed feedback correction factor that compensates for 4-20 mA tolerances.

2.2.3 – FD VSD Ramp Rate, Sec / 30Hz

Menu Location:	Menu<Parameters<Fuel-Air<Options<FD VSD Setup			**P:**	**2.2.3**
Password Level:	T, R	**Default Setting:**	**15**		**FD VSD Ramp Rate, Sec/30Hz**
P2.2.3 Determines the time the VSD requires to make a 30 Hz speed change.				**T:**	**127 - 128, 132 - 133**
Options: 8 to 15 Seconds The number of seconds it takes the VSD to change 30 Hz (with fan running) in response to a BMU 4-20 mA RPM setpoint change. **P2.2.3** is active at all firing rates, on increasing and decreasing firing rates.					

2.2.4 – FD VSD Min Hz

Menu Location:	Menu<Parameters<Fuel-Air<Options<FD VSD Setup			**P:**	**2.2.4**
Password Level:	T, R	**Default Setting:**	**15.0**		**Min Hz, FD VSD**
P2.2.4 Determines the minimum Hz the BMU will operate the VSD.				**T:**	**127 - 128, 132 - 133**
Options: 5.0 to 50.0 Hz **P2.2.4** determines the minimum Hz command that the BMU will send to the FD fan VSD.					

2.2.5 – FD VSD Off-Curve Lockout Deadband, Hz

Menu Location:	Menu<Parameters<Fuel-Air<Options<FD VSD Setup			**P:**	**2.2.5**
Password Level:	T	**Default Setting:**	**0.4**		**FD VSD Off-Curve Lockout Deadband, Hz**
P2.2.5 Sets maximum difference between the VSD Hz input and the VSD Hz feedback.				**T:**	**127 - 128, 132 - 133**
Options: 0.2 to 0.8 Hz If the +/- difference between the VSD Hz command input and the VSD Hz feedback output exceeds **P2.2.5** for more than 3 seconds while firing, an FD VSD Not at Position' Lockout will occur.					
Note: Smaller values can cause nuisance burner trips and larger values can cause less accurate fuel/air ratio control.					

2.3 – Aux 2 Setup

2.3.1 – Aux 2 Curve Option

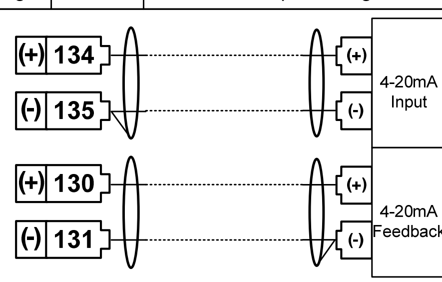
Menu Location:	Menu<Parameters<Fuel-Air<Options<Aux 2 Setup			**P:**	**2.3.1**
Password Level:	E, R	**Default Setting:**	**Disable**		**Aux 2 Curve Option**
P2.3.1 Determines if the Aux 2 curve will be used to position a device.				**T:**	**134 - 135, 130 - 131**

Options: **Disable:** Aux 2 curve is not used.
Enable: Aux 2 curve is used.

The Aux 2 curve can be used to position either a 4-20 mA device (4-20 mA feedback is required) ..OR.. Aux 2 can position the BMU Aux 2 Servo.

If an Aux 2 servo is configured:
The Aux 2 curve drives the Aux 2 servo
If an Aux 2 servo is NOT configured:
The Aux 2 curve drives the T135 4-20 mA Output and the T130 4-20 mA feedback must be used.

Rating	Terminal	Example Wiring



**** OR *****
BMU Servo configured as 'Aux 2'

Note: Typical applications: FGR Fan 4-20 mA VSD control, FGR mix box fresh air damper servo, Inner gas poker NOx control valve servo, Steam injection NOx control valve servo.

2.3.2 – Aux 2 FGR Trim Option

Menu Location:	Menu<Parameters<Fuel-Air<Options<Aux 2 Setup			**P:**	**2.3.2**
Password Level:	E, R	**Default Setting:**	**Disabled**	**Aux 2 FGR Trim Option**	
P2.3.2 Determines if the FGR Trim will be applied the Aux 2 output to maintain windbox O2.				**T:**	
Options: **Enabled** or **Disabled**					

2.3.3 – 4-20 Feedback Adjust, Aux 2

Menu Location:	Menu<Parameters<Fuel-Air<Options<Aux 2 Setup			**P:**	**2.3.3**
Password Level:	T, R	**Default Setting:**	**1.000**	**4-20 Feedback Adjust, Aux 2**	
P2.3.3 Adjusts the the 4-20 mA feedback to the BMU.				**T:**	**130 - 131**
Options: **0.970 to 1.030**					
Note: Corrects for 4-20 mA tolerances. **P2.3.3** is NOT used is an Aux 2 servo is configured.					

2.3.4 – 4-20 Ramp Rate, Sec / 100%, Aux 2

Menu Location:	Menu<Parameters<Fuel-Air<Options<Aux 2 Setup			**P:**	**2.3.4**
Password Level:	T, R	**Default Setting:**	**30 seconds**	**4-20 Ramp Rate, Sec/100%, Aux 2**	
P2.3.4 Determines the time the 4-20 mA requires to make a 100% change.				**T:**	**134 - 135, 130 - 131**
Options: **8 to 60 seconds** The number of seconds it takes the 4-20 mA to change 100% (16 mA) in response to a Aux 2 curve 100% output change. **P2.3.4** is active at all firing rates, on both increasing and decreasing firing rates.					

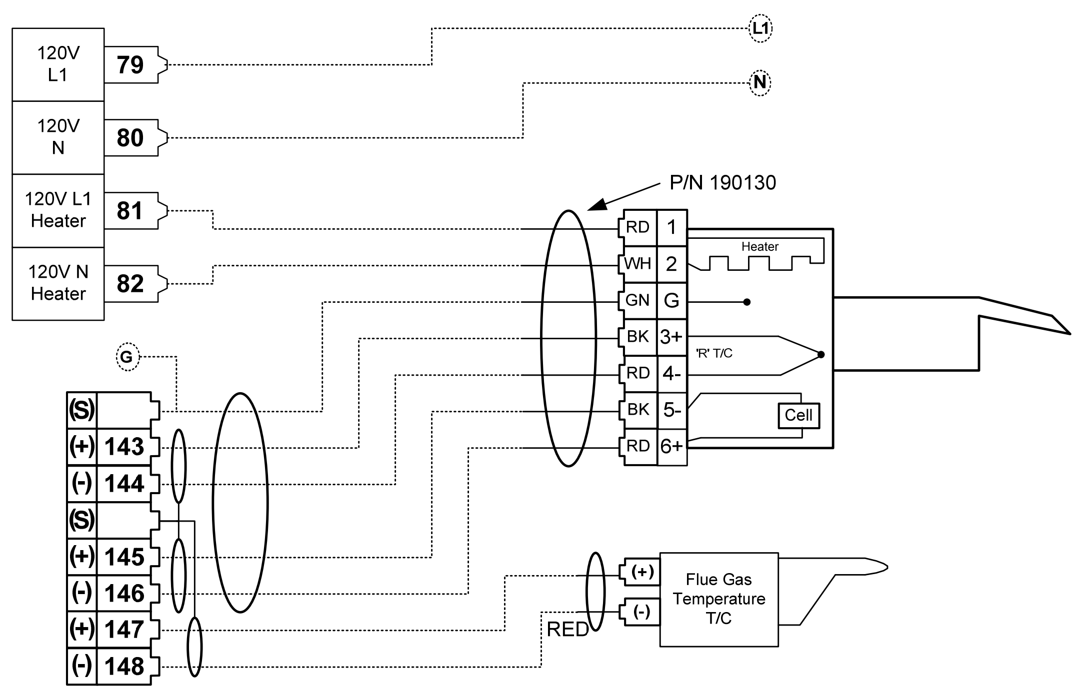
2.3.5 – 4-20 Off-Curve Lockout Deadband %, Aux 2

Menu Location:	Menu<Parameters<Fuel-Air<Options<Aux 2 Setup			**P:**	**2.3.5**
Password Level:	T	**Default Setting:**	**1.5 %**	**4-20 Off-Curve Lockout Deadband %, Aux 2**	
P2.3.5 Sets maximum difference between the 4-20 output and the 4-20 feedback.				**T:**	**127 - 128, 132 - 133**
Options: **0.2 - 4.8 %** If the +/- difference between the 4-20 output and the 4-20 feedback exceeds **P2.3.5** for more than 3 seconds while firing, an 'Aux 2 Not at Position' Lockout will occur.					
Note: Smaller values can cause nuisance burner trips and larger values can cause less accurate fuel/air ratio control. **P2.3.3** is NOT used is an Aux 2 servo is configured.					

2.4 – Oxygen Analyzer

2.4.1 – O2 Analyzer Option

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Analyzer			P:	2.4.1
Password Level:	E, R	**Default Setting:**	**Disable**		**O2 Analyzer Option**
P2.4.1 Determines if the O2 analyzer is enabled.				T:	**79 - 82, 143 - 148**
Options:	Disable: oxygen analyzer is not used.		Enable: oxygen analyzer is used.		
Rating	Terminal	Example Wiring			



Note: O2 probe maximum cold start load is 70 watts, normal operating is approximately 35 watts.
If a flue gas temperature T/C is not used, jumper T147 to T148.

2.4.2 – Low O2 Alarm SP

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Analyzer			P:	2.4.2
Password Level:	T	**Default Setting:**	**0.0**		**Low O2 Alarm SP**
P2.4.2 Determines the Low O2 Alarm setpoint.				T:	

Options: **0.0 to 20.0%**

If the Flue Gas Oxygen is below **P2.4.2** Low O2 Alarm SP for more than 3 seconds, the Common Alarm will be triggered.

Note: If **P2.4.2** is set at 0.0 or the Oxygen Analyzer is being calibrated the alarm will be disabled.

2.4.3 – Low O2 Lockout Option

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Analyzer			**P:**	**2.4.3**
Password Level:	E, R	**Default Setting:**	**Disable**		**Low O2 Lockout Option**
P2.4.3 Determines if the BMU will Lockout during a low O2 condition.				**T:**	

Options:

Disable: The BMU will not Lockout due to low oxygen.

Enabled: If the flue gas oxygen % is less than **P2.4.4** for more than **P2.4.5** seconds, the common alarm will be triggered and the BMU will cause the burner to Lockout.

Note: This parameter must be Enabled for MeteredServo-type Fuel-Air Control.
For JackshaftServo and PositionedServo, if **P2.4.2** is set to 0.0, or the Oxygen Analyzer is being calibrated, or an analyzer fault exists (see **P2.4.6**), the Low O2 Lockout Option becomes disabled.

2.4.4 – Low O2 Lockout SP

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Analyzer			**P:**	**2.4.4**
Password Level:	E, R	**Default Setting:**	**0.5**		**Low O2 Lockout SP**
P2.4.4 Determines the setpoint for low stack oxygen Lockout.				**T:**	

Options: 0.5 to 5.0%

If the flue gas oxygen % is less than **P2.4.4** for more than **P2.4.5** seconds, the common alarm will be triggered and the BMU will cause the burner to Lockout.

2.4.5 – Low O2 Lockout Delay

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Analyzer			**P:**	**2.4.5**
Password Level:	E, R	**Default Setting:**	**1**		**Low O2 Lockout Delay**
P2.4.5 Determines delay seconds before a low O2 Lockout.				**T:**	

Options: 1 to 40 Seconds

If the flue gas oxygen % is less than **P2.4.4** for more than **P2.4.5** seconds, the common alarm will be triggered and the BMU will cause the burner to Lockout.

2.4.6 – O2 Fault Lockout Option

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Analyzer			**P:**	**2.4.6**
Password Level:	E, R	**Default Setting:**	**Disable**		**O2 Fault Lockout Option**
P2.4.6 Determines if the FSG will Lockout on an analyzer fault.				**T:**	

Options:

Disable: The FSG will not Lockout due to oxygen analyzer faults.

Enable: Lockout the FSG if P2.4.1 is enabled and an oxygen analyzer fault occurs.

2.4.7 – O2 Low Cal Gas %

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Analyzer			**P:**	**2.4.7**
Password Level:	E	**Default Setting:**	**0.400**		**O2 Low Cal Gas %**
P2.4.7 is used to set the low O2 calibration gas percent.				**T:**	

Options: 0.300 to 3.000%

See the oxygen analyzer calibration instructions in Section 7 for more details.

2.4.8 – O2 High Cal Gas %

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Analyzer			**P:**	**2.4.8**
Password Level:	E	**Default Setting:**	**8.000**		**O2 High Cal Gas %**
P2.4.8 is used to set the high O2 calibration gas percent.				**T:**	
Options: **7.000 to 19.000%** See the oxygen analyzer calibration instructions in Section 7 for more details.					

2.4.9 – O2 Cell Slope Cal Data

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Analyzer			**P:**	**2.4.9**
Password Level:	E, R	**Default Setting:**	**20742**		**O2 Cell Slope Cal Data**
P2.4.9 is used to set the O2 slope calibration data.				**T:**	
Options: **0 to 30000** See the oxygen analyzer calibration instructions in Section 7 for more details.					

2.4.10 – O2 Cell Offset Cal Data

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Analyzer			**P:**	**2.4.10**
Password Level:	E, R	**Default Setting:**	**20596**		**O2 Cell Offset Cal Data**
P2.4.10 is used to set the O2 offset calibration data.				**T:**	
Options: **17000 to 23000** See the oxygen analyzer calibration instructions in Section 7 for more details.					

2.4.11 – O2 Cell Temp Cal Data

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Analyzer			**P:**	**2.4.11**
Password Level:	E, R	**Default Setting:**	**10730**		**O2 Cell Temp Cal Data**
P2.4.11 is used to set the O2 cell temperature calibration data.				**T:**	
Options: **10330 to 11130** See the oxygen analyzer calibration instructions in Section 7 for more details.					

2.4.12 – O2 Cal Data Checksum

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Analyzer			**P:**	**2.4.12**
Password Level:	E, R	**Default Setting:**	**00000**		**O2 Cal Data Checksum**
P2.4.12 is used to set the O2 calibration checksum.				**T:**	
Options: **-32768 to 32767** This is a combined security code for the three oxygen calibration parameters (slope, offset, and temperature) that are calculated by the BMU. If a factory calibrated replacement oxygen cell is being installed, enter the four values shown on the calibration tag (slope, offset, temperature, and checksum). If the cell is calibrated in the field with calibration gas, the BMU will calculate and enter the checksum value automatically at the end of a successful calibration. See the oxygen analyzer calibration instructions in Section 7 for more details.					
Note: If **P2.4.6** is enabled, the FSG will Lockout if the checksum is incorrect.					

2.4.13 – #6 Oil Efficiency Option

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Analyzer			**P:**	**2.4.13**
Password Level:	E, R	**Default Setting:**	**Disabled**	**#6 Oil Efficiency Option**	
P2.4.13 Determines if #2 Oil or #6 Oil is used in the Fuel Oil efficiency calculation.				**T:**	
Options: **Enabled** = #6 oil used, or **Disabled** = #2 oil used.					

2.5 – Oxygen Trim Setup

Warning!

Before placing the O2 Trim in automatic, the Commissioning Engineer or Technician must verify that combustion is Stable and Safe from Low Fire to High Fire with the scaled trim. To perform this test, use the Full Metered Tuning Screen Manual mode and force the trim to the Minimum (-) and maximum (+) positions allowed for that firing rate, as set up in **P2.6.4** and **P2.6.5**

2.5.1 – O2 Trim Option

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Trim Setup			**P:**	**2.5.1**
Password Level:	T, R	**Default Setting:**	**Disable**	**O2 Trim Option**	
P2.5.1 Determines if O2 trim control is used.				**T:**	
Options: **Disable:** The O2 trim option is not used. **Enable:** The O2 trim option is used.					
Note: If **P2.5.1** is enabled, then **P2.4.1** and **P2.4.3** must be enabled					

2.5.2 – Low Fire Disable, O2 Trim

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Trim Setup			**P:**	**2.5.2**
Password Level:	T	**Default Setting:**	**5.0**	**Low Fire Disable, O2 Trim**	
P2.5.2 Determines at what firing rate the O2 trim will be disabled.				**T:**	
Options: 1.0 to 40.0% firing rate Oxygen trim is nulled, (i.e. set to 0) when the firing rate is less than this value.					

2.5.3 – Burner Warmup Delay Sec, O2 Trim

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Trim Setup			**P:**	**2.5.3**
Password Level:	T	**Default Setting:**	**120**	**Burner Warmup Delay Sec, O2 Trim**	
P2.5.3 Determines the O2 trim warm up delay time.				**T:**	
Options: 30 to 300 seconds After light-off, the O2 trim remains nulled for **P2.5.3** Burner Warmup Delay Sec, O2 Trim.					

2.6 – Oxygen Trim – Test / Tuning Screen

Warning!
Before placing the O2 Trim in automatic, the Commissioning Engineer or Technician must verify that combustion is Stable and Safe from Low Fire to High Fire with the scaled trim. To perform this test, use the Full Metered Tuning Screen Manual mode and force the trim to the minimum (-) and maximum (+) positions allowed for that firing rate as set up in **P2.6.4** and **P2.6.5**

2.6.1 – SP Lag time, O2 Trim

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Trim Tune				**P:**	**2.6.1**
Password Level:	T	**Default Setting:**	**8.0**	**SP Lag Time, O2 Trim**		
P2.6.1 Determines the O2 trim Lag time.					**T:**	
Options: **2.0 to 12.0 Seconds** O2 trim setpoint lag time delay accounts for the transit time from the burner to the stack at lower firing rates.						
Note: It's important that the proper time is entered here for proper trim operation at lower firing rates.						

2.6.2 – Proportional Band, O2 Trim

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Trim Tune				**P:**	**2.6.2**
Password Level:	T	**Default Setting:**	**6.50**	**Proportional Band, O2 Trim**		
P2.6.2 Determines the proportional band for the O2 trim.					**T:**	
Options: **1.00 to 9.99% Oxygen** The oxygen change that resulted in a change from minimum trim to maximum trim.						
Caution: A small proportional can result in trim oscillation. **Note:** A smaller proportional band value results in tighter, more active PID control.						

2.6.3 – Minutes per Repeat, O2 Trim

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Trim Tune				**P:**	**2.6.3**
Password Level:	T	**Default Setting:**	**0.50**	**Minutes Per Repeat, O2 Trim**		
P2.6.3 Determines the integral ramp rate for the O2 trim.					**T:**	
Options: **0.20 to 2.50** The integral mode ramp rate, expressed in repeats per minute.						
Note: A smaller value makes the integral ramp in less time (i.e., faster). **CAUTION:** The trim and oxygen can oscillate if the integral time is too small.						

2.6.4 – +/- Max Fire Trim, O2

Menu Location:	Menu<Parameters<Fuel-Air<Options<Oxygen Trim Tune				**P:**	**2.6.4**
Password Level:	T	**Default Setting:**	**+/- 10.00**	**+/- O2 Trim Limits**		
P2.6.4 Limits the O2 trim range.					**T:**	
Options: **+/- 5.00 to +/-15.00%**						
Note: This is the trim amount before firing rate scaling is applied.						

2.6.5 – Min Fire Trim Scaler, O2 Trim (or Full Metered)

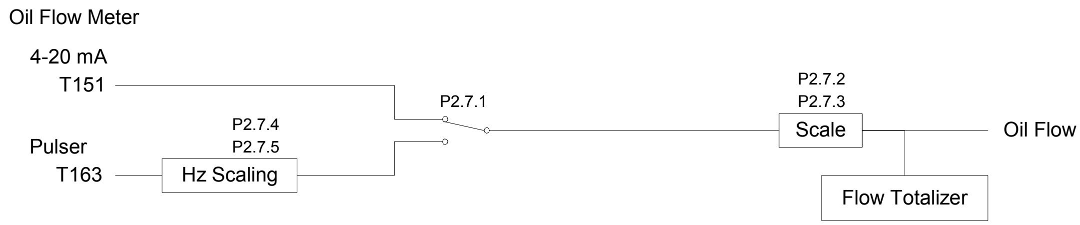
<table>
<tr><td>Menu Location:</td><td colspan="4">Menu<Parameters<Fuel-Air<Options<Oxygen Trim Tune</td><td>P:</td><td>2.6.5**</td></tr>
<tr><td>Password Level:</td><td>T</td><td>Default Setting:</td><td>0.20</td><td colspan="3">MinFireScale</td></tr>
<tr><td colspan="5">P2.6.5 Determines the Trim scaling multiplier at minimum fire.</td><td>T:</td><td></td></tr>
<tr><td colspan="7">Options: 0.01 to 0.60</td></tr>
<tr><td colspan="7">Notes: The Firing Rate Trim Scaling Multiplier decreases in proportion to the Fuel Servo position and P2.6.5.
Example: PID UnScaled Trim = +10.0%, P2.6.5 = 0.25
At Max Fuel, Scaled Trim = +10.00; At Min Fuel, Scaled Trim = +2.50; At mid stroke, Scaled Trim = +6.25

Initially, rough set P2.6.5 to the burner turndown percentage (12:1 => 0.08, 10:1 => 0.10, 8:1 => 0.13, 5:1 => 0.20, 4:1 => 0.25). After adjusting P2.13.1 - P2.13.4 near high fire, set the burner near low fire and adjust <u>only</u> P2.6.5. See the Trim Tuning Procedure for more information.

** P2.6.5 is shown on both the 'Full Metered Tune' and on the 'Positioned O2 Trim Tune' screens.
Only one of the two modes can be selected; therefore, there is no interaction.

WARNING: The Technician must verify that combustion is Stable and Safe from Low fire to High fire with the Unscaled Trim at the maximum '+' value and also at the maximum '-' value, via the Full Metered Tuning Screen MANUAL mode.</td></tr>
</table>

2.7 – Fuel Flow Setup – Oil Flow Meter

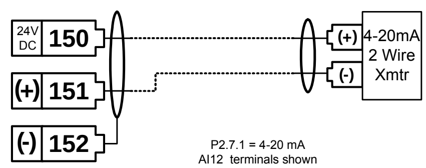


2.7.1 – Xmtr Signal, Oil Flow

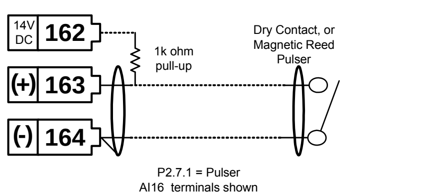
Menu Location:	Menu<Parameters<Fuel-Air<Options<Fuel Flow Setup<Oil Flow Meter			**P:**	**2.7.1**
Password Level:	E, R	**Default Setting:**	**4-20 mA**	**Xmtr Signal, Oil Flow**	
P2.7.1 Determines the oil flow meter signal type to be used .				**T:**	**150 -152**

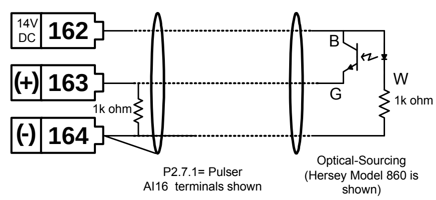
Options:
4-20 mA: Wire to terminals 150 - 152.
Pulser: Wire to terminals 162 - 164 based on the type of Pulser, as shown below.

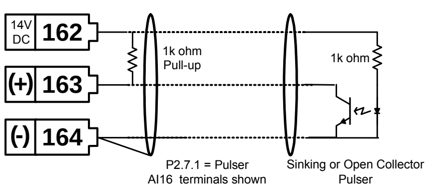
Rating	Terminal	Example Wiring

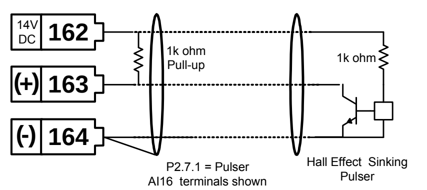


Rating	Terminal	Example Wiring









Note: BMU-1xxx and BMU-2xxx only. BMS Oil Fuel must be Enabled, **P1.1.1**

Pulser Compatibility Notes:
For indication / totalizing, Low fire pulse rate must be greater than 1 Hz (60 pulses/min or 3600pulses/hr) .
For Full Metered control, Low fire pulse rate should be greater than 3 Hz (180/minute or 19510/hr).
Maximum pulse rate is 650 Hz.
The minimum pulse 'On' (or 'Off') time must be greater than 0.4 milliseconds.

2.7.2 – Decimal Point, Oil Flow

Menu Location:	Menu<Parameters<Fuel-Air<Options<Fuel Flow Setup<Oil Flow Meter			**P:**	**2.7.2**
Password Level:	E, R	**Default Setting:**	**xxxx**	**Decimal Point, Oil Flow**	
P2.7.2 Determines decimal place in Oil flow display, and in P2.7.3 below.				**T:**	**150 - 151**

Options: xxxxx or xxx.x

Note: For Full Metering control use xxx.x whenever possible (for example 250.0 gph, instead of 250 gph).
CAUTION: If BMU is in Full Metered mode and this value is changed, the Oil Curves must be re-verified.

2.7.3 – GPH Span, Oil Flow

Menu Location:	Menu<Parameters<Fuel-Air<Options<Fuel Flow Setup<Oil Flow Meter			**P:**	**2.7.3**
Password Level:	E, R	**Default Setting:**	**400**	**GPH Span, Oil Flow**	
P2.7.3 is the flow rate that causes a flowmeter 20 mA output, or that causes **P2.7.5** pulses/sec.				**T:**	**150 - 152**
Options: 1.5 to 999.9 or 15 to 9999 GPH (or LPH). Decimal point determined by **P2.7.2**					
Note: The Span must be in GPH or LPH units (not GPM or LPM) for the Flow totalizer to indicate correctly. **CAUTION:** If BMU is in Full Metered mode and this value is changed, the Oil Curves must be re-verified.					

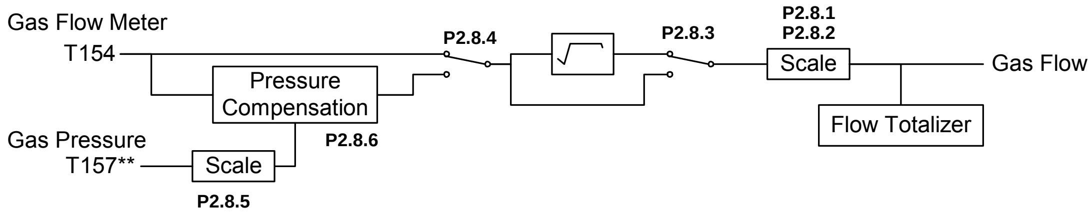
2.7.4 – Decimal Point, Oil Flow Pulser Frequency Span

Menu Location:	Menu<Parameters<Fuel-Air<Options<Fuel Flow Setup<Oil Flow Meter			**P:**	**2.7.4**
Password Level:	E, R	**Default Setting:**	**xx.xx**	**Decimal Point, Oil Flow Pulser Freq Span**	
P2.7.4 Determines decimal point position of **P2.7.5**, the Pulser Frequency Span.				**T:**	**162 - 164**
Options: xxx.x or xx.xx					
Note: For Full Metering control use xx.xx whenever possible (for example 25.14 Hz, instead of 25.1 Hz). **CAUTION:** If BMU is in Full Metered mode and this value is changed, the Oil Curves must be re-verified.					

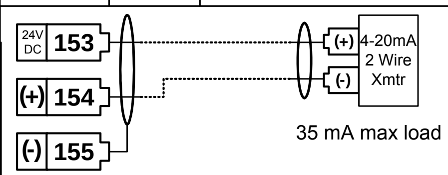
2.7.5 – Pulser Frequency Span, Oil Flow

Menu Location:	Menu<Parameters<Fuel-Air<Optios<Fuel Flow Setup<Oil Flow Meter			**P:**	**2.7.5**
Password Level:	E, R	**Default Setting:**	**50.00 Hz**	**Pulser Frequency Span, Oil Flow**	
P2.7.5 is the oil flow meter pulser Hz output when **P2.7.3** GPH is flowing through the meter.				**T:**	**162 - 164**
Options: 4.00 to 65.00 or 40.0 to 650.0 Hz (pulses per second). Decimal Point determined by **P2.7.4** The 'Hz' Frequency is determined by: $\frac{\text{GPH x Flow meter pulses per Gallon}}{3600}$					
CAUTION: If BMU is in Full Metered mode and this value is changed, the Oil Curves must be re-verified.					

2.8 – Fuel Flow Setup – Gas Flow Meter



2.8.1 – Decimal Point, Gas Flow

Menu Location:	Menu<Parameters<Fuel-Air<Options<Fuel Flow Setup<Gas Flow Meter				**P:**	**2.8.1**
Password Level:	E, R	**Default Setting:**	**xx.xx**	**Decimal Point, Gas Flow**		
P2.8.1 Determines decimal place in Gas flow display, and in **P2.8.2** below.					**T:**	**153 - 155**
				Rating	Terminal	Example Wiring
Options: xxxxx or xxx.x or xx.xx						
Note: For Full Metering control use the most 'active' digits possible, for example: 250.0, not 250; 10500, not 10.5 or 10.50 kscfh. **CAUTION:** If BMU is in Full Metered mode and this value is changed, the Gas Curves must be re-verified.						

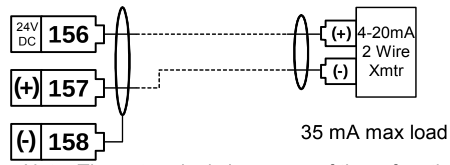
2.8.2 – Flow @ 20mA. Gas Flow

Menu Location:	Menu<Parameters<Fuel-Air<Fuel Flow Setup<Gas Flow Meter				**P:**	**2.8.2**
Password Level:	E, R	**Default Setting:**	**1.00**	**Flow @ 20 mA, Gas Flow**		
P2.8.2 is the flow rate that causes a flow xmtr 20 mA output.					**T:**	**153 - 155**
Options: 1.00 to 99.99 or 10.0 to 999.9 or 10 to 32000 Decimal point determined by **P2.8.1**						
Note: The Span must be in CFH or kCFH units (not CFM or kCFM) for the Flow totalizer to indicate correctly. **CAUTION:** If BMU is in Full Metered mode and this value is changed, the Gas Curves must be re-verified.						

2.8.3 – Sq Root, Gas Flow

Menu Location:	Menu<Parameters<Fuel-Air<Fuel Flow Setup<Gas Flow Meter				**P:**	**2.8.3**
Password Level:	E, R	**Default Setting:**	**Disabled**	**Sq Root Option, Gas Flow**		
P2.8.3 Determines if BMU applies Square Root to gas flow signal.					**T:**	**153 - 155**
Options: **Disabled:** Square Root is not applied to Gas Flow. **Enabled:** Square Root is applied Gas Flow.						
CAUTION: If BMU is in Full Metered mode and this value is changed, the Gas Curves must be re-verified.						

2.8.4 – Pressure Comp Option, Gas Flow

Menu Location:	Menu<Parameters<Fuel-Air<Options<Fuel Flow Setup<Gas Flow Meter			**P:**	**2.8.4**
Password Level:	E, R	**Default Setting:**	**Disabled**	**Pressure Comp Option, Gas Flow**	
P2.8.4 When this parameter is enabled, the BMU will pressure compensate the gas flow.				**T:**	**156 - 158**
				Rating / Terminal / Example Wiring	
Options: **Disabled:** Gas flow is not pressure compensated. **Enabled:** Gas flow is pressure compensated.				 Note: These terminals have one of three functions. **P2.8.4**, **P2.9.1**, and **P6.1.1** Only ONE of the three Options can be Enabled	
Note: Gas Flow Press. Comp. **P2.8.4** can only be Enabled, if: a)This is a BMU-1xxx or BMU-2xxx, and b) An Atomizing Valve servo has NOT been configured, and c)The Fuel 3 Flow Xmtr is NOT required. (Fuel 3 Flow Xmtr is only required if: **P2.1.1** = Metered Servo Mode and **P1.1.3** = Fuel 3 is Enabled). **CAUTION**: If BMU is in Full Metered mode and this value is changed, the Gas Curves must be re-verified.					

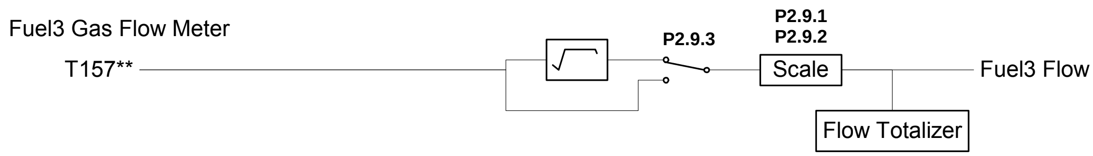
2.8.5 – Gas PSIG Xmtr Span

Menu Location:	Menu<Parameters<Fuel-Air<Options<Fuel Flow Setup<Gas Flow Meter			**P:**	**2.8.5**
Password Level:	E, R	**Default Setting:**	**30.00 psig**	**Gas PSIG Xmtr Span**	
P2.8.5 is the pressure that causes a 20 mA output from the transmitter.				**T:**	**156 - 158**
Options: 5.00 to 300.00 psig					
Note: The Span must be entered in psig units for a proper pressure compensation calculation. **CAUTION:** If BMU is in Full Metered mode and this value is changed, the Gas Curves must be re-verified.					

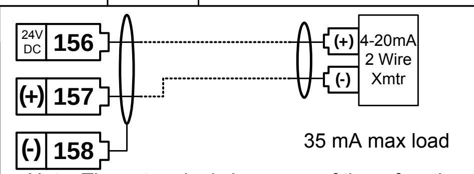
2.8.6 – Flow Comp Design PSIG, Gas Flow

Menu Location:	Menu<Parameters<Fuel-Air<Options<Fuel Flow Setup<Gas Flow Meter			**P:**	**2.8.6**
Password Level:	E, R	**Default Setting:**	**5.00 psig**	**Flow Comp Design PSIG, Gas Flow**	
P2.8.6 Determines the Flow Comp Design of the gas flow meter.				**T:**	**156 - 158**
Options: 0.50 to 25.00 psig					
Note: Gas flow meters are calibrated at a specific pressure, Enter the calibration pressure in this parameter. This pressure must be entered in psig units for a proper pressure compensation calculation. **CAUTION:** If BMU is in Full Metered mode and this value is changed, the Gas Curves must be re-verified.					

2.9 – Fuel Flow Setup – Fuel 3 Flow Meter



2.9.1 – Decimal Point, Fuel 3 Flow

Menu Location:	Menu<Parameters<Fuel-Air<Options<Fuel Flow Setup<Fuel 3 Flow Meter			**P:**	**2.9.1**
Password Level:	E, R	**Default Setting:**	**xxx.x**	**Decimal Point, Fuel 3 Flow**	
P2.9.1 Determines decimal place in Fuel 3 flow display, and in **P2.9.2** below.				**T:**	**156 - 158**
				Rating / Terminal / Example Wiring	
Options: xxxxx or xxx.x or xx.xx					
Note: For Full Metering control use the most 'active' digits possible, for example: 250.0, not 250; 10500, not 10.5 or 10.50 kscfh. **CAUTION:** If BMU is in Full Metered mode and this value is changed, the Fuel 3 Curves must be re-verified.				Note: These terminals have one of three functions. **P2.8.4**, **P2.9.1**, and **P6.1.1** Only ONE of the three Options can be Enabled	
Note: Terminals 156 - 158 can be used for the Fuel 3 Flow meter, If: a)This is a BMU-1xxx or BMU-2xxx, and b) An Atomizing Valve servo has NOT been configured, and c)Gas Flow Pressure Comp. is Disabled (P2.8.4)					

2.9.2 – Flow @ 20mA, Fuel 3 Flow

Menu Location:	Menu<Parameters<Fuel-Air<Options<Fuel Flow Setup<Fuel 3 Flow Meter			**P:**	**2.9.2**
Password Level:	E, R	**Default Setting:**	**10.0**	**Flow @ 20 mA, Fuel 3 Flow**	
P2.9.2 is the flow rate that causes a flow xmtr 20 mA output.				**T:**	**156 - 158**
Options: 1.00 to 99.99 or 10.0 to 999.9 or 10 to 32000 Decimal point determined by **P2.9.1**					
Note: The Span must be in CFH or kCFH units (not CFM or kCFM) for the Flow totalizer to indicate correctly. **CAUTION:** If BMU is in Full Metered mode and this value is changed, the Fuel 3 Curves must be re-verified.					

2.9.3 – Sq Root Option, Fuel 3 Flow

Menu Location:	Menu<Parameters<Fuel-Air<Options<Fuel Flow Setup<Fuel 3 Flow Meter			**P:**	**2.9.3**
Password Level:	E, R	**Default Setting:**	**Disabled**	**Sq Root Option, Fuel 3 Flow**	
P2.9.3 Determines if BMU applies Square Root to gas flow signal.				**T:**	**156 - 158**
Options: **Disabled:** Square Root is not applied to Fuel 3 Flow. **Enabled:** Square Root is applied Fuel 3 Flow.					
CAUTION: If BMU is in Full Metered mode and this value is changed, the Fuel 3 Curves must be re-verified.					

2.10 – Fuel Flow Setup – Totalizers

2.10.1 – Flow Totalizer Option

Menu Location:	Menu<Parameters<Fuel-Air<Options<Fuel Flow Setup<Totalizers			P:	2.10.1
Password Level:	T	**Default Setting:**	**Disabled**		**Flow Totalizer Option**
P2.10.1 Determines if flow totals are displayed on one of the boiler operating screens.				T:	

Options:

Disabled: Flow rates are not totalized.

Enabled: Flow rates are totalized and displayed as an LCD Operating screen.

Note: The following flows can be totalized: steam, oil, gas, and fuel 3 flows.

The flow totals are copied into the BMU EEPROM once every 60 minutes.
Upon a power loss, the unsaved interim totals are lost.
Upon power-up, Totalization resumes from the Totals in EEPROM.

Flow rates below 4% will not be totalized (prevents false totalization due to xmtr calibration drift).

#6 oil flow meters are typically installed upstream from a re-circulation valve that maintains flow when the burner is shutdown to prevent cold oil clogging. Oil Flow is not totalized when the Oil SSOV is closed.

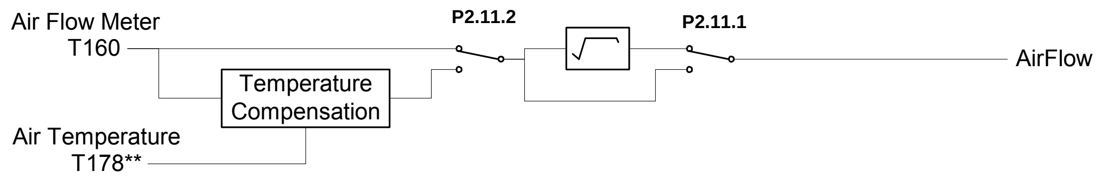
Disabling the Flow Totalizers resets all Totals to 00000000.

The Totalizer logic automatically applies a x10 multiplier or a /10 divisor based on the xmtr full scale flow rate parameters **P2.7.3, P2.8.3, P2.9.2, or P5.3.2** as follows:

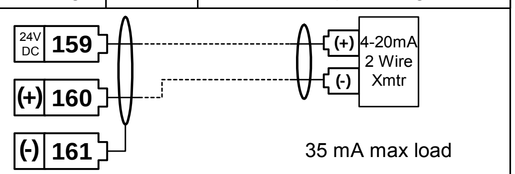
Decimal Point	Flow Xmtr Full Scale	1 Totalizer Count = ____ flow units	
xx.xx	1.00 - 4.99	0.001	/10 divisor
xx.xx	5.00 – 49.99	0.01	x1 multiplier
xx.xx	50.00 – 99.99	0.1	x10 multiplier
xxx.x	10.0 - 49.9	0.01	/10 divisor
xxx.x	50.0 – 499.9	0.1	x1 multiplier
xxx.x	500.0 – 999.9	1.0	x10 multiplier
xxxxx	100 - 499	0.1	/10 divisor
xxxxx	500 - 4999	1	x1 multiplier
xxxxx	5000 - 32000	10	x10 multiplier

Note: The above scaling illustrates what the totalized count and multiplier will be based on the decimal point and full scaled flow rate determined by the Parameter settings for the steam, oil, gas and fuel 3 flow meters.

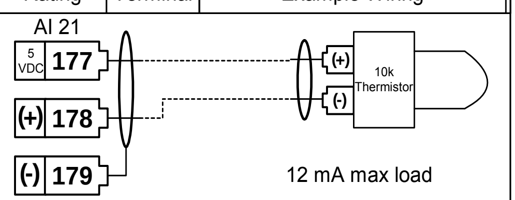
2.11 – Full Metered Setup – Air Flow Meter



2.11.1 – Sq Root Option, Air Flow

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Setup<Air Flow Meter			**P:**	**2.11.1**
Password Level:	E, R	**Default Setting:**	**Enabled**	**Sq Root Option, Air Flow**	
P2.11.1 Determine if a Sq Root is Enabled.				**T:**	**159 -161**
Options: **Disabled:** Sq Root is not applied to air flow signal. **Enabled:** Sq Root is applied air flow signal.				Rating | Terminal | Example Wiring	
CAUTION: If BMU is in Full Metered mode and this value is changed, the Oil, Gas, and Fuel 3 Curves must all be re-verified.					
Note: 20 mA corresponds to 100.0 % air flow and is not adjustable					

2.11.2 – Temperature Comp Option, Air Flow

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Setup<Air Flow Meter			**P:**	**2.11.2**
Password Level:	E, R	**Default Setting:**	**Disabled**	**Temp Comp Option, Air Flow**	
P2.11.2 Determines if the Air Flow is temperature Compensated.				**T:**	**177 - 179**
Options: **Disabled:** Air flow is not temperature compensated. **Enabled:** Air flow is temperature compensated.				Rating | Terminal | Example Wiring	
CAUTION: If BMU is in Full Metered mode and this value is changed, the Oil, Gas, and Fuel 3 Curves must all be re-verified.				 Note: These terminals have one of two functions. **P2.11.2** and **P3.5.1** Only ONE of the two Options can be Enabled	
Note: Temp Comp **P2.11.2** can only be enabled If: **P3.5.1** (OAT sensor channel) = AI5					

2.12 – Full Metered Setup – Misc Metered Setup

2.12.1** – Air Flow %, Disable Full Metered

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Setup< Misc Metered Setup			**P:**	**2.12.1****
Password Level:	T	**Default Setting:**	**10.0**	**Air Flow %, Disable Full Metered**	
P2.12.1 The % of Air Flow at which the control mode changes from 'fully metered' to 'positioned'.				**T:**	
Options: 0.0 to 25.5%					

Notes: Depending on the burner turndown and air flow transmitter style, the air flow signal may pulsate or be non-repeatable near low fire.
If the air flow drops below the **P2.12.1** setting for more than 2 seconds, the BMU automatically changes from the Full Metered control strategy to the Positioned control strategy.
When the air flow increases to (the **P2.12.1** setting + 2%) for more than 2 seconds, the BMU automatically changes back to the Full Metered control strategy.
When Full Metered is disabled due to **P2.12.1**, the Air Flow Deviation Lockout, Fuel Flow Deviation Lockout, and the Oxygen Trim become disabled.
Setting **P2.12.1** to 0.0 means that the BMU will NOT disable Full Metered control mode based on air flow.
This Parameter also appears on the Full Metering Tune screen, see the **P2.13.x** parameter section.

Air Flow versus Air Flow Setpoint Deviation Lockout

During Full Metered control, if the O2 trim corrected measured Air flow deviates too much from the Air flow Setpoint for longer than an adjustable time delay (**P2.12.5**), the BMU will Lockout and shutdown the burner.

The Lockout deviation band varies from **P2.12.2** at Low fire to **P2.12.3** at high fire in proportion to the firing rate. Example: **P2.12.2** = 20% deviation at low fire, **P2.12.3** = 10 % deviation at high fire.
At 25% firing the deviation band is +/- 17.5%; at 50% the band is +/- 15%; at 75% the band is +/- 12.5%

The **P2.12.2** and **P2.12.3** based Lockout deviation band represents '% of flow', as opposed to '% full scale'.
Example, If the deviation band is a constant +/-10% from low to high fire:
If air flow Setpoint (AFSP) = 90%, the band is +/-9%; if AFSP = 30%, the band is +/- 3%

The Air flow Deviation Lockout is bypassed to prevent nuisance Lockouts as follows:
For the first 8 seconds after completing MTFI.
During Commission Mode and for the first 8 seconds after exiting Commission Mode
When air flow is below **P2.12.1** (the BMU has reverted to Positioning mode).
During Low Fire Fuel Transfer and for the first 8 seconds after exiting Low Fire Fuel Transfer.

2.12.2 – % Air Flow, Low Fire Deviation Lockout

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Setup< Misc Metered Setup			**P:**	**2.12.2**
Password Level:	T	**Default Setting:**	**20.0**	**% Air Flow, Low Fire Deviation Lockout**	
P2.12.2 Determines the air flow deviation Lockout deviation band at Low Fire (see above).				**T:**	
Options: 2.0 to 30.0					

2.12.3 – % Air Flow, High Fire Deviation Lockout

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Setup< Misc Metered Setup			**P:**	**2.12.3**
Password Level:	T	**Default Setting:**	**10.0**	**% Air Flow, High Fire Deviation Lockout**	
P2.12.3 Determines the air flow deviation Lockout deviation band at High Fire (see above).				**T:**	
Options: 2.0 to 30.0%					

2.12.4 – % Fuel Flow, Deviation Lockout

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Setup< Misc Metered Setup			**P:**	**2.12.4**
Password Level:	T	**Default Setting:**	**25**	**% Fuel Flow, Deviation Lockout**	
P2.12.4 Determines the fuel flow deviation Lockout deviation band.				**T:**	
Options: 2 to 30%					

Notes:
During Full Metered control, if the measured Fuel flow deviates too much from the Fuel Flow stored during Commissioning at that fuel valve position for longer than an adjustable time delay (**P1.12.5**), the BMU will Lockout and shutdown the burner.

The **P2.12.4** Lockout deviation band represents a % of fuel flow as it relates to the full scale of that fuel's flow meter.

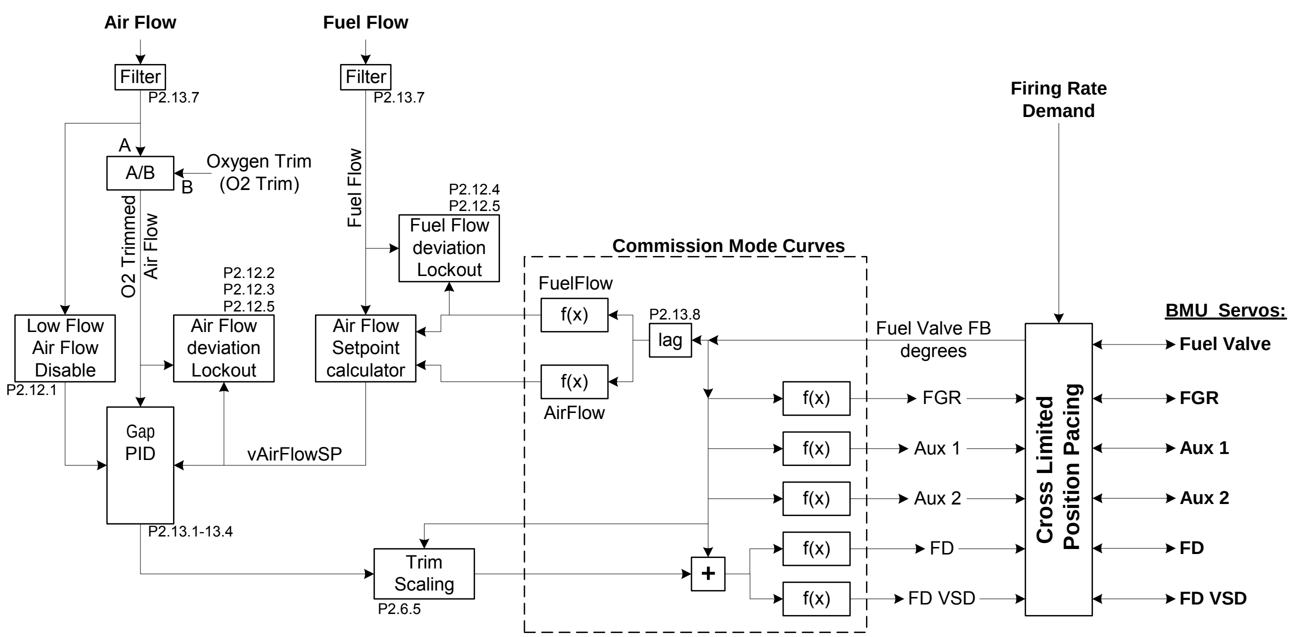
The Fuel Flow Deviation Lockout is bypassed to prevent nuisance Lockouts as follows:
During MTFI, Commission Mode, during Low Fire Fuel Transfer, and when **P2.12.1** switches from metered to positioned.

The fuel flow deviation Lockout deviation band can be set fairly wide. The BMU Full Metering logic compensates the Air Flow Setpoint for Fuel Flow deviations in order to maintain the Commissioned fuel/air ratio. Therefore, reasonable fuel flow deviations are not a concern.

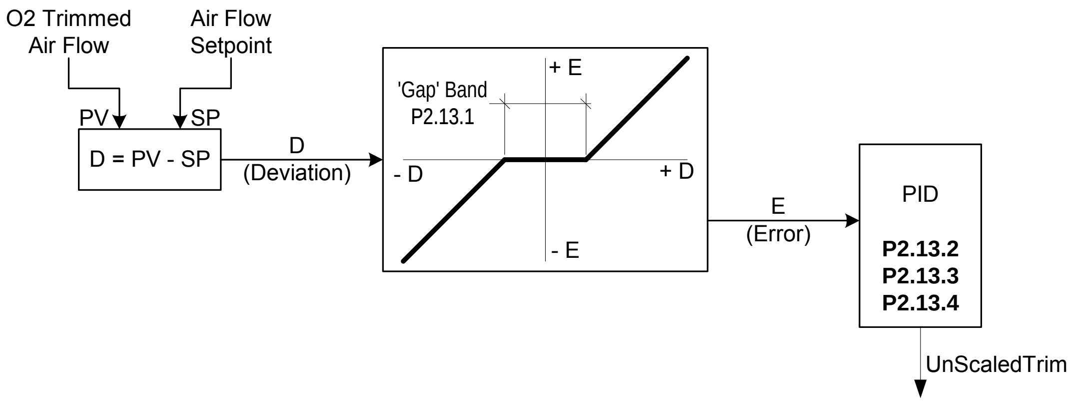
2.12.5 – Sec, Flow Deviation Lockout Delay

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Setup< Misc Metered Setup			**P:**	**2.12.5**
Password Level:	T	**Default Setting:**	**6 seconds**	**Sec, Flow Deviation Lockout Delay**	
P2.12.5 Determines the air flow and fuel flow deviation time delays before a Lockout occurs.				**T:**	
Options: 2 to 30 seconds					
Note: An air flow or a fuel flow deviation must persist for longer than **P2.12.5** seconds before a Lockout will occur. See also **P2.12-2, P2.12.3, P2.12.4** for more information.					

BurnerMate Universal Full Metered or Predictive Metered Control Strategy



2.13 – Full Metered Tune



2.13.1 – Gap Band, Full Metered Tune

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Tune			**P:**	**2.13.1**
Password Level:	T	**Default Setting:**	**0.3 % Air Flow**	**Gap Band, Full Metered Tune**	
P2.13.1 is used to prevent over-controlling when air flow is very close to setpoint.				**T:**	
Options: 0.1 to 3.0 % Air Flow					
Notes: The Gap Band is the +/- Air Flow band around the setpoint where the PID holds the Air Flow Trim at it's current value. This prevents unnecessary damper/VSD hunting due to normal air and fuel flow xmtr pulsations. If the Gap Band is too large, the PID will respond sluggishly to firing rate changes.					

2.13.2 – Prop Band, Full Metered Tune

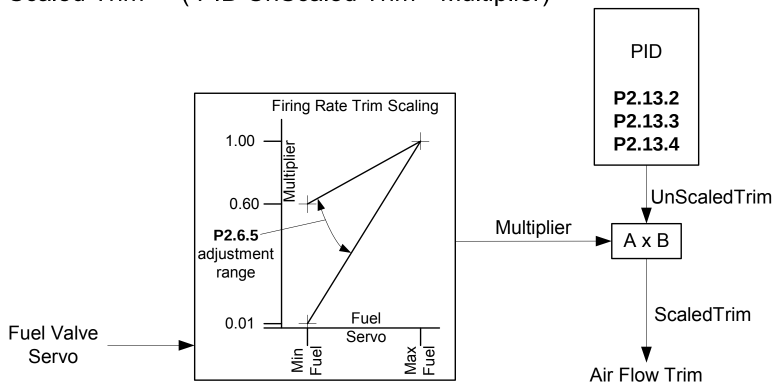
Menu Location:	Menu<Parameters<Fuel-Air<Full Metered Tune			**P:**	**2.13.2**
Password Level:	T	**Default Setting:**	**6.0 % Air Flow**	**Prop Band, Full Metered Tune**	
P2.13.2 Determines the PID Proportional Band for the Air Flow PID control.				**T:**	
Options: 3.0 to 60.0 % Air Flow					
Notes: Proportional band is defined as the air flow change required to change the trim by 20%. A larger Proportional band will result in less control action for a given change in air flow. A smaller Proportional Band value results in tighter, more active PID control. Proportional Band provides the initial control reaction to a change in air flow. **Caution:** A small Proportional band can result in air flow oscillation. Make sure that the **P2.13.7** and **P2.13.8** lag filters are properly adjusted before adjusting **P2.13.2**					

2.13.3 – Min / Repeat, Full Metered Tune

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Tune			**P:**	**2.13.3**
Password Level:	T	**Default Setting:**	**0.10**	**Min / Repeat, Full Metered Tune**	
P2.13.3 Determines the Min/Rep in the air flow PID control.				**T:**	
Options: 0.05 to 0.40 minutes					
Notes: Minutes per repeat is the time it takes for the Integral to ramp the Air Flow Trim up or down one more "Proportional" mode correction. A smaller value causes rapid Integral ramping. A larger value causes slower Integral ramping. Intergal is a slower secondary flow correction that occurs after the the initial proportional correction. **Caution:** The air flow can oscillate if the Integral time is too small. Make sure that the **P2.13.7** and **P2.13.8** lag filters are properly adjusted before adjusting **P2.13.2**					

Firing Rate Trim Scaling:

The Full Metered PID Trim needs to be larger at High Fire and smaller at Low Fire.
The Firing Rate Trim Scaling Multiplier decreases in proportion to: the Fuel Servo position and P2.6.5
Scaled Trim = (PID UnScaled Trim * Multiplier)



2.13.4 – Max Fire Trim + / -, Full Metered Tune

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Tune			**P:**	**2.13.4**
Password Level:	T	**Default Setting:**	**10.00**	**MaxFireTrim+/-, Full Metered Tune**	
P2.13.4 Limits the PID +/- Unscaled Trim range.				**T:**	
Options: 0.10 to 25.00					
Notes: **P2.13.4** establishes the maximum +/- Unscaled Trim range when the Fuel valve servo is at the highest curve position. **WARNING:** The Technician must verify that combustion is Stable and Safe from Low fire to High fire with the Unscaled Trim at the maximum '+' value and then at the maximum '-' value, via the Full Metered Tuning screen MANUAL mode.					

2.6.5** – Min Fire Trim Scaler, O2 Trim or Full Metered (also listed previously)

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Tune			**P:**	**2.6.5** **
Password Level:	T	**Default Setting:**	**0.20**	**MinFireScale**	
P2.6.5 Determines the Trim scaling multiplier at minimum fire.				**T:**	
Options: 0.01 to 0.60					
Notes: The Firing Rate Trim Scaling Multiplier decreases in proportion to the Fuel Servo position and **P2.6.5**. Example: PID Unscaled Trim = +/-10.0%, **P2.6.5** = 0.25 At Max Fuel, Scaled Trim = +/-10.00; At Min Fuel, Scaled Trim = +/-2.50; At mid stroke, Scaled Trim = +/-6.25 Initially, rough set **P2.6.5** to the burner turndown percentage (12:1 => 0.08, 10:1 => 0.10, 8:1 => 0.13, 5:1 => 0.20, 4:1 => 0.25). After adjusting **P2.13.1 - 2.13.4** near high fire, set the burner near low fire and adjust <u>only</u> **P2.6.5**. See the Trim Tuning Procedure for more information. ** **P2.6.5** is shown on both the 'Full Metered Tune' and on the 'Positioned O2 Trim Tune' screens. Only one of the two modes can be selected; therefore, there is no interaction. **WARNING:** The Technician must verify that combustion is Stable and Safe from Low fire to High fire with the Unscaled Trim at the maximum '+' value and also at the maximum '-' value, via the Full Metered Tuning Screen MANUAL mode.					

2.12.1** – Trim Null Air Flow %, Full Metered Tune (also listed previously)

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Tune			**P:**	**2.12.1**
Password Level:	T	**Default Setting:**	**10.0**	**Air Flow %, Disable Full Metered**	
P2.12.1 The % of Air Flow at which the control mode changes from 'fully metered' to 'positioned'.				**T:**	
Options: 0.0 to 25.5%					
Notes: See the **P2.12.1** description in the **P2.12.x** parameter section.					

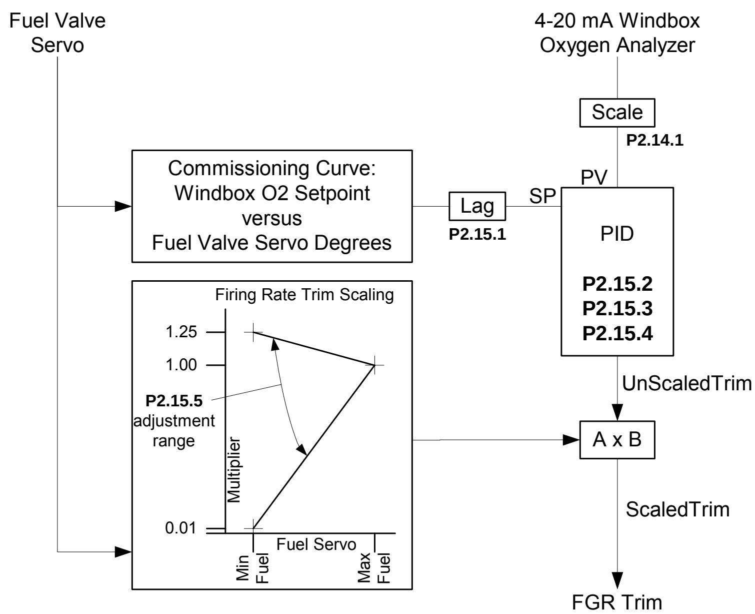
2.13.7 – Xmtr Filter Sec, Full Metered Tune

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Tune			**P:**	**2.13.7**
Password Level:	T	**Default Setting:**	**2.0 seconds**	**Xmtr Filter Sec, Full Metered Tune**	
P2.13.7 Determines the flow transmitters pulsation filter time constant.				**T:**	
Options: 0.1 to 10.0 seconds					
Note: This filter time constant is applied to all of the fuel and air flow meters. The filters reduce the normally occuring flow meter signal pulsations in order to prevent excessive control hunting. A larger number provides more smoothing. With the Trim in Manual and the burner running, adjust the Xmtr Filter Seconds until all the displayed flows are reasonably stable, but still very responsive. The smallest 'filter seconds' possible should be used. If the 'filter seconds' are too large, the flows will be "sluggish" and over controlling can result. If additional filtering is needed on an individual flow input, use additional filtering in the adjustments within that flow transmitter.					

2.13.8 –Flow SP Lag Sec, Full Metered Tune

Menu Location:	Menu<Parameters<Fuel-Air<Options<Full Metered Tune			**P:**	**2.13.8**
Password Level:	T	**Default Setting:**	**2.5 seconds**	**Flow SP Lag Sec, Full Metered Tune**	
P2.13.8 Delays the air flow setpoint calculation when firing rate changes.				**T:**	
Options: 0.1 to 10.0 seconds					
Note: When a firing rate change occurs, the servos respond quickly while the fuel and air flow meter signals lag behind (partially due to the design of the flow meters, and partially due to the **P2.13.7** filtering). **P2.13.8** delays the fuel valve servo position signal to allow the measued flow rates to catch up before a new air flow setpoint is calculated (based on measure fuel flow, commissioned fuel and air flow). Generally, **P2.13.8** will be larger than **P2.13.7** If this filter value is too small, the Air flow PID will over control during every load change. If this filter value is too large, the Air flow PID control lag behind after every load change.					

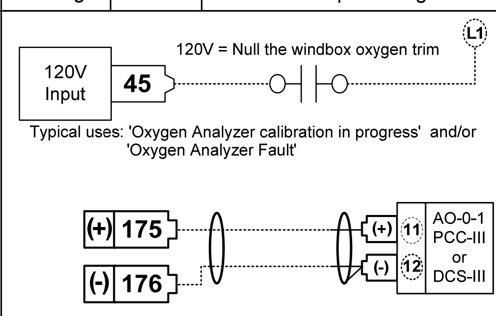
2.14 – FGR O2 Trim Setup



Warning!

BEFORE PLACING THE FGR O2 TRIM IN AUTOMATIC, THE COMMISSIONING ENGINEER OR TECHNICIAN MUST VERIFY THAT COMBUSTION IS STABLE AND SAFE FROM LOW FIRE TO HIGH FIRE WITH THE SCALED TRIM. TO PERFORM THIS TEST, USE THE FGR TRIM TUNING SCREEN MANUAL MODE AND FORCE THE TRIM TO THE MINIMUM (-) AND MAXIMUM (+) POSITIONS ALLOWED FOR ALL FIRING RATES AS SET UP IN **P2.15.4** AND **P2.15.5**

2.14.1 – Windbox Oxygen FGR Trim Option

Menu Location:	Menu<Parameters<Fuel-Air<Options<FGR O2 Trim Setup			**P:**	**2.14.1**
Password Level:	E, R	**Default Setting:**	**Disabled**	**Windbox Oxygen FGR Trim Option**	
P2.14.1 Determines if windbox oxygen FGR trim is used.				**T:**	**45, 175 -176**
				Rating	Terminal / Example Wiring
Options: **Disabled**: Windbox oxygen trim is not used. **Enabled**: Windbox oxygen trim is used. Trims the FGR curves based on measured windbox O2 versus the commissioning curve windbox O2 setpoint. T45 must be energized whenever the windbox oxygen signal is incorrect. Typically during the oxygen analyzer calibration cycle and also whenever an analyzer fault is detected. The BMU resumes FGR trimming as soon as T45 is de-energized. If required, provide external time delays.				 Example shows 4-20 mA oxygen input from a PCC-III or a DCS-III with an oxygen monitoring configuration.	
Note: Can only be Enabled on BMU-1xxx or BMU-2xxx models.					

2.14.2 – Windbox Oxygen @ 20 mA, Xmtr Cal

Menu Location:	Menu<Parameters<Fuel-Air<Options<FGR O2 Trim Setup			**P:**	**2.14.2**
Password Level:	E, R	**Default Setting:**	**21.0**	**Windbox Oxygen @ 20 mA, Xmtr Cal**	
P2.14.2 is the % Oxygen that causes a 20 mA output from the Analyzer.				**T:**	**45, 175 -176**
Options: 18.00 to 25.00%					
Note: 4 mA corresponds to 0.0% Oxygen, and the input signal must be linear.					

2.15 – FGR O2 Trim Tune

2.15.1 – SP Lag Seconds, FGR Trim Tune

Menu Location:	Menu<Parameters<Fuel-Air<Options<FGR O2 Trim Tune			**P:**	**2.15.1**
Password Level:	T	**Default Setting:**	**8.0 seconds**	**SP Lag Seconds, FGR Trim**	
P2.15.1 Determines Windbox O2 Setpoint delay time during load change.				**T:**	
Options: 0.5 to 20.0					
Note: P2.15.1 'Lag Seconds' should be set to delay and gradually ramp the curve Windbox O2 Setpoint after a load change at the same rate as the measured windbox O2 changes. If the setpoint and the measured O2 ramp at different rates, the FGR will un-necessarily trim after a load change and this can cause an oscillation. A larger number slows down the setpoint change, a smaller number speeds up the setpoint change. See Trim Tuning Procedure for more information.					

2.15.2 – Proportional Band, FGR Trim Tune

Menu Location:	Menu<Parameters<Fuel-Air<Options<FGR O2 Trim Tune			**P:**	**2.15.2**
Password Level:	T	**Default Setting:**	**5.00 % Oxygen**	**Proportional Band, FGR Trim**	
P2.15.2 Determines the Proportional Band for the FGR O2 Trim.				**T:**	
Options: 0.50 to 20.00 % oxygen					
Note: Proportional band is defined as the O2 change required to change the trim by 20%. A larger Proportional band will result in less control action for a given change in O2. A smaller Proportional Band value results in tighter, more active PID control. Proportional Band provides the initial control reaction to a change in O2. **Caution:** A small Proportional Band can result in O2 oscillation. Make sure that the **P2.15.1** lag filter is properly adjusted before adjusting **P2.15.2**.					

2.15.3 – Minutes Per Repeat, FGR Trim Tune

Menu Location:	Menu<Parameters<Fuel-Air<Options<FGR O2 Trim Tune			**P:**	**2.15.3**
Password Level:	T	**Default Setting:**	**0.50 minutes**	**Minutes per Repeat, FGR Trim**	
P2.15.3 Determines the Min/Repeat in the FGR O2 Trim PID control.				**T:**	
Options: 0.20 to 3.00 minutes					
Notes: Minutes per repeat is the time it takes for the Integral to ramp the FGR Flow Trim up or down one more "Proportional" mode correction. A smaller value causes rapid Integral ramping. A larger value causes slower Integral ramping. Integral is a slower secondary flow correction that occurs after the the initial proportional correction. **Caution:** The O2 can oscillate if the Integral time is too small. Make sure that the **P2.15.1** lag filter is properly adjusted before adjusting **P2.15.3**.					

2.15.4 – Max Fire Trim + / -, FGR Trim Tune

Menu Location:	Menu<Parameters<Fuel-Air<Options<FGR O2 Trim Tune				**P:**	**2.15.4**
Password Level:	T	**Default Setting:**	**10.00**	**MaxFireTrim+/-, FGR Trim**		
P2.15.4 Limits the PID +/- Unscaled Trim range.					**T:**	
Options: 0.01 to 15.00						

Notes: **P2.15.4** establishes the maximum +/- Unscaled Trim range when the Fuel valve servo is at the highest curve position.

WARNING: The Technician must verify that combustion is Stable and Safe from Low fire to High fire with the Unscaled Trim at the maximum '+' value and then at the maximum '-' value, via the FGR Trim Tuning screen MANUAL mode.

2.15.5 – Min Fire Trim + / -, FGR Trim Tune

Menu Location:	Menu<Parameters<Fuel-Air<Options<FGR O2 Trim Tune				**P:**	**2.15.5**
Password Level:	T	**Default Setting:**	**0.20**	**MinFireScale, FGR Trim**		
P2.15.5 Determines the Trim scaling multiplier at minimum fire.					**T:**	
Options: 0.01 to 1.25						

Notes:
The Firing Rate Trim Scaling Multiplier decreases in proportion to the Fuel Servo position and P2.15.5.
Example: PID Unscaled Trim = +10.0%, **P2.15.5** = 0.25
At Max Fuel, Scaled Trim = +10.00; At Min Fuel, Scaled Trim = +2.50; At mid stroke, Scaled Trim = +6.25

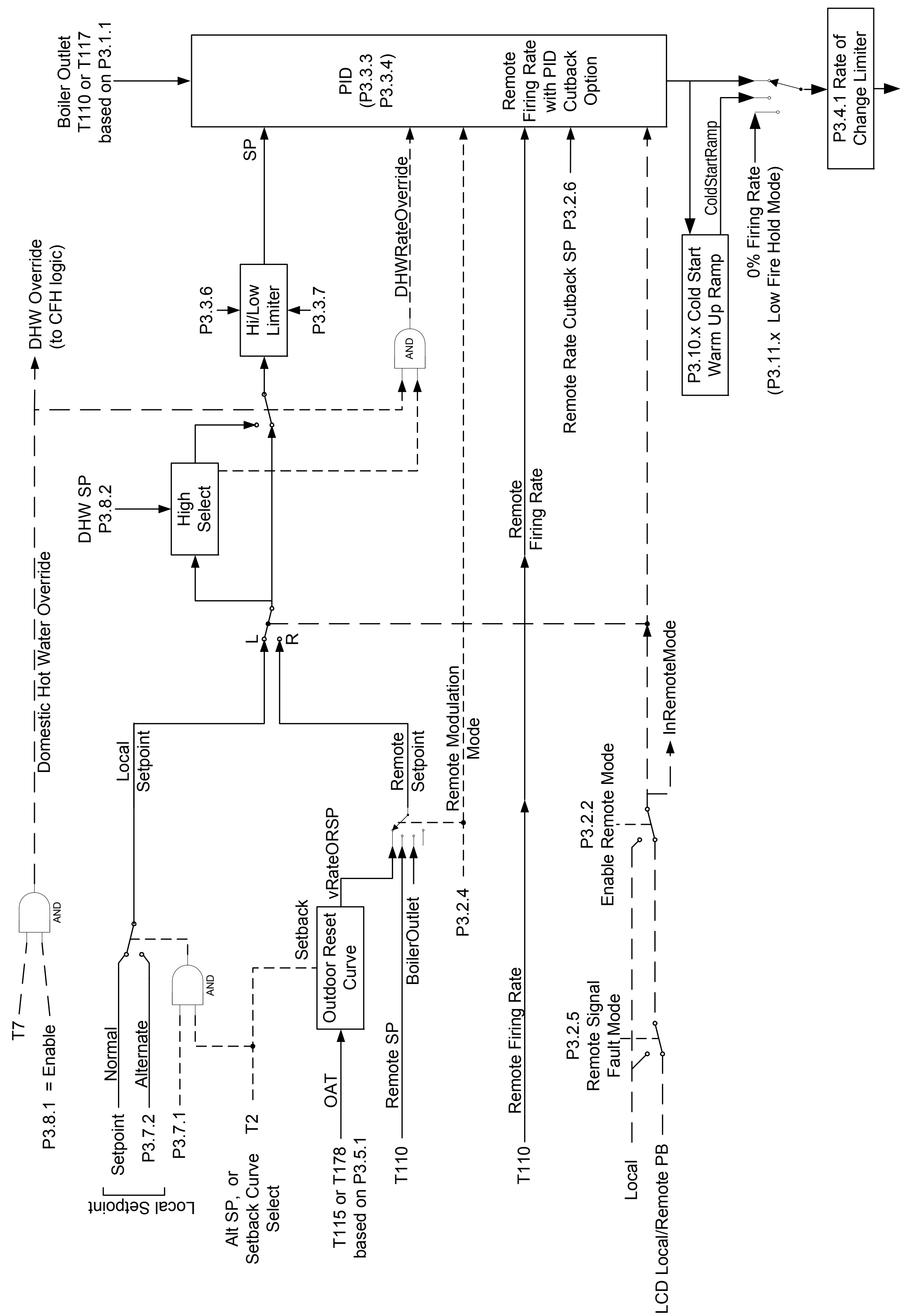
Initial rough settings for **P2.15.5:**
No mixing box, FGR enters in between FD fan damper and fan inlet:
Set to the burner turndown percentage
(12:1 => 0.08, 10:1 => 0.10, 8:1 => 0.13, 5:1 => 0.20, 4:1 => 0.25).

FGR / fresh air mixing box with fresh air damper, upstream from FD fan damper:
Set the MinFireScale to 1.00 initially.

After adjusting **P2.15.1 - P2.15.4** near high fire, set the burner near low fire and adjust only **P1.15.5**.
See the Trim Tuning Procedure (Section 5) for more information.

Warning!
Before placing the FGR O2 Trim in automatic, the Commissioning Engineer or Technician must verify that combustion is Stable and Safe from Low Fire to High Fire with the scaled trim.
To perform this test, use the FGR Trim Tuning Screen Manual mode and force the trim to the minimum (-) and maximum (+) positions allowed for all firing rates as set up in **P2.15.4** and **P2.15.5**

3. FIRING RATE



3.1 – Basic Setup – BLR Outlet Sensor

3.1.1 – Sensor Channel, Boiler Outlet***

Menu Location:	Menu<Parameters<Firing Rate<Basic Setup<Blr Outlet Sensor			**P:**	**3.1.1**
Password Level:	T	**Default Setting:**	**AI3**	**Sensor Channel, Boiler Outlet**	
P3.1.1 Selects the Boiler Outlet (Pressure or Temperature) signal used for firing rate control.				**T:**	**108-111, 117-118**

Options:

AI3: Thermistor, 4-20mA, 1-5VDC or 0-5 VDC sensor wired to Terminals 108-111. See **P3.1.2** to select sensor type

AI6: Thermocouple wired to Terminals 117-118. See **P3.1.3** to select thermocouple type.

Note: See **P3.1.2, P3.1.3** for wiring details.

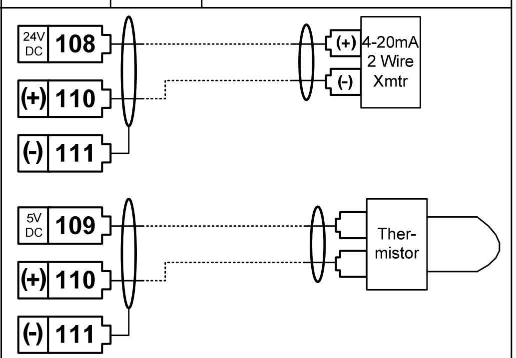
3.1.2 – AI3 Sensor Type***

Menu Location:	Menu<Parameters<Firing Rate<Basic Setup<Blr Outlet Sensor			**P:**	**3.1.2**
Password Level:	T	**Default Setting:**	**Thermistor**	**AI3 Sensor Type**	
P3.1.2 Determines AI3 Sensor Type. This is set to match the installed sensor or transmitter used in **P3.1.1**.				**T:**	**108 - 111**
				Rating / Terminal / Example Wiring	

Options:

Thermistor
4-20mA
1-5V, 0-5V

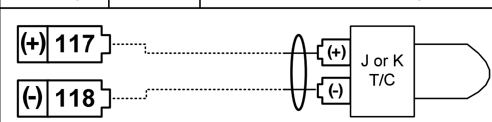
If a 4-20mA, 1-5VDC, or 0-5VDC transmitter is used then set **P3.1.5** and **P3.1.6** to match the transmitter full scale calibration.



3.1.3 – AI6 Sensor Type***

Menu Location:	Menu<Parameters<Firing Rate<Basic Setup<Blr Outlet Sensor			**P:**	**3.1.3**
Password Level:	T	**Default Setting:**	**J T/C**	**AI6 Sensor Type**	
P3.1.3 Selects AI6 thermocouple type used.				**T:**	**117 - 118**
				Rating / Terminal / Example Wiring	

Options:
J_T/C
K_T/C



3.1.4 – Degrees C Scaling***

Menu Location:	Menu<Parameters<Firing Rate<Basic Setup<Blr Outlet Sensor				**P:**	**3.1.4**
Password Level:	T	**Default Setting:**	**Disable**	**Degrees C Scaling**		
P3.1.4 Determines how all Thermocouple readings are displayed.					**T:**	

Options:
Disable: All Thermistor and Thermocouple sensor signals are displayed in deg F.
Enable: All Thermistor and Thermocouple sensor signals are displayed in deg C.

3.1.5 – Decimal Point, Boiler Outlet***

Menu Location:	Menu<Parameters<Firing Rate<Basic Setup<Blr Outlet Sensor				**P:**	**3.1.5**
Password Level:	T	**Default Setting:**	**x**	**Decimal Point, Boiler Outlet**		
P3.1.5 Determines the decimal point format used for boiler outlet temperature or pressure.					**T:**	

Options: **x or x.x**

Note: Thermistor or thermocouple sensors must use 'x' format.
The 4-20mA, 1-5V, or 0-5V sensors selected in **P3.1.6** with a value of 100 or larger must use the 'x' display format.

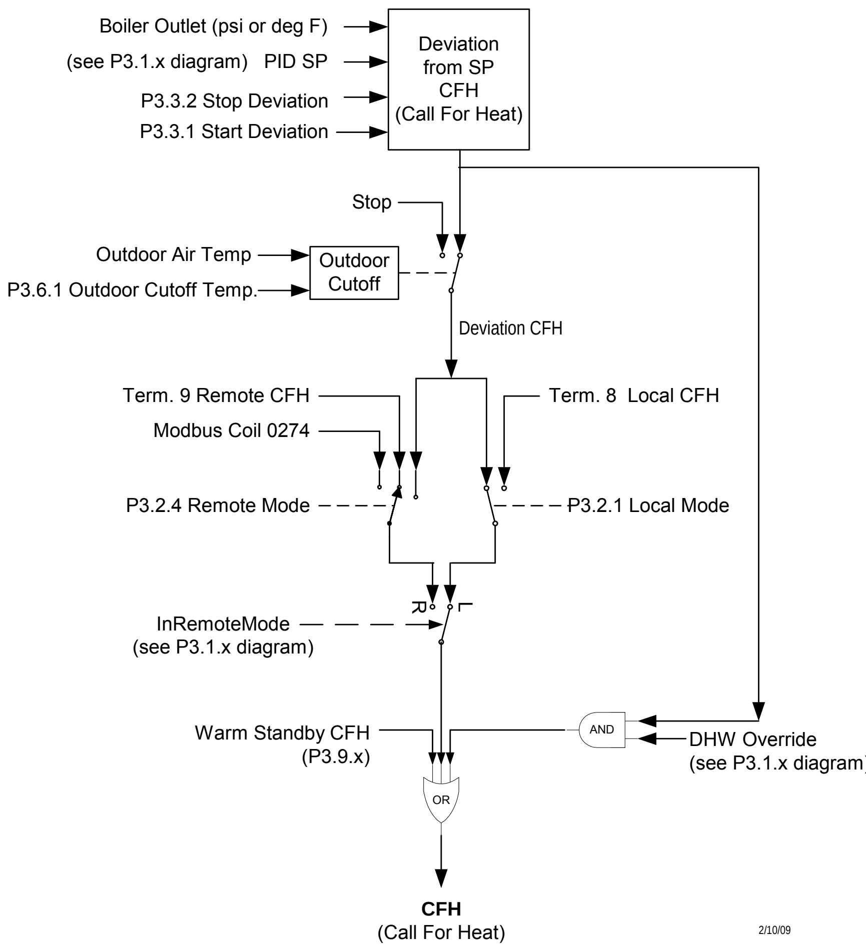
3.1.6 – Xmtr Span, Boiler Outlet***

Menu Location:	Menu<Parameters<Firing Rate<Basic Setup<Blr Outlet Sensor				**P:**	**3.1.6**
Password Level:	T	**Default Setting:**	**25.0**	**Xmtr Span, Boiler Outlet**		
P3.1.6 Should equal the full-scale calibration of the boiler outlet sensor at 20mA or 5VDC.					**T:**	

Options: **5.0 to 2000.0**
If Preferred Utilities supplied a boiler outlet sensor with the P/N:
P/N 70600 **P3.1.6** = 25.0 psi P/N 70601 **P3.1.6** = 200.0 psi P/N 70602 **P.3.1.6** = 500.0 psi

Note: **P3.1.6** should only be set up if; **P3.1.1** = AI3 and **P3.1.2** = 4-20mA, 1-5V or 0-5V.
4mA, 1VDC or 0VDC always corresponds to a BMU displayed value of 0.
If the boiler outlet sensor is a thermistor or thermocouple, ignore this parameter.

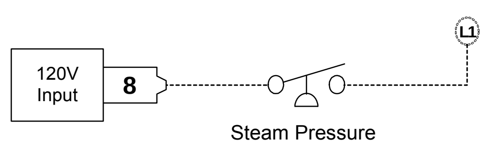
3.2 – Basic Setup – Local / Remote Mode



3.2.1 – CFH Local Mode***

<table>
<tr><td>Menu Location:</td><td colspan="4">Menu<Parameters<Firing Rate< Basic Setup< Local/Remote Mode</td><td>P:</td><td>3.2.1</td></tr>
<tr><td>Password Level:</td><td>T</td><td>Default Setting:</td><td>SPDeviation</td><td colspan="3">CFH Local Mode</td></tr>
<tr><td colspan="4" rowspan="2">P3.2.1 Determines the BMU "Call for Heat" (CFH) logic in local mode.</td><td></td><td>T:</td><td>8</td></tr>
<tr><td>Rating</td><td>Terminal</td><td>Example Wiring</td></tr>
<tr><td colspan="4">Options:

Terminal8: CFH is based on a 120 VDC contact closure to terminal 8.

SPDeviation:
CFH is based on the boiler outlet deviation from the current setpoint. This is based on the steam pressure or water temperature.</td><td colspan="3">
In the example wiring, P3.2.1 would be set for Terminal8. T8 is using a steam pressure switch as the Call For Heat input.</td></tr>
</table>

3.2.2 – Enable Remote Mode***

Menu Location:	Menu<Parameters<Firing Rate< Basic Setup< Local/Remote Mode			**P:**	**3.2.2**
Password Level:	T	**Default Setting:**	**Enable**	**Enable Remote Mode**	
P3.2.2 Determines if the BMU can accept a firing rate signal from a remote location.				**T:**	

Options:

Disable: Local Mode Only, Remote Mode can not be selected.

Enable: Remote Mode can be selected.

3.2.3 – CFH Remote Mode

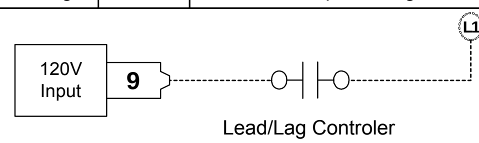
Menu Location:	Menu<Parameters<Firing Rate< Basic Setup< Local/Remote Mode			**P:**	**3.2.3**
Password Level:	T	**Default Setting:**	**Terminal9**	**CFH Remote Mode**	
P3.2.3 Determines the Call for Heat (CFH) logic in BMU in remote mode.				**T:**	**9**
				Rating / Terminal / Example Wiring	

Options:

Modbus: CFH is based on Modbus (1 = Start)

Terminal9: CFH is based on a 120 VAC contact closure to Terminal 9.

SPDeviation: CFH is based on the boiler outlet deviation from the current setpoint.



In the example wiring, **P3.2.3** would be set for Terminal9. T9 is using a lead/lag controller as the Call For Heat input.

Note: See **P3.2.2** for more details.

3.2.4 – Remote Modulation

Menu Location:	Menu<Parameters<Firing Rate< Basic Setup< Local/Remote Mode			**P:**	**3.2.4**
Password Level:	T	**Default Setting:**	**AI4_FR**	**Remote Modulation**	
P3.2.4 Determines the Modulation method used in the BMU during Remote mode.				**T:**	**112 - 113**
				Rating / Terminal / Example Wiring	

Options:

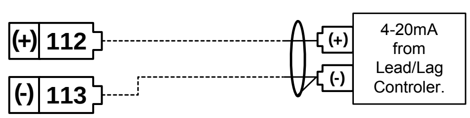
OAReset_SP: The Outdoor Air Temperature driven outdoor reset curve is the firing rate PID setpoint.

Modbus_SP: Modbus input supplies the firing rate PID setpoint.

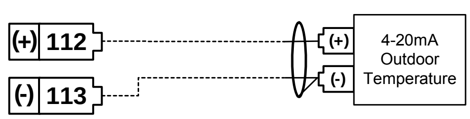
AI4_SP: The signal wired to AI4 is the firing rate PID setpoint. Setpoint signal scaling is configured by **P3.2.7 - P3.2.9**.

AI4_FR: The signal wired to AI4 is the firing rate. The BMU PID is not controlling firing rate. See also **P3.2.6**.

Modbus_FR: Modbus is the firing rate. The BMU PID is not controlling firing rate. See also **P3.2.6.**



Wiring diagram shows **P3.2.4** set for AI4_FR using a signal from a lead/lag controller for firing rate.



Wiring diagram shows **P3.2.4** set for OAReset_SP using a signal from a outdoor temperature sensor.

3.2.5 – Remote Fault Response

Menu Location:	Menu<Parameters<Firing Rate< Basic Setup< Local/Remote Mode			**P:**	**3.2.5**
Password Level:	T	**Default Setting:**	**Local**	**Remote Fault Response**	
P3.2.5 Determines what action the BMU will take with a Failed/Faulted remote modulation signal.				**T:**	**112 - 113**
Options: **Remote:** Remain in Remote, even if the Remote Modulation signal is faulty **Local:** Automatically switch into Local mode if the Remote Modulation signal is faulty.					
Note: The Remote Modulation signal is considered faulty as follows: - Outside Air Temperature (OAT) outside = -50F > OAT > 130F, - Remote Setpoint and Firing Rate outside -5% > AI4 > 105%, - No Modbus activity for longer than Modbus Timeout seconds.					
Note: Modbus Timeout location = Menu<Utilities<Modbus Setup<Timeout					

3.2.6 – Remote Rate Cutback SP

Menu Location:	Menu<Parameters<Firing Rate< Basic Setup< Local/Remote Mode			**P:**	**3.2.6**
Password Level:	T	**Default Setting:**	**2000.0**	**Remote Rate Cutback SP**	
P3.2.6 Determines the setpoint for the remote rate.				**T:**	
Options: **0.5 to 2000.0** If the BMU is in remote mode and **P3.2.4** = AI4_FR or Modbus_FR and the boiler outlet temperature or pressure has exceed **P3.2.6**; the remote firing rate is overridden and proportionally cutback. The cutback proportional band will equal (0.5 * **P3.3.3**).					
Note: 2000.0 = Disable the remote rate cutback logic.					

3.2.7 – AI4 Signal Type

Menu Location:	Menu<Parameters<Firing Rate< Basic Setup< Local/Remote Mode			**P:**	**3.2.7**
Password Level:	T	**Default Setting:**	**4 - 20mA**	**AI4 Signal Type**	
P3.2.7 Determines the remote setpoint or remote firing rate signal type.				**T:**	**112 - 113**
Options: **4-20mA** **1-5V** **0-5V**					
Note: P3.2.4 determines how AI4 is used. See also **P3.2.8** and **P3.2.9**.					

3.2.8 – Remote SP Span

Menu Location:	Menu<Parameters<Firing Rate< Basic Setup< Local/Remote Mode			**P:**	**3.2.8**
Password Level:	T	**Default Setting:**	**200.0**	**Remote SP Span**	
P3.2.8 Determines the remote setpoint signal span for AI4.				**T:**	**112 - 113**
Options: **0.0 to 2000.0** The remote setpoint signal scaling for an AI4 input of 20 mA or 5 VDC; based on **P3.2.7**.					
Note: The difference between **P3.2.8** and **P3.2.9** must be greater than 20. The remote setpoint span can be greater than the remote setpoint zero, or vice versa.					

3.2.9 – Remote SP Zero

Menu Location:	Menu<Parameters<Firing Rate< Basic Setup< Local/Remote Mode				**P:**	**3.2.9**
Password Level:	T	**Default Setting:**	**0**	**Remote SP Zero**		
P3.2.9 Determines the zero signal scaling for the AI4 remote setpoint.					**T:**	**112 - 113**
Options: 0.0 to 2000.0 The Remote Setpoint signal scaling for an AI4 input of 4 mA, 1 VDC, or 0 VDC; based on **P3.2.7.**						
Note: The difference between **P3.2.8** and **P3.2.9** must be greater than 20. The remote Setpoint Span can be greater than the Remote Setpoint Zero, or vice versa.						

3.3 – Basic Tuning – Firing Rate Tuning

3.3.1 – CFH Start Deviation**

Menu Location:	Menu<Parameters<Firing Rate<Basic Tuning				**P:**	**3.3.1**
Password Level:	0	**Default Setting:**	**5.0**	**CFH Start Deviation**		
P3.3.1 Determines the amount of deviation from setpoint needed to start a call for heat sequence.					**T:**	
Options: -50.0 to 500.0 The boiler starts when the boiler outlet drops **P3.3.1** degrees/psi/bar BELOW the current setpoint for more than 2 seconds.						
Note: P3.2.1 or **P3.2.3** must be set for SPDeviation for **P3.3.1** to be active. **P3.3.2** MINUS **P3.3.1** must be greater than +0.2 Setting a negative number here sets the start point above the Set Point. (i.e., set this parameter as a negative number if you want the burner cycle to start before the pressure or temperature drops below the set point.)						

3.3.2 – CFH Stop Deviation**

Menu Location:	Menu<Parameters<Firing Rate<Basic Tuning				**P:**	**3.3.2**
Password Level:	O	**Default Setting:**	**10.0**	**CFH Stop Deviation**		
P3.3.2 Determines the amount of deviation from setpoint to stop a call for heat sequence.					**T:**	
Options: 0.1 to 500.0 The boiler stops when the boiler outlet rises **P3.3.1** degrees/psi/bar above the current firing rate setpoint for more than 2 seconds.						
Note: P3.2.1 or **P3.2.3** must be set for SPDeviation for **P3.3.1** to be active. **P3.3.2** MINUS **P3.3.1** must be greater than +0.2						

3.3.3 – Proportional Band, Rate PID***

Menu Location:	Menu<Parameters<Firing Rate<Basic Tuning				**P:**	**3.3.3**
Password Level:	T	**Default Setting:**	**5.0**	**Proportional Band, Rate PID**		
P3.3.3 Determines the Boiler Outlet Temp. or Press change that results in a 100% Firing Rate.					**T:**	
Options: 0.05 to 50.00 A smaller proportional band value results in tighter, more active, PID control.						
Note: The burner firing rate can oscillate if the proportional band is too small. See also **P3.3.4** for additional firing rate tuning adjustments.						

3.3.4 – Minutes Per Repeat, Rate PID***

Menu Location:	Menu<Parameters<Firing Rate<Basic Tuning			**P:**	**3.3.4**
Password Level:	T	**Default Setting:**	**1.25**	**Minutes per Repeat, Rate PID**	
P3.3.4 Determines the PID Integral ramp rate.				**T:**	
Options: 0.75 to 10.00 The PID Integral ramp rate is expressed in Minutes per Repeat.					
Note: A smaller value makes the integral ramp in less time; faster. See also **P3.3.3** for additional firing rate tuning adjustments.					

3.3.5 – Rate Local SP

Menu Location:	Menu<Parameters<Firing Rate<Basic Tuning			**P:**	**3.3.5**
Password Level:	O	**Default Setting:**	**200.0**	**Rate Local SP**	
P3.3.5 Determines the process setpoint when the BMU is in local mode of operation.				**T:**	
Options: 0.0 to 2000.0					
Note: This is manually set by the operator. This parameter can be overridden by **P3.7.2, P3.8.2, P3.3.6** or **P3.3.7**.					

3.3.6 – Rate Max SP***

Menu Location:	Menu<Parameters<Firing Rate<Basic Tuning			**P:**	**3.3.6**
Password Level:	T	**Default Setting:**	**240.0**	**Rate Max SP**	
P3.3.6 Determines the upper limit setpoint for all local and remote modes of operation.				**T:**	
Options: 0.5 to 2000.0					
Note: P3.3.6 MINUS **P3.3.7** must be greater than +0.2 This parameter cannot be overridden by the display, modbus, outdoor reset, remote reset or domestic hot water demand(s).					

3.3.7 – Rate Min SP***

Menu Location:	Menu<Parameters<Firing Rate<Basic Tuning			**P:**	**3.3.7**
Password Level:	T	**Default Setting:**	**0**	**Rate Min SP**	
P3.3.7 Determines the lower limit setpoint for all local and remote modes of operation.				**T:**	
Options: 0.0 to 1900.0					
Note: P3.3.6 MINUS **P3.3.7** must be greater than +0.2 This parameter cannot be overridden by the display, modbus, outdoor reset, remote reset or domestic hot water demand(s).					

3.4 – Miscellaneous

3.4.1 – Sec / 100 % Rate Limit, Firing Rate

Menu Location:	Menu<Parameters<Firing Rate Options <Miscellaneous			**P:**	**3.4.1**
Password Level:	T	**Default Setting:**	**25**	**Sec/100% Rate Limit, Firing Rate**	
P3.4.1 Limits the rate of firing rate change in both manual and automatic.				**T:**	
Options: 25 to 120 seconds					

3.4.2 – Avoid Gap + / -, Firing Rate

Menu Location:	Menu<Parameters<Firing Rate Options <Miscellaneous			**P:**	**3.4.2**
Password Level:	T	**Default Setting:**	**+/- 0.5**	**+/- Avoid Gap, Firing Rate**	
P3.4.2 Determines by how much an avoid position is jumped over in the firing rate.				**T:**	

Options: **+/- 0.2 to 3.0 degrees fuel valve position**

Some burner/boiler combinations have an audible rumble at a specific firing rate.

If an avoid fuel position was stored in the combustion curve data, the BMU firing rate will jump over this firing rate within the range of +/- **P3.4.2** Avoid Gap, Firing Rate.

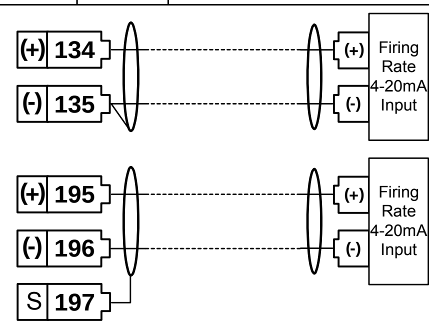
3.4.3 – Output Channel, Firing Rate

Menu Location:	Menu<Parameters<Firing Rate Options <Miscellaneous			**P:**	**3.4.3**
Password Level:	T, R	**Default Setting:**	**AO2**	**Output Channel, Firing Rate**	
P3.4.3 Selects the analog output channel that represents the BMU firing rate demand (0-100%).				**T:**	**134 - 135, 195 - 197**
	Rating	Terminal	Example Wiring		

Options:

Disable Firing rate output is not available.
AO2 Firing rate output is available at AO2.
AO6 Firing rate output is available at AO6.

This output is intended for remote display, lead/lag sequencer feedback, or similar uses.



Note: AO2 can not be selected if **P2.3.1** is enabled.
Caution: This output can not be used to drive a jackshaft, valve, or damper actuator.

3.5 – Outdoor Reset – Sensor Setup

3.5.1 – Sensor Channel, Outside Air

Menu Location:	Menu<Parameters<Firing Rate Options <Outdoor Reset < Sensor Setup		**P:**	**3.5.1**
Password Level: T	**Default Setting:**	**AI5**	**Sensor Channel, Outside Air**	
P3.5.1 Determines the outside air sensor input channel.			**T:**	**114 - 116**

Options:
AI5: Thermistor, 4-20mA, 1-5VDC, 0-5 VDC transmitter
AI21: Thermistor sensor

Note: Thermistor °F/°C scaling is determined by **P3.1.4**.
P3.5.1 (outside air) or **P3.9.4** (warm-up sensor) could determine how AI5 is used. Although AI5 can be selected by either parameter it can only be used by one of them, not both.

3.5.2 – AI5 Sensor Type

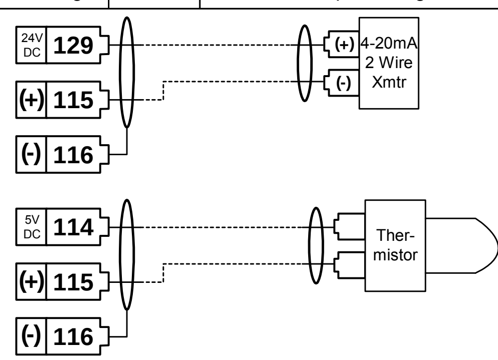
Menu Location:	Menu<Parameters<Firing Rate Options <Outdoor Reset < Sensor Setup		**P:**	**3.5.2**
Password Level: T	**Default Setting:**	**Thermistor**	**AI5 Sensor Type**	
P3.5.2 Determines the signal type used for AI5.			**T:**	**114 - 116**

Rating | Terminal | Example Wiring

Options:

Thermistor
4-20mA
1-5VDC, 0-5 VDC

P3.9.4 or **P3.5.1** determine how AI5 is used.
Set **P3.5.2** or **P3.9.5** for AI5 sensor type.



3.5.3 – AI5 Xmtr Span, Outdoor Temp

Menu Location:	Menu<Parameters<Firing Rate Options <Outdoor Reset < Sensor Setup		**P:**	**3.5.3**
Password Level: T	**Default Setting:**	**130**	**AI5 Xmtr Span, Outdoor Temp**	
P3.5.3 Determines the AI5 transmitter span temperature.			**T:**	**114 -116**
Options:	**-30 to +150 degrees**			

3.5.4 – AI5 Xmtr Zero, Outdoor Temp

Menu Location:	Menu<Parameters<Firing Rate Options <Outdoor Reset < Sensor Setup		**P:**	**3.5.4**
Password Level: T	**Default Setting:**	**-30**	**AI5 Xmtr Zero, Outdoor Temp**	
P3.5.4 Determines the AI5 transmitter zero temperature.			**T:**	**114 -116**
Options:	**-50 to +40 degrees**			

3.6 – Outdoor Reset – Reset Curve

3.6.1 – Outdoor Cutoff Deg

Menu Location:	Menu<Parameters<Firing Rate Options <Outdoor Reset < Reset Curve				**P:**	**3.6.1**
Password Level:	O	**Default Setting:**	**120**	**Outdoor Cutoff Deg**		
P3.6.1 Determines the outdoor temperature that turns the boiler off.					**T:**	
Options: 5 to 120 degrees **P3.6.1** applies if the BMU is in remote mode and **P3.2.3** = SPDev or the BMU is in local mode and **P3.2.1** = SPDev. In all other cases **P3.6.1** is ignored. When the Outdoor Air Temperature (OAT) is greater than **P3.6.1** for more than 30 seconds, the boiler is stopped.						
Note: P3.6.1 = 120 the call for heat will not be turned off based on OAT.						

3.6.2 – Low OAT Deg

Menu Location:	Menu<Parameters<Firing Rate Options <Outdoor Reset < Reset Curve				**P:**	**3.6.2**
Password Level:	O	**Default Setting:**	**10**	**Low OAT Deg**		
P3.6.2 Determines the low outdoor temperature reset temperature.					**T:**	
Options: -40 to +40 degrees						
Note: P3.6.2 must be lower than **P3.6.3.**						

3.6.3 – High OAT Deg

Menu Location:	Menu<Parameters<Firing Rate Options <Outdoor Reset < Reset Curve				**P:**	**3.6.3**
Password Level:	O	**Default Setting:**	**45**	**High OAT Deg**		
P3.6.3 Determines the high outdoor air temperature reset coordinate.					**T:**	
Options: 0 to +70 degrees						
Note: P3.6.2 must be lower than **P3.6.3**.						

3.6.4 – Normal SP at Low OAT

Menu Location:	Menu<Parameters<Firing Rate Options <Outdoor Reset < Reset Curve				**P:**	**3.6.4**
Password Level:	O	**Default Setting:**	**220**	**Normal SP at Low OAT**		
P3.6.4 Determines the normal setpoint for low outdoor air temperature reset.					**T:**	
Options: 245 to +45 degrees						

3.6.5 – Normal SP at High OA

Menu Location:	Menu<Parameters<Firing Rate Options <Outdoor Reset < Reset Curve				**P:**	**3.6.5**
Password Level:	O	**Default Setting:**	**190**	**Normal SP at High OAT**		
P3.6.5 Determines the normal setpoint for high outdoor air temperature reset.					**T:**	
Options: 245 to +45 degrees						

3.6.6 – Setback SP at Low OAT

Menu Location:	Menu<Parameters<Firing Rate Options <Outdoor Reset < Reset Curve				**P:**	**3.6.6**
Password Level:	O	**Default Setting:**	**200**	**Setback SP at Low OAT**		
P3.6.6 Determines the setback curve setpoint for low outdoor air temperature reset.					**T:**	
Options: 245 to +45 degrees						

3.6.7 – Setback SP at High OAT

Menu Location:	Menu<Parameters<Firing Rate Options <Outdoor Reset < Reset Curve			**P:**	**3.6.7**
Password Level:	O	**Default Setting:**	**170**	**Setback SP at High OAT**	
P3.6.7 Determines the setback curve setpoint for high outdoor air temperature reset.				**T:**	
Options: 245 to +45 degrees					

3.7 – Alt Local Set Point

3.7.1 – Alt Local SP Option

Menu Location:	Menu<Parameters<Firing Rate Options <Alternate Local Setpoint			**P:**	**3.7.1**
Password Level:	O	**Default Setting:**	**Disable**	**Alt Local SP Option**	
P3.7.1 Determines if an alternate local setpoint is used.				**T:**	**2**

Options:

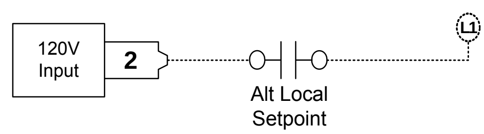
Disable: In local mode, **P3.3.5** is the firing rate setpoint.

Enable: In local mode, the firing rate setpoint is either **P3.3.5** or **P3.7.2** as determined by the Alternate SP, input T2.

If **P3.7.1** is enable and T2 = 0V The local setpoint = **P3.3.5**

If **P3.7.1** is enable and T2 = 120V the Alt Local Setpoint, **P3.7.2**

Rating	Terminal	Example Wiring



3.7.2 – Alt Local Set Point

Menu Location:	Menu<Parameters<Firing Rate Options <Alternate Local Setpoint			**P:**	**3.7.2**
Password Level:	O	**Default Setting:**	**125**	**Alt. Local Setpoint**	
P3.7.2 Determines the alternate local setpoint when T2 is energized.				**T:**	
Options: 0 to +2000.0 **P3.7.2** Alt. Local Setpoint is the firing rate setpoint when in local mode and **P3.7.1** is enable, and T2 = 120 VAC.					
Note: P3.7.2 can be overridden by **P3.8.2**, **P3.3.6** or **P3.3.7** (manually set by the operator).					

3.8 – Domestic Hot Water

3.8.1 – DHW Override Option

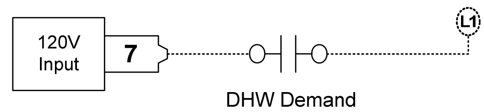
Menu Location:	Menu<Parameters<Firing Rate Options <Domestic Hot Water			P:	**3.8.1**
Password Level:	T	**Default Setting:**	**Disable**		**DHW Override Option**
P3.8.1 Determines if Domestic Hot Water (DHW) override is enabled.				**T:**	

Options:

Disable DHW override is not used.

Enable DHW override is enabled.

When T7 is energized, BMU will maintain the boiler outlet temperature at or above **P3.8.2**. If necessary, all other start/stop modes, firing rate setpoints, or remote firing rate signals will be overridden.

Rating	Terminal	Example Wiring
		

Note: Low fire hold and cold start warm-up cycle will not be overridden.
P3.8.1 and **P3.9.1** can not both be configured to use T7.

3.8.2 – DHW Set Point

Menu Location:	Menu<Parameters<Firing Rate Options <Domestic Hot Water			P:	**3.8.2**
Password Level:	T	**Default Setting:**	**180**		**DHW Setpoint**
P3.8.2 Determines the Domestic Hot Water (DHW) override setpoint.				**T:**	

Options: 0 to +2000.0

If **P3.8.1** is enabled the BMU will maintain the boiler outlet at or above **P3.8.2** DHW Setpoint to insure that DHW heating requirements are satisfied.

Note: P3.8.2 must be between **P3.3.7** and **P3.3.6**.

3.9 – Warm Standby

3.9.1 – Warm Standby Option

Menu Location:	Menu<Parameters<Firing Rate<Options < Warm Standby			**P:**	**3.9.1**
Password Level:	T	**Default Setting:**	**Disable**	**Warm Standby Option**	
P3.9.1 Determines if the boiler Warm Standby Option is enabled.				**T:**	**7**
				Rating	Terminal / Example Wiring

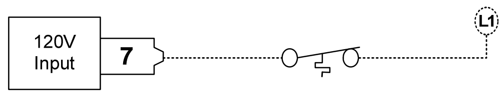
Options:

Disable: The boiler is not kept warm.

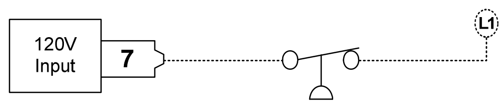
Terminal7: A warm standby temperature (or pressure) switch is connected to T7.
If T7 is de-energized, the burner starts and holds at low fire. When the boilers warms up, T7 energizes and the burner stops.

SensorAndTerm7:
If T7 is energized and the warm-up sensor signal drops below **P3.9.2**, the burner starts and stays at low fire.
If the warm-up sensor signal rises above **P3.9.2**, or if T7 de-energizes, the burner stops.

SensorAndModbus:
Same logic as "SensorAndTerm7" mode, except that Modbus enables/disables warm standby, instead of T7.



Temperature Switch



Pressure Switch

Notes: Warm standby start/stop is only in effect when all other Call For Heat (CFH) signals are <u>not</u> calling for the burner to run.
P3.9.1 or **P3.8.1** can be enabled, **but not both.**

3.9.2 – Start SP, Warm Standby

Menu Location:	Menu<Parameters<Firing Rate<Options < Warm Standby			**P:**	**3.9.2**
Password Level:	O	**Default Setting:**	**85.0**	**Start SP, Warm Standby**	
P3.9.2 Determines the warm standby start setpoint.				**T:**	**7**

Options: **0.0 to 1900.0** Units are the same as the warm-up sensor.
See **P3.9.1** for a description of this parameter.

Note: P3.9.3 must be greater than **P3.9.2**.

3.9.3 – Stop SP, Warm Standby

Menu Location:	Menu<Parameters<Firing Rate<Options < Warm Standby			**P:**	**3.9.3**
Password Level:	O	**Default Setting:**	**110.0**	**Stop SP, Warm Standby**	
P3.9.3 Determines the warm standby stop setpoint.				**T:**	**7**

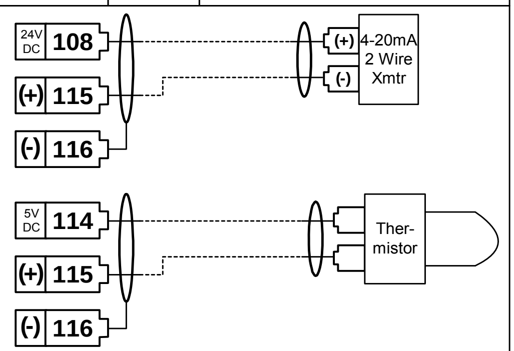
Options: **0.0 to 2000.0** Units are the same as the warm-up sensor.
See **P3.9.1** for a description of this parameter.

Note: P3.9.3 must be greater than **P3.9.2**.

3.9.4 – Sensor Channel, Warmup

Menu Location:	Menu<Parameters<Firing Rate<Options < Warm Standby			**P:**	**3.9.4**
Password Level:	T	**Default Setting:**	**AI6**	**Sensor Channel, Warmup**	
P3.9.4 Selects the channel used for Boiler Shell Temperature.				**T:**	
Options: **BoilerOutlet (AI3)** **AI5** **AI6** The warm-up signal represents the boiler shell temperature, boiler drum water temperature, or boiler steam pressure used for the following options: warm standby start/stop logic, low fire hold, or cold boiler warm-up.					
Note: AI6 can also be selected by **P3.1.1**. AI5 can be selected by **P3.5.1**.					

3.9.5 – AI5 Sensor Type

Menu Location:	Menu<Parameters<Firing Rate<Options < Warm Standby			**P:**	**3.9.5**
Password Level:	T	**Default Setting:**	**Thermistor**	**AI5 Sensor Type**	
P3.9.5 Determines the signal type used for AI5 (**P3.9.4**).				**T:**	**114 - 116**
				Rating / Terminal / Example Wiring	
Options: **Thermistor** **4-20mA** **1-5VDC, 0-5 VDC** **P3.9.4** and **P3.5.1** determine how AI5 is used. Set **P3.9.6** to the outdoor air temperature sensor or warm-up sensor signal type.					

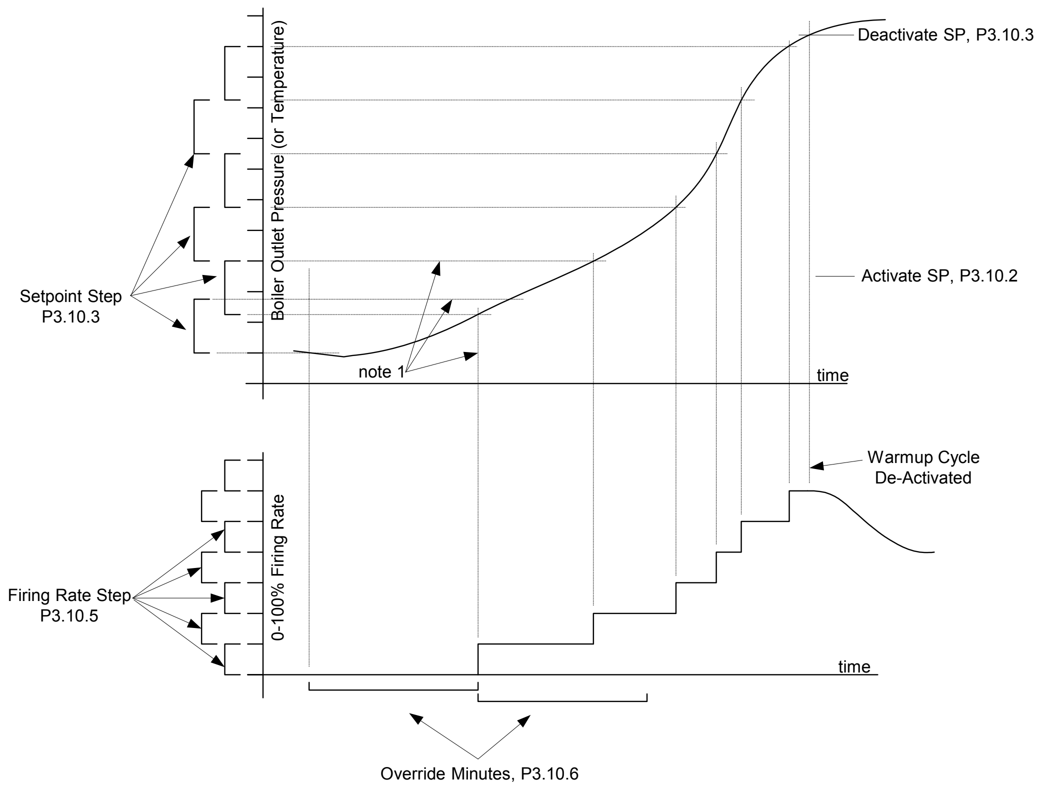
3.9.6 – AI5 Xmtr Span, Warmup Temp

Menu Location:	Menu<Parameters<Firing Rate<Options < Warm Standby			**P:**	**3.9.6**
Password Level:	T	**Default Setting:**	**300**	**AI5 Xmtr Span, Warmup Temp**	
P3.9.6 Determines AI5 sensor Span.				**T:**	
Options: **50 to 800**					
Note: AI5 can also be selected by **P3.5.1**.					

3.9.7 – AI6 Sensor Type

Menu Location:	Menu<Parameters<Firing Rate<Options < Warm Standby			**P:**	**3.9.7**
Password Level:	T	**Default Setting:**	**J_T/C**	**AI6 Sensor Type**	
P3.9.7 Determines the type of Thermocouple used for AI6.				**T:**	**117 - 118**
Options: **J or K Type Thermocouple**					
Note: See **P3.1.3** for wiring details. AI6 can also be selected by **P3.1.1** or **P3.9.4**. **P3.1.3** or **P3.9.7** determines the Thermocouple type.					

3.10 – Cold Start Warmup



Cold Start Warmup Cycle

Due to the stress created by thermal expansion, some boilers require
a slow warm-up if the boiler is 'cold'.

'Cold Start Warmup Option', **P3.10.1**, must equal 'Enable' for this Cycle to occur.

<u>When the BMS completes MTFI, if Boiler Outlet < Activate SP **P3.10.2**:</u>

The Cold Start Cycle activated.
The Firing Rate is set to 0%.
The Warmup Set Point becomes: Boiler Outlet + Set Point Step **P3.10.4**
The **P3.10.6** Override Timer is started.

<u>When the Cold Start Cycle is Active:</u>
If Boiler Outlet is greater than current Warmup Set Point:
Increase the Firing Rate and the Warmup Set Point
New Warmup Set Point = Old WarmupSetpoint + Set Point Step **P3.10.4**
New Firing Rate = Old Firing Rate+ Firing Rate Step **P3.10.5**
Re-Start the **P3.10.6** Override Timer at 0 minutes.

If the Override Timer >= Override Minutes **P3.10.6**:
(see 'note 1' scenario on the diagram)
Increase the Firing Rate and the Warmup Set Point
New Warmup Set Point = Old WarmupSetpoint + Set Point Step **P3.10.4**
New Firing Rate = Old Firing Rate+ Firing Rate Step **P3.10.5**
Re-Start the **P3.10.6** Override Timer at 0 minutes.

Any of the following will end the Cold Start Cycle:

1) Boiler Outlet > Deactivate SP **P3.10.3**
2) PID Firing Rate < Cold Start Firing Rate
3) The Operator changes the Firing Rate mode from Auto to Manual

3.10.1 – Cold Start Warmup Option

Menu Location:	Menu<Parameters<Firing Rate<Options < Cold Start Warmup			**P:**	**3.10.1**
Password Level:	T	**Default Setting:**	**Disable**	**Cold Start Warmup Option**	
P3.10.1 Determines if Cold Start Warmup is Enabled.				**T:**	

Options:
Disable: Cold Start Warmup Cycle not used.
Enable: Cold Start Warmup Cycle Active.

3.10.2 – Activate SP, Cold Start

Menu Location:	Menu<Parameters<Firing Rate<Options < Cold Start Warmup			**P:**	**3.10.2**
Password Level:	T	**Default Setting:**	**40.0**	**Activate SP, Cold Start**	
P3.10.2 Determines when the cold start is active.				**T:**	

Options: **0.1 to 1800.0**
If the boiler outlet is below the Activate SP, Cold Start when first released to modulate and **P3.10.1** is enabled, the cold start warm-up sequence is activated.
The cold start warm-up cycle does not activate until after **P3.12.1** has released. **P3.10.1** overrides **P3.11.1.**

Note: P3.10.3 must be greater than **P3.10.2**.

3.10.3 – Deactivate SP, Cold Start

Menu Location:	Menu<Parameters<Firing Rate<Options < Cold Start Warmup			**P:**	**3.10.3**
Password Level:	T	**Default Setting:**	**100.0**	**Deactivate SP, Cold Start**	
P3.10.3 Determines the cold start warm-up de-activation.				**T:**	

Options: **0.1 to 1800.0**
Cold start cycle de-activation methods:
1) Boiler outlet is greater than **P3.10.3** Deactivate SP, Cold Start.
2) PID firing rate demand is less than the cold start firing rate.
3) Operator puts firing rate control into manual mode.

Note: Deactivate SP, Cold Start must be greater than **P3.10.2**.

3.10.4 – Set Point Step, Cold Start

Menu Location:	Menu<Parameters<Firing Rate<Options < Cold Start Warmup			**P:**	**3.10.4**
Password Level:	T	**Default Setting:**	**10.0**	**Setpoint Step, Cold Start**	
P3.10.4 Determines the cold start warmup increase.				**T:**	

Options: **.1 to 200.0**
Every time cold start warmup increases the firing rate, the setpoint for the next firing rate increase becomes: current boiler outlet + P3.10.4 Setpoint Step, Cold Start.

3.10.5 – Firing Rate Step, Cold Start

Menu Location:	Menu<Parameters<Firing Rate<Options < Cold Start Warmup			**P:**	**3.10.5**
Password Level:	T	**Default Setting:**	**10.0**	**Firing Rate Step, Cold Start**	
P3.10.5 Determines firing rate increase per step increase.				**T:**	

Options: **2.0 to 30.0% Firing Rate**
The Firing Rate Step, Cold Start is the amount that the firing rate is increased when the current cold start setpoint is reached or when the override timer expires.

3.10.6 – Override Minutes, Firing Rate Step

Menu Location:	Menu<Parameters<Firing Rate<Options < Cold Start Warmup			**P:**	**3.10.6**
Password Level:	T	**Default Setting:**	**20**	**Override Minutes, Firing Rate Step**	
P3.10.6 Determines how long the BMU will wait before moving to the next step.				**T:**	

Options: 1 to 120 Minutes

If the boiler outlet doesn't reach the current cold start setpoint within this time limit, the firing rate will increase to the next step.

3.11 – Low Fire Hold

3.11.1 – Low Fire Hold Option

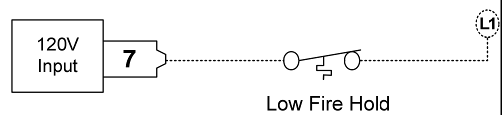
Menu Location:	Menu<Parameters<Firing Rate<Options < Low Fire Hold			**P:**	**3.11.1**
Password Level:	T	**Default Setting:**	**Disable**	**Low Fire Hold Option**	
P3.11.1 Determines if the Low Fire Hold Option is enabled.				**T:**	**7**
				Rating	Terminal	Example Wiring

Options:

Disable: Burner modulates immediately after Release to Modulate.

Terminal7: Burner stays at low fire until: Terminal 7 de-energizes or **P3.11.2** times out.

Warm Up Sensor: Burner stays at low fire until: **P3.9.4** is greater than **P3.11.3** or **P3.11.2** expires.



Notes: **P3.10.1** overrides **P3.11.1.** **P3.11.1 or P3.8.1 can be enabled, but not both**

3.11.2 – Override Seconds, Low Fire Hold

Menu Location:	Menu<Parameters<Firing Rate<Options < Low Fire Hold			**P:**	**3.11.2**
Password Level:	O	**Default Setting:**	**300**	**Override Seconds, Low Fire Hold**	
P3.11.2 Determines how long BMU will wait before overriding the low fire hold.				**T:**	

Options: 1 to 1800.0 seconds

Burner is Released to Modulate after **P3.11.2** Override Seconds, Low Fire Hold.

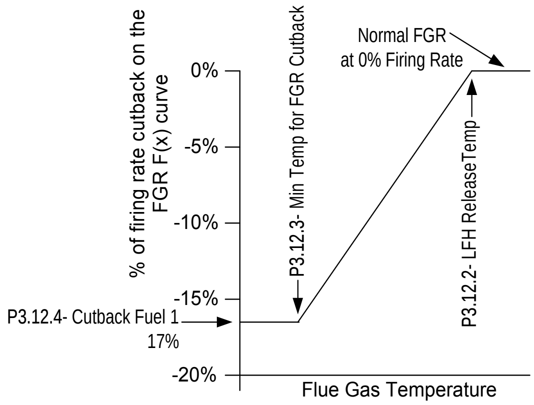
3.11.3 – Low Fire Hold SP

Menu Location:	Menu<Parameters<Firing Rate<Options < Low Fire Hold			**P:**	**3.11.3**
Password Level:	O	**Default Setting:**	**80.0**	**Low Fire Hold SP**	
P3.11.3 Determines the setpoint for low fire hold Release to Modulate.				**T:**	

Options: 0.0 to 200.0

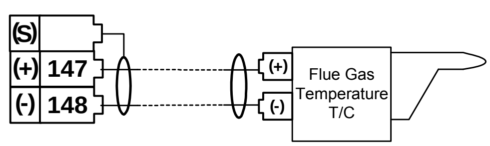
The burner is Released to Modulate when P3.9.4 is greater than P3.11.3 or P3.11.2 expires.

3.12 – FGR Low Fire Hold



The percent firing rate "X" point on the FGR curve that represents the maximun cutback is set at P3.12.4 (or P3.12.5 or P3.12.6). The temperature where the FGR starts to cutback is P3.12.2. The minimum temperature where the FGR will no longer cutback is P3.12.3.

3.12.1 – FGR Temp Low Fire Hold Option

<table>
<tr><td>Menu Location:</td><td colspan="3">Menu<Parameters<Firing Rate<Options < FGR Low Fire Hold</td><td>P:</td><td>3.12.1</td></tr>
<tr><td>Password Level:</td><td>T</td><td>Default Setting:</td><td>Disable</td><td colspan="2">FGR Temp. Low Fire Hold Option</td></tr>
<tr><td colspan="4">P3.12.1 Determines if the FGR Temp. Low Fire Hold Option is enabled.</td><td>T:</td><td>147 - 148</td></tr>
<tr><td colspan="4"></td><td>Rating | Terminal</td><td>Example Wiring</td></tr>
<tr><td colspan="4">Options:
Disable: The FGR Temp. Low Fire Hold Option is not used
Enable: After light-off, the burner holds at low fire until the flue temperature is greater than P3.12.2. While holding at low fire, the FGR is cutback in proportion to the flue gas temperature: 0% cutback at P3.12.2 and P3.12.4 - P3.12.6 cutback at P3.12.3. The cutback remains constant below the P3.12.3. Once released, the FGR low fire hold is de-activated until the next burner start-up.</td><td colspan="2"></td></tr>
</table>

3.12.2 – Release Temp, FGR LFH

<table>
<tr><td>Menu Location:</td><td colspan="3">Menu<Parameters<Firing Rate<Options < FGR Low Fire Hold</td><td>P:</td><td>3.12.2</td></tr>
<tr><td>Password Level:</td><td>T</td><td>Default Setting:</td><td>300.0</td><td colspan="2">Release Temp, FGR LFH</td></tr>
<tr><td colspan="4">P3.12.2 Determines the FGR low fire hold release temperature.</td><td>T:</td><td></td></tr>
<tr><td colspan="6">Options: 100.0 to 600.0 degrees
See P3.12.1 description.</td></tr>
<tr><td colspan="6">Note: If this temperature is set too high, the burner will not leave low fire. P3.12.2 must be greater than P3.12.3.</td></tr>
</table>

3.12.3 – Min Temp, FGR Cutback

Menu Location:	Menu<Parameters<Firing Rate<Options < FGR Low Fire Hold			**P:**	**3.12.3**
Password Level:	T	**Default Setting:**	**180.0**	**Min Temp, FGR Cutback**	
P3.12.3 Determines the minimum temperature for FGR cutback.				**T:**	
Options: 0.0 to 400.0 degrees See **P3.12.1** for description.					
Note: P3.12.2 must be greater than **P3.12.3**.					

3.12.4 – Fuel 1 Cutback %, FGR Min Temp

Menu Location:	Menu<Parameters<Firing Rate<Options < FGR Low Fire Hold			**P:**	**3.12.4**
Password Level:	T	**Default Setting:**	**0.0**	**Fuel 1 Cutback %, FGR Min Temp**	
P3.12.4 Determines FGR cutback for Fuel 1.				**T:**	
Options: 0.0 to 20.0% FGR % cutback based on flue gas temperature for Fuel 1. See **P3.12.1** description above. " **P3.12.4** % "means 0-100% of firing rate. 0% = No FGR cutback.					

3.12.5 – Fuel 2 Cutback %, FGR Min Temp

Menu Location:	Menu<Parameters<Firing Rate<Options < FGR Low Fire Hold			**P:**	**3.12.5**
Password Level:	T	**Default Setting:**	**0.0**	**Fuel 2 Cutback %, FGR Min Temp**	
P3.12.5 Determines FGR cutback for Fuel 2.				**T:**	
Options: 0.0 to 20.0% FGR % cutback based on flue gas temperature for Fuel 2. See **P3.12.1** description above. " **P3.12.5** % "means 0-100% of firing rate. 0% = No FGR cutback.					

3.12.6 – Fuel 3 Cutback %, FGR Min Temp

Menu Location:	Menu<Parameters<Firing Rate<Options < FGR Low Fire Hold			**P:**	**3.12.6**
Password Level:	T	**Default Setting:**	**0.0**	**Fuel 3 Cutback %, FGR Min Temp**	
P3.12.6 Determines FGR cutback for Fuel 3.				**T:**	
Options: 0.0 to 20.0% FGR % cutback based on flue gas temperature for Fuel 3. See **P3.12.1** description above. " **P3.12.6** % "means 0-100% of firing rate. 0% = No FGR cutback.					

4. DRAFT CONTROL

4.1 – Draft Basic Setup

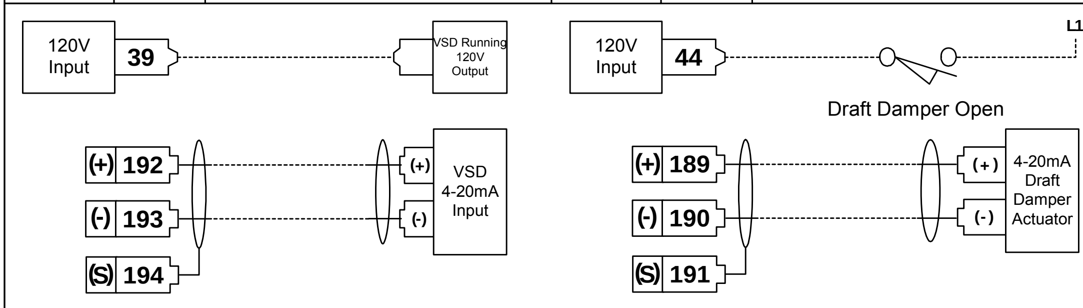
4.1.1 – Draft Control Option

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Basic Setup		**P:**	**4.1.1**
Password Level: E, R	**Default Setting:** **Disable**		**Draft Control Option**	
P4.1.1 Determines the type of draft control used, when enabled.			**T:**	**189 - 191 192 - 194**

Options:

Disable	Draft control is not used.
FloatingServo	Floating control with a servo actuator outlet damper.
Floating420	Floating control with a 4-20 mA actuator outlet damper, AO4 (Terminals 189-191).
FloatingVSD	Floating control with an ID Fan VSD, AO5 (Terminals 192-194).
PIDServo	PID control with a servo actuator outlet damper.
PID420	PID control with a 4-20 mA actuator outlet damper, AO4 (Terminals 189-191).
PIDVSD	PID control with an ID Fan VSD, AO5 (Terminals 192-194).
PIDVSDandServo	PID control with an ID Fan VSD, AO5 (Terminals 192-194) and servo actuator outlet damper.
PIDVSDand420	PID control with an ID fan VSD, AO5 (Terminals 192-194) and 4-20mAdc actuator outlet damper, AO4 (Terminals 189-191).

Rating	Terminal	Example Wiring	Rating	Terminal	Example Wiring



Note: This option can only be enabled if the BMU I/O expansion board is installed.
The servo output options can only be selected if the draft damper servo is configured in the servos menu.

NOTE:

The Draft Purge/Ignition Interlock is required for the following applications:

If **P4.1.1** `Draft Control Option' is set to FloatingServo, PIDServo, or PIDVSDandServo and **P4.3.3** `Draft Servo Check' is set to DISABLE – an interlock switch to prove the outlet damper is open and/or the ID VSD is up to a minimum speed must be wired to **T44.**

If **P4.1.1** `Draft Control Option' is set to Floating420, FloatingVSD, PID420, PIDVSD, PIDVSDandServo, or PIDVSDand420 – an interlock switch to prove the outlet damper is open and/or the ID VSD is up to a minimum speed must be wired to **T44.**

4.1.2 – Draft @ 4mA, Xmtr Cal

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Basic Setup			**P:**	**4.1.2**
Password Level:	T, R	**Default Setting:**	**+1.000**	**Draft @ 4 mA, Xmtr Cal**	
P4.1.2 Determines the draft pressure that corresponds to 4 mA.				**T:**	
Options: **-25.000 to +25.000** For fail open design, **P4.1.2** should correspond with the high pressure limit of the draft transmitter.					
Note: 1" w.c. = 2.45 millibar. The min-max ranges accommodate millibars as well as inches water column. **P4.1.2 - P4.1.3** must be greater than 0.500.					

4.1.3 – Draft @ 20mA, Xmtr Cal

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Basic Setup			**P:**	**4.1.3**
Password Level:	T, R	**Default Setting:**	**-1.000**	**Draft @ 20 mA, Xmtr Cal**	
P4.1.3 Determines the draft pressure/vacuum that corresponds to 20 mA.				**T:**	
Options: **-25.000 to +25.000** For fail open design, **P4.1.3** should correspond with the low pressure limit of the draft transmitter.					
Note: 1" w.c. = 2.45 millibar. The min-max ranges accommodate millibars as well as inches water column. **P4.1.2 - P4.1.3** must be greater than 0.500.					

4.1.4 – Outlet Damper Purge Position

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Basic Setup			**P:**	**4.1.4**
Password Level:	T, R	**Default Setting:**	**80.00**	**Outlet Damper Purge Position**	
P4.1.4 Determines the draft damper position during Purge.				**T:**	
Options: **30.00 to 200.00** Enter as degrees for servos or 0-100% for 4-20 mA actuators.					

4.1.5 – ID Fan VSD Purge Hz

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Basic Setup			**P:**	**4.1.5**
Password Level:	T, R	**Default Setting:**	**55.0**	**ID Fan VSD Purge Hz**	
P4.1.5 Determines the ID fan VSD speed during purge.				**T:**	
Options: **10.0 to 60.0**					

4.2 – Draft Alarm Setup

4.2.1 – Low Alarm SP, Draft

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Alarm Setup			**P:**	**4.2.1**
Password Level:	T	**Default Setting:**	**+25.000**	**Low Alarm SP, Draft**	
P4.2.1 Determines the draft low alarm setpoint.				**T:**	
Options: **-25.000 to +25.000** If the measured draft is greater than **P4.2.1** Low Alarm SP, Draft for more than **P4.2.2** seconds, the draft high pressure alarm will be triggered.					
Note: Setting **P4.2.1** to +25.000 disables this alarm.					

4.2.2 – Alarm Delay Sec, Draft

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Alarm Setup			**P:**	**4.2.2**
Password Level:	O	**Default Setting:**	**8**	**Alarm Delay Sec, Draft**	
P4.2.2 Determines the draft alarm delay.				**T:**	
Options: 0 to 60 seconds If the measured draft is greater than **P4.2.1** Low Alarm SP, Draft for more than **P4.2.2** seconds, the draft high pressure alarm will be triggered.					

4.3 – Draft Misc Setup

4.3.1 – Modulate Delay Sec, Draft

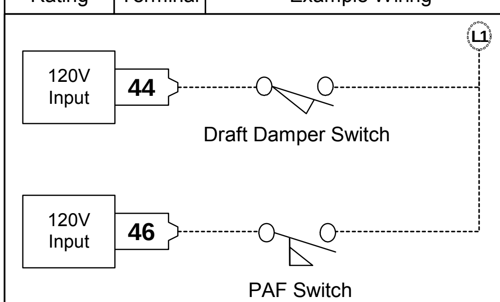
Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Misc Setup			**P:**	**4.3.1**
Password Level:	T	**Default Setting:**	**0**	**Modulate Delay Sec, Draft**	
P4.3.1 Determines the time delay between firing rate Release to Modulate and the draft control is put into automatic.				**T:**	
Options: 0 to 60 seconds Holds the damper/VSD at the Purge position or at the adjustable start setpoint for **P4.3.1** seconds after the BMU releases the burner to modulate.					
Note: See **P4.4.1** for adjustable start enable.					

4.3.2 – Cooldown Delay Sec, Draft

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Misc Setup			**P:**	**4.3.2**
Password Level:	T	**Default Setting:**	**0**	**Cooldown Delay Sec, Draft**	
P4.3.2 Determines the amount of time allowed for cooldown.				**T:**	
Options: 0 to 900 seconds Holds the damper/VSD at the Purge position for **P4.3.2** seconds after both the FD and ID fans have stopped. This provides an extended cool down for refractory lined furnaces.					

4.3.3 – Draft Servo Check Option

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Misc Setup			**P:**	**4.3.3**
Password Level:	E, R	**Default Setting:**	**Enable**	**Draft Servo Check Option**	
P4.3.3 Determines if the draft servo is checked for proper operation during Purge.				**T:**	**44, 46**
Options: Enable Disable Normally, this option is enabled and the draft servo drives from fully closed to fully open during PreStart to check for proper servo operation. The servo check also allows the servo to be used as the draft damper open interlock. A large ID fan motor might trip on overcurrent if the draft damper is fully opened while purging cold air through the furnace. **P1.5.1, P1.5.2**, and **P1.5.3** can be used to delay the ID fan start until after the draft damper servo check is completed. If this method is not practical, **P4.3.3** Draft ServoCheck Option can be set to disabled.	Rating	Terminal	Example Wiring		
Note: If Draft Servo Check Option is set to disabled, an external open damper switch must be wired to BMU T46 and **P4.4.1** must be disabled.					



4.4 – Draft Adjustable Start

4.4.1 – Adjustable Start Draft Option

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Adj Start			**P:**	**4.4.1**
Password Level:	E, R	**Default Setting:**	**Disable**	**Adjustable Start Draft Option**	
P4.4.1 Determines the operation of the draft damper/VSD, servo during PTFI and MTFI.				**T:**	

Options:

Disable The draft damper/VSD are at the Purge position(s) during PTFI & MTFI.

Enable The draft servo is at the Purge position during Purge. At the end of Purge, the draft servo moves to the currently selected fuel's Fuel x Adj Start Position.

If the measured draft is more positive than **P4.4.2**, the draft servo jogs open. When the measured draft is more negative than **P4.4.2**, the pilot is energized.Throughout PTFI and MTFI, if the measured draft becomes more positive than **P4.4.2**, the draft servo will again jog open. The draft servo will not jog closed during PTFI or MTFI.

Note: P4.1.1 must equal FloatingServo or PIDServo in order to enable **P4.4.1**.

4.4.2 – Adjustable Start Draft SP

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Adj Start			**P:**	**4.4.2**
Password Level:	E, R	**Default Setting:**	**-0.500**	**Adj Start Draft SP**	
P4.4.2 Determines the Draft Setpoint durnig PTFI and MTFI..				**T:**	

Options: **-0.100 to -5.00**

See **P4.4.1** for description.

Note: If **P4.4.2** is set too close to, or above, the Draft Setpoint; the Adj Starting Draft will be maintained at 0.250 more negative than the Draft Setpoint.

4.4.3 – Fuel 1 (Oil) Adjustable Start Position

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Adj Start			**P:**	**4.4.3**
Password Level:	E, R	**Default Setting:**	**50.00**	**Fuel 1 (Oil) Adj Start Position**	
P4.4.3 Sets the initial adjustable starting draft servo position after the completion of Purge.				**T:**	
Options:	**10.00 to 120.00**				

4.4.4 – Fuel 2 (Gas) Adjustable Start Position

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Adj Start			**P:**	**4.4.4**
Password Level:	E, R	**Default Setting:**	**50.00**	**Fuel 2 (Gas) Adj Start Position**	
P4.4.4 Sets the initial adjustable starting draft servo position after the completion of Purge.				**T:**	
Options:	**10.00 to 120.00**				

4.4.5 – Fuel 3 Adjustable Start Position

Menu Location:	Menu<Parameters<Draft Control< Draft Setup < Draft Adj Start			**P:**	**4.4.5**
Password Level:	E, R	**Default Setting:**	**50.00**	**Fuel 3 Adj Start Position**	
P4.4.5 Sets the initial adjustable starting draft servo position after the completion of Purge.				**T:**	
Options:	**10.00 to 120.00**				

4.5 – Draft Tuning – Floating Draft Tuning

4.5.1 – Proportional Band, Floating Draft

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < Floating Draft Tune			**P:**	**4.5.1**
Password Level:	T	**Default Setting:**	**0.600**	**Proportional Band, Floating Draft**	
P4.5.1 The draft change that causes the control to go from full speed closing to full speed opening.				**T:**	

Options: **0.200 to 15.000**
A smaller value causes more control action.

Example: Prop Band = 0.600, SP = -0.10"
If draft = +0.20, the damper/VSD will be opening at full speed.
If draft = 0.00, the damper/VSD will be opening at 33% of full speed.
If draft = -0.25, the damper/VSD will be closing at 50% of full speed.
If draft = -0.40, the damper/VSD will be closing at maximum speed.

Note: Full speed is determined by **P4.6.4**.
CAUTION: If the value is too small, the damper can oscillate.

4.5.2 – Deadband, Floating Draft

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < Floating Draft Tune			**P:**	**4.5.2**
Password Level:	T	**Default Setting:**	**0.030**	**Deadband, Floating Draft**	
P4.5.2 Determines the floating draft deadband.				**T:**	

Options: **0.010 to 0.500**
The floating control output stops changing and holds at the current value when the measured draft is within +/- **P4.5.2** floating draft deadband.

C**AUTION:** If this value is too small, the damper can oscillate

4.6 – Floating & PID Tuning

4.6.1 – Filter Sec, Draft Xmtr

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < Floating & PID Tune			**P:**	**4.6.1**
Password Level:	T	**Default Setting:**	**2.0**	**Filter Sec, Draft Xmtr**	
P4.6.1 Dampens furnace draft pulsations.				**T:**	

Options: **0.5 to 5.0 seconds**
Larger values = more damping.

Note: Excessively large filter times can cause control cycling.

4.6.2 – Max Damper Position in Auto, Draft

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < Floating & PID Tune			**P:**	**4.6.2**
Password Level:	T	**Default Setting:**	**100.0**	**Max Damper Position in Auto, Draft**	
P4.6.2 Limits the maximum damper position in Auto to prevent reset windup and oscillations.				**T:**	

Options: **20.00 to 200.00**

Note: P4.6.2 must be greater than **P4.6.3**.

4.6.3 – Min Damper Position in Auto, Draft

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < Floating & PID Tune			**P:**	**4.6.3**
Password Level:	T	**Default Setting:**	**0.00**	**Min Damper Position in Auto, Draft**	
P4.6.3 Limits the minimum draft damper position in Auto to prevent reset windup and oscillations.				**T:**	
Options: -20.00 to +90.00					
Note: P4.6.2 must be greater than **P4.6.3**.					

4.6.4 – Sec / 90 Deg Damper Rate Limit, Draft

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < Floating & PID Tune			**P:**	**4.6.4**
Password Level:	T	**Default Setting:**	**25**	**Sec/90 deg Damper Rate Limit, Draft**	
P4.6.4 Limits the damper actuator output rate of change to prevent over controlling.				**T:**	
Options: 15 to 60 seconds Set this value to the actual actuator speed (seconds it takes the actuator to move 90 degrees), or to a slower value.					
Note: If configured for a 4-20 mA damper, then the units are seconds per 16 mA of change.					

4.7 – PID Draft Tuning

4.7.1 – Proportional Band, Draft PID

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < PID Draft Tune			**P:**	**4.7.1**
Password Level:	T	**Default Setting:**	**0.600**	**Proportional Band, Draft PID**	
P4.7.1 Is the setpoint deviation that causes the PID proportional term to change.				**T:**	
Options: 0.200 - 15.000 Proportional Band is the Set Point deviation that causes the PID Proportional Term to change 60.00 (degrees, percent, or Hz; as appropriate) A smaller value causes more control action. Caution: If the value is too small, the damper can oscillate. Example: initially, if proportional band = 0.600, SP = -0.10", draft = -0.10", servo = 10 deg: If the draft increases from -0.10 to +0.50, the servo would move to 70 deg. If prop band = 0.300, the servo would try to move to 130 deg. If prop band = 1.200, the servo would move to 40 deg.					
CAUTION: If the value is too small, the damper can oscillate.					

4.7.2 – Minutes Per Repeat, Draft PID

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < PID Draft Tune			**P:**	**4.7.2**
Password Level:	T	**Default Setting:**	**0.25**	**Minutes Per Repeat, Draft PID**	
P4.7.2 Determines the minutes per repeat of the draft PID control loop.				**T:**	
Options: 0.12 to 2.00 Minutes The time it takes for the Integral term to ramp up or down 1 additional Proportional Band move. A smaller value causes more integral control action. Example: If the proportional band is causing a 20 deg. damper change, and the integral is set to 0.25 minutes; the PID will ramp from 20 to 40 deg. during the 15 sec after the initial 20 deg. proportional band move (If draft doesn't change). The PID output stops ramping, and remains at its current value, when the draft returns to the setpoint.					
CAUTION: If the value is too small, the damper can oscillate.					

4.7.3 – Gap, Draft PID

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < PID Draft Tune			**P:**	**4.7.3**
Password Level:	T	**Default Setting:**	**0.030**		**Gap, Draft PID**
P4.7.3 Is used to prevent over-controling when the draft is close to setpoint.				**T:**	

Options: **0.010 to 0.500**

The draft PID level on either side of the +/- **P4.7.3** Gap, Draft PID is where the proportional action is reduced to prevent over controlling.

Note: Draft is a noisy signal. Gap and gap gain prevent over-controlling when the draft is close to the setpoint.

4.7.4 – Gap Gain, Draft PID

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < PID Draft Tune			**P:**	**4.7.4**
Password Level:	T	**Default Setting:**	**0.30**		**Gap Gain, Draft PID**
P4.7.4 Determines the draft gap gain.				**T:**	

Options: **0.10 to 0.75**

The **P4.7.4** Gap Gain, Draft PID is a reduction factor inside the gap zone.

0.30 means that the proportional control action will only be 30% of what the normal proportional action would be outside of the gap zone.

Note: Draft is a noisy signal. Gap and gap gain prevent over-controlling when the draft is close to the setpoint.

4.8 – PID Feed Forward Curve

4.8.X – Draft Feed Forward Curve: Fuel 1

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < PID Feedfwd Curve			**P:**	**4.8.x, 4.9.x, 4.10.x**
Password Level:	T	**Default Setting:**	**0.00**		**Draft Feed Forward Fuel1**
P4.8.x Determines the draft feed forward for Fuel 1.				**T:**	

Options:

Feedforward only applies to the PID draft control options.

The PID feedforward draft damper position (or Draft VSD Hz) values for the following

8 Firing Rates: 0%, 10%, 20%, 30%, 40%, 60%, 80%, and 100%.

The firing rates can not be changed. The user enters the servo degrees,

4-20 mA 0-100% value, or VSD Hz value as determined by **P4.1.1**.

There is a separate feedforward curve for each of the three fuels. The fuel that is currently selected by the BMS is displayed and edited on the BMU LCD display screen:

Draft Feedforward

Fuel 1 (Oil)

Parameter	Firing Rate	Damper or VSD	
P8.8.1	0%	5.0	The underlined values can be edited by the user
P8.8.2	10%	7.2	
P8.8.3	20%	9.9	
P8.8.4	30%	15.6	
P8.8.5	40%	25.1	
P8.8.6	60%	41.3	
P8.8.7	80%	59.0	
P8.8.8	100%	80.0	

The draft control output is the sum of: (PID + Feedforward). Therefore the PID control action trims/biases the feedforward positions in order to bring the draft back to the setpoint. Feedforward causes the damper (or VSD) to start to move as soon as the firing rate changes.

Note: If feed forward is not desired, set all values to 0.0
Parameters **P4.9.x** are for Fuel 2 and Parameters **P4.10.x** are for Fuel 3.

4.9 – Draft Feed Forward Curve: Fuel 2

4.9.X Draft Feed Forward Curve: Fuel 2

See Parameter P4.8.x

4.10 – Draft Feed Forward Curve: Fuel 3

4.10.X – Draft Feed Forward Curve: Fuel 3

See Parameter P4.8.x

4.11 – ID Fan VSD Tune

4.11.1 – Max VSD Hz in Auto, Draft

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < ID Fan VSD Tune			**P:**	**4.11.1**
Password Level:	T	**Default Setting:**	**60.00**	**Max VSD Hz in Auto, Draft**	
P4.11.1 Limits the maximum VSD speed command in Auto to prevent reset windup and oscillations.				**T:**	**192 - 194**
Options: **20.00 to 60.00Hz**					

4.11.2 – Min VSD Hz in Auto, Draft

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < ID Fan VSD Tune			**P:**	**4.11.2**
Password Level:	T	**Default Setting:**	**10.00**	**Min VSD Hz in Auto, Draft**	
P4.11.2 Limits the minimum VSD speed command in Auto to prevent Reset Windup and Oscillations.				**T:**	
Options: **0.00 to 40.00Hz**					

4.11.3 – Sec / 60 Hz VSD Rate Limit, Draft

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < ID Fan VSD Tune			**P:**	**4.11.3**
Password Level:	T	**Default Setting:**	**25**	**Sec/60Hz VSD Rate Limit, Draft**	
P4.11.3 Limits the VSD speed command rate of change to prevent over controlling and/or VSD trips.				**T:**	
Options: **15 to 60 seconds**					

4.11.4 – SP Offset, Draft VSD / Damper Dual Output Mode

Menu Location:	Menu<Parameters<Draft Control< Draft Tuning < ID Fan VSD Tune			**P:**	**4.11.4**
Password Level:	T	**Default Setting:**	**0.510**	**SP Offset, Draft VSD/Damper Dual Output Mode**	
P4.11.4 Determines the draft damper bias from actual VSD draft setpoint.				**T:**	
Options: **0.020 to 0.510** Setpoint offset is only used if **P4.1.1** = PIDVSDandServo or PIDVSDand420. With these draft control options, an outlet damper and ID fan VSD are simultaneously controlled in order to maintain the draft at setpoint. The VSD control action attempts to hold the draft at the actual draft setpoint and the damper control action attempts to hold the draft at actual draft setpoint, **P4.11.4** . This allows the damper to control draft if the VSD is unable to slow down enough, or go wide open before the VSD starts to speed up.					
Note: If the VSD speeds increases before stack damper is wide open, increase **P4.11.4**. **P4.11.4** must be larger than (**P4.5.2** + .009).					

5. FEEDWATER CONTROL

5.1 – Feedwater Basic Setup

5.1.1 – Feedwater Control Option

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Feedwtr Basic Setup			P:	5.1.1
Password Level:	T	**Default Setting:**	**Disable**	**Feedwater Control Option**	
P5.1.1 Determines if feedwater control is used and what type.				T:	

Options:

Disable:	Feedwater control is not used.
SingleElement:	Single element feedwater control is used.
TwoElement:	Two element feedwater control is used.
ThreeElement:	Three element feedwater control is used.

Note: **P5.1.1** can only be enabled if the BMU I/O expansion board is installed.
If **P5.1.2** = ServoValve, the feedwater servo must be configured, zeroed and limits seeked before **P5.1.1** can be enabled.

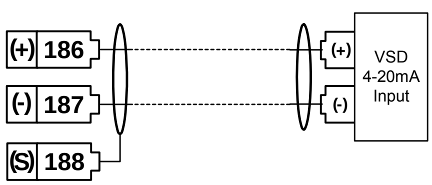
5.1.2 – Valve / Pump Output Type

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Feedwtr Basic Setup			P:	5.1.2
Password Level:	T	**Default Setting:**	**ServoValve**	**Valve/Pump Output Type**	
P5.1.2 Determines the type of feedwater control device.				T:	**186 - 188**

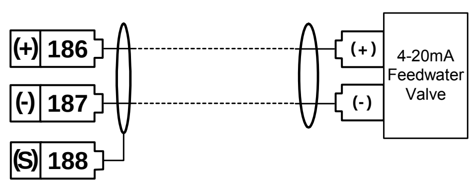
Options:

ServoValve	A servo actuator is used for feedwater valve control.
AO3Valve	A 4-20 mA actuator is used for feedwater valve control.
AO3VSD	VSD is used for feedwater pump control.

Rating	Terminal	Example Wiring	Rating	Terminal	Example Wiring



AO3VSD



AO3Valve

Note: ServoValve can only be selected if a feedwater servo is wired and configured.

5.1.3 – Drum Level @ 4 mA, Xmtr Cal

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Feedwtr Basic Setup				**P:**	**5.1.3**
Password Level:	T	**Default Setting:**	**+10.00**	**Drum Level @ 4 mA, Xmtr Cal**		
P5.1.3 Determines the water level that corresponds to a 4 mA drum level signal.					**T:**	**165 - 167**
Options: **-50.00 to +99.00** The level can be expressed in inches, centimeters, or any other units, as desired.						
Note: The 4 mA level versus the 20 mA level difference must be greater than 8.00						

5.1.4 – Drum Level @ 20 mA, Xmtr Cal

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Feedwtr Basic Setup				**P:**	**5.1.4**
Password Level:	T	**Default Setting:**	**-10.00**	**Drum Level @ 20mA, Xmtr Cal**		
P5.1.4 Determines the water level that corresponds to a 20 mA drum level signal.					**T:**	
Options: **-50.00 to +99.00** The level can be expressed in inches, centimeters, or any other units, as desired.						
Note: The 4 mA level versus the 20 mA level difference must be greater than 8.00						

5.2 – Feedwater Alarm Setup

5.2.1 – Low Alarm SP, Drum Level

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Feedwtr Alarm Setup				**P:**	**5.2.1**
Password Level:	O	**Default Setting:**	**-50.00**	**Low Alarm SP, Drum Level**		
P5.2.1 Determines the drum level low alarm setpoint.					**T:**	
Options: **-50.00 to +99.00** The low drum level alarm is triggered if the level has been below this setpoint for more than **P5.2.3** seconds.						
Note: The low alarm is disabled if **P5.2.1** = -50.00						

5.2.2 – High Alarm SP, Drum Level

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Feedwtr Alarm Setup				**P:**	**5.2.2**
Password Level:	O	**Default Setting:**	**+99.00**	**High Alarm SP, Drum Level**		
P5.2.2 Determines the high drum level alarm setpoint.					**T:**	
Options: **-50.00 to +99.00** The high drum level alarm is triggered if the level has been above this setpoint for more than **P5.2.3** seconds.						
Note: The high alarm is disabled if **P5.2.2** = 99.00						

5.2.3 – Alarm Delay Sec, Drum Level

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Feedwtr Alarm Setup				**P:**	**5.2.3**
Password Level:	O	**Default Setting:**	**10**	**Alarm Delay Sec, Drum Level**		
P5.2.3 Is used to prevent intermittent drum level alarms.					**T:**	
Options: **0 to 90 Seconds** Drum level must be less than **P5.2.1** or greater than **P5.2.2** for **P5.2.3** seconds before the alarm is active.						

5.3 – Steam Flow Setup

5.3.1 – Decimal Point, Steam Flow

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Steam Flow Setup			**P:**	**5.3.1**
Password Level:	T	**Default Setting:**	**xxx.x**	**Decimal Point, Steam Flow**	
P5.3.1 Determines the decimal point on the LCD display and for **P5.3.1**.				**T:**	**168 - 170**
Options: xxxx xxx.x xx.xx					
Note: P5.3.1 must be 999.9 or less for xxx.x format, and 99.99 or less for xx.xx format.					

5.3.2 – Flow @ 20mA, Steam Flow

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Steam Flow Setup			**P:**	**5.3.2**
Password Level:	T	**Default Setting:**	**100.0**	**Flow @ 20 mA, Steam Flow**	
P5.3.2 Determines the steam flow that corresponds to a 20 mA steam flow signal.				**T:**	
Options: **10 - 32000** **1.0 - 999.9** **1.00 - 99.99**					
Note: P5.3.2 must be 999.9 or less for xxx.x format, and 99.99 or less for xx.xx format.					

5.3.3 – Sq Root option, Steam Flow

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Steam Flow Setup			**P:**	**5.3.3**
Password Level:	T	**Default Setting:**	**Disable**	**Sq Root Option, Steam Flow**	
P5.3.3 Determines if steam flow input square root extraction is enabled.				**T:**	
Options: **Disable:** Square root is not performed in the BMU. **Enable:** Square root is performed in the BMU.					
Note 1: If a dp transmitter and flow element are used to measure the steam flow, the signal must have a square root extractor applied. If the transmitter's optional square root extractor is activated, then **P5.3.3** must be Disabled. **Note 2:** If **P5.5.3** Steam Flow Press Comp Option is Enabled, the square root extractor at the transmitter must be disabled and the **P5.3.3** must be utilized for the square root extraction.					

5.3.4 – Filter Sec, Steam Flow

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Steam Flow Setup			**P:**	**5.3.4**
Password Level:	T	**Default Setting:**	**1.5**	**Filter Sec, Steam Flow**	
P5.3.4 Smoothes the Steam Flow Signal.				**T:**	
Options: **0.5 to 6.0** Larger Number = More Smoothing					

5.3.5 – Low Flow Cutoff %, Steam Flow

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Steam Flow Setup			**P:**	**5.3.5**
Password Level:	T	**Default Setting:**	**1.00**	**Low Flow Cutoff %, Steam Flow**	
P5.3.5 Determines the Steam Low Flow Cutoff point.				**T:**	
Options: **0.00 to 20.00%** If the Filtered, Compensated, Square Rooted (as applies) Steam Flow is less than **P5.3.5** the Steam Flow is forced to 0.					

5.4 – Feedwater Flow Setup

5.4.1 – Decimal Point, Feedwater Flow

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Feedwtr Flow Setup				**P:**	**5.4.1**
Password Level:	T	**Default Setting:**	**xxx.x**	**Decimal Point, Feedwater Flow**		
P5.4.1 Determines the decimal point on the LCD display and for **P5.4.2**.					**T:**	**171 - 173**
Options: **xxxx xxx.x xx.xx**						
Note: P5.4.2 must be 999.9 or less for xxx.x format, and 99.99 or less for xx.xx format.						

5.4.2 – Flow @ 20mA, Feedwater Flow

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Feedwtr Flow Setup				**P:**	**5.4.2**
Password Level:	T	**Default Setting:**	**100.0**	**Flow @ 20 mA, Feedwater Flow**		
P5.4.2 Determines the feedwater flow that corresponds to a 20 mA feedwater flow signal.					**T:**	
Options: **10 to 32000 1.0 - 999.9 1.00 - 99.99**						
Note: P5.4.2 must be 999.9 or less for xxx.x format, and 99.99 or less for xx.xx format.						

5.4.3 – Sq Root Option, Feedwater Flow

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Feedwtr Flow Setup				**P:**	**5.4.3**
Password Level:	T	**Default Setting:**	**Disable**	**Sq Root Option, Feedwater Flow**		
P5.4.3 Determines if the feedwater flow input square root extractor is enabled.					**T:**	
Options: **Disable:** Square root is not performed in the BMU. **Enable:** Square root is performed in the BMU.						
Note: If a dp transmitter and flow element are used to meter feedwater flow, then the raw signal must have a square root extractor applied. However, most dp transmitters include an optional square root extractor. If activated in the transmitter, it must be disabled in the BMU.						

5.4.4 – Filter Sec, Feedwater Flow

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Feedwtr Flow Setup				**P:**	**5.4.4**
Password Level:	T	**Default Setting:**	**1.0**	**Filter Sec, Feedwater Flow**		
P5.4.4 Smoothes the feedwater flow signal.					**T:**	
Options: **0.5 to 6.0** Larger number = more smoothing.						

5.4.5 – Low Flow Cutoff %, Feedwater Flow

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Feedwtr Flow Setup				**P:**	**5.4.5**
Password Level:	T	**Default Setting:**	**1.00**	**Low Flow Cutoff %, Feedwater Flow**		
P5.4.5 Determines the feedwater low flow cutoff point.					**T:**	
Options: **0.0 to 20.00%** If the filtered, compensated, square rooted (as applies) signal is less than **P5.4.5**, feedwater flow is forced to 0.						

5.5 – Pressure Compensate

5.5.1 – Pressure Units, Boiler Outlet Xmtr

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Pressure Compensate			**P:**	**5.5.1**
Password Level:	T	**Default Setting:**	**psig**	**Pressure Units, Boiler Outlet Xmtr**	
P5.5.1 Determines the engineering units for the **P3.1.6** pressure calibration data.				**T:**	
Options: **psig** **bar_g** **kPa_g**					
Note: The correct pressure units are required if any of the pressure compensation options are enabled.					

5.5.2 – Drum Level Pressure Comp Option

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Pressure Compensate			**P:**	**5.5.2**
Password Level:	T	**Default Setting:**	**Disable**	**Drum Level Pressure Comp Option**	
P5.5.2 Determines if the drum level displayed is pressure compensated.				**T:**	
Options: **Disable:** The drum level signal is not compensated by the BMU. **Enable:** The drum level signal is compensated for the water density difference between the dP xmtr reference leg and the high temperature water density inside the steam drum. The boiler outlet steam pressure transmitter is set to saturated steam water density.					
Note: This option is intended for boilers 250 psig and higher. If this option is enabled, **P5.6.2** must still be used to correct the impulse piping temperature differences and other factors.					

5.5.3 – Steam Flow Press Comp Option

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Pressure Compensate			**P:**	**5.5.3**
Password Level:	T	**Default Setting:**	**Disable**	**Steam Flow Press Comp Option**	
P5.5.3 Determines is steam flow density compensation is enabled.				**T:**	
Options: **Disable:** Steam flow density is not pressure compensated by the BMU. **Enable:** Steam flow density is pressure compensated by the BMU based on the saturated steam density of the current boiler outlet pressure.					
Note: 0.3 - 1485.3 psig density range. If **P5.5.3** is Enabled, a Steam Pressure Transmitter must be wired to Analog Input 3, **T108**, **T109**, **T110** and **T111**.					

5.5.4 – Steam Flow Design Pressure

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Setup < Pressure Compensate			**P:**	**5.5.4**
Password Level:	T	**Default Setting:**	**125.0**	**Steam Flow Design Pressure**	
P5.5.4 Determines the pressure that was used for the steam flow transmitter calibration (**P5.3.2**).				**T:**	
Options: **0.5 to 1500**					
Note: This value must be expressed in the same units as **P5.5.1**.					

5.6 – Level Xmtr Tune

5.6.1 – Filter Sec, Drum Level

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < Level Xmtr Tune			**P:**	**5.6.1**
Password Level:	T	**Default Setting:**	**1.5**	**Filter Sec, Drum Level**	
P5.6.1 Smoothes the drum level signal.				**T:**	
Options: **0.5 to 6.0** Larger number = more smoothing					

5.6.2 – Drum Level Adjust

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < Level Xmtr Tune			**P:**	**5.6.2**
Password Level:	T	**Default Setting:**	**1.030**	**Drum Level Adjust**	
P5.6.2 Adjusts the drum level transmitter signal to agree with the sight glass.				**T:**	
Options: 0.850 to 1.350 Compensates for density differences due to sight glass bottom leg water temperature. Larger values increase the displayed water level.					

5.7 – 1 Element Level PID

5.7.1 – Proportional Band, 1 Elem FW

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < 1 Element Level PID			**P:**	**5.7.1**
Password Level:	T	**Default Setting:**	**5.00**	**Proportional Band, 1 Elem FW**	
P5.7.1 Determines the drum level PID proportional band for single element control.				**T:**	
Options: Proportional band is the setpoint deviation that causes the PID proportional term to change 100.00 (degrees, percent, or Hz; as appropriate). A smaller value causes more control action. The proportional band has the same units as **P5.1.3** and **P5.1.4**. If these parameters are entered as "wc, then the proportional band is also entered as "wc. Example: initially, if proportional band = 5.00", SP = +1.0", level = +1.0", servo = 30 deg: If the level decreases from +1.0 to -1.5", the servo would move to 80 deg If proportional band = 2.50, the servo would (try to) move to 130 deg. If proportional band = 7.50, the servo would move to 63.3 deg.					
CAUTION: If the value is too small, the level can oscillate.					

5.7.2 – Minutes Per Repeat, 1 Elem FW

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < 1 Element Level PID			**P:**	**5.7.2**
Password Level:	T	**Default Setting:**	**5.00**	**Minutes Per Repeat, 1 Elem FW**	
P5.7.2 Determines the drum level PID integral minutes for single-element control.				**T:**	
Options: **2.00 to 15.00 minutes** The time it takes for the integral term to ramp up or down one additional proportional band move. A smaller value causes more integral control action. Example: If the proportional band is causing a 20 deg valve change, and the integral is set to 5.00 minutes: The PID will ramp from 20 to 40 during the five minutes after the initial 20 deg proportional band move (if the level doesn't change). The PID output stops ramping, and remains at its current value, when the level returns to the setpoint.					
CAUTION: If the value is too small, the level can oscillate slowly, which can cause what appears to be steam load swings.					

5.8 – 2 / 3 Elem Level PID

5.8.1 – Proportional Band, 2 / 3 Elem FW

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < 2/3 Elem Level PID			**P:**	**5.8.1**
Password Level:	T	**Default Setting:**	**7.00**	**Proportional Band, 2/3 Elem FW**	
P5.8.1 Determines drum level PID proportional band for two- or three-element Control.				**T:**	
Options: See **P5.7.1** comments for a more detailed explanation. A smaller number increases the output change for a given setpoint deviation.					
CAUTION: If the value is too small, the level can oscillate.					

5.8.2 – Minutes Per Repeat, 2 / 3 Elem FW

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < 2/3 Elem Level PID			**P:**	**5.8.2**
Password Level:	T	**Default Setting:**	**6.50**	**Minutes Per Repeat, 2/3 Elem FW**	
P5.8.2 Determines the drum level PID integral minutes for two- or three-element control.				**T:**	
Options: **2.00 to 15.00 minutes** A smaller number increases the integral ramp rate.					
CAUTION: If the value is too small, the level can oscillate slowly, which can cause what appears to be steam load swings.					

5.8.3 – Feed Forward Type, FW

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < 2/3 Elem Level PID			**P:**	**5.8.3**
Password Level:	T	**Default Setting:**	**LinearGain**	**Feed forward Type, FW**	
P5.8.3 Determines the type of control used for Feedwater Feed Forward.				**T:**	
Options: Steam Flow Feed forward is only used in Two or Three Element Control Modes. **LinearGain:** Feed forward = Steam Flow Pct * **P5.8.4**. This is the preferred choice for Linearized control valves, VSD pumps, and for any type of valve in Three Element Control Mode. **Curve:** A user entered FW Feedforward Curve (8 values) determines the Feed forward versus Steam Flow. This is the preferred choice for 2 Element Control with a non-linear control valve.					
Note: This Parameter is ignored in Single Element Control Mode.					

5.8.4 – Feed Forward Gain, FW

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < 2/3 Elem Level PID			**P:**	**5.8.4**
Password Level:	T	**Default Setting:**	**0.75**	**Feedforward Gain, FW**	
P5.8.4 Is used to counteract drum level shrink and swell for proper drum level control.				**T:**	

Options: 0.25 - 1.29%

See **P5.8.3** for description.

The level control output is the sum of: (PID + feedforward). **P5.8.4** is used to counteract drum level "shrink" and "swell" caused by steam flow changes.

Example: shortly after a steam flow increase, the drum level increases for a period of time due to "swell". This causes the drum level PID value to decrease based on the proportional band. The steam flow feedforward value increases based on **P5.8.4**. During the initial level "swell", the PID response and feedforward should ideally cancel each other and the valve should remain in nearly the same position in order to prevent an excessive level drop off when the "swell" subsides.

If the valve closes too much during a steam flow increase level "swell", either increase the feedfoward gain value or increase the PID proportional band.

If the valve opens too much during a steam flow increase level "swell", either decrease the feedfoward gain value or decrease the PID proportional band.

Do the opposite during a steam flow decrease level "shrink".

Note: This parameter is not used in single-element control mode.

5.8.5 – Steam Flow %, 1 Elem Fallback

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < 2/3 Elem Level PID			**P:**	**5.8.5**
Password Level:	T	**Default Setting:**	**2.00**	**Steam Flow %, 1 Elem Fallback**	
P5.8.5 Determines when the BMU will switch from single-element to two- or three-element feedwater control.				**T:**	

Options: 0.00 to 25.00%

Two- and three-element feedwater control logic rely on the steam flow signal. The steam flow signal can be very inaccurate for low steam flow rates and during a cold boiler warm-up. BMU can automatically switch from Two- or three-element control into single-element control, and vice versa, based on **P5.8.5** Steam Flow %, 1 Elem Fallback.

If **P5.1.1** equals TwoElement or ThreeElement and the steam flow percentage drops below **P5.8.5** for more than **P5.8.6** seconds, the BMU will automatically change into single-element drum level control mode. When the steam flow rises above this level for more than **P5.8.7** seconds, BMU reverts to the original mode.

5.8.6 – Fallback On Delay Sec, FW

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < 2/3 Elem Level PID			**P:**	**5.8.6**
Password Level:	T	**Default Setting:**	**10**	**Fallback ON Delay Sec, FW**	
P5.8.6 Sets the fallback on delay for the feed water control.				**T:**	

Options: 2 to 30 seconds

5.8.7 – Fallback Off Delay Sec, FW

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < 2/3 Elem Level PID			**P:**	**5.8.7**
Password Level:	T	**Default Setting:**	**10**	**Fallback OFF Delay Sec, FW**	
P5.8.7 Sets the fallback off delay for the feed water control.				**T:**	

Options: 2 to 30 seconds

5.9 – FW Feed Forward Curve

5.9.X – Drum Level Steam Flow Feed Forward Curve

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < FW FeedFwd Curve			**P:**	**5.9.x**
Password Level:	T	**Default Setting:**	**0.00**	**Drum Level Steam Flow Feedforward Curve**	
P5.9.x Sets the curve for the feedwater feedforward vs steam flow.				**T:**	

Options: -20.00 to +20.00

Feedforward only applies to the two- and three-element drum level control options.

The PID steam flow feedforward valve position (or pump VSD Hz) values for the following eight steam flows: 0%, 10%, 20%, 30%, 40%, 60%, 80%, and 100% are entered by the user. The steam flows can not be changed.

The user enters the values in the right column as follows:

2 Elem FW, Servo Valve--enter value in units of valve degrees
2 Elem FW, 4-20mA Valve--enter value in units of valve 0-100% open
2 Elem FW, Pump VSD--enter value in units of 0-60 VSD Hz
3 Elem FW--enter value in units of 0-100% of feedwater flow transmitter range

2 Elem. Drum Level
Steam Flow FeedFwd

Parameter	Steam Flow%	Valve,VSD, Value	
P5.9.1	0%	5.0	The underlined values are entered by the user
P5.9.2	10%	7.2	
P5.9.3	20%	9.9	
P5.9.4	30%	15.6	
P5.9.5	40%	25.1	
P5.9.6	60%	41.3	
P5.9.7	80%	59.0	
P5.9.8	100%	80.0	

See **P5.8.4** for a description of how to use feedforward to counteract "shrink" and "swell".

Note: If feedforward is not desired, set all values to 0.0

5.10 – 3 Element Flow PID

5.10.1 – Flow Prop Band

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < 3 Element Flow PID		**P:**	**5.10.1**
Password Level: T	**Default Setting:**	**150.00**		**Flow Prop Band**
P5.10.1 Sets the proportional band of the PID for the three-element feedwater control.			**T:**	

Options: **100.00 to 320.00%**

The flow control PID proportional band when in three-element feedwater control mode. A smaller number increases the output change for a given setpoint deviation.

Proportional band (PB) is: the feedwater flow (or SP) % change that causes a 100 (deg, %, Hz) (valve or VSD) change.

Example: 90 deg servo valve

PB = 100%: A 20% flow (or flow SP) change moves the servo 20 degrees.

PB = 150%: A 20% flow (or flow SP) change moves the servo 13.3 degrees.

PB = 200%: A 20% flow (or flow SP) change moves the servo 10 degrees.

5.10.2 – Flow Min Per Repeat

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < 3 Element Flow PID		**P:**	**5.10.2**
Password Level: T	**Default Setting:**	**0.20**		**Flow Min per Repeat**
P5.10.2 Sets the integral minutes in the PID of the three-element feedwater control.			**T:**	

Options: 0.50 to 0.10

The flow control PID integral minutes when in three-element feedwater control mode. A smaller number increases the integral ramp rate.

5.11 – FW Pump VSD Curve

5.11.1 – No Flow VSD Hz, FW

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < FW Pump VSD Curve		**P:**	**5.11.1**
Password Level: T	**Default Setting:**	**30.00**		**No Flow VSD Hz, FW**
P5.11.1 Determines the minimum VSD speed required to overcome normal operating pressure.			**T:**	

Options: **5.00 to 50.00Hz**

P5.11.1 is only used if a VSD feedwater pump is controlling drum level.

A VSD controlled pump will have a minimum speed required to produce sufficient pressure to overcome the normal operating steam drum pressure.

To determine that speed perform the following procedure. While at the normal operating steam pressure, increase the pump VSD Hz until water just starts flowing into the boiler, then enter this value into **P5.11.1**.

5.11.2 – No Flow PID %, FW

Menu Location:	Menu<Parameters<Feedwater Control< Feedwater Tuning < FW Pump VSD Curve		**P:**	**5.11.2**
Password Level: T	**Default Setting:**	**8.00**		**No Flow PID %, FW**
P5.11.2 Determines how the PID will operate at low loads and drum pressures.			**T:**	

Options: 4.00 to 20.00% of PID Output

In most cases the default of 8% will not need to be adjusted.

If the drum level and pump speeds oscillates near low fire, increase **P5.11.2**.

If the drum level and pump speed acts sluggish at low fire, decrease **P5.11.2**.

Note: **P5.11.2** is only used if a VSD feedwater pump is controlling drum level.

6. ATOMIZING CONTROL

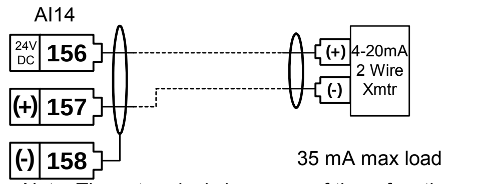
6.1 – Atomizing Setup

6.1.1 – Atomizing Pressure Control Option

Menu Location:	Menu<Parameters<Atomizing Control<Atomizing Setup			**P:**	**6.1.1**
Password Level:	E, R	**Default Setting:**	**Disable**	**Atomizing Pressure Control Option**	
When this parameter is Enabled, the BMU will control the atomizing pressure according to the Setpoint curve established set during commissioning.				**T:**	**156 - 158**
				Rating / Terminal	Example Wiring

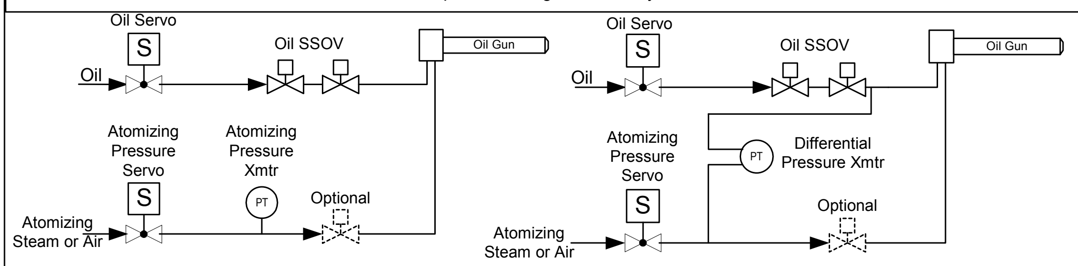
Options:

Disable: Atomizing Pressure Control not used.
Enable Atomizing Pressure Control is used.
In some cases the atomizing pressure, and in others, the oil-to-atomizing differential pressure, is measured.
The measurement method is selected by the burner manufacturer.



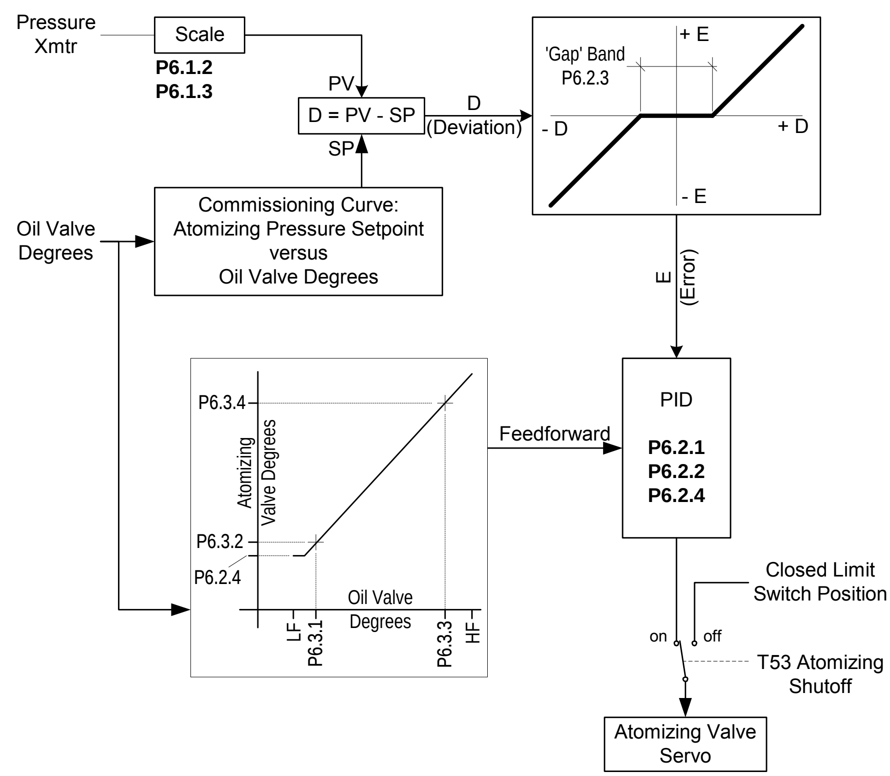
Note: These terminals have one of three functions.
P2.8.4, **P2.9.1**, and **P6.1.1**
Only ONE of the three Options can be Enabled

Example Atomizing Pressure Systems



Atomizing Pressure Control **Oil vs. Atomizing Differential Pressure Control**

Note: Atomizing Pressure Control (**P6.1.1**) can only be Enabled, if:
a)This is a BMU-1xxx or BMU-2xxx, and b) An Atomizing Valve servo has been configured, and
c)Gas Flow Pressure Comp. is Disabled (**P2.8.4**), and d)The Fuel 3 Flow Xmtr is NOT required.
(Fuel 3 Flow Xmtr is only required if: **P2.1.1** = Metered Servo Mode and **P1.1.3** = Fuel 3 is Enabled).



6.1.2 – Pressure @ 4mA, Xmtr Cal

Menu Location:	Menu<Parameters<Atomizing Control<Atomizing Setup			**P:**	**6.1.2**
Password Level:	E, R	**Default Setting:**	**0.0**	**Pressure @ 4 mA, Atomizing Xmtr Cal**	
Options: 0.0 to -500.0				**T:**	**156 - 158**
P6.1.2 is the pressure that causes a 4 mA output from the transmitter.					
Note: The "Span" must be greater than 10.0, that is: (**P6.1.3** - **P6.1.2**)					

6.1.3 – Pressure @ 20mA, Xmtr Cal

Menu Location:	Menu<Parameters<Atomizing Control<Atomizing Setup			**P:**	**6.1.3**
Password Level:	E, R	**Default Setting:**	**100.0**	**Pressure @ 20 mA, Atomizing Xmtr Cal**	
Options: 1.0 to 999.9				**T:**	**156 - 158**
P6.1.3 is the pressure that causes a 20 mA output from the transmitter.					
Note: The "Span" must be greater than 10.0, that is: (**P6.1.3** - **P6.1.2**)					

6.2 – Atomizing Tuning – PID Tune

6.2.1 – Proportional Band, Atomizing

Menu Location:	Menu<Parameters<Atomizing Control<Atomize Tuning<Atomizing PID Tune			**P:**	**6.2.1**
Password Level:	T	**Default Setting:**	**10.00**	**Proportional Band, Atomizing**	
Options: 2.00 to 320.00				**T:**	
P6.2.1 Determines the PID Proportional Band for the atomizing pressure control . Proportional band is defined as the pressure change that causes atomizing valve servo to move full stroke. It is expressed in the same units as the atomizing pressure xmtr zero and span (**P211** and **P212**). A large Proportional Band value will result in less control action for a given change in atomizing pressure. A smaller Proportional Band value results in tighter, more active PID control. Proportional Band provides the initial control reaction to a change in pressure.					
Caution: If the Proportional Band is too small, it can result in pressure oscillation.					

6.2.2 – Minutes Per Repeat, Atomizing

Menu Location:	Menu<Parameters<Atomizing Control<Atomize Tuning<Atomizing PID Tune			**P:**	**6.2.2**
Password Level:	T	**Default Setting:**	**1.00**	**Minutes per Repeat, Atomizing**	
Options: 0.50 to 15.00				**T:**	
P6.2.2 Determines the PID Minutes per Repeat for the atomizing pressure control . Minutes per repeat is the time it takes for the Integral to ramp the valve open or closed one more "Proportional" mode correction. A smaller value causes more rapid Integral ramping. A larger value causes slower Integral ramping. Intergal is a slower secondary valve correction that occurs after the the initial proportional correction.					
CAUTION: If the Minutes per Repeat is too small, it can result in pressure oscillation.					

6.2.3 – Gap Band, Atomizing Pressure

Menu Location:	Menu<Parameters<Atomizing Control<Atomize Tuning<Atomizing PID Tune			**P:**	**6.2.3**
Password Level:	T	**Default Setting:**	**0.2**	**Gap Band, Atomizing Pressure**	
Options: **0.1 - 20.0**				**T:**	
P6.2.3 is used to prevent over-controlling when the atomizing pressure is close to Setpoint. The Gap Band is the +/- pressure band around the setpoint where the PID holds the valve at it's current position. This prevent unecessary valve hunting.					
Note: If the Gap Band is too large, the PID will respond sluggishly to firing rate changes.					

6.2.4 – Minimum Modulation, Valve Degrees

Menu Location:	Menu<Parameters<Atomizing Control<Atomize Tuning<Atomizing PID Tune			**P:**	**6.2.4**
Password Level:	T	**Default Setting:**	**-5.00**	Minimum Modulation, Atomizing Valve Degrees	
Options: -50.00 to 180.00				**T:**	
P6.2.4 Determines the Minimum atomizing valve position during modulation. During oil firing, the PID should never be allowed to drive the valve completely closed to prevent nuisance smoking and/or flame failure. **P6.2.4** sets the minimum PID output (ie, valve position).					
Note: P6.2.4 does not prevent the valve from going full closed during Standby or Lockout. Therefore, a characterized ball valve can be used for both modulation and for tight shutoff when the burner is shutdown.					

6.3 – Atomizing Tuning - Valve Feed Forward curve

6.3.1 – Low Oil Deg

Menu Location:	Menu<Parameters<Atomizing Control<Atomize Tuning<Atomizing Valve Feedforward curve			**P:**	**6.3.1**
Password Level:	T	**Default Setting:**	**0.0**	**Atomizing Feedforward Low Oil deg**	
Options: -20.0 to 200.0				**T:**	
P6.3.1 and **P6.3.2** Determine the Atomizing Valve Feedforward Curve value near Low Fire (see the diagram on the previous page). Feedfoward causes the Atomizing valve to start to move as soon as the Oil valve starts to move for better Atomizing pressure control during load changes.					

6.3.2 – Low Atom Deg

Menu Location:	Menu<Parameters<Atomizing Control<Atomize Tuning<Atomizing Valve Feedforward curve			**P:**	**6.3.2**
Password Level:	T	**Default Setting:**	**0.0**	**Atomizing Feedforward Low Atom deg**	
Options: -20.0 to 200.0				**T:**	
See the description for **P6.3.1** above.					

6.3.3 – High Oil Deg

Menu Location:	Menu<Parameters<Atomizing Control<Atomize Tuning<Atomizing Valve Feedforward curve			**P:**	**6.3.3**
Password Level:	T	**Default Setting:**	**0.0**	**Atomizing Feedforward High Oil deg**	
Options: -20.0 to 200.0				**T:**	
P6.3.3 and **P6.3.4** Determine the Atomizing Valve Feedforward Curve value near High Fire. See the description for **P6.3.1** above.					

6.3.4 – High Atom Deg

Menu Location:	Menu<Parameters<Atomizing Control<Atomize Tuning<Atomizing Valve Feedforward curve			**P:**	**6.3.4**
Password Level:	T	**Default Setting:**	**0.0**	**Atomizing Feedforward High Atom deg**	
Options: -20.0 to 200.0				**T:**	
See the description for **P6.3.3** above.					

Parameter Overview and Cross Reference

BurnerMate Universal Parameter Overview and Cross Reference			
			revised 9/10/09
Category		Parameter	Default
Revised	Original		
Flame Safety < Basic (P1.1.x)			
1.1.1	1	Fuel 1 Enable	DISABLE
1.1.2	2	Fuel 2 Enable	DISABLE
1.1.3	3	Fuel 3 Enable	DISABLE
1.1.4	4	FuelRequest Source	CONTACTS
1.1.5	5	PAF Switch Installed	YES
1.1.6	6	ID Fan Installed	YES
1.1.7	7	Ignition Xfmr Mode	EARLY TERMINATE
1.1.8	8	Oil MTFI Sec	10 sec
1.1.9	9	Purge Time	30 sec
1.1.10	10	Post Purge Time	20 sec
1.2.1	new	Pilot Test Hold	
Flame Safety <Options <General (P1.3.x)			
1.3.1	34	Power Fail Response	Recycle
1.3.2	35	Assured Low Fire Cut Off	Disable
1.3.3	36	Fuel1 POC Installed	Yes
1.3.4	37	Fuel2 POC Installed	Yes
1.3.5	38	Fuel 3 POC Installed	Yes
Flame Safety <Options <Scanner (P1.4.x)			
1.4.1	39	Dual Flame Scanners	Disable
1.4.2	40	Scanner 1 Signal	4-20 mA
1.4.3	41	Scanner 2 Signal	4-20 mA
1.4.4	42	Scanner Alarm SP	0 %
Flame Safety <Options < Fan Start (P1.5.x)			
1.5.1	43	FD Fan Start Mode	PreStart
1.5.2	44	FD Fan Start Delay	1 sec
1.5.3	45	Aux Fan Start Delay	1 sec
Flame Safety <Options < Time Delays (P1.6.x)			
1.6.1	46	Min Air Flow Trip Delay	0 sec
1.6.2	47	Low Fuel Pressure Delay	0 sec
1.6.3	48	Low Atomizing Flow Delay	0 sec
1.6.4	49	Low Draft Cutout Delay	0 sec
1.6.5	50	HOLD Alarm Delay	45 sec
1.6.6	51	HOLD Lockout Delay	120 sec
Flame Safety <Options < Auxiliary Relays (P1.7.x)			
1.7.1	52	Aux Relay 1 Function	CommonAlarm
1.7.2	53	Aux Relay 2 Function	CommonAlarm
1.7.3	54	Aux Relay 3 Function	CommonAlarm
1.7.4	55	Aux Relay 4 Function	CommonAlarm
1.7.5	56	Aux Relay 5 Function	CommonAlarm
1.7.6	57	Hot Water Pump/ Valve Stop Delay	300 sec
Flame Safety <Options < Gas Leak Test (P1.8.x)			
1.8.1	58	Gas (Fuel2) Leak Test Option	Disable
1.8.2	New	Leak Test w/o Vent Valve Option	Disable
1.8.3	59	Upstream Test Sec	60 sec
1.8.4	60	Downstream Test Sec	60 sec

Flame Safety <Options < Oil Gun Purge (P1.9.x)			
1.9.1	61	Oil Gun Purge Option	Disable
1.9.2	62	Oil Gun Purge Sec	10 sec
Flame Safety <Options < High Flue Temp (P1.10.x)			
1.10.1	63	Flue Gas T/C Type	J_T/C
1.10.2	64	Alarm SP, Flue Temp	1000 deg
1.10.3	65	Lockout SP, Flue Temp	1000 deg
Flame Safety <Options < LWC Auto Blowdown (P1.11.x)			
1.11.1	66	LWC Auto Blowdown Option	Disable
1.11.2	67	Failed Test Response, Blowdown	Lockout
1.11.3	68	Min Steam Pressure, Blowdown	50.0 psi
1.11.4	69	Time of Day, Blowdown	8:00
1.11.5	70	Blowdown Seconds	10 sec
1.11.6	71	LWC Bypass Release Delay	5 sec
Flame Safety <Options < Fuel Transfer (P1.12.x) BMU-FM only			
1.12.1	New	Fuel Transfer Method	Restart
1.12.2	New	Low Fire Xfer Pilot Option	Disabled
1.12.3	New	Dual Fuel Time Limit, Sec	20
1.12.4	New	Low Fire Xfer Air Bias %	10.0
Fuel-Air < Basic (P2.1.x)			
2.1.1	11	Fuel-Air Control Type	Positioned Servo
2.1.2	New	FGR Servo Check Mode	Close then Open
Fuel-Air <Options < FD VSD Setup (P2.2.x)			
2.2.1	72	FD Fan VSD Option	Disable
2.2.2	73	FD VSD Feedback Adjust	1.00
2.2.3	74	FD VSD Ramp Rate, Sec/30Hz	15 sec
2.2.4	75	FD VSD Min Hz	5.0 Hz
2.2.5	76	FD VSD Off-Curve Lockout Deadband, Hz	0.4 Hz
Fuel-Air <Options < Aux 2 Setup (P2.3.x)			
2.3.1	77	Aux 2 Curve Option	Disable
2.3.2	New	Aux 2 FGR Trim Option- BMU-FM only	Disable
2.3.3	78	4-20 Feedback Adjust, Aux 2	1.00
2.3.4	79	4-20 Ramp Rate, Sec/100%, Aux 2	30 sec
2.3.5	New	4-20 Off-Curve Lockout Deadband %, Aux 2	1.5 %
Fuel-Air <Options < Oxygen Analyzer (P2.4.x)			
2.4.1	81	O2 Analyzer Option	Disable
2.4.2	82	Low O2 Alarm SP	0.0 %
2.4.3	83	Low O2 Lockout Option	Disable
2.4.4	84	Low O2 Lockout SP	0.5 %
2.4.5	85	Low O2 Lockout Delay	1 sec
2.4.6	86	O2 Fault Lockout Option	Disable
2.4.7	87	O2 Low Cal Gas %	0.400 %
2.4.8	88	O2 High Cal Gas %	8.000 %
2.4.9	89	O2 Cell Slope Cal Data	20742
2.4.10	90	O2 Cell Offset Cal Data	20596
2.4.11	91	O2 Cell Temp Cal Data	10730
2.4.12	92	O2 Cal Data Checksum	0000
2.4.13	New	#6 Oil Efficiency Option	Disable
Fuel-Air <Options < Oxygen Trim Setup (P2.5.x)			
2.5.1	93	O2 Trim Option	Disable
2.5.2	99	Low Fire Disable, O2 Trim	5.0 %
2.5.3	100	Burner Warmup Delay Sec, O2 Trim	120 sec

Fuel-Air <Options < Oxygen Trim- Test/Tuning Screen (P2.6.x)				
2.6.1	94	SP Lag Time, O2 Trim		8.0 sec
2.6.2	95	Proportional Band, O2 Trim		6.50 %
2.6.3	96	Repeats Per Minute, O2 Trim		0.50
2.6.4	97	+/- Max Fire Trim, O2		10.00 %
2.6.5**	98	Min Fire Trim Scaler, O2 Trim or Full Metered		0.20
Fuel-Air <Options < Fuel Flow Setup <Oil Flow Meter (P2.7.x) BMU-FM only				
2.7.1	New	Xmtr Signal, Oil Flow		4-20 mA
2.7.2	New	Decimal Point, Oil Flow		xxxx
2.7.3	New	GPH Span, Oil Flow		400
2.7.4	New	Decimal Point, Oil Flow Pulser Frequency Span		xx.xx
2.7.5	New	Pulser Frequency Span, Oil Flow		50.00 Hz
Fuel-Air <Options < Fuel Flow Setup <Gas Flow Meter (P2.8.x) BMU-FM only				
2.8.1	New	Decimal Point, Gas Flow		xx.xx
2.8.2	New	Flow @ 20 mA, Gas Flow		1.00
2.8.3	New	Sq Root, Gas Flow		Disabled
2.8.4	New	Pressure Comp Option, Gas Flow		Disabled
2.8.5	New	Gas PSIG Xmtr Span		30.00 psig
2.8.6	New	Flow Comp Design PSIG, Gas Flow		5.00 psig
Fuel-Air <Options < Fuel Flow Setup <Fuel 3 Flow Meter (P2.9.x) BMU-FM only				
2.9.1	New	Decimal Point, Fuel 3 Flow		xxx.x
2.9.2	New	Flow @ 20 mA, Fuel 3 Flow		10.0
2.9.3	New	Sq Root Option, Fuel 3 Flow		Disabled
Fuel-Air <Options < Fuel Flow Setup <Totalizers (P2.10.x) BMU-FM only				
2.10.1	New	Flow Totalizer Option		Disabled
Fuel-Air <Options < Full Metered Setup <Air Flow Meter (P2.11.x) BMU-FM only				
2.11.1	New	Sq Root Option, Air Flow		Enabled
2.11.2	New	Temp Comp Option, Air Flow		Disabled
Fuel-Air <Options < Full Metered Setup <Misc Metered Setup (P2.12.x) BMU-FM only				
2.12.1**	New	Air Flow %, Disable Full Metered		10.0 %
2.12.2	New	% Air Flow, Low Fire Deviation Lockout		20.0 %
2.12.3	New	% Air Flow, High Fire Deviation Lockout		10.0 %
2.12.4	New	% Fuel Flow, Deviation Lockout		25 %
2.12.5	New	Sec, Flow Deviation Lockout Delay		6 sec
Fuel-Air <Options < Full Metered Tune (P2.13.x) BMU-FM only				
2.13.1	New	Gap Band, Full Metered Tune		0.3
2.13.2	New	Prop Band, Full Metered Tune		0.6
2.13.3	New	Min/Repeat, Full Metered Tune		0.10
2.13.4	New	Max Fire Trim +/-, Full Metered Tune		10.00
2.6.5**	98	Min Fire Trim Scaler, O2 Trim or Full Metered		0.20
2.12.1**	New	Trim Null Air Flow %, Full Metered Tune		10.0 %
2.13.7	New	Xmtr Filter Sec, Full Metered Tune		2.0 sec
2.13.8	New	Flow SP Lag Sec, Full Metered Tune		2.5 sec
Fuel-Air <Options < FGR O2 Trim Setup (P2.14.x) BMU-FM only				
2.14.1	New	Windbox Oxygen FGR Trim Option		Disabled
2.14.2	New	Windbox Oxygen @ 20 mA, Xmtr Cal		21.00 %
Fuel-Air <Options < FGR O2 Trim Tune Tune (P2.15.x) BMU-FM only				
2.15.1	New	SP Lag Seconds, FGR Trim Tune		8.0
2.15.2	New	Proportional Band, FGR Trim Tune		5.00
2.15.3	New	Minutes per Repeat, FGR Trim Tune		0.50
2.15.4	New	Max Fire Trim +/-, FGR Trim Tune		10.00 %
2.15.5	New	Min Fire Scale, FGR Trim Tune		1.00

Firing Rate <Basic Setup < Blr Outlet Sensor (P3.1.x)				
3.1.1	12	Sensor Channel, Boiler Outlet		AI-3
3.1.2	13	AI3 Sensor Type		THERMISTOR
3.1.3	14	AI6 Sensor Type		J_T/C
3.1.4	15	Degrees C Scaling		DISABLE
3.1.5	16	Decimal Point, Boiler Outlet		xxxxx
3.1.6	17	Xmtr Span, Boiler Outlet		25.0
Firing Rate <Basic Setup < Local/Remote Mode (P3.2.x)				
3.2.1	18	CFH Local Mode		SPDEVIATION
3.2.2	19	Enable Remote Mode		ENABLE
3.2.3	20	CFH Remote Mode		TERMINAL9
3.2.4	21	Remote Modulation		AI4_FR
3.2.5	22	Remote Fault Response		LOCAL
3.2.6	23	Remote Rate Cutback SP		2000.0
3.2.7	24	AI4 Signal Type		4-20mA
3.2.8	25	Remote SP Span		200.0
3.2.9	26	Remote SP Zero		0.0
Firing Rate <Basic Tuning <Firing Rate Tuning (P3.3.x)				
3.3.1	27	CFH Start Deviation		5.0
3.3.2	28	CFH Stop Deviation		10.0
3.3.3	29	Proportional Band, Rate PID		5.00
3.3.4	30	Minutes Per Repeat, Rate PID		1.25
3.3.5	31	Rate Local SP		200.0
3.3.6	32	Rate Max SP		240.0
3.3.7	33	Rate Min SP		0
Firing Rate <Options < Miscellaneous (P3.4.x)				
3.4.1	101	Sec/100% Rate Limit, Firing Rate		25
3.4.2	102	Avoid Gap +/-, Firing Rate		0.5
3.4.3	103	Output Channel, Firing Rate		AO2
Firing Rate <Options < Outdoor Reset < Sensor Setup (P3.5.x)				
3.5.1	104	Sensor Channel, Outside Air		AI5
3.5.2	105	AI5 Sensor Type		Thermistor
3.5.3	106	AI5 Xmtr Span, Outdoor Temp		130
3.5.4	107	AI5 Xmtr Zero, Outdoor Temp		-30
Firing Rate <Options <Outdoor Reset< Reset Curve (P3.6.x)				
3.6.1	108	Outdoor Cutoff Deg		120
3.6.2	109	Low OAT Deg		10
3.6.3	110	High OAT Deg		45
3.6.4	111	Normal SP at Low OAT		220
3.6.5	112	Normal SP at High OAT		190
3.6.6	113	Setback SP at Low OAT		200
3.6.7	114	Setback SP at High OAT		170
Firing Rate <Options < Alt Local Setpoint (P3.7.x)				
3.7.1	115	Alt Local SP Option		Disable
3.7.2	116	Alt Local Setpoint		125.0
Firing Rate <Options < Domestic Hot Water (P3.8.x)				
3.8.1	117	DHW Override Option		Disable
3.8.2	118	DHW Setpoint		180.0

Firing Rate <Options < Warm Standby (P.3.9.x)				
3.9.1	119	Warm Standby Option		Disable
3.9.2	120	Start SP, Warm Standby		85.0
3.9.3	121	Stop SP, Warm Standby		110.0
3.9.4	122	Sensor Channel, Warmup		AI6
3.9.5	123	AI5 Sensor Type		Thermistor
3.9.6	124	AI5 Xmtr Span, Warm Temp		300
3.9.7	125	AI6 Sensor Type		J_T/C
Firing Rate <Options < Cold Start Warmup (P3.10.x)				
3.10.1	126	Cold Start Warmup Option		Disable
3.10.2	127	Activate SP, Cold Start		40.0
3.10.3	128	Deactivate SP, Cold Start		100.0
3.10.4	129	Setpoint Step, Cold Start		10.0
3.10.5	130	Firing Rate Step, Cold Start		10.0
3.10.6	131	Override Minutes, Firing Rate Step		20
Firing Rate <Options < Low Fire Hold (P3.11.x)				
3.11.1	132	Low Fire Hold Option		Disable
3.11.2	133	Override Seconds, Low Fire Hold		300 sec
3.11.3	134	Low Fire Hold SP		80.0
Firing Rate <Options < FGR Low Fire Hold (P3.12.x)				
3.12.1	135	FGR Temp Low Fire Hold Option		Disable
3.12.2	136	Release Temp, FGR LFH		300.0 deg
3.12.3	137	Min Temp, FGR Cutback		180.0 deg
3.12.4	138	Fuel1 Cutback %, FGR Min Temp		0.0 %
3.12.5	139	Fuel2 Cutback %, FGR Min Temp		0.0 %
3.12.6	140	Fuel3 Cutback %, FGR Min Temp		0.0 %

Draft Control <Draft Setup < Draft Basic Setup (P4.1.x)				
4.1.1	141	Draft Control Option		Disable
4.1.2	142	Draft @ 4mA, Xmtr Cal		+1.000
4.1.3	143	Draft @ 20mA, Xmtr Cal		+1.000
4.1.4	144	Outlet Damper Purge Position		80.00 deg. or %
4.1.5	145	ID Fan VSD Purge Hz		55.0 Hz.
Draft Control <Draft Setup < Draft Alarm Setup (P4.2.x)				
4.2.1	146	Low Alarm SP, Draft		+25.00
4.2.2	147	Alarm Delay Sec, Draft		8 sec.
Draft Control <Draft Setup < Draft Misc setup (P4.3.x)				
4.3.1	148	Modulate Delay Sec, Draft		0 sec.
4.3.2	149	Cooldown Delay Sec, Draft		0 sec.
4.3.3	150	Draft Servo Check Option		Enable
Draft Control <Draft Setup < Draft Adj Start (P4.4.x)				
4.4.1	151	Adjustable Start Draft Option		Disable
4.4.2	152	Adj Start Draft SP		-0.500 in.
4.4.3	153	Fuel 1 (oil) Adj Start Position		50.00 deg
4.4.4	154	Fuel 2 (gas) Adj Start Position		50.00 deg
4.4.5	155	Fuel 3 Adj Start Position		50.00 deg
Draft Control < Draft Tuning < Floating Draft Tuning (P4.5.x)				
4.5.1	156	Proportional Band, Floating Draft		0.600
4.5.2	157	Deadband, Floating Draft		0.030
Draft Control < Draft Tuning < Floating & PID Tuning (P4.6.x)				
4.6.1	158	Filter Sec, Draft Xmtr		2.0 sec
4.6.2	159	Max Damper Position in Auto, Draft		100.00
4.6.3	160	Min Damper Position in Auto, Draft		0.00
4.6.4	161	Sec/90 deg Damper Rate Limit, Draft		25

Draft Control < Draft Tuning < PID Draft Tuning (P4.7.x)			
4.7.1	162	Proportional Band, Draft PID	0.600
4.7.2	163	Minutes Per Repeat, Draft PID	0.25
4.7.3	164	Gap, Draft PID	0.030
4.7.4	165	Gap Gain, Draft PID	0.30
Draft Control < Draft Tuning < PID Feedforward Curve (P4.8.x, P4.9.x, P4.10.x)			
4.8.x	166a	Draft Feed Forward Curve: Fuel1	
4.8.1		Firing Rate %: 0	0.00
4.8.2		10	0.00
4.8.3		20	0.00
4.8.4		30	0.00
4.8.5		40	0.00
4.8.6		60	0.00
4.8.7		80	0.00
4.8.8		100	0.00
4.9.x	166b	Draft Feed Forward Curve: Fuel2	
4.9.1		Firing Rate %: 0	0.00
4.9.2		10	0.00
4.9.3		20	0.00
4.9.4		30	0.00
4.9.5		40	0.00
4.9.6		60	0.00
4.9.7		80	0.00
4.9.8		100	0.00
4.10.x	166c	Draft Feed Forward Curve: Fuel3	
4.10.1		Firing Rate %: 0	0.00
4.10.2		10	0.00
4.10.3		20	0.00
4.10.4		30	0.00
4.10.5		40	0.00
4.10.6		60	0.00
4.10.7		80	0.00
4.10.8		100	0.00
Draft Control < Draft Tuning < ID Fan VSD Tune (P4.11.x)			
4.11.1	167	Max VSD Hz in Auto, Draft	60.00 Hz
4.11.2	168	Min VSD Hz in Auto, Draft	10.00 Hz
4.11.3	169	Sec/60Hz VSD Rate Limit, Draft	25
4.11.4	170	SP Offset, Draft VSD/Damper Dual Output Mode	0.510

Feedwater Control <Feedwater Setup < Feedwatr Basic Setup (P5.1.x)			
5.1.1	171	Feedwater Control Option	Disable
5.1.2	172	Valve/Pump Output Type	ServoValve
5.1.3	173	Drum Level @ 4 mA, Xmtr Cal	+10.00
5.1.4	174	Drum Level @ 20 mA, Xmtr Cal	-10.00
Feedwater Control <Feedwater Setup < Feedwatr Alarm Setup (P5.2.x)			
5.2.1	175	Low Alarm SP, Drum Level	-50.00
5.2.2	176	High Alarm SP, Drum Level	+99.00
5.2.3	177	Alarm Delay Sec, Drum Level	10

Feedwater Control <Feedwater Setup < Steam Flow Setup (P5.3.x)			
5.3.1	178	Decimal Point, Steam Flow	xxx.x
5.3.2	179	Flow @ 20 mA, Steam Flow	100.0
5.3.3	180	Sq Root Option, Steam Flow	Disable
5.3.4	181	Filter Sec, Steam Flow	1.5 sec
5.3.5	182	Low Flow Cutoff %, Steam Flow	1.00 %
Feedwater Control <Feedwater Setup < Feedwatr Flow Setup (P5.4.x)			
5.4.1	183	Decimal Point, Feedwater Flow	xxx.x
5.4.2	184	Flow @ 20 mA, Feedwater Flow	100.0
5.4.3	185	Sq Root Option, Feedwater Flow	Disable
5.4.4	186	Filter Sec, Feedwater Flow	1.0 sec
5.4.5	187	Low Flow Cutoff %, Feedwater Flow	1.00 %
Feedwater Control <Feedwater Setup < Pressure Compensate (P5.5.x)			
5.5.1	188	Pressure Units, Boiler Outlet Xmtr	psig
5.5.2	189	Drum Level Pressure Comp Option	Disable
5.5.3	190	Steam Flow Press Com Option	Disable
5.5.4	191	Steam Flow Design Pressure	125.0
Feedwater Control <Feedwater Tuning < Level Xmtr Tune (P5.6.x)			
5.6.1	192	Filter Sec, Drum Level	1.5 sec
5.6.2	193	Drum Level Adjust	1.030
Feedwater Control <Feedwater Tuning < 1 Element Level PID (P5.7.x)			
5.7.1	194	Proportional Band, 1 Elem FW	5.00
5.7.2	195	Minutes Per Repeat, 1 Elem FW	5.00
Feedwater Control <Feedwater Tuning < 2/3 Elem Level PID (P5.8.x)			
5.8.1	196	Proportional Band, 2/3 Elem FW	7.00
5.8.2	197	Minutes Per Repeat, 2/3 Elem FW	6.50
5.8.3	198	Feed forward Type, FW	LinearGain
5.8.4	199	Feedforward Gain, FW	0.75
5.8.5	200	Steam Flow %, 1 Elem Fallback	2.00
5.8.6	201	Fallback On Delay Sec, FW	10 sec
5.8.7	202	Fallback OFF Delay, Sec, FW	10 sec
Feedwater Control <Feedwater Tuning < FW FeedFwd Curve (P5.9.x)			
5.9.x	203	Drum Level Steam Flow Feedforward Curve	
5.9.1		Steam Flow Rate %: 0	0.00
5.9.2		10	0.00
5.9.3		20	0.00
5.9.4		30	0.00
5.9.5		40	0.00
5.9.6		60	0.00
5.9.7		80	0.00
5.9.8		100	0.00
Feedwater Control <Feedwater Tuning < 3 Element Flow PID (P5.10.x)			
5.10.1	206	Flow Prop Band	150.00
5.10.2	207	Flow Min Per Repeat	0.20
Feedwater Control <Feedwater Tuning < FW Pump VSD Curve (P5.11.x)			
5.11.1	208	No Flow VSD Hz, FW	30.00
5.11.2	209	No Flow PID %, FW	8.00

Atomizing Control < Atomizing Setup (P6.1.x) BMU-FM Only				
6.1.1	New	Atomizing Pressure Control Option		Disable
6.1.2	New	Pressure @ 4 mA, Xmtr Cal		0.0
6.1.3	New	Pressure @ 20 mA, Xmtr Cal		100.0
Atomizing Control < Atomizing Tuning < Atomizing PID Tune (P6.2.x) BMU-FM only				
6.2.1	New	Proportional Band, Atomizing		10.00
6.2.2	New	Minutes per Repeat, Atomizing		1.00
6.2.3	New	Gap Band, Atomizing Pressure		0.2
6.2.4	New	Minimum Modulation, Valve Degrees		-5.00
Atomizing Control < Atomizing Tuning < Atomizing Valve Feedforward Curve (P6.3.x)				
6.3.1	New	Low Oil deg		0.0
6.3.2	New	Low Atom deg		0.0
6.3.3	New	High Oil deg		0.0
6.3.4	New	High Atom deg		0.0

Section 4 Index

Section 4 Index - continued

Physical Specifications:

Mechanical	
Back Panel Assembly:	
Size:	14.813 Length; 8.188” Width; 4.875” Height
Weight:	5 lbs (excluding plug in modules)
Message Display:	
Size:	4.625” Height; 5.188” Width
Panel Cutout:	Refer to BurnerMate Universal LCD Mounting
Enclosure Type:	Flush panel mounted
Weight:	1/2 lbs.
Environmental	
Operating Temp:	32 to 140 deg. F. (0 to 60 deg. C.)
Storage Temp:	-20 to 150 deg. F. (-28 to 65 deg. C.)
Humidity Limits:	15 to 95% (non-condensing)
Front Panel:	NEMA 13, IP65
Electrical	
Input Power:	120 VAC (+/- 15%) 60 Hz
Power Consumption	42 VA
	This includes the **BurnerMate Universal**, plus the following BMU 24 VDC powered external devices: (1) BMU-LCD plus a combined quantity of (19) Servos and 4-20 mA loops.
	120 VAC loads that are not included in the above: Output Terminals **T51** to **T60**, and **T61** BMU-SM-3 120 VAC motor: 5 VA BMU-SM-15 120 VAC motor: 11 VA BMU-SM-37 120 VAC motor: 21 VA BMU-UM-072 120 VAC motor 20 VA BMU Flame Scanner 120 VAC: 2 VA
	NOTE: If the combined quantity of: (Servos + 4-20 mA loops) is 20 or more, a UL508 Approved external 24 VDC power supply must be installed. Externally powered 4-20 mA loops should not be included in the combined quantity.
Testing Authority	UL Recognized

Installation Notes:

Mounting Overview

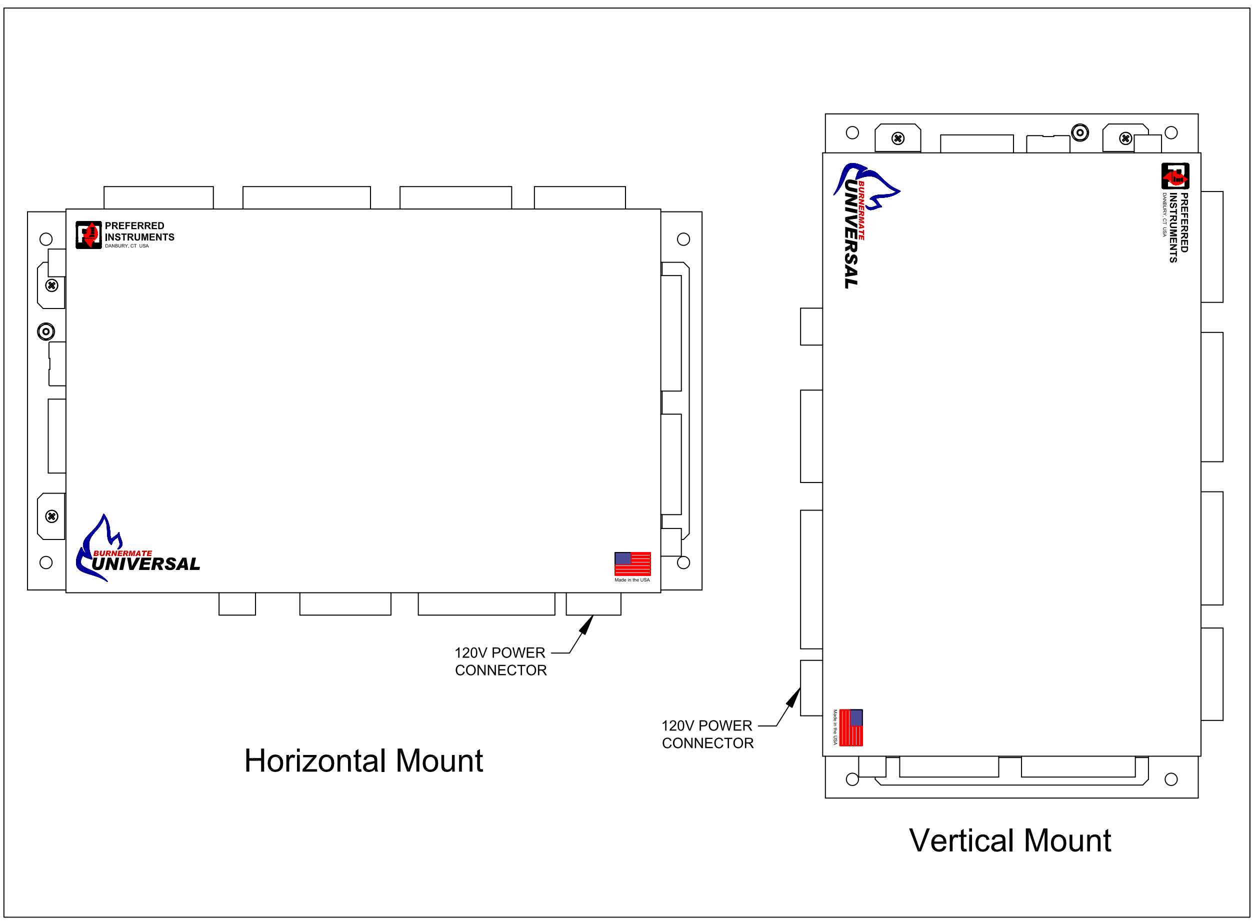
The **BurnerMate Universal** controller assembly is designed for mounting in a NEMA 12 or NEMA 4 enclosure in a non-condensing, 32-132 F environment. If installed outdoors, consideration should be given to heating the enclosure. The controller should not be subjected to excessive vibration. Adequate clearance (4”) on the top, bottom, and sides of the controller should be provided for cooling and access to the terminal blocks.

The 4 x 20 character LCD touch pad is shipped loose for flush mounting on the enclosure and is rated NEMA 4 for 32-132 F environments. Optionally, the LCD touch pad can be factory mounted on the BMU cover.

Mounting Details

Refer to the **BurnerMate Universal** mounting and LCD cutout dimension drawings that follow. For proper cooling, mount the **BurnerMate Universal** in either orientation shown below.

Proper Mounting Orientation to Provide Sufficient Cooling



Mounting Details cont'd
For the LCD touch pad, cut the hole in the enclosure. Remove any burrs and loose metal chips. Drill the six mounting holes. Insert the LCD touch pad and gasket, and fasten it down using the six nuts provided. The gasket is required for NEMA 4 & 12 environments.

Notice

Limit devices connected to the BurnerMate Universal must be listed or recognized by authorities having jurisdiction over this type of equipment and its intended function. Wiring must comply with all applicable codes, ordinances and regulations.

Notice

Disconnect the power supply to all system equipment before beginning the installation. This will prevent electrical shock, product and/or system equipment damage.

HAZARDOUS VOLTAGES MUST BE ISOLATED BEFORE THE INSTALLATION OR SERVICE WORK IS CARRIED OUT.

There may be more than one power supply to the fired equipment. Use an approved test meter to insure there is no power present on any of the wires entering the control panel.

Notice

Interlock switches whose set points are typically in the "inches water column" range and that are connected to fluids that can contain moisture (humid air or flue gas as examples) must be connected to the process with piping that <u>slopes downward towards the process</u> (i.e. switch piping connection is higher than the process). At the switch connection point, a piping "tee" should be installed with one connection pointing straight downward and fitted with at least a 12" long drip leg with a blow off valve and plug.

NOTICE

The Burner will not Start

until the BurnerMate Universal (BMU) Parameters have been configured.
See the BMU Instruction Manual for complete details.

A Temporary 'Engineer' Level Password must be entered in order to Edit the BMU Parameters and to Edit/Establish the Local Passwords.

One of the Contacts below can create a Temporary Password based on the following information (obtained from the BMU LCD 'Utilities' Menu):

1) The BMU Serial Number.
2) The BMU Clock's Time and Date when the Password will be used.

A Temporary Password can be obtained from:

The Burner Manufacturer
A Preferred Instruments Representative (www.preferredinstruments.com)
A Preferred Instruments Regional Sales Manager (www.preferredinstruments.com)
Preferred Instruments Service Dept (203-743-6741)

Notes:

- After Entering the Temporary Password, Edit/Establish the Local Engineer, Technician, and (optional) Operator passwords and record them in a secure location. Another Temporary Password can be created in the future if the Local Passwords are not available.
- The Temporary Password expires 6 hours after the BMU Time and Date used to create it.
- Changing the BMU Clock's time/date disables Temporary Passwords for 6 hours. Do NOT change the BMU Clock's time/date until AFTER the Local Passwords have been Entered and Tested.

NOTICE

The BurnerMate Universal (BMU) is a Primary Safety Controller.

A qualified person must edit the BMU Parameters to suit the design of the Burner being controlled by the BMU.

Qualifications include: Knowledge of the Burner Design and Operation, Combustion experience, and the ability to apply all applicable Flame Safeguard, Boiler Safety Interlock, and related National Codes.

⚠ **Notice: The BurnerMate Universal *(*BMU*)* controls potentially dangerous combustion processes. Verify that the fired equipment being controlled has been safely secured, isolated or bypassed (as required by site conditions) before making any wiring changes to the boiler, burner or BMU controller. Failure to do so can result in equipment damage, injury or death.**

⚠ **Notice: It is very common to have multiple sources of power connected to the BMU. Verify that all sources of power have been disconnected before working on wiring. Failure to do so can result in injury or death.**

Wiring -General

All panel and field wiring should conform to national and local electrical codes.

120 Volts AC Ground

Connect the incoming AC power ground (i.e. "green wire" ground) to the stud marked "GROUND" on the **BMU** base plate.

Terminal Blocks

All field wiring terminals are plug-in type and can be separated from the PC boards. This allows rapid **BurnerMate Universal** replacement without disconnecting individual field wires. Verify that terminals are inserted properly before applying power.

The AC terminals on the CPU board are numbered L1, N, and 1-99. Low-voltage DC wires are numbered 100-197. Physically separate all AC wiring from all DC wiring.

All terminals will accept 12–24 ga. wire and should be tightened to 4.5 in-lb torque. Each terminal will accept (2) 14 ga. stranded wires.

Wire Type

All wiring (AC, DC, and shielded cable) should be copper, stranded, 150 V min., and rated 60° C minimum.

Shielded Cable

All 4-20mA / 0-5 VDC input and output wiring should be 22 gauge minimum, 100% foil shield and have twisted pairs (Belden 8737 or equal).

Wiring Practices and the Suppression of Electrical Noise

In addition to safety code requirements, there are numerous methods and practices that help to reduce nuisance start-up and operational problems due to electrical noise. Variable Speed Drives (VSD) and ignition transformers are the major electrical noise generators on a boiler system, and their installation should be closely scrutinized.

General Wiring Requirements

1. Physically separate AC wiring from DC wiring. Do not run AC and DC wiring in the same conduit or trough. When necessary, AC and DC wiring should cross at a 90-degree angle.
2. DC shielded cables: The drain/shield should be connected at one end only, and only as shown on the electrical drawings that follow. Generally, the shield is connected to the DC common of its power supply (not to earth ground). All shield foils and shield wires should be insulated (taped or heat shrink) to prevent accidental connection to earth or power ground. Shields connected at both ends, or unintentional second grounds, can actually add extra noise to a signal instead of reducing noise.

Ignition Transformer Wiring / Mounting

1. Ignition transformers should be mounted as close to the spark electrode as possible to keep the igniter lead wire short and to make the return current path through the burner steel to the transformer as short as possible. Igniter spark gaps should be as small as possible but within the burner manufacturing recommendation.
2. Ensure there is good grounding contact of the transformer and of the igniter assembly (use star washers).
3. Use only automotive style “Resistance Core” ignition wire. Do not use copper core ignition wire.

VSD Wiring

1. The wiring from the VSD output to the motor must be in a dedicated conduit and must be separate from all other wiring. Do not run the VSD input wiring in this conduit. Do not run through junction boxes that include any other wiring.
2. VSD outputs generate high levels of electrical noise. The metal conduit and conduit connectors contain the noise inside the conduit. The VSD to motor conduit must be metallic and have either threaded or non-insulating compression fittings. PVC conduit and EMT set screw-style hub connectors are not acceptable.
3. A dedicated ground wire must be run from the VSD frame to the motor frame within the motor conduit for safety and to reduce electrical noise. A second ground wire must be run from the VSD frame to the AC power source for NEC safety grounding.
4. All DC wiring conduits should be kept as far away from VSD-to-motor conduits as possible.
5. Preferred Utilities strongly recommends that the wiring between the VSD and the motor be of a special shielded cable specifically designed for suppression of the electrical noise associated with the VSD (available from Alpha Wire or Belden).

Wiring Practices and the Suppression of Electrical Noise

Oxygen Analyzer Wiring

1. See Note below. Use only P/N 190130 cable for O2 detector wiring. Run this cable in a separate conduit from the detector back to the control panel. Avoid splices. Only a shielded thermocouple wire used for flue gas temperature can be run with the O2 cable. No other wires, AC or DC, are allowed in this conduit.
2. Maximum wiring length is 500 feet.
3. Connect the detector ground wire directly to the BMU power supply ground.
4. Do not connect any shield drain wires at the detector. Insulate shields to prevent shorts to ground or to other shields.
5. Connect the O2 cable shield drain wires to the (S) terminals as shown on the drawings.

Note: To assure that the integrity of system communications is maintained and that the adverse influence of “electrical noise” is minimized, it is required that the “BMU-CABLE-XX” for interconnection of the BurnerMate Universal to the LCD and Servos and Catalog Number 190130 ZP O2 Analyzer to **BurnerMate Universal** interconnecting cable is used in the interconnection of these devices. Preferred Utilities will not warranty the operation of the **BurnerMate Universal** system if wired in any other form.

Scanner Wiring

1. If a BMU Scanner with the included cable is used the connecting field wiring must be installed exactly as shown on the “BurnerMate Universal Field Wiring Standard” drawing page 1 of 8. The wire shield is connected to earth ground at the scanner via the prefabricated cable and must be insulated at all other locations to prevent accidental grounding. Do not connect the shield wire to terminals **T102** or **T105**.
2. For all other scanners, the **BurnerMate Universal** requires a 120 VAC input on terminals **T30** for Flame Scanner 1 and **T31** for Flame Scanner 2.
3. For all other scanners where the Flame Intensity inputs will be utilized, contact Preferred Instruments Technical Support for the proper wiring requirements.

Detailed I/O Terminal Description & Rating

Power Supply

No.	Description	Type
L1	**Hot**, 120 VAC / 60 Hz Power Supply. 1800 VA maximum total connected load. Note: All 120 VAC Inputs must be connected to the same phase as 'L1' Reference **P1.3.1** for power up options.	
N	**Neutral**, 120 VAC Neutral Power Supply	
	Ground Stud	

Reset Input

No.	Description	Type
T1	**External Lockout Reset**, Optional (120V = Reset) Either the external Reset OR the LCD RESET button resets Burner Lockout. Connect to a manual pushbutton within sight and sound of the burner. Do not connect to remote pushbuttons or automated contacts.	Input 120 VAC

Operating Mode Inputs

No.	Description	Type
T2	**Alternate Setpoint**, Optional (0V = Setpoint, 120V = Alternate Setpoint) If **P3.7.1 Alt Local SP Option** = Enable and the **BMU** is in LOCAL mode: 0V: The Firing Rate Setpoint is equal to **P3.3.5 Rate Local SP.** 120V: The Firing Rate Setpoint is equal to **P3.7.2 Alt Local SP.** If Remote Setpoint Source = 'OASP' And the **BMU** is in REMOTE mode: 0V : The Firing Rate Setpoint = 'Normal' Outdoor Reset Curve. 120V: The Firing Rate Setpoint = 'Setback' Outdoor Reset Curve.	Input 120 VAC
T3	**Fixed Speed FD Fan** (120V = Fixed Speed, 0V = FD Fan VSD) Note: If VSD is not installed 120V must be applied when fan is to start. **T34** must be energized when VSD is not installed. **T35** must be energized when VSD installed	Input 120 VAC
T4	**LWC Bypass PB** (120 V = Bypass Low Water Cutouts) Low Water Cutout Blowdown Bypass Pushbutton.	Input 120 VAC

Non-Interlock Alarm Inputs

No.	Description	Type
T5	**Low Water Alarm**, Optional (120 V = Alarm)	Input 120 VAC
T6	**High Water Alarm**, Optional (120 V = Alarm)	Input 120 VAC

Call for Heat (CFH) Inputs

No.	Description	Type
T7	**Warm Standby, Low Fire Hold or DHW Override,** Optional **P3.9.1 Warm Standby Option, P3.11.1 Low Fire Hold Option,** and **P3.8.1 DHW Override Option** configure this terminal. If **P3.9.1 Warm Standby Option** = 'Terminal7' or 'SensorAndTerm7': 0V = The Boiler is Warm (Stop Burner or Release Low Fire Hold) 120V = The Boiler is Cool (Start Burner or Hold at Low Fire) **P3.11.1 Low Fire Hold Option**- reference the Parameter Guide for details. **P3.8.1 DHW Override Option** = 'Enable': 120V = Activate the Domestic Hot Water (DHW) override Setpoint and CFH logic. NOTE: **DHW Override** cannot be enabled if either **Warm Standby** or **Low Fire Hold** are enabled (and vice versa).	Input 120 VAC
T8	**Local Call for Heat (CFH) Start**, Optional (120 V = CFH) **BMU** Local mode CFH: contact, pressure switch, or temperature switch Input. See **P3.2.1 CFH Local Mode** for further details.	Input 120 VAC
T9	**Remote Call for Heat (CFH) Start** (120 V = CFH) **BMU** Remote mode CFH: contact, Lead-Lag controller contact, pressure switch, or temperature switch Input. See **P3.2.3 CFH Remote Mode** for further details.	Input 120 VAC

Recycling Limit Inputs

No.	Description	Type
T10	**Burner On / Off Switch** (0V = Stop, 120 V = Run) See also Emergency Stop **T29**	Input 120 VAC
T11	**Operating Limit** (Steam Pressure or Water Temperature)(120 V = Run)	Input 120 VAC
T12	**Low Water Level Cutout** (0 V = Low Water Level) Jumper to 120V if not installed.	Input 120 VAC
T13	**Low Water Flow** (Hot Water Boiler) (0 V = Low Flow) Jumper to 120V if not installed.	Input 120 VAC
T14	Fresh Air Damper Open (120 V = Damper Open) See **P1.5.1 FD Fan Start Mode** to delay FD starts until this Limit makes. Jumper to 120V if not installed.	Input 120 VAC
T15	**Recycling Limit Spare 1** (0 V = Shutdown Burner) Jumper to 120V if not installed.	Input 120 VAC

Fuel Specific Non-Recycling Limit Inputs

No.	Description	Type
T16	**External Oil (Fuel1) Request**, Optional (120 V = Oil Requested) See **P1.1.4 Fuel Request Source**	Input 120 VAC
T17	**High Oil Pressure** (0 V = High Pressure) Reference **P1.6.2** for delay options.	Input 120 VAC
T18	**Low Oil Pressure** (0 V = Low Pressure) Reference **P1.6.2** for delay options.	Input 120 VAC
T19	**Low Atomizing Steam (or Air) Pressure** (0 V = Low Pressure)	Input 120 VAC
T20	**Low Atomizing Steam (or Air) Flow** (0 V = Low Flow or Pressure) Reference **P1.6.3** for delay options.	Input 120 VAC
T21	**High/Low Oil Temperature** (0 V = High Temp or Low Temp) Wire High and Low Oil temperature switches in series. Jumper for Light Oil.	Input 120 VAC
T22	**Oil Gun in Firing Position** (120 V = In Firing Position)	Input 120 VAC
T23	**External Gas (Fuel2) Request** (120 V = Gas Requested) See **P1.1.4 Fuel Request Source**	Input 120 VAC
T24	**High Gas Pressure** (0 V = High Pressure) Reference **P1.6.2** for delay options.	Input 120 VAC
T25	**Low Gas Pressure** (0 V = Low Pressure) Reference **P1.6.2** for delay options.	Input 120 VAC
T26	**External Fuel 3 Request** (120 V = Fuel 3) See **P1.1.4 Fuel Request Source**	Input 120 VAC
T27	**High Fuel 3 Pressure** (0 V = High Pressure) Reference **P1.6.2** for delay options.	Input 120 VAC
T28	**Low Fuel 3 Pressure** (0 V = Low Pressure) Reference **P1.6.2** for delay options.	Input 120 VAC

NOTE: If any of the above Limits (for an Enabled fuel) are NOT installed, Jumper it to 120V.

Common Non-Recycling Limit Inputs

No.	Description	Type
T29	**Emergency Stop** (0 V = Emergency Stop, 120 V = Normal Operation) Removing power from terminal 29 de-energizes the internal Safety Relay, which de-energizes terminals **T51-T58** (all fuel valves, ignition transformer, and pilot valves).	Input 120 VAC
T30	**Flame Scanner 1** 'Flame On' contact (120 V = Flame Present)	Input 120 VAC
T31	**Flame Scanner 2** 'Flame On' contact, Optional (120 V = Flame Present) See **P1.4.1 Dual Flame Scanners**	Input 120 VAC
T32	**High Limit** (Steam Pressure or Water Temperature) (0 V = High Pressure or Temperature)	Input 120 VAC
T33	**Minimum Air Flow** (0 V = Low Air Flow) Reference **P1.6.1** for delay options.	Input 120 VAC
T34	**FD Fan Energized** (120 V = Full Speed Fan Motor is Energized) If a VSD is driving the FD Fan, terminal **T34** is ignored. See Fixed Speed FD Fan input terminal **T3**.	Input 120 VAC
T35	**Variable Speed Drive** (VSD) FD Fan Running with No Faults (120 V = VSD Running Normally) If a fixed speed motor starter is driving the FD Fan, terminal **T35** is ignored. See Fixed Speed FD Fan input terminal **T3**.	Input 120 VAC
T36	**Low-Low Water Level Cutout** (0 V = Low-Low Water Level)	Input 120 VAC
T37	**High Water Level Cutout**, Optional (0 V = High Water Level) Jumper to 120V if not installed.	Input 120 VAC
T38	**Low Draft Cutout** (also known as 'High Flue Pressure')(0 V = Higher Pressure) See **P1.6.4 Low Draft Cutout Delay**. Jumper to 120V if not installed.	Input 120 VAC
T39	**ID Fan Energized** (120 V = ID Fan Motor is Energized) Either Fixed or Variable Speed Drive motors. For Variable Speed Drive ID Fans, connect to the VSD 'Running with No Faults' contact. See **P1.1.6 ID Fan Installed**	Input 120 VAC
T40	**FGR Fan Energized** (120 V = FGR Fan Motor is Energized) Jumper to 120V if not installed.	Input 120 VAC
T41	**Non-Recycling Limit Spare1** (0 V = Lockout the Burner)	Input 120 VAC

Non-Recycling Spare Limits or Leak Test Switch Inputs

No.	Description	Type
T42	**Non-Recycling Limit Spare 2** or **High Leak Test Pressure** **P1.8.1 Gas (Fuel 2) Leak Test** option configures this terminal. When **P1.8.1 Gas (Fuel 2) Leak Test** option = 'DISABLED' : Terminal **T42** is Non Recycling Limit Spare 2 Input (0V = Lockout the Burner). Jumper to 120V if not installed. When **P1.8.1 Gas (Fuel 2) Leak Test** option = 'ENABLED' : Terminal **T42** is the High Leak Test Pressure switch Input. (Timing = **P1.8.3**) (120V = Pressure is above the high setpoint)	Input 120 VAC
T43	**Non-Recycling Limit Spare 3** or **Low Leak Test Pressure** **P1.8.1 Gas (Fuel 2) Leak Test option** configures this terminal. If **P1.8.1 Gas (Fuel 2) Leak Test** option = 'DISABLED' : Terminal **T43** is Non Recycling Limit Spare 3 Input (0V = Lockout the Burner) Jumper to 120V if not installed. If **P1.8.1 Gas (Fuel 2) Leak Test** option = 'ENABLED' : Terminal **T43** is the Low Leak Test Pressure switch Input (timing = **P1.8.4**) (120V = Pressure is below the low setpoint)	Input 120 VAC

Purge & Ignition Interlock Inputs

No.	Description	Type
T44	**Draft Purge/Ignition Interlock**, Optional (120 V = ready to purge and start the Pilot Trial for Ignition) Required if \`Draft Control Option' is set to FloatingServo, PIDServo, or PIDVSDandServo and **P4.3.3** \`Draft Servo Check' is set to DISABLE. An interlock switch to prove outlet damper is open and/or the ID VSD is up to minimum speed must be wired to **T44**. Also required if **P4.1.1** \`Draft Control Option' is set to Floating420, FloatingVSD, PID420, PIDVSD, PIDVSDandServo, or PIDVSDand420. An interlock switch to prove the outlet damper is open and/or the ID VSD is up to a minimum speed must be wired to **T44**. If an outlet damper servo only is used, reference **P4.3.3** Note that **T44** must remain energized during both Purge and PTFI.	Input 120 VAC
T45	**Null FGR Trim**, from the remote windbox O2 analyzer indicating a problem and to stop FGR trim operation.	Input 120 VAC
T46	**Purge Air Flow Interlock,** Optional (120 V = Purge Flow Proven) Usage depends on system design and Code Requirements. If installed, set **P1.1.5 PAF Switch Installed** = Yes	Input 120 VAC
T47	**Oil (Fuel 1) SSOV Proof Of Closure (POC)** (120 V = Valves Closed) If not required by Code, and not installed: Set **P1.3.3 Fuel1 Proof Of Closure Installed** = No.	Input 120 VAC
T48	**Gas (Fuel 2) SSOV Proof Of Closure (POC)** (120 V = Valves Closed) **P1.8.1 Gas (Fuel 2) Leak Test** option configures this terminal. If **P1.8.1 Gas (Fuel 2) Leak Test** option = DISABLED: Connect all Gas (Fuel 2) SSOV POCS, in series, to this input. If not installed and not required by Code, Set **P1.3.4 Fuel2 Proof Of Closure Installed** = No. If **P1.8.1 Gas (Fuel 2) Leak Test** option = ENABLED: Connect only the Upstream Gas (Fuel2) SSOV POC to this input.	Input 120 VAC
T49	**Fuel 3 SSOV Proof Of Closure** or Second Gas (Fuel 3) SSOV Proof Of Closure (120 V = Valves Closed) **P1.8.1 Gas (Fuel 2) Leak Test** option configures this terminal. If **P1.8.1 Gas (Fuel 2) Leak Test** option = DISABLED: Connect all Fuel 3 SSOV POCS, in series, to this input. If not installed and not required by Code, Set **P1.3.5 Fuel3 Proof Of Closure Installed** = No. If **P1.8.1 Gas (Fuel 2) Leak Test** option = ENABLED: Connect only the Downstream Gas (Fuel2) SSOV POC to this input.	Input 120 VAC

Safety Relay Protected Outputs

No.	Description	Type
T51	**Ignition Transformer** See **P1.1.7 Ignition Xfmr Mode** Rating: 120Vac, 5A transformer	Output 120 VAC
T52	**Pilot Gas Valve** See **P1.1.7 Ignition Xfmr Mode** Rating: 120Vac, 2A pilot duty	Output 120 VAC
T53	**Atomizing Steam (or Air) Valve for Oil firing** Rating: 120Vac, 2A pilot duty	Output 120 VAC
T54	**Oil (Fuel 1) SSOVs** Rating: 120Vac, 2A pilot duty or 65 VA pilot duty plus 1250 VA opening / 500 VA holding motorized valve See **P1.1.8 Oil MTFI Sec** and **P1.1.1 Fuel 1 Enable**	Output 120 VAC
T55	**Oil Gun Post Purge** Rating: 120Vac, 2A pilot duty See **P1.9.1 Oil Gun Purge Option**	Output 120 VAC
T56	**Gas (Fuel 2) SSOV** Reference **P1.1.2 Fuel 2 Enable** Rating: 120Vac, 2A pilot duty or 65 VA pilot duty plus 1250 VA opening / 500 VA holding motorized valve If **P1.8.1 Gas (Fuel 2) Leak Test** option = DISABLED: **Connect all Gas (Fuel 2) SSOVs in parallel, to this output.** If **P1.8.1 Gas (Fuel 2) Leak Test** option = ENABLED: Connect only the Upstream Gas (Fuel2) SSOV to this output.	Output 120 VAC
T57	**Fuel 3 SSOV or Gas (Fuel 2) Downstream SSOV** Reference **P1.1.3 Fuel 3 Enable** Rating: 120Vac, 2A pilot duty or 65 VA pilot duty plus 1250 VA opening / 500 VA holding motorized valve If **P1.8.1 Gas (Fuel 2) Leak Test** option = DISABLED: Connect all Fuel 3 SSOVs in parallel, to this output. If **P1.8.1 Gas (Fuel 2) Leak Test** option = ENABLED: Connect only the Downstream Gas (Fuel2) SSOV to this output.	Output 120 VAC
T58	**Gas (Fuel 2) Leak Test Vent Valve** Rating: 120Vac, 2A pilot duty If **P1.8.1 Gas (Fuel 2) Leak Test option** = DISABLED: Do NOT connect anything to this output. If **P1.8.1 Gas (Fuel 2) Leak Test option** = ENABLED: Connect the Gas (Fuel2) Vent Valve to this output.	Output 120 VAC

Auxiliary Relay Outputs

No.	Description	Type
T59	**Auxiliary Relay 1 P1.7.1 Aux Relay 1 Function** configures this output Rating: 120Vac, 5A pilot duty	Output 120 VAC
T60	**Lockout Alarm Relay** Lockout Alarm Rating: 120Vac, 2A pilot duty	Output 120 VAC
T61 **T62**	**FD Fan Motor Starter Isolated Contact** Rating: 120Vac, 5A pilot duty, ½ Hp Reference **P1.5.1, P1.5.2** and **P1.5.3** for FD Fan start options.	Output Dry Contact
T63	**Auxiliary Relay 2 P1.7.2 Aux Relay 2 Function** configures this output Rating: 120Vac, 5A pilot duty	Output 120 VAC
T64 **T65** **T66**	NC **Auxiliary Relay 3** Isolated SPDT relay contacts. C **P1.7.3 Aux Relay 3 Function** configures this output NO Rating: 120Vac, 5A pilot duty	Output Dry Contact
T67 **T68** **T69**	NC **Auxiliary Relay 4** Isolated SPDT relay contacts. C **P1.7.4 Aux Relay 4 Function** configures this output NO Rating: 120Vac, 5A pilot duty	Output Dry Contact
T70 **T71** **T72**	NC **Auxiliary Relay 5** Isolated SPDT relay contacts. C **P1.7.5 Aux Relay 5 Function** configures this output NO Rating: 120Vac, 5A pilot duty	Output Dry Contact

Communication Terminals

No.	Description	Type
COM1: **RS485+** **RS485-** **SHIELD**	**Modbus Slave Communications Port** For Touchscreen or SCADA communications	RS485
COM2:	Not Used	
OUT **24Vdc+** **24Vdc-** **COMM+** **COMM-** **SHIELD**	**Servo and LCD Display Communications Port** 24 VDC: 350 mA maximum load (Internal Power Supply only)	RS485

Firing Rate Control Analog Inputs

No.	Description	Type
T100 24 VDC+ **T101**+ Input **T102** -	**AI1: Scanner 1 Flame Intensity Input** See **P1.4.2 Flame Scanner 1 Signal** SW1-1 = ON = Internal 250 ohm resistor from Terminal **T101** to **T102**	4-20 mA, 0-20 mA, 0-5 VDC
T103 24 VDC+ **T104** + Input **T105** -	**AI2: Scanner 2 Flame Intensity Input,** Optional See **P1.4.3 Flame Scanner 2 Signal** SW1-2 = ON = Internal 250 ohm resistor from Terminal **T104** to **T105**	4-20 mA, 0-20 mA, 0-5 VDC
T106 + **T107** -	**Optional Combustion Control External + 24 VDC Power Supply Input** (only used for NFPA 85 compliant installations)	
T108 24 VDC+ **T109** 5.00Vdc+ **T110** + Input **T111** - & Shield	**AI3: Boiler Outlet Water Temperature** or **Boiler Steam Pressure** See **P3.1.1 Sensor Channel, Boiler Outlet** Wiring: Thermistor: **T109-T110**, **BMU** powered 4-20mA: **T108-T110**, External powered 4-20 mA and 0-5 VDC: **T110-T111**	10k Thermistor 4-20 mA, 1-5 VDC or 0-5 VDC
T112 + Input **T113** - & Shield	**AI4: Remote Boiler Outlet Setpoint** or **Remote Firing Rate** See **P3.2.4 Remote Modulation** External powered	4-20 mA, 1-5Vdc 0-5 VDC
T114 5.00Vdc+ **T115** + Input **T116** - & Shield	**AI5: Outdoor Air** or **Boiler Warm-up Shell Temperature** See **P3.9.4 Sensor Channel, Warm-up** and **P3.5.1 Sensor Channel, Outside Air** Wiring: Thermistor: **T114-T115**, **BMU** powered 4-20mA: **T129-T115**, External powered 4-20 mA and 0-5 VDC: **T115-T116**	10k Thermistor 4-20 mA, 1-5 VDC or 0-5 VDC
T117 + **T118** - (red)	**AI6: Boiler Outlet Water** or **Boiler Warm-up Shell Temperature** See **P3.1.3 Sensor Channel, Boiler Outlet** and **P3.9.4 Sensor Channel, Warmup**	TC Type J or K
T127 + Input **T128** - & Shield	**AI7: FD Fan Variable Speed Drive Speed Feedback** (Externally powered 4-20 mA) Reference **P2.2.2 VSD FB Adjust**	4-20 mAdc
T129 24Vdc+ **T130** + Input **T131** - & Shield	**AI8: FGR Fan Variable Speed Drive Speed Feedback** (Externally powered 4-20 mA) Reference **P2.3.1 FGR Fan VSD Option**	4-20 mAdc

Firing Rate Control Analog Outputs

No.	Description	Type
T132 + **T133** -	**AO1: FD Fan Variable Speed Drive Speed Command** (4 mA = 0 Hz, 20 mA = 60 Hz)	4-20 mAdc
T134 + **T135** -	**AO2: FGR Fan Variable Speed Drive Speed Command** (4 mA = 0 Hz, 20 mA = 60 Hz)	4-20 mAdc

Oxygen Analyzer Inputs

No.	Description	Type
T79 H 120Vac Supply **T80** N 120Vac Supply **T81** H Heater Output **T82** N Heater Output Ground Lug	**Oxygen Analyzer, Optional** **120 VAC Wiring** Use Preferred P/N 190130 cable. Connect **BMU** terminal **T81** to ZP Probe terminal 1 Connect **BMU** terminal **T82** to ZP Probe terminal 2 Maximum Cold Start Load: 70 watts, Operating: approx 35 watts	
S Shield **T143** Cell R T/C + **T144** Cell R T/C – (red) **S** Shield **T145** Cell mV - **T146** Cell mV + **T147** Flue T/C + **T148** Flue T/C – (red)	**Oxygen Analyzer, Optional** **Low Voltage Signal Wiring** See **P2.4.1 O2 Analyzer Option, P1.10.1 Flue Gas T/C Type** and **P3.12.1 FGR Temp. Low Fire Hold Option** Use Preferred P/N 190130 cable. **AI9:** Connect **BMU** terminal **T143** to ZP Probe terminal 3 Connect **BMU** terminal **T144** to ZP Probe terminal 4 **AI10:** Connect **BMU** terminal **T145** to ZP Probe terminal 5 Connect **BMU** terminal **T146** to ZP Probe terminal 6 **AI11:** If Flue Gas Temperature Thermocouple is not installed, Jumper terminal **T147** to **T148**	

BurnerMate Universal I/O Expansion Board Analog Inputs

No.	Description	Type
T150 24 VDC+ **T151** + Input **T152** - & Shield	**AI12: Oil Flow Rate**, Optional Reference **P2.7.1** to **P2.7.5** for set up instructions. Do not use this input if **AI16** is being used.	4-20 mAdc
T153 24 VDC+ **T154** + Input **T155** - & Shield	**AI13: Natural Gas Flow Rate**, Optional Reference **P2.8.1** to **P2.8.3** for set up instructions	4-20 mAdc
T156 24 VDC+ **T157** + Input **T158** - & Shield	**AI14: User Configured Analog Input**, Optional. This input can be used for only one of the three following options: 1) Natural Gas Pressure- for flow compensation, reference **P2.8.4** to **P2.8.6** 2) Fuel 3 Flow Rate- reference **P2.9.1** to **P2.9.3** 3) Atomizing Steam Pressure- reference **P6.1.1** to **P6.1.3**	4-20 mAdc
T159 24 VDC+ **T160** + Input **T161** - & Shield	**AI15: Air Flow**, Optional Reference **P2.11.1** for instructions.	4-20 mAdc
T162 24 VDC+ **T163** + Input **T164** - & Shield	**AI16: Oil Flow Pulse Sensor Input**, Optional Reference **P2.7.1** to **P2.7.5** for set up instructions. Do not use this input if **AI12** is being used.	Pulse
T165 24 VDC+ **T166** + Input **T167** - & Shield	**AI17: Drum Level**, Optional See Tab 3 Feedwater Control. Reference **P5.1.3** and **P5.1.4** for transmitter zero and span settings.	4-20 mAdc
T168 24 VDC+ **T169** + Input **T170** - & Shield	**AI18: Steam Flow**, Optional See Tab 3 Feedwater Control. Reference **P5.3.1 Decimal Point, Steam Flow**	4-20 mAdc
T171 24 VDC+ **T172** + Input **T173** - & Shield	**AI19: Feedwater Flow**, Optional See Tab 3 Feedwater Control. Reference **P5.4.1 Decimal Point, Feedwater Flow**	4-20 mAdc
T175 + Input **T176** - Input	**AI20:** Windbox Oxygen level input from a remote analyzer. Reference **P2.14.1** and **P2.14.2**	4-20 mAdc
T177 5.00 VDC+ **T178** + Input **T179** - & Shield	**AI21: User Configured Analog Input**, Optional. This input can be used for only one of the two following options: 1) Combustion Air Temperature to compensate the air flow. Reference **P2.11.2** 2) Outdoor Air Temperature, reference **P2.11.2** and **P3.5.1**	10k Thermistor
T180 24 VDC+ **T181** + Input **T182** - & Shield	**AI22: Draft Pressure**, Optional See Tab 3 Draft Control. Reference **P4.1.1** to **P4.1.3**	4-20 mAdc

BurnerMate Universal I/O Expansion Board Analog Outputs

No.	Description	Type
T186 + **T187** - **T188** Shield	**AO3: Feedwater Valve** or **Feedwater Pump Variable Speed Drive Speed Command, Optional** See Section 3 Feedwater Control. Reference **P5.1.2 Valve/Pump Output Type**	4-20 mAdc
T189 + **T190** - **T191** Shield	**AO4: Outlet Draft Damper Actuator**, Optional See Section 3 Draft Control Reference **P4.x.x** for Draft Control Option	4-20 mAdc
T192 + **T193** - **T194** Shield	**AO5: ID Fan Variable Speed Drive Speed Command**, Optional See Section 3 Draft Control. Reference **P4.x.x** for Draft Control Option	4-20 mAdc
T195 + **T196** **-** **T197** Shield	**AO6: Current Firing Rate 0-100%** Optional output	4-20 mAdc

Analog Input / Output Ratings:

5.00 VDC supply terminals: 12 mA load per terminal.
24 VDC supply terminal: 35 mA load per terminal.
4-20 mA Inputs have 250 ohm internal resistors.
Parameter selectable 4-20 mA Inputs connect 250 ohms to the Input via internal relay.
Thermistor curve: 10k @ 25C, 817 ohms @ 100C

Dip Switch Detail:

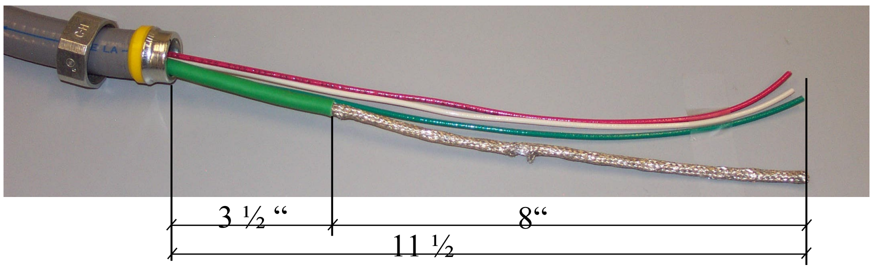
DS1 Hold on pilot light before release to modulate. Must be off (up position) for normal operation.
DS2 Not used in current release
DS3 Not used in current release
DS4 Not used in current release
DS5 Flame scanner 1 input select from 4-20 mA to 0-5 VDC must be on (down position) for use with Preferred flame scanner models BMU-IR, BMU-UV and BMU-UVSC.
DS6 Flame scanner 2 input select from 4-20 mA to 0-5 VDC must be on (down position) for use with Preferred flame scanner models BMU-IR, BMU-UV, and BMU-UVSC.

BurnerMate Universal (BMU) Servo Wiring and Shaft Rotation

<u>Prepare the shielded cable ends before pulling the cables into the servo.</u>

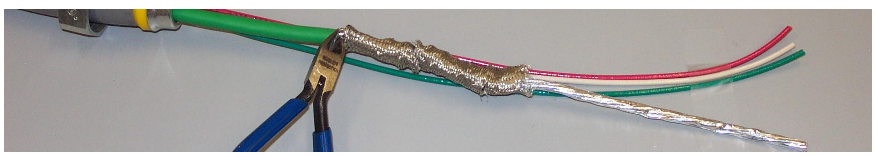
Pull p/n BMU-CABLE along with (3) 16 ga THHN wires through a ½" flex conduit with enough slack for servicing.

Install (2) conduits for daisy chain wiring, <u>one</u> BMU-CABLE & three 16 ga. wires in each conduit (see BMU wiring diagrams). <u>Do not pull (2) shielded cables through one servo conduit connection!</u>



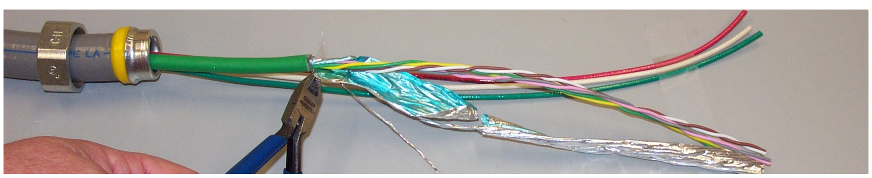
Cut to the length shown

Remove 8" of green cable insulation



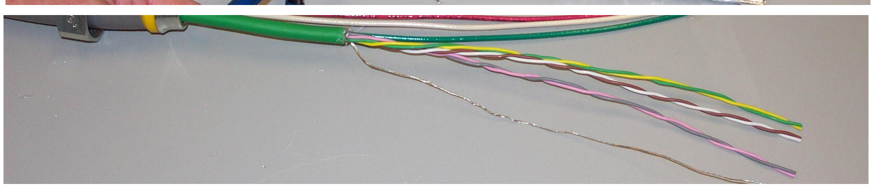
Push back the braided shield. Cut it off

Do not cut off the bare 'drain' wire.



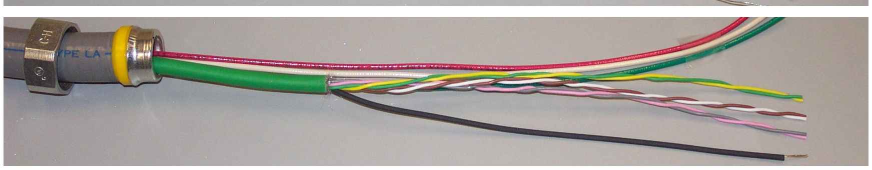
Remove the foil shield.

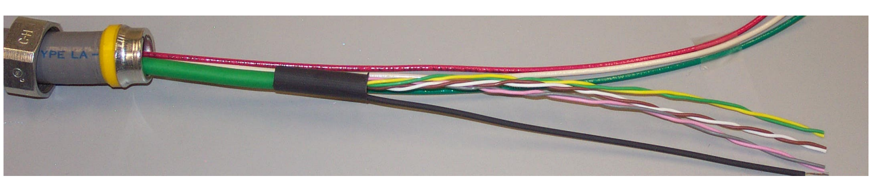
Keep the wire pairs twisted together



Separate the bare 'drain' wire

Mark the pink/gray pairs:
'IN' from the BMU or previous servo
'OUT' to next servo in daisy chain



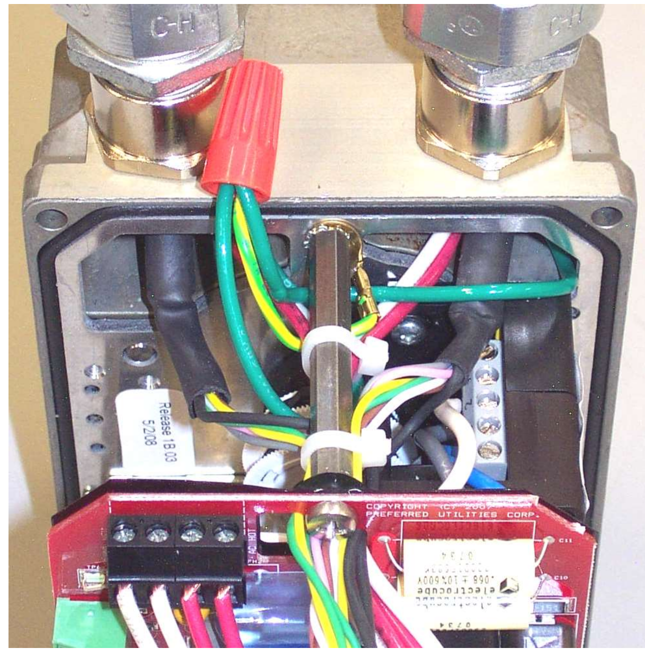


Slide the small insulator tubing over the drain wire and heat-shrink it

Slide the large insulator tubing over the exposed shield braid and heat-shrink it in place

<u>CAUTION:</u> All shielded cable braid, foil, and bare drain wire <u>must be insulated</u>. If any of these touch the conduit, servo metal, ground, or any other exposed wires; electrical noise will be increased!!

After preparing the shielded cable ends, pull the shielded cables and the 120 VAC wires through the conduit connections and into the servo, and connect the flex conduit to the servo.



Use wire ties to route the wires as shown. Keep the wires on the back side of the stand-off to provide clearance for the cover.

Keep the wires away from the white limit switch cam adjustment wheels.

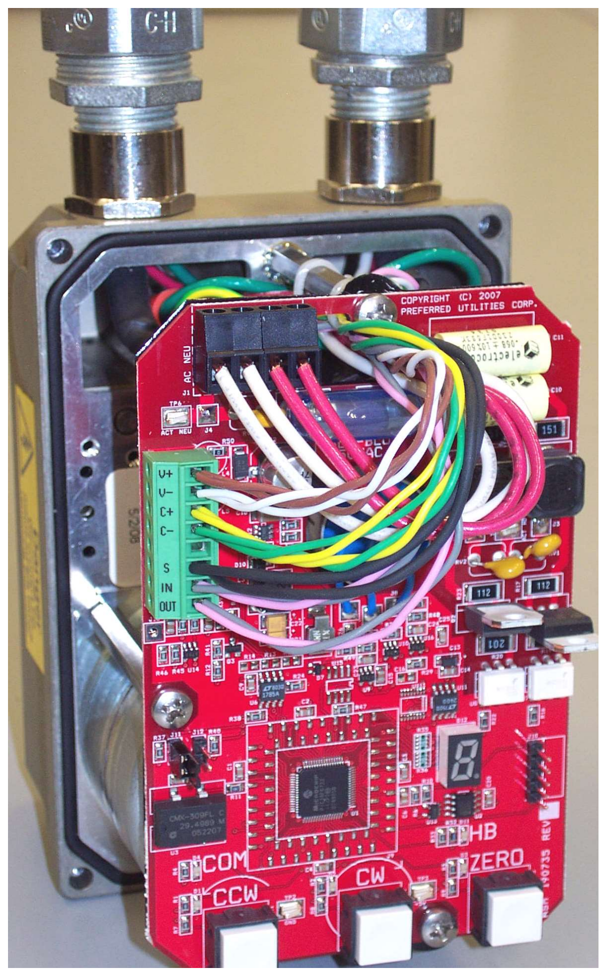
Wire nut the field wiring ground wires to the green/yellow servo ground wire.

Ferrules on the wire ends are recommended to prevent stray strand shorts and to insure good connections.

Very firmly tighten all terminal block screws.

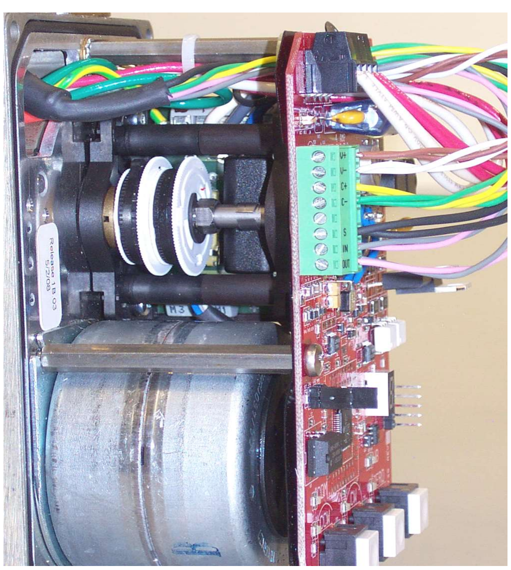
Tug on each individual wire in each terminal to ensure that there is a good connection.

Horizontal AC terminal strip:
Left two terminals: Neutral
Right two terminals: 120 VAC Hot
(terminal pairs are connected internally)



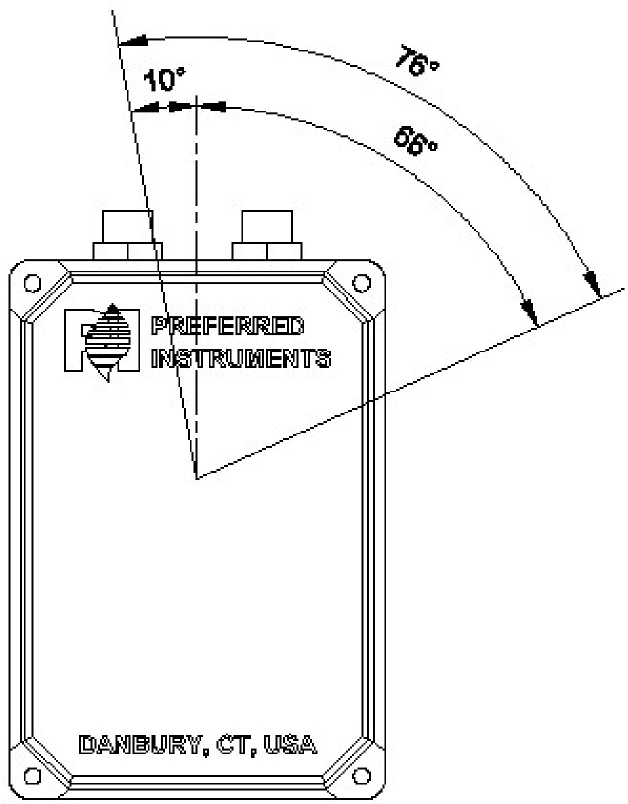
Vertical DC shielded cable terminal strip:

V+	Brown	(+ 24 VDC)
V-	White	(24 VDC Common)
C+	Yellow	(Communications +)
C-	Green	(Communications -)
Blank	not used	
S	Shield drain wire (Heat shrink covered)	
IN	pink/gray pair (from the BMU or the previous servo)	
OUT	Pink/gray pair (to the next servo in the 'daisy chain')	



Shaft Rotation Forbidden Zone

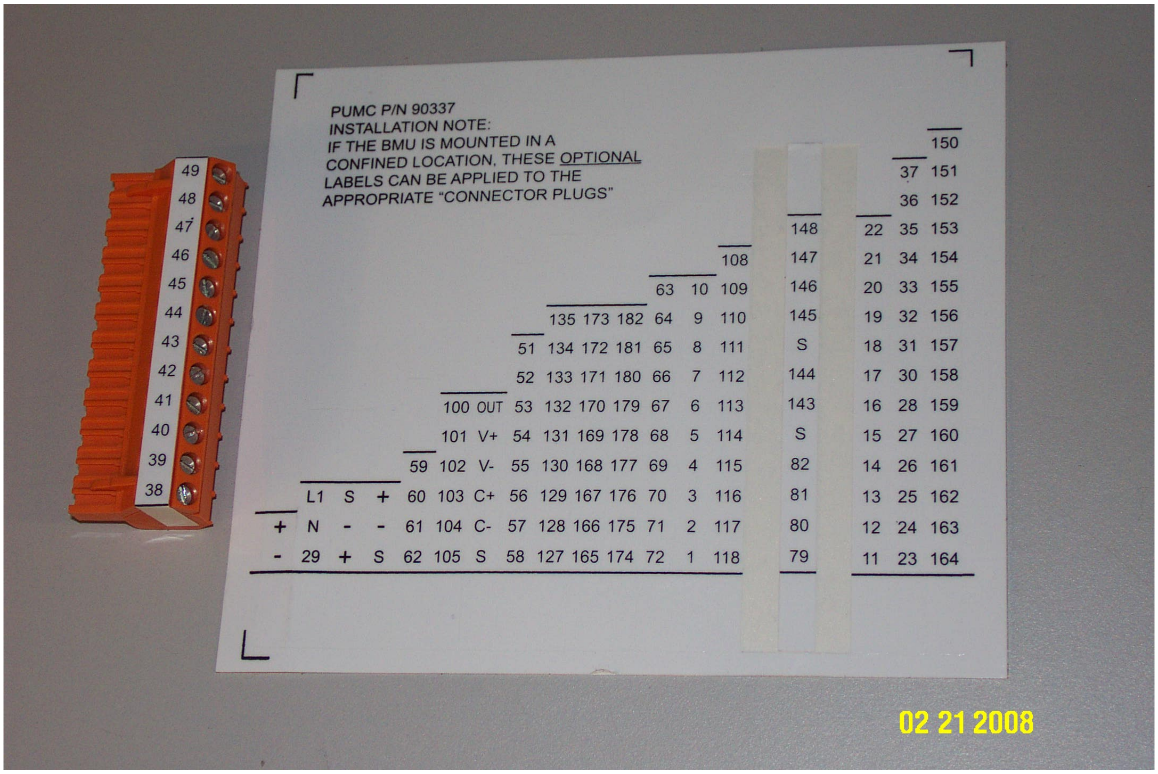
(Perpendicular to the flat on the shaft)



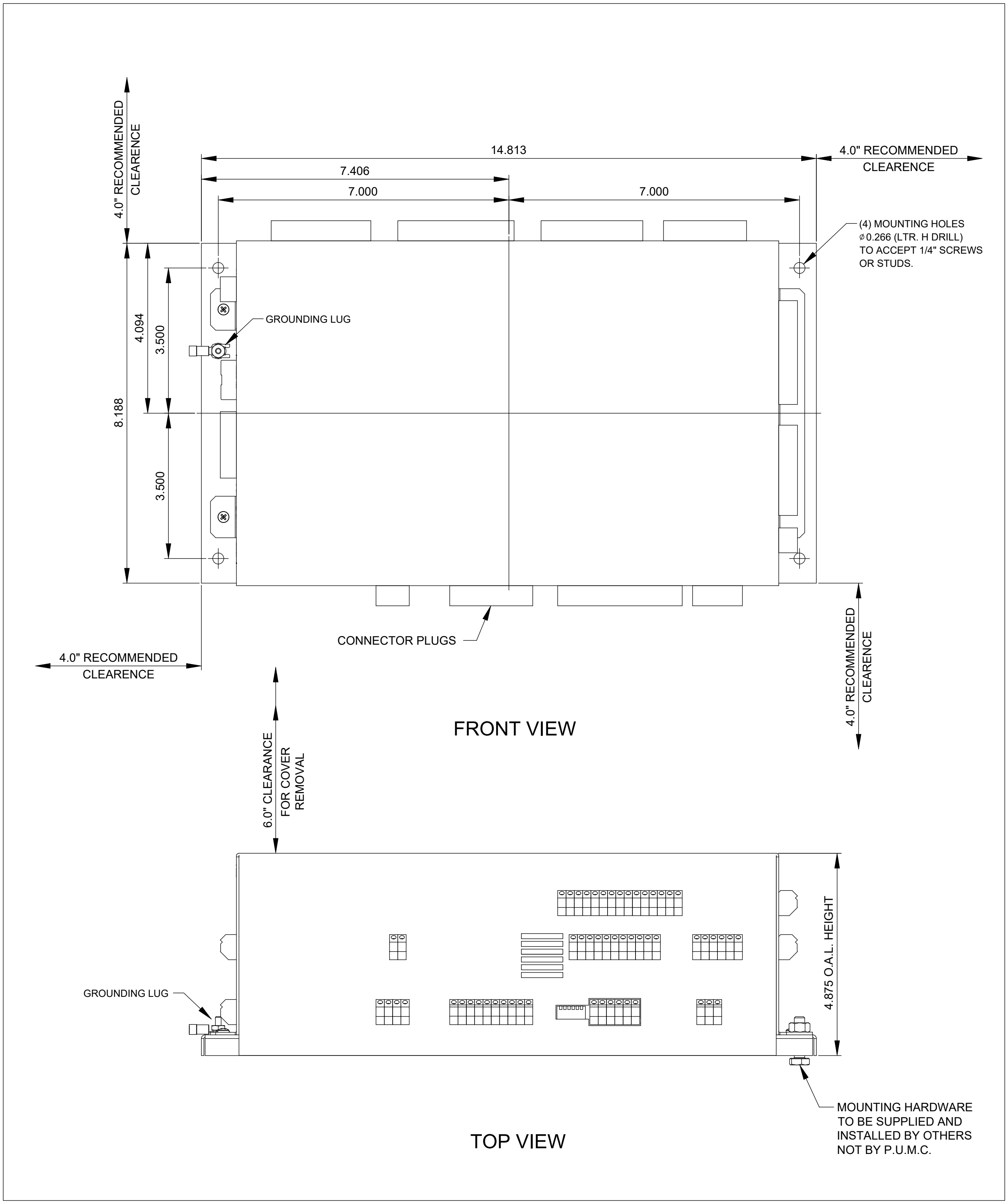
Typical for BMU-SM-03, BMU-SM-15, BMU-SM-37 Servos

Terminal Connector Plugs - Labels

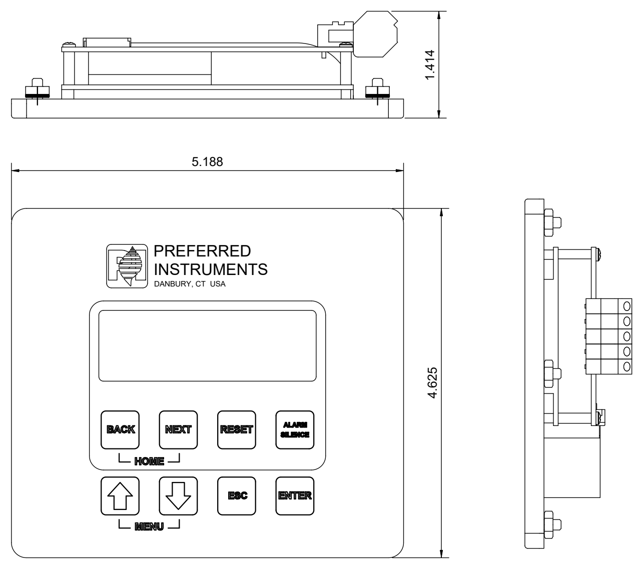
In many cases, both with pre-wired standard panels and retrofits in an existing panel, the terminal connector plugs end up in a confined area where viewing of the terminal number on the **BurnerMate Universal** cover is impossible. For those installations Preferred Instruments provides labels that can be placed on the appropriate connector plug.



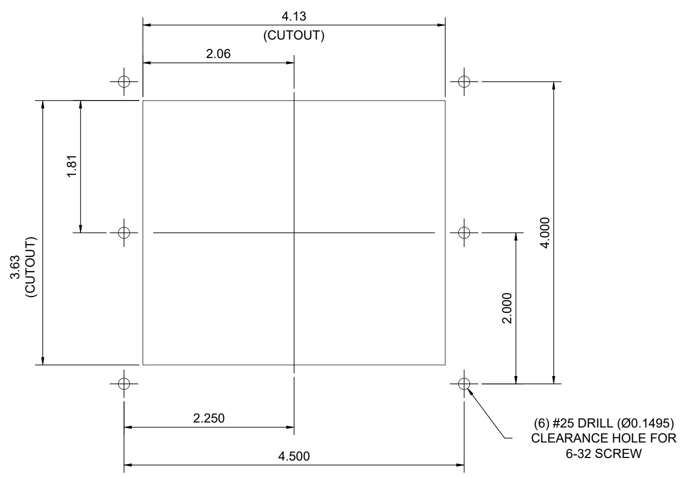
BurnerMate Universal
Control Chassis Mounting



BurnerMate Universal
LCD Mounting

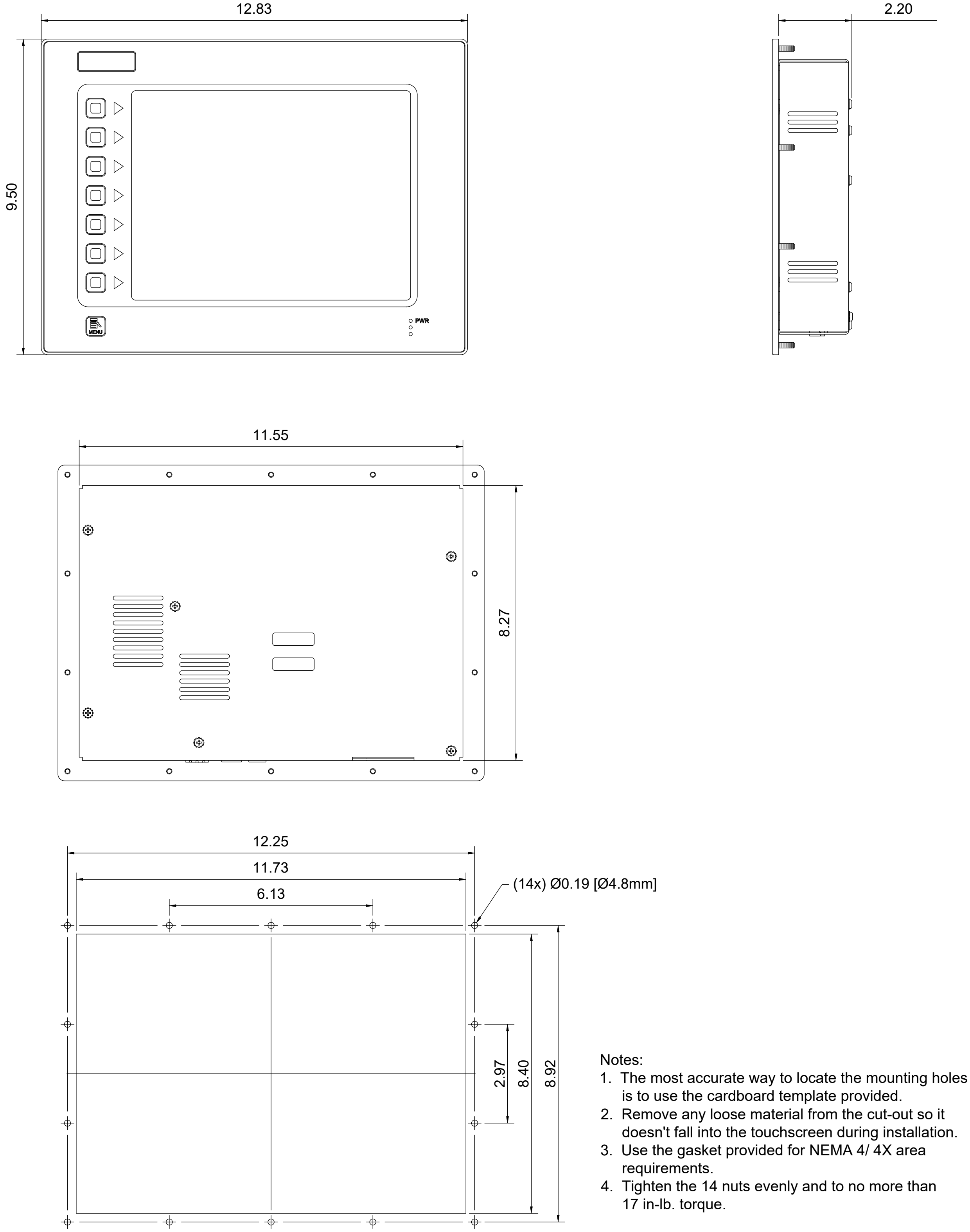


LCD DISPLAY
OVERALL DIMENSIONS



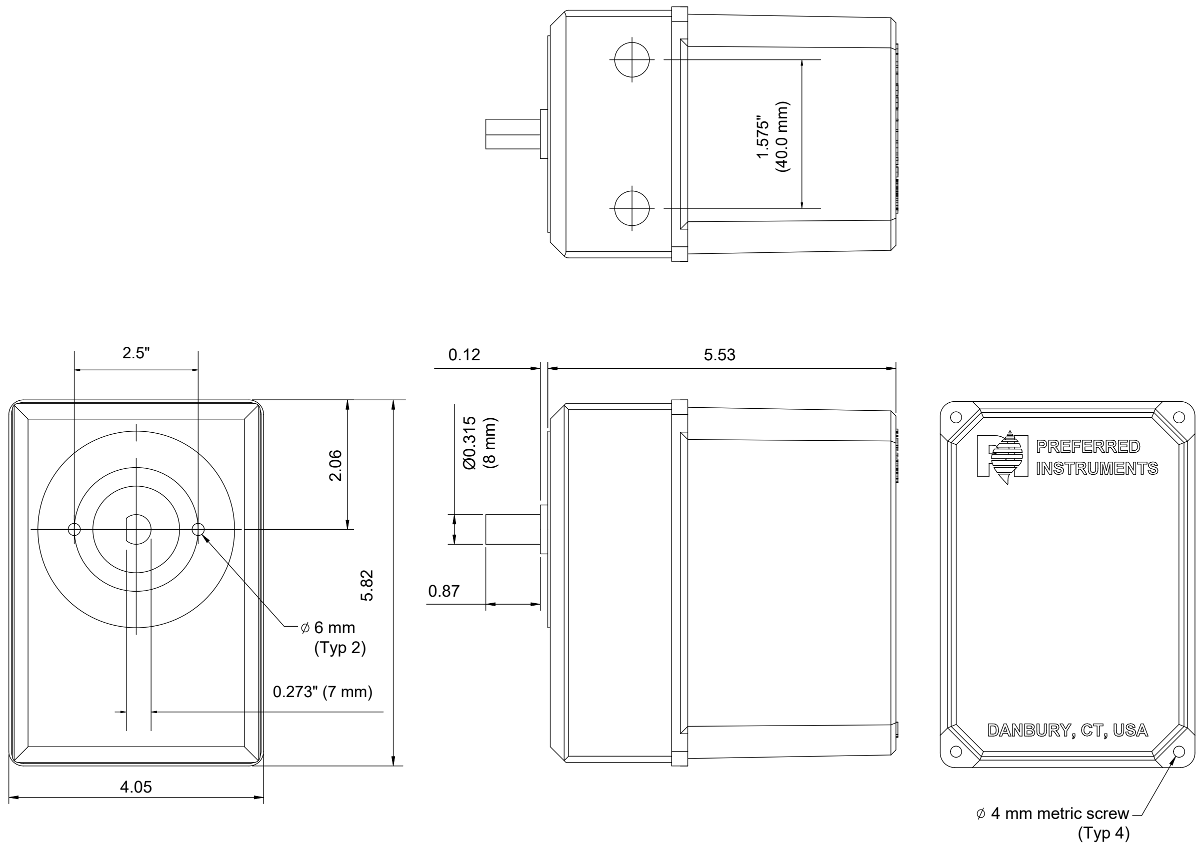
LCD DISPLAY
CUTOUT DIMENSIONS

BurnerMate Universal
10" Touchscreen Mounting

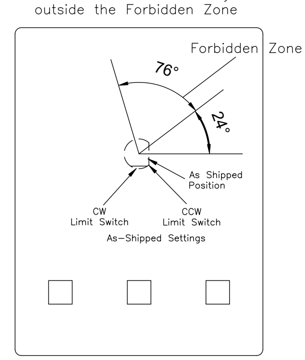


Notes:
1. The most accurate way to locate the mounting holes is to use the cardboard template provided.
2. Remove any loose material from the cut-out so it doesn't fall into the touchscreen during installation.
3. Use the gasket provided for NEMA 4/ 4X area requirements.
4. Tighten the 14 nuts evenly and to no more than 17 in-lb. torque.

BurnerMate Universal
SM-3 Servo Dimensions



Limit Switches can be set anywhere outside the Forbidden Zone



Shaft Viewed from Servo Pushbuttons
(Looking through the back of the Servo)

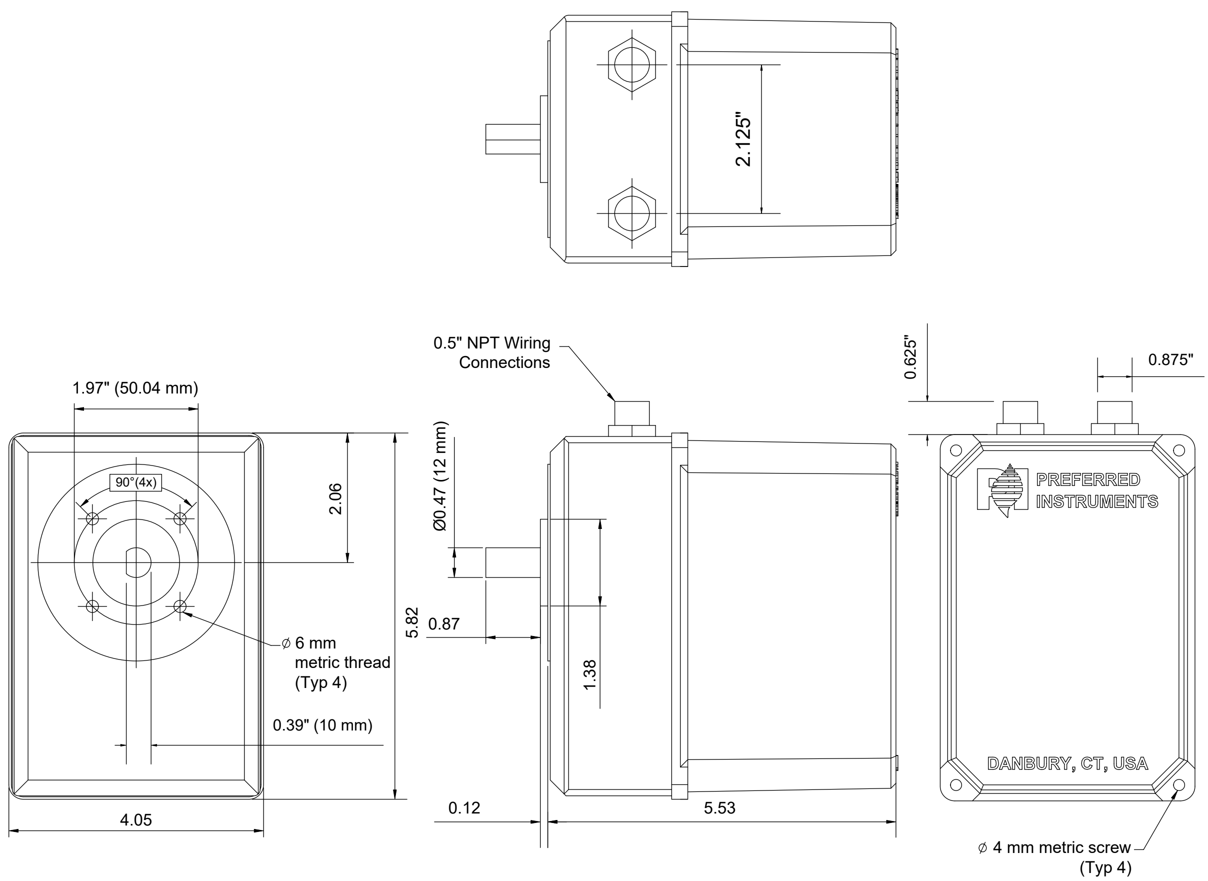
PREFERRED INSTRUMENTS
31-35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Mfg. Corp.

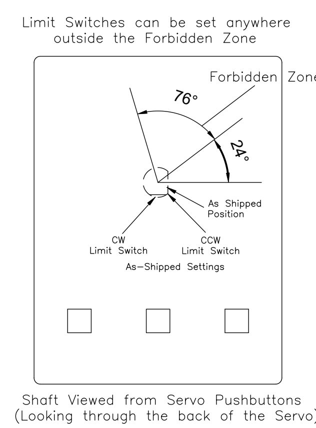
BMU-SM-3 SERVO RATINGS

Torque:	3 ft-lb
Speed:	25 sec/ 90°
Rotation:	15° - 180°
Ambient:	32°F - 131°F
Duty Cycle:	100%
Orientation:	Any
Motor:	120 Vac, 60 Hz, 5 VA
Positioner:	24 Vdc, 22 mA

See BMU Manual for Wiring

BurnerMate Universal
SM-15 Servo Dimensions





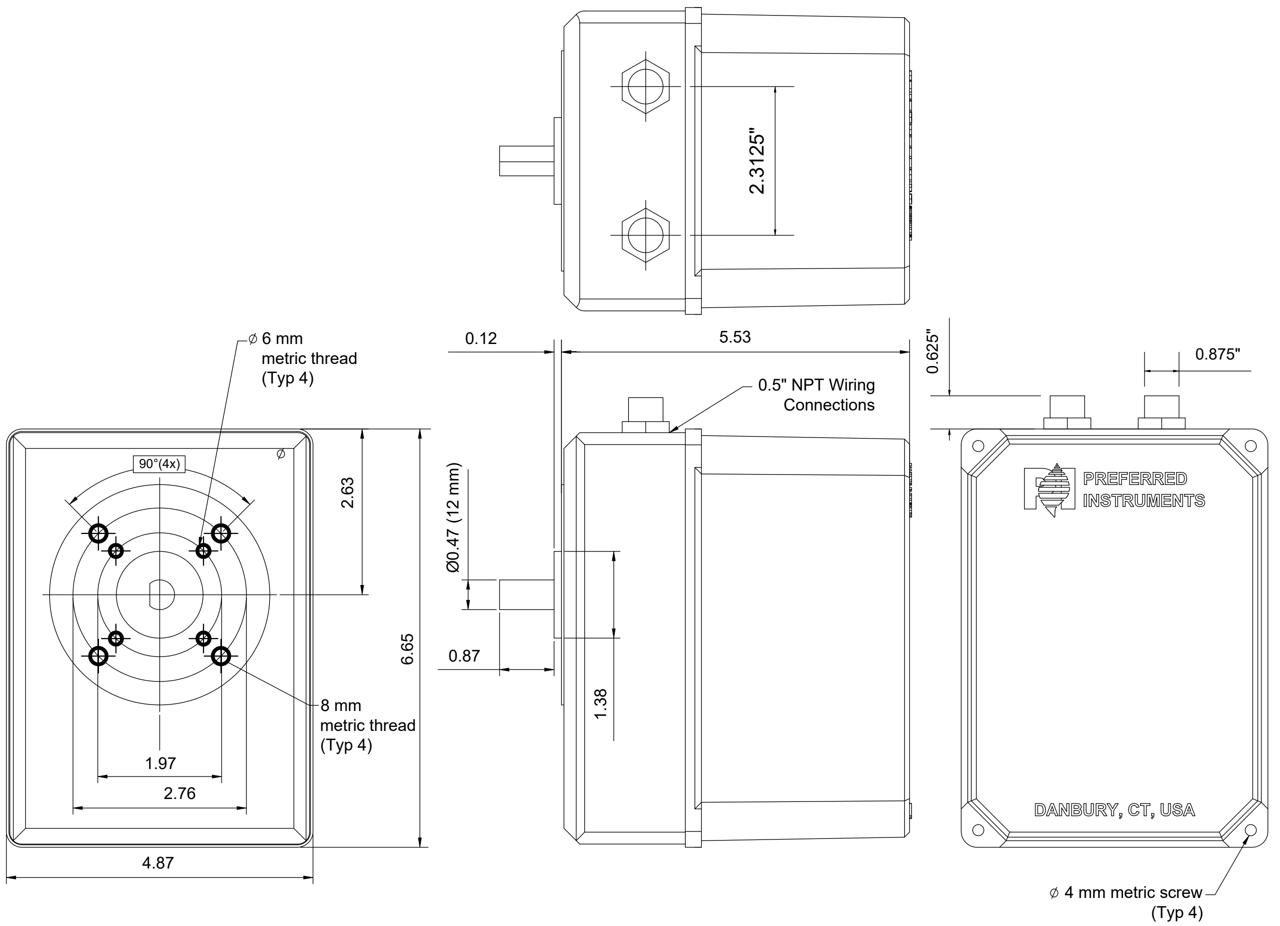
PREFERRED INSTRUMENTS
31-35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Mfg. Corp.

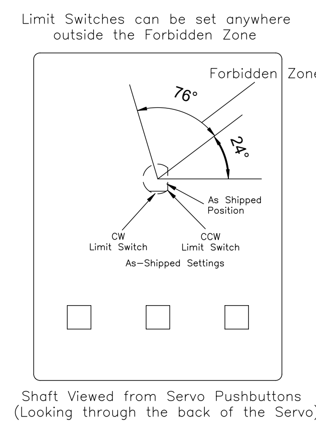
BMU-SM-15 SERVO RATINGS

Torque:	15 ft-lb
Speed:	25 sec/ 90°
Rotation:	15° - 180°
Ambient:	32°F - 131°F
Duty Cycle:	100%
Orientation:	Any
Motor:	120 Vac, 60 Hz, 5 VA
Positioner:	24 Vdc, 22 mA

See BMU Manual for Wiring

BurnerMate Universal
SM-37 Servo Dimensions





PREFERRED INSTRUMENTS
31-35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Mfg. Corp.

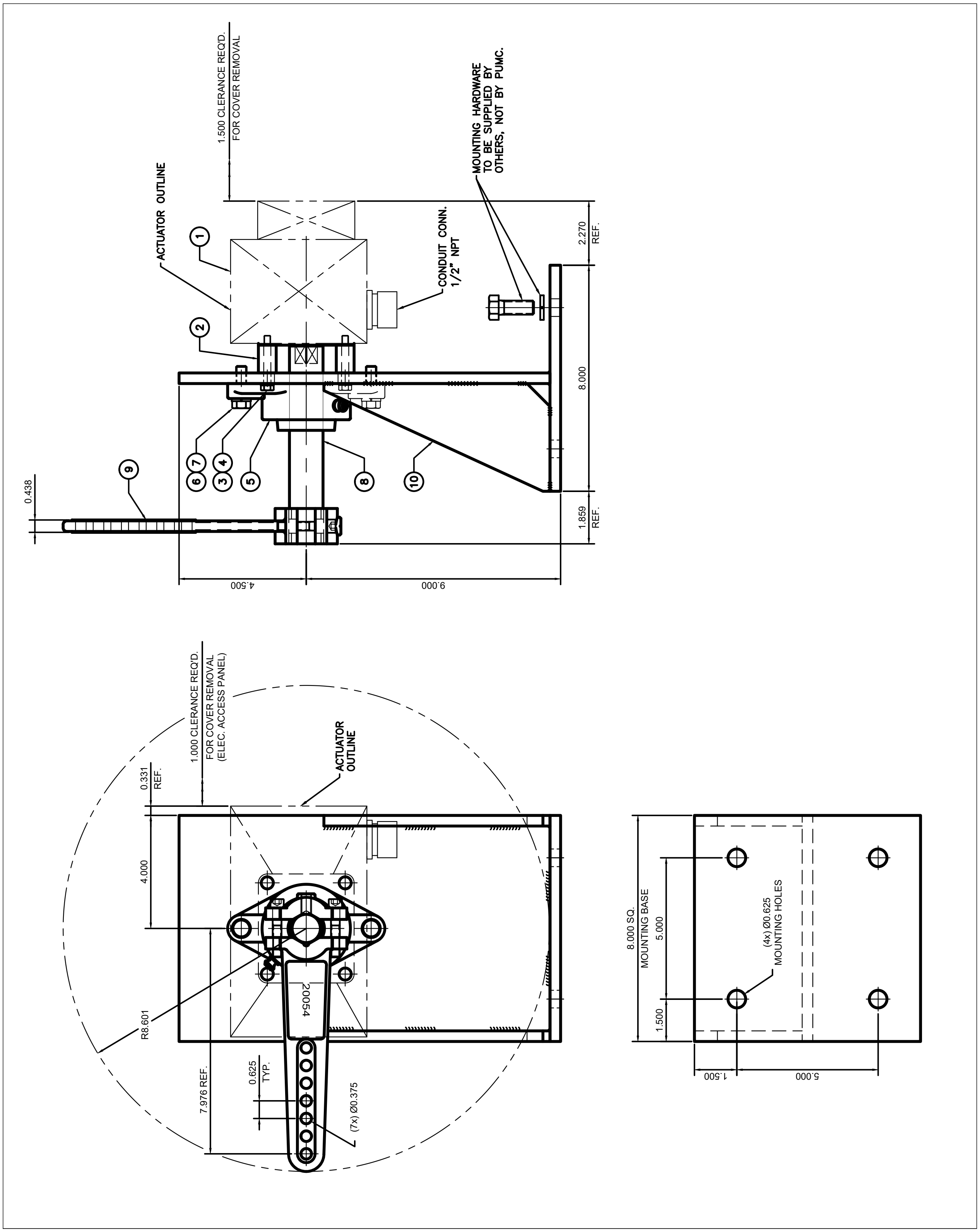
BMU-SM-37 SERVO RATINGS

Torque:	37 ft-lb
Speed:	25 sec/ 90°
Rotation:	15° - 180°
Ambient:	32°F - 131°F
Duty Cycle:	100%
Orientation:	Any
Motor:	120 Vac, 60 Hz, 5 VA
Positioner:	24 Vdc, 22 mA

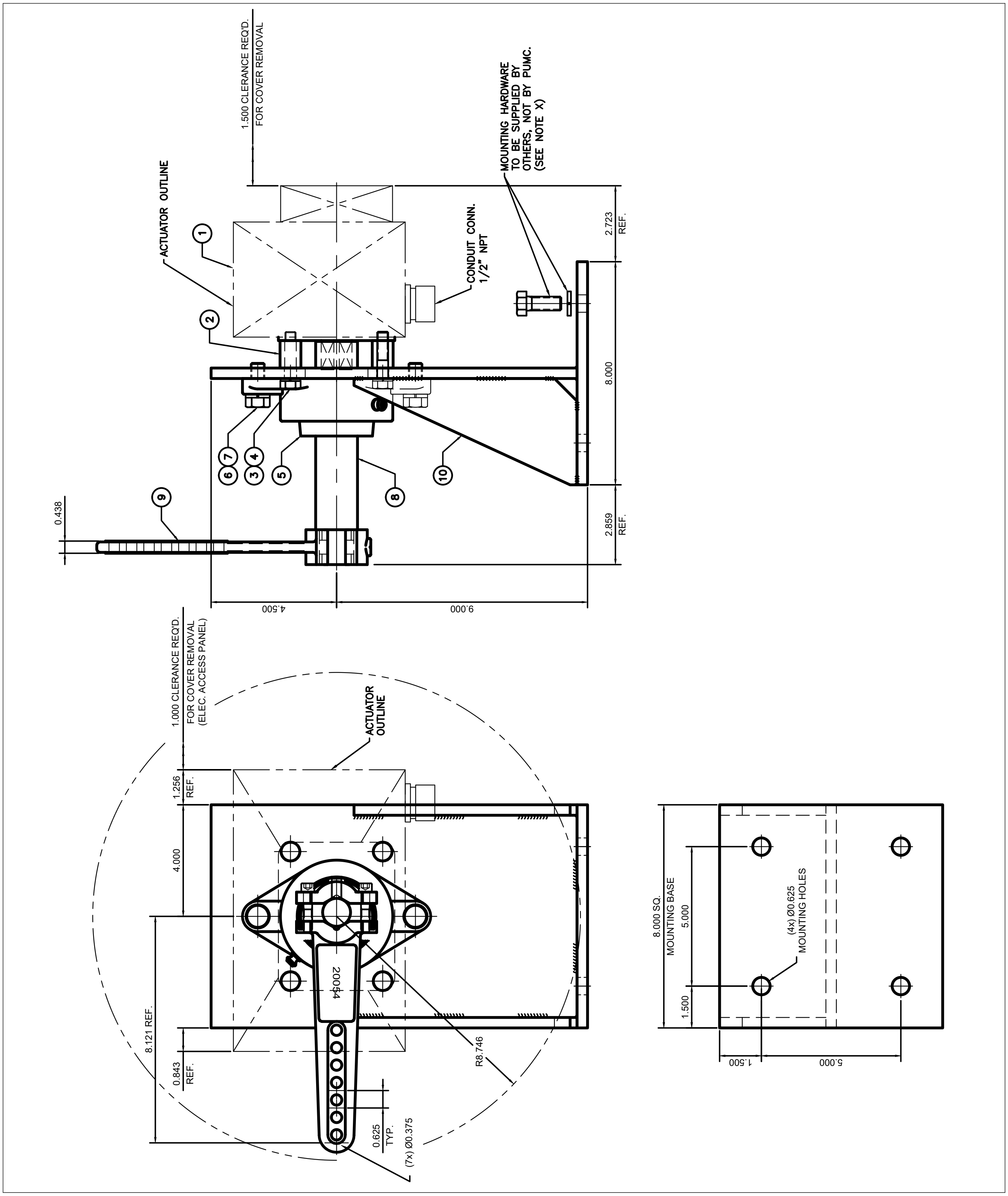
See BMU Manual for Wiring

BurnerMate Universal

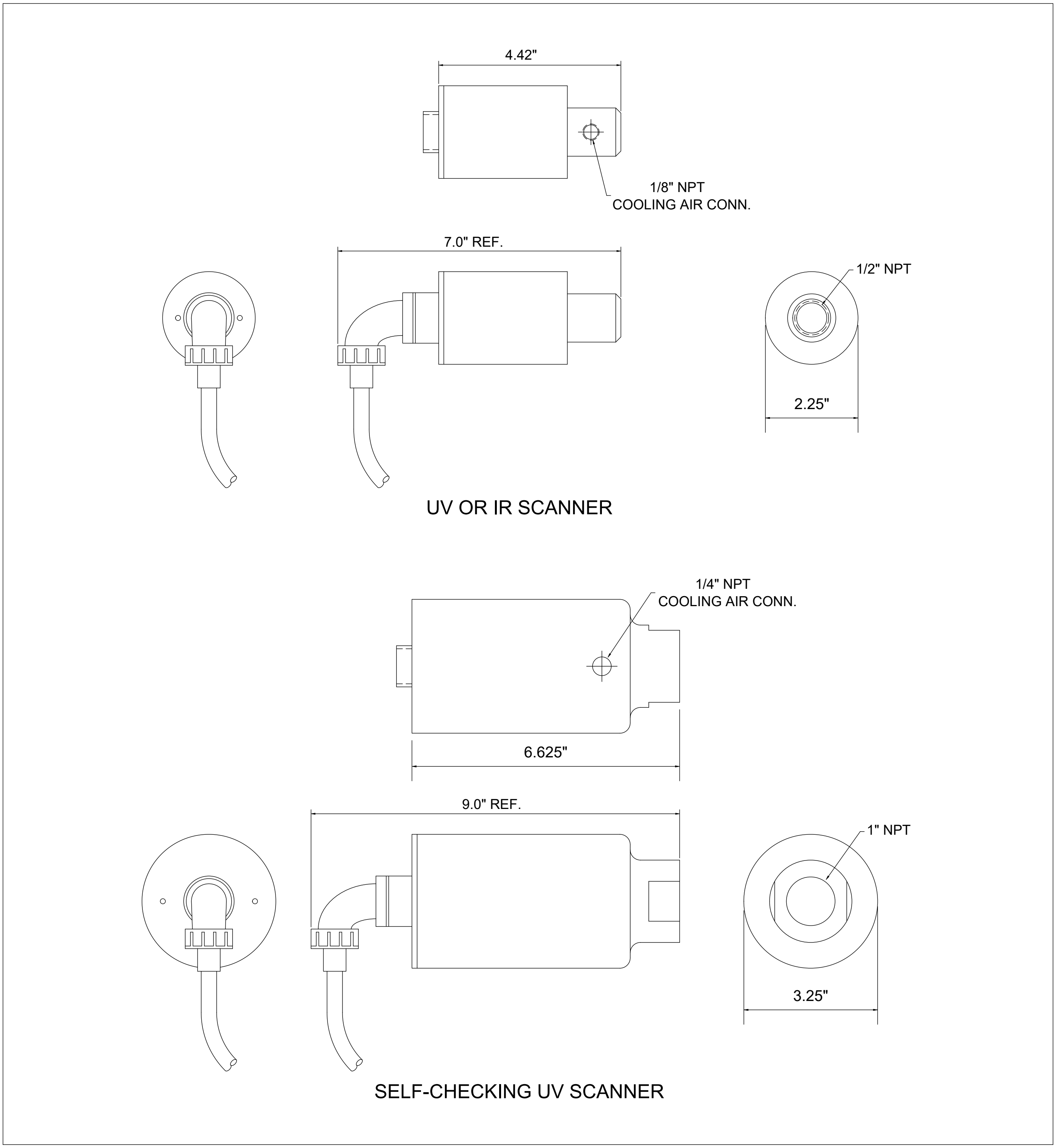
UM-072-FS Servo Dimensions



BurnerMate Universal
UM-140 Servo Dimensions



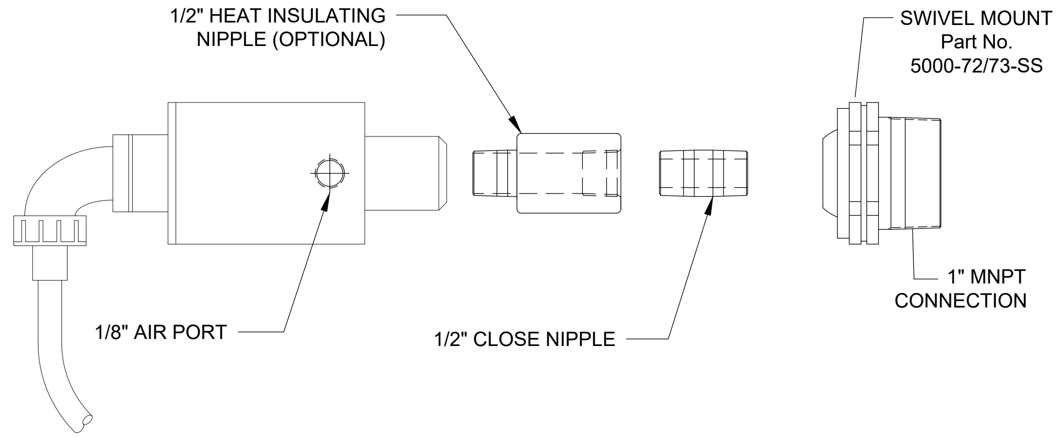
BurnerMate Universal
Scanner Dimensions



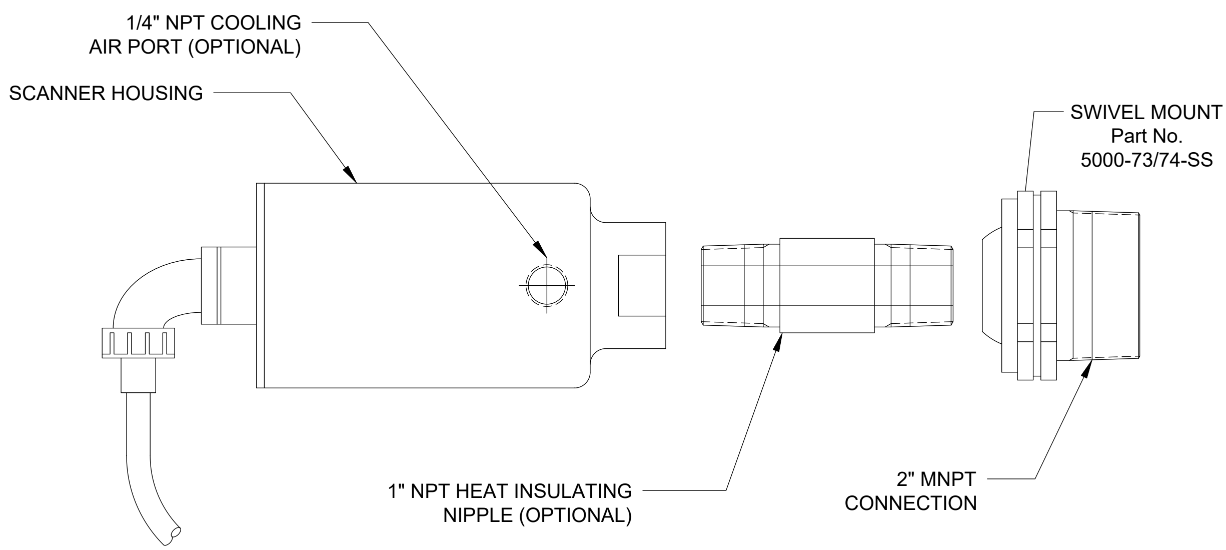
Notes:
Ensure adequate clearance is available for scanner mounting through full range of swivel mount motion.
Ensure adequate slack in connector cable for full range of scanner movement.
Provide enough clearance for possible boiler thermal growth.

BurnerMate Universal

Scanner Mounting



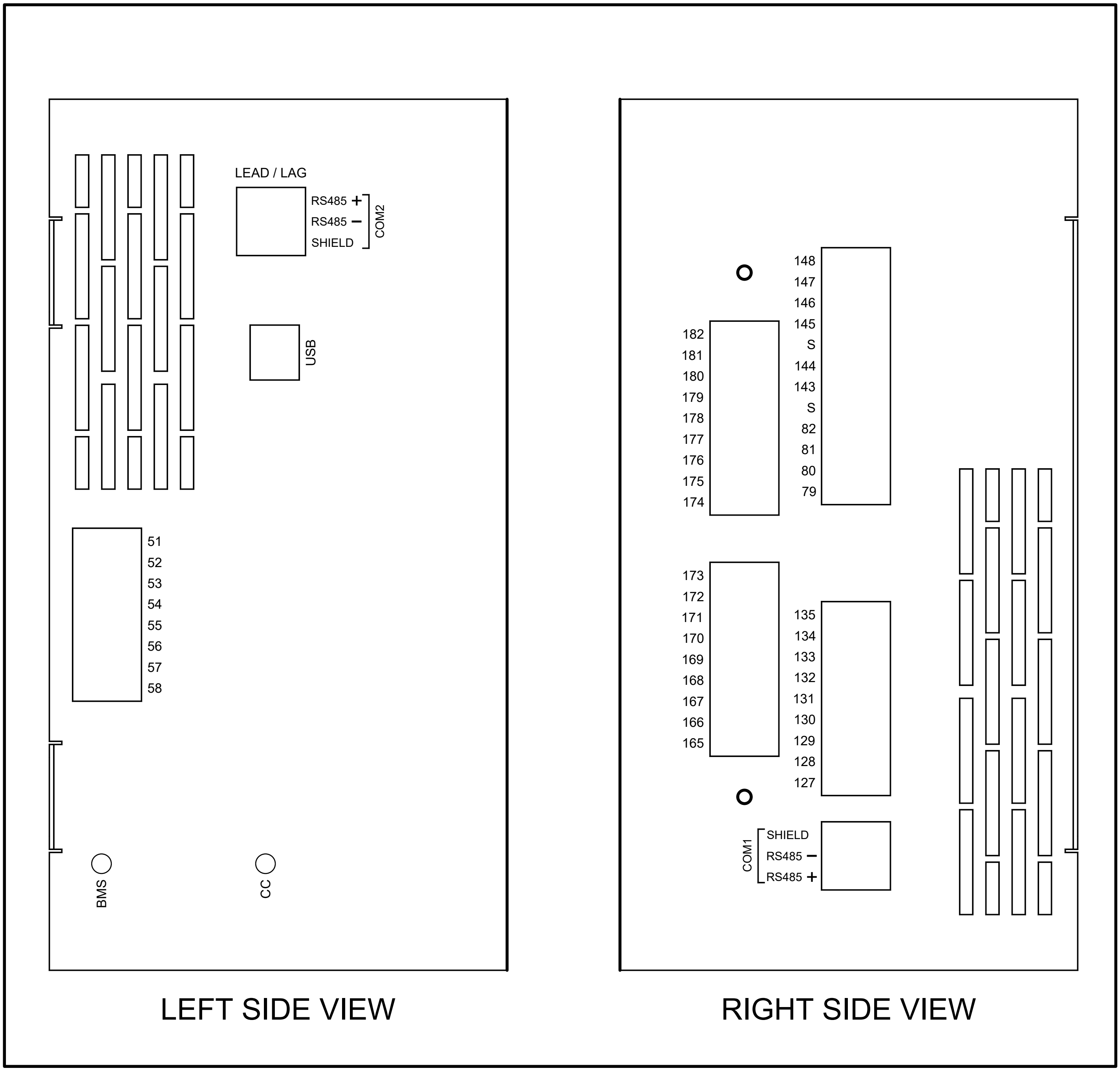
UV OR IR SCANNER



SELF-CHECKING UV SCANNER

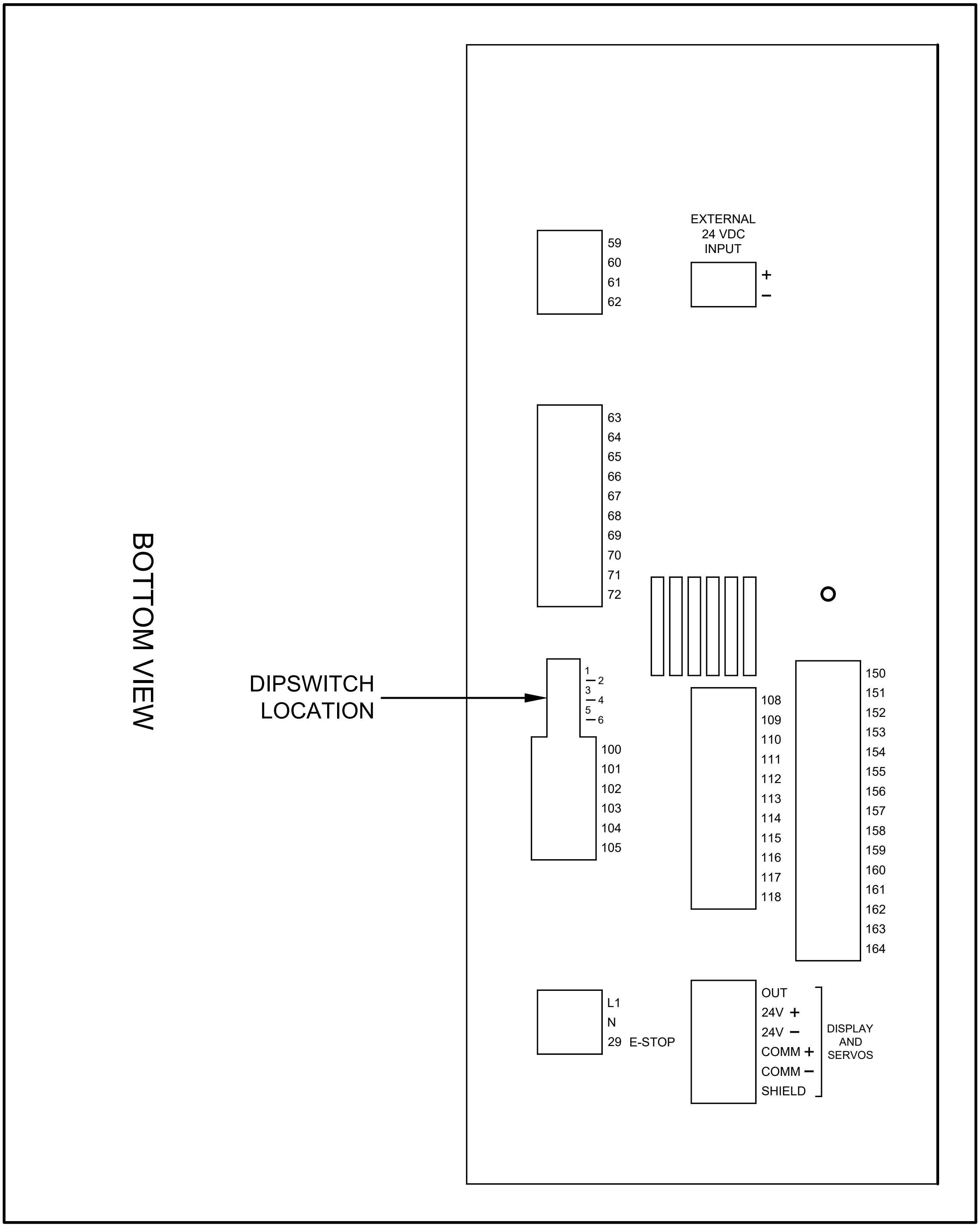
Notes:
Heat insulating nipples reccomended for windbox temperatures over 150 deg. F
Optional cooling/purge air may be required for additional cooling or to keep the scanner lens clean.

BMU Chassis Terminal Block Locations



Notes:
1. Terminals L1, N, and 1-99 are high voltage (120 VAC)
2. Terminals 100-197 are low voltage (24VDC max)
3. Do not wire high voltage inputs to low voltage terminals.

BMU Chassis Terminal Block Locations



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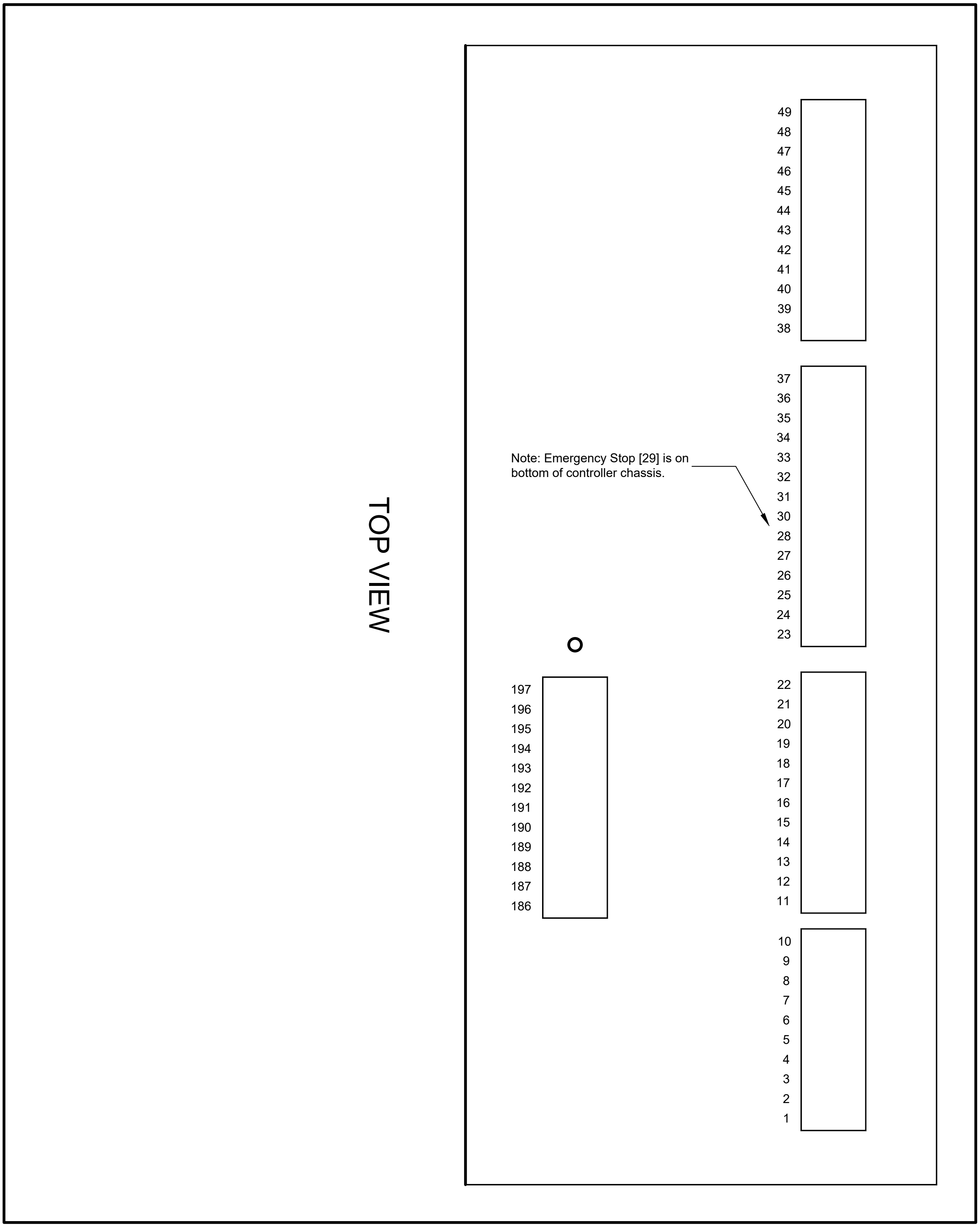

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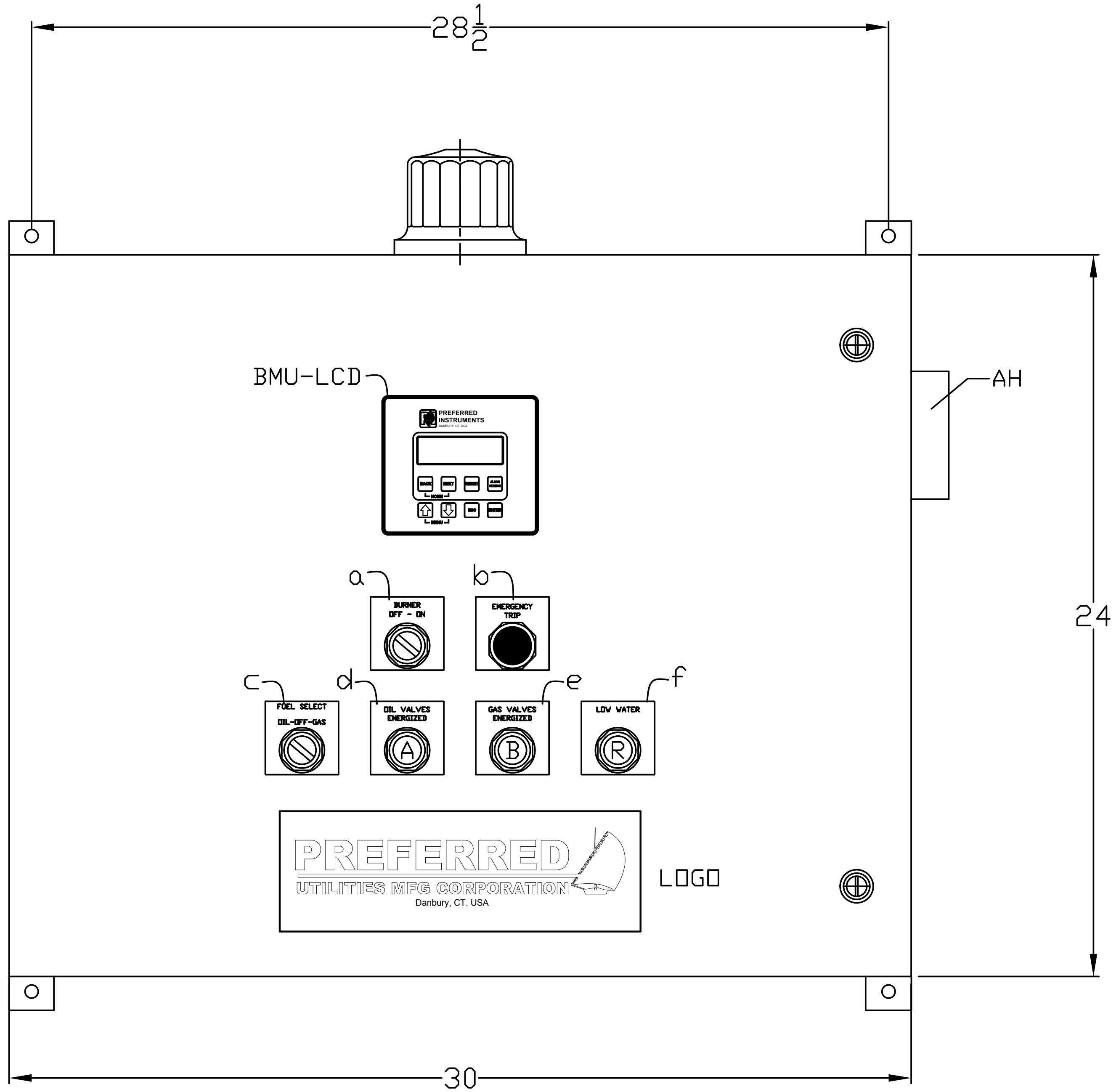
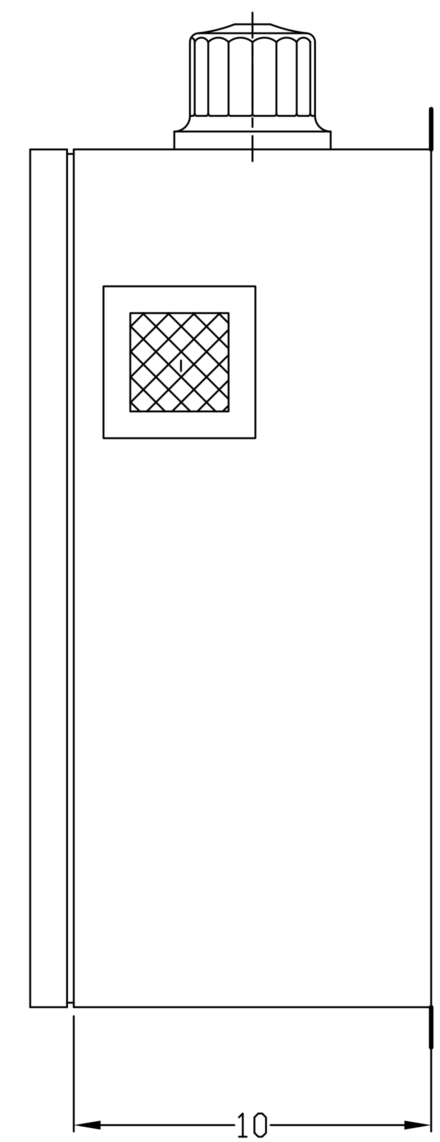




NOTES:

CABINET: 24"H x 30"W X 10"D-NEMA 12
#14 GA. STEEL
CONTINUOUS SEAM WELDED CONSTRUCTION

ALL INTERNAL COMPONENTS MOUNTED
ON A REMOVABLE SUBPLATE

FINISH: PRIME COATED & PAINTED
CABINET: GRAY ENAMEL
SUBPLATE: WHITE ENAMEL

NAMEPLATES : BLACK PHENOLIC
WITH WHITE LETTERS

NAMEPLATE LEGEND

a.	BURNER/OFF-ON	(PREF.#90099)
b.	EMERGENCY TRIP	(PREF.#90099)
c.	FUEL SELECT/OIL-OFF-GAS	(PREF.#90099)
d.	OIL VALVES ENERGIZED	(PREF.#90099)
e.	GAS VALVES ENERGIZED	(PREF.#90099)
f.	LOW WATER	(PREF.#90099)

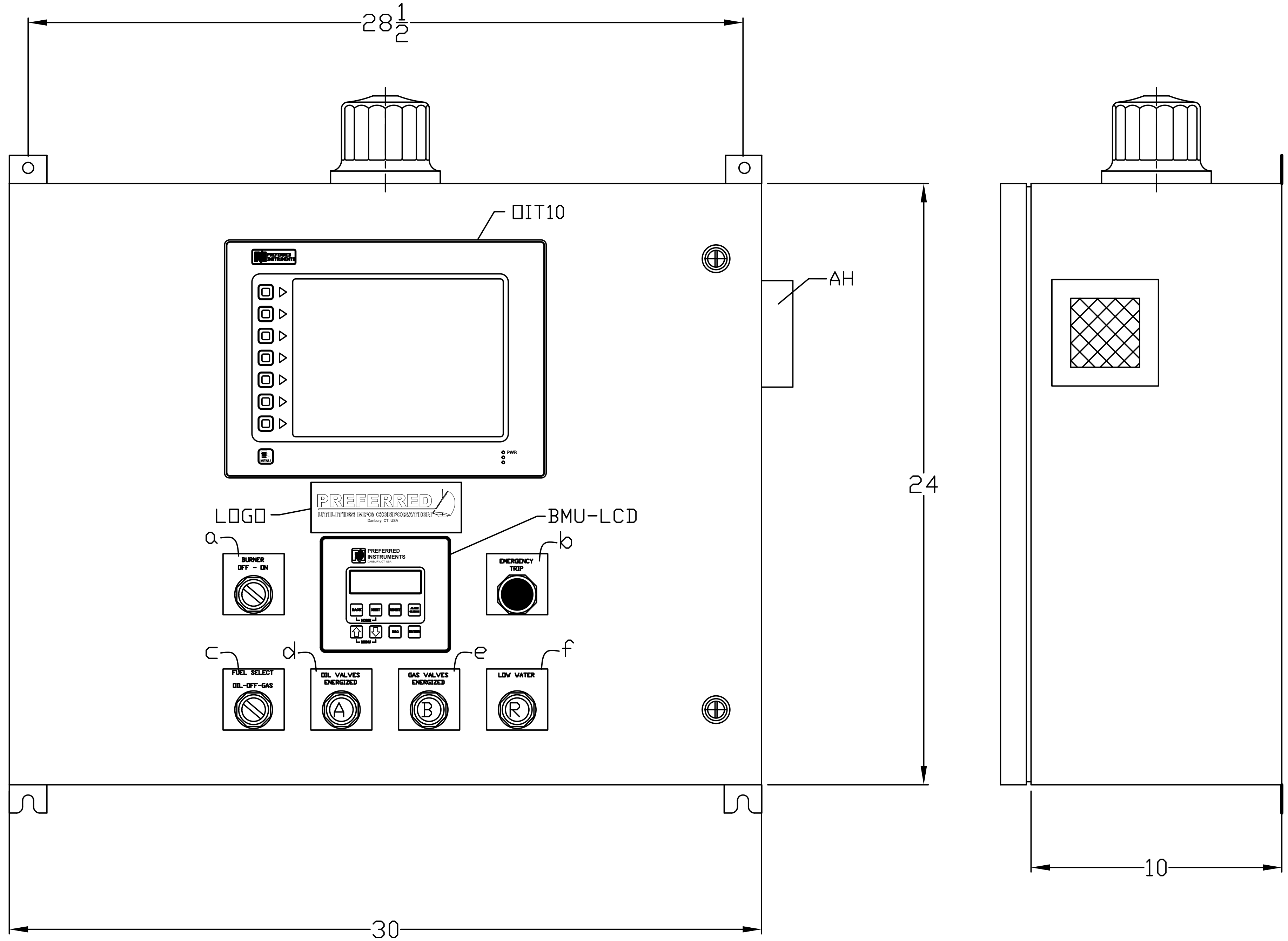
PREFERRED INSTRUMENTS
31-35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Mfg. Corp.

BURNERMATE UNIVERSAL
LCD BASIC
-CABINET LAYOUT-

LET.	REVISIONS	INIT	DATE
3	Revised to Date	Re	4-13-18

FILE

SUPERSEDES:
ASS'Y:
SCALE:
SHT 1 OF 1
DRN: ASL 5/3/07
APPR'D.:
BMU-LCD-2430



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d.	OIL VALVES ENERGIZED	(PREF.#90099)
e.	GAS VALVES ENERGIZED	(PREF.#90099)
f.	LOW WATER	(PREF.#90099)

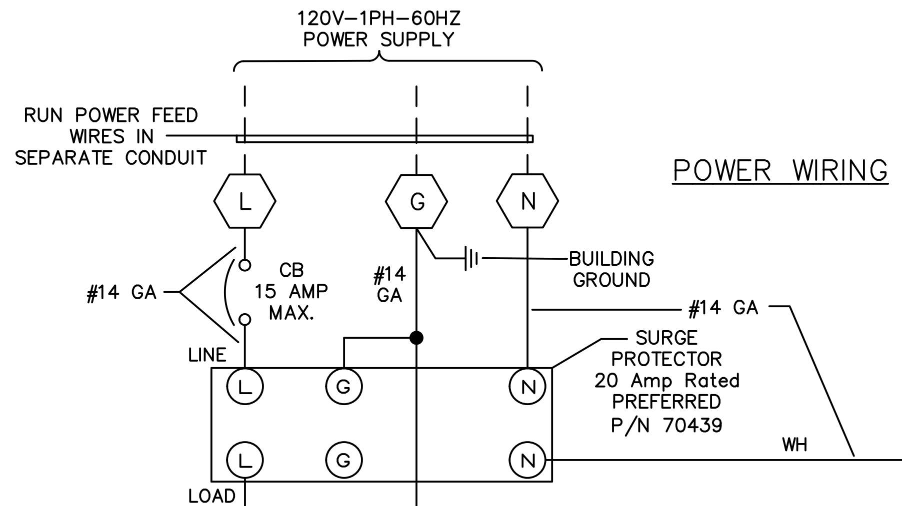
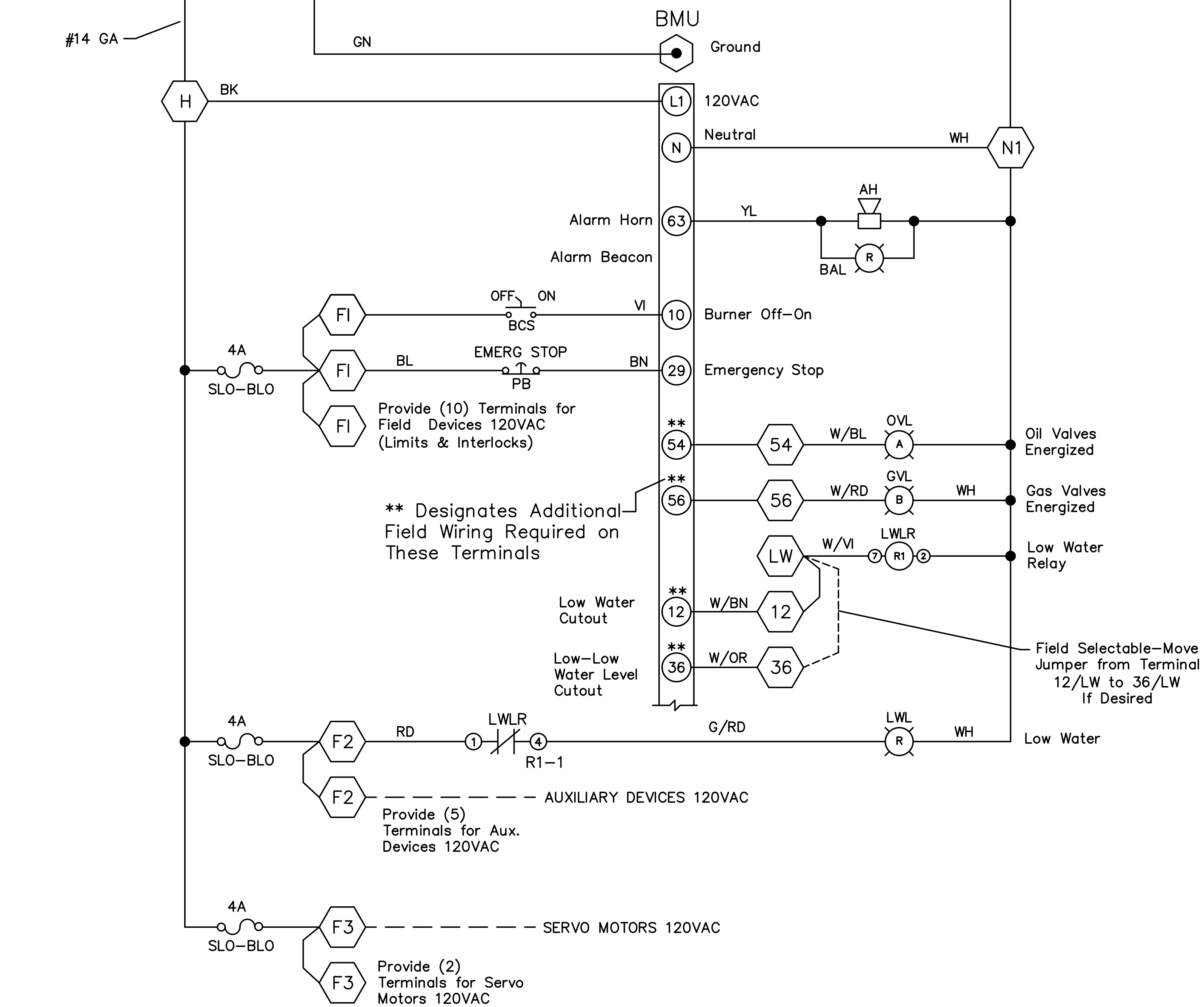
PREFERRED INSTRUMENTS
31-35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Mfg. Corp.

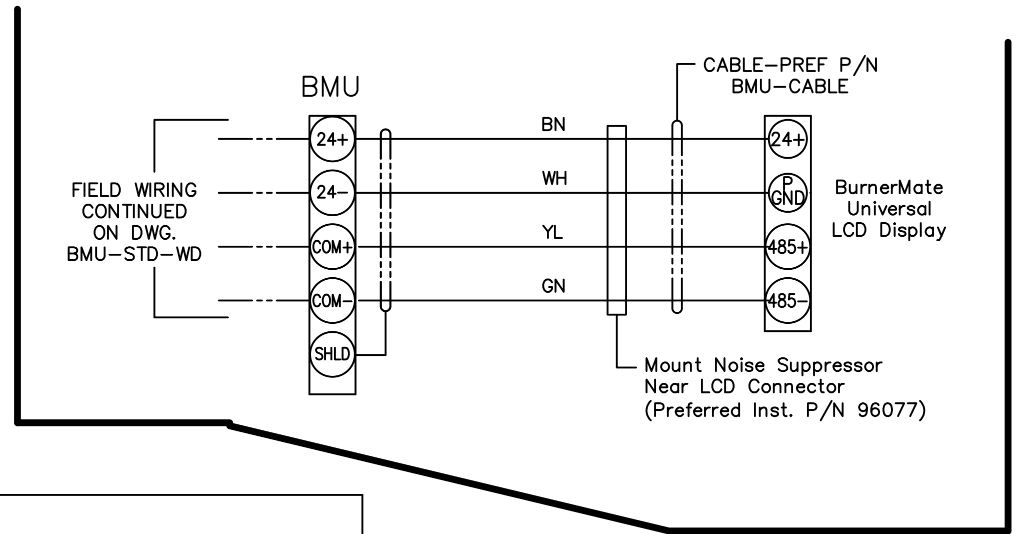
BURNERMATE UNIVERSAL
BASIC w/ OIT 10
-CABINET LAYOUT-

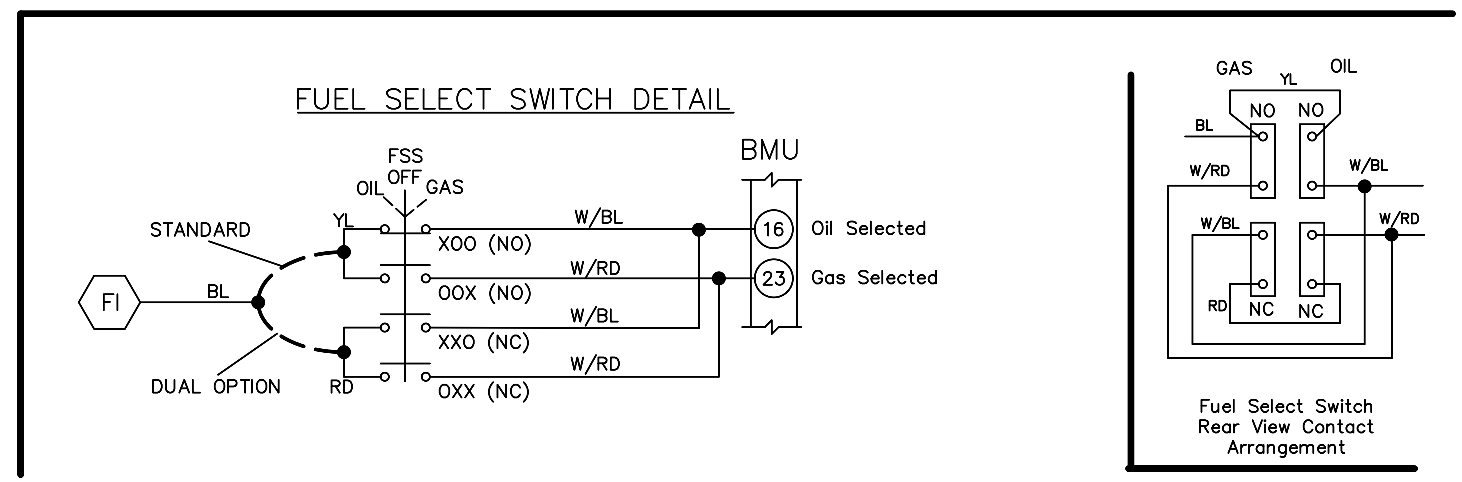
LET.	REVISIONS	INIT	DATE
3	Revised to Date	Re	4-13-18

FILE

SUPERSEDES:
ASS'Y:
SCALE:
SHT 1 OF 1
DRN: ASL 5/3/07
APPR'D.:
BMU-OIT-2430





NOTE:

1. Restart Fuel Transfer (standard, as shipped):
   Set "Burner" switch to OFF, Change "Fuel Select" switch, Set "Burner" switch to ON.
   OIL-OFF-GAS label is installed on the Fuel Selector Switch.
   Blue wire is connected to the Yellow wire of the Fuel Select switch.
   Parameter P1.12.1 is set to "Restart"
2. Dual Fuel Transfer (field configured option):
   A. WARNING: This option should not be used unless the burner mfg. has confirmed taht this burner configuration is compatible with Low Fire Fuel Transfer (see BMU manual for details).
   B. Set "Fuel Select" switch to DUAL, After new fuel lights...Set "Fuel Select" switch to the new Fuel. Install the OIL-DUAL-GAS label is on the Fuel Selector Switch.
   Remove the Blue wire from the Yellow wire of the Fuel Select switch.
   Connect the Blue wire to the Red wire of the Fuel Select switch.
   Set Parameter P1.12.1 to "Low Fire"
3. Other Transfer Options
   Contact Factory for other possible automated Fuel Transfer Options

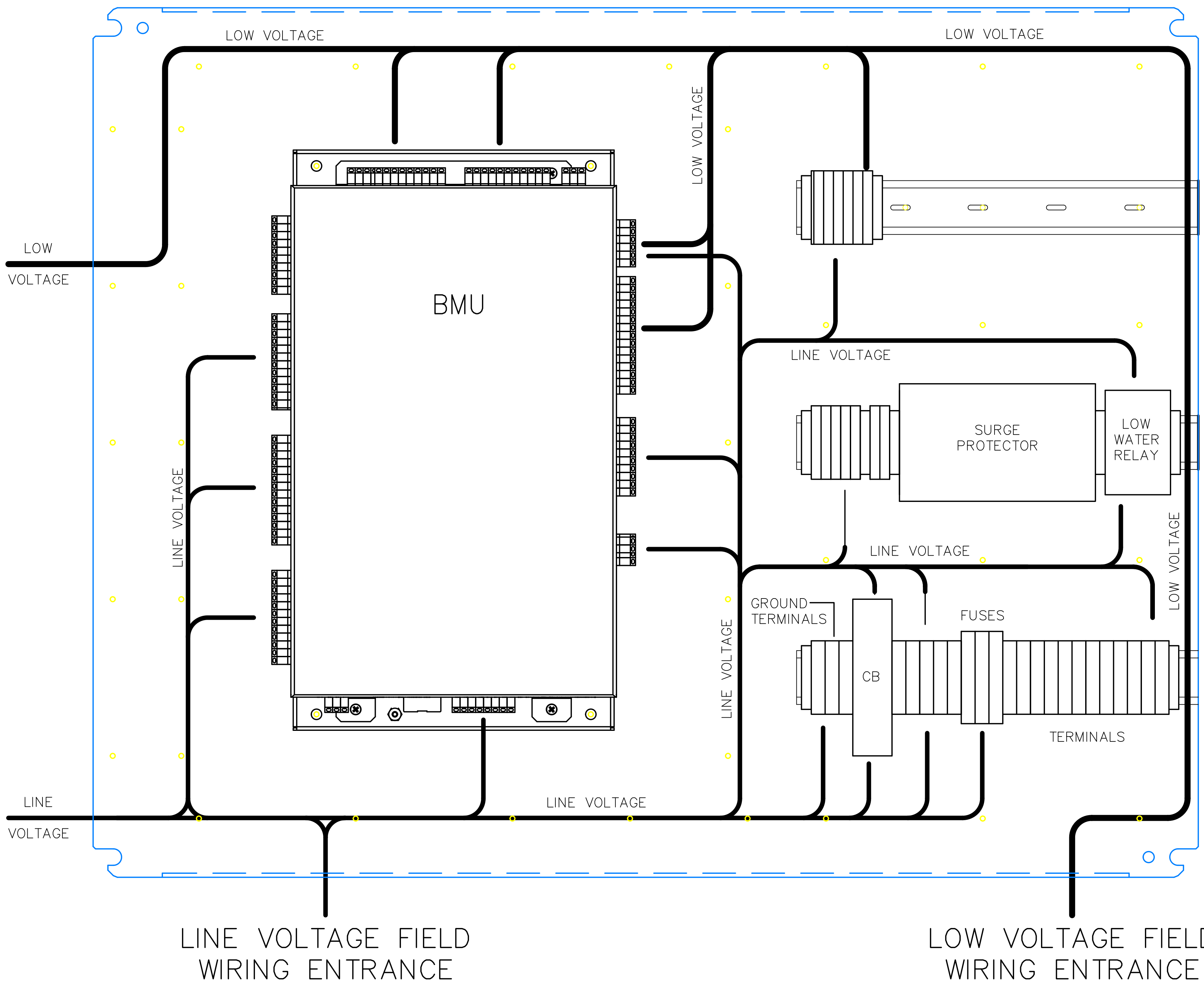
PREFERRED INSTRUMENTS
31-35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Mfg. Corp.

BURNERMATE UNIVERSAL
FACTORY WIRING
LCD STANDARD

LET.	REVISIONS	INIT	DATE
3	Revised to Date	Re	4-13-18

FILE BMU-WIRING-STD

SUPERSEDES:. | ASS'Y:.
SCALE: . | SHT 1 OF 2
DRN: WFL 9/20/07
APPR'D.:
BMU-PANEL-LCD-WD



RECOMMENDED CABINET FIELD WIRE ROUTING

NOTE #1:
KEEP LINE VOLTAGE AND LOW VOLTAGE SEPARATED TO MINIMIZE ELECTRICAL NOISE

NOTE #2:
DO NOT BUNDLE LINE AND LOW VOLTAGE WIRES TOGETHER

NOTE #3:
IF LINE AND LOW VOLTAGE WIRE CROSSING IS NECESSARY
CROSS WIRES AT 90 DEGREES ONLY

NOTE #4:
FOR OXYGEN PROBE AND SERVO ACTUATOR WIRING
REFER TO SECTION 4, SHEETS 4 & 6
IN THE INSTRUCTION MANUAL

PREFERRED INSTRUMENTS
31–35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Mfg. Corp.

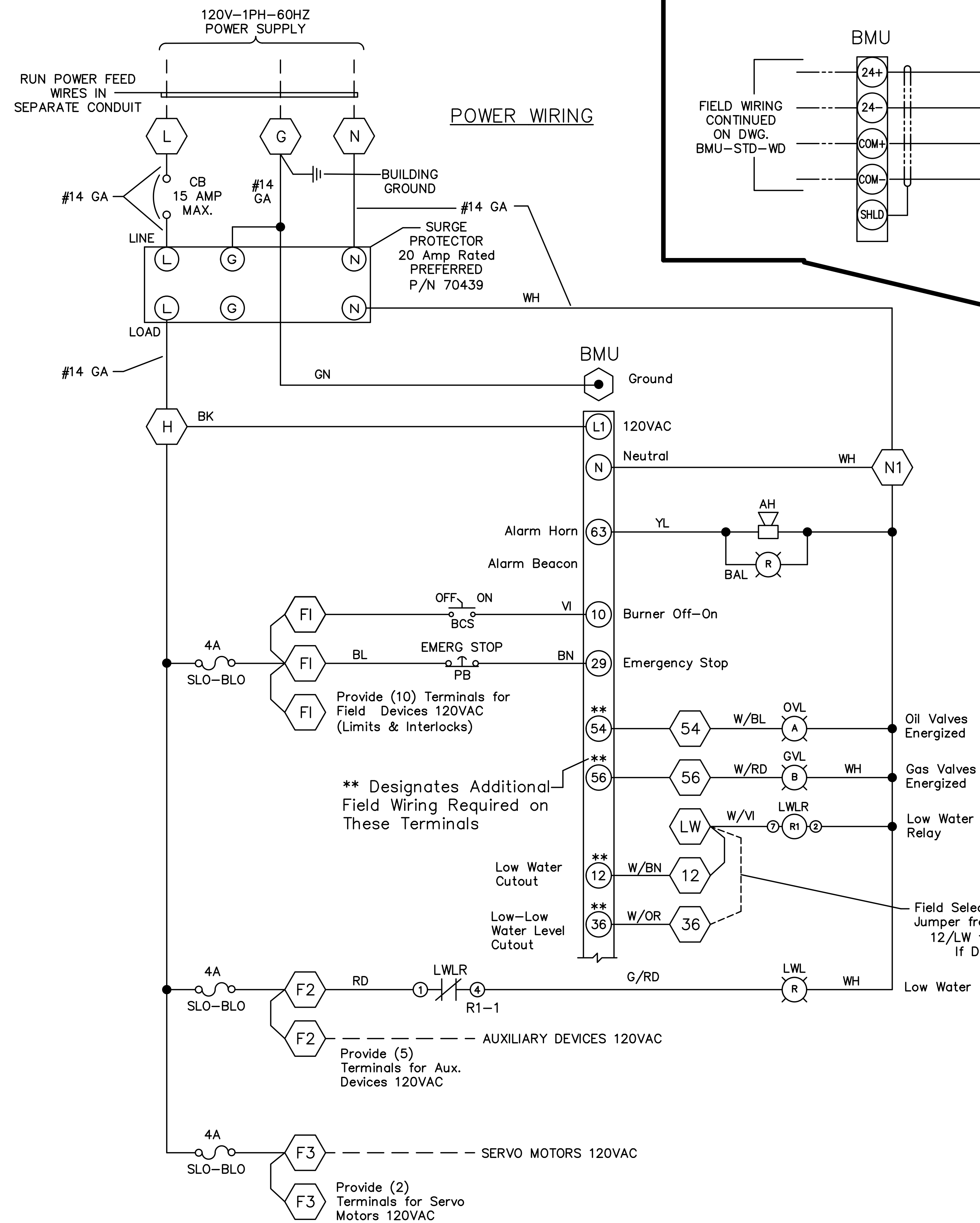
BURNERMATE UNIVERSAL
SUB–PLATE LAYOUT
LCD with OIT10 STANDARD

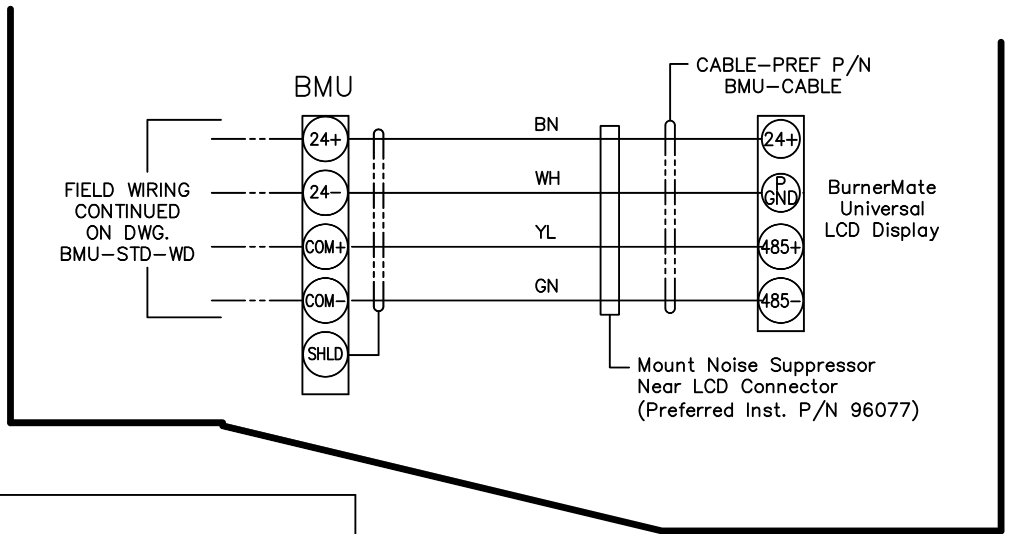
LET.	REVISIONS	INIT	DATE
3	Revised to Date	Re	4-13-18

FILE BMU–WIRING–STD

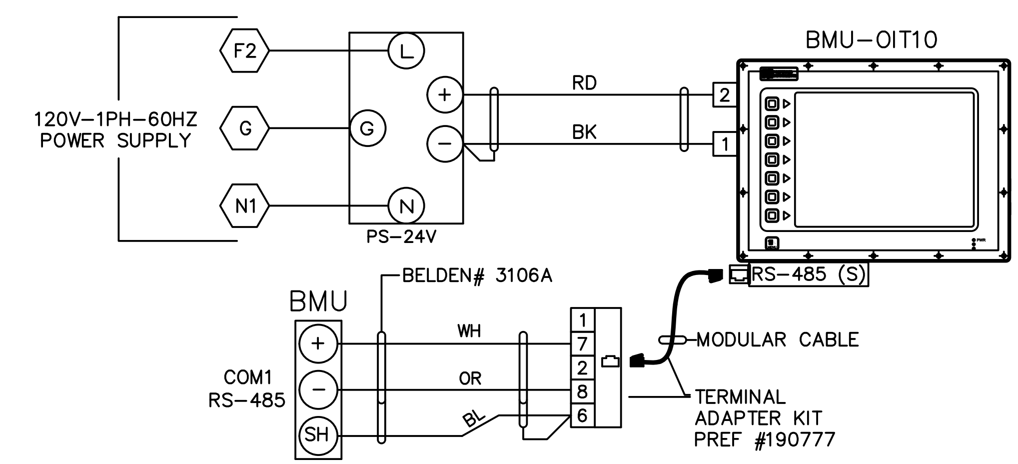
SUPERSEDES:. | ASS'Y:.
SCALE: . | SHT 2 OF 2
DRN: WFL 9/20/07
APPR'D.:
BMU–PANEL–LCD–WD

POWER WIRING

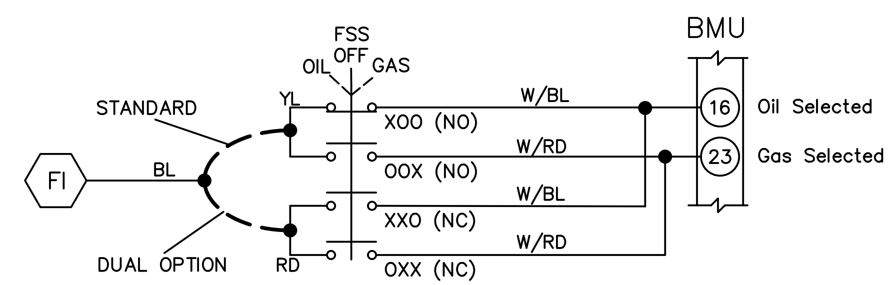


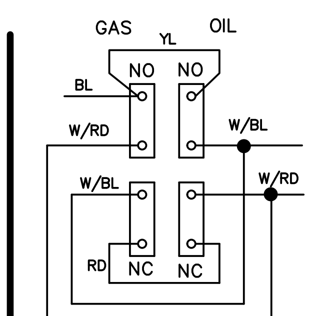


BMU–OIT10 TOUCHSCREEN MONITOR WIRING



FUEL SELECT SWITCH DETAIL





Fuel Select Switch Rear View Contact Arrangement

NOTE:
1. Restart Fuel Transfer (standard, as shipped):
   Set "Burner" switch to OFF, Change "Fuel Select" switch, Set "Burner" switch to ON.
   OIL–OFF–GAS label is installed on the Fuel Selector Switch.
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   A. WARNING: This option should not be used unless the burner mfg. has confirmed taht this burner configuration is compatible with Low Fire Fuel Transfer (see BMU manual for details).
   B. Set "Fuel Select" switch to DUAL, After new fuel lights...Set "Fuel Select" switch to the new Fuel. Install the OIL–DUAL–GAS label is on the Fuel Selector Switch.
   Remove the Blue wire from the Yellow wire of the Fuel Select switch.
   Connect the Blue wire to the Red wire of the Fuel Select switch.
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3. Other Transfer Options
   Contact Factory for other possible automated Fuel Transfer Options

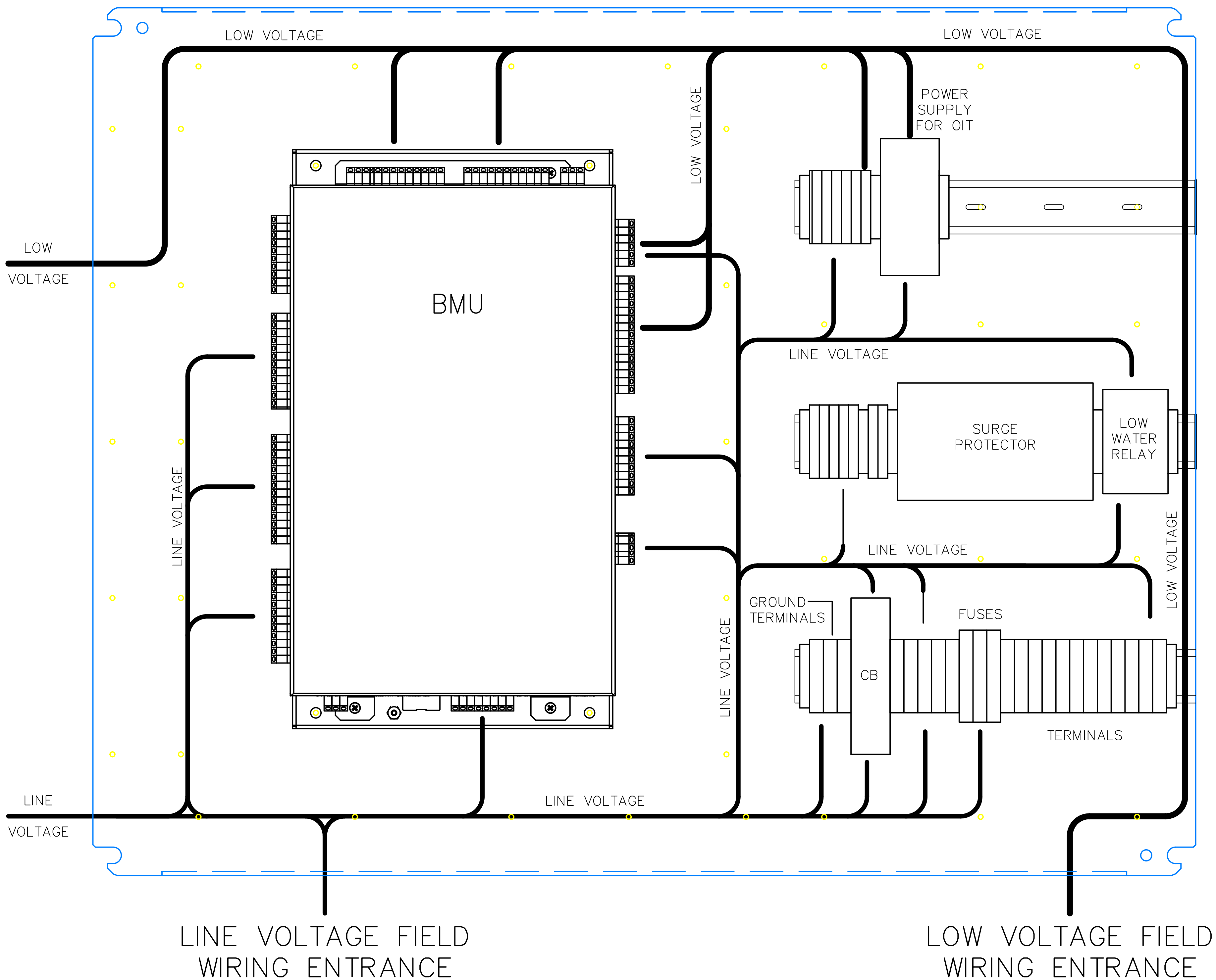
PREFERRED INSTRUMENTS
31–35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Mfg. Corp.

BURNERMATE UNIVERSAL
FACTORY WIRING
LCD with OIT10 STANDARD

LET.	REVISIONS	INIT	DATE
3	Revised to Date	Re	4–13–18

FILE BMU–WIRING–STD

SUPERSEDES:. | ASS'Y:.
SCALE: . | SHT 1 OF 2
DRN: WFL 9/20/07
APPR'D.:
BMU–PANEL–OIT–WD



RECOMMENDED CABINET FIELD WIRE ROUTING

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KEEP LINE VOLTAGE AND LOW VOLTAGE SEPARATED TO MINIMIZE ELECTRICAL NOISE

NOTE #2:
DO NOT BUNDLE LINE AND LOW VOLTAGE WIRES TOGETHER

NOTE #3:
IF LINE AND LOW VOLTAGE WIRE CROSSING IS NECESSARY
CROSS WIRES AT 90 DEGREES ONLY

NOTE #4:
FOR OXYGEN PROBE AND SERVO ACTUATOR WIRING
REFER TO SECTION 4, SHEETS 4 & 6
IN THE INSTRUCTION MANUAL

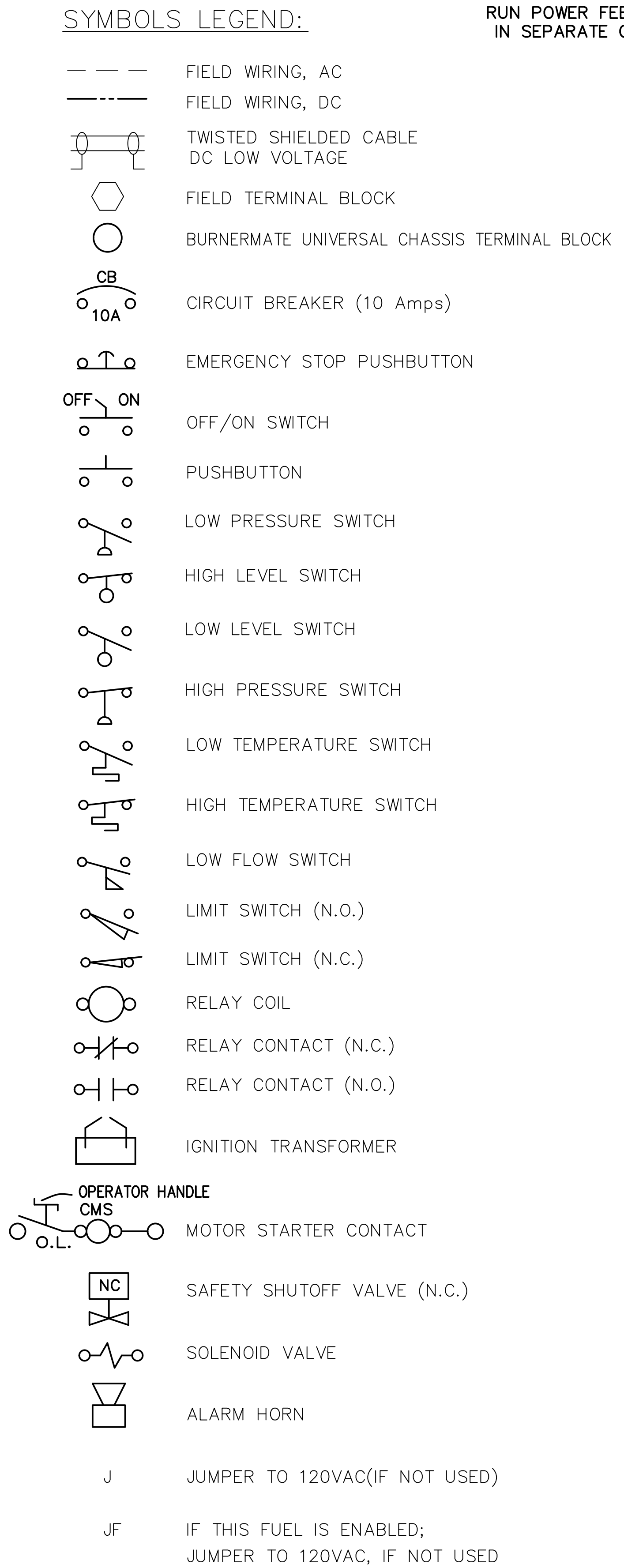
PREFERRED INSTRUMENTS
31–35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Mfg. Corp.

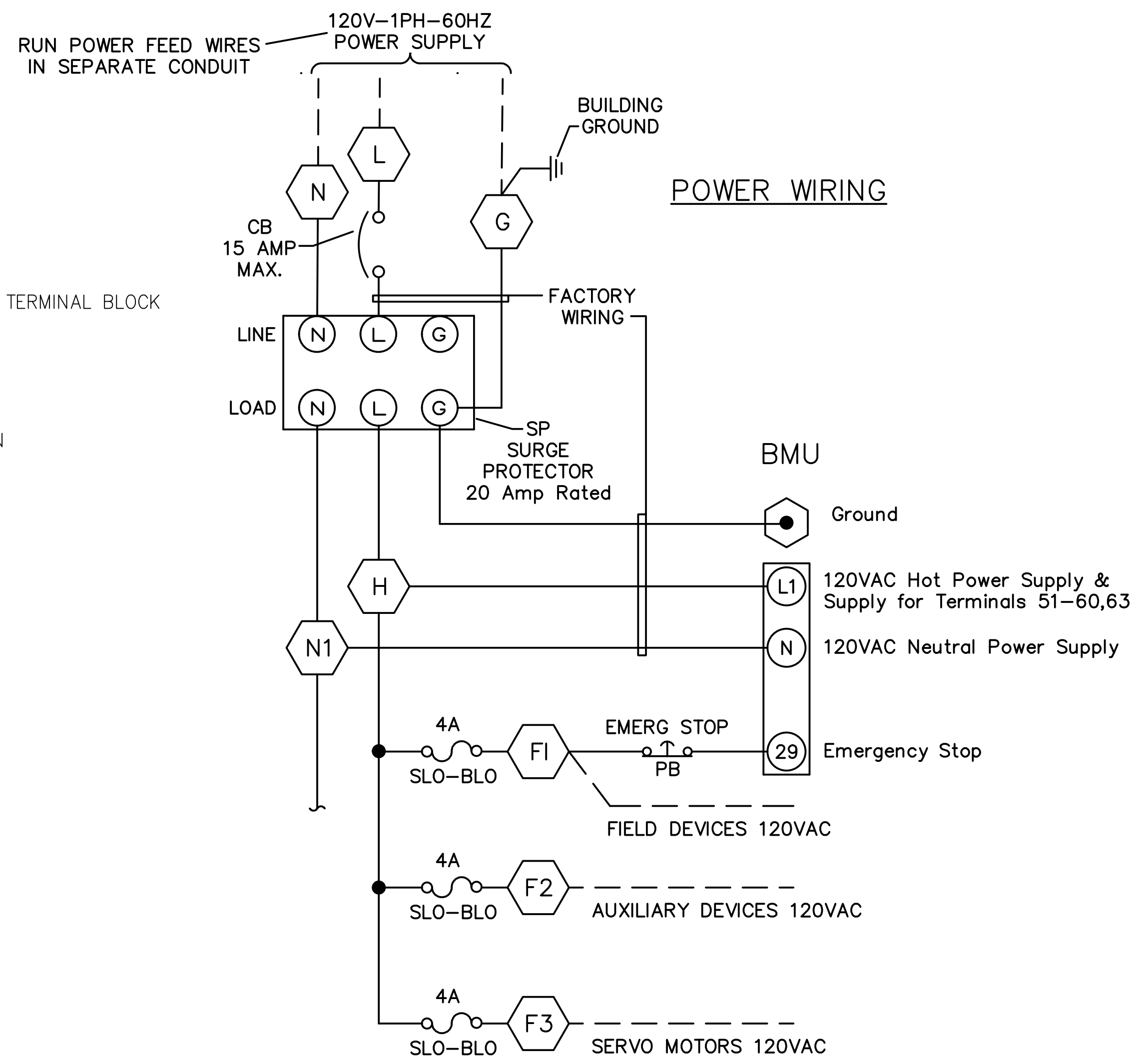
BURNERMATE UNIVERSAL
SUB–PLATE LAYOUT
LCD with OIT10 STANDARD

LET.	REVISIONS	INIT	DATE
3	Revised to Date	Re	4–13–18

SUPERSEDES:. | ASS'Y:.
SCALE: . | SHT 2 OF 2
DRN: WFL 9/20/07
APPR'D.:
BMU–PANEL–OIT–WD

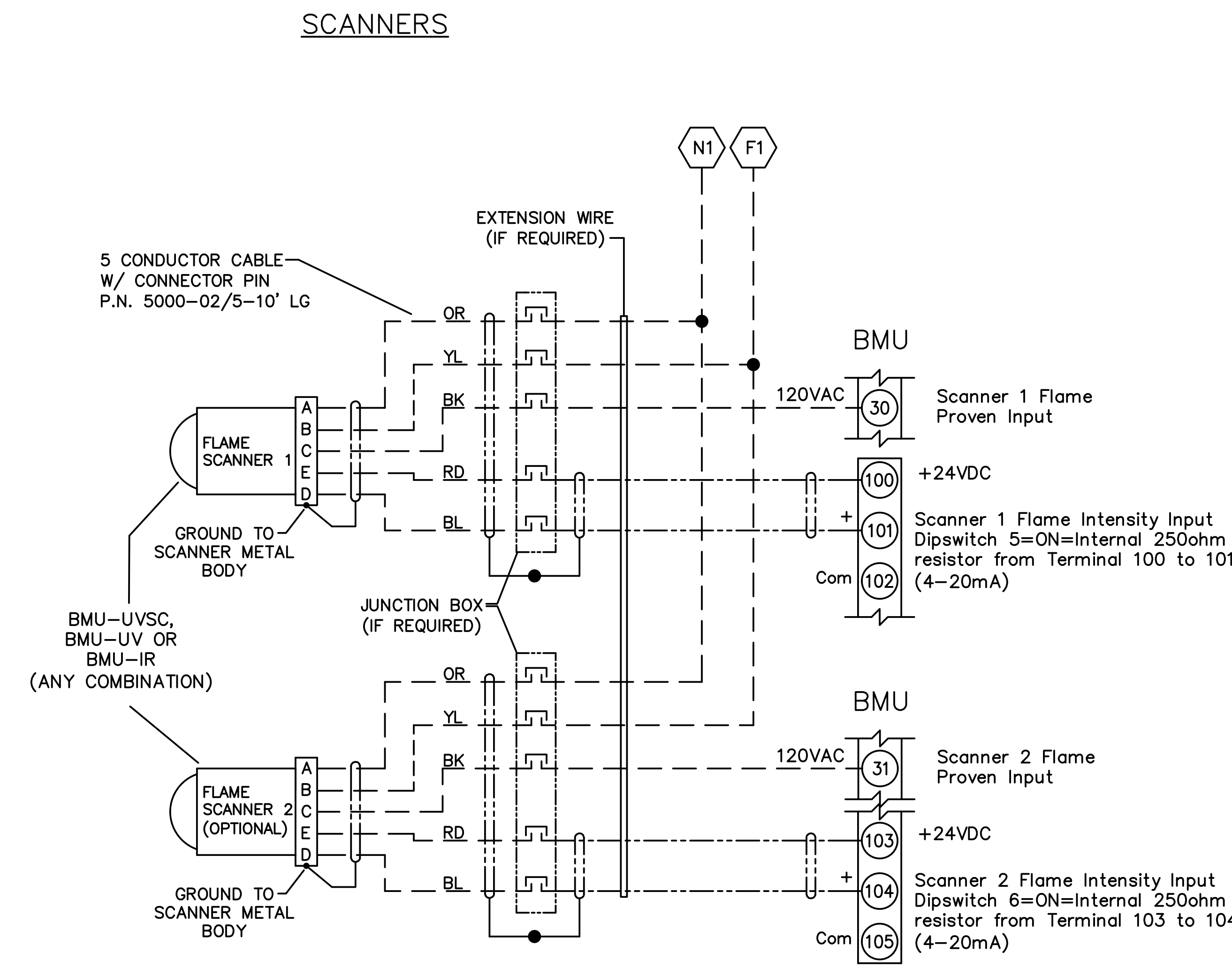
FILE BMU–WIRING–STD





NOTE:
1. ALL TERMINALS WILL ACCEPT 12-24 GA. WIRE AND SHOULD BE TIGHTENED TO 4.5 IN-LB TORQUE.
2. ALL TERMINALS WILL ACCEPT (2) 14 GA. STRANDED WIRES.
3. ALL WIRING (AC, DC AND SHIELDED CABLE) SHOULD BE COPPER, STRANDED, 150V MIN., AND RATED 60 C MINIMUM.
4. SHIELDED CABLE - ALL 4-20mA/0-5 VDC INPUT AND OUTPUT WIRING SHOULD BE 22 GA. MINIMUM, 100% FOIL SHIELD AND HAVE TWISTED PAIRS (BELDEN 8737 OR EQUAL)
5. REFER TO TAB 4 OF BURNERMATE UNIVERSAL MANUAL FOR FURTHER INSTALLATION AND WIRING PRACTICES.

GENERAL NOTES:
1. WIRING SHOWN IS TYPICAL AND HAS NOT BEEN REVIEWED WITH RESPECT TO ANY PARTICULAR APPLICATION.
2. FIELD DEVICES SHOWN ON THIS DRAWING MAY NOT BE SUPPLIED AS PART OF THIS ORDER.
3. LOW VOLTAGE D.C. WIRING -USE #22 GA. MIN. SHIELDED CABLE. DO NOT RUN IN CONDUIT WITH A.C. VOLTAGE. GROUND SHIELD ONLY WHERE SHOWN. INSULATE EXPOSED SHIELDS TO PREVENT UNINTENDED CONNECTIONS TO CASE GROUND. LABEL EACH END OF LOW VOLTAGE CABLE.
5. CONSULT TAB 4 OF THE BURNERMATE UNIVERSAL O&M MANUAL FOR ADDITIONAL NOISE PREVENTION PRACTICES.
6. DIGITAL INPUTS FOR ANY DEVICES NOT REQUIRED BY CODE, AND NOT ON THE BOILER/BURNER SHOULD BE JUMPERED TO 120VAC.
7. ALL WIRING TO BE IN ACCORDANCE WITH NEC AND ANY APPLICABLE STATE OR LOCAL CODES.
8. J = JUMPER WHEN NOT USED.



NOTE:
Always route scanner wiring far away from ignition and Variable Speed Drive wiring to avoid electrical noise interference.
All scanner wiring must be run in a separate conduit away from all other wiring (Multiple scanner wiring run in a single conduit is acceptable).
Routing of AC/DC Scanner wiring together in the same conduit is acceptable.
No other BMU AC & DC wiring should be combined in the same conduit, unless otherwise noted.

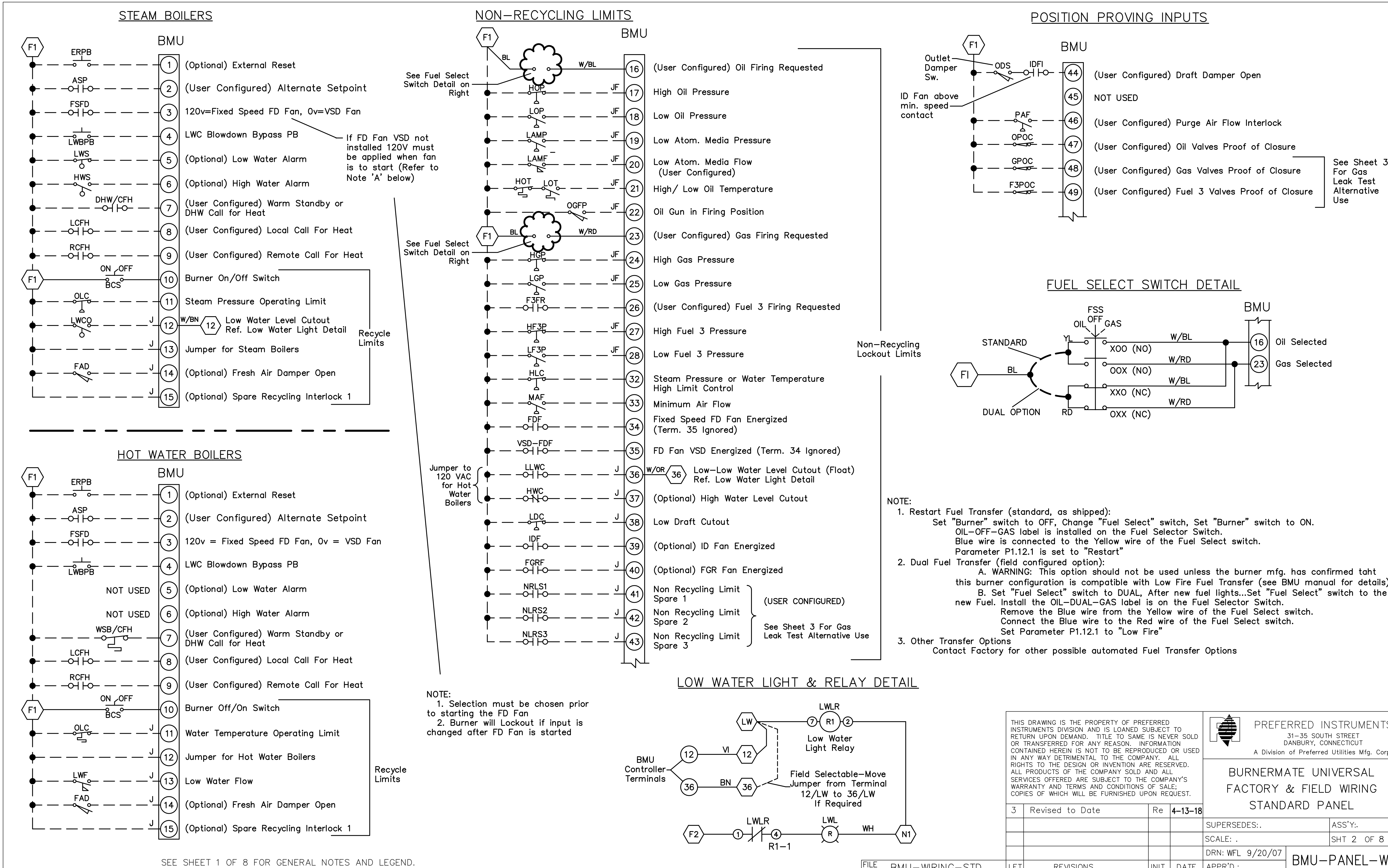
PREFERRED INSTRUMENTS
31-35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Mfg. Corp.

BURNERMATE UNIVERSAL
FACTORY & FIELD WIRING
STANDARD PANEL

LET.	REVISIONS	INIT	DATE
3	Revised to Date	Re	4/13/18

FILE BMU-WIRING-STD

SUPERSEDES:. | ASS'Y:.
SCALE: . | SHT 1 OF 8
DRN: WFL 9/20/07 | APPR'D.:
BMU-PANEL-WD


STEAM BOILERS
BMU
F1
ERPB
1 (Optional) External Reset
ASP
2 (User Configured) Alternate Setpoint
FSFD
3 120v=Fixed Speed FD Fan, 0v=VSD Fan
LWBPB
4 LWC Blowdown Bypass PB
If FD Fan VSD not installed 120V must be applied when fan is to start (Refer to Note 'A' below)
LWS
5 (Optional) Low Water Alarm
HWS
6 (Optional) High Water Alarm
DHW/CFH
7 (User Configured) Warm Standby or DHW Call for Heat
LCFH
8 (User Configured) Local Call For Heat
RCFH
9 (User Configured) Remote Call For Heat
ON OFF
BCS
10 Burner On/Off Switch
OLC
11 Steam Pressure Operating Limit
LWCO
W/BN
12 Low Water Level Cutout Ref. Low Water Light Detail
Recycle Limits
13 Jumper for Steam Boilers
FAD
14 (Optional) Fresh Air Damper Open
15 (Optional) Spare Recycling Interlock 1
HOT WATER BOILERS
BMU
1 (Optional) External Reset
2 (User Configured) Alternate Setpoint
3 120v = Fixed Speed FD Fan, 0v = VSD Fan
4 LWC Blowdown Bypass PB
NOT USED
5 (Optional) Low Water Alarm
NOT USED
6 (Optional) High Water Alarm
WSB/CFH
7 (User Configured) Warm Standby or DHW Call for Heat
8 (User Configured) Local Call For Heat
9 (User Configured) Remote Call For Heat
10 Burner Off/On Switch
11 Water Temperature Operating Limit
12 Jumper for Hot Water Boilers
LWF
13 Low Water Flow
Recycle Limits
14 (Optional) Fresh Air Damper Open
15 (Optional) Spare Recycling Interlock 1
SEE SHEET 1 OF 8 FOR GENERAL NOTES AND LEGEND.
NON-RECYCLING LIMITS
BMU
See Fuel Select Switch Detail on Right
BL
W/BL
16 (User Configured) Oil Firing Requested
HOP
17 High Oil Pressure
LOP
18 Low Oil Pressure
LAMP
19 Low Atom. Media Pressure
LAMF
20 Low Atom. Media Flow (User Configured)
HOT LOT
21 High/ Low Oil Temperature
OGFP
22 Oil Gun in Firing Position
W/RD
23 (User Configured) Gas Firing Requested
HGP
24 High Gas Pressure
LGP
25 Low Gas Pressure
F3FR
26 (User Configured) Fuel 3 Firing Requested
HF3P
27 High Fuel 3 Pressure
LF3P
28 Low Fuel 3 Pressure
HLC
32 Steam Pressure or Water Temperature High Limit Control
MAF
33 Minimum Air Flow
FDF
34 Fixed Speed FD Fan Energized (Term. 35 Ignored)
VSD-FDF
35 FD Fan VSD Energized (Term. 34 Ignored)
Jumper to 120 VAC for Hot Water Boilers
LLWC
W/OR
36 Low-Low Water Level Cutout (Float) Ref. Low Water Light Detail
HWC
37 (Optional) High Water Level Cutout
LDC
38 Low Draft Cutout
IDF
39 (Optional) ID Fan Energized
FGRF
40 (Optional) FGR Fan Energized
NRLS1
41 Non Recycling Limit Spare 1
NLRS2
42 Non Recycling Limit Spare 2
NLRS3
43 Non Recycling Limit Spare 3
(USER CONFIGURED)
See Sheet 3 For Gas Leak Test Alternative Use
Non-Recycling Lockout Limits
JF
J
NOTE:
1. Selection must be chosen prior to starting the FD Fan
2. Burner will Lockout if input is changed after FD Fan is started
POSITION PROVING INPUTS
BMU
Outlet Damper Sw.
ODS
IDFI
ID Fan above min. speed contact
44 (User Configured) Draft Damper Open
45 NOT USED
PAF
46 (User Configured) Purge Air Flow Interlock
OPOC
47 (User Configured) Oil Valves Proof of Closure
GPOC
48 (User Configured) Gas Valves Proof of Closure
F3POC
49 (User Configured) Fuel 3 Valves Proof of Closure
See Sheet 3 For Gas Leak Test Alternative Use
FUEL SELECT SWITCH DETAIL
FSS
OIL OFF GAS
BMU
STANDARD
YL
W/BL
XOO (NO)
16 Oil Selected
W/RD
23 Gas Selected
FI
BL
OOX (NO)
W/BL
XXO (NC)
DUAL OPTION
RD
W/RD
OXX (NC)
NOTE:
1. Restart Fuel Transfer (standard, as shipped):
Set "Burner" switch to OFF, Change "Fuel Select" switch, Set "Burner" switch to ON.
OIL-OFF-GAS label is installed on the Fuel Selector Switch.
Blue wire is connected to the Yellow wire of the Fuel Select switch.
Parameter P1.12.1 is set to "Restart"
2. Dual Fuel Transfer (field configured option):
A. WARNING: This option should not be used unless the burner mfg. has confirmed taht this burner configuration is compatible with Low Fire Fuel Transfer (see BMU manual for details).
B. Set "Fuel Select" switch to DUAL, After new fuel lights...Set "Fuel Select" switch to the new Fuel. Install the OIL-DUAL-GAS label is on the Fuel Selector Switch.
Remove the Blue wire from the Yellow wire of the Fuel Select switch.
Connect the Blue wire to the Red wire of the Fuel Select switch.
Set Parameter P1.12.1 to "Low Fire"
3. Other Transfer Options
Contact Factory for other possible automated Fuel Transfer Options
LOW WATER LIGHT & RELAY DETAIL
LWLR
LW
7 R1 2
Low Water Light Relay
BMU Controller Terminals
12
VI
12
36
BN
36
Field Selectable-Move Jumper from Terminal 12/LW to 36/LW If Required
F2
1
LWLR
4
R1-1
LWL
R
WH
N1
THIS DRAWING IS THE PROPERTY OF PREFERRED INSTRUMENTS DIVISION AND IS LOANED SUBJECT TO RETURN UPON DEMAND. TITLE TO SAME IS NEVER SOLD OR TRANSFERRED FOR ANY REASON. INFORMATION CONTAINED HEREIN IS NOT TO BE REPRODUCED OR USED IN ANY WAY DETRIMENTAL TO THE COMPANY. ALL RIGHTS TO THE DESIGN OR INVENTION ARE RESERVED. ALL PRODUCTS OF THE COMPANY SOLD AND ALL SERVICES OFFERED ARE SUBJECT TO THE COMPANY'S WARRANTY AND TERMS AND CONDITIONS OF SALE; COPIES OF WHICH WILL BE FURNISHED UPON REQUEST.
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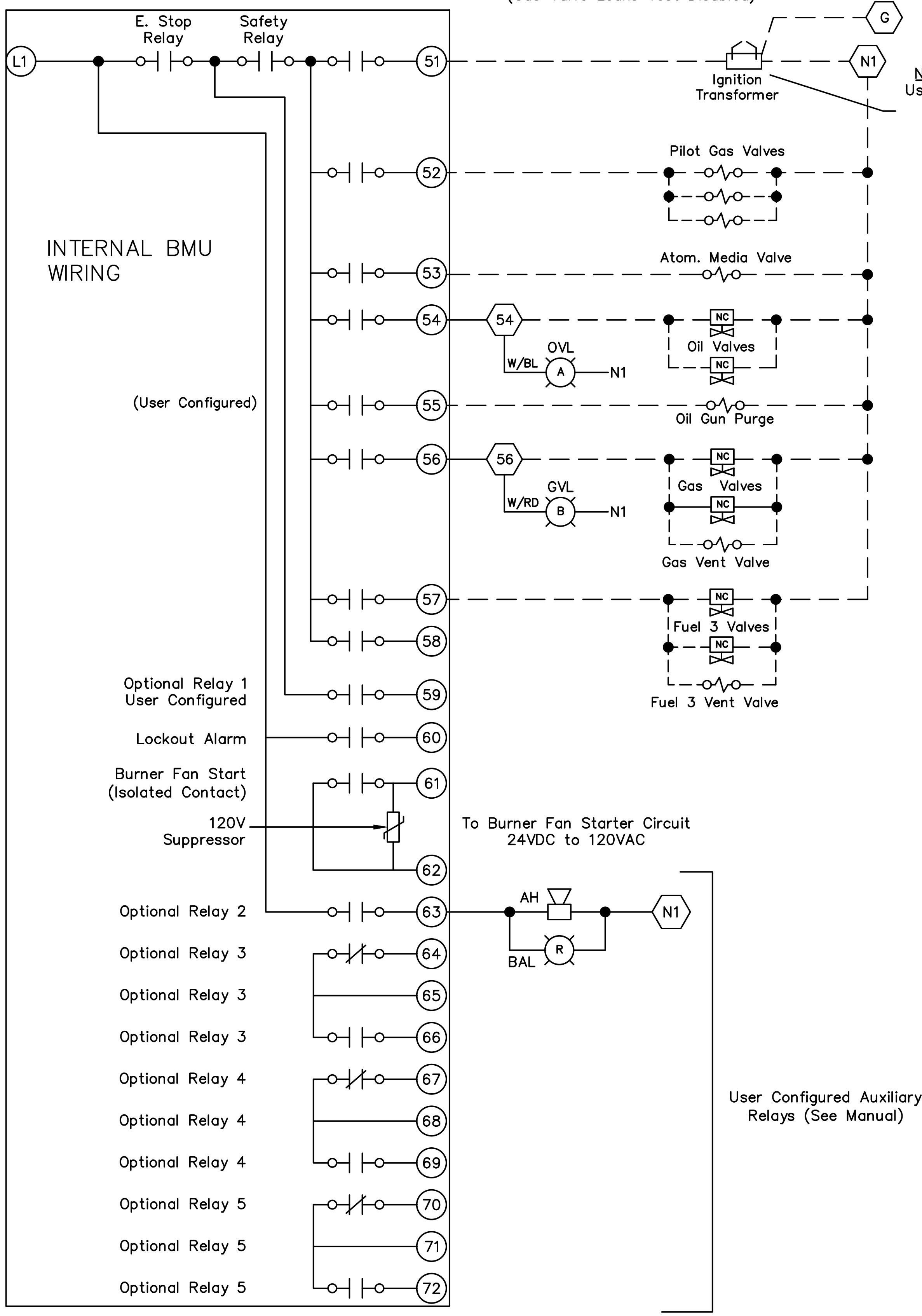
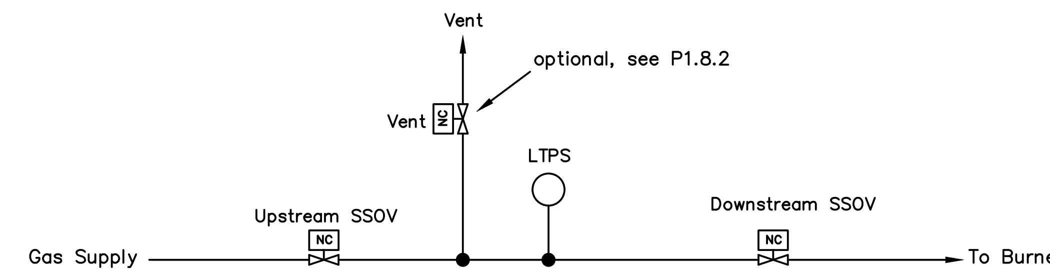
31-35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Mfg. Corp.
BURNERMATE UNIVERSAL FACTORY & FIELD WIRING STANDARD PANEL
3 Revised to Date Re 4-13-18
SUPERSEDES:.
ASS'Y:.
SCALE: .
SHT 2 OF 8
DRN: WFL 9/20/07
BMU-PANEL-WD
FILE BMU-WIRING-STD
LET. REVISIONS INIT DATE APPR'D.:

FUEL VALVES
(Gas Valve Leaks Test Disabled)

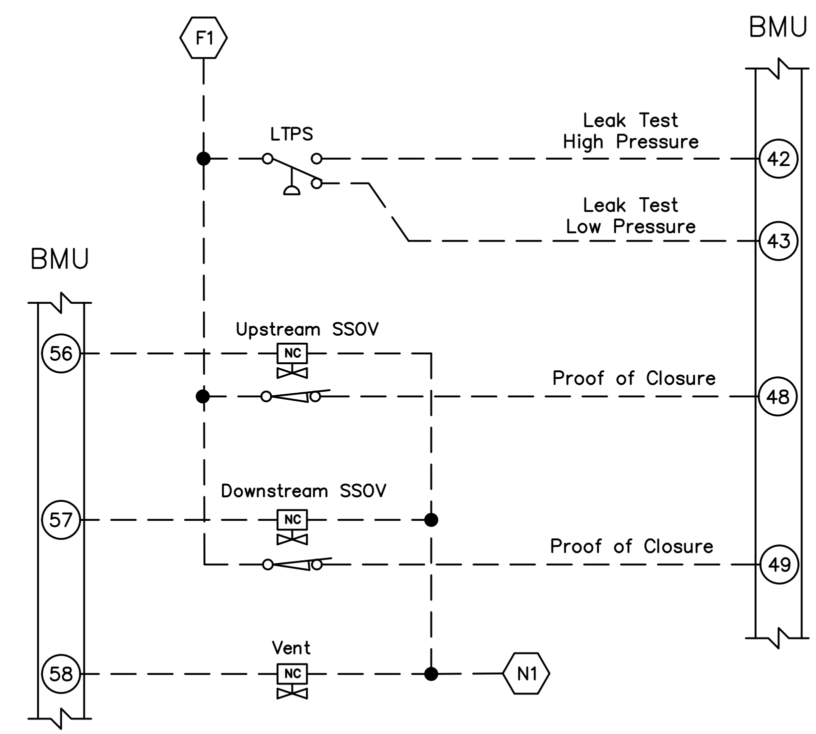


NOISE SUPPRESSION NOTE:
Use Spark Plug Resistor Cap
NGK IOEH (or equal)
PUMC:P/N 20177 (CAP)
P/N 20176 (Extention)

OPTIONAL
GAS VALVE LEAK TEST



PIPING SCHEMATIC



WIRING SCHEMATIC

RELAY CONTACTS

SEE SHEET 1 OF 8 FOR GENERAL NOTES AND LEGEND.

PREFERRED INSTRUMENTS
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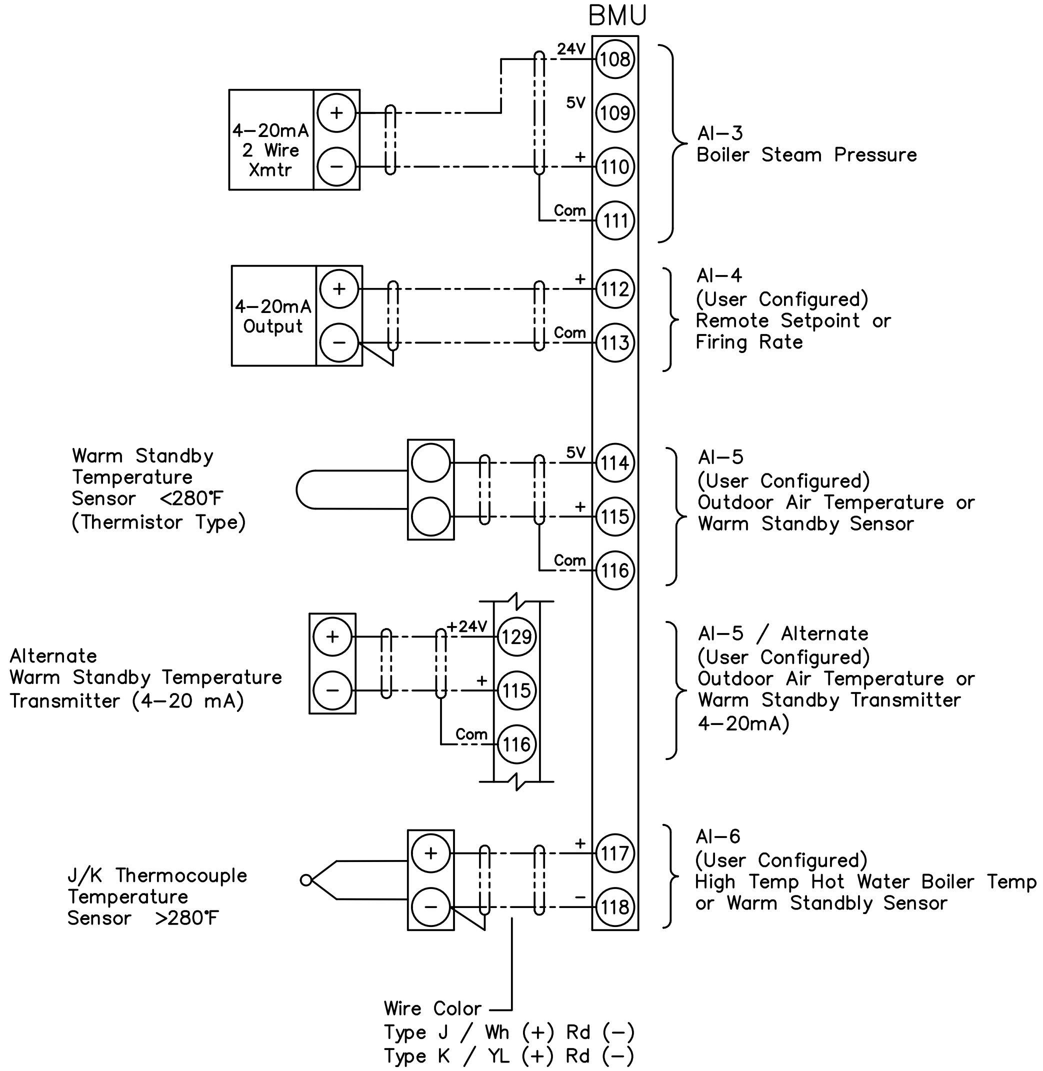
A Division of Preferred Utilities Mfg. Corp.

BURNERMATE UNIVERSAL
FACTORY & FIELD WIRING
STANDARD PANEL

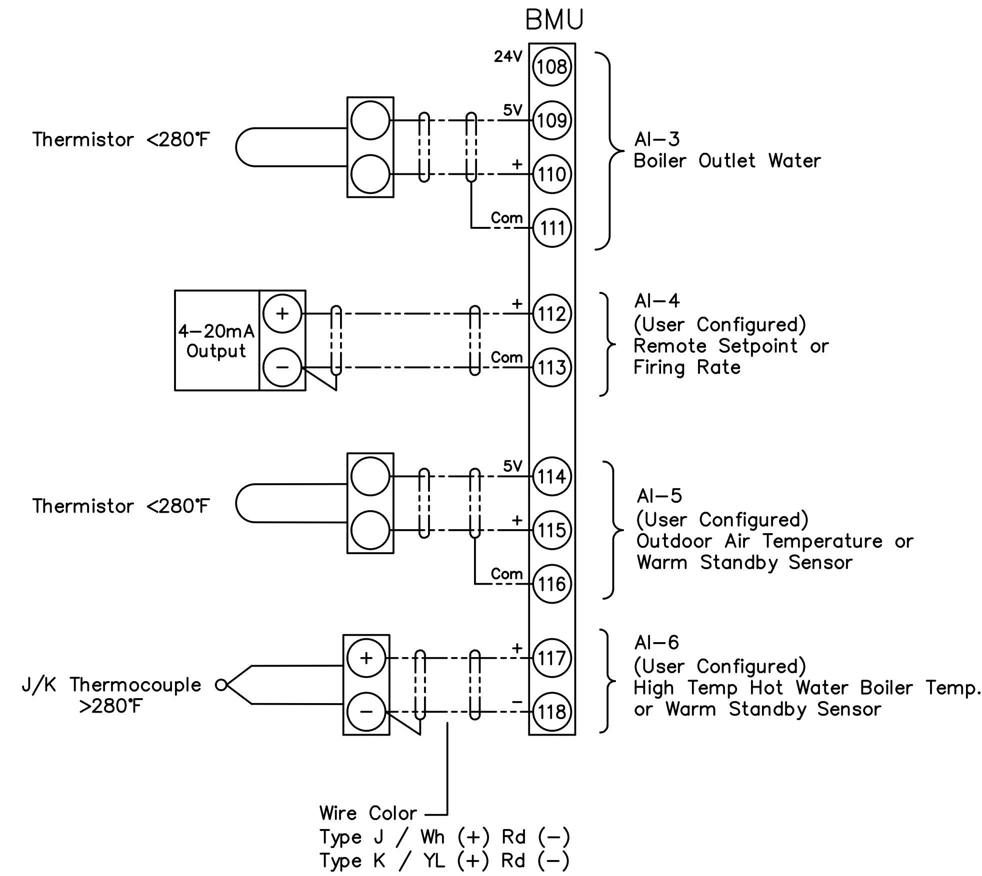
LET.	REVISIONS	INIT	DATE
3	Revised to Date	Re	4-13-18

SUPERSEDES:. | ASS'Y:.
SCALE: . | SHT 3 OF 8
DRN: WFL 9/20/07
APPR'D.:
FILE BMU-WIRING-STD
BMU-PANEL-WD

ANALOG INPUTS FOR STEAM BOILERS

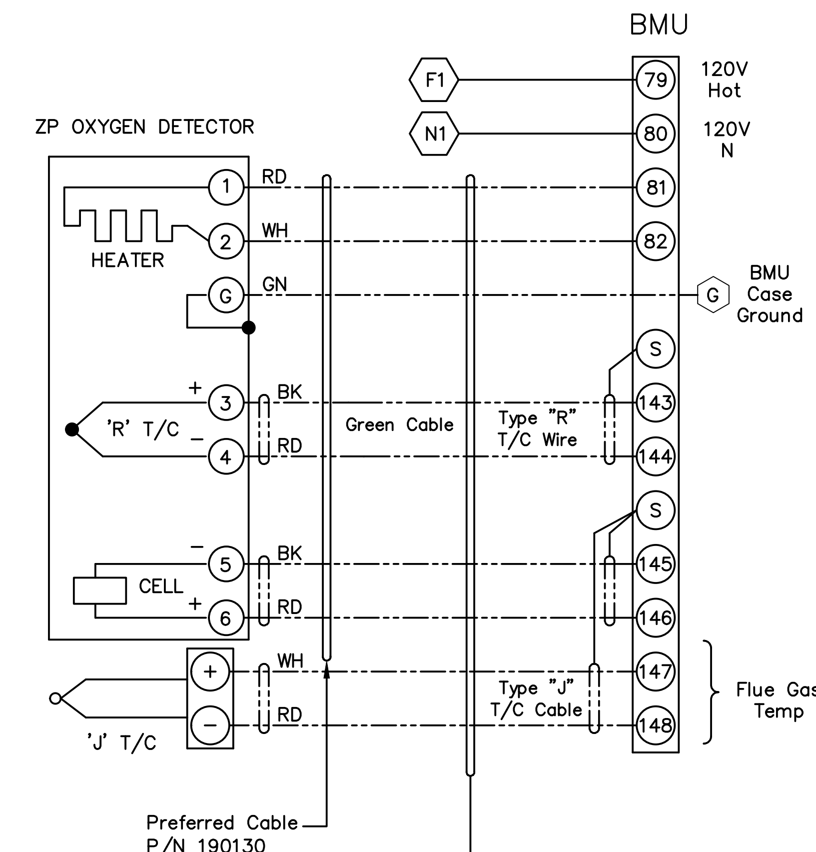


ANALOG INPUTS FOR HOT WATERS BOILERS



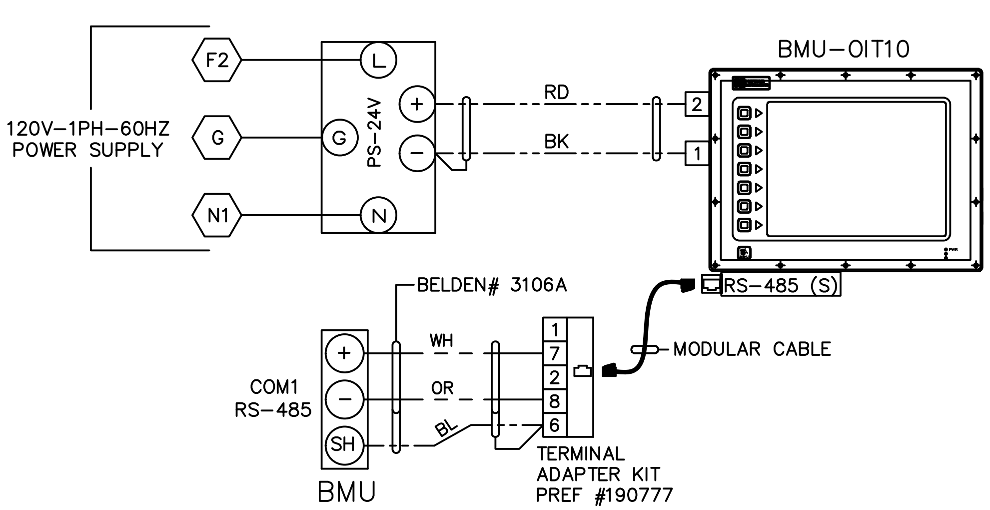
ZP OXYGEN ANALYZER

For Models BMU xZxx

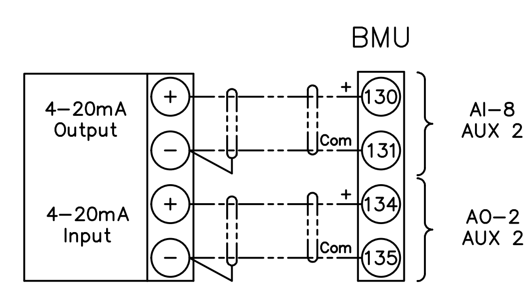


All wires must be run in a single conduit.
Do not include any other AC or DC wires in this conduit.
500 ft max wiring length. No splices.

OPTIONAL OIT10 TOUCHSCREEN MONITOR WIRING



USER CONFIGURED "AUX 2" 4–20mA CURVE DEVICE



NOTE:
- AUX 2 Curve Device is Enabled/Disabled via Parameters
- AUX 2 Device can be either a BMU Servo or a 4–20mA Positioned Device (One or the other – not both)
- 4–20 mA Devices require 4–20 mA Position Feedback– Burner will trip if Feedback does not Match Command
- Requires Release 2A.xx or Higher Hardware/Software

NOTE:
Routing of AC/DC Oxygen Analyzer Probe wiring together in the same conduit is acceptable.
No other BMU AC & DC wiring should be combined in the same conduit, unless otherwise noted.

SEE SHEET 1 OF 8 FOR GENERAL NOTES AND LEGEND.

PREFERRED INSTRUMENTS
31–35 SOUTH STREET
DANBURY, CONNECTICUT
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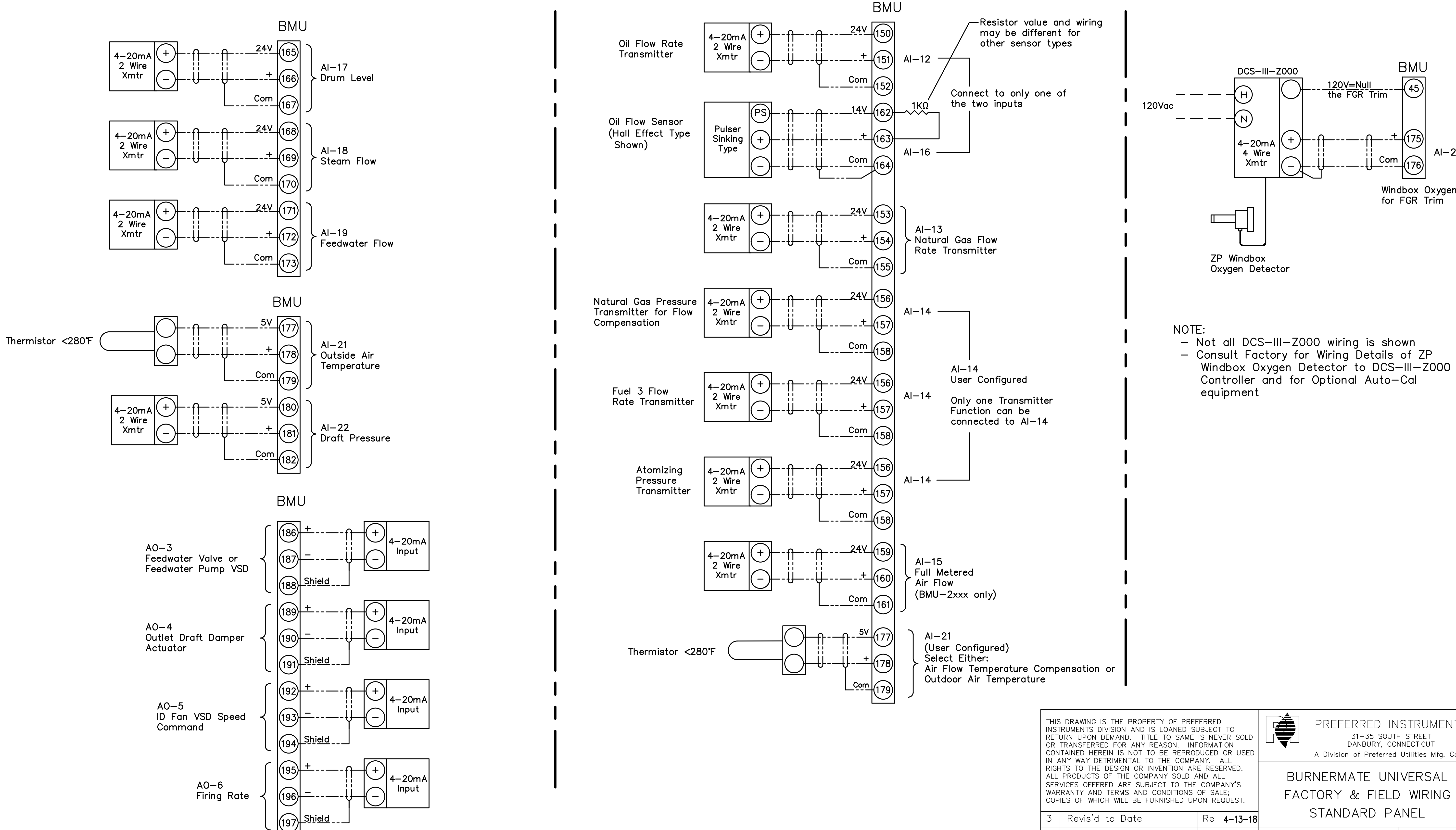
BURNERMATE UNIVERSAL
FACTORY & FIELD WIRING
STANDARD PANEL

LET.	REVISIONS	INIT	DATE
3	Revised to Date	Re	9-18-09

SUPERSEDES:. ASS'Y:.
SCALE: . SHT 4 OF 8
DRN: WFL 9/20/07
APPR'D.:
FILE BMU–WIRING–STD
BMU–PANEL–WD

BMU –1xxx and BMU –2xxx EXPANDED I/O OPTION BOARD WIRING



NOTE:
- Not all DCS–III–Z000 wiring is shown
- Consult Factory for Wiring Details of ZP Windbox Oxygen Detector to DCS–III–Z000 Controller and for Optional Auto–Cal equipment

SEE SHEET 1 OF 8 FOR GENERAL NOTES AND LEGEND.

PREFERRED INSTRUMENTS
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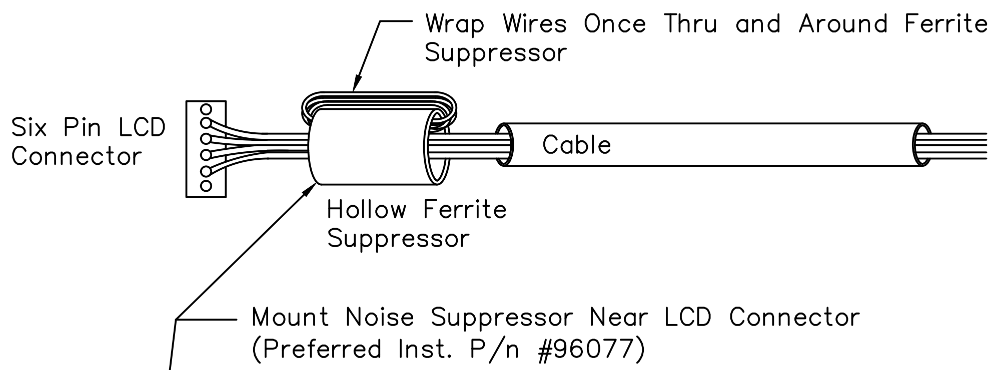
BURNERMATE UNIVERSAL
FACTORY & FIELD WIRING
STANDARD PANEL

LET.	REVISIONS	INIT	DATE
3	Revis'd to Date	Re	4–13–18

SUPERSEDES:. ASS'Y:.
SCALE: . SHT 5 OF 8
DRN: WFL 9/20/07
APPR'D.:
BMU–PANEL–WD
FILE BMU–WIRING–STD

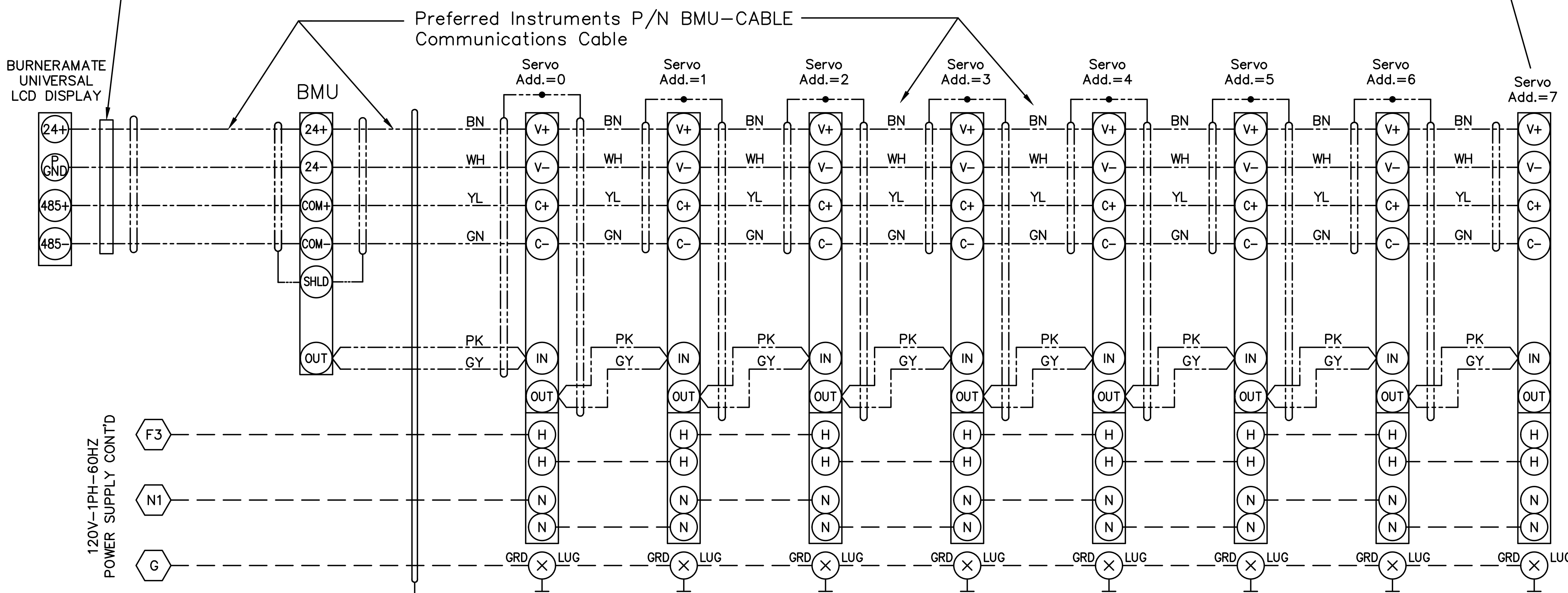


NOTE:
1. Servo Terminal Marking are changing:

New	Old
V+	+24V
V–	24 Rtn
C+	485+
C–	485–
(none)	SHLD

2. The shield does not have to connect to the SHLD terminal

SERVO WIRING



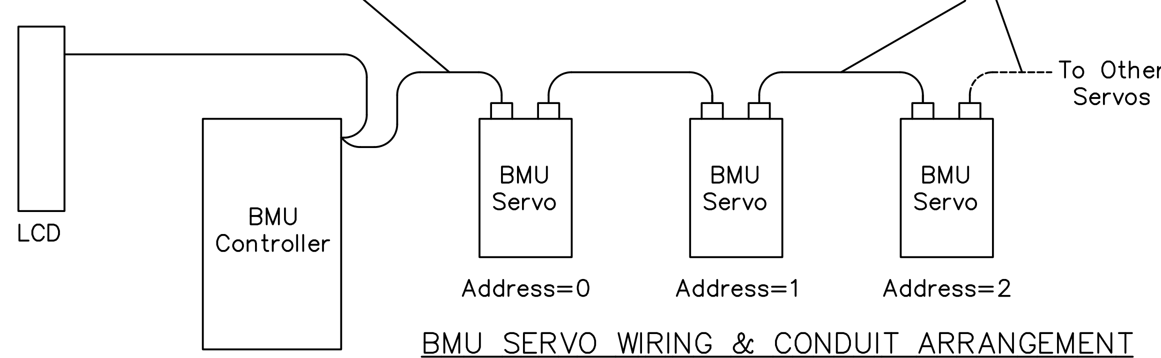
SERVO ADDRESS	FUNCTION
0	*
1	
2	
3	
4	
5	
6	
7	
8	
9	

* USER SHOULD FILL IN FUNCTION DURING INSTALLATION

All wires must be run in a single conduit. Do not include any other AC or DC wires in this conduit. 500 ft max wiring length. No splices.

NOTE #1:
THE SERVO 'H', 'N' & 'G' 120 VAC WIRES CAN BE RUN IN THE SAME CONDUIT AS THE BMU–CABLE WIRING
No other BMU AC & DC wiring should be combined in the same conduit, unless otherwise noted.

NOTE:
DO NOT CONNECT ANY OTHER AC LOADS TO THIS END OF THE SERVO AC POWER WIRING



BMU SERVO WIRING & CONDUIT ARRANGEMENT

SEE SHEET 1 OF 8 FOR GENERAL NOTES AND LEGEND.

PREFERRED INSTRUMENTS
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DANBURY, CONNECTICUT
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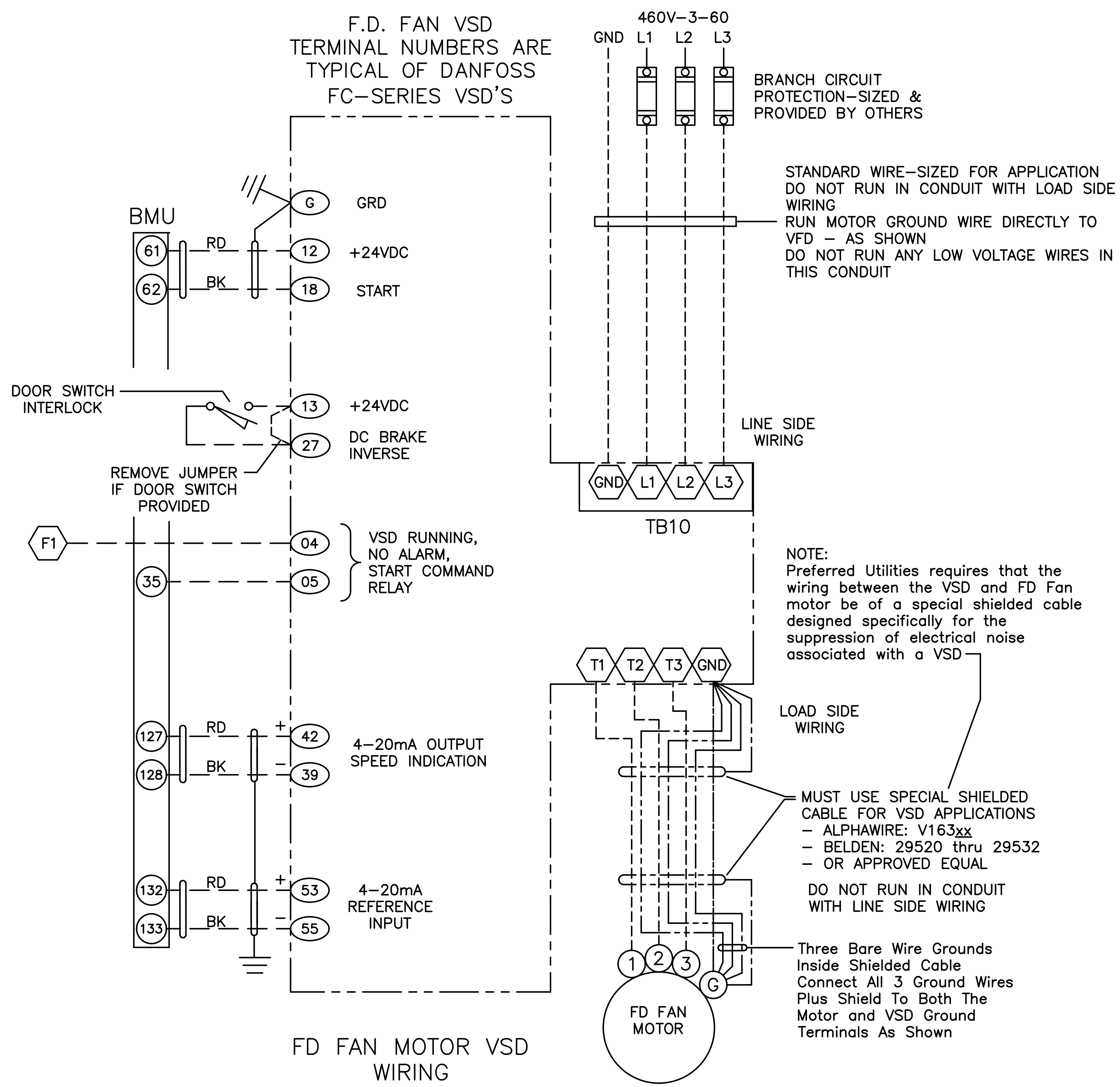
BURNERMATE UNIVERSAL FACTORY & FIELD WIRING STANDARD PANEL

LET.	REVISIONS	INIT	DATE
3	Revised to Date	Re	4-13-18

SUPERSEDES:. ASS'Y:.
SCALE: . SHT 6 OF 8
DRN: WFL 9/20/07
APPR'D.:
FILE BMU–WIRING–STD
BMU–PANEL–WD

OPTIONAL VSD WIRING – WITHOUT BY-PASS



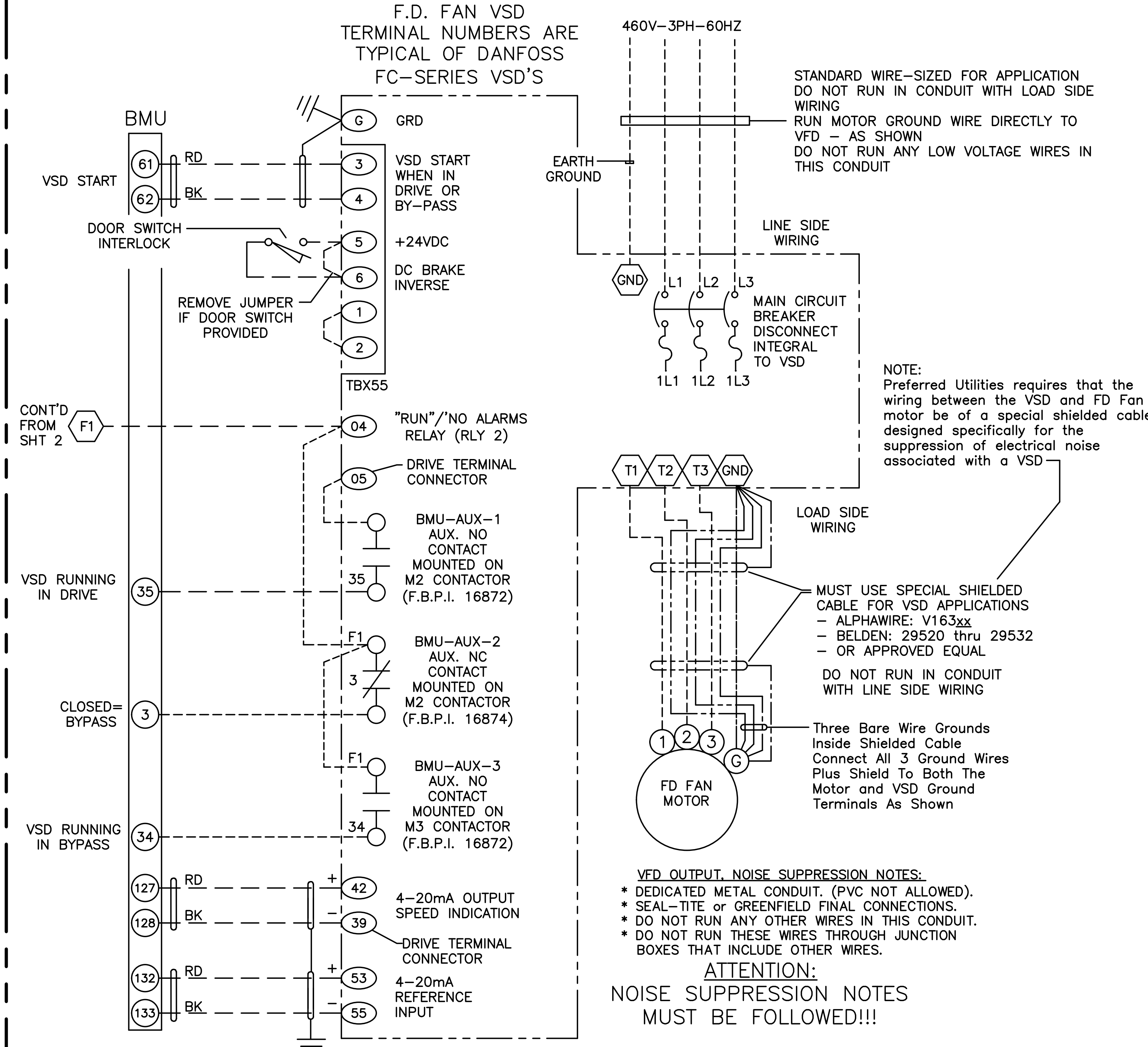
FD FAN MOTOR VSD
WIRING
(WIRING BY OTHERS)

VFD OUTPUT, NOISE SUPPRESSION NOTES:
* DEDICATED METAL CONDUIT. (PVC NOT ALLOWED).
* SEAL–TITE or GREENFIELD FINAL CONNECTIONS.
* DO NOT RUN ANY OTHER WIRES IN THIS CONDUIT.
* DO NOT RUN THESE WIRES THROUGH JUNCTION BOXES THAT INCLUDE OTHER WIRES.

ATTENTION:
NOISE SUPPRESSION NOTES MUST
BE FOLLOWED!!!

OPTIONAL VSD WIRING – WITH BY-PASS

CUSTOMER SUPPLIED CIRCUIT PROTECTION INPUT
POWER AND MOTOR WIRING MUST BE SELECTED
IN ACCORDANCE WITH N.E.C., ANY APPLICABLE
CODES AND THE DRIVE CURRENT RATING



FD FAN MOTOR VSD WITH
BY–PASS WIRING
(WIRING BY OTHERS)

PREFERRED INSTRUMENTS
31–35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Mfg. Corp.

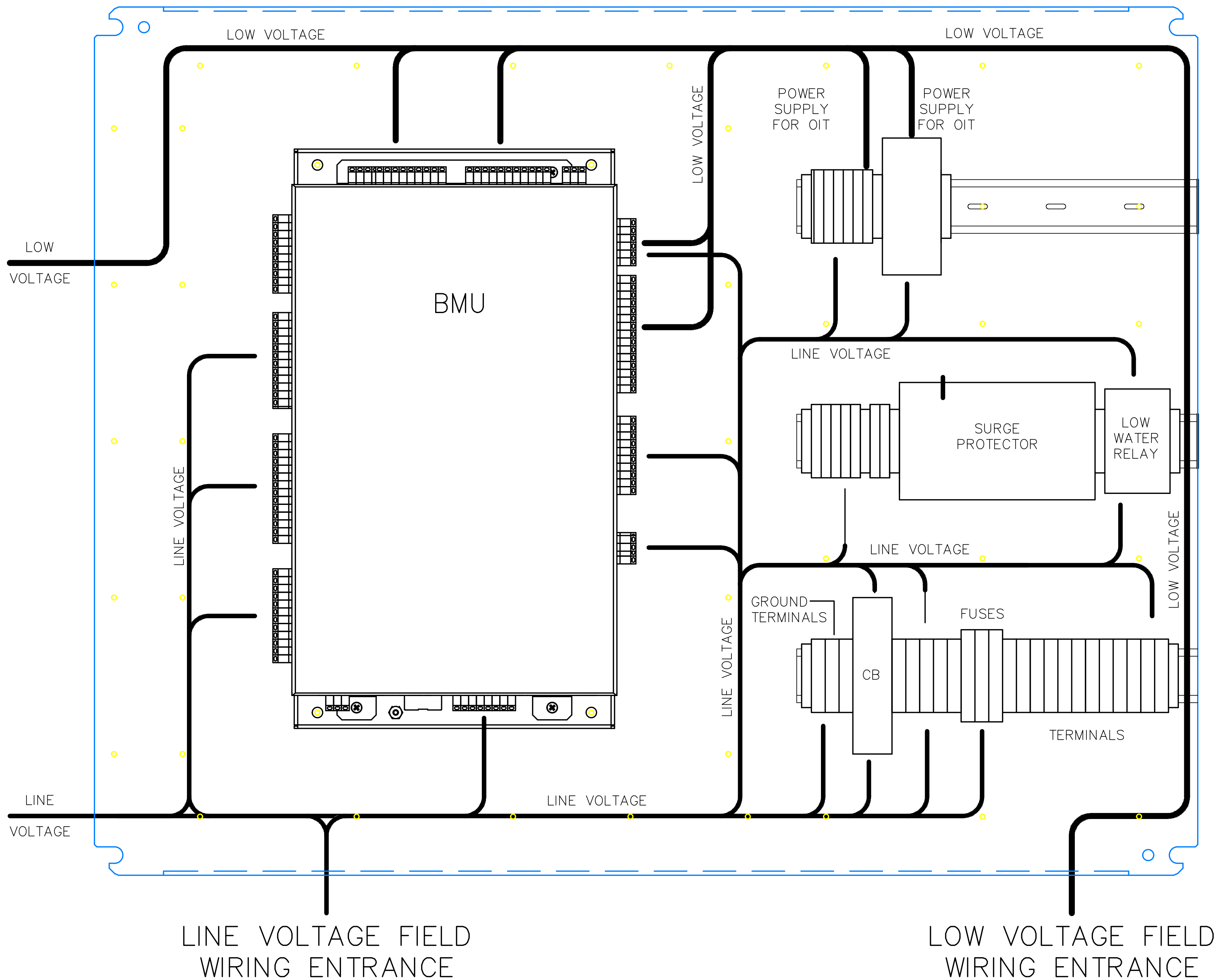
BURNERMATE UNIVERSAL
FACTORY & FIELD WIRING
STANDARD PANEL

LET.	REVISIONS	INIT	DATE
3	Revised to Date	Re	4–13–18

SUPERSEDES:. ASS'Y:.
SCALE: . SHT 7 OF 8
DRN: WFL 9/20/07
APPR'D.:
BMU–PANEL–WD

FILE BMU–WIRING–STD

SEE SHEET 1 OF 8 FOR GENERAL NOTES AND LEGEND.



RECOMMENDED CABINET FIELD WIRE ROUTING

NOTE #1:
KEEP LINE VOLTAGE AND LOW VOLTAGE SEPARATED TO MINIMIZE ELECTRICAL NOISE

NOTE #2:
DO NOT BUNDLE LINE AND LOW VOLTAGE WIRES TOGETHER

NOTE #3:
IF LINE AND LOW VOLTAGE WIRE CROSSING IS NECESSARY
CROSS WIRES AT 90 DEGREES ONLY

NOTE #4:
FOR OXYGEN PROBE AND SERVO ACTUATOR WIRING
REFER TO SECTION 4, SHEETS 4 & 6
IN THE INSTRUCTION MANUAL

SEE SHEET 1 OF 8 FOR GENERAL NOTES AND LEGEND.

PREFERRED INSTRUMENTS
31-35 SOUTH STREET
DANBURY, CONNECTICUT
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BURNERMATE UNIVERSAL FACTORY & FIELD WIRING STANDARD PANEL

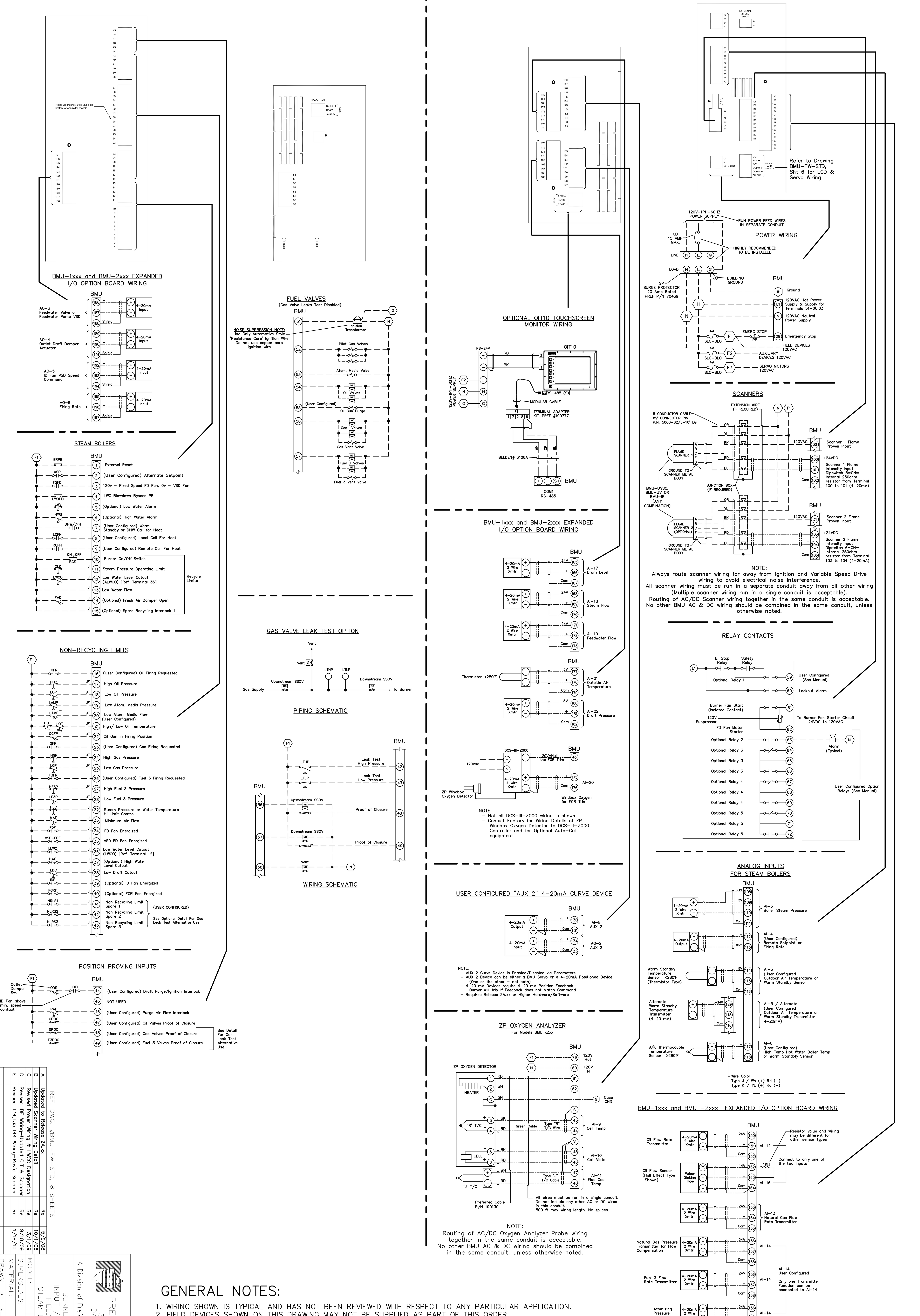
LET.	REVISIONS	INIT	DATE
3	Revised to Date	Re	4-13-18

SUPERSEDES:.	ASS'Y:.
SCALE: .	SHT 8 OF 8
DRN: WFL 9/20/07	BMU-PANEL-WD
APPR'D.:	

FILE BMU-WIRING-STD

NOTE:
Terminals L1, N and 1–99 are High Voltage (120 VAC)
Do Not wire High Voltage Inputs to Low Voltage Terminals

NOTE:
Terminals 100–197 are Low Voltage (24 VDC max.)
Do Not wire High Voltage Inputs to Low Voltage Terminals



GENERAL NOTES:

1. WIRING SHOWN IS TYPICAL AND HAS NOT BEEN REVIEWED WITH RESPECT TO ANY PARTICULAR APPLICATION.
2. FIELD DEVICES SHOWN ON THIS DRAWING MAY NOT BE SUPPLIED AS PART OF THIS ORDER.
3. LOW VOLTAGE D.C. WIRING –USE #22 GA. MIN. SHIELDED CABLE. DO NOT RUN IN CONDUIT WITH A.C. VOLTAGE. GROUND SHIELD ONLY WHERE SHOWN. ISOLATE EXPOSED SHIELDS TO PREVENT UNINTENDED CONNECTIONS TO CASE GROUND. LABEL EACH END OF LOW VOLTAGE CABLE.
5. CONSULT TAB 3 OF THE BURNERMATE UNIVERSAL O&M MANUAL FOR ADDITIONAL NOISE PREVENTION PRACTICES.
6. DIGITAL INPUTS FOR ANY DEVICES NOT REQUIRED BY CODE, AND NOT ON THE BOILER/BURNER SHOULD BE JUMPERED TO 120VAC.
7. ALL WIRING TO BE IN ACCORDANCE WITH NEC AND ANY APPLICABLE STATE OR LOCAL CODES.
8. J = JUMPER WHEN NOT USED.
9. TERMINALS L1, N and 1–99 ARE HIGH VOLTAGE (120VAC) – DO NOT WIRE HIGH VOLTAGE TO LOW VOLTAGE TERMINALS
10. TERMINALS 100–197 ARE LOW VOLTAGE (24VDC max.) – DO NOT WIRE HIGH VOLTAGE TO LOW VOLTAGE TERMINALS

FILE #BMU FIELD

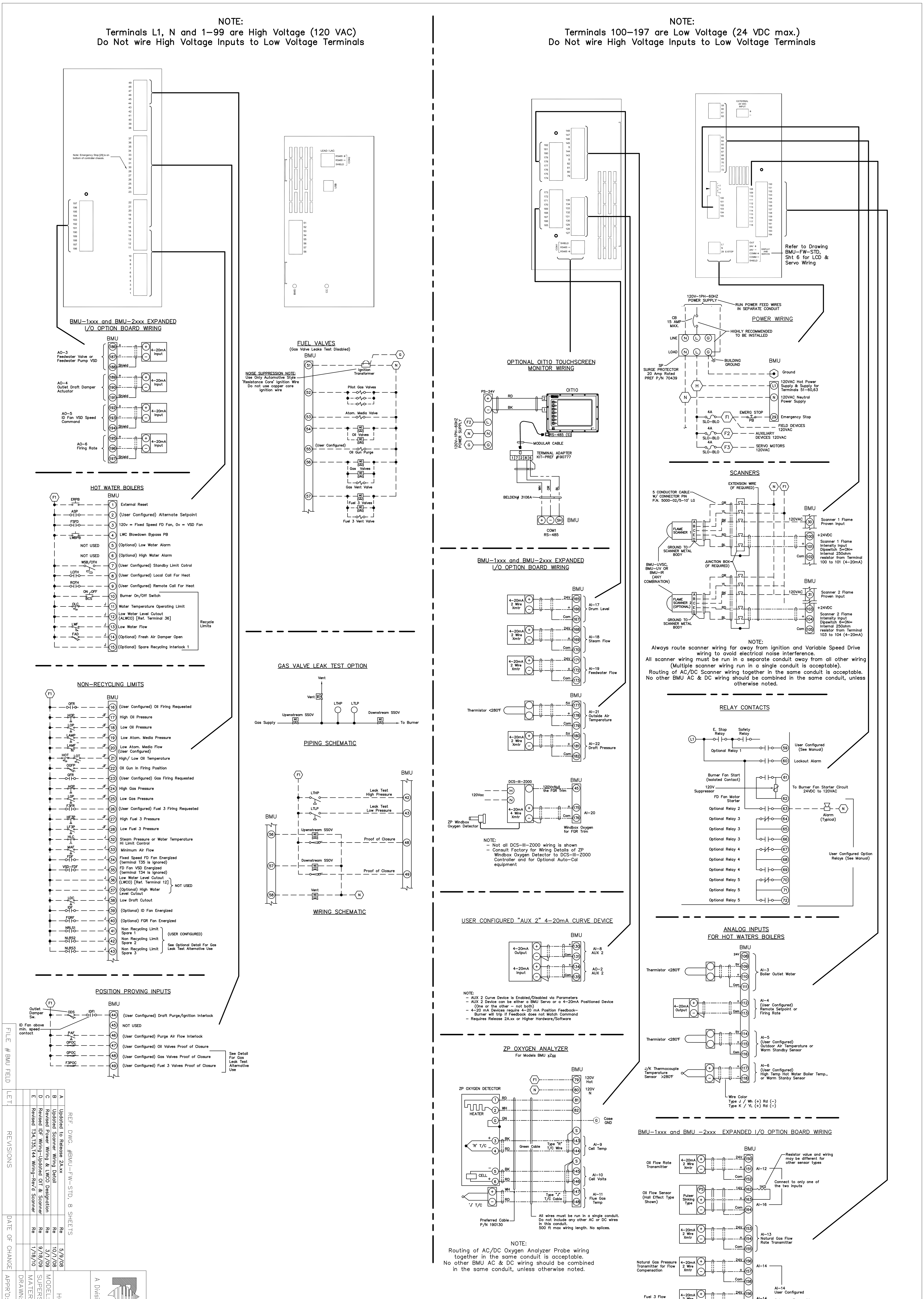
REF. DWG. #BMU–FW–STD, 8 SHEETS

LET.	REVISIONS		DATE OF CHANGE
A	Updated to Release 2A.xx	Re	5/9/08
B	Updated Scanner Wiring Detail	Re	10/7/08
C	Revised Power Wiring & LWCO Designation	Re	3/7/09
D	Revised IDF Wiring–Updated OIT & Scanner	Re	9/18/09
E	Revised T34,T35,T44 Wiring–Rev'd Scanner	Re	1/18/10

PREFERRED INSTRUMENTS
31–35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Manufacturing Corp.

BURNERMATE UNIVERSAL
INPUT / OUTPUT TERMINALS
FIELD WIRING DETAILS
STEAM BOILER APPLICATION

MODEL: | SIZE: | TYPE:
SUPERSEDES: | ASSY NO.:
MATERIAL: | SCALE: NONE
DRAWN: RE 3–1–08
APPR'D:
BMU–FW–STM



GENERAL NOTES:

1. WIRING SHOWN IS TYPICAL AND HAS NOT BEEN REVIEWED WITH RESPECT TO ANY PARTICULAR APPLICATION.
2. FIELD DEVICES SHOWN ON THIS DRAWING MAY NOT BE SUPPLIED AS PART OF THIS ORDER.
3. LOW VOLTAGE D.C. WIRING –USE #22 GA. MIN. SHIELDED CABLE. DO NOT RUN IN CONDUIT WITH A.C. VOLTAGE. GROUND SHIELD ONLY WHERE SHOWN. ISOLATE EXPOSED SHIELDS TO PREVENT UNINTENDED CONNECTIONS TO CASE GROUND. LABEL EACH END OF LOW VOLTAGE CABLE.
5. CONSULT TAB 3 OF THE BURNERMATE UNIVERSAL O&M MANUAL FOR ADDITIONAL NOISE PREVENTION PRACTICES.
6. DIGITAL INPUTS FOR ANY DEVICES NOT REQUIRED BY CODE, AND NOT ON THE BOILER/BURNER SHOULD BE JUMPERED TO 120VAC.
7. ALL WIRING TO BE IN ACCORDANCE WITH NEC AND ANY APPLICABLE STATE OR LOCAL CODES.
8. J = JUMPER WHEN NOT USED.
9. TERMINALS L1, N and 1–99 ARE HIGH VOLTAGE (120VAC) – DO NOT WIRE HIGH VOLTAGE TO LOW VOLTAGE TERMINALS
10. TERMINALS 100–197 ARE LOW VOLTAGE (24VDC max.) – DO NOT WIRE HIGH VOLTAGE TO LOW VOLTAGE TERMINALS

PREFERRED INSTRUMENTS
31–35 SOUTH STREET
DANBURY, CONNECTICUT
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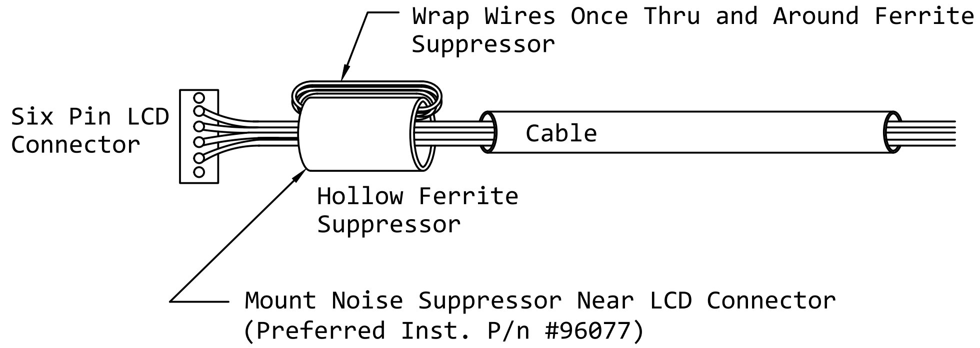
BURNERMATE UNIVERSAL
INPUT / OUTPUT TERMINALS
FIELD WIRING DETAILS
HOT WATER BOILER APPLICATION

MODEL: | TYPE:
SUPERSEDES: | SIZE:
MATERIAL: | ASS'Y NO.:
DRAWN: RE 3–1–08 | SCALE: NONE
APPR'D: | BMU–FW–HW

REF. DWG. #BMU–FW–STD, 8 SHEETS

LET.	REVISIONS		DATE OF CHANGE
A	Updated to Release 2A.xx	Re	5/9/08
B	Updated Scanner Wiring Detail	Re	10/1/08
C	Revised Power Wiring & LWCO Designation	Re	3/1/09
D	Revised OF Wiring–Updated OIT & Scanner	Re	9/18/09
E	Revised T34,T35,T44 Wiring–Rev'd Scanner	Re	1/18/10

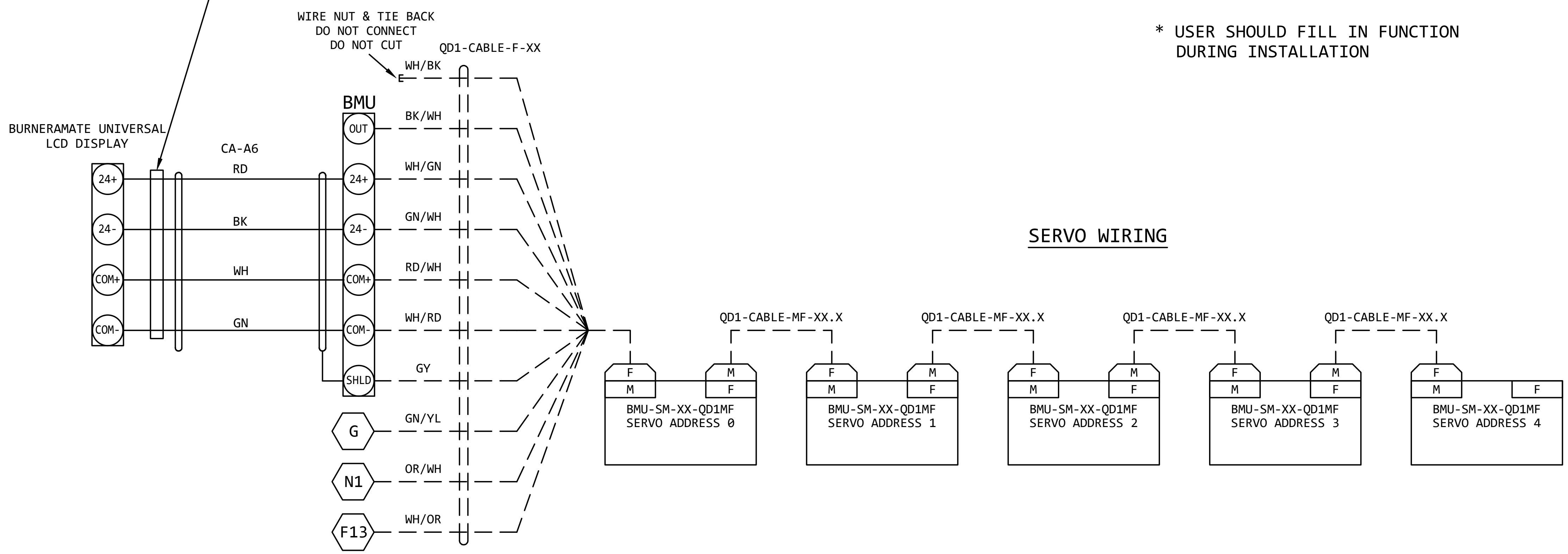
FILE #BMU FIELD



SERVO ADDRESS	FUNCTION
0	*
1	
2	
3	
4	

* USER SHOULD FILL IN FUNCTION DURING INSTALLATION

SERVO WIRING



NOTE #1
QD1 CABLES MUST BE PROTECTED BY A 3 AMP FUSE IN THE BURNER PANEL

NOTE #2
CABLES ARE ITC-ER (EXPOSED RUN) AND DO NOT NEED TO BE RUN IN CONDUIT, IF THE FOLLOWING ARE TRUE:
- CABLE IS PROTECTED FROM PHYSICAL DAMAGE BY BEING SUPPORTED AND SECURED TO CABLE TRAYS, STRUTS, ANGLES, CHANNELS, COLD PIPES, CONDUITS, ETC.
- CABLE MUST BE SUPPORTED AND SECURED AT INTERVALS NOT EXCEEDING 6 FT.
- CABLE MUST **NOT** CONTACT, OR BE SECURED TO, SURFACES EXCEEDING 185 F (85 C)

NOTE #3
CONNECTORS ARE NEMA 4 RATED WHEN HAND TIGHT: DO **NOT** OVERTIGHTEN.

NOTE #4
MAXIMUM COMBINED CABLE LENGTH IS 250 FT. MAXIMUM QD-JB SERVO HUB LENGTH IS 20 FT.

NOTE #5
SERVO ADDRESSES MUST FOLLOW THE DAISY CHAIN SEQUENCE, AND NOT SKIP ANY VALUES.

NOTE #6
FOR QD1 QUICK DISCONNECT CABLE CONNECTIONS (DAISY CHAINED, QD1-JB JUNCTION BOX & MIXED DAISY CHAIN / QD1-JB), CABLE CONNECTOR PIN-OUT & CONDUCTOR COLOR CODE, AND JUNCTION BOX DIMENSIONS REFER TO THE TECHNICAL BULLETIN IN INSTRUCTION MANUAL.

PREFERRED
UTILITIES MFG CORPORATION
31-35 SOUTH STREET DANBURY, CONNECTICUT
TEL:203-743-6741 FAX:203-798-7313.
WWW.PREFERRED-MFG.COM

CUSTOMER:

JOB NAME:

SALES ORDER:

REV.	DATE	DESCRIPTION	BY	APP

DRAWING NAME:
'QD1' QUICK DISCONNECT CABLES TO BURNERMATE UNIVERSAL WIRING DIAGRAM

BILL OF MATERIAL:

REFERENCED DOCUMENTS:

DESIGNED BY:
LDA: 03/05/2019

DRAWING NUMBER:
BMU-QD1-WD
SHEET 01 OF 01

SECTION 5 INDEX

BurnerMate Universal Technical Bulletins

BurnerMate Universal Initial Power Up

Before proceeding further, ensure that all of the field devices have been properly installed and that all electrical wiring has been completed.

Close the hand valves on the gas and oil piping trains to ensure fuel is not inadvertently introduced into the furnace. Insure that the AC power supply is within the specified range noted in Tab 4. Insure that the burner On/Off switch is in the Off position. Insure all field wires have been terminated to prevent electrical shorts to ground, which will result in damage to the **BurnerMate Universal**. Turn on the AC power supply and observe the LCD display.

If the touch pad display is blinking and there is a warning message “Parameter Mismatch, Copy BMU→LCD or Copy LCD→BMU”, move the cursor to “Copy BMU→LCD” and press the Enter push button.

Note: The **BurnerMate Universal** and LCD touch pad each have EEPROM chips that store the controller’s configuration data. However, the data is only stored on the **BurnerMate Universal** chassis EEPROM until you exit the Commission Mode. Then it is automatically backed up to the LCD. If, during power up, the power is disconnected during commissioning, the LCD will blink and display the “Parameter Mismatch” message. **<u>In most instances, you will want to copy the BMU configuration to the LCD touch pad.</u>**

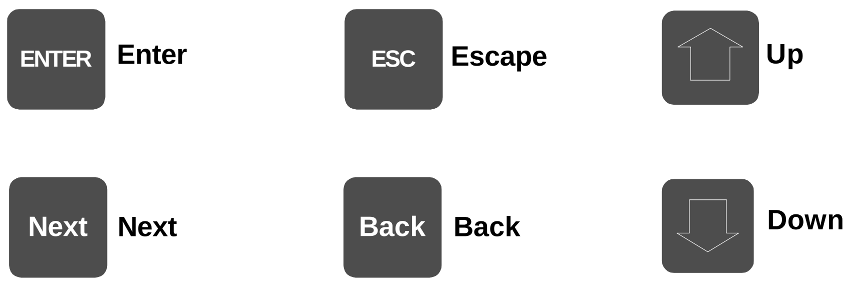
In addition, the LCD provides another means of uploading a completed configuration into successive units. This can be done by removing the LCD touch pad from the completed unit and installing it on the successive unit. When power is applied, the **BurnerMate Universal** will recognize that the configurations are different. The LCD will prompt the technician to either copy the configuration from the BMU→LCD or Copy from LCD→BMU. In this case one should copy the LCD to the BMU. This will download all the configuration data from the first unit to the successive unit. Be aware that it will be necessary to set up all of the servos individually and verify the curves on <u>each</u> successive unit to which data is copied from the first unit.

Caution: The commissioning engineer must read these instructions carefully and be certain that they fully understand this product’s requirements and the application as it applies to the specific fired equipment being retrofitted. Failure to follow these instructions could result in damage to the product and/or a hazardous condition. Check the ratings given in these instructions to ensure that this product is suitable for the intended application. After installation is complete, check that the actual operation of this product is as it is described in these instructions.

The following instructions are utilizing the LCD and not the OIT Touch Screen, as the OIT is optional equipment and may not appear on all applications.

Reference **Section 3** for information on LCD display and Menu navigation, Password access levels, and Parameter function details

In this section, each LCD push button is identified by its name spelled out in **Bold** as follows:



BurnerMate Universal Commissioning Process

The following is the basic sequence recommended for a complete and successful start up of the **BurnerMate Universal**, including the tuning and final commissioning functions.

<u>After the power is on, access Utilities in the Main Menu and record the current Date/Time and Serial Number. With this information, call and obtain a temporary password so that the site passwords can be entered.</u>

1. Review the application and configure the appropriate Parameters as they apply to this installation.
2. Set up and calibrate all of the **BurnerMate Universal** servos.
3. Place the **BurnerMate Universal** in the Commission mode.
4. Pre-program the Standby, Purge and Ignition positions.
5. Start the burner sequence and confirm the operation of all safety non-recycle and operating recycle limits.
6. Verify the Purge and Ignition positions and fire the burner.
7. Enter the curve points. Repeat for all fuels.
8. Verify all curve points.
9. Operate in automatic and perform the final PID tuning.
10. Document all the Parameter settings, limit switch settings and combustion and servo data.
11. Provide operator training as required by the final end user.

Obtaining and Entering a Password

To obtain a temporary password for the **BurnerMate Universal** access the Utilities menu from the Main Menu. Record the current Date, Time and Serial Number exactly as it appears. Do not change this information until after the password has been entered or the process will be delayed approximately 6 hours.

Once you have this information, contact Preferred Instruments in Danbury, CT (203-743-6741), a Preferred Instruments Regional Sales Manager, or your local Preferred Instruments Authorized Factory Representative and they will issue a temporary password. Enter the temporary password into the **BurnerMate Universal** and then proceed to assign new passwords specific to that application. Note that the temporary password is <u>only valid for 6 hours</u>.

Passwords and User Access

Parameters, options, and servo setup can be viewed at all times, regardless of the current Password Level. However, in order to modify the Parameters, options, fuel/air curves and servo setup the user must enter the appropriate password for the required Privilege Level of that Parameter. Password mode is only accessed through the LCD display and not on the touch screen. Note that if the power to the **BurnerMate Universal** is cycled, the current password level is cancelled and the user must re-enter the required password to resume work.

A detailed description of each **BurnerMate Universal** Parameter Privilege Level can be found in Section 3 of this manual. Below indicates the Privilege Levels accessible with each Password.

LCD Display	Accessible Parameter Privilege Level
Operator	“O”
Tech	“O” or “T”
Engineer	“O” “T” or “E”
OEM Tech	“O” “T” or “E”
OEM Eng	“O” “T” or “E”

As noted above, once the temporary password is entered into the **BurnerMate Universal,** the commissioning engineer must assign new passwords for each security level in accordance with the specific requirements of that application.

If security is not required at the Operator password level, set the password to “9999” or 0 (zero), either of which means that no password is required and the operator will not be denied access after the automatic 6 hour time out period. All other password levels should maintain a limited degree of security so that only authorized personnel can make Parameter changes.

Commissioning Step 1- Application Review and Configuration of Parameters

Following is a sample of the Application Setup Questionnaire, which was developed to identify the key information needed to perform a pre-commissioning application set up function. A copy of this questionnaire can be found at the end of this section. We encourage the commissioning engineer to complete the questionnaire well in advance of startup as doing so simplifies and abbreviates the Parameter entry process at the time of commissioning. The Parameters that are indicated on the questionnaire are considered the minimum parameters that should be addressed before attempting to commission the **BurnerMate Universal**. Although all parameters relative to the application must be addressed and finalized before the commissioning process is complete, many of the factory default settings are suitable for some application.

At the end of this section is a document entitled “**BurnerMate Universal** Parameter Configuration Sheet”. This document is a list of all the Parameters, their default settings and the other selectable options in that parameter. Where the Application Setup Questionnaire is designed to ask the generally questions relevant to the installation, the Parameter Configuration Sheet is designed to address the specifics. In order to make the initial Parameter setting easier, fill out the configuration sheet as complete as possible with the information known. Using the keys on the LCD Display, configure the applicable parameters before starting the commissioning portion of the start up. Application and parameter set up is made easier when done through the OIT Touch Screen if one has been provided. Refer to Section 8 for details on using the OIT Touch Screen.

In addition to the Parameter Configuration Sheet, there is a Safety Limit Sheet and an Operational Data Sheet. We encourage the commissioning engineer to complete both of these documents prior to leaving the job site so they can be used for future reference.

Application Questions	Choices / Options	Application Specifics
What Fuels are being fired?	**P1.1.1**- Fuel 1 (oil) **P1.1.2**- Fuel 2 (gas) **P1.1.3**- Fuel 3 (Biogas, etc.)	
What source determines the fuel to be fired?	**P1.1.4**- Contacts, Display, Display or Modbus	
Purge Air Flow Switch Installed?	**P1.1.5**- Yes or No	
Induced Draft Fan Installed?	**P1.1.6**- Yes or No	
What will be the Ignition Transformer mode used?	**P1.1.7**- Early Terminate, With Pilot or Direct Spark	
How long is the Oil Main Trial for Ignition?	**P1.1.8**- 10 to 15 seconds	
How long is the Purge time?	**P1.1.9**- 15 to 1800 seconds	
How Long is the Post Purge Time?	**P1.1.10**- 15 to 1800 seconds	
What to do after a power failure?	**P1.3.1**- Recycle or Lockout	
Enable “Assured Low Fire Cutoff” option?	**P1.3.2**- Yes or No	
Are there “Proof of Closure Switches” installed?	Yes or No **P1.3.3**- Fuel 1 **P1.3.4**- Fuel 2 **P1.3.5**- Fuel 3	
How many scanners are used?	**P1.4.1**- One or Two	
What is the scanner intensity input signal?	**P1.4.2** and **P1.4.3-** 4-20 mA 0-20 mA, 0-5 VDC, 0-3 VDC, or 0-1 VDC	
Are you using Time Delays for the Fuel, Air, Atomizing or Draft Limit Switches?	**P1.6.1**- Minimum Air Flow **P1.6.2**- Low Fuel Pressure **P1.6.3**- Low Atom. Flow **P1.6.4**- Low Draft Cutout **P1.6.5**- HOLD Alarm Time **P1.6.6**- HOLD Lockout Time	
Are you using any of the Auxiliary Relay Option?	Five are available **P1.7.1** thru **P1.7.5**	
Are you using the Gas Leak Test Option? (Fuel 2 only)	**P1.8.1**- Yes or No	
Are you using the Oil Atomizer Purge? (Fuel 1 only)	**P1.9.1**- Yes (Pump back or Blow thru) or No	
High Flue Temperature Alarm/Shutdown?	**P1.10.3**- Yes or No	
What is the fuel transfer method used?	**P1.12.1**- Restart or Low Fire	
What is the Combustion Control Strategy?	**P2.1.1**-Jackshaft or Parallel Positioning or Metered	
Does the FD Fan have a VSD?	**P2.2.1**- Yes or No	
Will FGR Trim be used?	**P2.3.1**- Yes or No	

Is an O2 Analyzer Installed?	**P2.4.1**- Yes or No	
Is O2 Trim being used?	**P2.5.1**- Yes or No	
What kind of boiler outlet sensor is used?	**P3.1.1** to **P3.1.3**- Thermistor, 4-20 mA, 1-5 VDC, 0-5 VDC J-T/C or a K-T/C	
Set the outlet sensor dec. pt.	**P3.1.5**-	
What is the span of the outlet sensor device?	**P3.1.6**- 5.0 to 2000.0	
How will you call the boiler on?		
Call for Heat Options		
CFH Local Firing Rate Demand	**P3.2.1**- Outlet Deviation from SP or Terminal 8 Contact Closure	
Will there be a remote CFH?	**P3.2.2**- Yes or No	
CFH Remote Firing Rate Demand	**P3.2.3**- Modbus, Outlet Deviation from SP or Terminal 9 Contact Closure	
Remote Firing Rate Demand	**P3.2.4**- Outdoor Air Reset SP, Modbus SP, Input AI4 SP, Input AI4 Firing Rate or Modbus Firing Rate	
What type of signal is used for Analog Input 4?	**P3.2.7**- 4-20 mA, 1-5 VDC or 0-5 VDC	
How will the firing rate be controlled?		
Firing Rate Options		
Alternate Local Firing Rate SP Example: Summer/Winter Switch	**P3.7.1**- Yes or No	
DHW Firing Rate Override	**P3.8.1**- Yes or No	
Warm Standby Option	**P3.9.1**- No, Terminal 7, Sensor & Terminal 7 or Sensor & Modbus	
Cold Start Warm-up Cycle Option	**P3.10.1**- Yes or No	
Low Fire Hold Option	**P3.11.1**- No, Terminal 7, Warm-up Sensor	

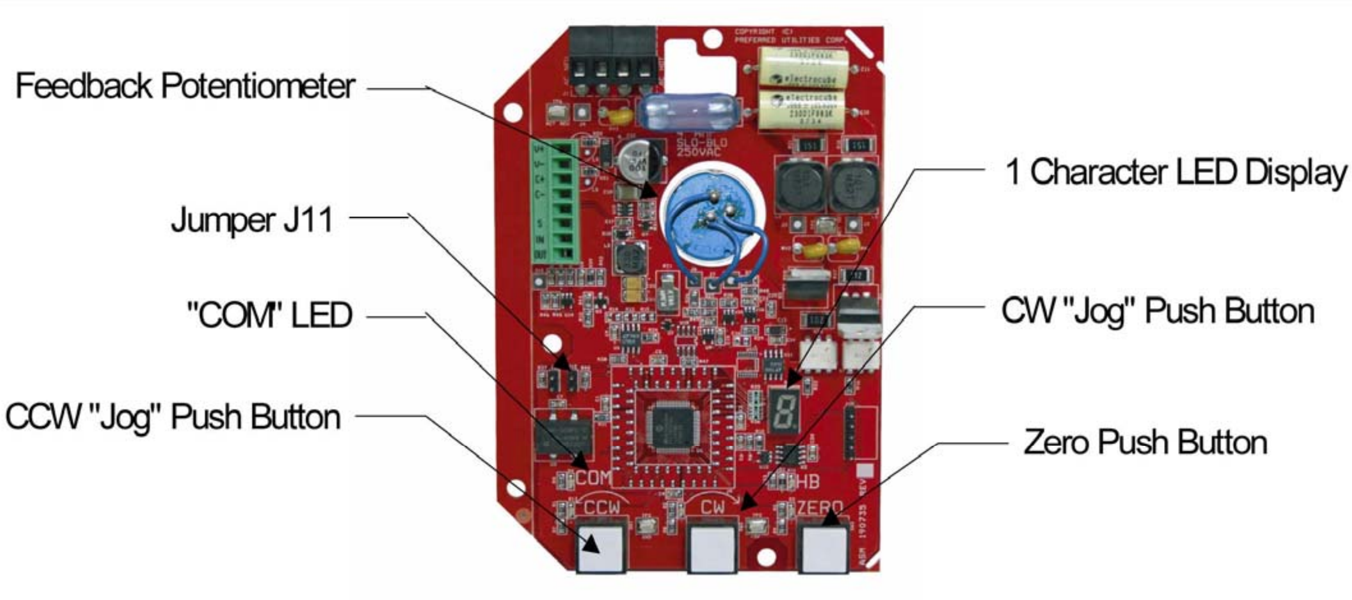
Is Draft Control being used?	**P4.1.1**- Yes or No	
If Draft Control is being used, what kind?	**P4.1.1**- Floating Servo, Floating 4-20 mA Floating with VSD PID Servo PID 4-20 mA PID with VSD PID with VSD and Servo PID with VSD and 4-20 mA	
Additional Draft Parameters	**P4.1.2** to **P4.11.4**	
Is Feedwater Control being used?	**P5.1.1**- Yes or No	
If Feedwater Control is being used, what kind?	**P5.1.1**- Single Element Two Element Three Element	
Additional Feedwater Parameters	**P5.1.2** to **P5.11.2**	
Are you using the Pressure Control option for the atomizing media?	**P6.1.1**- Yes or No	
Additional Atomizing Pressure Control Parameters	**P6.1.2** to **P6.3.4**	

Servo Description and Operation

The servos for the **BurnerMate Universal** are unique because of the integral actuator circuit board that provides controller to servo interface as well as a local servo control device for the service technician. The servos themselves utilize a proprietary digital communication protocol. The actuator circuit board receives the **BurnerMate Universal** commands and in turn positions the servo. The servos' sealed potentiometer provides the servo position feedback signal upon which the system depends to assure positioning accuracy and safe operation.

The proprietary digital communication protocol allows the servos to be daisy chained to the **BurnerMate Universal** chassis in any order. This allows the installing contractor to wire the servos in the best way to allow the shortest and cleanest conduit runs. The commissioning engineer assigns each servo an address (depending on that servo's position in the daisy chain) and a function during the set up procedure.

Features of the BurnerMate Universal Servo Actuators



Servo-Actuator Control Board

The servo board contains three pushbuttons that are used to manually position and zero calibrate the servo actuators.

CCW Counter Clockwise
CW Clockwise
Note: CCW & CW are only active when: ZERO calibration mode is active, the servo is not communicating with the **BurnerMate Universal** chassis or the J11 jumper is removed.
ZERO Sets up the servo address and the direction the servo travels to close.

Four LED's provide continuous status indication of the servo operation.

CCW	ON = Servo motor is being driven counter clockwise (all modes)
CW	ON = Servo motor is being driven clockwise (all modes)
ZERO	The **BurnerMate Universal** Combustion Control board has activated the servo zero calibration mode. --Blinking: in zero cal mode, zero position has not been established. --ON: in zero cal mode, zero position has been established.
COMM	ON = Servo motor is communicating with the **BurnerMate Universal** (all modes) OFF = The **BurnerMate Universal** has not sent a message to this specific servo for more than 1 second.

A 7-segment (single character) LED display continuously scrolls a message indicating the servo position (Pxx.x), the servo function (Sxx), the servo address (Axx), and any error messages for that servo (Ex). Below is the key for interpreting these messages. Note that the (x) replaces the actual letter or number.

Servo Position

Pxx.x = Position in degrees (tenths of a degree resolution)
= 'uu.u' if 'Unknown', (unit has not been 'Zeroed' yet)
= '-xx.x' if negative, suppresses leading zeros

Servo Function

SFx = Servo, Fuel x
- SF1 = Fuel 1 (Oil)
- SF2 = Fuel 2 (Gas)
- SF3 = Fuel 3
- SF4 = Tandem Fuel 1 & Fuel 2

SAx = Servo, Air x
- SA1 = FD Fan Damper
- SA2 = Auxiliary Damper/Valve (FD or FGR)
- SA3 = FGR Damper
- SA4 = Oxygen Trim Actuator

SCx = Servo, Control Loop
- SC1 = Jackshaft Actuator
- SC2 = Outlet Damper
- SC3 = Feedwater Valve
- SC4 = Atomizing Valve

Servo Address

Axx = communications address
= 0 thru 9, determined by location in the wiring daisy chain
= default address is 9

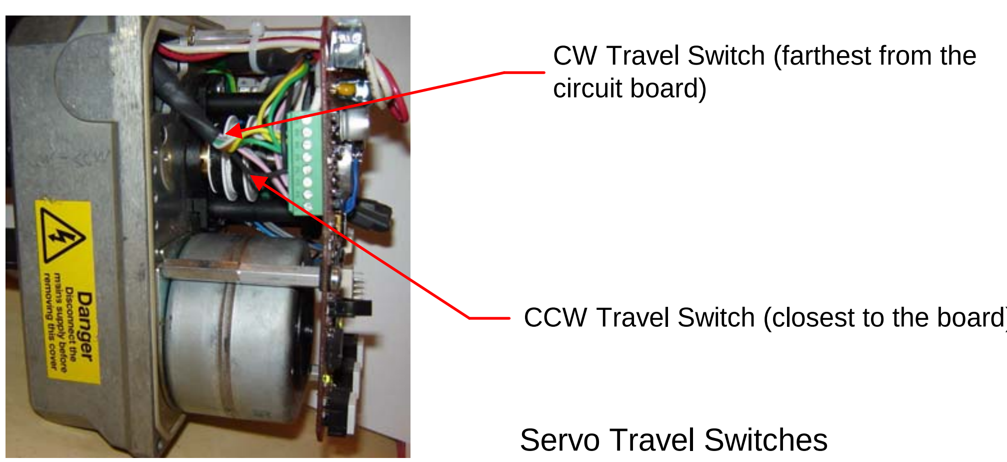
Errors are checked in order from E1 to E17. The first error detected is displayed.

E0 = No errors
E1 = Pot reference voltage out of range (low or high)
Feedback pot wiring incorrect or shorted
E2 = A/D converter error primary versus backup A/D disagree
E3 = Pot wiper voltage is too high (i.e., above CW end of the pot) Greater than Vmax. Pot wiring error, bad pot (open circuit), pot wiper dirty
E4 = Pot wiper voltage is too Low (i.e., below CCW end of the pot) Less than Vmin. Pot wiring error, bad pot (open circuit)
E5 = Motor vs. Pot direction error. Swap the motor CW and CCW wires.
E6 = Attempting to move into the feedback pot "CW Forbidden Zone".
E7 = Attempting to move into the feedback pot "CCW Forbidden Zone"
E8 = J11 jumper not installed
E9 = Servo not communicating with the **BurnerMate Universal**
E10 = Configuration data bad
E11 = Zero data bad
E12 = Limit switch position
E13 = Deadband data bad
E14 = Zero is near “Open”
E15 = Span is too small
E16 = Span is too large
E17 = Measured speed

Travel Limit Switches

The **BurnerMate Universal** servos include a clockwise and a counter clockwise travel limit switch. These switches are factory set for 90° of servo travel. But the **BurnerMate Universal** will allow the servos to be configured for as little as 15° of travel and as much as 180° for the BMU-SM servo and a maximum of 90° for the BMU-UM servo by adjusting these travel switches. Always span the servo to take advantage of the full range of travel of the valve or damper it is driving. If it is determined that the full span of the valve or damper is not required, then the travel can be limited by how the curve points are entered during commissioning.

Shown at right is the BMU-SM servo. Refer to the Appendix for information on the travel switch setting on the BMU-UM.



Servo Travel Switches

Commissioning Step 2- Servo Set Up

The **BurnerMate Universal** uses 0.1° accuracy servo actuators for very precise fuel/air ratio control. The **BurnerMate Universal** chassis communicates with the servos by a proprietary digital protocol. To achieve 0.1° accuracy and ensure the servos are working correctly, the **BurnerMate Universal** chassis constantly communicates with each servo actuator and monitors the feedback signal from the sealed feedback potentiometer.

The second step in the commissioning process is to set up and calibrate the servos. Each servo must be stroked for zero & span, assigned a function and address in the daisy chain and assigned a direction of travel for zero.

The complete servo set up procedure is outlined in detail in the following pages.

Below are the five simple steps required to set up and calibrate the servos:

1. Remove jumper J11 and stroke the servo (using the CCW & CW buttons) to set up the minimum and maximum travel limit switches as they best suit that device.

2. With J11 still removed, press and hold the zero button until all 3 push button lights flash. Use the CCW & CW buttons to set the address (the 1st servo in the data chain is address “0”). Push zero again. Install the J11 jumper.

3. On the LCD, go to the servo menu and select “Configure Servo”. Name each servo according to its address and function (address “0” Gas Valve, address “1” Oil Valve, etc.). Enter the appropriate feedback potentiometer full ohms, 90 degrees ohms and deadband data depending on the servo used.

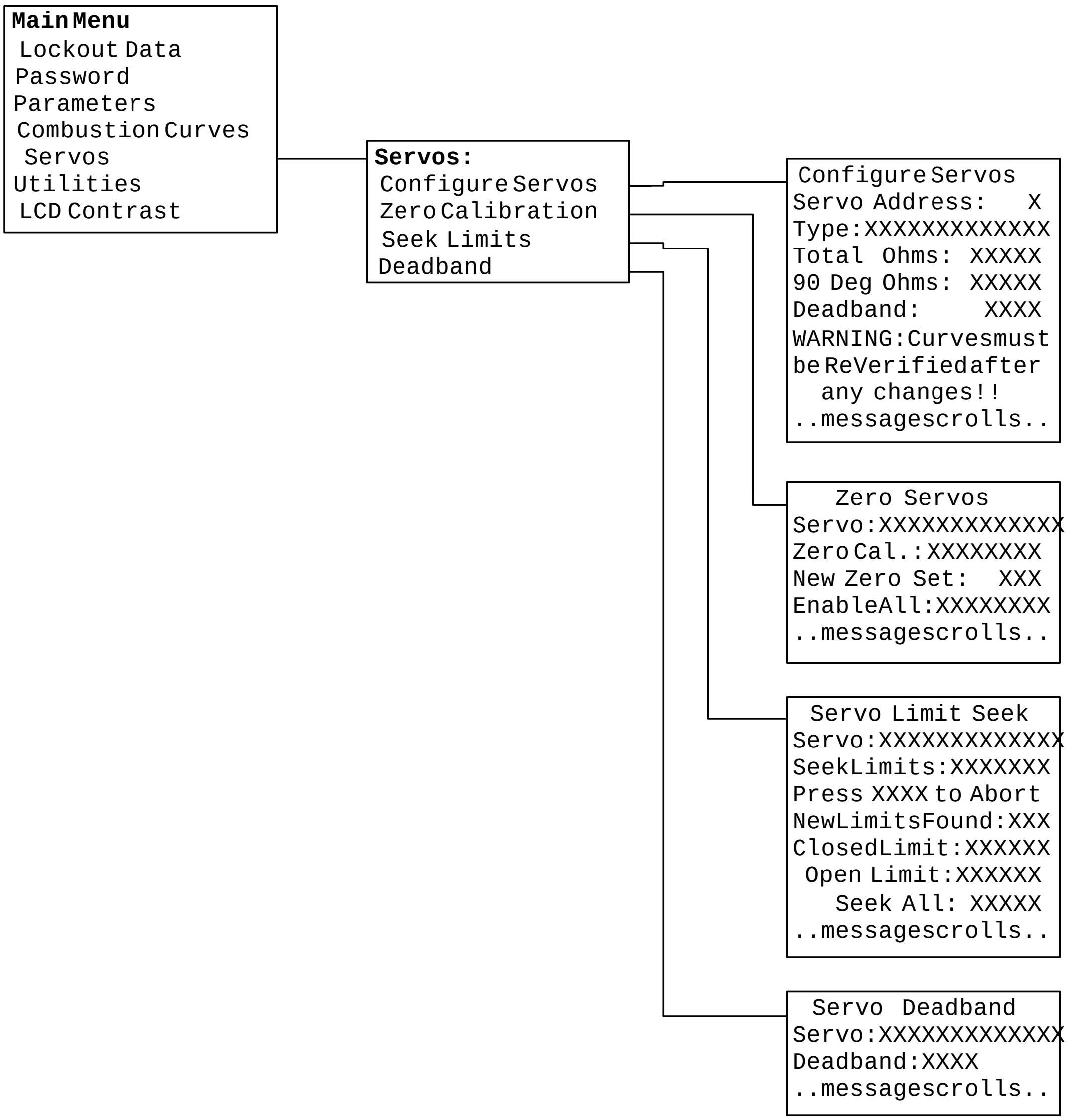
4. In the servo menu, select “Zero Calibration”. Enable the Function. Place the servo in the zero position. Press and hold zero and then press the direction button (CW or CCW) that indicates the direction the servo travels to get to zero. Disable the function.

5. In the servo menu, select “Seek Limits”. Select the servo and toggle the Start to Seek. Screen will return to Start - when Seek is complete. Record the Open and Closed degree information for reference when commissioning the BMU.

If there are no errors then the servo set up is done.

Servo Set Up Menu Tree

Below is the portion of the menu tree that is accessed from the LCD Display and is referenced in the following pages.



Servo Set Up Step 1- Travel Limit Switch Adjustment

WARNING!
Misalignment of the servo shaft relative to the valve (or damper) shaft can result in equipment damage, system malfunction, injury or death.

To set each servo actuator's mechanical range of travel, follow these steps:

1. Note that the BMU-SM servo can be stoked out to 180 degrees but the BMU-UM servo is limited to a maximum of a 90 degree stroke.
2. Remove jumper J11 located on the actuator circuit board to obtain local control of the servo. Use the **CW** and **CCW** buttons to "jog" the servo to the full open/close positions of the valve or damper. Verify the servo has sufficient torque and that mechanical binding does not occur at any point in the stroke. When testing fan dampers, the fan should be running in order to test the servo under full torque conditions.
3. Use the **CW** button to move the servo to its fully clockwise position
4. Turn the white gear on the CW travel switch clockwise until the switch makes. If the servo stops before the valve or damper is full open or closed, turn the CW gear counter-clockwise to give the servo more travel. Confirm that the servo is not binding and that there is not an E6 or E7 “Forbidden Zone” error displayed.

Note: while adjusting the travel switches on the servo; it may appear the switch contactor itself isn't moving. This is because there is a reducing gear between the adjusting knob and the actual switch contactor that allows for more precise switch adjustment (but slower movement).

WARNING!
To avoid damaging the servo, valve, or damper, jog the servo buttons slowly and frequently check for binding. **DO NOT** drive the servo at full speed into a valve or damper mechanical stop.

1. Jog the servo fully counter-clockwise using the **CCW** button.
2. Turn the white gear on the CCW travel switch counter-clockwise until the switch is made.
3. Jog the servo back and forth through its range of motion, ensuring that the servo does not bind in either direction. To prevent binding, the travel switches should stop the motor before the servo reaches a mechanical stop.
4. Re-install jumper J11.
5. Repeat steps 2 to 7 for each servo

Servo Set Up Step 2- Configure the Servo's Address

Perform the following to configure the address for each servo-actuator.

1. Open the Emergency Stop circuit on terminal **T29** of the **BurnerMate Universal** chassis.
2. Remove jumper J11 located on the actuator circuit board.
3. Press and hold the **Zero** button until all push button LEDs blink, then release.
4. Press **CW** or **CCW** to set the actuator address. The first servo in the daisy chain (the servo wired directly to the **BurnerMate Universal** chassis) is A0; the second is A1, etc.
5. Press **Zero** again to enter the address into memory.
6. Reinstall jumper J11.
7. Repeat steps 3 to 6 for each servo.

Warning!
Servo address is determined by the order in which it is wired in the servo "daisy chain." Incorrect servo function assignment can result in equipment damage, injury or death.

Servo Set up Step 3- Configure the Servo's Function and Feedback Potentiometer Data.

With each servo having been assigned an address, the next step is to assign a function (i.e. fuel valve, air damper, etc.) and to set the feedback pot characteristics for each servo address through the LCD touch pad.

1. From the main menu on the LCD touch pad, scroll down to Servos, press **Next**, and select Configure Servos by pressing **Next** again.
2. For each servo address in the daisy chain, press Down to Type and select the correct function for that servo from the options that are displayed.
3. Enter the appropriate feedback potentiometer and deadband data for each servo:

	BMU-SM-xx	**BMU-UM-xxx**
Total Ohms:	5000	1000
90 Deg. Ohms:	1324	900
Deadband:	0.1 deg (or higher)	0.4 deg (or higher)

NOTE:
The Default values in the BMU are the BMU-SM-xx values.
If a BMU-UM-xxx is being configured, you must change all three values.

The servos are now individually configured and the **BurnerMate Universal** must learn the zero and span ranges of each actuator using the signal from the feedback potentiometers.

(this page revised 11/28/11)

Servo Set Up Step 4- Servo Zero and Direction of Travel

WARNING!

If the burner had been commissioned previously, re-zeroing a servo changes all combustion curves that use this servo. The technician must re-validate the affected curves in the Commissioning Mode before the burner can be operated in Run mode.

To zero each servo and set it's direction of travel:

1. Select Zero Calibration from the servo menu, Press **Enter** and **Down** to the servo you want to zero.
2. Press **Enter** again and **Down** to Disable. Press **Enter** to change this value to Enable – this may take up to 30 seconds. The servo Zero LED will start to blink.
3. If this is a new installation where all of the servos are being calibrated, scrolling to Enable All will allow all servos to be set for calibration at one time.
4. "Jog" the servo all the way to the fully closed position.
5. The Zero LED should be either blinking or on continuously. Press and hold the servo **Zero** button – Zero LED will turn off. While still holding down the **Zero** button, press the "closed" direction button (**CW** or **CCW**). Hold both buttons down until the Zero LED turns back on and remains on. Make sure that the correct button was pushed for the Zero direction, otherwise the servo is not zeroed.
5. Release both buttons.
6. Repeat steps 1 to 5 for each servo.

Note: during initial **BurnerMate Universal** commissioning, all servos need to be zeroed. If a servo is replaced, or its zero position is changed, you will need to re-zero only that servo again.

Servo Set Up Step 5- Configure the Servo Span by Seeking the Limits

The procedure above tells the **BurnerMate Universal** the zero position and direction of travel for each servo. The following procedure tells the **BurnerMate Universal** the span limits for each servo. Recall the **BurnerMate Universal** uses a resistance signal from the feedback potentiometer to determine servo position.

1. From the servo menu, press **Down** and select Seek Limits. There should be a scrolling message that states … "Error on Servo 0." This is normal. Notice that now each servo will be identified by function rather than address.
2. For each servo in the daisy chain, press **Down** and select Start or Select All – if this is a new installation. The LCD touch pad will read … "Seeking." The servo will move back and forth a couple of times. After you perform the Seek Limits routine on Servo 0, the scrolling message will change to …"Error on Servo 1- Servo 1 needs seek limits"

When you have finished the Seek Limits process for all the servos, the display will scroll… "No Errors."

Note: in the Seek Limits screen for each servo, press **Down** until you see CLOSED LIMIT: and OPEN LIMIT. The numbers you see are the closed and open limits for each servo (in degrees) All the curve points you enter during commissioning need to be within these limits and must be a minimum of 2 degrees away from these limits. They should be recorded and referenced during combustion tuning when curve points are entered.

Servo Trouble-Shooting

If the servos are wired correctly and the instructions above have been followed diligently, but a servo is not working, check the following items:

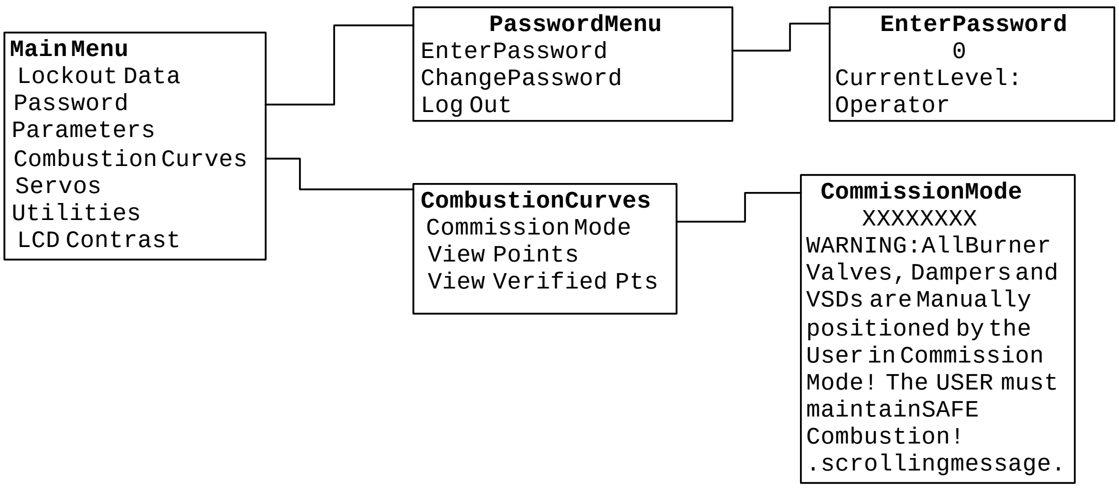
- Ensure there is not a servo error messages on the LCD touch pad.
- Ensure the COMM LED at each servo is ON.
  If the COMM LED is OFF:
  -- Ensure there is 24 VDC at the Display and Servo power terminals.
  -- Ensure there is less than 0.75 VDC from servo terminal "IN" to the 24 VDC negative terminals.
  If not, start at the **BurnerMate Universal** chassis OUT terminal and determine which servo's OUT terminal is the problem, or where the field-wiring problem is.
- Ensure the polarity and continuity of the RS485 wiring (terminals Comm + and Comm –) is correct.
- Ensure the scrolling message on <u>every</u> servo indicates the correct servo <u>Function</u> (Sxx).
  See the list of servo functions and abbreviations previously noted.
- Ensure the servo address (Axx) matches the servo daisy chain position. If not, change the servo addresses to match the wiring.
- Ensure the Servo "Pxx.x" display is within +/- 5 degrees of the actual position.
  --If the displayed position is <u>negative</u> ("P-45.0"): The wrong "Closed" direction button (CW or CCW) was pressed during the ZERO procedure. Repeat the ZERO procedure.

> Note: When a servo is replaced, the "zero degrees" position for that servo is different, and the BMU will automatically un-Verify ALL curve points associated with that servo.
> These curve points must then be re-verified in Commission Mode, with the burner firing. The burner will Lockout if a Start-up is attempted with any un-Verified curve points.

Now that the parameters are configured and the servos are set up, the **BurnerMate Universal** is ready to be commissioned.

Commissioning Step 3- Place BurnerMate Universal in Commission Mode

When the **BurnerMate Universal** is first installed, there is no data in the combustion curves, and the Combustion Control will not allow the burner to start. The technician must enable Commission Mode in order to enter data into the start positions and combustion curves.

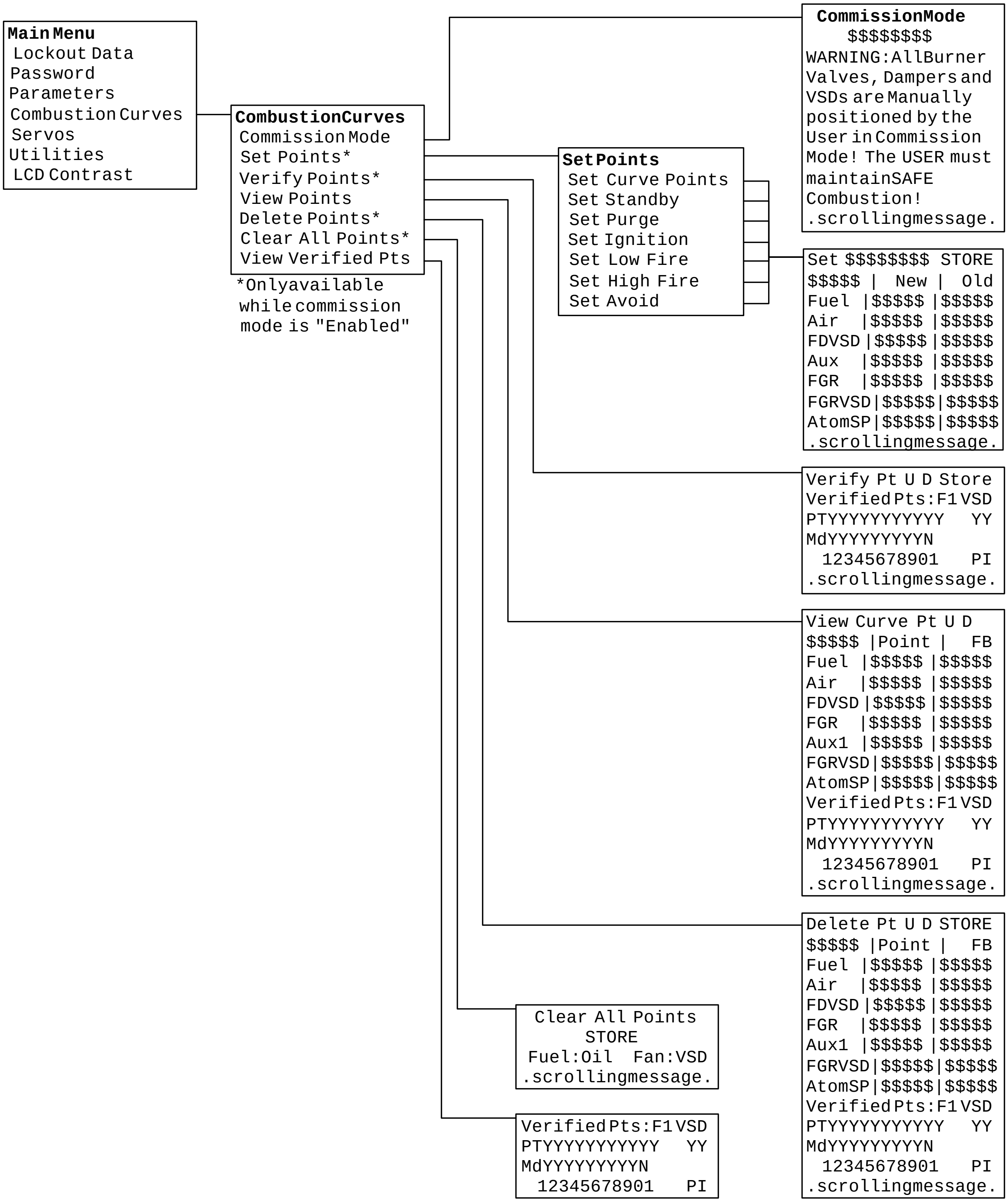


The Commissioning Mode is entered from the Main Menu on the LCD screen. To enter the Commission Mode, a qualified technician or engineer must first enter the appropriate Password level. To do this, view the Main Menu by pressing the **Up** & **Down** push buttons simultaneously. Scroll down to “Password” and press **Enter**. Press **Enter** again to go into Enter Password. Change the current level to a minimum level of Technician. Press **Escape** twice to return to the Main Menu.

Now that the password is set, place the **BurnerMate Universal** in the Commission Mode. To do this, from the Main Menu scroll down to Commission Mode and press **Enter**. Press **Enter** again to toggle Disable to Enable. Press **Escape** once to view the Combustion Curves menu.

While in the Commission Mode, if the power is cycled, the **BurnerMate Universal** will boot up and still be in the Commission Mode. However, whenever the power is cycled the Password changes back to the Operator level. The appropriate level Password will have to be re-entered to resume work in the Commission Mode or to exit the Commission Mode.

Navigating in the Combustion Curves Menu



Commissioning Step 4- Preset Positions and Curve Point Values

The three primary positions, Purge, Ignition and Standby must be preset prior to the start of the burner sequence. Combustion curve points can also be preloaded at this time if the technician knows the approximate information beforehand. Reference the Closed and Open limit values recorded after the Seek Limits procedure earlier in this section. All values entered must fall within theses limits. Warning, do not enter a value that is within 2 degrees, 2 percent or 1 Hz of the Closed or Open values.

```
CombustionCurves
 Commission Mode
 Set Points*
 Verify Points*
 View Points
 Delete Points*
 Clear All Points*
 View Verified Pts
*Only available
 while commission
 mode is "Enabled"
```

```
SetPoints
 Set Curve Points
 Set Standby
 Set Purge
 Set Ignition
 Set Low Fire
 Set High Fire
 Set Avoid
```

```
Set XXXXXXXX STORE
XXXXX |  New |  Old
Fuel |XXXXX |XXXXX
Air  |XXXXX |XXXXX
FDVSD|XXXXX |XXXXX
Aux  |XXXXX |XXXXX
FGR  |XXXXX |XXXXX
FGRVSD|XXXXX|XXXXX
AtomSP|XXXXX|XXXXX
.scrollingmessage.
```

Preset or existing curve data can be revised from Set Points by storing a new set of data at a previously entered fuel position. After the curve data has been entered, the technician must verify safe and efficient burner operation midway between each entered fuel position before the burner can operate in automatic by the Combustion Control System. This is accomplished in the Verify Points menu.

From Set Points, scroll **Down** until you reach Purge, press **Enter**. On this screen you will see Store in the upper right corner followed by a list of the servos, VSDs or Analog outputs that have been enabled. Next to each servo, VSD or output is a number that represents the current output to each device … degrees for servos, Hz for VSDs, O2% for O2 set points and 0-100% for all other analog outputs. Scroll to each device and enter the value desired for that position. When the desired values have been entered, scroll up to Store and press **Enter** to save the values. Insure the value shown for each device/output is exactly what is desired. Once Store is pressed, all the values shown are now saved for that point. Repeat this procedure for Standby and Ignition positions. Combustion curve points can also be preloaded at this time if the technician knows the approximate information beforehand.

Although values have been entered and stored in the Set Points menu – verification of these values must be by the technician. The only point that does not need to be verified is Standby. The LCD screen will prompt the technician when each point must be verified.

Hint: If the curve points are entered from the Standby State, both the curve points and midpoints will need to be verified. However, if the curve points are entered after the MTFI, then only the midpoints will need to be verified as the curve points are considered verified when they are entered.

Commissioning Step 5- Start the Burner Sequence

Turn on all burner switches and insure the recycle limits are made to start a burner sequence. The **BurnerMate Universal** will perform a Safe Start Check and then a Servo Check – also called the Prestart. During the Prestart the servos will move to their minimum position and then to their maximum position where the servo calibration data is confirmed. At the end of Prestart, after the Fresh Air Damper (if applicable) is proven open, the fans will start (reference the **P1.5.x** Parameters for the fan start options), and all applicable pre-ignition interlocks (selected fuel limits and common Non-Recycle Limits) must prove made or the LCD display will indicate, “Hold”. Should any of the pre-ignition (non-recycle) interlocks not prove within the **P1.6.6** time, the **BurnerMate Universal** will Lockout.

Warning!

It is the responsibility of the commissioning technician to verify that all operating and safety limits are working and set correctly. A safety Limits Data Sheet is available at the end of this section to document the check out and the final settings of the switches or devices.

Commissioning Step 6- Verify the Purge and Ignition Positions

Once all safety and operating limits are proven, all servos and VFDs will move to their previously configured Purge positions. The unselected fuel servos will move to their Standby position. When the active servos and outputs are at their Purge position, the LCD display will read “Holding: Purge Position Unverified”. Return to the commission sub-menu and scroll to Verify Points. Use the **Down** push button to scroll over to Store. Press **Enter** once to enter the Verify mode. Press **Enter** again and the display located below Store will now read “Purge Position Verified”. Note that whenever entering the Verify mode for the first time, **Enter** will need to be pressed twice when the cursor is on Store to activate the Verify mode.

Note that if a position (Purge or Ignition) needs to be verified, the **BurnerMate Universal** will continue to hold for the **P1.6.5** “HOLD Alarm Delay” time. At the end of the **P1.6.5** time, the common alarm horn will sound. If the Purge or Ignition position has not been verified by the allowed **P1.6.6** “HOLD Lockout Delay” time, the **BurnerMate Universal** will Lockout.

Prior to verifying the Purge or Ignition points, the technician is allowed to fine tune any of the positions as desired by adjusting and storing that point.

Hint: The Purge time will not start until all of the servos are at their Purge position, including the fuel servo. To shorten the waiting time before the purge timer starts, set the Purge position of the fuel servo to an open position. The fuel servo will then go to the Ignition position at the same time as the VSD and dampers.

Also, if the fans are programmed to run during the Servo Check, this time can be calculated as part of the required purge time.

Parameter **P2.1.2** controls the action of the FGR Servo during the Servo Check procedure. The options are “Close then Open” or “Open then Closed”. The action is usually determined by how the burner manufacturer wants the position of the FGR damper during the burner purge.

After the Purge position is verified the purge timer will start. At the end of Purge, the servos and VSDs will move to the Ignition position and the display will read “Holding: Ignition Position Unverified”. Enter the commission sub-menu and verify this position by repeating the procedure used to verify Purge.

After the Ignition position is verified, the pilot will energize and if a flame is detected, the sequence will proceed to MFTI. Should pilot and main flame ignition be successful, the servos and VSDs will remain in the ignition position until that point is stored as the first point on the combustion curve. Note that this point in the curve does not necessarily represent the minimum firing rate, nor does it have to be at the same excess air level as at light off. Prior to storing this first point on the combustion curve, the air can be adjusted to a different, more desirable operating excess air level. If the air setting is different at this first point verses Ignition position, after the MTFI and at the Release to Modulate State, the fuel will stay in place and the air servos and VSDs will adjust to their appropriate curve points. Twenty (20) seconds is allowed for the VSD or air related servos to adjust to curve point. If they fail to do so a Lockout will result.

If either the pilot or main flame did not light, the **BurnerMate Universal** will Lockout on “Flame Failure”. The **Purge** and **Ignition** points will not have to be verified again unless the positions in the commission sub-menu are changed. Press the **Reset** push button and the burner sequence will start again. If the **Ignition** position needs to be adjusted to establish a better pilot or main flame light off, the **Ignition** position will again need to be verified prior to the start of the PTFI.

Warning!

When the Commission Mode is Enabled, all fuel and air outputs to the burner servos and VSDs are in manual. To ensure safe, efficient combustion, the technician must use a portable combustion analyzer and visual observations to monitor stack oxygen, carbon monoxide, NOx and smoke emissions and flame stability.

Pilot Test Hold

The technician can hold the **BurnerMate Universal** in the Ignition position to perform a Pilot Turndown Test or to make a flame scanner sighting adjustment. Access **P1.2.1** and change the Parameter from “Off” to “On”. When the testing is complete, change the parameter back to “Off”. The sequence will continue to MTFI. This Parameter will automatically reset to “Off” after each burner cycle and during power off.

Commissioning Step 7- Fuel/Air Ratio Curve Data Entry, Deletion, and Display

At this time, the Commission Mode is still Enabled and the burner has successfully lit the main flame, firing at the same fuel position as during the Ignition position. Before storing this first point as the first curve point, ensure that the air is adjusted to the desired excess air level and that there is no smoke or appreciable carbon monoxide present. To store this first point, in the Set Points Sub-Menu go to the section labeled Set Curve Points. Use the **Down** push button to move to the output to be changed. Press **Enter** to get the edit cursor. Using **Up** & **Down**, carefully adjust the output until the emissions target for that fuel point is obtained. Scroll up to Store and press **Enter**. The message displayed below Store will say “Data Saved”. The first curve point is now established. If the data is not Stored before exiting Set Curve Points, the output just entered will not be saved and all setting will revert back to the previous values.

It is recommended that the first curve point entered be the same as the Ignition point. A lower point can be added later to obtain the burner’s turndown. Also, to insure a clean light off and an easy transition between the Ignition point and the first curve point, the technician should go back and try the first curve point’s air settings in the Ignition set up.

At least 3 curve points, 1+ degree apart, and no less than 5 degrees total (excluding midpoints) must be entered during the initial start up or the **BurnerMate Universal** will not allow the technician to exit the commission mode for that fuel. This minimum requirement is normally used so that the burner doesn’t have to stay in the Commission Mode during the warm up or during boil out.

The fuel servo degrees always act as the “X” axis for all other curve points. All of the other output data is interpreted as the “Y” axis points tied to each curve.

Entering Additional Curve Points

In the Set Curve Points menu the output values in the “New” column are the current command values of the servos, VSDs and analog outputs. Change these values by scrolling to the value you want to change, press **Enter** to obtain the edit cursor. Use the arrow push buttons to change the value and press **Enter** again. Note that the servo moves to the new position as soon as you press **Enter**. To accept the new values, move the cursor to Store and press **Enter**. The display will scroll the message “Data Saved”.

> **Warning!**
> When the Commission Mode is Enabled, all fuel and air outputs to the burner servos and VSDs are in manual. To ensure safe, efficient combustion, the technician must use a portable combustion analyzer and visual observations to monitor stack oxygen, carbon monoxide, NOx emissions, smoke and flame stability.

To enter additional curve points (Commission Mode required), carefully increase the air and fuel servos and outputs to a point that represents an approximate 10% increase in fuel flow. To ensure safe and efficient combustion, a portable combustion analyzer along with visual observations must be used to verify stack oxygen, carbon monoxide, NOx emissions, smoke and burner stability. Press Store to save this data as a new Curve Point.

Hint: as noted above, if the fuel servo is not at least 1.01 degree from the previous point, pressing Store will overwrite that previous point. Once 3 points a minimum of 5+ degrees apart have been entered, the technician can move between established points using the Verify Points mode. Prior to the minimum of 3 points entered, the technician will be required to move each servo or output individually.

The commissioning technician can freely move between the Verify Points and Set Curve Points mode. It is recommended that the Verify Points mode be used to move from point to mid-point to point. To edit an existing curve point or to enter a new point, use the Set Curve Points mode.

To view the existing or newly entered curve points, scroll to View Points in the Combustion Curves sub-menu (see Navigation on page 5-20) and press **Enter**. Place the curser on the U (Up) or D (Down) and press **Enter** again to move from point to point. The lower portion of this screen will also indicate if the point or mid-point has been or needs to be verified.

To delete a point, scroll to Delete Points in the Combustion Curves sub-menu and press **Enter**. Place the curser on the U (Up) or D (Down) and press **Enter** again to move to the point to be deleted. Scroll the curser to Store and press **Enter**. That point has now been deleted.

Should the technician want to completely delete all curve points and start fresh, scroll to the Clear All Points in the Combustion Curves sub-menu and press **Enter**. Scroll the curser to Store and press **Enter** – All points have now been deleted.

If the **BurnerMate Universal** is equipped with an Oxygen Analyzer and the O2 trim is Enabled, the trim will automatically be disabled while you enter or edit curve points. The O2 values for each point will be automatically entered when you Store each curve point and will become the O2 trim set point.

Commissioning Step 8- Verify Curve Points

The **BurnerMate Universal** has a unique safety feature. Before the technician can disable Commission Mode or put the burner controls into automatic, each curve point and midpoint must be verified as being safe. To enter the Verify mode, from the Combustion Curves sub-menu, scroll to Verify Points and press **Enter**. Note that whenever entering the Verify mode, you must move the cursor to Store and press **Enter** to activate the Verify mode. This will also move any servo, VSD or analog output to the current fuel curve point if they are not already there.

```
CombustionCurves
 Commission Mode
 Set Points*
 Verify Points*
 View Points
 Delete Points*
 Clear All Points*
 View Verified Pts
*Onlyavailable
 while commission
 mode is "Enabled"
```

```
Verify Pt U D Store
Verified Pts:F1VSD
PTYYYYYYYYYYY   YY
MdYYYYYYYYYN
  12345678901   PI
.scrollingmessage.
```

When in Verify, the fuel is under the commissioning technician's manual control. The air damper, FGR, VSDs, and auxiliary servos are all positioned automatically on the curve points according to the fuel servo position. At any time, the commissioning engineer can exit the Verify mode and resume complete manual control of all outputs by returning to the Set Curve Points screen. Verify allows the user to rapidly move all servos or actuators from point to point by simply pressing **Enter** while the cursor is highlighting U (up) or D (down) or by changing the fuel value. The other outputs follow the curve as the fuel changes. Every time **Enter** is pushed while U or D is highlighted, the outputs will move to the next curve point or curve midpoint.

When the servos stop moving at each curve point or midpoint, give the burner time to settle out. Check the flue gas oxygen, NOx, CO, and other emissions using a portable analyzer. Visually inspect the flame to ensure the burner is running properly and safely. Scroll over to Store and press **Enter** to accept (verify) that point. Pressing Store will not re-enter or change existing curve data, only accept the curve point displayed.

Note that curve points and not midpoints can be tuned. If the midpoint is unacceptable the commissioning engineer must tune the curve points before or after the mid-point.

If further tuning is required for any of the curve points, move from Verify Points back to Set Points and then Set Curve Points to reset the position of any of the servo, VSD or actuator.

Repeat the above steps until all points and midpoints have been verified.

Warning!

If you try to enter a curve point outside the range of travel of a servo, the display will scroll the message, "Error, Not At Position." This means the servo feedback didn't match the output signal to the servo and the **BurnerMate Universal** will not allow you to save that point.

Helpful hint: in the Verify Points screen, fuel, air, FGR, and other outputs will have their first letter capitalized if those values are at desired positions. Un-capitalized values indicate that the point has not yet been reached.

After the complete curve has been verified, Commission Mode can be Disabled and the burner can now be operated in manual or automatic from the Main Screen. If you are unable to Disable Commission Mode because of “unverified points”, it's likely that a point or midpoint has not been verified after making a tuning change. If you are certain all your curve points and midpoints are verified, re-start the burner and ensure that the Purge and Ignition positions are verified (Purge and Ignition can only be verified during the burner light off sequence).

If all of the curve points, Ignition and Purge have been verified and the Commission Mode still cannot be Disabled, check the settings of the Low Fire and High Fire points.

Helpful hint; at the very bottom of the Combustion Curves menu is View Verified Points. This screen will show the number of points entered and whether or not that point or midpoint has been verified.

Note: if any point of the curve is subsequently edited, the adjacent midpoint(s) of the curve will have to be re-verified before you will be able to Disable the Commission Mode. When the commissioning engineer enters data from the Curve Point screen while the burner is running, the curve point does not need to be verified (only the mid-points on either side of that curve point). If any data is edited while the burner is in the Standby or Lockout State, the new data curve point as well as the midpoints will need to be verified. If this is the case, the **BurnerMate Universal** will Lockout on the next attempt to start the burner and the Commission Mode will need to be Enabled.

Other Options from the Set Points Sub-menu Screen

On many applications, it is sometimes desirable to limit the firing range (at either low fire, high fire or both) of the burner. This can be done by simply setting the following two options:

Set Low Fire: The factory default value is 0. Should the technician determine that the burner cannot go below a certain firing rate due to burner stability or for mechanical reasons, they can enter the fuel degree data (from anywhere on the established curve) and the firing rate in both automatic and manual will not be allowed to go below that point. If this feature is not used, set the Low Fire below the lowest curve point.

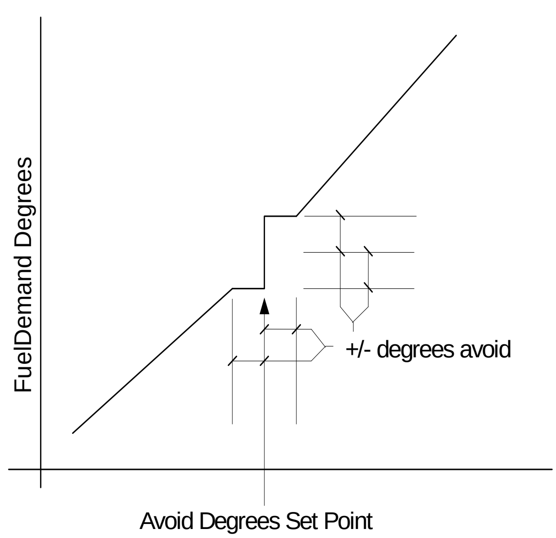
Set High Fire: The factory default value is 0. Same as the Low Fire option but in this case the **BurnerMate Universal** will prevent the firing rate from going above this predetermined fuel degree point. If this feature is not used, set the High Fire above the highest curve point.

Note that the **BurnerMate Universal** will not exit the Commission Mode until the High Fire point is properly set to a position above 0.

Once the low and high fire limits are set, the displayed Firing Rate of 0-100% will automatically adjust between those two points to prevent operator confusion.

Set Avoid: Common with burners that are set up for low NOx operation or are fitted with VSDs, there may be a certain firing rate that produces an audible harmonic or undesirable vibration. The technician can program the **BurnerMate Universal** to skip over this point. The fuel servo degrees from any place on the curve is entered into this option. Parameter **P3.4.2** determines the size of the gap that will be skipped over, from 0.2 to 3.0 degrees of fuel position. The gap degrees will be split above and below the avoid set point.

As illustrated below, the fuel servo will stay on either side of the avoid gap until the firing rate demand is such that the servos can travel through the avoid gap without stopping.



Commissioning Step 9- Tuning the PID Loops in the BurnerMate Universal

The PID provides a Proportional, Integral, and Derivative control algorithm. The PID equation used in the **BurnerMate Universal** is called the "Parallel" form by the Instrument Society of America.

The Proportional Function

The Proportional constant is expressed as Proportional Band (PB) as opposed to Gain (G). PB = (100 / G), i.e. a PB of 5% equals a Gain of 20. In the **BurnerMate Universal**, the PB is expressed as the set point to process variable deviation (error) that results in a change in the controlled output.

The Proportional Band is expressed in the same engineering units as the process being controlled and the amount of error required to produce a full movement servo degrees or loop output as noted in the PB Parameter.

The PB output values for the four PID loops in the **BurnerMate Universal** are expressed as such:

- Firing Rate- the actual temperature or pressure change that will result in a 100% firing rate change.
- O2 Trim- the flue gas oxygen change that resulted in a change from minimum trim to maximum trim.
- Feedwater- There are two PID functions available for the Feedwater option, one for single element control and one for two or three element control. In both PIDs, the PB represents the actual error in the drum level that will result in a change of 100.0 degrees if a servo is controlled, 100% for an analog output, or 100.0 Hz if a VSD is being controlled – whichever is appropriate for the application.
- Draft- As a draft control loop can be very sensitive and require fast response timing, the Proportion Band in the Draft PID represents the change in the draft required to result in a change of 60.0 degrees if a servo is controlled, 60% for an analog output, or 60 Hz if a VSD is being controlled – whichever is appropriate for the application.

  With a draft loop tending to be the most sensitive and the draft signal is usually "noisy", the **BurnerMate Universal** provides a Gap PID and Gap Gain options. When the actual draft falls within the +/- the Gap value from set point, the PB is reduced to prevent over controlling. The Gap Gain is the value that is multiplied by the PB to reduce the PID control when the draft is within the Gap zone.

Example: using Drum Level control, say the PB = 5.0” (inches water column),
SP = +1.0”
drum level (PV) = +1.0”
servo = 30 degrees:

If the level decreases from +1.0” to –1.5” (2.5”= ½ the PB), the servo would move to 80 degrees (a total of 50 degrees, ½ of the 100 degrees).

If the PB = 2.5”, the servo would move to 130 degrees (the error = the PB so the servo movement is 100 degrees)

If the PB = 7.5”, the servo would move to 63.3 degrees (2.5’ = 1/3 the PB which is 33.3 degrees, 1/3 of 100 degrees.

The above illustrates how the Proportional Band in the **BurnerMate Universal** can be used to calculate the exact movement of the servo based on the error or deviation between the process set point and the actual process value. The lower the PB setting, the more movement that will result at the servo. A higher PB value will result is less servo movement for the same error.

The Integral Function

The Integral constant in the PID function can be expressed either as a reset rate (repeats per minute) or as a time constant (minutes per repeat). The **BurnerMate Universal** uses Minutes Per Repeat. The values set in the Minutes Per Repeat is the time it takes before the PID ramps up or down 1 additional PB move. A smaller value causes more integral control action.

Example: If the PB is causing a 20 degree servo change due to a set point to process deviation, and the integral is set at 3.0 minutes: The PID will ramp the servo an additional 20 degrees during the next three minutes after the initial 20 degree move (if the deviation has not changed). The PID output stops ramping, and remains at its current value, when there is no longer a deviation between the set point and the process.

The Derivative Function

Derivative is a rate function that is not used in the **BurnerMate Universal**.

Recommended Procedure for Tuning a PID Loop

The default values in the PID related parameters are approximate and only a suggested starting point for tuning.

Tuning a controller requires subjective judgments. The person tuning the PID loop must be fully aware of the systems operational constraints and safety considerations before proceeding.

Always be ready to put the controller in manual should an uncontrollable cycling occur.

Never tune a PID loop unless you have sufficient time to monitor the operation. During the monitoring period, try to simulate every probable load swing condition that might upset the loop.

BE VERY PATIENT!!!! Observe the process variable, the controller output and the entire plant operation during various load conditions to insure smooth controller performance.

General Steps for Tuning the BurnerMate Universal PID Loop

Step 1: Identify the control loop about to be tuned and determine the relative speed of the loop. Examples are as follows:

- A fast loop has a response time from less than one second to about 10 seconds, such as a flow loop.
- A medium speed loop has a response time of several seconds up to about 30 seconds, such as flow, temperature, and pressure.
- A slower loop has a response time of more than 30 seconds, such as most temperature, steam pressure and level loops.

Step 2: Identify the units of the PID controller.

- Proportional Band as related to the magnitude of output change for a given SP vs. PB error.
- Consider the time constant as it relates to the loops speed. How often should the PB ramp be repeated?

Step 3- Adjust the Proportional Band: With the loop in automatic**,** make a small change in the set point or wait for a disturbance in the process. Then watch for a process variable (PV) and control output responses. Keep the Minutes Pre Repeat at a higher value at this point so that it imposes very little influence on the loop.

- If no visible change in the output occurs upon a change in the set point, or there is no over reaction, decrease the PB by 50%.
- If the PV is unstable or has sustained oscillation, with overshoot greater than 25%, increase the PB by 50%.
- A smaller PB value will cause repeated loop oscillation, too large a PB value will result in a very sluggish loop.
- Continue to create loop upsets by changing the set point or wait for an actual change in the process. Adjust the PB value until the loop responds with a tolerable overshoot followed by a settling affect without continued oscillation.

Step 4- Add Integral: When the PB tuning is reasonable, the observed action of the loop will show that the process will never seem to be able to return to the set point in a reasonable amount of time. This is where the integral will help. By decreasing the time between repeats the loop will have the ability to correct the error and return to the set point in an acceptable amount of time.

- With the loop in automatic, observe how long it takes the process to return to set point.
- If the time is to long, lower the Minutes Per Repeat by 50%.
- If the loop is constantly hunting while attempting to return to set point, increase the Minutes Per Repeat by 50%.

Note: as Integral is added, a higher Proportional Band maybe desirable.

Step 5- Be Patient: Don't be too quick to make adjustment to the PB or integral. After making an adjustment, observe the loop response through several upsets. When the tuning of the PID loop is complete, place the system in full automatic under a normal plant load condition.

Remember that acceptable loop response is the opinion of the plant engineers and not that of the contractor doing the tuning. If the best possible tuning is unacceptable to the plant engineers, the controlled devices and the fired equipment should reevaluated. The first indicator of the problem being in the devices, fired equipment or the process itself, is to determine if the loop can be operated in manual to the satisfaction of the plant demands. If the process cannot be controlled in manual, it will never be able to control in automatic. Objectivity and reason will best serve to resolve any issues encountered during the final tuning process.

Commissioning Step 10- Documentation

The final step in commissioning the **BurnerMate Universal** is completing the related documentation that will serve as a future reference and proof that the important issues have been addressed.

Review all Parameter that were utilized on the application and insure that the settings are correct.

At the end of this section are three forms that must be completed during the commissioning process and prior to leaving the boiler plant.

- Safety Limit Data Sheet- settings, trip points and comments.
- Boiler Operating Data Sheet- curve data, combustion and operating data.
- Final Parameter Values- circle or fill in the final values of the Parameters used.

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SECTION 6 INDEX

BurnerMate Universal – Notes:

Warning: Do not jumper any input terminals connected to field devices. This may cause an unsafe condition that could result in equipment damage, personnel injury, or death.

LCD Messages

The **BurnerMate Universal** LCD messages that are listed on the following pages describe both normal operation, alarm, and shutdown conditions. This alphabetical list of messages provides explanations – and possible corrective actions – that the technician can use as a starting pointing for troubleshooting.

Lockout Data

If the condition results in a lockout, a snap shot of the value of virtually every input, output, servo and sensor at the time of the Lockout is stored in the **BurnerMate Universal** time/date stamped “Lockout Data” memory. Lockout data for each of the last 10 Lockouts can be viewed via the LCD Main Menu 'Lockout Data' menu item.

I/O Data Display

LCD Menu item: Menu < Utilities < I/O Data Display provides a means to view the real-time value of every **BurnerMate Universal** field wiring 120 Vac Input, Analog Inputs, Relay Output, and Analog Outputs. This provides a means to simultaneously test field device operation, field wiring, and control hardware operation.

The '120V Input' sub-menu shows the on/off status, its name, and field wiring terminal, DI.xx, xx = terminal number. The 'Relay Output' sub-menu displays the current on/off command for each relay, its name, and field wiring terminal.

The 'Analog Inputs' submenu shows the current input signal scaled according to the Engineering units of the related Parameter along with the signal name. Wiring terminals are not displayed because some of the signals can be wired to more than one set of terminals; consult the parameter values in Section 3 and the field wiring in Section 4 to determine the terminals for each signal.

The BMU-OIT also provides screens for viewing terminal I/O status.

Electrical Noise

Electrical noise is a common problem with burner circuitry because of the mix of 120 VAC, low voltage DC, Variable Speed Drive (VSD) fan motors, and 5,000 to 10,000 volt ignition transformer circuits. Sporadic shutdowns, lost or corrupt data, controller re-boots, and "Internal Error" message shutdowns can be caused by electrical noise. If you suspect electrical noise problems, inspect the boiler wiring for the following issues:

- The shields of all 4-20 mA / 0-5 VDC, Thermistor, Thermocouple, Servo and LCD communications, and scanner cables should be connected at one end only, as shown on the wiring schematics. <u>All shield foils, braids, and shield drain wires should be insulated (with either tape or heat shrink) to prevent connections to earth or power ground.</u> Shielded cables that have been pulled through under-sized conduits or fittings with excessive force can have a torn outer casing inside the conduit (out of sight), which allow the shields to connect to the conduit. Shields connected at both ends, or with unintentional second grounds, actually <u>add extra noise to a signal instead of reducing noise</u>!

- To prevent noise pick-up, shielded cables should never be run in conduits or trays with AC wiring (any voltage). There are only 3 exceptions to this rule, as detailed on the field wiring diagram (scanner, servos, and the ZP Oxygen Analyzer).
- Ignition Transformer Pilot Spark wiring is particularly noisy. If any problems occur during the time that the Spark is active, replace the Pilot high voltage wire with automotive grade Noise Suppression spark plug cabling (either resistance core or spiral wound 'Mag' core cable).
- The 'load' wires that connect a Variable Speed Drive (VSD or VFD) to the motor contain massive amounts of electrical noise potential during normal operation. Carefully read and scrupulously follow ALL notes for this wiring, as shown on the field-wiring diagram. Modern shielded 3 phase wiring cables with integral Grounding wire(s) are now available from Belden, Alpha, and others to further reduce this electrical noise. Improperly shielded VSD generated noise can/will travel through boiler and building steel and can affect both 120 Vac and low voltage signals in conduits that are far away from the VSD 'load' wiring.
- If the electrical installation appears to be in accordance with all of the above practices, and sporadic problems are still occurring, the power problems in other parts of the facility might be causing electrical noise in the AC power supply. Harmonic distortion surges, spikes, and drop-outs are common problems in plant power distribution systems today. 120 Vac line voltage conditioners from Control Concepts, Sola, or Preferred p/n 70438 (or 70439) can help reduce this noise. More exotic line conditioning power transformers and some UPS systems are also possible solutions.

" … Not At Position" Lockouts

The following are considered Fuel-Air-FGR Ratio control devices, and can cause a 'Not At Position' Lockout:

Servos: Oil Valve, Gas Valve, Fuel 3, Oil/Gas, FD Fan Damper, FGR Damper, Aux 1, Aux 2, Jackshaft, LTA O2 Trim

VSDs: FD VSD, Aux 1 VSD

The **BurnerMate Universal** reads the position (or VSD speed) feedback of all of these devices every 0.5 sec and determines the deviation between the actual position and the established 'On Curve' setpoint. A '…Not At Position' Lockout occurs if any device's deviation is more than twice it's Deadband (or 0.3 degrees, whichever is larger) for longer than 3.5 seconds.

'…Not At Position' Lockout Exceptions

This Lockout does not occur during Standby or when already in Lockout for some other reason.

This Lockout does not occur when in Commission Mode.

This Lockout does occur when the Verify command is activated during Commission Mode.

The duration is extended to 10 seconds during the following transitions:

MTFI to Modulate

Upon exiting Commission Mode

Upon activating the Verify command of Commission Mode

Dual Fuel Low Fire Transfer back to single fuel firing transition

Reasons for a 'Not at Position' Lockout

Mechanical binding of the coupling, valve, or damper that the servo is connected to.
- Review the Lockout Data to see if it re-occurs consistently at the same approx position.
- Re-align the mounting to reduce coupling binding.

Undersized Servo – insufficient torque.
- Widening the servo deadband can be a temporary solution for medium/low performance burners.

Loss of 120 Vac to the servo
- Loose wiring.

FD VSD or Aux 1 VSD internal rate limiting is slower than the **P2.2.3** or **P2.3.4** setting.
- The Parameters must be set to a slower ramp rate than the slowest VSD ramp rate.
- This is a manual setting that must be set by the start-up technician.

FD VSD or Aux 1 VSD Hz feedback 4-20 mA signal calibration doesn't match the required 0-60Hz/4-20mA.
- Adjust the VSD 4-20 calibration. Adjust **P2.2.2** or **P2.3.3**. Adjust **P2.2.5** or **P2.3.5** deadband.

The torque requirement for the valve has changed over time (i.e., dried grease, stiffened valve), causing a decrease in servo speed (E17 on servo LCD).
- Re-seek limits on servo; valve may need to be loosened or re-greased (if re-greasing the valve, re-seek servo limits afterward, as there will be a change in the torque exerted by the servo);

Servo limit switch too close to curve points.
- Servo limit switches are not as repeatable as the servo feedback pot. If a servo limit switch trip position shifts, and stops the servo motor before the desired curve position is reached, a Not At position Lockout can occur.
- Example: Fuel valve curve range is 2.2 – 47.0 degrees; limit switches are set to 2.0 and 47.2 degrees. The burner modulates as desired for many weeks or months and then the closed limit switch trip position shifts to 2.6 degrees. When the burner modulates down to low fire, the servo limit switch stops the servo at 2.6 degrees with the **BurnerMate Universal** calling for 2.2 deg, a '…Not At Position" Lockout would occur. Re-adjust the limit switches further away from the curve points and then Re-Seek the Limits from the Servo Menu on the LCD. It is not necessary to re-verify the curves after seeking the Limits.
- All servo limit switches must activate at least 1.5 to 2 degrees away from the closest curve point.
  - Example: If the FGR Damper curve data runs from 9.7 deg up to 63.5 degrees…
    - The Closed Limit Switch should trip at 8.2 degrees, or lower.
    - The Open Limit Switch should trip at 65.0 degrees, or higher.
  - Use the BMU_Edit, TouchScreen Servo Setup screen, or the LCD Servo Seek Limits screen to view each servo's limit switch positions.
- If Oxygen Trim is Enabled, The FD Damper Servo Open Damper limit switch should be set 17-20% higher than the highest curve point.
    - This allows the O2 Trim to increases the airflow at high fire without tripping the open limit switch. Calculate 20% as follows: If the FD damper curve ranges from 13.0 – 79.0 degrees, the span is 66 degrees. 20% of 66 deg = 13.2 deg. The open limit switch should be set to 92.2 degrees (79 + 13.2), or higher.

LCD Messages, Alphabetical Listing

A complete listing of the possible messages displayed on the BMU-LCD has been provided below. The messages have been broken down into the following categories:

HOLD/LOCKOUT Messages (non-recycling limits)
Recycle Messages (recycling limits)
Alarm Only Messages
Operational Error Messages
Normal Operational (Non-Error) Messages

HOLD/LOCKOUT Messages (non-recycling limits)
The following is a list of messages that appear if a non-recycling limit does not energize or "make"; these are known as either HOLD or LOCKOUT messages. A HOLD is when the **BurnerMate Universal** waits or "holds" its operation until the limit is made, while a LOCKOUT is when the **BurnerMate Universal** immediately shuts down boiler operation until the Reset button is pushed. There are check columns next to each message to denote the limit's operation; if the limit goes into immediate "LOCKOUT" (no HOLD delay), the "L" column will be checked; if the limit goes into HOLD before going into LOCKOUT, then both the "L" and the "H" column will be checked (a limit will not be a HOLD only; either the limit will make or a LOCKOUT will result). Refer to parameters **P1.6.5** and **P1.6.6** for HOLD time delay settings.

L	H	Message	Possible Cause and Corrective Action (Note: **Txx** = Terminal xx, **Px.x.x** = Parameter x.x.x)
√		Aborted ALFCO: Did not move to Low Fire	When ALFCO (Assure Low Fire Cut Out) is enabled by parameter P1.3.2 the BMU drives the burner to low fire before it shuts down. This message appears if all servos do not move to low fire within 100 seconds due to servo malfunction, bound device, etc.
√		Air Flow Temperature Sensor Out Of Range	The air flow temperature is outside the -40 to 260 F range
√		Air Flow Trim In Manual Mode during PreStart	Safe Start Check. The airflow trim PID was under manual control when the burner was started. Put the airflow trim in automatic mode and restart the burner.
√		Air Flow vs. Setpoint Deviation	The measured airflow did not match the desired airflow while modulating. Check the airflow device and the Air Flow Deviation Trip parameters P2.12.2 and P2.12.3.
√		Air Flow Xmtr Out Of Range	The air flow transmitter is not functioning properly
√	√	Aux 1 Non-recycle Limit	This message appears when terminal T41 opens. Auxiliary limits can be used for any limit switches not covered by the pre-assigned limit inputs.
√	√	Aux 2 Non-recycle Limit	This message appears when terminal T42 opens. Auxiliary limits can be used for any limit switches not covered by the pre-assigned limit inputs.
√	√	Aux 3 Non-recycle Limit	This message appears when terminal T43 opens. Auxiliary limits can be used for any limit switches not covered by the pre-assigned limit inputs.
√	√	Aux Not At Position	See the "Not At Position" Lockouts section of the Trouble Shooting Guide.

L	H	Message	Possible Cause and Corrective Action (Note: **Txx** = Terminal xx, **Px.x.x** = Parameter x.x.x)
√		**BMS/CC2/LCD Parameters don't match CC**	Downloading from LCD or a PC just before burner start-up can cause a temporary mismatch. This is usually a result of electrical noise. Reset. If this persists consult factory.
√		**CC Comm Failure**	Servo reported a loss of communication with the BMU
√		**Combustion Curve Setup Changed: Please Re-Verify**	A curve–related parameter or servo was changed. Re-verify all curve points for the current fuel selection via Commission Mode VERIFY command.
√		**Curve Fuel Values Not In Ascending Order**	Possible curve data corruption. Use VIEW and DELETE PT to erase bad point(s). Re-verify all curve points for the current fuel selection via Commission Mode VERIFY command.
√		**Curve Min, Low, High, Max Values** Note: if this happens during the "Safe Start", a Lockout will occur. If during Commissioning, you will not be allowed to exit the Commission Mode.	Min = lowest fuel servo degrees in curve, Max = highest fuel servo degrees in curve, Low = Low fire limiter fuel degrees, High = High fire limiter degrees. The following rules apply: Min =< Low < High =< Max. (Max - Min) > 10 degrees (High - Low) > 10 degrees *LOCKOUT only if trying to start burner; message also given as a non-LOCKOUT when attempting to leave commission mode
√	√	**Draft Adjustable Start Interlock Not Made**	Either the draft servo has not reached the Adj Start Position (P4.4.3, P4.4.4, P4.4.5) or the draft is higher than the Adj Start Draft SP P4.4.2. Check servo operation. Verify that there is sufficiently negative draft available.
√	√	**Draft Open Damper Switch**	The draft damper open proving switch T44 did not make during Purge. This interlock is only required for non-servo actuators, VSD's, or if the Draft Servo Check Option P4.3.3 is Enabled. (Refer to Section 4, Page 16 for additional Information regarding terminal T44 requirements
√	√	**Draft Servo Not At Position**	See the "Not At Position" Lockouts section of the Trouble Shooting Guide.
√		**Emergency Stop**	Emergency stop input at T29 is open.
√	√	**FD Damper Not At Position**	See the "Not At Position" Lockouts section of the Trouble Shooting Guide.
√		**FD Fan Mode Changed: Full Speed vs. VSD**	The FD Fan can be driven by a VSD controlled motor or by a full speed motor. The mode is determined by terminal T3 and can only be changed during Standby or Lockout. The burner will lockout if changed during burner operation.
√		**FD Fan Starter**	The FD fan "motor starter" interlock opened T34. Check fan motor starter and overload relays.
√	√	**FD Fan VSD**	The FD Fan VSD Run / Fault Interlock opened T35.
√	√	**FD VSD Not At Position**	See the "Not At Position" Lockouts section of the Trouble Shooting Guide.
√	√	**FGR Damper Not At Position**	See the "Not At Position" Lockouts section of the Trouble Shooting Guide.
√	√	**FGR Fan Starter**	The FGR fan "motor starter" interlock opened T40. Check fan motor starter and overload relays.

L	H	Message	Possible Cause and Corrective Action (Note: **Txx** = Terminal xx, **Px.x.x** = Parameter x.x.x)
√		**Flame Detected During Standby**	Flame was detected during Standby for more than 30 seconds. Visually inspect furnace for burning oil or gas. Run FD fan until no flame is detected. Do not attempt to re-light if oil or gas is burning in the furnace. If an IR scanner is used, the false flame could be caused by the scanner seeing hot refractory. Re-sight scanner so that refractory is not visible, or switch to a UV scanner.
√		**Flame Failure**	Flame proven contact at T30 opened. If “Dual Scanners” is enabled, flame proven contact was lost on both T30 and T31. Check Lockout Data to determine if this occurred during MTFI, Modulation, or ALFCO. Check scanner sighting and flame appearance during this state or firing rate.
√	√	**Fresh Air Damper Not Open**	HOLD: The fresh air damper interlock is open T14. The burner will start when the damper is proven open. If the interlock opens during burner operation, the burner will shutdown and will restart when T14 is energized. LOCKOUT: The interlock was open for more than P1.6.6 seconds while holding in Pre-Start.
√		**Fuel 3 Flow Xmtr Out Of Range**	The (4-20mA) Fuel 3 Flow Transmitter is outside the acceptable range (either less than 3.2mA or greater than 20.8 mA); could be due to a wiring problem or a calibration issue.
√		**Fuel 3 SSOV Not Closed**	Fuel 3 SSOV (Safety Shut Off Valve) Proof of Closure interlock T49 was 0 VAC. SSOV must be closed during Standby, Safe Start, Pre Start, Purge, PTFI, and when fuel is not selected during MTFI, Modulate and ALFCO.
√		**Fuel 3 SSOV Not Open**	Fuel 3 SSOV (Safety Shut Off Valve) Proof of Closure interlock T49 was 120 VAC. SSOV must be open during MTFI, Released to Modulate, Low Fire Xfer, and ALFCO when this Fuel is selected.
√		**Fuel Flow vs. Curve Deviation**	The measured fuel flow did not match the desired fuel flow while modulating. Check the fuel flow device and the Fuel Flow Deviation Trip Set Point, P2.12.4.
√	√	**Fuel Not At Position**	See the "Not At Position" Lockouts section of the Trouble Shooting Guide.
√		**Gas Flow Xmtr Out Of Range**	The (4-20mA) Gas Flow Transmitter is outside the acceptable range (either less than 3.2mA or greater than 20.8 mA); could be due to a wiring problem or a calibration issue.
√		**Gas Pressure Xmtr Out Of Range**	The (4-20mA) Gas Pressure Transmitter is outside the acceptable range (either less than 3.2mA or greater than 20.8 mA); could be due to a wiring problem or a calibration issue.
√		**Gas SSOV 1 Not Closed** Only if the Gas Leak Test P1.8.1 is Enabled	Gas SSOV (Safety Shut Off Valve) ‘closed’ interlock opened T48. Must be closed during Standby, Safe Start, Pre Start, Purge, PTFI, and when fuel is not selected during MTFI, Modulate and ALFCO.
√		**Gas SSOV 1 Not Open** Only if the Gas Leak Test P1.8.1 is Enabled	Gas SSOV 1 (Safety Shut Off Valve) did not open during MTFI or closed during operation for Fuel 2 (Gas) firing; valve may not be functioning properly, or may have experienced power loss; check wiring between valve and panel.
√		**Gas SSOV 2 Not Closed** Only if the Gas Leak Test P1.8.1 is Enabled	Gas SSOV (Safety Shut Off Valve) ‘closed’ interlock opened T49. Must be closed during Standby, Safe Start, Pre Start, Purge, PTFI, and when fuel is not selected during MTFI, Modulate and ALFCO.
√		**Gas SSOV 2 Not Open** Only if the Gas Leak Test P1.8.1 is Enabled	Gas SSOV 2 (Safety Shut Off Valve) did not open during MTFI or closed during operation for Fuel 2 (Gas) firing; valve may not be functioning properly, or may have experienced power loss; check wiring between valve and panel.
√		**High Flue Temperature**	High flue gas temperature, T147 & T148. Check for Low Water level in the drum or economizer. Could also be caused by gas leakage through tangent tubes on a watertube boiler.

BurnerMate Universal Trouble Shooting Guide

L	H	Message	Possible Cause and Corrective Action (Note: **Txx** = Terminal xx, **Px.x.x** = Parameter x.x.x)
√	√	**High Fuel 3 Pressure**	High fuel 3 pressure interlock opened T27. Check switch location. Ensure switch is installed downstream of SSOV's.
√	√	**High Gas Pressure**	High gas pressure interlock opened T24. Check switch location. Ensure switch is installed downstream of SSOV's.
√	√	**High Limit Open**	High-High steam pressure or water temperature interlock T32. Ensure water temperature element is installed correctly in a location with adequate boiler water flow.
√	√	**High Oil Pressure**	High oil pressure interlock opened T17. Check location of high oil pressure switch--should be downstream of oil SSOV's.
√	√	**High Or Low Oil Temperature**	High or low oil temperature interlock opened T21. This input assumes separate switches wired in series. Low oil temperature can be caused by heat loss due to un-insulated pipes.
√	√	**High Water**	High water level cutout interlock opened T37. Visually inspect water level. A high water level can be caused by foaming due to improper boiler water chemistry, or a feedwater valve leaking by.
√	√	**ID Fan Starter**	The ID (Induced Draft) fan “motor starter” interlock opened T39. Check fan motor starter and overload relays.
√		**Ignition Position Is Not On Curve**	The fuel servo ignition position must be greater than the lowest fuel position and lower than the highest fuel position.
√	√	**Ignition Position Unverified**	PTFI (Pilot Trial For Ignition) won't begin until the Ignition positions are Verified. Verify via Commission Mode VERIFY command.
√		**Leak Test Downstream SSOV Failed**	The downstream gas SSOV (Safety Shut Off Valve) failed the Leak Test. Inspect and manually test to confirm.
√		**Leak Test Pressure High After Venting**	Indicates that the gas vent valve is not opening.
√		**Leak Test Pressure Low After Pressurizing**	Indicates that the gas vent valve is not closing; could also indicate a leak in the gas piping train, the downstream SSOV, or the vent valve.
√		**Leak Test Upstream SSOV Failed**	The upstream gas SSOV (Safety Shut Off Valve) failed the leak test. Inspect and manually test to confirm.
√		**Leak Test: Did not move to Low Fire**	The fuel servo failed to move to the low fire position for the leak test. The feedback signal from the feedback potentiometer did not match the output signal from the BMU chassis. This could be due to a bound servo, a loose mounting bracket, or a wiring problem. Check Lockout Data to determine if this occurred during Purge, PTFI, MTFI, or Modulation. Check servo operation. Check servo limit switch positions.
√		**Link Trim Servo Not At Position**	See the "Not At Position" Lockouts section of the Trouble Shooting Guide.
√	√	**Low Atomizing Flow**	Low atomizing steam flow interlock opened T20. Check switch operation. Ensure sensor tubing is clean, run correctly and the switch is the correct DP range.
√	√	**Low Atomizing Pressure**	Low atomizing pressure interlock opened T19. Check switch operation. Check to see if manual isolation valve is open.

L	H	Message	Possible Cause and Corrective Action (Note: **Txx** = Terminal xx, **Px.x.x** = Parameter x.x.x)
√	√	**Low Draft**	Low Draft pressure interlock opened T38 for more than P1.6.4 seconds. "Low Draft" is a traditional, but confusing, term. For a negative Draft design, it means either positive or not negative enough. For a positive Draft design, it means the pressure is higher than desirable. In either case, it could mean that the damper is not open enough, that the ID fan is not functioning properly, or that there isn't enough natural draft. Ensure sensor tubing is run correctly and free of condensate. Check switch for condensate in the diaphragm.
√	√	**Low Fuel 3 Pressure**	Low fuel 3 pressure switch interlock opened T28. Momentary low pressure during the first P1.6.2 seconds of MTFI will not cause a Lockout. Monitor gas pressure during re-light and check PRV operation. Fast opening SSOV's often will not give the PRV enough time to respond. Ensure fuel train manual isolation valve is open.
√	√	**Low Gas Pressure**	Low gas pressure switch interlock opened T25. Momentary low pressure during the first P1.6.2 seconds of MTFI will not cause a Lockout. Monitor gas pressure during re-light and check PRV operation. Fast opening SSOV's often will not give the PRV enough time to respond. Ensure fuel train manual isolation valve is open.
√	√	**Low Oil Pressure**	Low oil pressure switch interlock opened T18. Momentary low pressure during the first P1.6.2 seconds of MTFI will not cause a Lockout. Monitor oil pressure during re-light. Ensure fuel train manual isolation valve is open.
√		**Low Oxygen**	Low oxygen was detected for more than P2.4.5 seconds. Check the settings of all P2.4.X Parameters. Possible causes: O2 sensor faulty, O2 sensor out of calibration, burner F/A ratio out of calibration, or burner maintenance problem. A combustion technician must re-inspect the burner for proper operation.
√	√	**Low Purge Air Flow, T.46**	Low purge airflow switch interlock opened T46 during Purge. If enabled by P1.1.5, this switch is only active during Purge cycle. Ensure sensor tubing is run correctly and free of condensate. Check switch for condensate in the diaphragm.
√	√	**Low Water Level**	Low-Low water level switch interlock opened T36. Check for sludge build-up in water column. Blow down water column as required. Manually test both low water cutouts and clean or repair, as required.
√		**LLWC or LWC did not Open during Blowdown** See P1.11.2, this can be Lockout or Alarm only.	During the LWC (Low Water Cutout) automatic blowdown cycle, neither of the two low water interlocks opened: LLWC (Low Low Water Cutout) T36 or LWC (Low Water Cutout) T12. Manually test both low water cutouts and clean or repair, as required.
√	√	**Minimum Air Flow**	Minimum airflow switch interlock was open T33 for more than P1.6.1 seconds. Check switch operation. Ensure sensor tubing is run correctly and free of condensation. Check switch for condensation in the switch diaphragm.
√		**MTFI Flame Fail**	Flame proven contact at T30 opened during main trial for ignition (MTFI). If "Dual Scanners" is enabled, flame proven contact was lost on both T30 and T31. Check scanner sighting and flame appearance during main gas light-off.
√		**O2 A/D Error**	Both Low O2 Lockout Option P2.4.3 and O2 Fault Lockout Option P2.4.6 are enabled and an O2 analyzer A/D error was detected that could cause a false O2 reading.
√		**O2 Calibration Data Bad**	Both Low O2 Lockout Option P2.4.3 and O2 Fault Lockout Option P2.4.6 are enabled and an O2 calibration data error was detected that could cause a false O2 reading.

L	H	Message	Possible Cause and Corrective Action (Note: **Txx** = Terminal xx, **Px.x.x** = Parameter x.x.x)
√		O2 Cell Not at Temperature	Both Low O2 Lockout Option P2.4.3 and O2 Fault Lockout Option P2.4.6 are enabled and an O2 analyzer cell temperature error was detected that could cause a false O2 reading.
√		O2 Cell T/C Cold Junction Sensor Error	Both Low O2 Lockout Option P2.4.3 and O2 Fault Lockout Option P2.4.6 are enabled and an O2 analyzer T/C cold junction error was detected that could cause a false O2 reading.
√		O2 Impedance Relay Error	Both Low O2 Lockout Option P2.4.3 and O2 Fault Lockout Option P2.4.6 are enabled and an O2 analyzer impedance test relay error was detected that could cause a false O2 reading.
√		O2 Trim In Manual Mode during PreStart	O2 Trim was enabled and in Manual control mode during Safe Start Check. Must be disabled by a technician on the oxygen trim test/tune screen (under Fuel/air Ratio Options)
√		Oil Flow Pulser Out Of Range	Pulser frequency less than 3.2%, or greater than 112.5% of P2.7.5 when firing oil in Metering Mode
√		Oil Flow Xmtr Out Of Range	4-20 mA xmtr was less than 3.2 mA or greater than 20.8 mA
√	√	Oil Gun Not In	Oil gun in position switch interlock opened T22. For most burners, this input will be jumpered to 120 VAC. Otherwise, inspect switch operation and restart.
√		Oil Gun Purge Aborted. Not at Low Fire	The fuel servo did not go to low fire within 100 seconds of a planned shutdown. Oil gun Blow Thru purge did not occur. See parameters P1.9.1 and P1.9.2.
√		Oil SSOV Not Closed	Oil SSOV (Safety Shut Off Valve) 'closed' interlock opened T47. Must be closed during Standby, Safe Start, Pre Start, Purge, PTFI, and when fuel is not selected during MTFI, Modulate and ALFCO.
√		Oil SSOV Not Open	Oil SSOV (Safety Shut Off Valve) did not open during MTFI for Fuel 1 (Oil) firing; valve may not be functioning properly, or may not be connected to power; check wiring to valve.
√		Parameter Error: ...parameter name....	Safe Start Check. The value of parameter name is outside the min/max range – OR – the value violated a rule shown in the Note section of this parameter.
√		Power Failure	Loss of AC power. Burner Lockout occurred due to parameter P1.3.1. This Parameter can be set to Restart or Lockout.
√		PTFI Flame Fail	Flame proven contact at T30 opened during pilot trial for ignition (PTFI). If "Dual Scanners" is enabled, flame proven contact was lost on both T30 and T31.
√		Purge Intlk Open for more than 30 Sec (during Purge)	Purge interlocks not made for more than 30 seconds during purge cycle. Depending on the BMU setup, this is a combination of servo position, VSD Hz feedback, and PAF switch T46.
√	√	Purge Position Unverified	If purge position isn't verified, the burner will hold at purge waiting for the position to be verified by the technician. The purge position can only be verified during boiler purge mode.
√		Safety Relay Did Not Open	Internal Fuel Bus Safety relay did not open. Possible welded contacts due to overloading or direct short to ground. Consult factory for repairs.
√		Scanner 1 False Flame	Scanner 1 T30 detected flame during Safe Start, Pre-Start, or Purge.
√		Scanner 2 False Flame	Scanner 2 T31 detected flame during Safe Start, Pre-Start, or Purge.
√		Servo # A/D Error	Servo # (0-9) detected an A/D error that can cause an incorrect servo position feedback. Can be caused by electrical noise or a malfunction. If the error re-occurs, repair/replace the servo.

BurnerMate Universal Trouble Shooting Guide

L	H	Message	Possible Cause and Corrective Action (Note: **Txx** = Terminal xx, **Px.x.x** = Parameter x.x.x)
√		**Servo # Address / Daisy Chain Error**	Servo # (0-9) address does not match its position in the daisy chain. Check the addresses of each servo. A0 is wired to BMU, A1 is wired to A0, etc.
√		**Servo # CC Comm Failure**	Servo # (0-9) is not communicating with the BMU CC board. Check wiring.
√		**Servo # Closed Limit data doesn't match CC**	Servo # (0-9) Data is okay, but doesn't match previous setup. Servos may have been swapped. Re-Seek Limit switch positions.
√		**Servo # Config Data Bad**	Data was corrupted electrical noise. Eliminate the source of the noise. Re-enter configuration data.
√		**Servo # Config data doesn't match CC**	Servo Data is OK, but doesn't match previous setup. Servos may have been swapped. Zero servo, seek limits, and re-verify all curve points.
√		**Servo # Deadband Data Bad**	Data was corrupted (possibly by electrical noise) Set the proper servo deadband.
√		**Servo # Desired / Observed Direction Mismatch**	Servo CW/CCW motor wires swapped or potentiometer CW/CCW wires were swapped; correct wiring, Zero servo, seek limits, and re-verify all curve points.
√		**Servo # Entered CCW Forbidden Zone**	Servo has been driven too far CCW, past the active portion of the feedback potentiometer range of travel. Remove J11 in servo, Jog the servo CW until servo feedback is normal. Adjust servo limit switch. Seek limits again. Note: servo travel is limited to 180 degrees maximum travel.
√		**Servo # Entered CW Forbidden Zone**	See CCW comments above.
√		**Servo # Incompatible Software Version**	The servo # (0-9) software version is not compatible with the CC board. The burner will not start.
√		**Servo # Limits Data Bad**	Data was corrupted (possibly by electrical noise); re-seek the limits.
√		**Servo # Limits Span Is Too Large**	Limit switches are set too far apart. Must be < 180 deg.
√		**Servo # Limits Span Is Too Small**	Limit switches are set too close together. Must be > 15 deg.
√		**Servo # Local Override Jumper J11 Missing**	Re-install the J11 on the servo circuit board for normal operation.
√		**Servo # Lost Communication**	Servo # (0-9) is not communicating with the BMU CC board. Check wiring.
√		**Servo # Needs Seek Limits**	Servo # (0-9) has not 'learned' its limit switch positions; re-seek limits.
√		**Servo # Needs Zero Cal**	Servo # (0-9) has not been calibrated for Zero position. Zero servo, seek limits, and re-verify all curve points.
√		**Servo # Open Limit data doesn't match CC**	Servo # (0-9) Data is okay, but doesn't match previous setup. Servos may have been swapped. Re-seek limit switch positions.

L	H	Message	Possible Cause and Corrective Action (Note: **Txx** = Terminal xx, **Px.x.x** = Parameter x.x.x)
√		**Servo # Pot Ref Voltage Out of Range**	Servo # (0-9) detected a potentiometer voltage error that can cause an incorrect servo position feedback. Can be caused by electrical noise or a malfunction. If the error re-occurs, repair/replace the servo.
√		**Servo # Pot Voltage Too High**	Servo # (0-9) detected a potentiometer voltage error that can cause an incorrect servo position feedback. Can be caused by electrical noise or a malfunction. If the error re-occurs, repair/replace the servo.
√		**Servo # Pot Voltage Too Low**	Servo # (0-9) detected a potentiometer voltage error that can cause an incorrect servo position feedback. Can be caused by electrical noise or a malfunction. If the error re-occurs, repair/replace the servo.
√		**Servo # Potentiometer Alignment Changed**	Both the Open and Closed Limit Switch positions did not match the previously learned positions during the burner pre-start Servo Check. Potentially dangerous situation; re-seek servo limits and carefully bring the burner up from low to high fire, checking firing rate/valve position/servo feedback against combustion constituent (i.e., Oxygen) levels; verify normal operation.
√		**Servo # Servo Check or Seek Limits Aborted By User**	LOCKOUT: User pressed a servo positioner button during a Safe Start Servo Check. Non-Lockout: User pressed a servo positioner button or the LCD ABORT during Servo Seek Limits.
√		**Servo # Speed Out of Range, Seek Limits Req'd**	The speed measured during Seek Limits must be between 13 sec/90 deg and 80 sec/90 deg. Check for binding. Re-seek limits.
√		**Servo # Zero Cal data doesn't match CC**	Servo # (0-9) Data is okay, but doesn't match previous setup. Servos may have been swapped. Re–zero the servo
√		**Servo # Zero Data Bad**	Data was corrupted (electrical noise, etc.) Re-zero servo.
√		**Servo # Zero Is Near Open, Zero Cal Req'd**	0.0 degrees must be closer to the Closed Limit Switch position than to the Open Limit switch position. Re-zero the servo.
√		**Servo Config Menu: Address vs. Function Error**	The LCD Servo Configure menu has a function error: same function assigned to more than one servo, an address was skipped, or an illegal function was assigned.
√		**Terminal ##: Relay was OFF, should be ON**	Relay output terminal ## did not have 120 VAC present when it should have. Electrical noise or defective relay. If error re-occurs, contact the factory for repair instructions.
√		**Terminal ##: Relay was ON, should be OFF**	Relay output terminal ## had 120 VAC present when it should not have. Electrical noise, a field wiring “short,” or a defective relay could be to blame. Check field wiring, direct shorts can weld contacts closed. If error re-occurs, contact the factory for repair instructions.
√		**Too Few Curve Points**	A minimum of three valid curve points, 15 degrees minimum total span must be entered and verified. Enter and verify more points via the Commission Mode screens.
√		**Unverified Curve Points**	One of the curve points is not verified. Via the Commission Mode screens, determine which point(s) are not verified and then verify (or edit) these points.
√		**Windbox O2 FGR Trim In Manual Mode during PreStart**	Safe Start Check. The windbox FGR trim PID was under manual control when the burner was started. Put the windbox FGR trim in automatic mode and restart the burner.

Recycle Messages (recycling limits)

The following is a list of messages that appear if a recycle limit de-energizes. Both recycling and non-recycling limits shut the boiler down should any de-energize; however, the **BurnerMate Universal** automatically restarts the boiler when a recycle limit re-energizes

Message	Possible Cause and Corrective Action (Note: **Txx** = Terminal xx, **Px.x.x** = Parameter x.x.x)
`Aux Low Water`	The Low Water Cutout (LWC) interlock T12 is open. The LWC is set to a higher water level than the LLWC (Low Low Water Cutout T36). The burner will restart when the LWC makes. Ensure sludge has not built up in the water column. Blow down water column as needed.
`Aux Recycle Limit 1`	Burner is in Standby because auxiliary limit at T15 is open. This is a recycle limit. Burner will start automatically when T15 is powered.
`Burner Off`	The Burner On/Off switch input T10 is not energized. Burner will automatically start when switched to On (T10 input re-energized).
`Call For Heat Open`	Burner is in Standby because there is no Call for Heat. The Call for Heat signal source depends on Parameters: P3.2.1 – 3.2.3, P3.3.1, P3.3.2, P3.6.1 and the remote/local mode.
`Low Water Flow`	Hot Water Boiler Low Water Flow interlock is open T13. The burner will not start. The burner will recycle (start) when the interlock makes. Ensure the flow switch is installed in a part of the circulating system with adequate flow for the switch to make.
`Operating Limit Open`	High steam pressure or high boiler water temperature switch T11 is open. Burner is in Standby and will relight automatically when switch makes.

Alarm Only Messages

The following is a list of messages that are alarm only.

Message	Possible Cause and Corrective Action (Note: **Txx** = Terminal xx, **Px.x.x** = Parameter x.x.x)
`Atomizing Servo Error`	There is an error with the atomizing steam servo; check error via Servo Deadband screen on BMU-LCD (Main Menu>>Servos>>Deadband); check servo wiring; check servo address; re-zero and seek limits. Check servo-valve linkage for binding.
`Bad OAT Sensor`	Outdoor air temperature sensor is faulty. Ensure parameter P3.5.2 selection matches installed sensor. Check sensor, check wiring, replace sensor if necessary.
`Bad Remote Set Point/ Remote Firing Rate`	Remote set point or Firing Rate signal is out of range. Check terminals T112 and T113 for faulty wiring, bad connections, etc.
`Draft Servo Error`	There is an error with the draft servo; check error via Servo Deadband screen on BMU LCD (Main Menu>>Servos>>Deadband); check servo wiring; check servo address; re-zero and seek limits. Check servo-valve linkage for binding.
`Feedwater Servo Error`	There is an error with the feedwater servo; check error via Servo Deadband screen on BMU-LCD (Main Menu>>Servos>>Deadband); check servo wiring; check servo address; re-zero and seek limits. Check servo-valve linkage for binding.
`High Drum Level`	Alarm only, not a shutdown interlock. Either T6 is energized or the 4-20 mA drum level is above P5.2.2. Check for leak by on the feedwater valve.
`Low Drum Level`	Alarm only, not a shutdown interlock. Either T5 is energized or the 4-20 mA Drum level is below P5.2.1. Manually verify water level. Check feedwater pump and control valve operation.

Operational Error Messages

The following is a list of error messages that are associated with **BurnerMate Universal** software, hardware, set-up, commissioning, or operational problems.

Message	Possible Cause and Corrective Action (Note: **Txx** = Terminal xx, **Px.x.x** = Parameter x.x.x)
`Can't VERIFY. Fuel Points Too Close`	The point cannot be verified. The BMU requires a minimum separation of 2 degrees between fuel points
`Can't VERIFY. Slope Too Great`	The point cannot be verified. The BMU requires that for every 1 degree of fuel servo movement, the other devices may move a maximum of 10 degrees.
`Curve Mismatch!  CC has INVALID combustion curves`	On power up, the BMU noticed that the curve data has been corrupted. If cycling power does not fix the problem, you can attempt to use the backup curve data from the LCD by selecting the "Copy LCD -> BMU" option. You could also try to restore the data from a BMU Edit configuration file.
`Curve Mismatch!  LCD and CC have INVALID combustion curves`	Both the BMU and LCD copies of the curve data have been corrupted. If cycling power does not fix the problem, you can try to restore the curve data from a BMU Edit configuration file. Otherwise, you will need to re-verify the curve data. Pay particularly close attention while re-verifying, because something has been unintentionally changed.
`Curve Mismatch!  LCD has INVALID combustion curves`	The backup curve data on the LCD has been corrupted. If cycling power does not fix the problem, you can select the "Copy BMU -> LCD" option.
`Curve Mismatch!` **`Copy  BMU -> LCD`** **`Copy  LCD -> BMU`**	The curve data on the BMU and the backup copy on the LCD are out of sync. You may elect to use the data on the LCD or the data on the BMU. See Section 5 for a detailed explanation.
`Error! At Least 3 Points Must Be Stored Before Using VERIFY`	While setting up the combustion curve, at least 3 curve points, a minimum of a 15 degree span, must be set up and stored in the BMU before any of them can be verified.
`Error, A Single Fuel Must Be Selected`	In order to Store a Point in Commission mode, or in order to activate Verify Mode, a desired fuel must be selected.
`Error, Fuel Feedback Must Be Within Curve Min and Max`	Can't exit Commission Mode, or can't activate Verify mode, unless the fuel valve position is within the range of the fuel curve points.
`Error, Not At Positions`	The desired curve device positions were not reached. The curve point was not stored
`Failed To Learn Closed Limit Position`	Servo failed to learn closed limit position after 180 seconds (i.e., it took the servo longer than 180 seconds to complete a “seek limits” command); could be due to a stiff valve, or mechanical binding of the servo/valve linkage; otherwise, consult factory.
`Failed To Learn Open Limit Position`	Servo failed to learn open limit position after 180 seconds (i.e., it took the servo longer than 180 seconds to complete a “seek limits” command); could be due to a stiff valve, or mechanical binding of the servo/valve linkage; otherwise, consult factory.
`Fuels Not at Biased Ignition Position`	The air trim devices moved off of their desired positions during a fuel transfer; fuel transfer was aborted after 2.5 seconds.
`Internal Error!` **`Board: x  Code: x`** **`Data:  xxxx xxxx`**	Generally caused by electrical noise corrupting data inside a processor. Write down the Board #, Code #, and the 8 digit Data. Press the RESET button on the LCD (or cycle power to the BMU). If this Internal Error does not occur again, it was probably a nuisance trip. If the same, or similar, Code occurs again, Call the Factory. If Board 5, Code 7? occurs: One of the 120 Vac inputs is not fed from the same 120 Vac phase as the phase that supplies L1 of the BMU.
`Invalid Segment - Fuel Points Too Close`	The BMU requires a minimum separation of 2 degrees between fuel points

Message	Possible Cause and Corrective Action (Note: **Txx** = Terminal xx, **Px.x.x** = Parameter x.x.x)
Invalid Segment - Slope Too Great	The BMU requires that for every 1 degree of fuel servo movement, the other devices may move a maximum of 10 degrees.
LCD: Invalid Software Version	The LCD software version is not compatible with the CC board. Check the software versions on both the BMU and the LCD. Consult the factory.
Leak Test Aborted: Low Gas Pressure	Low gas pressure switch interlock T25 was open at the start of the leak test sequence. The leak test was NOT performed.
Learn Aborted - Servo Reported Error	A servo reported an error during the limit switch detection procedure. You will need to perform the limit seek procedure again
Parameter Mismatch! BMU loaded DEFAULT data on Boot Up	The parameter data on the BMU has been corrupted and defaults have been loaded. You may elect to restore the parameters from the LCD backup copy or a BMU Edit configuration file if possible.
Parameter Mismatch! LCD has DEFAULT data	The parameter data on the LCD has been corrupted and defaults have been loaded. You may elect to use the parameters from the BMU or a BMU Edit configuration file.
Parameter Mismatch! LCD has DEFAULT data and BMU loaded DEFAULT data on Boot Up	The parameter data on both the LCD and the BMU has been corrupted and defaults have been loaded. You will need to restore the parameters either manually or from a BMU Edit configuration file.
Parameter Mismatch! **Copy BMU -> LCD** **Copy LCD -> BMU**	The parameter data on the LCD and the BMU is out of sync. You may use either the BMU's parameters or the parameters from the LCD. See Section 5 for a detailed explanation.
Purge Positions Not Verified	Purge won't begin until purge position is verified. Verify via Commission Mode VERIFY command.
Single Fuel Not Selected	Either no fuel is selected or more than one fuel is selected. Check wiring or Modbus Master logic.
Waiting For AUX	The curve device manager is unable to find a valid position for the Aux device. This is most likely due to a curve point outside of the servo limit switch positions.
Waiting For Aux 2	The curve device manager is unable to find a valid position for the Aux 2 device. This is most likely due to a curve point outside of the servo limit switch positions.
Waiting For FD Damper	The curve device manager is unable to find a valid position for the FD damper. This is most likely due to a curve point outside of the servo limit switch positions.
Waiting For FD (VSD)	The curve device manager is unable to find a valid position for the FD damper. This is most likely due to a curve point outside of the allowed operating range. Check P2.2.4, pFDVSDCtrlMinHz
Waiting For FGR Damper	The curve device manager is unable to find a valid position for the FGR damper. This is most likely due to a curve point outside of the servo limit switch positions.
Waiting For FUEL Valve	The curve device manager is unable to find a valid position for the Fuel valve. This is most likely due to a curve point outside of the servo limit switch positions.
Waiting For Purge, Ignition, or Modulate	No valid purge, ignition, or modulating curve points have been stored into the combustion curve (points may either not exist or be outside their admissible ranges); these must be set (via Commission mode) before the burner will start.
WARNING! Press STORE to Move Outputs To The Curve. Change Command To Exit	A curve point must be stored on the combustion curve before setting a new one; the BMU does not store these points automatically.
Xfer Took Too Long	The low fire transfer was aborted since the dual fuel firing phase lasted longer than P1.12.3, pDualFuelMaxSeconds

Normal Operational Messages

The following list of messages when displayed – denote normal boiler operation. These are provided to allow the user to distinguish between error messages and non-error messages.

Message	Possible Cause and Corrective Action (Note: **Txx** = Terminal xx, **Px.x.x** = Parameter x.x.x)
`Cold Start Warm Up`	The BMU is in a cold start cycle. The firing rate will be incremented in stages until the burner warms up. Refer to the P3.10.X Parameters
`Downstream SSOV Test`	The second Gas SSOV (Safety Shut Off Valve) is being leak tested.
`FGR Temp Low Fire Hold`	FGR will not engage during low fire due to low flue temperature. Check the P3.12.X Parameters
`Fuel Transfer Restart`	Burner is restarting based on fuel transfer request.
`Fuel Xfer`	A low fire fuel transfer is taking place.
`Low Fire Hold`	Boiler is holding at low fire. Check the P3.11.X Parameters
`MAF And PAF Open Test`	During Safe Start, the MAF (Minimum Airflow) T33 and PAF (Purge Airflow) T46 switches are checked to ensure switches are not made when the fans are de-energized. (Ensures air switches are open and/or not jumpered)
`MAF Test Bypassed`	The FD fan T33 & T34 or ID fan T39 were energized during Safe Start so the test is bypassed.
`Min Air Flow Safe Start Test`	Either the minimum airflow T33 or the purge airflow T46 switch was closed (when it should have been open) during the Safe Start 'MAF and PAF Open Test'. Check wiring, check/replace defective MAF or PAF switch.
`Oil Gun Pump Back`	Oil Gun Pump Back in progress during post purge. See parameters P1.9.1 and P1.9.2.
`Safe Start`	Safe start tests are executed prior to purge cycle. Safety Relay is tested, no scanner false flame is detected, all Parameters and curve data are checked for validity, and all servos are cycled and checked against previous feedback data.
`System Starting... LCD Offline`	If this message does not disappear after 10-20 seconds, then the LCD is not communicating with the BMU. Check the LCD wiring.
`Test Hold Pilot`	Test Hold dipswitch (1) on BMS board is in the "down" position. This switch can be used to hold the BMU at Ignition for pilot turndown testing.
`Upstream SSOV Test`	The first gas SSOV (Safety Shut Off Valve) is being Leak tested.

Lockout Data Stored in LCD EEPROM

	Lockout Data
1	BMS State
2	Commission Mode
3	Selected Fuel
4	Firing Rate %
5	Scanner 1
6	Scanner 2
7	Oxygen
8	O2 Trim PID SP
9	O2 Trim
10	Scaled Air Trim
11	Boiler Outlet Temp/Press
12	Shell Temp
13	Atomizing Pressure
14	Atomizing SP
15	Draft
16	Drum Level
17	Steam Flow
18	Feedwater Flow
19	Fuel Demand deg
20	Oil Servo SP
21	Oil Servo FB
22	Gas Servo SP
23	Gas Servo FB
24	Fuel 3 Servo SP
25	Fuel 3 Servo FB
26	FD Servo SP
27	FD Servo FB
28	FD VSD Hz SP
29	FD VSD Hz FB
30	Aux Servo SP
31	Aux Servo FB
32	FGR Cutback
33	FGR Servo SP
34	FGR Servo FB
35	Aux 2 SP
36	Aux 2 FB
37	Jackshaft Servo SP
38	Jackshaft Servo FB
39	Atomizing Valve SP
40	Atomizing Valve FB
41	Draft Damper SP

	Lockout Data
42	Draft Servo FB
43	Draft VSD SP
44	Feedwater Valve SP
45	Feedwater Servo FB
46	Feed Pump VSD SP
47	Oil Flow
48	Gas Pressure
49	Gas Flow
50	Fuel 3 Flow
51	Curve Oil Flow
52	Curve Gas Flow
53	Curve Fuel 3 Flow
54	Curve Air Flow
55	Air Flow Temperature
56	Air Flow
57	Air Flow, O2 Trimmed
58	Air Flow SP
59	Air Flow Trim
60	Air Flow Trim Manual Cmd
61	Windbox Oxygen
62	Windbox Oxygen Setpoint
63	Unscaled FGR Trim
64	Scaled FGR Trim
65	Password Level
66	Firing Rate PID SP
67	Remote Firing Rate
68	Remote SP
69	OA Sensor Bad
70	Modbus Comm Bad
71	Remote SP/FR mA In Bad
72	Cold Junction Error
73	O2 A/D Error
74	O2 Cell Open or Combustibles
75	O2 Test Relay Error
76	O2 Cell Temp
77	O2 Cell mV
78	Flue Temp
79	O2 Cell Ohms
80	Fuel Transfer
81	ALWC with Bypass
82	Oil SSOV Open

	Lockout Data
83	Gas SSOV Open
84	Fuel 3 SSOV Open
85	HF3P TDR
86	HGP TDR
87	HOP TDR
88	LASF TDR
89	LDCO TDR
90	LF3P TDR
91	LGP TDR
92	LOP TDR
93	LWC with Bypass
94	MAF TDR
	RO.xx Safety Relay
95	RO.51 Ign Xfmr
96	RO.52 Pilot
97	RO.53 Atomizing
98	RO.54 Oil SSOV
99	RO.55 Oil Gun Purge
100	RO.56 Gas SSOV
101	RO.57 Fuel3 SSOV/LT DownStr SSOV
102	RO.58 Gas Vent
103	RO.59 FD Fan
104	RO.61 Lockout
105	RO.62 Option 1
106	RO.63 Option 2
107	RO.66 Option 3
108	RO.69 Option 4
109	RO.72 Option 5
110	DI.1 Ext Reset
111	DI.2 Alt SP
112	DI.3 FD Fan Type
113	DI.4 LWC Bypass PB
114	DI.5 Low-Low Water Alm
115	DI.6 High Water Alm
116	DI.7 WarmUp or DHW
117	DI.8 Local CFH
118	DI.9 Remote CFH
119	DI.10 Burner On/Off
120	DI.11 Oper Limit
121	DI.12 LWC
122	DI.13 Low Water Flow
123	DI.14 Fresh Air Open
124	DI.15 Recycle Spare 1

	Lockout Data
125	DI.16 Oil Fuel Select
126	DI.17 HOP
127	DI.18 LOP
128	DI.19 LASP
129	DI.20 LASF
130	DI.21 HOT or LOT
131	DI.22 Oil Gun In Place
132	DI.23 Gas Fuel Select
133	DI.24 HGP
134	DI.25 LGP
135	DI.26 Fuel 3 Select
136	DI.27 Fuel 3 HP
137	DI.28 Fuel 3 LP
138	DI.29 E Stop
139	DI.30 Scanner 1
140	DI.31 Scanner 2
141	DI.32 High Limit
142	DI.33 MAF
143	DI.34 FD Fixed Starter
144	DI.35 FD VSD Starter
145	DI.36 LLWC
146	DI.37 HWC
147	DI.38 LDCO/HFP
148	DI.39 ID Starter
149	DI.40 FGR Starter
150	DI.41 Non-Recycle Spare 1
151	DI.42 Non-Recycle Spare 2 / HLTP
152	DI.43 Non-Recycle Spare 3 / LLTP
153	DI.44 Draft Damper Open
154	DI.45 Null Windbox O2 FGR Trim
155	DI.46 PAF
156	DI.47 Oil SSOV POC
157	DI.48 Gas SSOV POC
158	DI.49 Fuel 3 POC/Gas SSOV2 POC
159	ROFB Safety Relay
160	ROFB.51 Ign. Xfmr
161	ROFB.52 Pilot
162	ROFB.53 Atomizing
163	ROFB.54 Oil SSOV
164	ROFB.55 Oil Gun Purge
165	ROFB.56 Gas/Fuel
166	ROFB.57 Fuel3 SSOV/LT DownStr SSOV

SECTION 7 INDEX

Notes:

BurnerMate Universal

In-Situ Oxygen Analyzer

Instruction Manual

Revision 2.0
September 1, 2008

Instruction Manual
Part Number: 90770

Preferred Instruments
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System Overview

Monitoring flue gas oxygen levels minimizes fuel expense and insures safe combustion for all combustion processes. For low NOx burners that utilize Flue Gas Recirculation (FGR), windbox oxygen monitoring provides accurate feedback of the FGR/air ratio for stable NOx control.

To add oxygen monitoring/oxygen trim to a **BurnerMate Universal** requires only a model ZP oxygen sensor and P/N 190130 connecting cable.

The Model ZP detector is an in-situ, direct insertion, zirconium oxide element with proven accuracy and long term stability. The heater is a reliable ceramic element. The detector uses ambient air (instead of plant compressed air) for its reference, so it is immune to damage caused by water and oil in compressed air systems. The ZP is suitable for use in processes fired by gas, all grades of oil, and process off-gasses.

A standard 3” flange is used to mount the ZP probe. The sample gas filter can be cleaned without removing the probe from the stack. The Detector can be repaired or replaced without removing the probe from the stack.

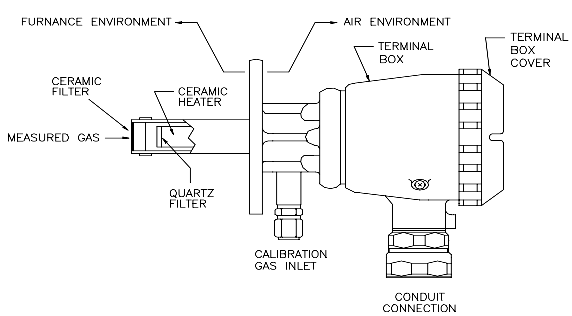
The ZP oxygen probe is directly wired to the **BurnerMate Universal** chassis (eliminates a field mounted transmitter), which simplifies installation. The **BurnerMate Universal** provides digital cell temperature control, electrical isolation, diagnostics and multiple alarms.

Oxygen Sensor

The ZP oxygen sensor is pre-assembled and consists of a detector and a probe. The ZP sensor is field installed into the boiler flue gas outlet to sense flue gas oxygen concentration. The oxygen sensor is a direct sampling IN-SITU type and <u>doesn’t</u> require an extractive sampling system.

Detector

The detector consists of a zirconium oxide cell, a ceramic heater with thermocouple, terminals for connecting to the controller unit, a flange for connection to the probe, an opening to accept reference (ambient) air and a connection for calibration gas.



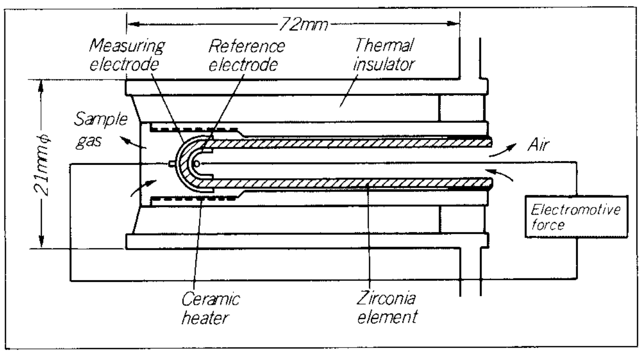
The detector works on a principle that when heated to 800 C (1472 ºF), the cell generates an electrical signal directly related to the oxygen concentrations of the flue gas. Flue gases are passed through a filter to prevent dust and dirt from contaminating the cell. Calibration gas can be injected into the space behind the ceramic and quartz filters to allow on-line calibration without removal from the stack.

Measuring Principle

Zirconium (ZrO_2) ceramic sintered with a small amount of yttrium (Y_2O_3) is a solid electrolyte with oxygen ion conductivity at temperatures above 500 Deg. C. A solid electrolyte tube coated with porous platinum on both surfaces acts as an oxygen sensor. The **differential** oxygen concentration (% flue gas oxygen vs. % room air oxygen) in contact with both platinum electrodes produces a voltage as follows:

$E = RT/4F * \ln(P1/P2)$

R	:	Gas Constant
F	:	Faraday Constant
T	:	Temperature of Electrodes (Deg.K)
P1	:	Reference Air Oxygen Concentration
P2	:	Measured Oxygen Concentration



For example, when the sensor element is heated to 800 Deg. C, Reference Oxygen (P1) = 20.6%, and the measured oxygen (P2) = 2.0%, an output signal of about 54 mV is generated. Lower measured oxygen levels produce higher voltage levels.

A ceramic heater with type R Thermocouple temperature feedback is used to maintain the zirconium oxygen sensor at precisely 800 C (1472 F). The **BurnerMate Universal** monitors the thermocouple, and regulates the power applied to the heater.

Ambient air provides the oxygen for the reference side of the cell. Air circulates around the reference electrode of the zirconia element. The air is rapidly circulated by convection because the sensor is very hot, and the gas volume is small. The sample gas reaches the measuring electrode by rapid convection in a manner similar to the Reference electrode.

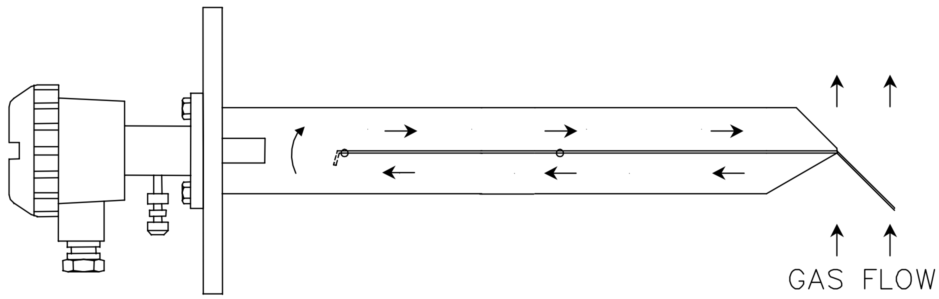
When troubleshooting a Zirconium Oxide oxygen analyzer, it is important to remember that the cell makes a differential measurement. Said another way, the cell compares the unknown oxygen percentage in the flue gas against the "known" oxygen percentage in the ambient air inside the cell. Ambient air typically is 20.6%; however, it can range from 19.5% to 20.9% as relative humidity and temperature change.

If the flue gas duct is pressurized, and duct leaks allow flue gas to enter the detector head, the ambient oxygen percentage can be substantially lower. Combustible gasses in the ambient air will consume the oxygen on the surface of the cell and will also lower the percent oxygen in the ambient air inside the cell.

If the ambient oxygen percentage is low, a Zirconium cell will sense a lower differential and will cause the analyzer to indicate a higher oxygen level than is actually in the flue gas.

Probe
The probe is a stainless steel assembly that mounts on a 3 inch 125 lb flange (flat face) located on the flue gas duct or stack. The probe protrudes into the flue gas stream, and directs boiler flue gases from the middle third of the flue gas stream to the detector. The probe design provides for the removal of the detector for service or replacement without the need for probe removal.

The probe is installed so the tip of the probe functions as a scoop when in the flue gas flow. The probe utilizes the dynamic differential pressure produced by the flue gas velocity and the probe tip as the means to move the flue gas through the probe. The probe internal pressure drop is very low and high velocity sample gas flow is provided to the detector, even when mounted vertically or upside down.



Oxygen Sensor Gas Flow

<u>The ZP probe must always be horizontal or pitched down (away from the detector) to prevent accumulation of condensed flue gas water at the Detector.</u>

Flue gas contains a significant amount of water vapor. If liquid water comes in contact with the cell (heated to 800 C), the ceramic will crack and will have to be replaced. This is true for all brands of zirconium oxide Oxygen Analyzers.

Installation

<u>CAUTION - FRAGILE</u>: DO NOT DROP THE DETECTOR. If the ceramic zirconium oxide cell inside the detector is cracked, it must be replaced.

The general Installation procedure is:

Select a stack location
Mount a 3” pipe nipple and a 3”-125# flat faced flange on the duct. (nipple & flange supplied by others)
Mount the ZP Probe and Detector on the flange.
Check the Flange Temperature.
Run ¼” calibration gas tubing to floor level.
Run conduit from the **BurnerMate Universal** to the ZP (with flexible “service loop” at the ZP).
Pull P/N 190130 cable through the conduit and terminate the wiring.

Location

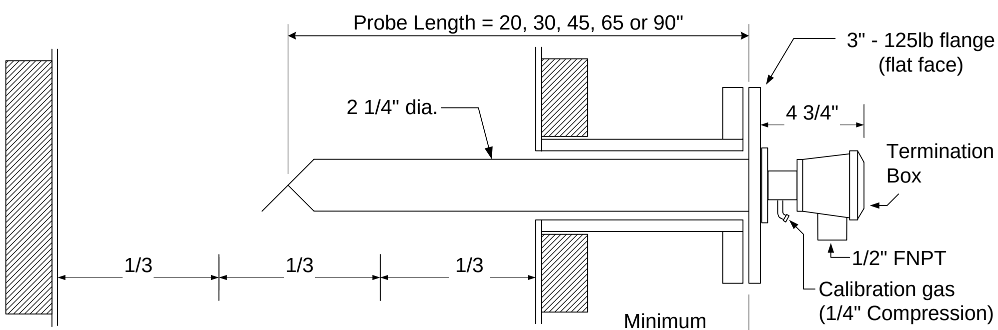
Locate the end of the probe in the middle one third of the flue gas stream as shown below and approximately perpendicular to the flue gas flow. The location must be upstream of any ambient air infiltration (and thus oxygen) caused by stack leaks. The probe should be located in an area free from any abrupt variations in flue gas pressure or temperature and flow stagnation pockets. The probe should be mounted in an area of uniform flue gas flow. The probe should not be subjected to excessive vibration. The standard ZP is designed for indoor use. If located outdoors, purchase and install the optional rain cover.

The detector uses ambient air as a reference, air containing abnormal oxygen levels causes measuring errors. Make sure that flue gas is not leaking out in the vicinity of the probe.

<u>The ZP probe must always be horizontal or pitched down (away from the detector)</u> to prevent accumulation of condensed flue gas water at the Detector. Flue gas contains a substantial amount of gaseous water. The ceramic detector cell operates at 800 C (1472 F), if liquid water comes in contact with the cell, the ceramic cell will damaged. The Probe should not be vertical, and should not be pitched down more than 45º, to avoid overheating the mounting flange and internal seals.

Mounting Nipple and Flange
The 3”-125# flat faced mounting flange must be mounted on an exposed, non-insulated, nipple as shown in the diagram below. This nipple cools the flue gas to prevent overheating the detector head. The ZP detector flange must be less than 260° F in order to prevent damage to the calibration gas and ambient air seals within the detector head.

The mounting flange bolt clearance holes should be installed so that the ZP flow arrows are aligned with the flue gas flow. This allows the end of the probe tip to function as a scoop when in the flue gas flow. The tip is designed to direct the flue gas to the detector by utilizing the dynamic differential pressure produced by the probe tip. The ZP sensor flange has 8 bolt clearance holes, but only 4 will be used. The extra 4 holes allow the user to rotate the probe after installation (see below).



Length	Stack
6"	0 - 500 F
9"	500 - 750 F
12"	750 - 1000 F

Check Flange Temperature

The ZP detector flange temperature must be less than 260 °F in order to prevent long-term damage to the calibration gas and ambient air elastomer seals within the detector head. After the ZP is bolted to the duct-mounting flange, the burner should be operated for enough time for the ZP detector flange temperature to stabilize (typically 20-40 min.). Observe the temperature sensitive label on the detector flange (see below).

Temperature
Under 260 Deg F

Temperature
Above 260 Deg F

Temperature Sensitive Labels

If the duct is insulated, and the nipple and flange are not insulated, and the proper nipple length is used (see chart in Installation sketch), the detector flange temperature will not exceed 260 F.

If the detector temperature exceeds 260 °F, use one or all of the following to lower the temperature:

- Reduce duct radiant heating by insulating exposed ductwork.
- Add another flange gasket
- Rotate the probe <u>one</u> bolt hole to reduce flue gas flow to the detector.

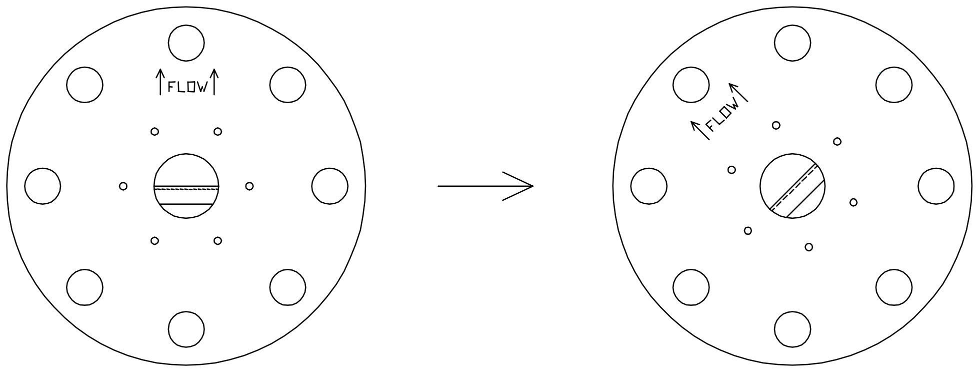
<u>NOTE:</u> The temperature sensitive label CAN NOT be re-used if the temperature exceeded 260F. Use a new label or some other means (thermocouple, surface thermometer,) to measure the temperature after modifications are made.

Rotating the Probe to Lower Flange Temperature

If the flue gas velocity in the duct is unusually high, the higher flow rate through the probe and past the detector can cause detector over heating. Rotating the probe flange one bolt hole to purposely misalign the probe tip will reduce the flue gas flow rate through the probe.

If the probe is horizontal, rotate it <u>counter-clockwise</u>. The detector has an opening for atmospheric air on the lower left side of the detector housing. Rotating <u>counter-clockwise</u> will keep the inlet pointing downward, minimizing the possibility of water infiltration.

Rotating the Probe **ONE** Bolt Hole
to Lower Detector Flange Temperature



Normal Orientation

High Temperature Orientation

Calibration Gas Tubing

When the detector is installed, the detector calibration gas inlet fitting and tubing should slope downwards to prevent the entry of condensed water into the cell. Install copper tubing from the calibration gas port down to an easily accessible location. Terminate the end with a valve, cap plug, ZP-Cal assembly, or other means to positively prevent ambient air infiltration into the calibration gas port.

Wiring

The **BurnerMate Universal** and ZP 120 Vac power supplies should only be turned off for ZP maintenance or for extended boiler shutdowns. The 120 Vac power should NOT be turned off every time the burner is shut down. Excessive power cycling can shorten the life of the ZP detector. Provide a “service loop” in the flex conduit at the detector to allow removal disconnecting the wiring. Note: The terminal screws in the detector head are M4x0.7 metric screws.

The ZP sensor and the **BurnerMate Universal** option board are factory calibrated as a matched pair. The sensor and option board are marked with the same serial number. Install and wire the ZP Sensor and the **BurnerMate Universal** as a matched pair.

Periodic O2 Cell Calibration

Due to the excellent stability of the detector, there is very little drift even over long periods of time. Six to twelve month calibration checks are normal for natural gas and #2 diesel fuel oil fired units. Fuels with high sulfur, heavy metals or other contaminants should be checked every three to nine months.

The main indicator for the need for re-calibration is cell Impedance. Note and record the cell impedance during start-up and after each re-calibration. Re-calibrate again after cell impedance increases another 100-200 ohms.

The ZP oxygen sensor can be checked or calibrated without being removed from the stack, and without shutting down the burner. To check for proper operation, simply apply a known concentration test gas at 2-3 SCFH (at 1-5 psig) to the ¼" compression fitting at the bottom of the ZP detector.

A single test gas can be used to check the operation of the ZP sensor and **BurnerMate Universal**.

Note: ZP oxygen probes are calibrated at the factory. For initial BMU start-ups, or adding a ZP oxygen probe to an existing **BurnerMate Universal** installation, the user only needs to enter the values shown on the calibration data tag into parameters **P2.4.9** to **P2.4.12**.

The procedure shown below is for field calibration using calibration gases. This is done in the field as required (every 6-12 months). The user should check the calibration of the O2 cell by applying test gas to the probe every 6 months to determine if the ZP needs recalibration.

A calibration check is accomplished by applying low range calibration gas (with a known % oxygen concentration) to the ZP probe, doing a reasonableness test, saving the low range cell mV, then applying a high range calibration gas to the ZP Probe, doing a reasonableness test, saving the high range cell mV, saving the cell temperature, and then calculating two probe calibration coefficients.

Note: the low range calibration gas must be between 0.300% and 3.000% oxygen mixed with dry nitrogen. 1-2% is typical for combustion applications. The high range calibration gas must be between 7.000% and 19.000% oxygen mixed with dry nitrogen. 8% is typical for combustion applications, 18% for FGR ratio (Flue Gas Recirculation) applications.
Calibration test gas that is tested and certified to be within +/- 2% of labeled oxygen concentration can be obtained from Preferred Instruments (203) 743-6741.

If a calibration check indicates the O2 cell requires calibration, oxygen cell calibration is initiated from the **Utilities** submenu on the LCD touch pad. The touch pad will prompt the user through the calibration steps.

The calibration can be aborted at ANY step by pressing the EXIT button.

The calibration can be aborted at ANY step if any oxygen hardware faults occur.

During calibration, the low oxygen lockout option is bypassed and the oxygen trim option is bypassed.

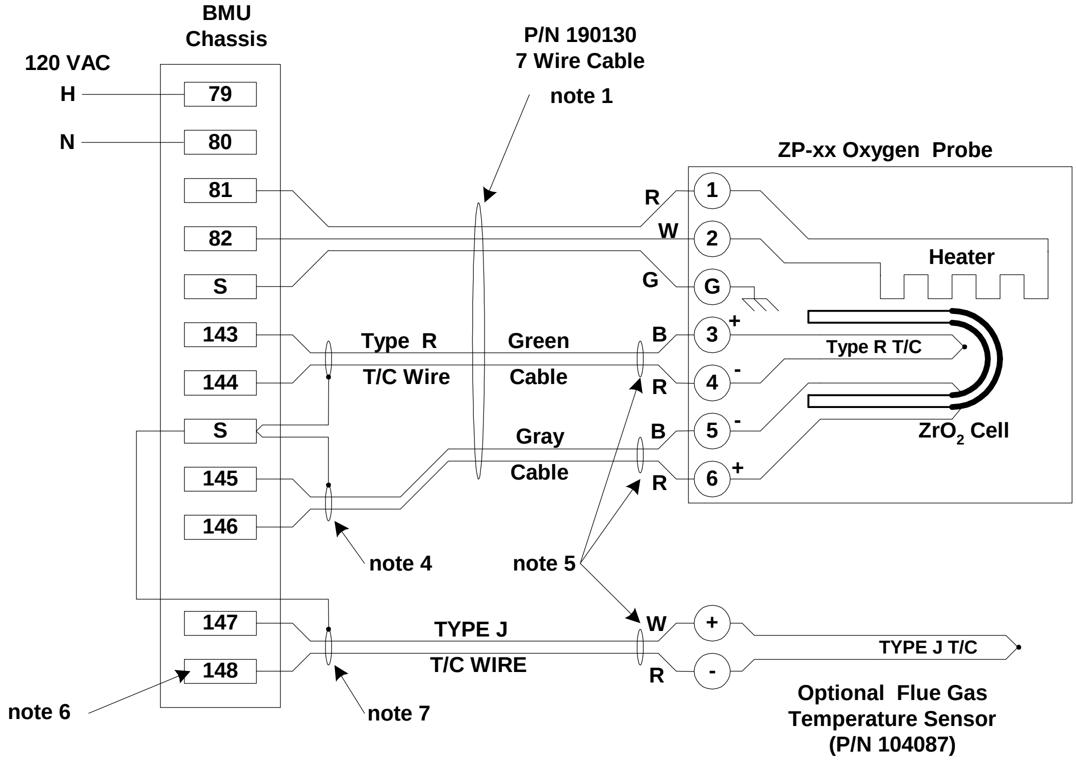
Oxygen calibration can only be initiated if the **BurnerMate Universal** is in Commission Mode.

O2 Probe Calibration Error Messages:

ERROR: Cell mV was too High. Press EXIT	The cal gas O2 content was too low; the cal gas contains combustibles, or cell wiring partially open.
ERROR: Cell mV was too Low. Press EXIT	The cal gas O2 content was too high, cal gas flow was too low, outer filter is cracked and cal gas is escaping, or ambient air is leaking into O2 cell.
ERROR: New Offset is Out of Range. Press EXIT	Cal gas O2 content is different than expected according to parameters **P2.4.7** and **P2.4.8**. Check cal gas O2 content. O2 cell may be old or damaged.
ERROR: New Slope is Out of Range. Press EXIT	Cal gas O2 content is different than expected according to parameters **P2.4.7** and **P2.4.8**. Check cal gas O2 content. O2 cell may be old or damaged.
ERROR: O2 Cell T/C or wiring: Open Circuit	Check O2 cell thermocouple field wiring and detector for an open circuit.
ERROR: O2 Cell T/C or wiring: Open Circuit, Press EXIT	Check O2 cell thermocouple field wiring and detector for an open circuit.
ERROR: O2 Cell T/C Short, Heater Open, or Vac Open	Check O2 cell thermocouple field wiring.
ERROR: O2 Cell T/C Short, Heater Open, or Vac Open, Press EXIT	Check O2 cell thermocouple field wiring.
ERROR: O2 Cell T/C wiring Reversed	Check O2 cell thermocouple field wiring.
ERROR: O2 Cell T/C wiring Reversed, Press EXIT	Check O2 cell thermocouple field wiring.
ERROR: O2 Cell Temp Abnormal	The O2 cell temperature drifted out of range during calibration cycle. Check O2 probe wiring, check for 120 VAC line noise.
ERROR: O2 Cell Temp Abnormal, Press EXIT	The O2 cell temperature drifted out of range during calibration cycle. Check O2 probe wiring, check for 120 VAC line noise.
ERROR: O2 Cell Temp Too High	The O2 cell temperature drifted too high during calibration cycle. Check O2 probe wiring, check for 120 VAC line noise.
ERROR: O2 Cell Temp Too High, Press EXIT	The O2 cell temperature drifted too high during calibration cycle. Check O2 probe wiring, check for 120 VAC line noise.
ERROR: O2 Impedance Relay Stuck Closed	If O2 cell is more than 2 years old, replace detector assembly. If cell is new, check for wiring loose connections.
ERROR: O2 Impedance Relay Stuck Closed, Press EXIT	If O2 cell is more than 2 years old, replace detector assembly. If cell is new, check for wiring loose connections.

O2 Probe Calibration Error Messages:

O2 Calibration Data Bad	
O2 Cell Not at Temperature	Wait for O2 cell temperature to warm-up to 800 deg. C. This should take no more than 15 minutes.
O2 Cell Open or Combustibles	O2 cell voltage input is greater than 130 mV. If O2 cell is cold, wait for it to warm up. Check cell field wiring and detector for an open circuit. This message will appear if combustibles are present in the stack gas.
O2 Cell T/C Cold Junction Sensor Error	
O2 Impedance Relay Malfunction	
O2 Test Relay Error	
WARNING: Cal Gas % differs from O2OldCalData % by more than 0.75%. Press YES to Proceed, or EXIT	Warning appears if the calibration gas O2 concentration is different than the calibration gas set point input to the **BurnerMate Universal**. This may be normal if a new cal gas bottle with different O2 concentration is being used.
WARNING: Low O2 Lockout and O2 Trim are Bypassed during Calibration. YES=Continue, EXIT=Abort	Warning appears to remind the technician O2 trim and low O2 alarm are disabled during O2 probe calibration.



Notes:

1. Run all wires in one conduit. 500 ft. maximum wiring length – avoid splices. Use only Preferred Instruments P/N 190130 cable between the ZP Detector and the **BurnerMate Universal**. The twisted shielded Cell and T/C wire with twisted AC wiring prevents electrical noise.
   Multiple ZP cables may be run in one conduit.
   Flue gas temperature wire can be in this conduit, if shielded T/C wire is used.
   Do not include any other AC or DC wires in this conduit.
   3/4" conduit or larger is required for one 190130 cable.
2. Connect terminals 79 and 80 to 120 VAC power when installing ZP probe. Must be same phase as BMU power.
3. The BMU shield terminals are internally grounded.
4. Connect shields to "S". Insulate shields to prevent shorts to the case or other shields
5. Do not connect shields at the sensor. Insulate shields to prevent shorts to the case or other shields.
6. Flue Gas Temperature (FGT) Sensor is optional, **Jumper Input if not used**.
7. Shielded cable is not required if run in conduits that do not have: ZP probe wires, AC wires, or noisy DC wiring.

Handling, Operation, and Maintenance

Handling Precautions

CAUTION

The ZP flange and tip external surface temperatures approach 200 °F when outside the stack or duct. When installed, Flue gas temperatures can substantially increase the ZP surface temperatures. Always wear protective gloves to avoid burns.

The zirconium cell, cell heater, and dust filters are ceramic and can be damaged if dropped.

Do not drop the ZP Sensor assembly or ZP detector – package with cushion before shipping.

Liquid water should not be allowed to come in contact with the cell. Water vapor is not a concern.

Liquid water that contacts a hot cell or heater can crack the element and destroy it.

Calibration gas must be dry and tubing must slope down to prevent trapping condensation.

Condensation can cause water drops – observe start-up shutdown procedures below.

Operation

Internally, the cell and heater operate at 800 °C (~1470 F). The system should remain powered up whenever possible. The heater uses less than 70 Watts (typically 40-50 W). Do not subject the detector to excessive heat-up and cool-down cycles. If the burner cycles more than once per day, the ZP should not be routinely powered-up and down every time the burner cycles on and off.

Flue gas contains a substantial percentage of water vapor. Avoid water condensation in the detector. If the detector is hotter or the same temperature as the flue gas, the water vapor can not condense.

Boiler Start-up and Shut-down:

If the ZP is kept in the stack, powered up, and kept at operating temperature, the burner can be started and stopped at any time without affecting the ZP. Because the cell is at 800 °C, water will not condense inside the ZP detector.

Insertion into a Hot Stack or Duct:

If a room temperature ZP is inserted into hot stack or duct, the “cold” metal of the ZP can condense the flue gas water vapor and form liquid water droplets inside the cell or heater. This can damage or corrode the ZP internals.

Before inserting a ZP into a hot stack or duct, power-up the ZP and allow it to reach operating temperature, and then insert it into the stack.

CAUTION

The ZP flange and tip external surface temperatures approach 200 °F. Always wear protective gloves to avoid burns.

Powering-Down a ZP:

If both the Boiler and the ZP are being shut down: Shut down the boiler first, and keep the ZP powered until after the temperature inside the stack or duct has cooled down to it's lowest normal off-line temperature.

If the boiler is going to remain in operation, or if you can't wait for the stack to cool down: Leaving the ZP probe in the stack, cautiously remove ZP Detector from the probe flange with gloved hands and expose it to room air, and then power-down the ZP. If the duct pressure is positive, a cover plate and should be used to prevent flue gas flow through the open hole in the probe flange after the detector is removed.

Maintenance

See the calibration section above for suggested calibration frequency.

WARNING

The **BurnerMate Universal** O2 Trim system must be disabled, bypassed or placed in Manual by a qualified control system technician before removing the ZP detector from the stack or duct. Failure to do so could result in equipment damage, injury, or death.

CAUTION

The ZP flange and tip external surface temperatures approach 200 °F when outside the stack or duct. When installed, flue gas temperatures can substantially increase the ZP surface temperatures. Always wear protective gloves to avoid burns.

Inspect and Clean the Detector Filter and the Probe

Fuel Type:	Frequency:
Solid Fuels and #6 oil	every 3 months
#2 oil and off-gasses	every 6 months
Natural Gas	every 12 months

Cleaning the Detector and Probe

Leaving the ZP probe in the stack, cautiously remove ZP detector from the probe flange with gloved hands and expose it to room air, and then power-down the ZP. If the duct pressure is positive, a cover plate and should be used to prevent flue gas flow through the open hole in the probe flange after the detector is removed.

Using clean, dry, compressed air or nitrogen, blow air gently across the face of the filter at a 20-degree angle. Caution: Water in the air can damage filter.

Using compressed air connected to a long tube, blow any dust inside the ZP probe duct into the stack or duct.

Changing Filter

If the filter is clogged with dust, replace it with a spare filter. The filter assembly can be removed by turning it counter clockwise with a wrench.

Trouble Shooting

ZP "Wet" Measurement vs. "Dry" Measurements
The most common "problem" encountered is that the ZP "% Oxygen" does not match the "% Oxygen" measured by a portable or extractive Oxygen Analyzer. This is normal and the two measurements should NOT be the same.

Wet Measurement (ZP): The ZP Detector Cell is located inside the Flue Gas and measures Oxygen as a percentage of all of the total flue gas component gasses (O_2, N_2, CO_2, CO, H_20). This is known as a "Wet" oxygen measurement, because the water vapor occupies a substantial percentage of the total volume of the flue gas.

Dry Measurement (Portable & Extractive): A portable oxygen analyzer or an EPA CEM oxygen analyzer extracts a sample of the flue gas from the duct and transports it to a measurement device that is located outside of the duct. Since the temperature of the connecting tubing and/or the external measurement cell is below the dew point (that is, condensation temperature) of the water vapor in the flue gas sample, the water vapor in the flue gas condenses.

This is known as a "Dry" oxygen measurement, because the condensed water occupies a negligible percentage of the total volume of the flue gas. Effectively, a portable or other extractive ("Dry") oxygen analyzer measures Oxygen as a percentage of all of the "Dry" flue gas component gasses (O_2, N_2, CO_2, CO). Therefore, a "Dry" % Oxygen measurement will always be higher than a "Wet" % Oxygen measurement of the same flue gas.

Approximate Correction Factors:

Natural Gas:	Wet = 0.888 * Dry	OR	Dry = 1.125 * Wet
#2 thru #6 oils:	Wet = 0.930 * Dry	OR	Dry = 1.075 * Wet

Coal, wood, and solid fuels vary widely based on the moisture content of the fuel as burned.

Trouble Shooting

Normal Operating Values:
The Values below are approximate and provided for trouble shooting purposes. The values for each individual ZP sensor will vary somewhat. See page 9 for the wiring terminal numbers.

Cell Thermocouple (type R): 7.8 – 8.0 mV
Cell Heater: 45 – 55 ohms
Cell mV for various Oxygen Concentrations are shown below:

% Oxygen	Cell mV	% Oxygen	Cell mV
0.01	168.15	6.5	25.42
0.05	132.68	7.0	23.79
0.1	117.41	7.5	22.27
0.5	81.94	8.0	20.84
1.0	66.67	9.0	18.25
1.2	62.65	10.0	15.93
1.4	59.25	11.0	13.83
1.5	57.73	12.0	11.91
1.6	56.31	13.0	10.14
1.8	53.71	14.0	8.511
2.0	51.39	15.0	6.991
2.2	49.29	16.0	5.569
2.4	47.37	17.0	4.233
2.6	45.61	18.0	2.973
2.8	43.98	19.0	1.782
3.0	42.46	20.0	0.651
3.5	39.06	20.6	0.0
4.0	36.12	21.0	-0.4238
4.5	33.52	22.0	-1.449
5.0	31.20	23.0	-2.428
5.5	29.10	24.0	-3.366
6.0	27.18	25.0	-4.266

Trouble Shooting

Slow Response Time:
Check for excessive dirt on detector filter, or inside the probe.
As the cell approaches the end of it's life, the cell Impedance increase toward 1100 ohms and the cell response time becomes longer.

Reading is Lower than Expected:
See "Wet" verses "Dry" measurement discussion above.

Check for CO or combustibles in the flue gas. CO or combustibles will oxidize on the internal surface of the cell. This consumes the Oxygen locally within the Detector, and causes a low reading.

Check with a certified calibration gas.

Check to see if the filter is dirty or blocked.

Check for detector leaks – see page 21.

Reading is Higher than Expected:
It is important to remember that the cell makes a differential measurement. That is, the cell compares the unknown oxygen percentage in the flue gas against the "known" oxygen percentage in the ambient air inside the cell. Ambient air is typically 20.6% oxygen; however, it can range from 19.5% to 20.9% as relative humidity and temperature change.

If the flue gas duct is pressurized, and a duct leak allows flue gas to enter the detector head, the ambient oxygen percentage can be substantially lower. Combustible gasses in the ambient air will consume the oxygen on surface of the cell and will also lower the percent oxygen in the ambient air inside the cell.

<u>If the ambient oxygen percentage inside the cell is low, a Zirconium cell will sense a lower differential and will cause the analyzer to indicate a higher oxygen level than is actually in the flue gas.</u>

<u>If the ceramic Cell is dropped and cracks, the measured flue gas and ambient air will intermingle and the oxygen percentage on both sides of the cell will equalize. A zirconium cell will sense a lower differential and will cause the analyzer to indicate a higher oxygen level than is actually in the flue gas.</u>

See "Wet" verses "Dry" measurement discussion on page 17.

Check with a certified calibration gas.

Verify that the calibration gas port and tubing are plugged or the valve is closed during operation to prevent infiltration of air.

Check to see if the filter is dirty or blocked.

Check for detector leaks – see page 21.

Trouble Shooting

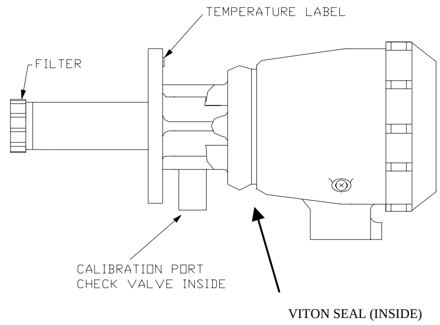
Cell will not Come up to Operating Temperature:
Check the AC line voltage, must be 60 Hz and greater than 102 volts.

Check the AC line voltage for excessive electrical noise.

Low Calibration Gas Flow Rate:
Disconnect the tubing at the calibration port on the detector. Verify that the gas is flowing up to the detector.

If the detector flange is overheated, the elastomer calibration gas check valve may become stuck shut. Use a toothpick or paper clip to gently push open the check valve. See the figure on the next page for the location of the check valve.

Trouble Shooting



Detector Leak Test:
If the cell is cracked or broken, flue gas can leak into the reference side of the cell and cause an incorrect reading. If the Viton seal between the cell tube extension and the detector head is overheated it can leak and cause an incorrect reading. See “Oxygen Sensor – Measuring Principle” above for a drawing and for the principle of operation.

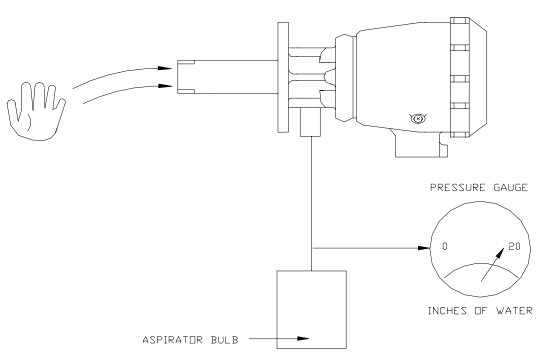
Test for leaks as follows:
Turn off power and remove the detector from the process. Wait for the detector to cool down. Remove the outer filter and the inner calibration gas deflector washer.

Insert small paper clip or toothpick into the check valve, to hold it open during the test (remove after testing). Using a rubber sheet or the palm of your hand to seal the end of threaded tube, pressurize the calibration port to 10-15" H_2O. The detector should hold pressure. If the pressure rapidly drops to zero, the cell is broken, replace the detector.

All detectors are inspected and pressure tested before shipment. The reason for the broken cell could be:

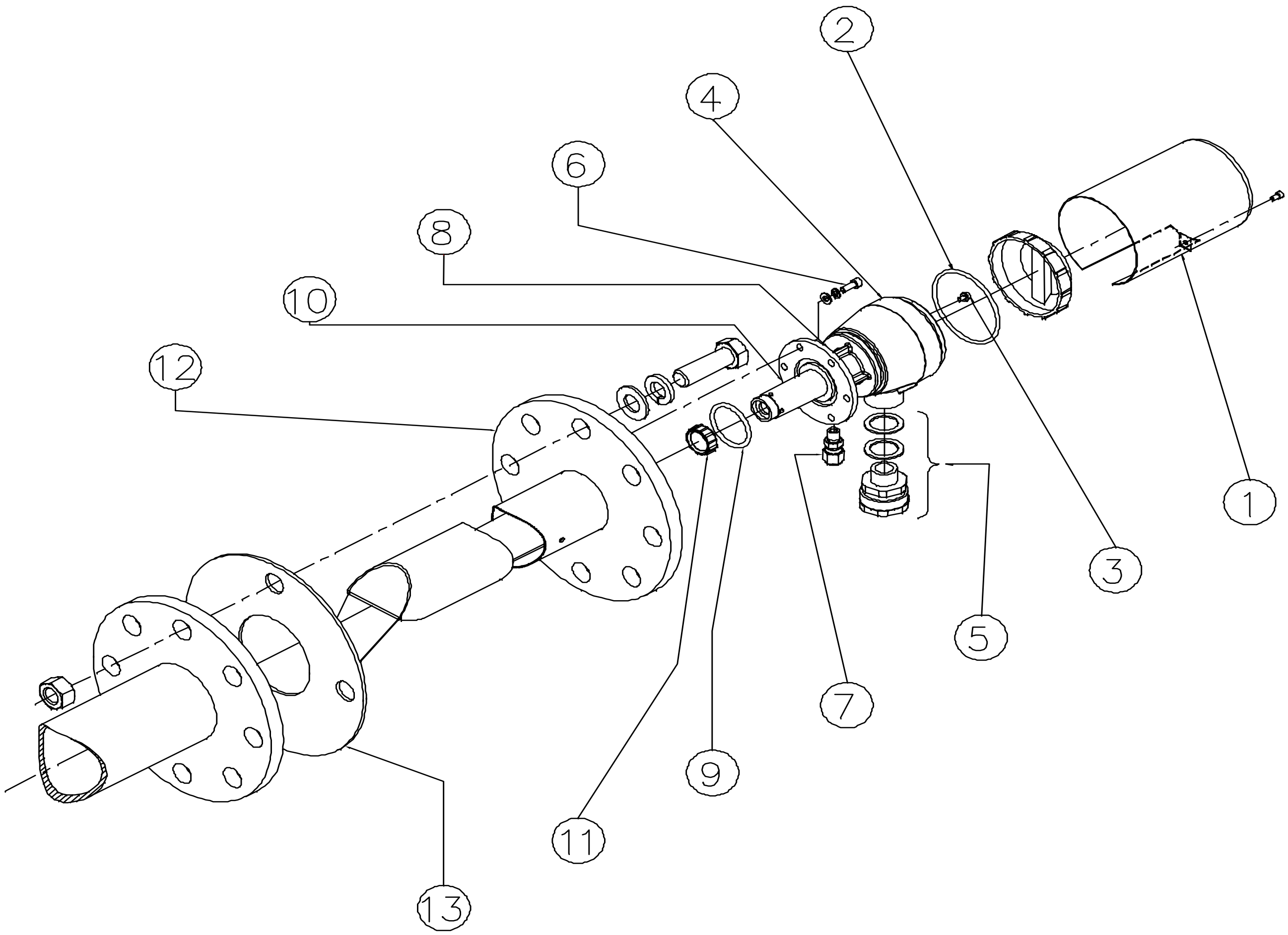
a) Dropped during shipping, receiving or installation
b) Hit with liquid water when hot. (Damage by liquid water can be caused by water in the calibration line or blow down line if a self-cleaning probe is used).

If unit leaks slowly, inspect the temperature label. If black, the detector has been overheated and the Viton seal is leaking. Replace detector, or return it to the factory for replacement.



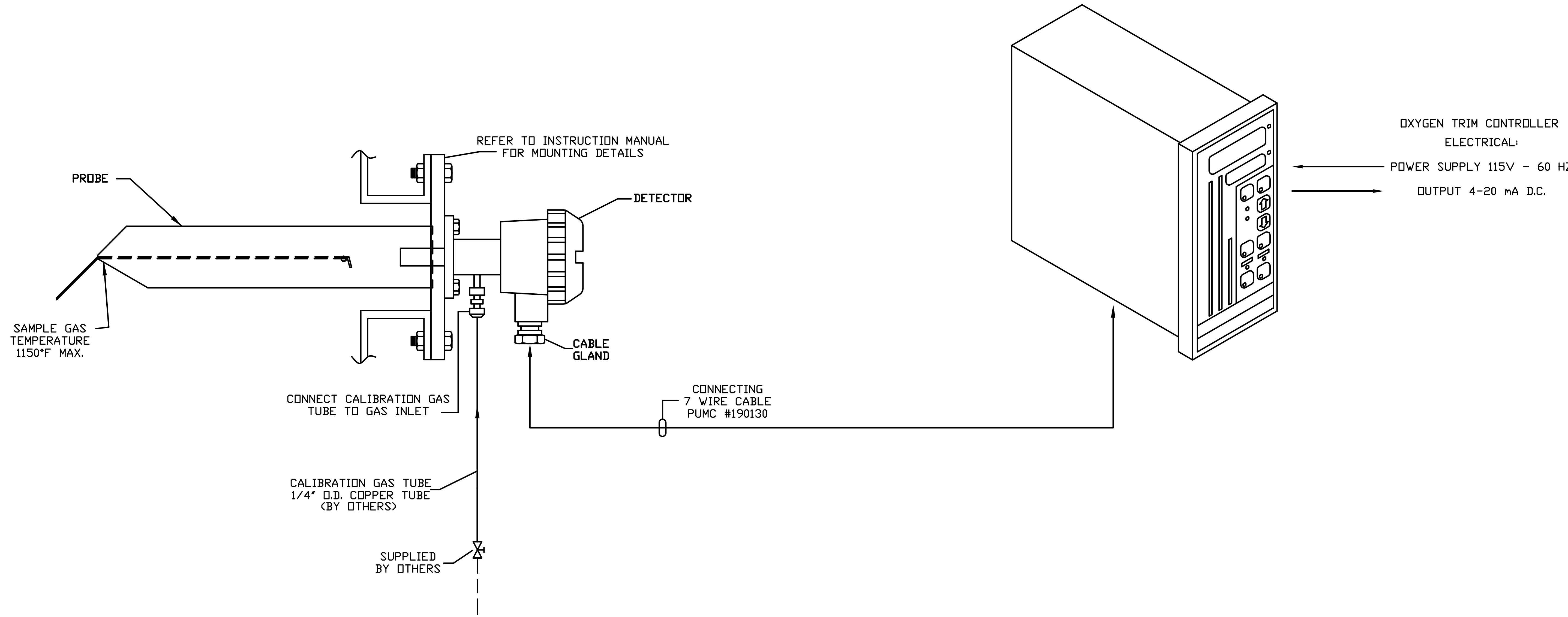
Parts

(Contact your local representative for price and availability)



Oxygen Sensor Exploded View

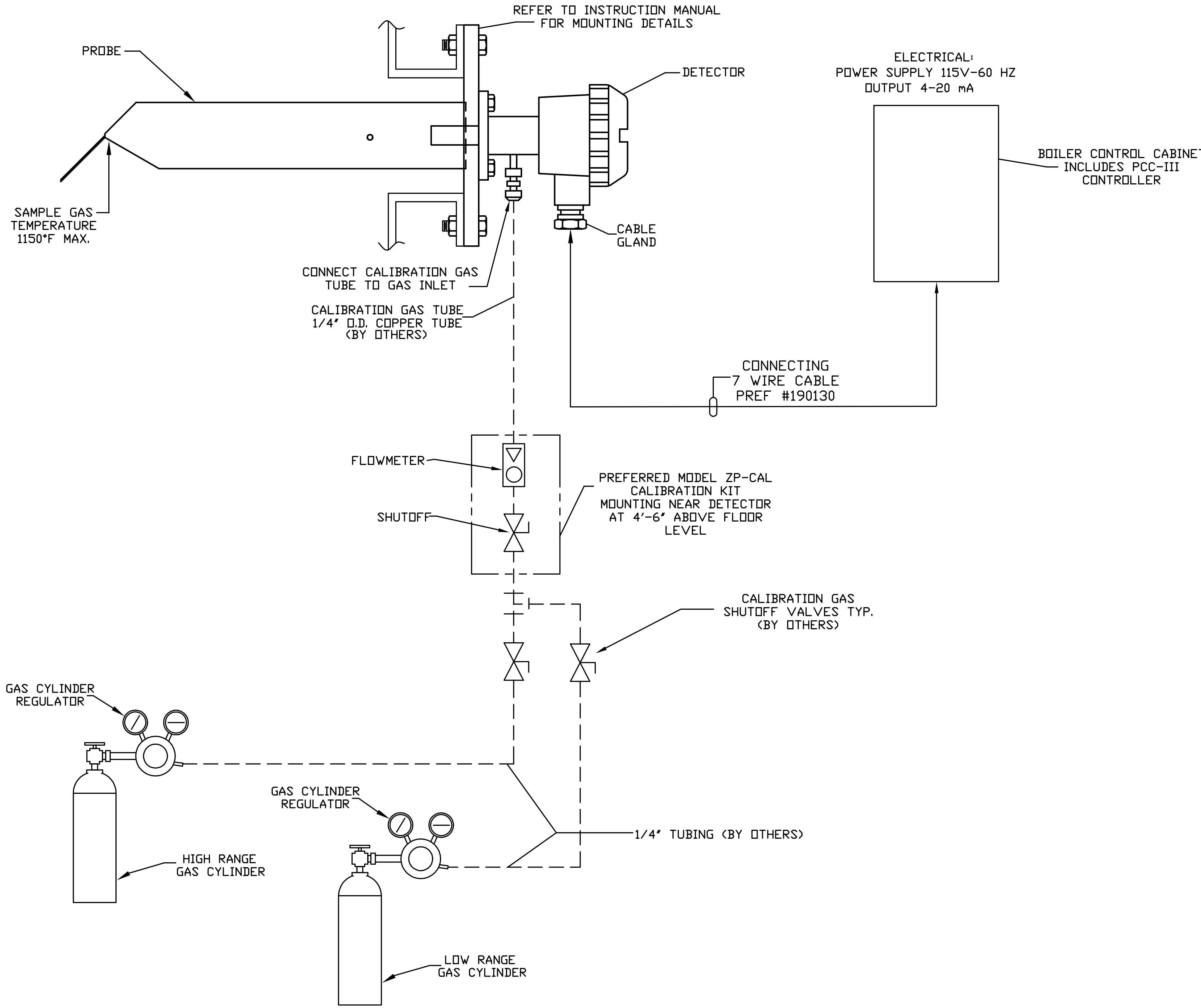
Item #	Description
1	Rainproof Detector Cover (Optional)
2	O-Ring for Detector Cover
3	Terminal Screw (M4x0.7 metric thread)
4	Detector
5	Cable Conduit Gland
6	Socket Head Cap Screw, 10-32, SS
7	Calibration Gas Port
8	Temperature Sensitive Label (260 deg F)
9	O-Ring for Detector Flange
10	Replacement Cell with Heater and Thermocouple
11	Filter Assembly
12	Oxygen Probe
13	Full Faced, 4 Bolt, 125#, 3” Flange Gasket



PREFERRED INSTRUMENTS
31-35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Manufacturing Corp

OXYGEN ANALYZER
CONNECTION DETAILS

				MODEL:	SIZE:	TYPE:
				SUPERSEDES:	ASS'Y NO:	
				MATERIAL:	SCALE: NONE	
				DRAWN: JMC 9/13/01	SDW-1812	
FILE # S1812	LET.	REVISIONS	DATE OF CHANGE	APPR'D:		



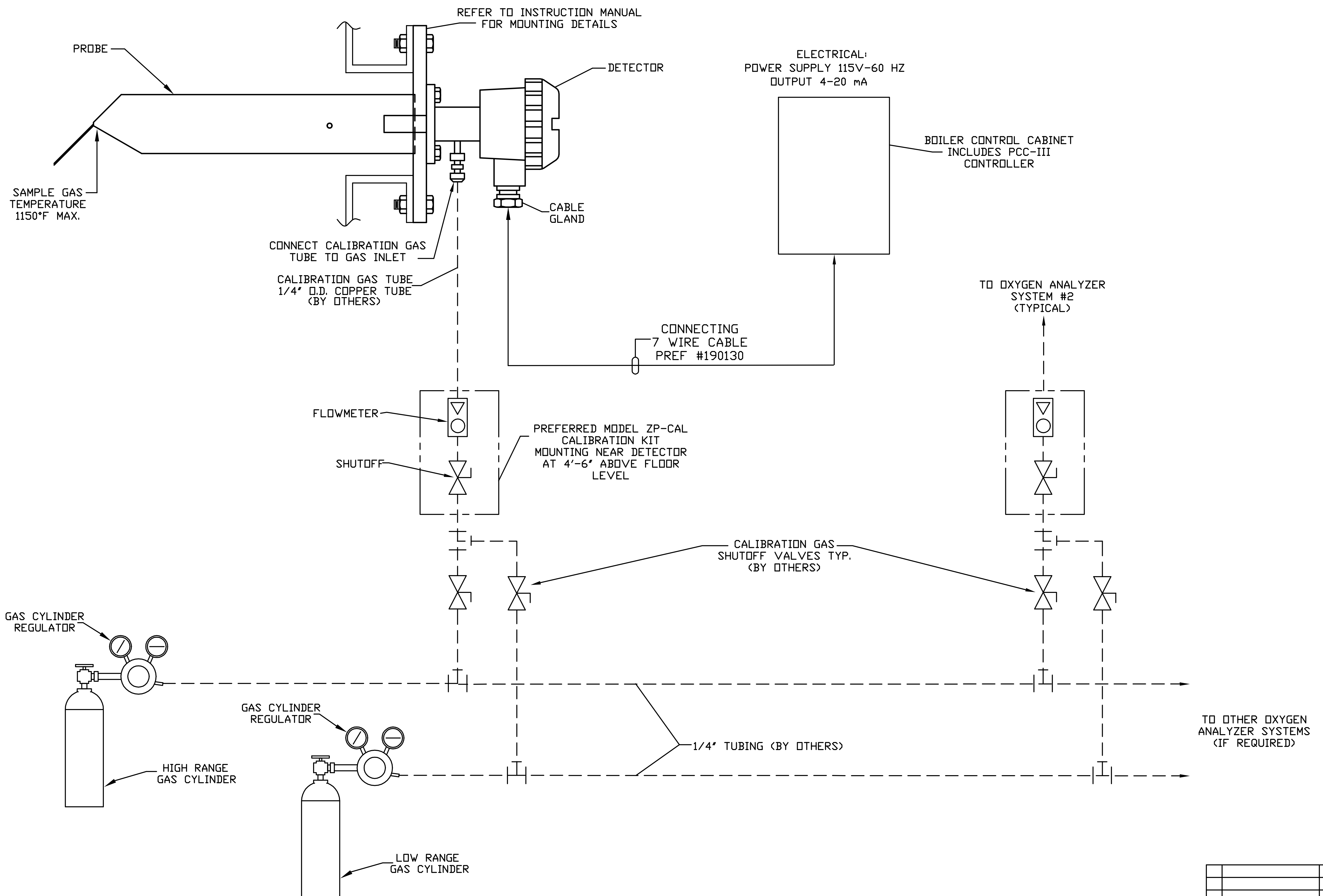
PREFERRED INSTRUMENTS
31-35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Manufacturing Corp

OXYGEN ANALYZER WITH
CALIBRATION GAS

MODEL:	SIZE:	TYPE:	
SUPERSEDES:		ASS'Y NO:	
MATERIAL:		SCALE:	NONE
DRAWN: JMC 9/20/01		SDW-1812-1	
APPR'D:			

LET.	REVISIONS	DATE OF CHANGE

FILE # S18121



PREFERRED INSTRUMENTS
31-35 SOUTH STREET
DANBURY, CONNECTICUT
A Division of Preferred Utilities Manufacturing Corp

OXYGEN ANALYZER WITH
HEADER CALIBRATION GAS

MODEL:	SIZE:		TYPE:
SUPERSEDES:		ASS'Y NO:	
MATERIAL:		SCALE: NONE	
DRAWN: JMC 7/9/01		SDW-1812-4	
APPR'D:			

LET.	REVISIONS	DATE OF CHANGE

FILE # S1812A

Section 8 Index

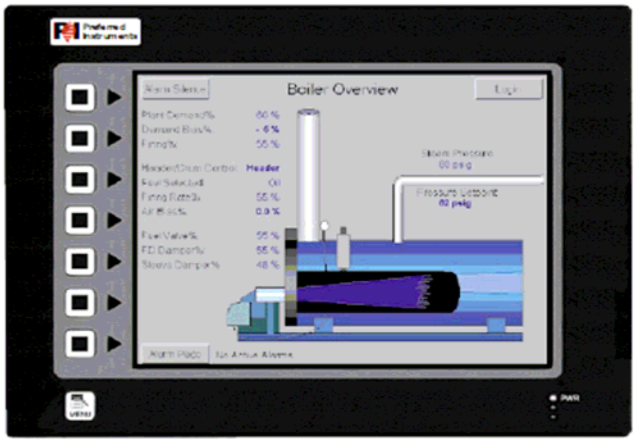
Notes:

Preferred Instruments

Tel +1 (203) 743-6741
Fax +1 (203) 798-7313
www.preferredinstruments.com

Bulletin No. SDI-OIT10
Released 05/05

MODEL OIT10 - GRAPHIC LCD OPERATOR INTERFACE TERMINAL WITH VGA DISPLAY AND TOUCHSCREEN



- *Up to 5 **RS-232/422/485 communications ports** (2 RS-232 and 1 RS-422/485 on board, 1 RS-232 and 1 RS422/485 on optional communications card)*
- ***10 Base T/100 Base-TX Ethernet Port** to network units and host web pages*
- ***Unit's configuration is stored in non-volatile memory** (8Mbyte Flash)*
- ***CompactFlash® Socket** to increase memory capacity*
- ***10.4-inch TFT 256 Color VGA 640x480 pixel LCD***
- ***Sunlight Visible Outdoor Unit with UV rated overlay available***
- ***8-button keypad** for on-screen menus*
- ***Three user programmable front panel LEDs***
- ***Power unit from 24VDC ±20% supply***
- ***Resistive Analog Touchscreen***

GENERAL DESCRIPTION

The Operator Interface Terminal (OIT) is built around a high performance core with integrated functionality. The OIT is able to communicate with many different types of hardware using high-speed RS232/422/485 communications ports and Ethernet 10 Base T/100 Base-TX communications. A CompactFlash socket is provided so that Flash cards can be used to collect your trending and data logging information as well as to store larger configuration files.

In addition to accessing and controlling of external resources, the OIT allows a user to easily view and enter information. A sunlight visible outdoor version is available for direct sunlight applications. Users can enter data through the touchscreen or front panel 8-button keypad. The three front panel LEDs can be programmed to indicate specific conditions.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the controller to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the controller.

The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.

CAUTION: Read complete instructions prior to installation and operation of the unit.	CAUTION: Risk of electric shock.

CompactFlash is a registered trademark of CompactFlash Association.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
OIT10	Operator Interface for indoor applications only, textured finish with embossed keys	90280
	Operator Interface for indoor or outdoor applications, glossy finish with UV rated overlay (keys are not embossed)	90281
	256 MB CompactFlash Card	90282
	512 MB CompactFlash Card	90283
	Optional Communications Cards [1]	90284
	90280 Backlight Replacement	90285
	90281 Backlight Replacement	90286
	Replacement Battery[2]	90287

[1] Contact your Preferred Instruments distributor for complete selection.
[2] Battery type is lithium coin type CR2025.

SPECIFICATIONS

1. **POWER REQUIREMENTS**:
   90280: +24 VDC ±20% @ 33 W maximum.
   90281: +24 VDC ±20% @ 50 W maximum.
   Must use Class 2 or SELV rated power supply.
   Power connection via removable three position terminal block.
   Notes:
   1. *The front panel PWR LED indicates power unless configured otherwise.*
   2. *The OIT10's circuit common is not connected to the enclosure of the unit. See "Connecting to Earth Ground" in the section "Installing and Powering the OIT10."*
2. **BATTERY**: Lithium coin cell. Typical lifetime of 10 years.
3. **LCD MODULE DISPLAYS**:

MODEL	90280	90281
SIZE	10.4-inch	10.4-inch
TYPE	TFT	TFT
COLORS	256 VGA	256 VGA
PIXELS	640 X 480	640 X 480
BRIGHTNESS	350 cd/m^2	850 cd/m^2
BACKLIGHT*	50,000 HR TYP.	20,000 HR TYP.

*Lifetime at room temperature. Refer to "Display" in the "Unit Operation" section.

4. **8-KEY KEYPAD**: for on-screen menus.
5. **TOUCHSCREEN**: Resistive analog
6. **MEMORY**:
   On Board User Memory: 8 Mbyte of onboard non-volatile Flash memory.
   Memory Card: CompactFlash Type II slot for Type I and Type II CompactFlash cards.
7. **COMMUNICATIONS**:
   USB Port: Adheres to USB specification 1.1. Device only using Type B connection.
   Serial Ports: Format and Baud Rates for each port are individually software programmable up to 115,200 baud.
   PGM Port: RS232 port via RJ12.
   COMMS Ports: RS422/485 port via RJ45, and RS232 port via RJ12.
   DH485 TXEN: Transmit enable; open collector, V_{OH} = 15 VDC, V_{OL} = 0.5 V @ 25 mA max.
   Note: For additional information on the communications or signal common and connections to earth ground please see the "Connecting to Earth Ground" in the section "Installing and Powering the G310."
   Ethernet Port: 10 BASE-T / 100 BASE-TX
   RJ45 jack is wired as a NIC (Network Interface Card).
8. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: 0 to 50°C
   Storage Temperature Range: 90280: -20 to 70°C
   90281: -20 to 60°C
   Operating and Storage Humidity: 80% maximum relative humidity (non-condensing) from 0 to 50°C.
   Altitude: Up to 2000 meters.
9. **CERTIFICATIONS AND COMPLIANCES**:
   SAFETY
   IEC 1010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
   IP66 Enclosure rating (Face only), IEC 529
   Type 4X Enclosure rating (Face only), UL50
   ELECTROMAGNETIC COMPATIBILITY
   Emissions and Immunity to EN 61326: Electrical Equipment for Measurement,
   Immunity to Industrial Locations:

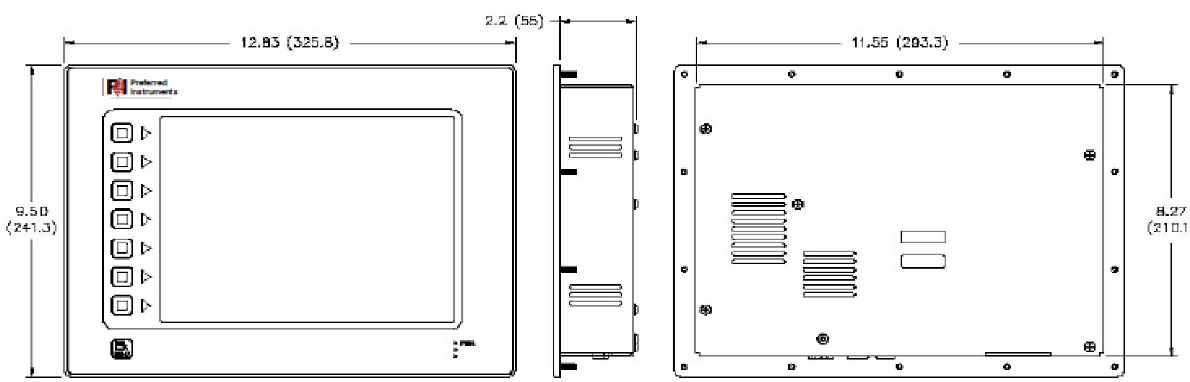
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power
RF conducted interference	EN 61000-4-6	Criterion B 3 V/rms

   Emissions:

Emissions	EN 55011	Class A

   Control and Laboratory use.
   Notes:
   1. *Criterion A: Normal operation within specified limits.*
   2. *Criterion B: Temporary loss of performance from which the unit self-recovers.*
10. **CONSTRUCTION**: Steel rear metal enclosure with NEMA 4X/IP66 aluminum front plate when correctly fitted with the gasket provided. Installation Category II, Pollution Degree 2.
11. **MOUNTING REQUIREMENTS**: Maximum panel thickness is 0.25" (6.3 mm). For NEMA 4X/IP66 sealing, a steel panel with a minimum thickness of 0.125" (3.17 mm) is recommended.
    Maximum Mounting Stud Torque: 17 inch-pounds (1.92 N-m)
12. **WEIGHT**: 5.53 lbs (2.51 Kg)

DIMENSIONS In inches (mm)

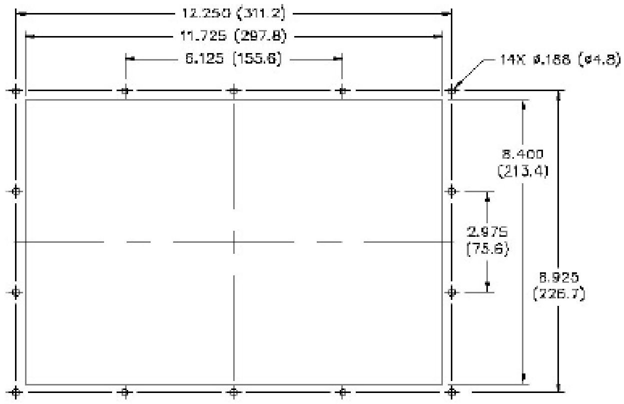


Installing and Powering the OIT10

MOUNTING INSTRUCTIONS

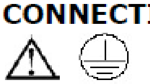
This operator interface is designed for through-panel mounting. A panel cut-out diagram and a template are provided. Care should be taken to remove any loose material from the mounting cut-out to prevent that material from falling into the operator interface during installation. A gasket is provided to enable sealing to NEMA 4X/IP66 specification. Install the 14 kep nuts provided and tighten evenly for uniform gasket compression.

Note: Tightening the kep nuts beyond a maximum of 17 inch-pounds (1.92 N-m) may cause damage to the front panel.



All tolerances ±0.010" (±0.25 mm).

CONNECTING TO EARTH GROUND



The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.

Each OIT10 has a chassis ground terminal on the back of the unit. Your unit should be connected to earth ground (protective earth).

The chassis ground is not connected to signal common of the unit. Maintaining isolation between earth ground and signal common is not required to operate your unit. But, other equipment connected to this unit may require isolation between signal common and earth ground. *To maintain isolation between signal common and earth ground care must be taken when connections are made to the unit.* For example, a power supply with isolation between its signal common and earth ground must be used. Also, plugging in a USB cable may connect signal common and earth ground.[1]

1. USB's shield may be connected to earth ground at the host. USB's shield in turn may also be connected to signal common.

POWER SUPPLY REQUIREMENTS

The 90280 requires a 24 VDC power supply rated at 33 W, and the 90281 requires a 24 VDC power supply rated at 50 W. Your unit may draw considerably less the rated power depending upon the options being used. As additional features are used your unit will draw increasing amounts of power. Items that could cause increases in current are additional communications, optional communications card, and CompactFlash card.

In any case, it is very important that the power supply is mounted correctly if the unit is to operate reliably. Please take care to observe the following points:

– The power supply must be mounted close to the unit, with usually not more than 6 feet (1.8 m) of cable between the supply and the operator interface. Ideally, the shortest length possible should be used.

– The wire used to connect the operator interface's power supply should be at least 22-gage wire. If a longer cable run is used, a heavier gage wire should be used. The routing of the cable should be kept away from large contactors, inverters, and other devices which may generate significant electrical noise.

– A power supply with a Class 2 or SELV rating is to be used. A Class 2 or SELV power supply provides isolation to accessible circuits from hazardous voltage levels generated by a mains power supply due to single faults. SELV is an acronym for "safety extra-low voltage." Safety extra-low voltage circuits shall exhibit voltages safe to touch both under normal operating conditions and after a single fault, such as a breakdown of a layer of basic insulation or after the failure of a single component has occurred.

Communicating With the OIT10

ETHERNET COMMUNICATIONS

Ethernet communications can be established at either 10 BASE-T or 100 BASE-TX. The OIT10 unit's RJ45 jack is wired as a NIC (Network Interface Card). For example, when wiring to a hub or switch use a straight-through cable, but when connecting to another NIC use a crossover cable.

The Ethernet connector contains two LEDs. A yellow LED in the upper right, and a bi-color green/amber LED in the upper left. The LEDs represent the following statuses:

LED COLOR	DESCRIPTION
YELLOW solid	Link established.
YELLOW flashing	Data being transferred.
GREEN	10 BASE-T Communications
AMBER	100 BASE-TX Communications

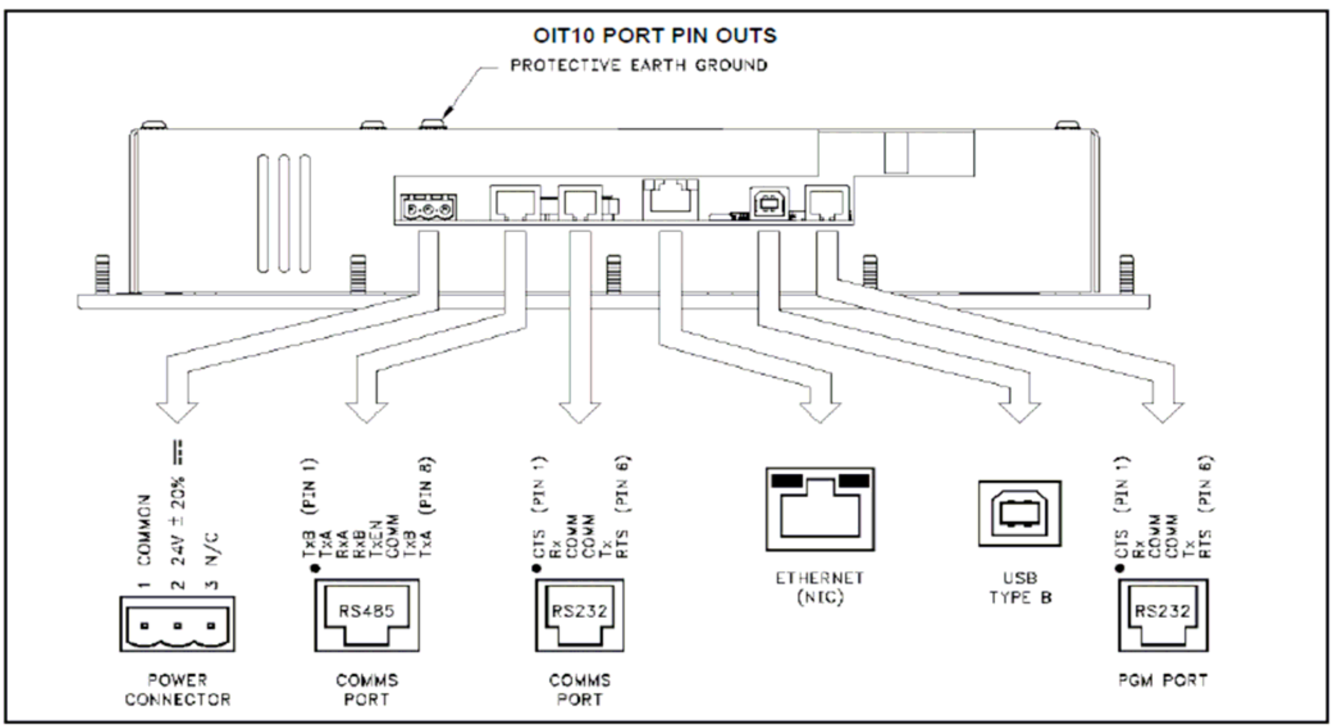
RS232 PORTS

The OIT has two RS232 ports. There is the PGM port and the COMMS port. Although only one of these ports can be used for programming, both ports can be used for communications with a controller.

Examples of RS232 communications could involve another Preferred product or a PC. By using a cable with RJ12 ends on it, and a twist in the cable, RS232 communications with another controller can be established.

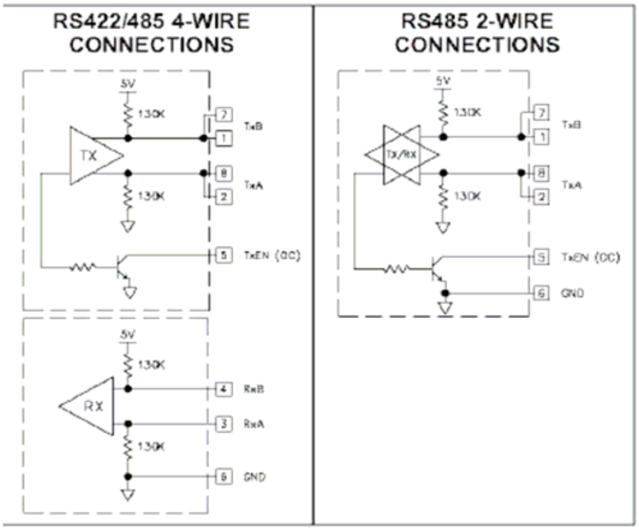
OIT RS232 to a PC

Connections			
OIT: RJ12	Name	PC: DB9	Name
4	COMM	1	DCD
5	Tx	2	Rx
2	Rx	3	Tx
	N/C	4	DTR
3	COM	5	GND
	N/C	6	DSR
1	CTS	7	RTS
6	RTS	8	CTS
	N/C	9	RI



RS422/485 COMMS PORT

The OIT10 has one RS422/485 port. This port can be configured to act as either RS422 or RS485.



DH485 COMMUNICATIONS

The OIT10's RS422/485 COMMS port can also be used for Allen Bradley DH485 communications.

WARNING: **DO NOT** use a standard DH485 cable to connect this port to Allen Bradley equipment. A cable and wiring diagram are available from Preferred Instruments.

OIT to AB SLC 500 (CBLAB003)

Connections			
RJ45: OIT	Name	RJ45: A-B	Name
1	TxB	1	A
2	TxA	2	B
3, 8	RxA	-	24V
4, 7	RxB	-	COMM
5	TxEN	5	TxEN
6	COMM	4	SHIELD
4, 7	TxB	-	COMM
3, 8	TxA	-	24V

Unit Operation

DISPLAY

This operator interface uses a liquid crystal display (LCD) for displaying text and graphics. The display utilizes a cold cathode fluorescent tube (CCFL) for lighting the display. The CCFL tubes can be dimmed for low light conditions.

These CCFL tubes have a limited lifetime. Backlight lifetime is based upon the amount of time the display is turned on at full intensity. Turning the backlight off when the display is not in use can extend the lifetime of your backlight. This can be accomplished through the Crimson software when configuring your unit.

FRONT PANEL LEDS

There are three front panel LEDs. Shown below is the default status of the LEDs.

LED	INDICATION
RED (TOP, LABELED "PWR")	
FLASHING	Unit is in the boot loader, no valid configuration is loaded.[1]
STEADY	Unit is powered and running an application.
YELLOW (MIDDLE)	
OFF	No CompactFlash card is present.
STEADY	Valid CompactFlash card present.
FLASHING RAPIDLY	CompactFlash card being checked.
FLICKERING	Unit is writing to the CompactFlash, either because it is storing data, or because the PC connected via the USB port has locked the drive.[2]
FLASHING SLOWLY	Incorrectly formatted CompactFlash card present.
GREEN (BOTTOM)	
FLASHING	A tag is in an alarm state.
STEADY	Valid configuration is loaded and there are no alarms present.

1. If the light remains in the flashing state continuously, try cycling power. If the LED still continues to flash, contact Preferred Instruments.
2. Do not turn off power to the unit while this light is flickering. The unit writes data in two minute intervals. Later Microsoft operating systems will not lock the drive unless they need to write data; Windows 98 may lock the drive any time it is mounted, thereby interfering with logging.

KEYPAD

The OIT10 keypad consists of eight keys for on-screen menus.

TOUCHSCREEN

This operator interface utilizes a resistive analog touchscreen for user input. The unit will only produce an audible tone (beep) when a touch on an active touchscreen cell in sensed. The touchscreen is fully functional as soon as the operator interface is initialized, and can be operated with gloved hands.

TROUBLESHOOTING YOUR OIT10

If for any reason you have trouble operating, connecting, or simply have questions concerning your new OIT10, contact Preferred's technical support. For contact information, refer to the back page of this bulletin for phone and fax numbers.

EMAIL: info@preferredinstruments.com
Web Site: http://www.preferredinstruments.com

BATTERY & TIME KEEPING

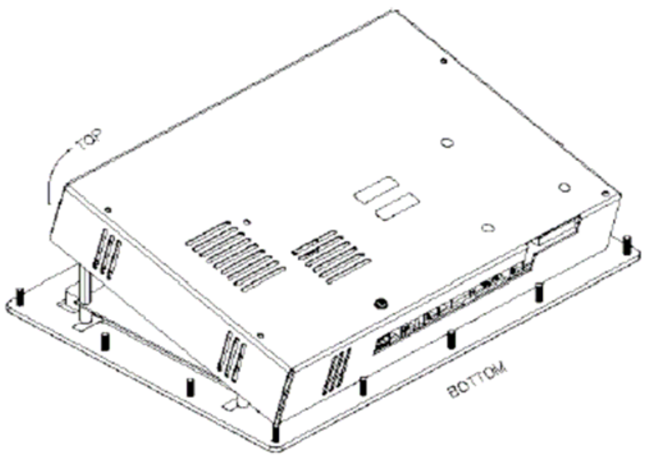
A battery is used to keep time when the unit is without power. Typical accuracy of the OIT10 time keeping is less than one minute per month drift. The battery of a OIT10 unit does not affect the unit's memory, all configurations and data is stored in non-volatile memory.

CAUTION: RISK OF ELECTRIC SHOCK
The inverter board, attached to the mounting plate, supplies the high voltage to operate the backlight. Touching the inverter board may result in injury to personnel.

CAUTION: The circuit board contains static sensitive components. Before handling the operator interface without the rear cover attached, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the operator interface at a static controlled clean workstation. Also, do not touch the surface areas of the circuit board. Dirt, oil, or other contaminants may adversely affect circuit operation.

To change the battery of a OIT10, remove power, cabling, and then the rear cover of the unit. To remove the cover, remove the five screws designated by the arrows on the rear of the unit. Then, by lifting the top side, hinge the cover, thus providing clearance for the connectors on the bottom side of the PCB as shown in the illustration below. Install in the reverse manner.

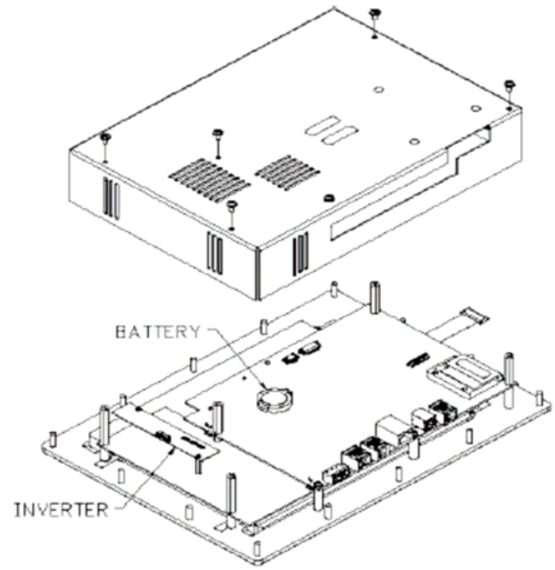
Remove the old battery* from the holder and replace with the new battery. Replace the rear cover, cables, and re-apply power. Using the unit's keypad, enter the correct time and date.



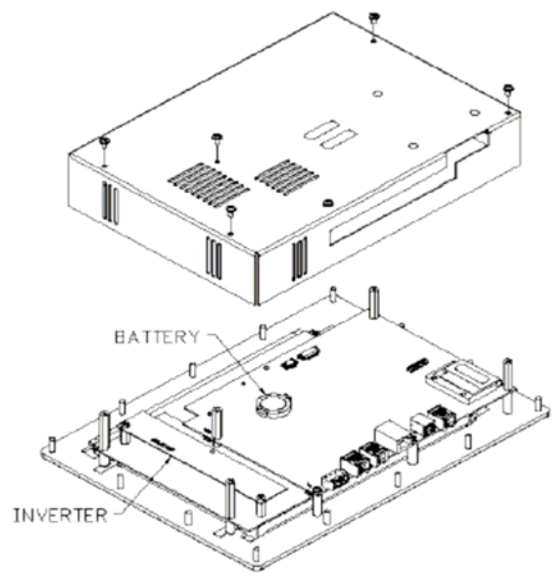
** Please note that the old battery must be disposed of in a manner that complies with your local waste regulations. Also, the battery must not be disposed of in fire, or in a manner whereby it may be damaged and its contents come into contact with human skin.*

The battery used by the OIT10 is a lithium type CR2025.

90280



90281



Optional Features and Accessories

INDOOR VERSUS OUTDOOR

Preferred offers two versions of its OIT10 unit. The 90280 uses an overlay with a textured finish and keys that are embossed. This overlay is not rated for outdoor use. The 90281 uses an overlay with a glossy finish that uses UV rated material for outdoor use. The keys on this overlay are not embossed. The display is significantly brighter than the 90280.

OPTIONAL COMMUNICATION CARD

Preferred offers optional communication cards for fieldbus communications. These communication cards will allow your OIT10 to communicate with many of the popular fieldbus protocols.

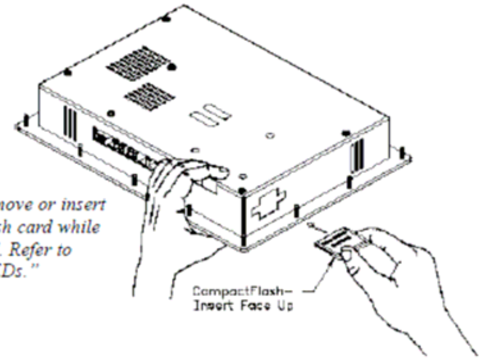
Preferred is also offering a communications card for additional RS232 and RS422/485 communications.

COMPACTFLASH SOCKET

CompactFlash socket is a Type II socket that can accept either Type I or II cards. Use cards with a minimum of 4Mbytes with the OIT10's CompactFlash socket. Cards are available at most computer and office supply retailers.

CompactFlash can be used for configuration transfers, larger configurations, data logging, and trending.

Note: Do not remove or insert the CompactFlash card while power is applied. Refer to "Front Panel LEDs."



Information stored on a CompactFlash card by a OIT10 can be read by a card reader attached to a PC. This information is stored in IBM (Windows®) PC compatible FAT16 file format.

LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company's liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company's option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Preferred Utilities Mfg. Corp (PUMC) harmless from, defend, and indemnify PUMC against damages, claims, and expenses arising out of subsequent sales of PUMC products or products containing components manufactured by PUMC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company's products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.

Preferred Instruments

http://www.PreferredInstruments.com

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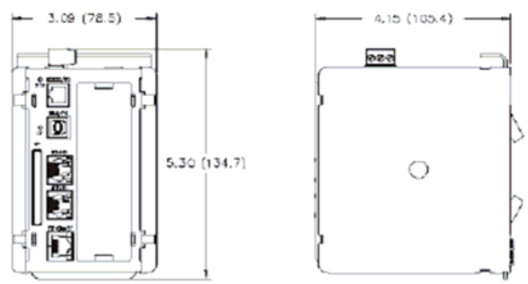
Phone: (203) 743-6741
Fax: (203) 798-7313
Email: info@preferredinstruments.com

Preferred Instruments CommStation
Model OIT BRIDGE

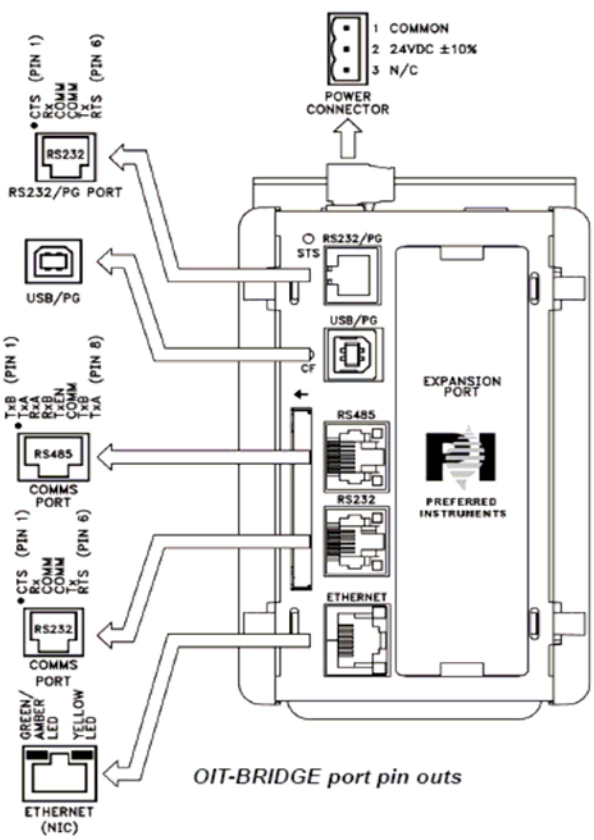
- Advanced communication
  - 10 Base T/100 Base-TX Ethernet
  - One RS-485, Second Optional
  - Two RS-232 Ports
  - Remote Web Access
  - Isolated, Simultaneous Modbus Master & Slave
- Easy to use OIT_Edit Configuration software

Model OIT BRIDGE
(W)3.09" x (H)5.30" x (D)4.15"

Application
The Preferred Instruments OIT-BRIDGE provides a pre-configured communication interface between the controller network(Modbus) and the facility networks via a variety of open protocols including Modbus, Ethernet, and Bacnet. The OIT-BRIDGE is a plant wide communication hub, offering connections to controller, drive and ethernet TCP/IP networks and web connectivity through standard internet browsers.



Dimensions in inches (mm)



OIT-BRIDGE port pin outs

Ordering Information
Specify OIT Catalog Number below

Description	Catalog Number
Optional Web Browser Remote Operation module, with pre-configured operation and comissioning displays that are visable from a standard Web Browser, one Ethernet, one RS-485 and two RS-232 communications ports are built-in. PC is not included.	OIT-BRIDGE
Optional Accessories	**Catalog Number**
Historical Memory 512 MB Compact Flash Card for extended historical memory collection and export to MS Excel	90283
Communication Expansion Card, provides (1) additional RS-232 and RS-485 Ports	90290
OIT_Edit, Operator Interface Terminal Configuration Software	OIT_EDIT

Preferred Instruments CommStation
Model OIT BRIDGE

MECHANICAL

Enclosure Size:	*(W)3.09" x (H)5.30" x (D)4.15"*
Mounting:	Snaps onto standard DIN style top hat (T) profile mounting rails according to EN50022 -35 x 7.5 and -35 x 15.
Weight:	15.1 oz (456.4 g)

LED INDICATION

STS:	Status LED indicates condition of the OIT-BRIDGE **Rapidly Flashing**: The unit is currently running the boot loader. **Steady**: The unit is operating properly.
TX/RX:	Transmit/REceive LEDs show serial activity. **Green**: Transmitting **Red**: Receiving
Ethernet:	Link and activity LEDs. **Yellow (solid)**: Link established **Yellow (flashing)**: Network activity **Green**: 10 BASE-T Communications **Amber**: 100 BASE-TX Communications
CF:	CompactFlash LED indicates card status and read/write activity. **Off**: No ComplashFlash Card is present. **Steady**: Valid CompactFlash card is present. **Flashing Rapidly**: CompactFlash card is being checked. **Flickering**: Unit is writing to the CompactFlash, either because it is storing data, or because the PC connected via the USB port has locked the drive. **Flashing Slowly**: Incorrectly formatted CompactFlash card present.

ENVIRONMENTAL

Operating Temp:	0 to 50°C
Storage Temp:	-20 to 70°C
Humidity Limits:	80% maximum relative humidity (non-condensing) from 0 to 50°C
Vibration:	5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g's.
Shock:	Operational 30 g, 11 msec in 3 directions.

ELECTRICAL

Input Power:	+24 VDC ±20% @ 33 W maximum
External Power Supply:	120 Vac / 24 VDC
Battery:	Lithium coin cell. Typical lifetime of 10 years.

SOFTWARE

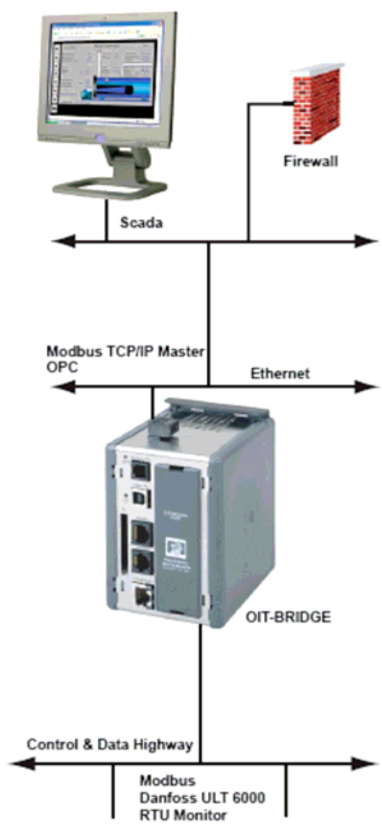
Application Software:	OIT_Edit (Windows based)

COMMUNICATIONS

Ethernet Port:	10 BASE-T / 100 BASE-TX, RJ45 jack connection
Protocols:	Web enabled Modbus TCP/IP Master, TCP/IP Slave, Encapsulated Modbus Master Allen Bradley DF1 Master OPC Consult factory for other available protocols
RS422/485 Port:	(1) standard, (1) Optional, up to 115,200 baud, RJ45 jack connection
Protocols:	Modbus Universal Master, ASCII Slave, RTU Monitor, RTU Slave Danfoss VLT 6000 Allen Bradley DF1 Master, DH485 Master Siemens S7 via MPI Adapter, S7 via PPI, Simovert via USS, TI-500 Series Consult factory for other available protocols
RS232 Ports:	(2) Serial ports, up to 115,200 baud. RJ12 jack connection
Protocols:	Modbus Universal Master, ASCII Slave, RTU Monitor, RTU Slave Danfoss VLT 6000 Consult factory for other available protocols
USB Port:	Programming, Type B connection

CERTIFICATIONS AND COMPLIANCES

Safety:	UL Listed, File #E302106, UL508, CSA 22.2 No. 14-M05 LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.

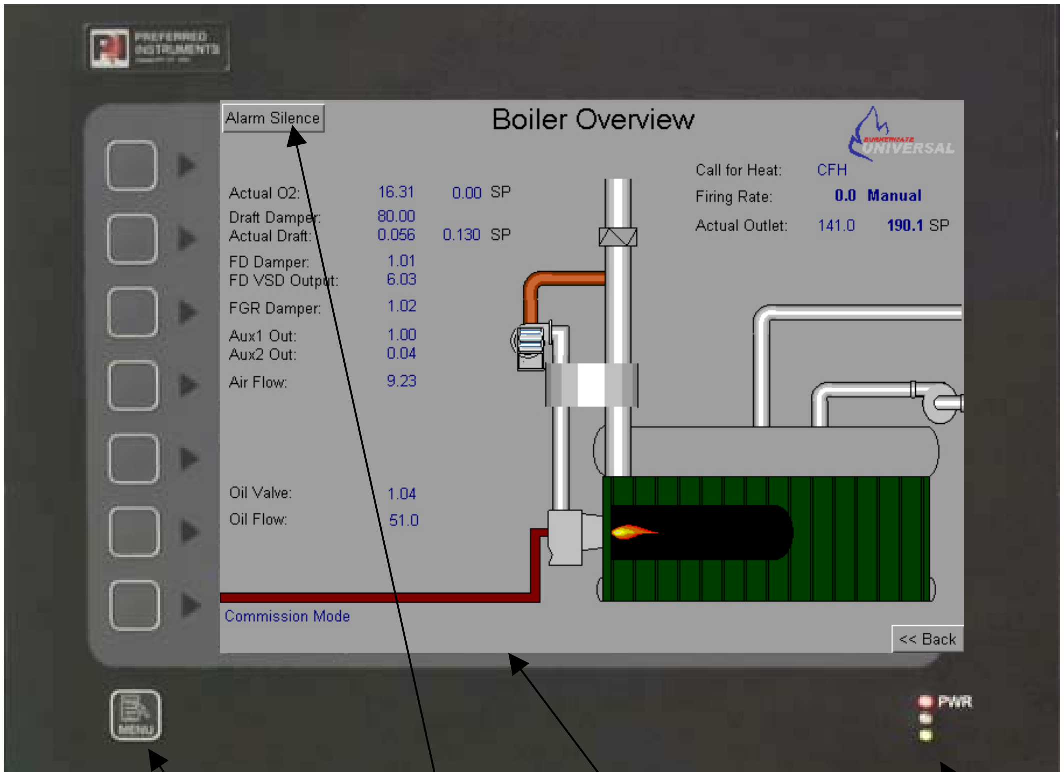


Sample Application

System Overview

The Preferred Instruments BMU-OIT10 offers an enhanced boiler operator interface as well as easy to use commissioning tools. All commissioning and operating can be done via the LCD display as discussed in the rest of the manual. This section of the manual will cover features and functionality of the touch screen, but will not restate all of the details involved in the various commissioning steps from the rest of the manual.

OIT10 Interface



Menu Button:
Shows Screen Display button titles for 3 seconds

Screen Display Buttons:
Press button to show selected Screen

Alarm Silence Button:
Press button to silence alarm horn or bell.

Alarm Banner:
The alarm banner shows active alarms

Alarm Silence Button:
Press button to silence Alarms and Events when an alarm or event is active.

Front Panel LEDs:
Red On = Unit is powered and running an application.
Yellow On = Valid Compact Flash card present.
Green On = No Alarms
Green Flash = Alarm present

Display
The 10" display shows the various available screens. The display has a built- in screen saver mode that turns off the terminal's backlight after a period of no activity. Pressing any button will re-activate the terminal's backlight.

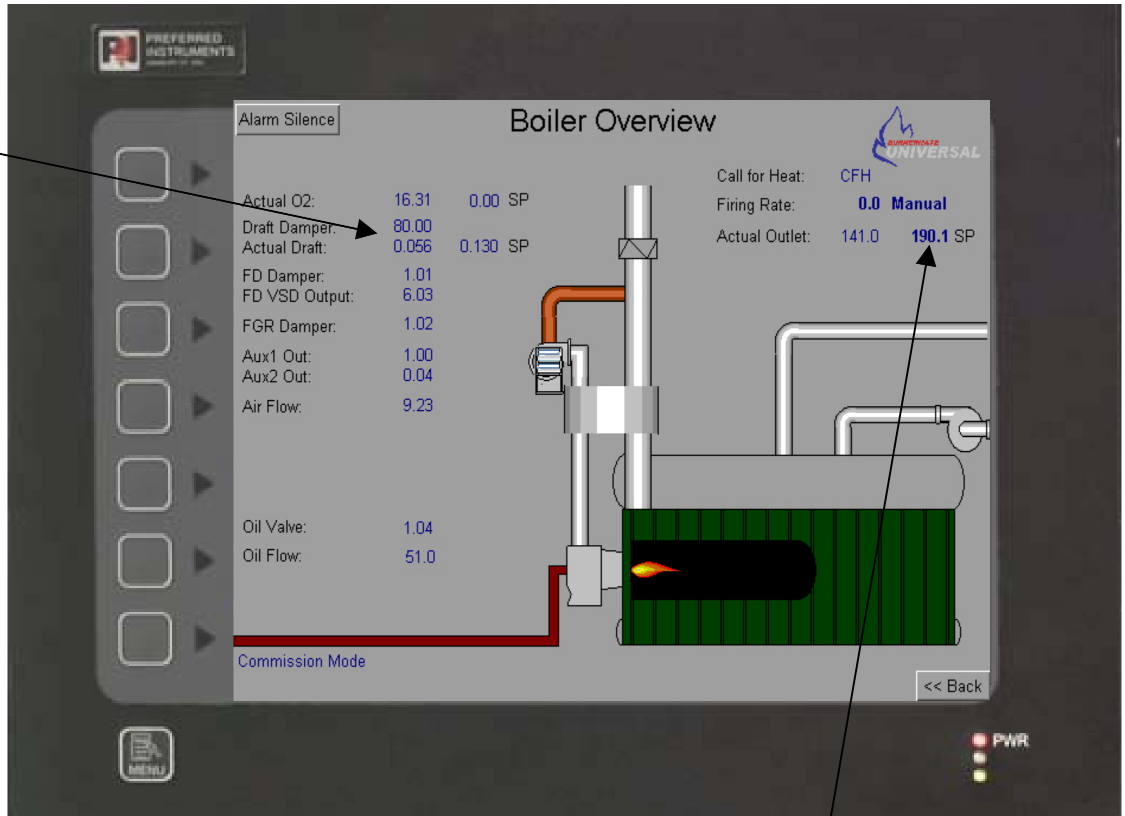
Common buttons
The Alarm Page, Alarm Silence and Login buttons are available on all screens. Their individual functions can be accessed at any time from any screen.

Front Panel LEDs
The LEDs give operator terminal status. When screen saver mode is active the LEDs continue to provide operator terminal status.
If the Red LED light is either blinking or off, a technician should be called to determine the cause of the problem. The technician will need a laptop or desktop computer with OIT Edit software in order to diagnose the problem and re-load the software.

See OIT-10 specifications or optional compact flash LED status information

Green Light (Alarm LIGHT)
The Alarm light blinks after a new alarm occurs, and will continue to blink until the ACCEPT button (located on the Alarm Page) is pressed and the alarm clears.

Display Values:
Value is for display only. Static text values are in normal text (editable are in bold.)



"Value Edit Box"
Shown with Steam Pressure Setpoint Selected

RAISE & LOWER Button:
Press arrow buttons to instantly change the selected value

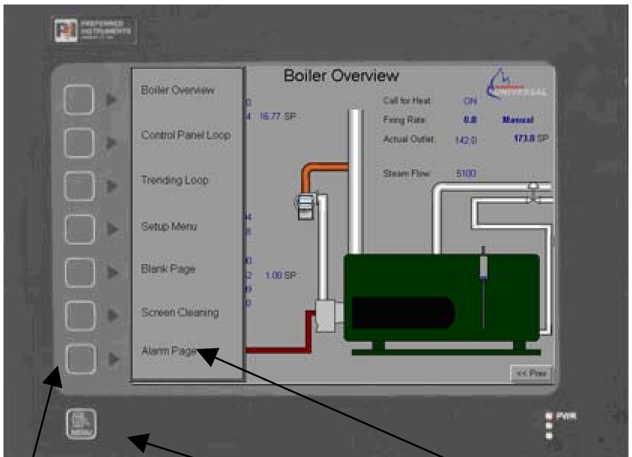
PREV & NEXT Buttons:
Press PREV & NEXT buttons to cycle through all of the Editable Values and 'Soft Button's on the screen

ENTER & EXIT Button:
Press either ENTER or EXIT buttons to close the "Value Edit Box"

Editable Values & Soft Buttons
Many screens have values and/or 'soft buttons' that the operator can change. They are called editable items. They are marked by being in bold print, and when selected get a blue box surrounding them.

MENU and SCREEN Buttons

Pressing the menu button displays what each side button does. Each line item is also a button, pushing the 'Trending Loop' line will bring you to the trending screens, the side button next it will also bring you to that same screen. The setup and tuning enters the commissioning part of the controller. The last button is provided for cleaning the touch screen.

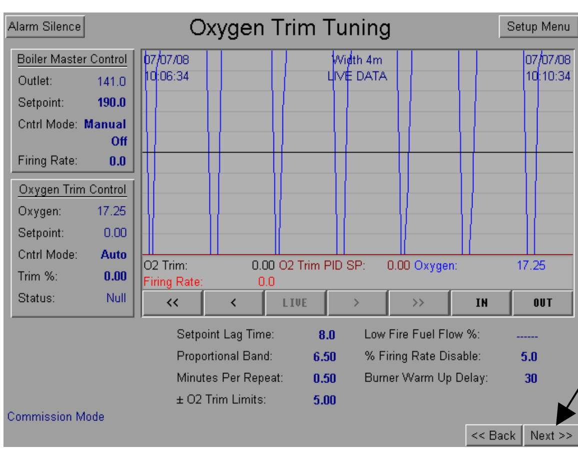


Screen Buttons:
Screens are directed to individual pushbuttons. Use the pushbuttons on the OIT10 to "jump" to the desired screen. Use the menu button to find out which button is assigned to what screen.

Menu Button:
Pressing the Menu Button pops up a window that shows you were each side button on the OIT goes, as well as each line item being a touch button.

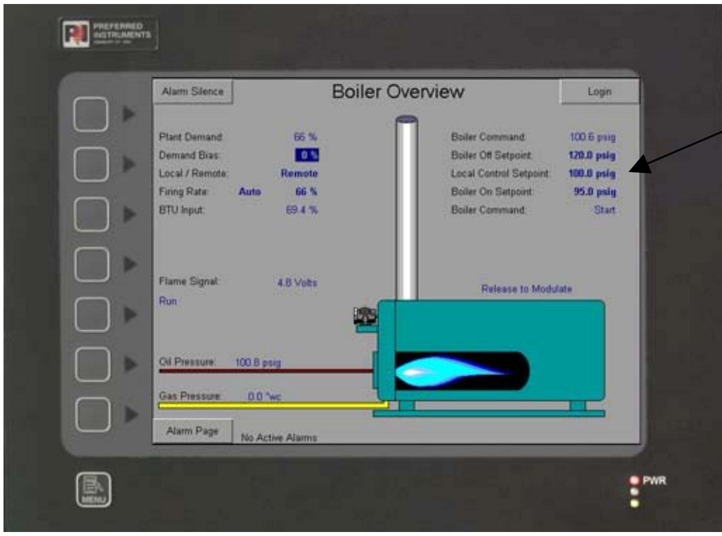
SCREEN LOOP

Pressing Back or Next page buttons causes the display to cycle through all of the screens in the screen loop, as shown below.



Back and **Next**:
On some screens these buttons are the title of the next or previous page, cycling through a loop of screens.

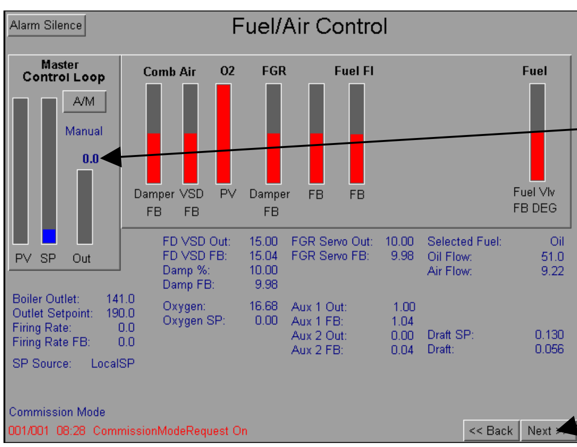
Boiler Overview – This is the main page that displays monitored values such as Flue temperature, Firing Rate, Call for Heat, Steam Flow/Header Temperature.



Soft Buttons:
From the Boiler overview page, you can change the firing rate, and the Outlet set point.

Control Panel Loop –

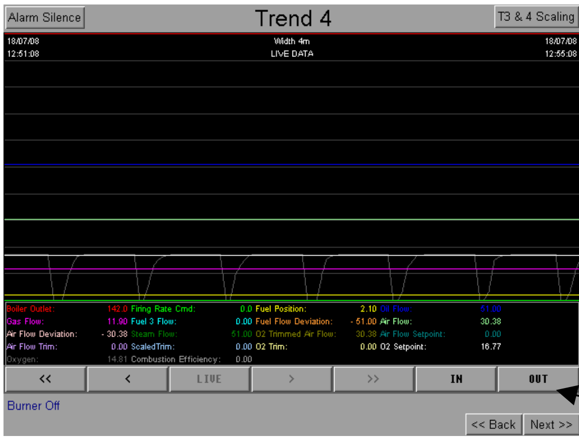
This button is linked to the Fuel/Air Control page, from here you can view much more specific values pertaining to fuel/air control. Depending on the options enabled, hitting Next and Back will cycle through the Drum and Draft Control Panel pages.



Master Control Loop:
From the master control loop box, you can you can change the firing rate of the boilers, by first ensuring that you are in 'Manual' not 'Auto.' Than press the 'soft button' above the Out bar to change the firing rate.

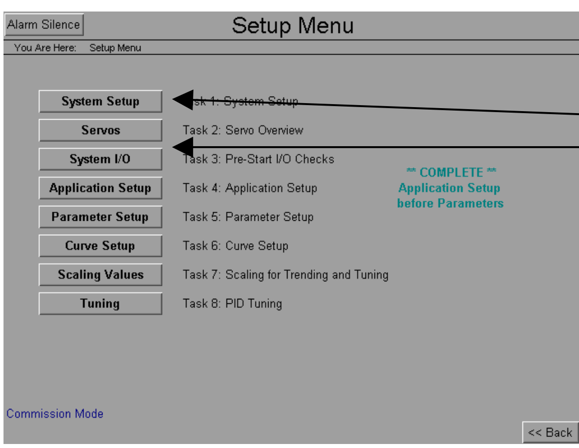
Pressing the Next or Back buttons brings you to the Drum Level and Draft Control screens.

Trending Loop –
This takes you to the Trend 1 screen, here you can view a graph that shows values you setup to be seen in the Scaling values pages. There are a total of 8 trending screens, Trend screen 1 and 2 are linked to the Boiler Master & Fuel Air Ratio Scaling page, 3 and 4 are the Fuel / Air flows & O2 Scaling, 5 and 6 the Windbox & Feedwater Scaling, 7 and 8 are the Draft Atomizing Scaling values page.



Trending screen:
Touching anywhere on the graph brings up the Live Data cursor, this allows you to see exactly what time an event happened. Hitting the LIVE button will bring you back to the screen without the cursor. Using the arrows you can go backwards in time to see previous readings, and using the IN and OUT button you can change the Width in Minutes of the graph, default is 10 minutes.

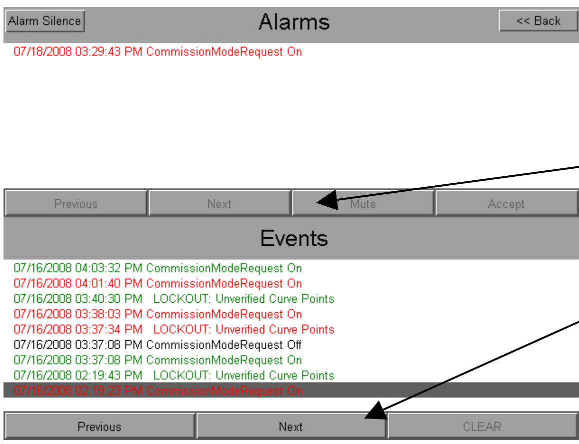
Setup Menu –
Pressing the Setup and Tuning button opens the commissioning section of the controller. The setup menu allows access to groups of settings. These groups also use screen loops to cycle through various settings screens.



'Setup Menu Buttons.

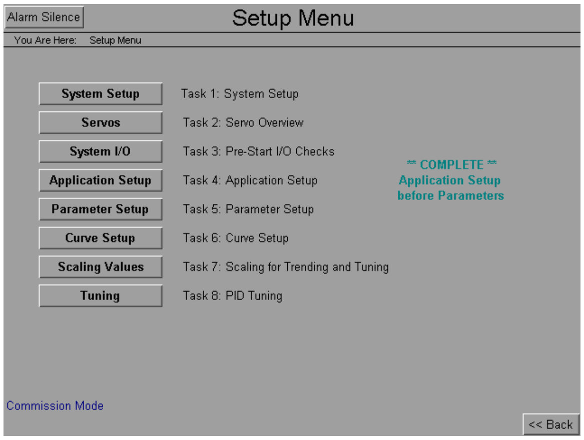
Blank / Cleaning Screen
These screens have no active buttons and can be used to clean the screen without accidentally changing any values. Clean the screen with a dry cloth and a cleaner approved for use with plastics. Mostly, water should be sufficient if cleanings are regular.

Alarm Page –
Alarms and Events are listed here.



Using the Previous and Next buttons you can scroll through the alarms and events. The alarms part of the screen also has a Mute and Accept button

Setup Menu Navigation –



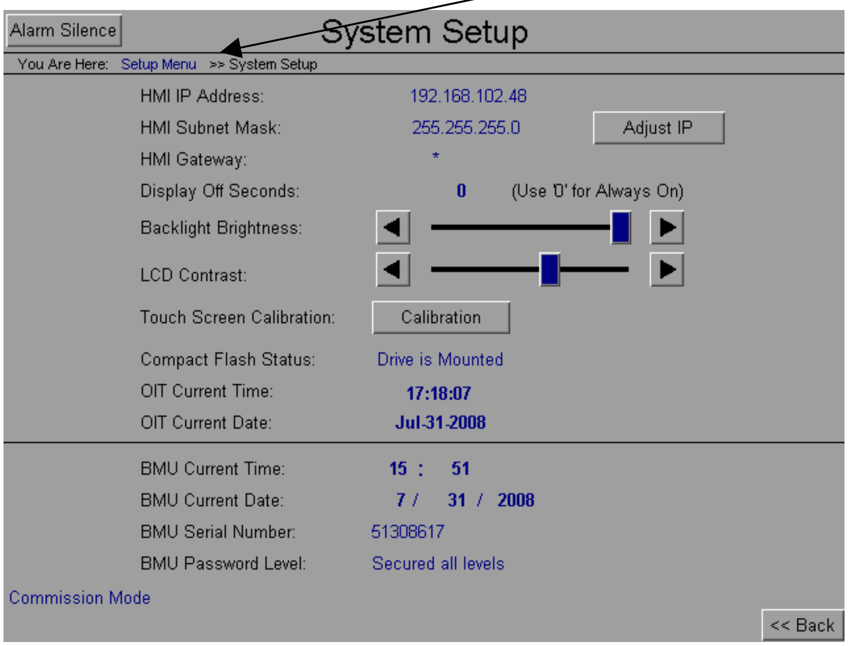
The setup menu steps the installation technician through the commissioning process. Each task is designed to be done in order for a first time installation as well as provide the main areas for troubleshooting and information after the BMU has been commissioned.

WARNING:
Commissioning should only be attempted by a trained boiler technician who has experience with the controls in use. The Technician is responsible for the safety of the burner and boiler at all times. Failure to comply with safety measures can result in equipment damage, injury or death.

Setup Steps

Step 1 – System Setup menu

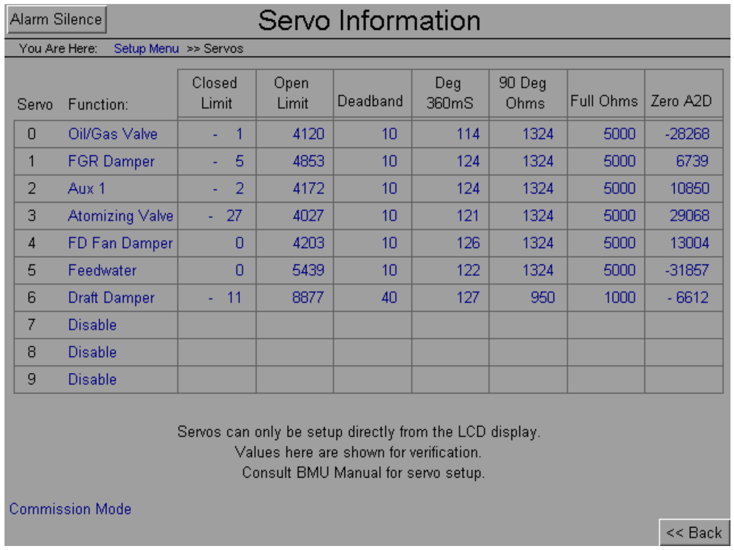
Short Cut Buttons



From here you can view and adjust the IP address, set a display off timer, set the brightness and contrast, and calibrate the touch screen. The tech can also view the compact flash status, the OIT and BMU times and dates, the BMU serial number and the current BMU Password level.

The Short cut buttons show where you are at in the screen loops you have gone through, and by pressing the Blue text of the name of a page, you go straight to the page. This is very useful especially when setting up the parameters later on.

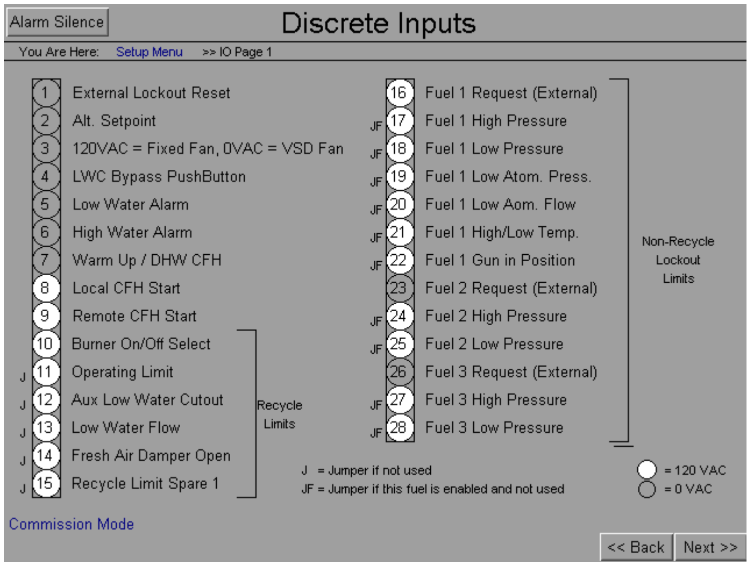
Step 2 – Servos Screen



Servo	Function:	Closed Limit	Open Limit	Deadband	Deg 360mS	90 Deg Ohms	Full Ohms	Zero A2D
0	Oil/Gas Valve	- 1	4120	10	114	1324	5000	-28268
1	FGR Damper	- 5	4853	10	124	1324	5000	6739
2	Aux 1	- 2	4172	10	124	1324	5000	10850
3	Atomizing Valve	- 27	4027	10	121	1324	5000	29068
4	FD Fan Damper	0	4203	10	126	1324	5000	13004
5	Feedwater	0	5439	10	122	1324	5000	-31857
6	Draft Damper	- 11	8877	40	127	950	1000	- 6612
7	Disable							
8	Disable							
9	Disable							

You can view all the settings of 10 different servos from this page, Servos can only be setup directly from the LCD display; this is a view only page.

Step 3 – System I/O

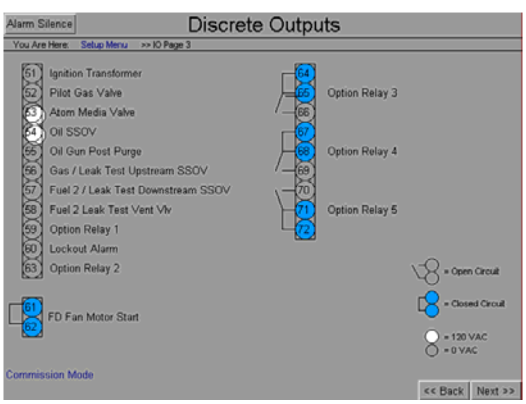


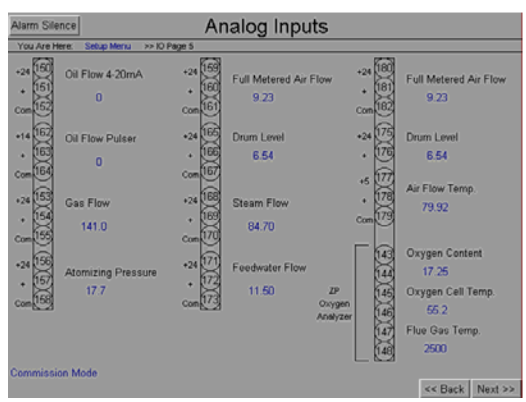
From here you can view all the current status of the inputs and outputs that are hooked up to the BMU. The input follows the wiring drawings found in the commissioning section of this manual. For a further description of some of the details in the wiring, please refer to that section.

A legend is provided to show the meaning of certain status and symbols.

Pressing Back and Next allows you to navigate through all of the I/O screens within the I/O screen loop.

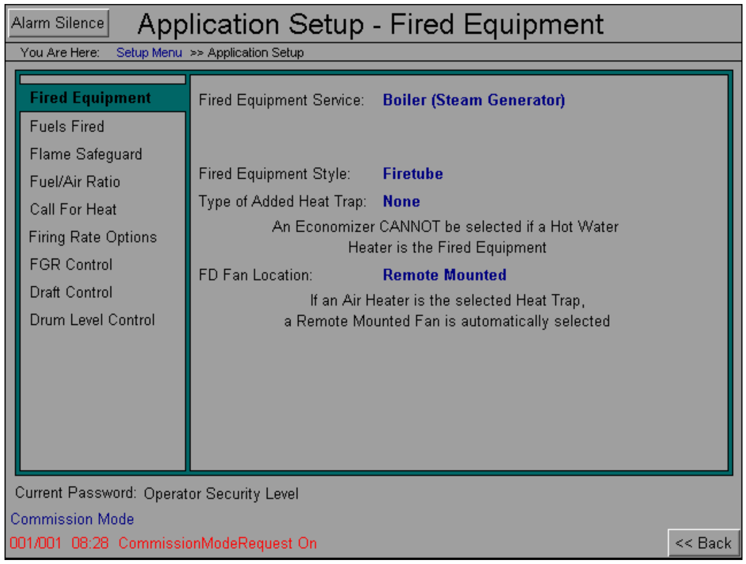
Other Examples of IO Screens





Step 4 – Application Setup

Application setup pages are designed to remove unneeded parameters from the parameters section of the commissioning. By answering a few questions up front about your installation, certain options will be disabled, and various parameters pre-set.



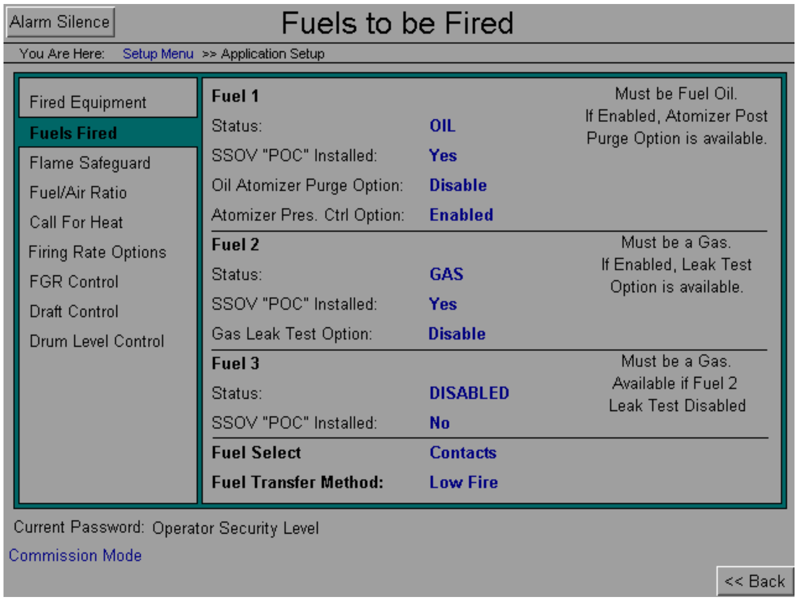
Fired Equipment Service – The choices are … Hot Water Heater; Boiler (Steam Generator); and Other … Selection of "Hot Water Heater" automatically eliminates Drum Level Control and the Low Water Cutout Automatic Blowdown Options. Selection of "Boiler" only eliminates the Hot Water Pump Stop Delay Option. Selection of "Other" allows one to select any of the available options. However, one need be careful when selecting "Other", as it becomes their responsibility to select (or eliminate) the appropriate Options (as an example … Boiler Drum Level Control would not be the correct Option to select if an Incinerator is the Fired Equipment unless a Waste Heat Boiler is also installed). The Overviews are mildly affected … Boiler Outlet Temperature is the control variable for a "Hot Water" Heater while Pressure is the control variable for a "Boiler" as an example … Consider that the Overviews might have to be changed considerably to be appropriate if "Other" is selected.

Fired Equipment Style – The choices are … Firetube or Watertube. This only affects the Overviews.

Type of Added Heat Trap – The choices are … Economizer; Air Heater or None. This only affects the Overviews. An "Economizer" cannot be selected if the Fired Equipment Service is "Hot Water Heater". A "Remote Mounted" FD Fan Location will automatically be selected if an "Air Heater" is the selected Heat Trap.

FD Fan Location – The choices are … Burner Mounted and Remote Mounted. This only affects the Overviews. See the note above regarding the influence of the type of Heat Trap.

Step 4 – Application Setup *(continued)*



Note: Be aware that a Gas Leak Test Option is only available with Fuel #2 and can only be selected if Fuel #3 is NOT a Fuel Option.

<u>Fuel #1</u> *(“Status”*, Parameter 1.1.1) - The choices are … OIL and DISABLED. The related Options are whether or not a Safety Shutoff Valve Proof of Closure Switch is installed (Yes or No) and if an Atomizer Post Purge Option is desired/required and the type. The choices for this Option are … Disable; Blowthru; Pumpback. In the “Blowthru” mode, the oil side of the Atomizer is purged using a diverted source of Atomizing Media. In the “Pumpback” mode the oil in the Atomizer is sucked out using a pump.

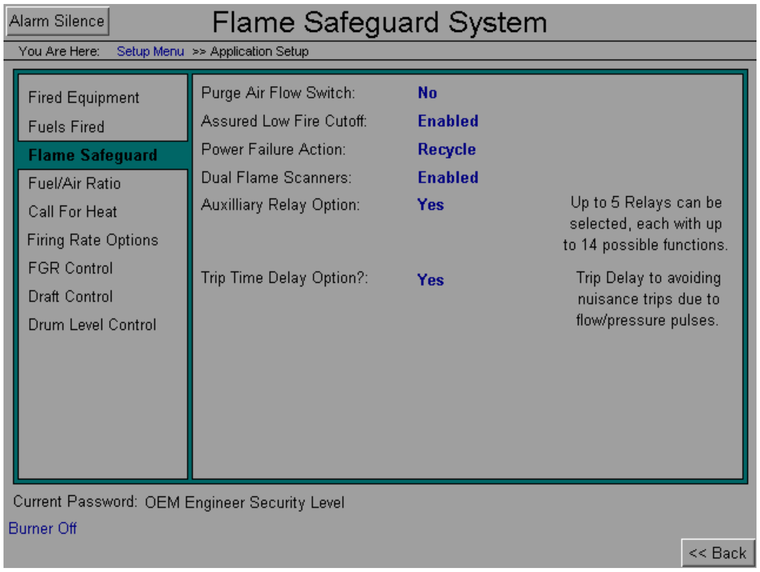
<u>Fuel #2</u> *(“Status”*, Parameter 1.1.2) - The choices are … DISABLED; Gas; (Bgas) Bio Gas; (dgas) Digester Gas; (ogas) Off Gas; FUEL2. The related Options are whether or not a Safety Shutoff Valve Proof of Closure Switch is installed (Yes or No) and if a Gas Leak Test Option is desired/required. As noted above the Gas Leak Test Option is only available for Fuel #2 and it cannot be elected if Fuel #3 is an available Fuel option.

<u>Fuel #3</u> *(“Status”*, Parameter 1.1.3)- The choices are … DISABLED; (Bgas) Bio Gas; (dgas) Digester Gas; (ogas) Off Gas; FUEL3. The related Option is whether or not a Safety Shutoff Valve Proof of Closure Switch is installed (Yes or No). As noted above the Gas Leak Test Option is NOT available for Fuel #3 and Fuel #3 cannot be elected if both Fuel #2 and its Gas Leak Test Option are elected.

<u>Fuel Select (Parameter 1.1.4)</u> – The Choices are, Contacts; Display; Disp Or Modbus.

<u>Fuel Transfer Method (Parameter 1.12.1)</u> – The choices are Low Fire and Restart.

Step 4 – Application Setup *(continued)*



Purge Air Flow Switch Installed ***(“PAF Switch Installed”*, Parameter 1.1.5) –** The choices are … Yes or No. Please be aware that some means of establishing Purge … Damper Position(s), Pressure(s), Motor Starter Contact(s), VFD Hz … must be provided on every application.

Enable “Assured Low Fire Cut Off” ***(“Assured Low Fire Cut Off”*, Parameter 1.3.2)** The choices are … Enable or Disable … If “Enable” this features assures that the Burner is always directed to the Minimum Firing Rate state prior to shutdown.

Power Failure Action ***(“Power Fail Response”*, Parameter 1.3.1)** The choices are … Recycle or Lockout.

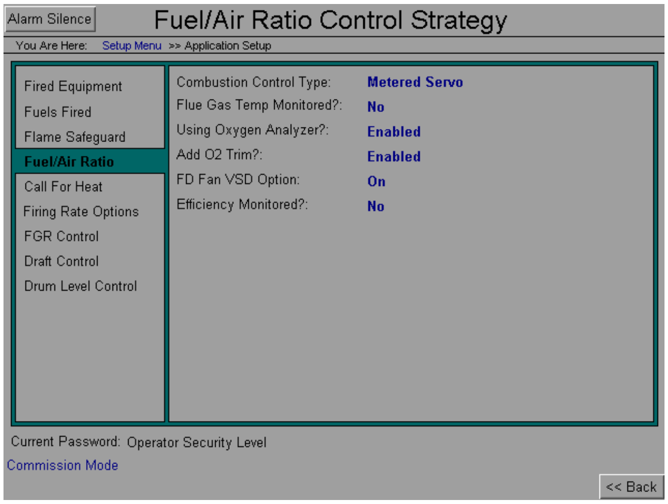
Dual Flame Scanners ***(“Dual Flame Scanners”*, Parameter 1.4.1) –** The choices are … Enable or Disable … “Disable” results in the selection of a Single Scanner. “Enable” results in the selection of Dual Scanners. In the Dual Scanner mode only one Scanner needs to view Flame for Burner operation to continue.

Auxiliary Relay Option ***(“Aux Relay 1 Function”*, Parameter 1.7.1; *“Aux Relay 2 Function”*, Parameter 1.7.2; *“Aux Relay 3 Function”*, Parameter 1.7.3; *“Aux Relay 4 Function”*, Parameter 1.7.4; *“Aux Relay 5 Function”*, Parameter 1.7.5)–** The choices are … Yes or No … If “Yes” is selected any number of the 5 Auxiliary Relays can be setup in the Parameter Setup Section. Selection of “No” indicates that none of the Auxiliary Relays are desired/required.

Trip Time Delay Option? ***(“Min Air Flow Trip Delay”*, Parameter 1.6.1; *“Low Fuel Pressure Delay”*, Parameter 1.6.2; *“Low Atomizing Flow Delay”*, Parameter 1.6.3; *“Low Draft Cutout Delay”*, Parameter 1.6.4) –** The choices are … Yes or No. These are for preventing nuisance trips due to momentary pressure/flow fluctuations. Up to 4 second delays (8 for the Low Draft Cutout) can be selected.

Note: Be aware that selecting *“No”* disallows selection of ALL time delay options while selection of *“Yes”* allows setup of any one or all of the Time Delay Options.

Step 4 – Application Setup *(continued)*



Combustion Control Type (*"Fuel-Air Control Type"* Parameter 2.1.1) – The choices are … Positioned Servo; and Jackshaft Servo. In *"Jackshaft Servo"* all Dampers and Fuel Valves are presumed to be mechanically linked to one Jackshaft. If *"Positioned Servo"* is selected every Valve and Damper is presumed to have its own Servo Actuator.

Flue Gas Temp Monitored?: – The choices are … Yes or No.

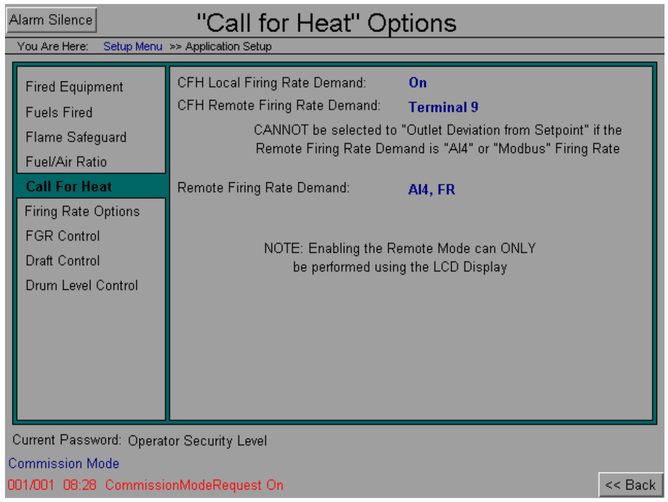
Using Oxygen Analyzer? (*"O2 Analyzer Option"* Parameter 2.4.1) – The choices are … Enabled or Disabled. Select *"Disabled"* if NEITHER O2 Monitoring or O2 Trim is desired/required. Select *"Enabled"* if EITHER O2 Monitoring or O2 Trim IS desired/required.

Add O2 Trim? (*"O2 Trim Option"* Parameter 2.5.1) – The choices are … Enabled; or Disabled. Select *"Disabled"* if O2 Trim is NOT desired/required. Select *"Enabled"* if O2 Trim IS desired/required.

FD Fan VSD Option (*"FD Fan VSD Option"* Parameter 2.2.1) – The choices are … Yes or No.

Efficiency Monitored? – The choices are … Yes or No.

Step 4 – Application Setup *(continued)*

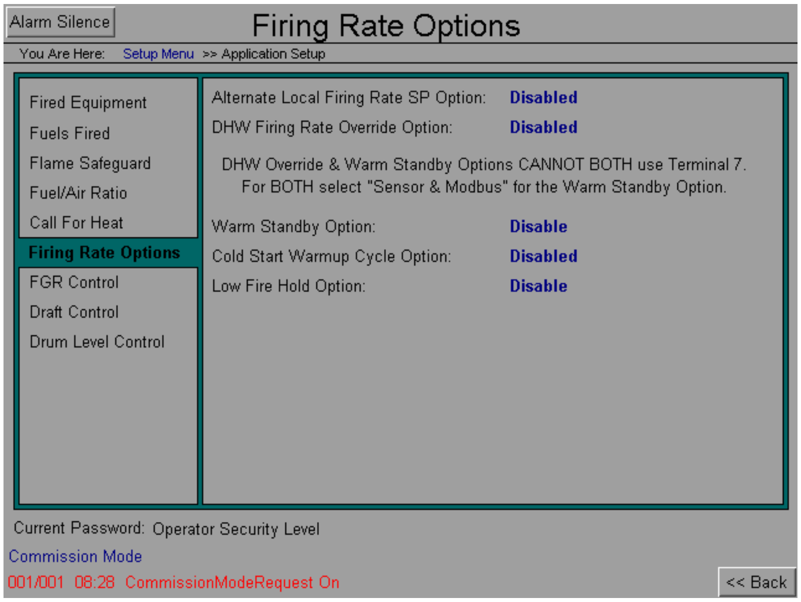


<u>CFH Local Firing Rate Demand (*"CFH Local Mode"* Parameter 3.2.1)</u> – The choices are On or Off.

<u>CFH Remote Firing Rate Demand (*"CFH Remote Mode"* Parameter 3.2.3)</u> – **The choices are Modbus; Outlet Deviation from Setpoint; or Terminal 9 Contact Closure. If *"Modbus"* is selected then a Call for Heat is established based on the applicable Modbus address. If *"Outlet Deviation from Setpoint"* is selected, the Firing Rate demand is generated as a result of the Outlet condition's deviation from the current setpoint. If *"Terminal 9 Contact Closure"* is selected then a Call for Heat is established by a 120 Volt contact closure at Terminal 9. The Overviews are NOT affected by this selection.**

<u>Remote Firing Rate Demand (*"Remote Modulation"* Parameter 3.2.4)</u> – **The choices are Outdoor Air Reset Setpoint; Modbus Setpoint; Terminal AI4 Setpoint; Terminal AI4 Firing Rate; or Modbus Firing Rate. The Overviews are NOT affected by this selection.**

Step 4 – Application Setup *(continued)*



Alternate Local Firing Rate SP Option (*"Alt Local SP Option"*, Parameter 3.7.1) The choices are Enable or Disable If *"Disable"* then the *"Rate Local SP"* (Parameter 31) is the Firing Rate Setpoint. If *"Enable"* the Firing Rate Setpoint is EITHER the *"Rate Local SP"* (Parameter 31) if there is 0 Volts on Terminal 2, OR *"Alt Local SP"* (Parameter 116) if there is 120 Volts on Terminal #2.

Note: The *"Alt Local SP"* can be overridden by either the *"DHW SP"* (Parameter 3.8.2), the *"Rate Max SP"* (Parameter 3.3.6) or *"Rate Min SP"* (Parameter 3.3.7)

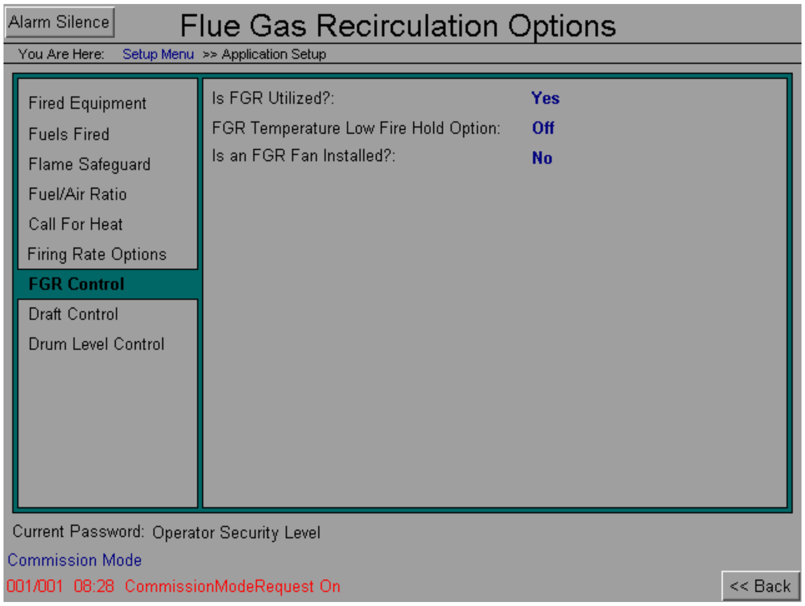
Domestic Hot Water Firing Rate Override Option (*"DHW Override Option"*, Parameter 3.8.1) – The choices are Enable or Disable … If *"Disable"* then this option is not available. If *"Enable"* the Firing Rate Setpoint is the *"DHW Setpoint"* (Parameter 118) if there is 120 Volts on Terminal 7. Please note that the *"DHW Override Option"* and the *"Warm Standby Option"* CANNOT both be configured to use Terminal 7.

Warm Standby Option (*"Warm Standby Option"*, Parameter 3.9.1) – The choices are Disable; Terminal 7; SensorAndTerm7; and SensorAndModbus … If *"Disable"* then this option is not available. The *"Warm Standby Option"* is ONLY IN EFFECT when no other Call for Heat Option is active. As noted above the *"DHW Override Option"* and the *"Warm Standby Option"* CANNOT both be configured to use Terminal 7 (or SensorAndTerm7).

Cold Start Warmup Cycle Option (*"Cold Start Warmup Option"*, Parameter 3.10.1) The choices are Enable or Disable … If *"Disable"* then this option is not available. Please note that the *"Cold Start Warmup Option"* will NOT activate until after the "FGR Temp Low Fire Hold" is Released (*"Release Temp FGR LFH"* Parameter 136). In addition the *"Cold Start Warmup Option"* (overrides the *"Low Fire Hold Option"* (Parameter 132).

Low Fire Hold Option (*"Low Fire Hold Option"*, Parameter 3.11.1) – The choices are Disable; Terminal 7; and Warm Up Sensor … If *"Disable"* then this option is not available. The *"Cold Start Warmup Option"* overrides the *"Low Fire Hold Option"*.

Step 4 – Application Setup *(continued)*

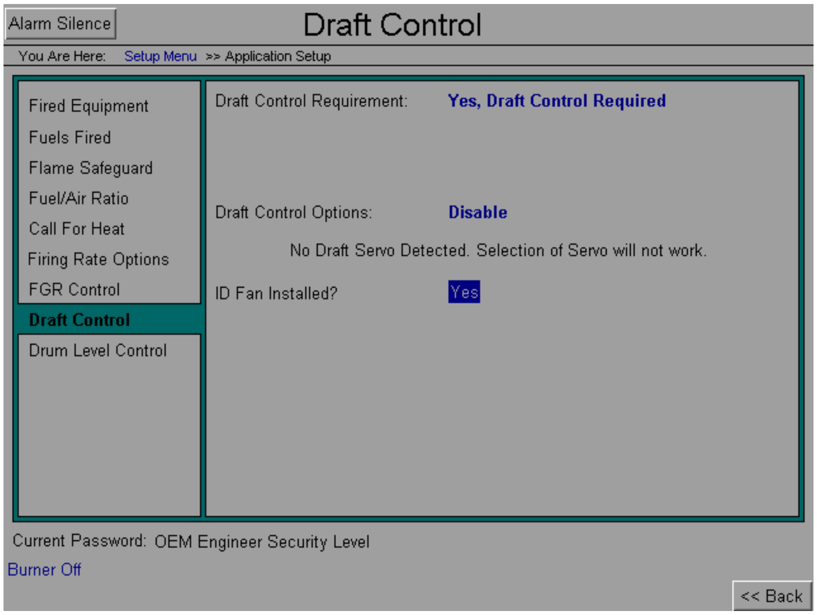


<u>Is FGR Utilized?</u> – The choices are … Yes; or No. If *"No"* is selected then all of the remaining choices on this page disappear/disable. If "*Yes"* is selected an FGR Damper is presumed to be the Flow Control element whether or not the FGR Fan VSD Option is elected (*"FGR Fan VSD Option"* Parameter 77). The Overviews are affected by this selection.

<u>FGR Temperature Low Fire Hold Option</u> (*"FGR Temp Low Fire Hold Option"* Parameter 3.12.1) – The choices are … Enable; or Disable. If *"Disable"* is selected then this option is not elected. If "Enable*"* is selected then the Burner is maintained at Low Firing Rate until the FGR Temperature reaches the Release Temperature (*"Release Temp, FGR LFH"* Parameter 136). The Overviews are unaffected by the selection.

<u>Is an FGR Fan Installed?</u> – The choices are … Yes; or No. If *"No"* is selected then the *"FGR Fan VSD Option"* (Parameter 77) disappears/disables. If "*Yes"* is selected an FGR Damper is presumed to be the Flow Control element whether or not the FGR Fan VSD Option is elected (*"FGR Fan VSD Option"* Parameter 77). The Overviews are affected by this selection.

Step 4 – Application Setup *(continued)*

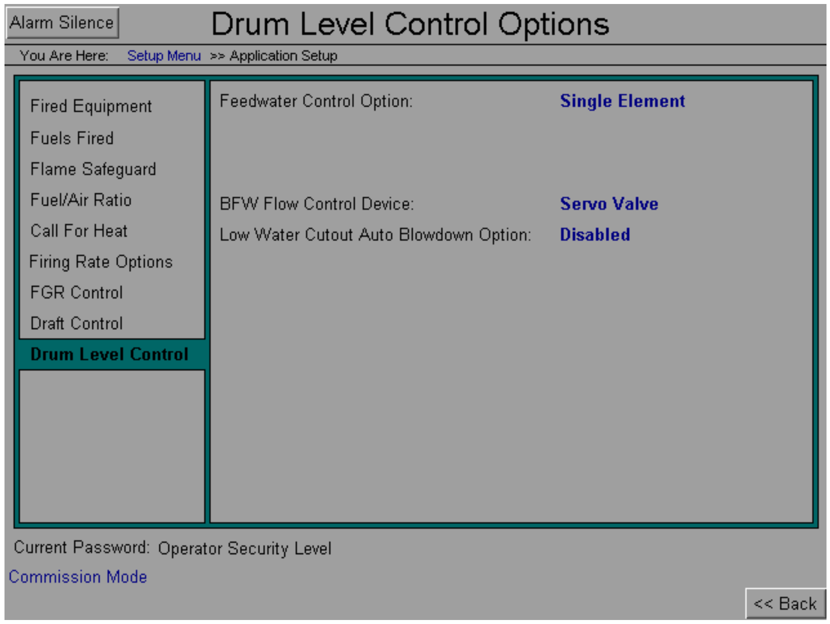


<u>Draft Control Requirement (*“Draft Control Option”* Parameter 4.1.1)</u> – The choices are … Not Required; Yes, Draft Control Required or No, Existing System. If *“Not Required”* is selected then the remaining options on this page disappear/disable. If *“No, Existing System”* is selected then the required “Purge” and “Draft” Interlocks must be incorporated. The Overviews are affected by this selection and those on the remainder of this page.

<u>Draft Control Option (“Draft Control Option”, Parameter 4.1.1)</u> – This Parameter, is AUTOMATICALLY selected based on the choices made previously on this page. The Overviews are NOT affected by this selection.

<u>ID Fan Installed? (*“ID Fan Installed”* Parameter 1.1.6)</u> – The choices are … Yes or No. If *“No”* is selected then the *“ID Fan VSD Option”* disappears/disables. If *“Yes”* is selected then EITHER an ID Fan VSD or a Draft Damper MUST be installed. The Overviews are affected by this selection.

Step 4 – Application Setup *(continued)*



<u>Feedwater Control Option (*“Feedwater Control Option”* Parameter 5.1.1)</u> – The choices are … Disable; Single Element; Two Element; or Three Element. If a “Hot Water Heater” is the “Fired Equipment Service” then this option and the remaining options on this page except for the “Hot Water Pump Stop Delay Option” disappear/disable. If “Fired Equipment Service” is a “Boiler” then the “Hot Water Pump Stop Delay Option” disappears/disables. If “Fired Equipment Service” is “Other” then every option listed on this page is available. Select “Single Element” if only Drum Level is to be used as the control variable; select “Two Element” if Drum Level is the control variable with feedforward action provided by a Steam Flow input; or select “Three Element” if in addition to Drum Level and Steam Flow, a Feedwater Flow input is utilized as control feedback. The Overviews are affected by this selection.

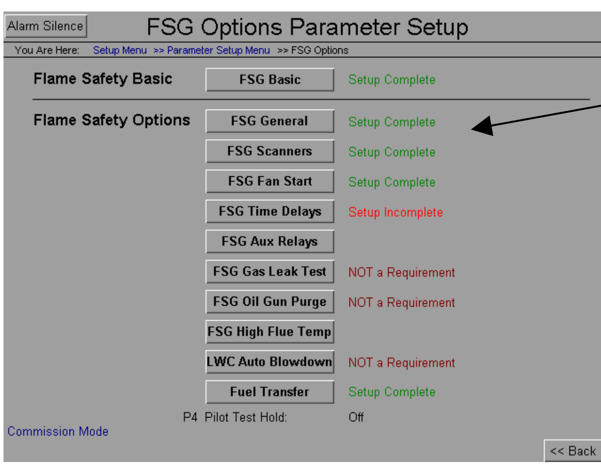
<u>BFW Flow Control Device (*“Valve/Pump Output Type”* Parameter 5.1.2)</u> – The choices are … Servo Actuated Valve; 4-20 madc Actuated Valve; or BFW Pump VSD. The Overviews are affected by this selection.

<u>Low Water Cutout Auto Blowdown Option (*“LWC Auto Blowdown Option”* Parameter 66)</u>
- The choices are … Disable or Enable. If a “Hot Water Heater” is the “Fired Equipment Service” then this option disappears/disables. If the “Fired Equipment Service” is either a “Boiler” or “Other” then this option is available. The Overviews are affected by this selection.

Step 5 – Parameter Setup

The Parameter Setup menu is designed to mirror the LCD's menu structure. Each page brings up more menus that walk the installation technician through the menus in order. See the LCD Parameters Menu section of this manual for more details.

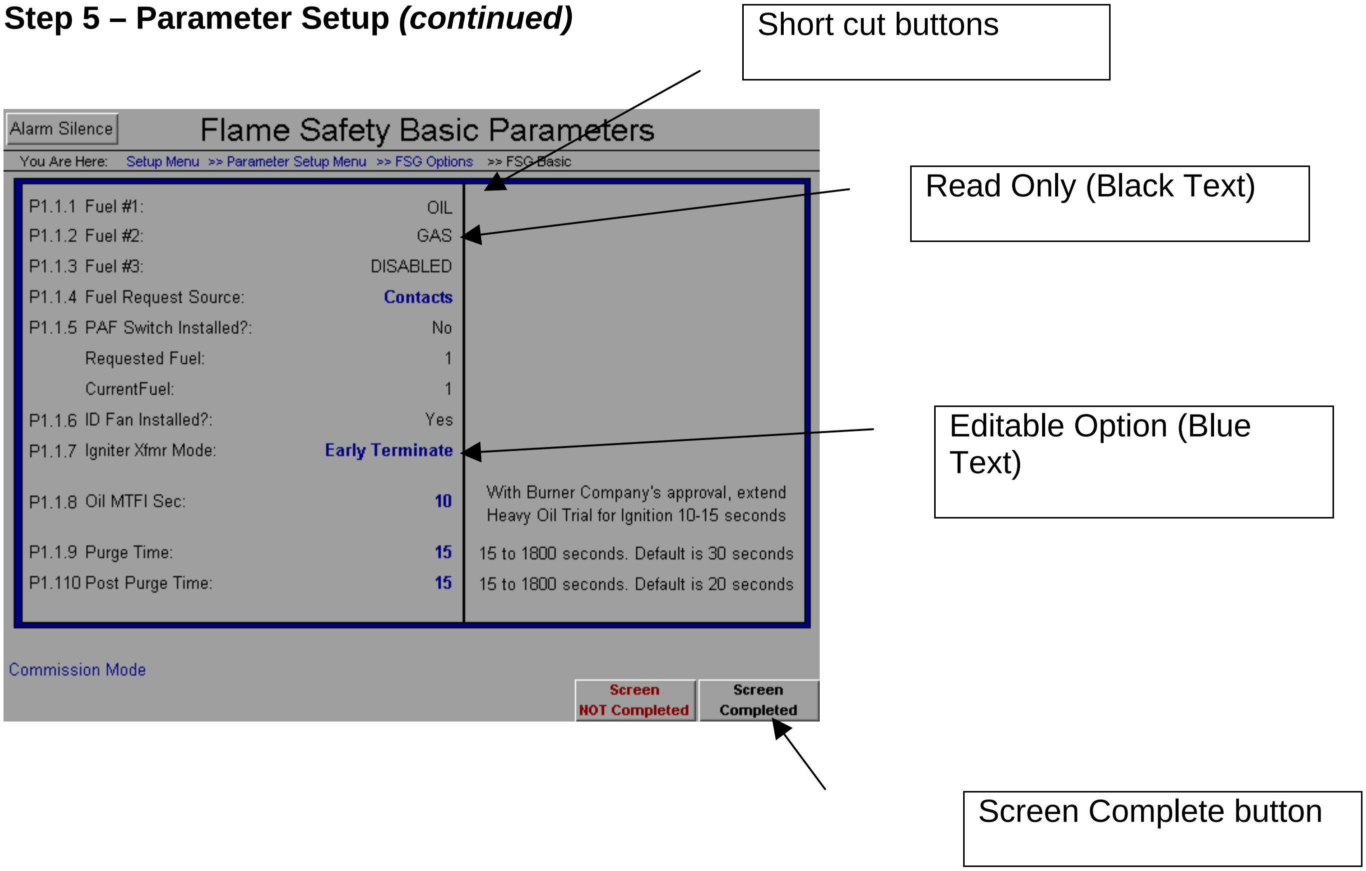
The OIT is designed to only show parameters required by the technician. The questions answered in "Step 3: Application Setup" remove various parameters making commissioning simpler. Sections of parameters may be marked as not being required.



Each Menu Page is shown with its current value

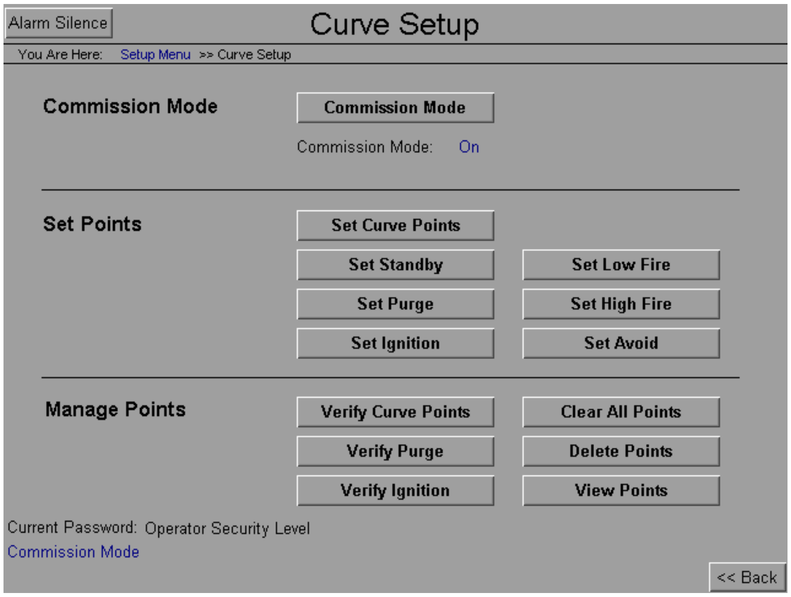
Setup Complete: This screen has values required by the application, but has been marked "Completed" by the Technician
Setup Incomplete: This screen has values required by the application, and has not been marked "Completed" by the Technician
NOT a Requirement: This screen does not have values required by the application

Step 5 – Parameter Setup *(continued)*



Within the parameter setup menus options, there is a page similar to the above. The black text is read only; the bold blue text is editable text. Once the parameters are read through, and are setup correctly, press the Screen Completed button, this will enable a green text saying 'Setup Complete' to the right of the button to that parameter page. There is also a Screen NOT Complete button, this will show a red Setup Incomplete next to the page button. This shows you what pages are completed and which ones are not, to ensure that all the parameters are gone through and checked on each page.

Step 6 – Curve Setup



The Curve Setup section allows the technician to set the combustion curves. Gain, care was taken to emulate the LCD's Commissioning section. Detailed descriptions of setting and verifying the points are outlined in that section of the manual. Understanding those principles is required.

The functionality of "Curve Command" has been made easier by automatically setting its value dependent on the screen you go to both in the LCD and in the OIT. However, its functionality is still important to understand as certain screens in the OIT are re-used but with certain functionality removed dependent on the status of Curve Command.

With Technician Level security or above, the technician can enter Commission Mode. Each button in the menu takes you to a different screen to perform the various curve functions.

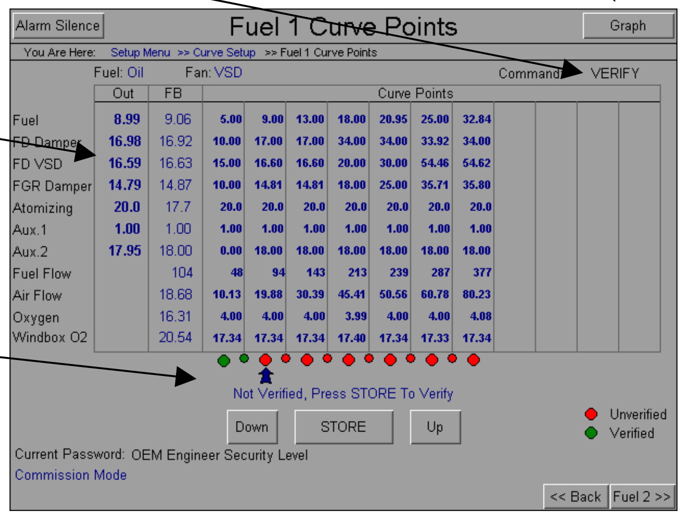
Step 6 – Curve Setup *(continued)*

Current Curve Command Value

Graph button displays curve points graphically

Output values are editable in the Set Point Screens.

Points and midpoints are displayed as verified or not. The blue arrow shows current position.

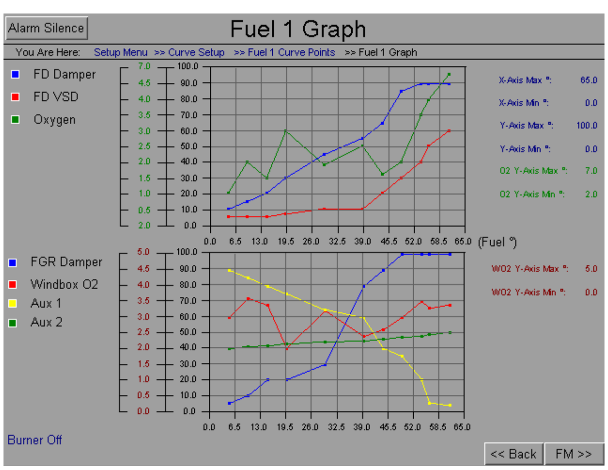


This page displays the curve points in the controller. Each point is displayed in text form for each used function. Some of the values will be hidden if the application does not require them.

For Set Point, use the editable Out values to drive the outputs to the desired positions. Pressing store will save the points. (For detailed overview of Set Point, see the curve section of this manual)

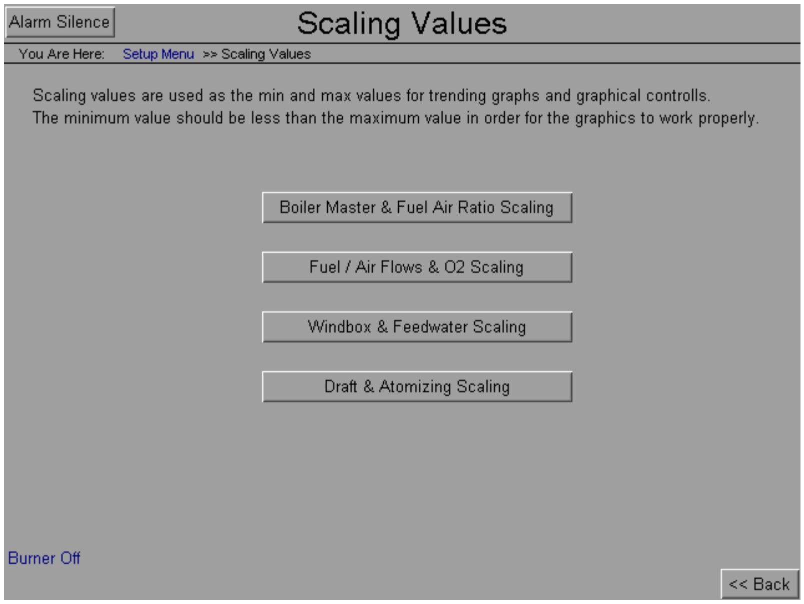
For Verify Points, use the Up and Down buttons to move to each Point and midpoint. Press store to verify. (For detailed overview of Verify Point, see the curve section of this manual)

Graph Button jumps to the detailed graph of the curve points. X and Y values for the different plots are editable.

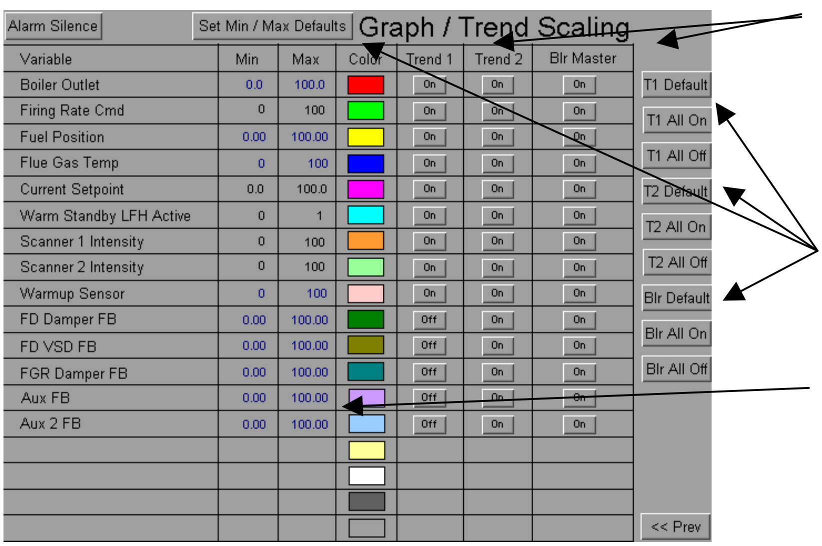


X and Y plots are editable

Step 7 – Scaling for Trending and Tuning



Trended values are split into four groups. Each group of pens is used in the trending section, as well as in the tuning control pages. Individual scaling has been added for points that require scaling, and the technician has full control over which pens are made visible.



Variable	Min	Max	Color	Trend 1	Trend 2	Blr Master
Boiler Outlet	0.0	100.0		On	On	On
Firing Rate Cmd	0	100		On	On	On
Fuel Position	0.00	100.00		On	On	On
Flue Gas Temp	0	100		On	On	On
Current Setpoint	0.0	100.0		On	On	On
Warm Standby LFH Active	0	1		On	On	On
Scanner 1 Intensity	0	100		On	On	On
Scanner 2 Intensity	0	100		On	On	On
Warmup Sensor	0	100		On	On	On
FD Damper FB	0.00	100.00		Off	On	On
FD VSD FB	0.00	100.00		Off	On	On
FGR Damper FB	0.00	100.00		Off	On	On
Aux FB	0.00	100.00		Off	On	On
Aux 2 FB	0.00	100.00		Off	On	On

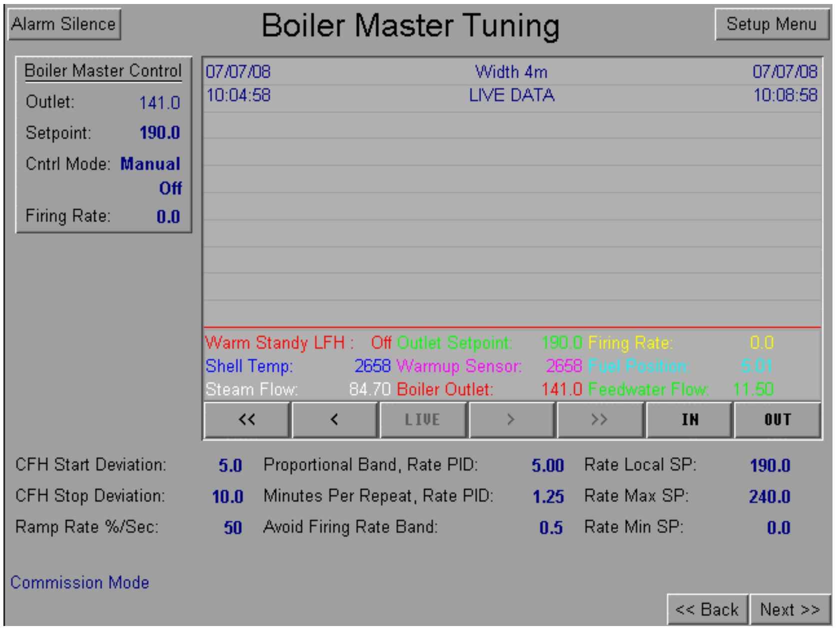
Each group is given two trend pages in the trend loop.

Groups also display values in the tuning pages.

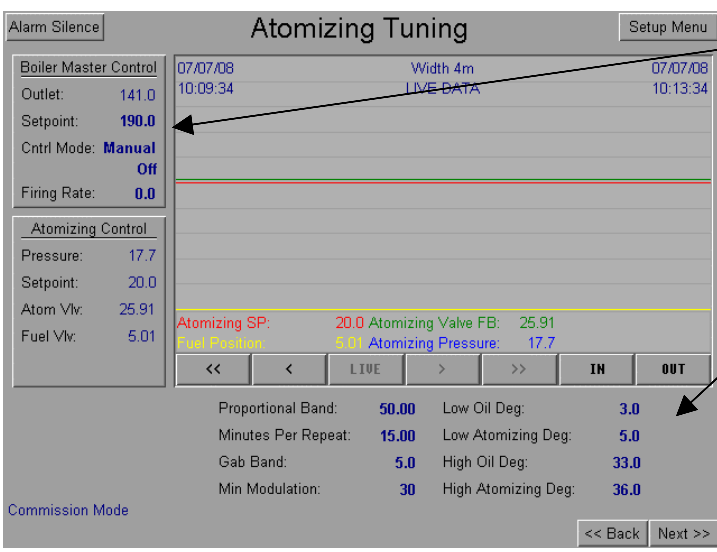
Use the default buttons to preselect default settings

Set the Min and Max for each pen with Blue values. Min MUST be lower than Max.

Step 8 – PID Tuning



Each PID loop is shown with an auto/manual station as well as all relevant tuning parameters. For a detailed overview of tuning a PID loop, see the commissioning section of this manual.



Use the Control Panels to place loops in Manual and set outputs

Tuning Parameters are listed below the trend

Application Questions

Application Questions	Choices/ Options	Application Specifics
What kind of Fired Equipment is installed?	Hot Water Heater, Boiler, and Other	
What style of Fired Equipment?	Firetube or Watertube	
What Type of Added Heat Trap (if any)	Economizer, Air Heater, none	
Where is the FD Fan Located?	Burner Mounted, Remote Mounted	
What Fuels are being fired?	Fuel 1; Fuel 2; Fuel 3	
What source determines the fuel to be fired?	Contacts, Display , Display or Modbus	
What is the fuel transfer method used?	Restart or Low Fire	
Purge Air Flow Switch Installed?	Yes or No	
Do you want Assured Low Fire Cut off enabled?	Enable, Disable	
What type of Power Failure Action?	Recycle, Lockout	
Dual Flame Scanners installed?	Enable, Disable (Disable if you have a single flame scanner installed.)	
Are you using any of the 5 auxiliary relays?	Yes or No	
Do you want a Trip Time Delay Option to prevent nuisance trips?	Yes or No	
What type of combustion Control is being used?	Positioned Servo, Jackshaft Servo	

Flue Gas Temp Monitored?	Yes or No	
Using an Oxygen Analyzer?	Enabled, Disabled	
Add O2 Trim?	Enabled, Disable	
Does the FD Fan have a VSD?	Yes or No	
Is the Efficiency Monitored?	Yes or No	
Are you using a CFH Local Firing Rate Demand?	On or Off	
Call for Heat Options		
CFH Local Firing Rate Demand	Outlet Deviation from SP or Terminal 8 Contact Closure	CFH Local Firing Rate Demand
CFH Remote Firing Rate Demand	Modbus, Outlet Deviation from SP or Terminal 9 Contact Closure	CFH Remote Firing Rate Demand
Remote Firing Rate Demand	Outdoor Air Reset SP, Modbus SP, Terminal AI4 SP, Terminal AI4 Firing Rate or Modbus Firing Rate	Remote Firing Rate Demand
How will the firing rate be controlled?		
Firing Rate Options		
Alternate Local Firing Rate SP	Yes or No	
DHW Firing Rate Override	Yes or No	
Warm Standby Option	No, Terminal 7, Sensor & Terminal 7 or Sensor & Modbus	
Cold Start Warmup Cycle Option	Yes or No	
Low Fire Hold Option	No, Terminal 7, Warmup Sensor	
Is FGR Utilized?	Yes or No	

FGR Temperature Low Fire Hold Option (keep a lower firing rate until a FGR temperature is reached)	Enable or Disable	
Is an FGR Fan Installed?	Yes or No	
Induced Draft Fan Installed?	Yes or No	
Is Feedwater Control being used?	Yes or No	
If Feedwater Control is being used, what kind?	Single Element Two Element Three Element	
What is the valve/pump output type?	Servo Actuated Valve, 4-20 madc Actuated Valve, BFW Pump VSD	
Low Water Cutout Auto Blowdown Option	Enable, Disable	
What will be the Ignition Transformer mode used?	Early Terminate, With Pilot or Direct Spark	
How long is the Main Trial for Ignition?	10 to 15 seconds	
How long is the Purge time?	15 to 1800 seconds	
How Long is the Post Purge Time?	15 to 1800 seconds	
What to do after a power failure?	Recycle or Lockout	
Enable “Assured Low Fire Cutoff” option?	Yes or No	
Are there “Proof of Closure Switches” installed ?	Yes or No	
How many scanners are used?	One or Two	
Are you using Time Delays for the Fuel, Air, Atomizing or Draft?	Yes or No	
Are you using the Gas Leak Test Option? (Fuel 2 only)	Yes or No Vent or no vent valve	
Are you using the Oil Atomizer Purge? (Fuel 1 only)	Yes (Pump back or Blow thru) or No	
High Flue Temperature Alarm/Shutdown?	Yes or No	

What is the Combustion Control Strategy?	Jackshaft or Parallel Positioning	
Does the FD Fan have a VSD?	Yes or No	
Is an O2 Analyzer Installed?	Yes or No	
Is O2 Trim used?	Yes or No	
What kind of boiler outlet sensor is used?	Thermistor, 4-20 mA, 1-5 VDC, 0-5 VDC J-T/C or a K-T/C	
What is the span of the outlet sensor device?	5.0 to 2000.0	
Is Draft Control being used?	Yes or No	
If Draft Control is being used, what kind?	Floating Servo, Floating 4-20 mA Floating with VSD PID Servo PID 4-20 mA PID with VSD PID with VSD and Servo PID with VSD and 4-20 mA	
Are you using the Pressure Control option for the atomizing media?	Yes or No	

Modbus Address Information

Preferred Instruments
31-35 South St, Danbury, CT 06810
203-743-6741, FAX: 203-798-7313

OIT Modbus Ethernet Communication Addresses

Port: 502
Address: field selectable

OIT RS-485 Connection Addresses (Optional)

Address: 1
Port Settings: 38400, 8,1,None

Revised: 8/25/2008

Address	Description	Write Enabled	EGU for 0	EGU for 10000	Notes
400001	Scanner 1 Signal	ReadOnly	0	10000	0 = "4-20 mA" ; 1 = "0-20 mA" ; 2 = "0-5 V" ; 3 = "0-3 V" ; 4 = "0-1 V" ;
400002	Scanner 2 Signal	ReadOnly	0	10000	0 = "4-20 mA" ; 1 = "0-20 mA" ; 2 = "0-5 V" ; 3 = "0-3 V" ; 4 = "0-1 V" ;
400003	Fuel 2 Enable	ReadOnly	0	10000	0 = "DISABLED" ; 1 = "GAS" ; 2 = "bGAS" ; 3 = "dGAS" ; 4 = "oGAS" ; 5 = "FUEL2" ;
400004	Fuel 3 Enable	ReadOnly	0	10000	0 = "DISABLED" ; 1 = "bGAS" ; 2 = "dGAS" ; 3 = "oGAS" ; 4 = "FUEL3" ;
400005	Decimal Point- Boiler Outlet	ReadOnly	0	10000	0 = "xxxxx" ; 1 = "xxx.x" ;
400006	Xmtr Span- Boiler Outlet	ReadOnly	0	1000	
400007	Draft @ 20 mA- Xmtr Cal	ReadOnly	0	10	
400008	Draft @ 4 mA- Xmtr Cal	ReadOnly	0	10	
400009	Drum Level @ 4 mA- Xmtr Cal	ReadOnly	0	100	
400010	Drum Level @ 20 mA- Xmtr Cal	ReadOnly	0	100	
400011	Decimal Point- Steam Flow	ReadOnly	0	10000	0 = "xxxxx" ; 1 = "xxx.x" ; 2 = "xx.xx" ;
400012	Flow @ 20 mA- Steam Flow	ReadOnly	0	10000	
400013	Decimal Point- Feedwater Flow	ReadOnly	0	10000	0 = "xxxxx" ; 1 = "xxx.x" ; 2 = "xx.xx" ;
400014	Flow @ 20 mA- Feedwater Flow	ReadOnly	0	10000	
400015	DraftSP	ReadOnly	0	10	
400016	Valve/Pump Output Type	ReadOnly	0	10000	0 = "Servo Valve" ; 1 = "AO3 Valve" ; 2 = "AO3 VSD" ;
400017	Drum Level SP	ReadOnly	0	100	
400018	Decimal Point- Oil Flow Pulser Freq. Span	ReadOnly	0	10000	1 = "xxx.x" ; 2 = "xx.xx" ;
400019	Pulser Frequency Span- Oil Flow	ReadOnly	0	10000	
400020	GPH Span- Oil Flow	ReadOnly	0	10000	
400021	Decimal Point- Oil Flow	ReadOnly	0	10000	0 = "xxxxx" ; 1 = "xxx.x" ;
400022	Decimal Point- Gas Flow	ReadOnly	0	10000	0 = "xxxxx" ; 1 = "xxx.x" ; 2 = "xx.xx" ;
400023	Flow @ 20 mA- Gas Flow	ReadOnly	0	10000	
400024	Decimal Point- Fuel 3 Flow	ReadOnly	0	10000	0 = "xxxxx" ; 1 = "xxx.x" ; 2 = "xx.xx" ;
400025	Flow @ 20 mA- Fuel 3 Flow	ReadOnly	0	10000	
400026	Fuel1FlowSP	ReadOnly	0	100	

400027 Oil Servo SP	ReadOnly	0	100	
400028 Oil Servo FB	ReadOnly	0	100	
400029 Fuel2FlowSP	ReadOnly	0	100	
400030 Gas Servo SP	ReadOnly	0	100	
400031 Gas Servo FB	ReadOnly	0	100	
400032 Fuel3FlowSP	ReadOnly	0	100	
400033 Fuel 3 Servo SP	ReadOnly	0	100	
400034 Fuel 3 Servo FB	ReadOnly	0	100	
400035 FD Servo SP	ReadOnly	0	100	
400036 FD Servo FB	ReadOnly	0	100	
400037 FD VSD Hz SP	ReadOnly	0	100	
400038 FD VSD Hz FB	ReadOnly	0	100	
400039 Aux Servo SP	ReadOnly	0	100	
400040 Aux Servo FB	ReadOnly	0	100	
400041 FGR Servo SP	ReadOnly	0	100	
400042 FGR Servo FB	ReadOnly	0	100	
400043 Aux 2 SP	ReadOnly	0	100	
400044 Aux 2 FB	ReadOnly	0	100	
400045 LinkTrimOut	ReadOnly	0	100	
400046 LinkTrimFB	ReadOnly	0	100	
400047 Fuel1or2ValveFB	ReadOnly	0	100	
400048 Jackshaft Servo FB	ReadOnly	0	100	
400049 Draft Servo FB	ReadOnly	0	100	
400050 Feedwater Servo FB	ReadOnly	0	100	
400051 Firing Rate FB	ReadOnly	0	1000	
400052 Fuel2Pressure	ReadOnly	0	100	
400053 Fuel1or2ValveOut	ReadOnly	0	100	
400054 Jackshaft Servo SP	ReadOnly	0	100	
400055 Firing Rate %	ReadOnly	0	100	
400056 RateFB	ReadOnly	0	1000	
400057 WarmUpSensor	ReadOnly	0	10000	
400058 SysMessage	ReadOnly	0	10000	
400059 BMS State	ReadOnly	0	10000	
400060 Selected Fuel	ReadOnly	0	10000	0 = "None" ; 1 = "Oil" ; 2 = "Gas" ; 3 = "Fuel3" ;
400061 Scanner 1	ReadOnly	0	10000	
400062 Scanner 2	ReadOnly	0	10000	
400063 Firing Rate	ReadOnly	0	1000	
400064 Oxygen	ReadOnly	0	100	
400065 Flue Temp	ReadOnly	0	10000	
400066 O2 Trim	ReadOnly	0	100	
400067 O2 Trim PID SP	ReadOnly	0	100	
400068 Fuel Demand deg	ReadOnly	0	100	
400069 Outlet Setpoint	ReadOnly	0	1000	
400070 Draft	ReadOnly	0	10	
400071 DraftDamperCmd	ReadOnly	0	100	
400072 DraftVSDCmd	ReadOnly	0	100	

400073 Draft Damper SP	ReadOnly	0	100
400074 Draft VSD SP	ReadOnly	0	100
400075 Drum Level	ReadOnly	0	100
400076 FeedwaterOutputCmd	ReadOnly	0	100
400077 Steam Flow	ReadOnly	0	10000
400078 Feedwater Flow	ReadOnly	0	10000
400079 FWFlowSP	ReadOnly	0	100
400080 Feedwater Valve SP	ReadOnly	0	100
400081 Feed Pump VSD SP	ReadOnly	0	100
400082 HWRTemp	ReadOnly	0	100
400083 Outdoor Air Temp	ReadOnly	0	10000
400084 Boiler Outlet Temp/Press	ReadOnly	0	10000
400085 Combustion Efficiency	ReadOnly	0	100
400086 Oil Flow	ReadOnly	0	10000
400087 Gas Flow	ReadOnly	0	10000
400088 Fuel 3 Flow	ReadOnly	0	10000
400089 Air Flow	ReadOnly	0	100
400090 Gas Pressure	ReadOnly	0	100
400091 Air Flow Temperature	ReadOnly	0	100
400092 Atomizing Pressure	ReadOnly	0	1000
400093 Air Flow SP	ReadOnly	0	100
400094 Air Flow Trim	ReadOnly	0	100
400095 Atomizing Valve SP	ReadOnly	0	100
400096 Air Flow- O2 Trimmed	ReadOnly	0	100
400097 Windbox Oxygen	ReadOnly	0	100
400098 Windbox Oxygen Setpoint	ReadOnly	0	100
400099 Unscaled FGR Trim	ReadOnly	0	100
400100 SPARE			
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Address	Description	Write Enabled	Coil for 0	Coil for 1	Notes
1	CFH Local Mode	ReadOnly	Terminal 8	SP Deviation	
2	Air Flow Trim Manual Cmd	ReadOnly	Auto	Manual	
3	Manual SP Mode- 3 Elem FW Flow	ReadOnly	Auto	Manual	
4	FGR Trim Manual Cmd	ReadOnly	Auto	Manual	
5	Enable Remote Mode	ReadOnly	Disabled	Enabled	
6	RateRemoteCmd	ReadOnly	Local	Remote	
7	RateAutoCmd	ReadOnly	Manual	Auto	

8	DraftAutoCmd	ReadOnly	Manual	Auto
9	FeedwaterAutoCmd	ReadOnly	Manual	Auto
10	Commission Mode	ReadOnly	Off	On
11	ServoEnabledFuel1Valve	ReadOnly	Off	On
12	ServoEnabledFuel2Valve	ReadOnly	Off	On
13	ServoEnabledFuel3Valve	ReadOnly	Off	On
14	ServoEnabledFuel1Or2Valve	ReadOnly	Off	On
15	ServoEnabledFDDamper	ReadOnly	Off	On
16	ServoEnabledAux	ReadOnly	Off	On
17	ServoEnabledFGRDamper	ReadOnly	Off	On
18	ServoEnabledLinkTrim	ReadOnly	Off	On
19	ServoEnabledJackshaft	ReadOnly	Off	On
20	ServoEnabledDraftDamper	ReadOnly	Off	On
21	ServoEnabledFeedwaterValve	ReadOnly	Off	On
22	ServoEnabledAtomizingValve	ReadOnly	Off	On
23	ServoEnabledAux2	ReadOnly	Off	On
24	Draft Servo Alarm	ReadOnly		Alarm
25	Feedwater Servo Alarm	ReadOnly		Alarm
26	Atomizing Servo Alarm	ReadOnly		Alarm
27	Oil SSOV Open	ReadOnly	Closed	Open
28	Gas SSOV Open	ReadOnly	Closed	Open
29	Fuel 3 SSOV Open	ReadOnly	Closed	Open
30	Flame Scanner 1 Signal Alarm	ReadOnly	Disabled	Enabled
31	Flame Scanner 2 Signal Alarm	ReadOnly	Disabled	Enabled
32	Lockout	ReadOnly		
33	Holding	ReadOnly		
34	Alarm	ReadOnly		
35	RO Safety Relay	ReadOnly	Off	On
36	RO.51 Ign Xfmr	ReadOnly	Off	On
37	RO.52 Pilot	ReadOnly	Off	On
38	RO.53 Atomizing	ReadOnly	Off	On
39	RO.54 Oil SSOV	ReadOnly	Off	On
40	RO.55 Oil Gun Purge	ReadOnly	Off	On
41	RO.56 Gas SSOV	ReadOnly	Off	On
42	RO.57 Fuel3 SSOV/LT DownStr SSOV	ReadOnly	Off	On
43	RO.58 Gas Vent	ReadOnly	Off	On
44	RO.59 FD Fan	ReadOnly	Off	On
45	RO.61 Lockout	ReadOnly	Off	On
46	RO.62 Option 1	ReadOnly	Off	On
47	RO.63 Option 2	ReadOnly	Off	On
48	RO.66 Option 3	ReadOnly	Off	On
49	RO.69 Option 4	ReadOnly	Off	On
50	RO.72 Option 5	ReadOnly	Off	On
51	IO_AuxStarterOptionRelay	ReadOnly	Off	On
52	IO_CommonAuxsOptionRelay	ReadOnly	Off	On
53	IO_Fuel1AuxiliaryOptionRelay	ReadOnly	Off	On

54 IO_Fuel2AuxiliaryOptionRelay	ReadOnly	Off	On
55 IO_Fuel3AuxiliaryOptionRelay	ReadOnly	Off	On
56 IO_FlameOnOptionRelay	ReadOnly	Off	On
57 IO_BlowdownValveOptionRelay	ReadOnly	Off	On
58 IO_CommonAlarmOptionRelay	ReadOnly	Off	On
59 IO_HotWaterPumpOptionRelay	ReadOnly	Off	On
60 IO_Fuel1OpenOptionRelay	ReadOnly	Off	On
61 IO_Fuel2OpenOptionRelay	ReadOnly	Off	On
62 IO_Fuel3OpenOptionRelay	ReadOnly	Off	On
63 IO_FuelXOpenOptionRelay	ReadOnly	Off	On
64 IO_LimitsMadeOptionRelay	ReadOnly	Off	On
65 DI.1 Ext Reset	ReadOnly	Off	On
66 DI.2 Alt SP	ReadOnly	Off	On
67 DI.3 FD Fan Type	ReadOnly	VSD	Fixed Speed
68 DI.4 LWC Bypass PB	ReadOnly	Off	On
69 DI.5 Low Water Level	ReadOnly	OK	Alarm
70 DI.6 High Water Level	ReadOnly	OK	Alarm
71 DI.7 WarmUp or DHW	ReadOnly	Off	On
72 DI.8 Local CFH	ReadOnly	Off	On
73 DI.9 Remote CFH	ReadOnly	Off	On
74 DI.10 Burner On/Off	ReadOnly	Off	On
75 DI.11 Oper Limit	ReadOnly	Off	On
76 DI.12 ALWC	ReadOnly	Off	On
77 DI.13 Low Water Flow	ReadOnly	Off	On
78 DI.14 Fresh Air Open	ReadOnly	Off	On
79 DI.15 Recycle Spare 1	ReadOnly	Off	On
80 DI.16 Oil Fuel Select	ReadOnly	Off	On
81 DI.17 HOP	ReadOnly	Off	On
82 DI.18 LOP	ReadOnly	Off	On
83 DI.19 LASP	ReadOnly	Off	On
84 DI.20 LASF	ReadOnly	Off	On
85 DI.21 HOT or LOT	ReadOnly	Off	On
86 DI.22 Oil Gun In Place	ReadOnly	Off	On
87 DI.23 Gas Fuel Select	ReadOnly	Off	On
88 DI.24 HGP	ReadOnly	Off	On
89 DI.25 LGP	ReadOnly	Off	On
90 DI.26 Fuel 3 Select	ReadOnly	Off	On
91 DI.27 Fuel 3 HP	ReadOnly	Off	On
92 DI.28 Fuel 3 LP	ReadOnly	Off	On
93 DI.29 E Stop	ReadOnly	Off	On
94 DI.30 Scanner 1	ReadOnly	Off	On
95 DI.31 Scanner 2	ReadOnly	Off	On
96 DI.32 High Limit	ReadOnly	Off	On
97 DI.33 MAF	ReadOnly	Off	On
98 DI.34 FD Fixed Starter	ReadOnly	Off	On
99 DI.35 FD VSD Starter	ReadOnly	Off	On

100 DI.36 LWC	ReadOnly	Off	On
101 DI.37 HWC	ReadOnly	Off	On
102 DI.38 LDCO/HFP	ReadOnly	Off	On
103 DI.39 ID Starter	ReadOnly	Off	On
104 DI.40 FGR Starter	ReadOnly	Off	On
105 DI.41 NonRecycle Spare 1	ReadOnly	Off	On
106 DI.42 NonRecycle Spare 2 / HLTP	ReadOnly	Off	On
107 DI.43 NonRecycle Spare 3 / LLTP	ReadOnly	Off	On
108 DI.44 Draft Damper Open	ReadOnly	Off	On
109 DI.45 Null Windbox O2 FGR Trim	ReadOnly	Off	On
110 DI.46 PAF	ReadOnly	Off	On
111 DI.47 Oil SSOV POC	ReadOnly	Off	On
112 DI.48 Gas SSOV POC	ReadOnly	Off	On
113 DI.49 Fuel 3 POC/Gas SSOV2 POC	ReadOnly	Off	On
114 ROFB Safety Relay	ReadOnly	Off	On
115 ROFB.51 Ign Xfmr	ReadOnly	Off	On
116 ROFB.52 Pilot	ReadOnly	Off	On
117 ROFB.53 Atomizing	ReadOnly	Off	On
118 ROFB.54 Oil SSOV	ReadOnly	Off	On
119 ROFB.55 Oil Gun Purge	ReadOnly	Off	On
120 ROFB.56 Gas/Fuel	ReadOnly	Off	On
121 ROFB.57 Fuel3 SSOV/LT DownStr SSOV	ReadOnly	Off	On
122 High Flue Temp Alarm	ReadOnly		Alarm
123 Bad Remote Alarm	ReadOnly		Alarm
124 Bad OAT Alarm	ReadOnly		Alarm
125 Bad Modbus Alarm	ReadOnly		Alarm
126 Low Draft Alarm	ReadOnly		Alarm
127 DraftManualEnable	ReadOnly	Disabled	Enabled
128 Drum High Level	ReadOnly		Alarm
129 Drum Low Level	ReadOnly		Alarm
130 SPARE			
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Address	Description	Write Enabled	EGU for 0	EGU for 10000	Notes
400201	Firing Rate	Read / Write	0	1000	
400202	Outlet Setpoint	Read / Write	0	1000	
400203	DraftDamperCmd	Read / Write	0	100	
400204	DraftVSDCmd	Read / Write	0	100	
400205	FeedwaterOutputCmd	Read / Write	0	100	
400206	SPARE				
400207	SPARE				
400208	SPARE				
400209	SPARE				
400210	SPARE				

Address	Description	Write Enabled	Coil for 0	Coil for 1	Notes
201	RateAutoCmd	Read / Write	Manual	Auto	
202	DraftAutoCmd	Read / Write	Manual	Auto	
203	FeedwaterAutoCmd	Read / Write	Manual	Auto	
204	SPARE				
205	SPARE				
206	SPARE				
207	SPARE				
208	SPARE				
209	SPARE				
210	SPARE				