

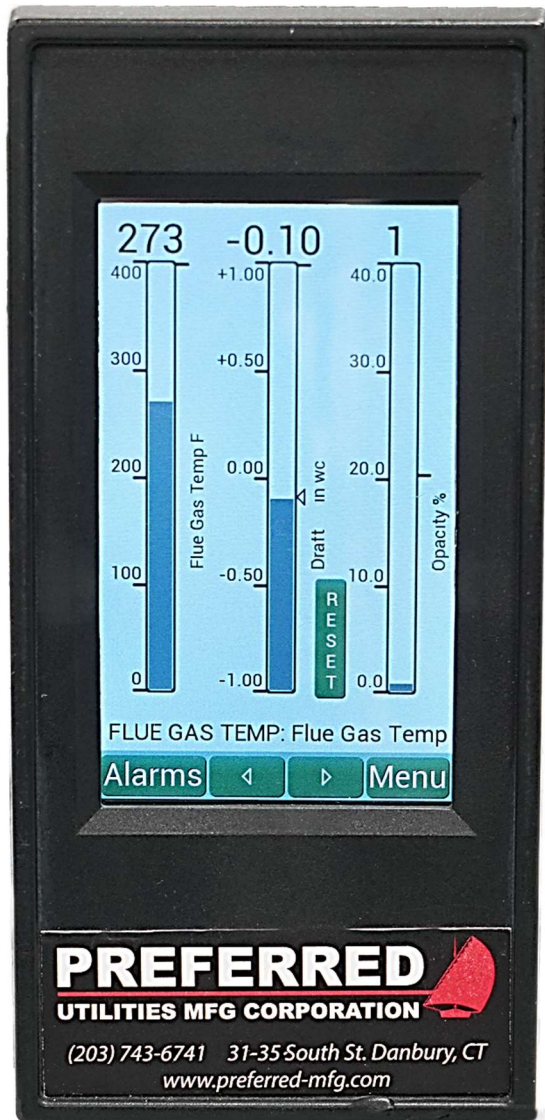
Preferred Utilities Mfg Corp

Preferred Instruments div.
31-35 South Street, Danbury CT 06810
203-743-6741 www.preferred-mfg.com

JC-23D2 Flue Temp, Opacity, Draft Controller

NYC DEP Accepted

Installation & Operation Instructions



The **JC-23D2** 3-in-1 Flue Temp, Opacity and Draft controller maintains the flue gas at a constant positive or negative Draft by modulating the outlet damper on a boiler or furnace while also monitoring flue gas temperature and stack opacity. A separate 4-20mA Draft transmitter is required to modulate the damper.

The **JC-23D2** interfaces to the burner flame safeguard to automatically sequence the outlet damper Open for: Purge, Light-Off, and Post-Purge. The sequence closes the damper after the burner shutdown to minimize heat loss up the stack.

A separate time delayed Draft Cutout switch wired into the flame safeguard Lockout Limits is required by Code for Safety.

The **JC-22XMTR-xxCO** includes a separate Draft xmtr and a separate time delayed Draft Cutout switch in a single enclosure to reduce installation effort.

The **JC-23D2** includes a burner shutdown relay that can be wired into the FSG limits circuit for a high flue temp shutdown or a high opacity shutdown or both.

Features

- Automatic Draft Control for increased boiler efficiency and reliability.
- Precision Outlet Draft Control for low NOx induced FGR burners.
- Firing Rate Feedforward option is included and assures stable draft during load changes. Separate curves for up to two fuels.
- Automatic Damper Sequencing for purge, lightoff, post-purge burner shutdown, and standby. Simple Flame Safeguard interface.
- Damper Adjustable Start Position option is included for installations with excessively high draft during lightoff.
- High Flue Temp, Draft, and Opacity Alarms with time stamped alarm and event history.
- Light Source and Sensor 190851S and 190851D interface directly with the JC-23D2.
- Opacity Calibration is automated, there are no manual adjustments.
- Automatic Opacity Calibration can be configured to occur when the burner fan shuts off.
- Flue Temperature Sensor accepts Type J or K thermocouple input.
- 5" Color LED Touchscreen for easy viewing. All setup can be done from the touchscreen.
- Modbus Communication with RS-485 and Ethernet capability.

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SAFETY



DANGER

Electric Shock Hazard

Multiple power sources may be present.

Disconnect all electric power sources, local and remote, before servicing



WARNING

This product is intended for use in Commercial and Industrial installations,
it is NOT intended for Residential use.

This product is intended to be used by Trained Operators.

Installation, start-up, and troubleshooting is intended to be done by
Experienced Technicians familiar with Industrial Safety Codes
and all Safety Codes specific to burners and boilers.



WARNING

This product is NOT a Primary Safety Interlock rated device.

The Relay Outputs should only be used as an
additional auxiliary Operating limit and should not replace or bypass
any Primary Safety Interlock devices required by Safety Codes.

A High Draft Cutout switch and Open Damper position switch are required
to be installed and wired into the flame safeguard system.

Failure to do so can result in equipment damage, injury, or death.

If the Adjustable Starting Draft Option is used,
an additional Outlet Damper Low Fire Start position proving switch
will be required and wired into the flame safeguard low fire circuit.

**Incorrect wiring connections to burner/boiler Flame Safeguard controls
can cause Equipment Damage, Injury, or Death**

Operation

Home Screens

When all three channels are enabled, there are 5 home screens that can be cycled with the left/right arrows. The 5 home screens are: 3-Bargraph screen, single bargraph flue temp, single bargraph draft, single bargraph opacity, and 3-channel large number screen.

All bargraph scaling can be configured in the setup menus. On the single bargraph draft screen, there is an auto/manual button and an output command for manual operation of the draft output.

If a channel is not being used, that channel's bargraph and home screen will not be displayed. At least one channel must be enabled at all times.

Alarms

The lower left button on all screens indicates one of these three words:

Silence or **Alarms** or **History**

When a new Alarm occurs, **Silence** and the bargraph blink, and the Alarm Relay energizes. Touch **Silence** to stop the blinking and to de-energize the Alarm Relay.

Alarms is displayed after silencing (if an Alarm is still active).

History is displayed when there are no active Alarms.

Active Alarms Screen

From any other screen, touch the **Alarms** button to display the Active Alarms Screen.

If there are no active Alarms, **Alarms** will not be displayed on the Home or Menu screens.

All active Alarms are displayed on this screen: High Draft Pressure Alarm, Configuration Errors, Hardware Faults, etc....

When the Alarms screen is displayed, **History** and **Home** are displayed.

Touch **History** to display the History screen.

Touch **Home** return to the Home screen.

History

Touch **History** to display the History screen.

The History screen displays the Time/Date of the most recent 50 Alarms and Events.

Events include: when an Alarm Clears, a Shutdown Reset, JC-23D2 power-up, etc..

For High Flue Temp alarms, the peak temperature is recorded in the alarm history.

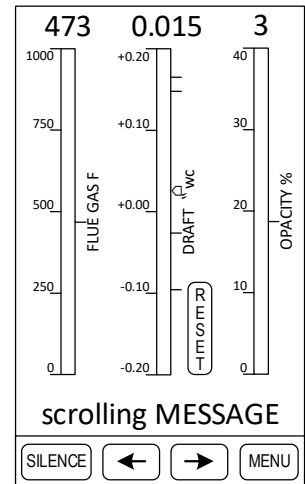
Touch the **Up** or **Down** arrow to advance to the next page of History. Touch **Date** to enter a time/date and then to jump to the nearest History records.

The **Hide Events** and **Show Events** removes or displays Events.

The History memory is retained when powered down. The History can be extracted via the USB port using the free JC_TG_Edit Windows App.

Menu Screens

To set clock, Alarm Setpoints, and other initial Setup.....See pages 12-15



Active Alarms		
Servo Not Moving		
ALARM	13:25:18	
	10/07	
High Draft		
0.56 in wc ALARM	13:23:47	
	10/07	

History Home

History	▲ ▼	Date
Servo Not Moving		
ALARM		13:25:18
		10/07
High Draft		
0.56 in wc ALARM		13:23:47
		10/07
AIN B1-2: Out Of Range Low		
Clear		08:15:37
		10/07
AIN B1-2 Out Of Range Low		
ALARM		08:15:13
		10/07
Powerup		
		08:07:16
		10/07

Silence Hide Events Home

Alarms Show Events

High Flue Temp Alarm Sequence

The Bargraph and Numeric display continuously indicate the flue gas temperature (FGT). The "Warning" and "Shutdown" alarm setpoints are indicated on the bargraph with tic marks. If the FGT exceeds the Warning Setpoint for more than 30 seconds (adjustable), the bargraph blinks, the WARNING message appears, the Common Alarm Relay energizes, and the current temperature is logged with a time/date stamp. Pressing the ALARM SILENCE button de-energizes the Common Alarm Relay.

If the FGT continues to increase and exceeds the Shutdown setpoint for more than 15 seconds (adjustable), the bargraph blinks, the SHUTDOWN message appears, the Shutdown relay de-energizes and latches into "Manual Reset" mode, the Common Alarm Relay re-energizes, and the current temperature is logged with a time/date stamp. Pressing the ALARM SILENCE button de-energizes the Common Alarm Relay.

If the **JC-23D2** Shutdown relay is wired into the burner Start Limits, the burner shuts down. The Shutdown Relay remains de-energized and the SHUTDOWN message remains on the display. After the temperature has fallen below the "shutdown" setpoint, the Operator can press the RESET pushbutton to energize the Shutdown relay.

The Common Alarm Relay can be used to activate an external bell or horn. If the **JC-23D2** is not in SHUTDOWN, the Common Alarm Relay de-energizes automatically when the temperature drops below the Warning Alarm setpoint. Alternately, pressing the **JC-23D2** Alarm Silence pushbutton, or energizing the 120 Vac Alarm Silence input, or the 24 Vdc Alarm Silence input, or sending a Modbus command will de-energize the Common Alarm Relay in order to silence an audible alarm.

Opacity Alarm Sequences

STANDARD Sequence

The hash mark to the right of the bargraph indicates the Alarm Setpoint. The Alarm contacts will close and the bargraph will blink if the Opacity has been above the Setpoint continuously for 20 seconds (adjustable from 0-120 sec.).

Press the **Silence** button to stop the blinking and to de-energize the Alarm Relay (typically wired to an external bell, horn, or strobe).

When the opacity drops below the Setpoint, the bargraph will stop blinking and the Alarm relay will de-energize (if it hadn't already been Silenced).

If the Opacity is continuously above the Alarm Setpoint for more than 120 seconds (adjustable from 0-180 sec.), the Shutdown relay will de-energize and display the message SHUTDOWN. Typically, the Shutdown relay N.O. contacts are wired in series with the burner Operating Limits circuit and this will cause the burner to shutdown.

After the opacity has dropped below the Alarm Setpoint, you must press the RESET button to re-energize the Shutdown before the burner can re-start (assuming the shutdown contacts are wired to shutdown the burner). The Shutdown Relay remains de-energized, the burner will not re-start, and SHUTDOWN is displayed until the JC-23D2 has been RESET.

If the AC power has cycled Off and then ON, the JC-23D2 cannot be RESET until after the Lamp has completed WARM UP.

NYC-BAR Sequence

The NYC-BAR Sequence is the same as the STANDARD Sequence described above with two differences:

The **Alarm Time Delay** is fixed at 0 seconds and cannot be adjusted. This means that the Alarm Relay will activate as soon as the Opacity is greater than the Alarm Setpoint.

The **Shutdown Time Delay** is fixed at 120 seconds and cannot be adjusted.

A **30% Opacity Test Filter** is attached to the Light Source. You can clean the windows/Lens and then hang the filter on the screw to verify that the Alarm Setpoint is set correctly and that the calibration is reasonable. The 30% Opacity value of the filter is approximate.

Operation (Continued)

Window-Lens Cleaning

- The Light Source window, Light Detector lens, and any Purge Cap windows should be cleaned periodically. Use a soft, lint free cloth dampened with "Windex".
- Re-calibrate after every cleaning** (from the CALIBRATE Menu).
- If cleaning the windows/lens and re-calibrating doesn't clear the "LENS IS DIRTY" message, then the Source and Detector might need to be re-aligned.

The message "LENS IS DIRTY" is displayed after a calibration when:

0% Opacity mA is less than 15 and Detector Gain = High and Lamp Brightness = 17.

Re-calibration fails when 0% Opacity ("0 mA") is less than 8.

		↑	↓	DATE
CALIBRATION HISTORY				
Before-After-Lamp-Gain-0 mA-100 mA				
16	0	17	H	17.24 3.96
10/20/20 07:03 18 Fan Starts				
15	0	16	H	22.93 3.92
10/15/20 21:03 1 Fan Starts				
Calibration Failed:				
Calibration Aborted by Fan				
10/15/20 14:10 22 Fan Starts				
10	0	14	H	22.03 3.96
10/11/20 13:32 20 Fan Starts				
12	0	12	H	22.73 3.90
10/07/20 13:01 24 Fan Starts				
14	0	10	H	21.58 3.95
10/03/20 12:32 21 Fan Starts				

The **Calibration History** screen (Menu/Calibrate Opacity/Calibration History) shows the results of the last 60 calibrations. The trend of increasing Lamp values, then decreasing 0 mA values, allows you to anticipate a nuisance Opacity shutdown.

"Before" is the Opacity (due to dirt/soot) just before a calibration.. If these values are consistently near the Alarm setpoint, increase Purge air flow or service the burner or re-calibrate more frequently, to prevent nuisance shutdowns.

"Fan Starts" is the number of starts since the last calibration. If a small number of starts increases "Before" opacity, consider cleaning the oil nozzles or changing the burner light-off settings to reduce the initial puff of soot.

If the AutoCal is enabled (see page 10), the time interval between Lens cleanings will be much longer because AutoCal calibrates out the normal dust build-up on the optical surfaces. AutoCal can prevent nuisance Lockouts due to soot buildup.

Calibration

Calibration is required After Installing; After cleaning the windows & Lens; After Source or Detector re-alignment; or After the LED Lamp has been replaced.

How to Start a Calibration:

- The burner fans must be OFF during the entire calibration.
- Once started by the User, Calibration is fully automated and takes approximately 3 minutes.
- From the Home screen, touch **Menu**, then **Calibrate Opacity**, then **Calibrate Now**
- Wait: For Stack to Clear** displays and counts down to 0 after the burner Fan stops to allow dust to settle.
- Wait: Lamp Warming Up** displays and counts down to 0 when initially powered up, or whenever the Lamp has been Off.
- When both Waits are done, the **Start** button appears. Press **Start** to begin the Calibration. Press **Back**, **Home**, **Silence**, **Alarms**, or **History** on any of the Calibration screens to abort the Calibration process.
- During the first phase of calibration, the 190851x Light Source "Auto Ranging" occurs, as follows:
 - The Lamp brightness (2-17) and Detector Gain (Low/High) are automatically varied to find the maximum Detector mA signal.
 - The Wait timer counts down from 180 seconds, but can complete Auto Ranging in as short as 120 sec. (depending on distance, alignment, etc...)

Calibrate Opacity	
Detector: xx.xx mA Opacity: xxx.xx %	
Waiting for Warm Lamp ### sec	
OR	Waiting for Burner Fan OFF
OR	Waiting for Clear Stack ### sec
OR	Press Start to Proceed
To Exit: Press BACK or HOME ...Status MESSAGE...	
Silence	Back Home

Alarms

History

Calibrate Opacity	
Detector: xx.xx mA Auto Range in Progress	
Auto Range Waiting for Complete	
Cal Auto Range 180 Sec	
To Exit: Press BACK or HOME ...Status MESSAGE...	

Calibration (continued)

- After a successful AutoRanging is completed, Opacity Calibration begins with ON to find the 0% Opacity mA signal.
- 10 second Wait for the mA signal to start to settle down.
- After that, every 5 seconds the Detector mA signal is checked.
- When two successive mA vales are within 0.3% of each other, the Opacity value is saved.
- Then the Lamp is turned OFF to find the 100% Opacity mA signal.
- When two successive mA vales are within 0.3% of each other, the 100% value is saved.

Calibrate Opacity
Detector: xx.xx mA Calibration in Progress
Auto Range Successful
0% Opacity Cal Settling 10 Sec 0.020 % Change Light Source ON
To Exit: Press BACK or HOME ...Status MESSAGE...

the Lamp

0%

Opacity

- After a successful Calibration is completed, the Auto Ranging and Calibration displayed and is also stored in the Calibration History Log.
- The Lamp turns back ON and the Warm Up delay counts down.
- **If an Error occurs** during Auto Ranging or Opacity Calibration, this screen will with the Error Message (see Trouble Shooting section)
- This screen will continue to be displayed (forever) until the **Back, Home, Alarms,** or **History** button is touched.

Calibrate Opacity
Detector: xx.xx mA Opacity: xxx.xx %
Auto Range Successful Lamp Brightness: 10 Detector Gain: LOW
Calibration Successful 0% Opacity, Detector mA: 22.31 100% Opacity, Detector mA: 4.03
Auto Range Successful
Calibration Successful
To Exit: Press BACK or HOME Waiting for Warm Lamp

data is

display

Silence,

- If **CLEAN LENSE** is displayed on the Status line, the Detector mA signal is very weak. Opacity has been successfully Calibrated. However, if the Optics aren't cleaned and/or re-aligned, the next Calibration might not be successful.

AutoCal After Burner Shutdown

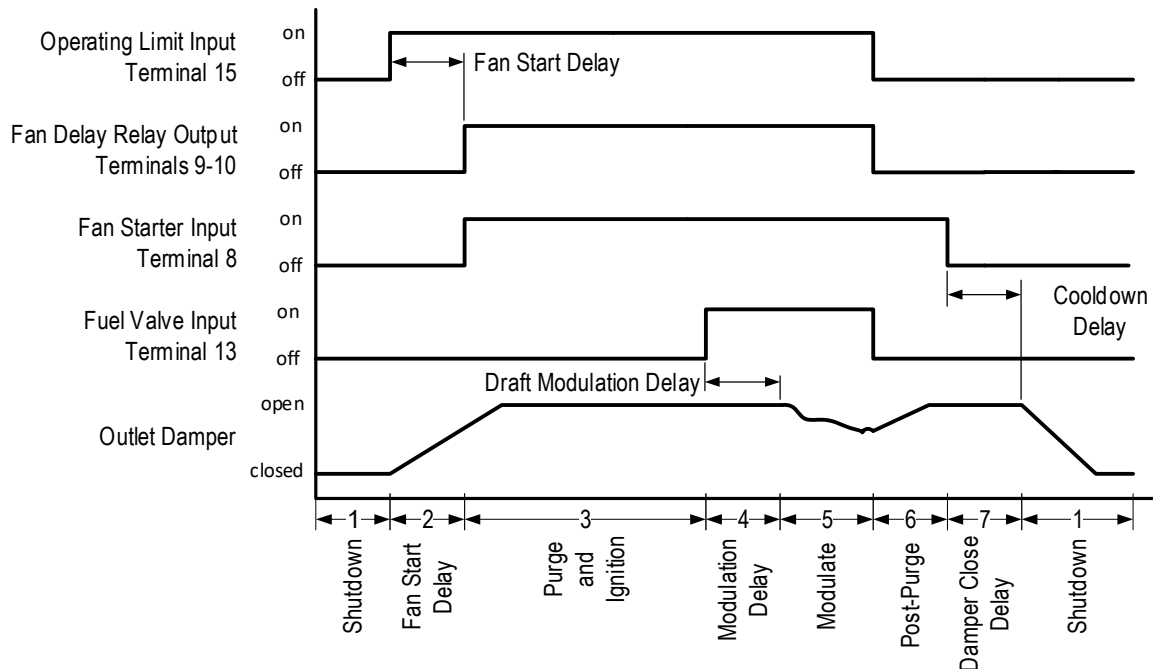
The main reason for Opacity drift and/or nuisance burner trips is soot/dust build-up on the windows or the Detector lens. A calibration cycle cancels out the normal dust/soot build-up on the optical surfaces. The **JC-23D2** can initiate an unattended fully **Automated Calibration (AutoCal)** cycle after the burner fan stops running.

The calibration screens above are not displayed during AutoCal. The normal bargraph screen is displayed with the status message **Auto Calibration in Progress**. After a successful AutoCal has completed **Calibration Successful** is displayed and the data is saved in the Calibration Log. If AutoCal is not successful, the last successful calibration data will continue to be used.

To enable this feature: In the Configure/Setup menu, enable the AutoCal Option, and Wire terminal 8 to the 120 Vac fan starter coil as shown in the Wiring section.

See the Menu section (page 10) for additional AutoCal settings.

Standard Draft Sequence



Sequence Steps	Burner Flame Safeguard Sequence (Typical)	JC-23D2 Draft Controller Sequence
1. Shutdown	Operating Limits, Fan and Fuel Valve inputs = OFF	Fan Delay relay output = OFF
2. Fan Start Delay	"Call for Heat " Operating Limits make and energize JC-23D2 terminal 15. Burner fan starts after JC-23D2 Fan Delay relay energizes.	The JC-23D2 commands the outlet damper to start opening and also starts the 15 sec. (adjustable.) When the timer expires, the Fan Delay relay closes, which completes the Burner Limits input which starts the Burner fan. By then the outlet damper should be open enough to prevent pressurizing the furnace with the burner fan running.
3. Purge	When both burner and outlet damper actuators limit switches make, the Purge starts. When Purge is complete the burner actuator returns to low fire for Ignition.	The outlet damper continues to fully open position. The outlet damper remains wide open.
4. Release To Modulate Delay	Burner main flame trial period	The outlet damper remains wide open. The 15-sec. (adjustable) release to modulate timer holds the outlet damper wide open during the flame safeguard main flame trial period and longer if desired.
5. Modulate	Burner Modulates	Outlet damper modulates when the JC-23D2 is in Auto. In Manual the operator sets the damper position.
6. Post Purge	No Call for Heat (Operating Limits and Fuel Valve inputs = OFF, Fan remains on for post-purge)	The JC-23D2 commands the outlet damper to wide open for post purge.
7. Damper Close Delay	Burner completes post-purge and stops the Fan (Operating Limits, Fan and Fuel Valve inputs = OFF)	Cooldown Delay timer (0 seconds, field adjustable) starts. This timer is typically only used with refractory lined furnaces that need an extended cooldown period. It keeps the outlet damper open for a time delay after the Fan stops. When this timer expires, if the JC-23D2 is in AUTO, the outlet damper moves to the fully closed.

Draft Control Types, Control Options, and Actuators

The JC-23D2 allows field selection of: control types, output/actuator type etc.... The field wiring and the required auxiliary equipment changes based on the selections made. Please read the following descriptions.

Control Types: Floating vs. PID

- **Floating** control has (2) tuning adjustments: Deadband (DB) and Proportional Band (PB). PB slows down the actuator/VSD rate of change (speed) as the Draft approaches the Setpoint, which makes overshoot and oscillation less likely. This makes it easier to tune and provides very good control.
- **PID** control has (3) tuning adjustments: Deadband (DB), Proportional Band (PB), and Integral (I) (also called "Reset"). Instrument Technicians are typically more familiar with this type of controller tuning and can tune for tight Draft control. However, burner technicians who are less familiar with PID tuning can improperly tune the controller and inadvertently cause overshoot and Draft control oscillation.

Command Types: Triac vs. mA

- **Triac** output is used with a 3 wire AC reversible actuator with Open, Close, Neutral terminals. The JC-23D2 internal solid state Triacs energize the Open or Close outputs. Some Triac actuators have a position feedback potentiometer, such as: models R-AL-2A, SM-xx, UM-xxx, some do not: models: PL-2A-xxx. **Triac actuators without a position feedback pot** can not be used with some features, see the compatibility chart below.
- **4-20 mA or 0-20 mA** output can be used with actuators that have with built-in "positioners" (electric or pneumatic) that move the actuator to a position proportional to the mA command. mA outputs can also command an ID Fan VSD. External resistors (available separately) can be used to convert the mA signal into a wide variety of DC voltage signals: 1-5V, 2-10V, 0-5V, 0-10V. The Adjustable Starting Position option cannot be used with a mA Command actuator or VSD.

Firing Rate Feedforward

- During a burner firing rate change, Feedforward control starts to move the damper (or VSD) before the change in burner air flow causes the draft to deviate from the Setpoint. This is very beneficial for low NOx burners that require tight FGR and air flow control in order to prevent combustion issues. The JC-23D2 has a Feedforward Proportional Band tuning adjustment and has 2 "firing rates versus damper position" Feedforward curves for dual fuel burners. See the compatibility chart below.
- A burner Firing Rate signal is required: 4-20mA, 0-5V, 0-10V, or Potentiometer. The **Model SPS (Shaft Position Sensor)** includes linkage for jackshaft style burners

Adjustable Start Position Option

- Installations with extremely tall stacks, or with an oversized ID fan, can create an excessively negative draft if the Draft Damper wide open during light-off. This can cause nuisance pilot flame failures. The default JC-23D2 sequence positions the damper wide open for Purge, Ignition, and Main Flame Trial.
- The Adj. Start Position option positions the damper wide open for Purge and then moves to a partially closed position after Purge completes. When the damper reaches this position, if the measured draft not sufficiently negative, the damper will jog open until the Draft is more negative that the User set Adj. Start Draft Setpoint. When the Draft is acceptable, the JC-23D2 Adj Start Relay Output energizes.
- **NOTE:** This Option should NOT be used unless absolutely required by the site conditions. This Option requires a second damper proving switch to be used as a Burner Flame Safeguard Ignition Interlock, see page 11 wiring diagram.

Configuration Compatibility Chart

Actuator		Compatible Control Type and Options		
Command Type	Triac Feedback	Control Type	Feedforward	Adj. Start Position
Triac	No	Floating	No	No
Triac	Yes	PID or Floating	Yes*	Yes**
4-20 or 0-20 mA damper or VSD	N/A	PID or Floating	Yes*	No

*The controller must have a firing rate input to use the Feed-forward option.

**The controller must have either a firing rate input or a purge/low fire DIN indication from the FSG to use the Adjustable Start option.

Installation

JC-23D2 Indicator Mounting:

The JC-23D2 Indicator is designed for flush mounting in an enclosure located rated NEMA 12 or better.

The JC-23D2 should not be subjected to excessive vibration. Continuous operation is guaranteed over the 32-131 F (0-55C) ambient operating range.

Temperature Sensor Mounting:

The 20" 104087D and the 12" 104087E type J thermocouple temperature sensors are designed for mounting in a NEMA 4 environment. The thermocouple should not be subjected to excessive vibration.

Locate the temperature sensor where the tip of the probe will sense a representative flue gas temperature.

Typically, the tip should be in the middle 1/3 of the flue gas duct. Shielded T/C extension wire is recommended.

Light Source & Detector Mounting

The Light Source and Detector are designed for mounting in an indoor NEMA 1 environment, with 32-149F (0-65C) ambient, and without excessive vibration.

- **See last page for Full Size Cutout Template.**

- Locate such that the light beam passes through the complete smoke profile at all flow rates. See the sketch at right for locations after an Elbow, T, Fan, Damper, or other uneven flow profile.
- Do NOT locate the Light Source and Detector near any sources of bright light (outside windows, light fixtures, ...). If this is not possible, 190713 Light Shields may be required.
- Do NOT locate the Light Source and Detector upstream from an Oxygen Analyzer. Air entering the duct would give a false stack Oxygen indication.
- Locate the Source and Detector where it is accessible for routine cleaning.
- The distance from the face of the Light Source to the face of the Light Detector must be greater than 3 ft. and less than 10 ft.
- The 3/4" mounting pipe should be horizontal.
- The 3/4" mounting pipe maintains the optical alignment from the Source to the Detector. The flue gas heat expands and contracts the pipe length.
One end of the mounting pipe should be welded, or clamped, to the duct.

The other end of the mounting pipe must be free to move.

Do NOT connect BOTH ends of the mounting pipe to the duct.

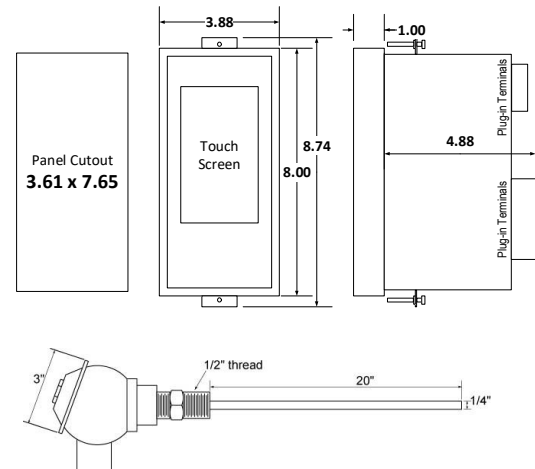
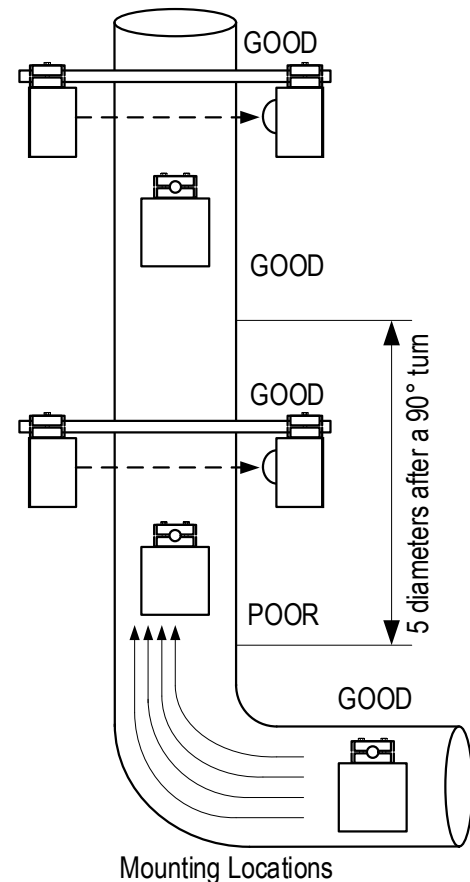
Do NOT use 2 stubs on opposite sides of the duct to mount the Source and Detector because the alignment will shift as the duct heats and cools.

- For positive pressure ducts, install a pressure cap (ie, window) to prevent flue gas and dust from exiting the duct. The 107226P pressure caps can be used without purge air for low soot installations. For high soot applications, clean dry compressed air should be connected to 107226P pressure caps.

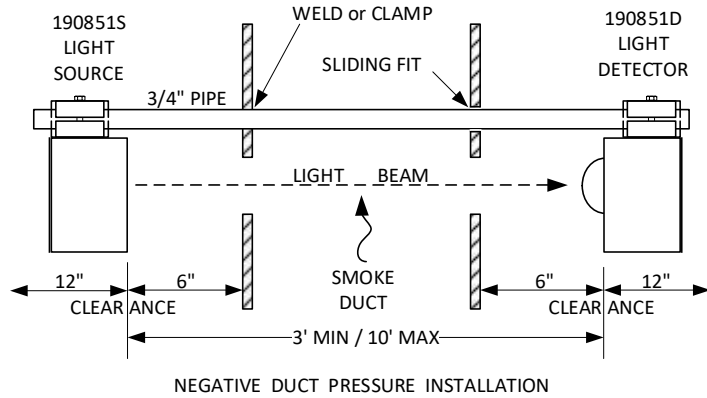
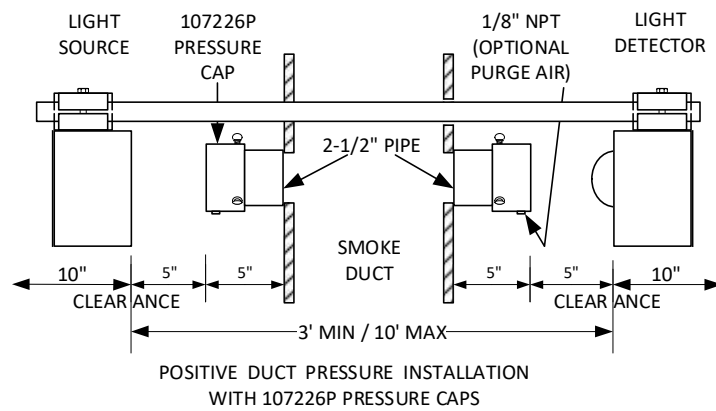
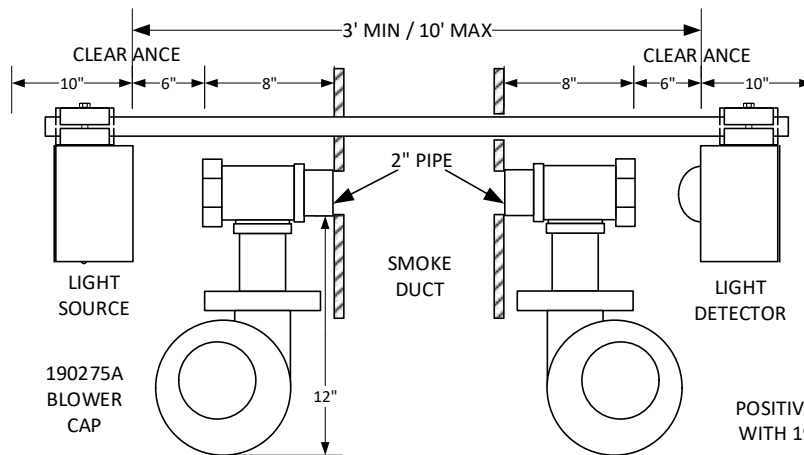
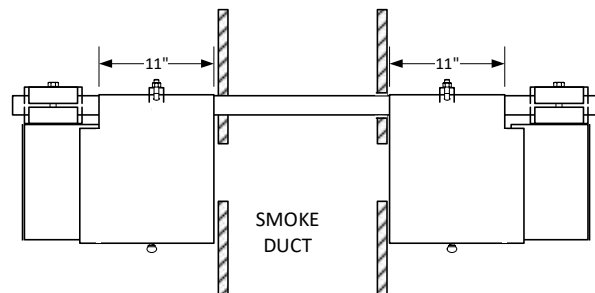
See SDI-107226P instructions for further details.

- If Clean, dry compressed air is not available, the 190275A Blower Caps are suitable for duct pressures less than +1.0" wc.

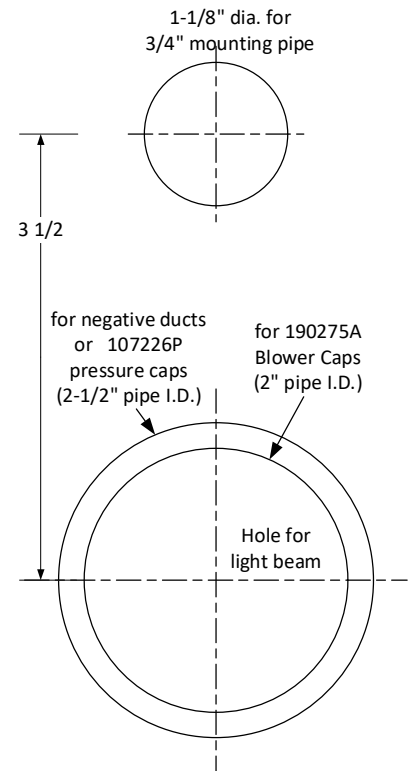
See the 190275A instructions for further details.



Light Source and Light Detector Dimensions



Duct Penetration Dimensions for Light Source and Detector



See last page for Full Size Cutout Template

JC-22XMTR-xxCO Mounting

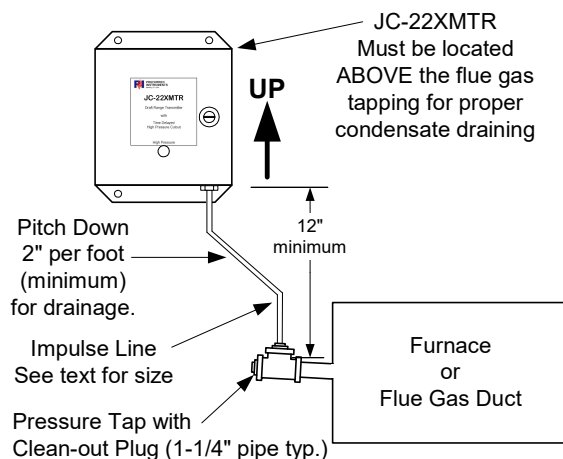
The JC-22XMTR-xxCO is the standard xmtr for use with the JC-23D2. Other 4-20 mA xmtrs may be used with the JC-23D2.

Mount the transmitter in a location that is free from excessive vibration and that will remain at a stable temperature. To prevent incorrect pressure measurements, the pressure tap in the duct should be flush with the inside wall of the duct and should be perpendicular to the primary flow pattern.

Burner flue gas contains a significant amount of water vapor, which condenses inside the impulse tubing. If the condensed water collects and remains in the impulse tubing, a false higher pressure will be applied to the transmitter, which will cause improper draft control system operation and/or nuisance burner trips.

Mounting the JC-22XMTR close to the pressure tap minimizes condensate drainage problems.

See the SDI-JC-22XMTR-xxCO instruction manual for additional important installation details.



Damper Actuator Linkage:

The linkage arrangement between the servo actuator and the damper is important. The wrong arrangement can make it very difficult to control the draft at reduced firing rates.

Single blade and Parallel blade dampers have a very non-linear flow vs. rotation characteristic. Rotating from fully closed toward open, the flow increases very rapidly as the damper opens. The flow changes much less near the fully open end of the rotation.

The linkage for single and parallel blade dampers should be arranged in a 'Slow Opening' configuration in order to linearize the draft control loop. Near the Closed position, the servo rotation opens the damper very slowly.

Opposed blade dampers have a more linear flow vs. rotation characteristic. The linkage for a properly sized opposed blade damper should be between Linear. Oversized opposed blade dampers may require a Slow Opening linkage arrangement.

Damper Style:

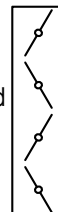
Single
Blade



Parallel
Blade

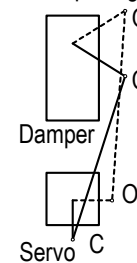


Opposed
Blade

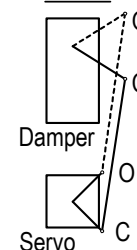


Linkage Setup:

Slow Opening:



Linear:



Wiring Requirements



DANGER

Electric Shock Hazard

Multiple power sources may be present.
Disconnect all electric power sources, local and remote, before servicing



WARNING

This product is intended for use in Commercial and Industrial installations,
it is NOT intended for Residential use.

This product is intended to be used by Trained Operators.

Installation, start-up, and troubleshooting is intended to be done by
Experienced Technicians familiar with Industrial Safety Codes
and all Safety Codes specific to burners and boilers.

This product is NOT a Primary Safety Interlock rated device.

The Relay Outputs should only be used as an
additional auxiliary Operating limit and should not replace or bypass
any Primary Safety Interlock devices required by Safety Codes.

A High Draft Cutout switch and Open Damper position switch are required
to be installed and wired into the flame safeguard system.

Failure to do so can result in equipment damage, injury, or death.

If the Adjustable Starting Draft Option is used,
an additional Outlet Damper Low Fire Start position proving switch
will be required and wired into the flame safeguard low fire circuit.

**Incorrect wiring connections to burner/boiler Flame Safeguard controls
can cause Equipment Damage, Injury, or Death**

BEFORE installing the wiring:

Consult with the burner control system designer to determine which wiring options on the following pages should be installed. The **JC-23D2** has field selectable options for: Control Type, Actuator type, Feedforward, Sequence, etc..

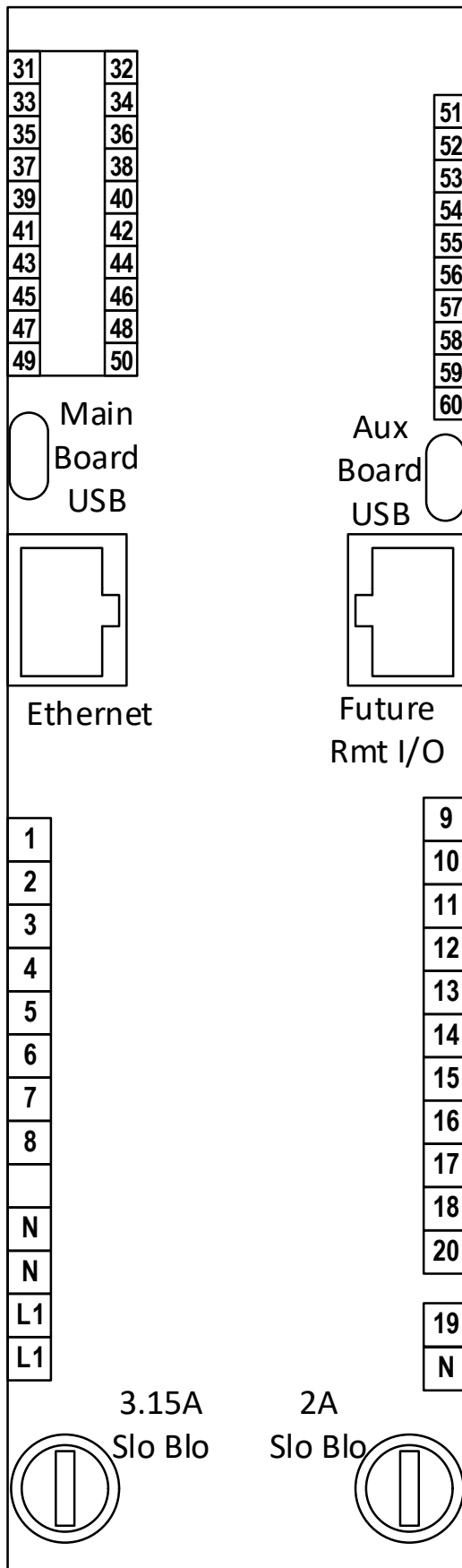
Wiring Requirements (Continued)

- The Light Source and Light Detector final connection wiring must be installed with flexible conduit to allow the light beam to be aimed/aligned and for cleaning.
- Inside the Light Source, insulate the bare shield wires so that they do not short to the enclosure or to any of the components on the circuit board.
- The wiring from the thermocouple to the JC-23D2 must be thermocouple extension wire. Do not use copper wire for any part of this wiring. Use the same wire type as the thermocouple: type J wire for a type J thermocouple.
- The Red wire is the '-' for all thermocouple types. Connect the Red wire to the red or '-' screw in the thermocouple head. Connect the Red wire to JC-23D2 terminal 33.
- Avoid splicing the thermocouple extension wire. Each splice is a potential source of temperature error.
- If shielded thermocouple wire is used, insulate the shield wire inside the thermocouple head to prevent shorting to ground.
- All wiring must comply with all local and national electrical codes. Tighten all terminals to 4.4 in-lb. Wire must be stranded copper, 12-24 ga., 150V / 75 C insulation minimum.
- AC and DC wiring must be separated and must not be run in the same conduit to prevent electrical noise coupling.
- Use shielded cables where shown, connect shields only where shown, insulate to prevent shield grounding.
- Ignition transformer and motor VFD wiring are particularly noisy and should be kept away from all AC and DC wiring.
- Mount 96059 RC Snubber directly on the Coil terminals of the FD Fan Motor Starter.
- Relay contacts are rated: 10 A resistive, 9 FLA / ½ Hp / 120 Vac
- If the 4-20 mA output will not be used, jumper terminal 42 to 43 to prevent the OUTPUT FAILURE error message.
- RS485 is electrically Isolated from all other DC and AC wiring.
- All DC '-', terminals are connected together internally.
- Terminals 1-20 are Line Voltage AC. Terminals 31-60 are low voltage DC.
- An external Line Voltage supply switch or circuit breaker, marked as the disconnect for this instrument, suitably located and easily reached, and complying with IEC 60947-1 and -3 must be provided.

Fuse: 3.15 amp Slo-Blo, 250 V, 5x20mm (Littlefuse 02393.15HXP, Belfuse 5TT 3.15-R, Preferred Utilities 16740-3.15S)
2 amp Slo-Blo, 250 V, 5x20mm (Littlefuse 0239002.HXP, Belfuse 5TT 2-R, Preferred Utilities 16740-2S)

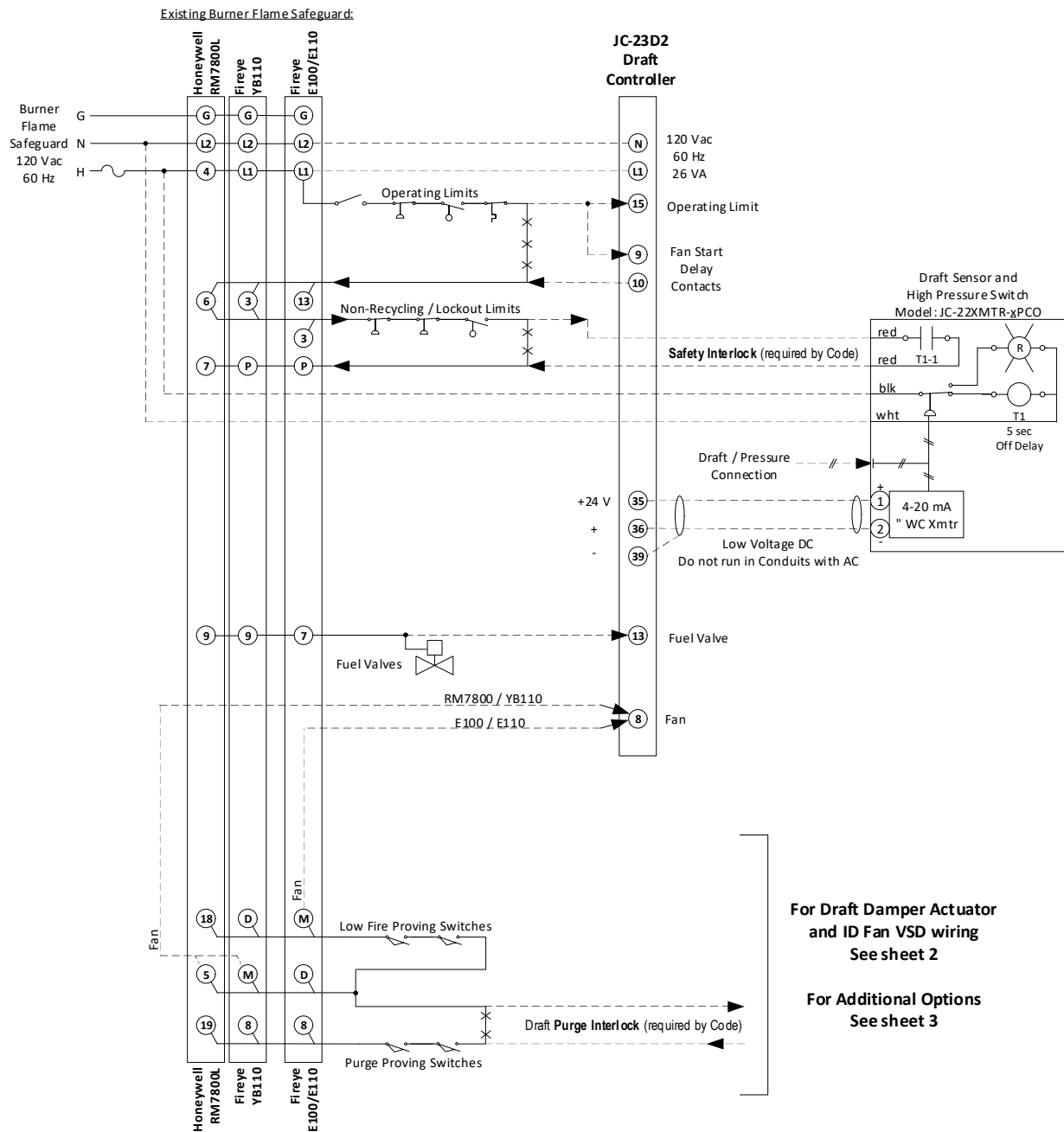
Caution: To reduce the risk of fire, only replace fuses with the same type.

Terminal Layout and Wiring Diagrams



Low Voltage DC terminals		
31	+24 Vdc	
32	2.5Vref	
33	DC -	Flue Gas Thermocouple -
34	AIN 1	Flue Gas Thermocouple +
35	+24 Vdc	JC-22XMTR term 1, 4-20mA "+"
36	AIN 2	JC-22XMTR term 2, 4-20mA "-"
37	+24 Vdc	Opacity Light Source +
38	AIN 3	Opacity Intensity mA
39	DC -	Opacity Light Source -
40	AOUT 1	4-20 mA Output +
41	DC -	4-20 mA Output -
42	AOUT 2	Damper (or VSD) 4-20mA Command
43	DC -	Damper (or VSD) 4-20mA Command
44	DC DIN 1	Remote Alarm Silence
45	RS485 A+	
46	DC DIN 2	Burner at Purge Position
47	RS485 B-	
48	DOUT 1	Opacity Light Source Command
49	RS485 Com	
50	DOUT 2	
51	+24 Vdc	
52	2.5Vref	Actuator Feedback Pot Closed
53	AIN 4	Actuator Feedback Pot Wiper
54	DC -	Actuator Feedback Pot Open
55	+24 Vdc	Burner Firing Rate, Vdc or mA
56	AIN 5	Burner Firing Rate, Vdc or mA
57	DC -	Burner Firing Rate, Vdc or mA
58	future	
59	future	
60	future	
Line Voltage AC terminals		
N	N	
N	N	
L1	L1	
L1	L1	
1	ROUT 1 NO	Common Alarm
2	ROUT 1 C	Common Alarm
3	ROUT 1 NC	
4	ROUT 2 NO	User Configured
5	ROUT 2 C	User Configured
6	ROUT 2 NC	
7	AC DIN 1	Burner at Purge Position
8	AC DIN 2	Fan Starter Energized
9	ROUT 3 NO	Fan Start Delay Contacts
10	ROUT 3 C	Fan Start Delay Contacts
11	ROUT 4 NO	Adj Start at Position
12	ROUT 4 C	Adj Start at Position
13	AC DIN 3	Fuel Valve Energized
14	AC DIN 4	Fuel 2 Select
15	AC DIN 5	Operating Limits Made
16	Close Triac	Damper Actuator x Vac Close Cmd.
17	Open Triac	Damper Actuator x Vac Open Cmd.
18	Triac Power	Actuator 24-120Vac Power Input
20	Actuator Common	Damper Actuator Motor AC Common
19	Fused 120 Vac Output	
N	N	

Typical JC-23D2 Interfacing to a Burner Flame Safeguard



WARNING:

- * Some Flame Safeguard Wiring is Omitted for Clarity.
- * Consult Burner Manual for Complete Wiring Diagram.
- * An Experienced Burner Technician must adapt this TYPICAL wiring diagram to each specific burner wiring diagram.

Legend:

- Existing AC Wire (**Do NOT change this wiring**)
 Remove Existing AC Wire
 New AC Wire
 New Shielded Low Voltage DC Cable
 Do Not Run in Conduits with AC Wires

**For Draft Damper Actuator
and ID Fan VSD wiring
See sheet 2**

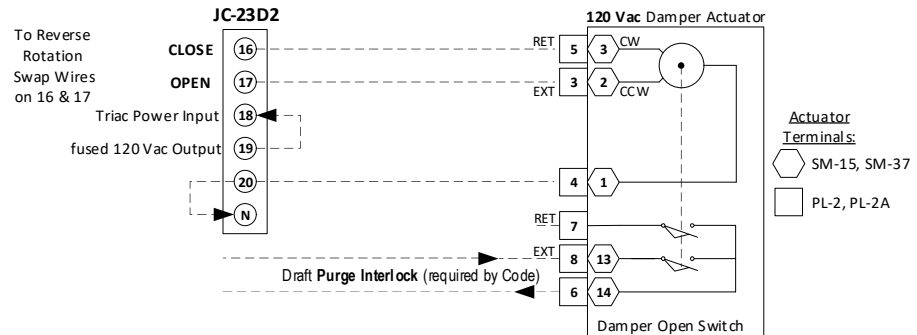
**For Additional Options
See sheet 3**

Damper Actuator (or ID Fan VSD) Wiring

Command: Triac
Feedback: None

Actuator Compatibility
YES: Floating Control.
NO: PID, Feedforward, Adj. Start.

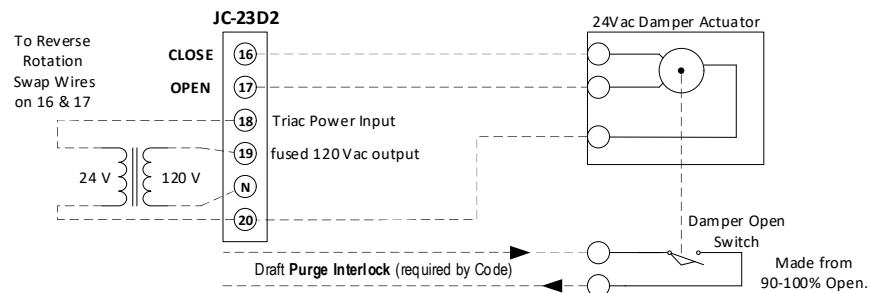
Note
Terminal 20 is connected to the internal Triac surge suppressors



Command: Triac
Feedback: None

Actuator Compatibility
YES: Floating Control
NO: PID, Feedforward, Adj. Start.

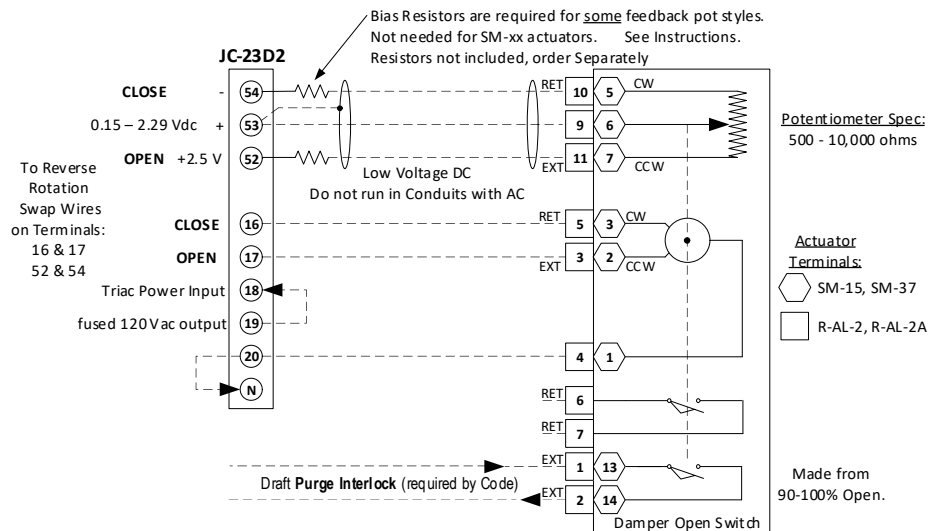
Note
Terminal 20 is connected to the internal Triac surge suppressors



Command: Triac
Feedback: Pot

Actuator Compatibility
YES: Floating Control, PID, Feedforward, Adj. Start.

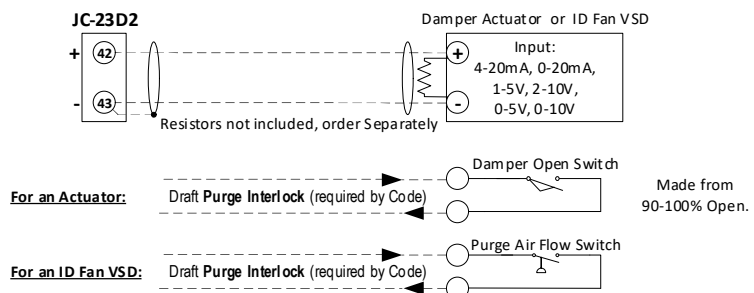
Note
Terminal 20 is connected to the internal Triac surge suppressors



Command: 4-20mA or 0-20mA
Feedback: None

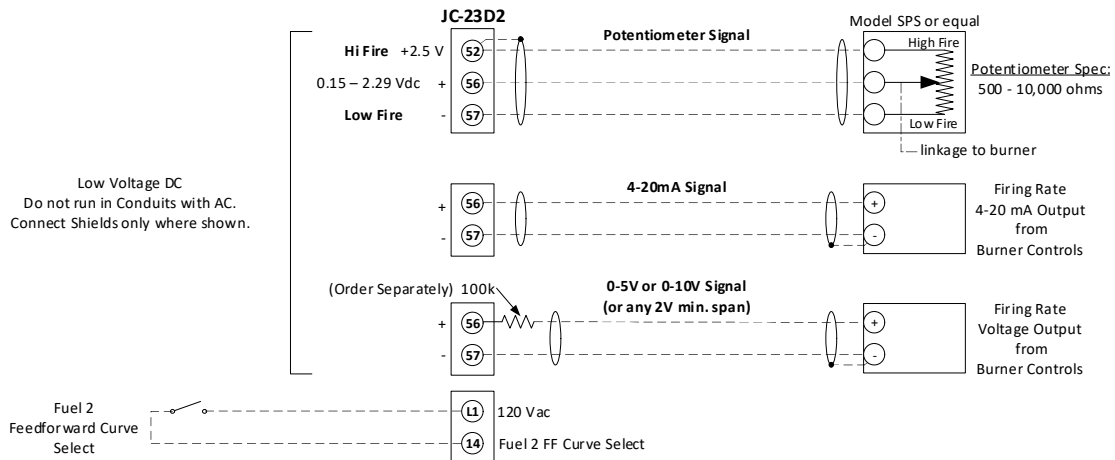
Actuator Compatibility
YES: Floating Control, PID, Feedforward
NO: Adj. Start.

Command/Output	Input	Resistor
4-20 mA	4-20 mA	none
4-20 mA	1-5 V	250 ohms
4-20 mA	2-10V	500 ohms
0-20mA	0-20mA	none
0-20mA	0-5V	250 ohms
0-20mA	0-10V	500 ohms



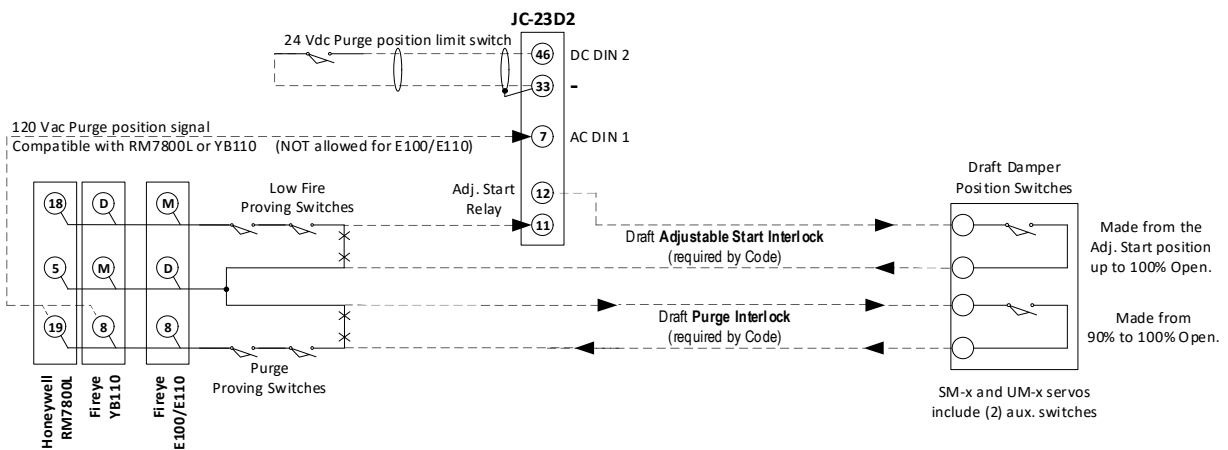
Feedforward, Adj. Start, Miscellaneous Wiring

Burner Firing Rate Signal Types (choose one), required for the Feedforward Option

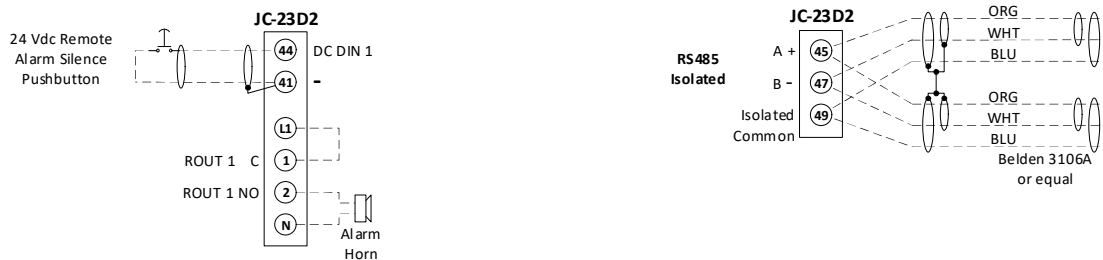


Adjustable Starting Draft Sequence Option Wiring

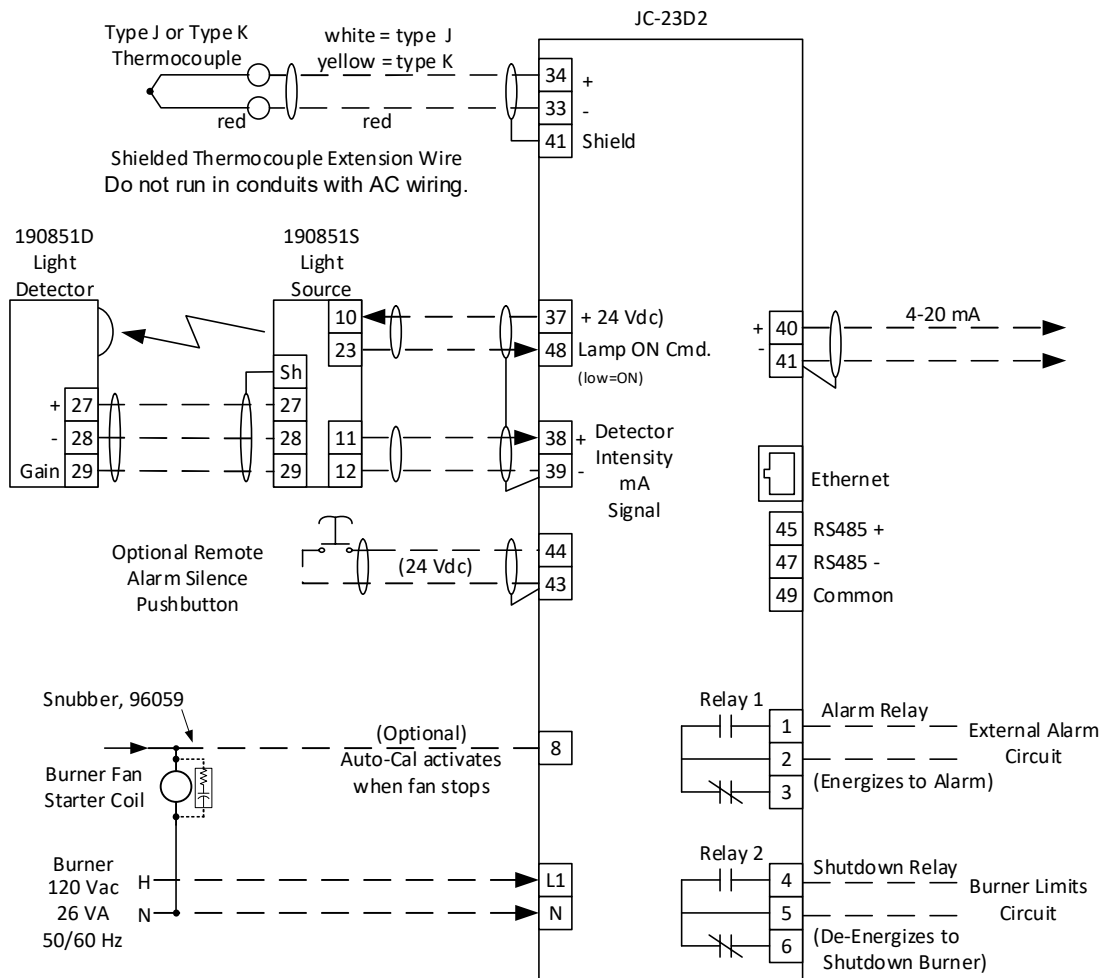
- All wiring on Sheet 1 is also required
- All wiring on Sheet 2 for **Command: Triac / Feedback: Pot** is also required
- A signal indicating when the burner is at the **Purge Position** is required.
There are 3 options, choose one: Burner Firing Rate Signal (above), AC DIN 1, or DC DIN 2.



Miscellaneous Optional Wiring

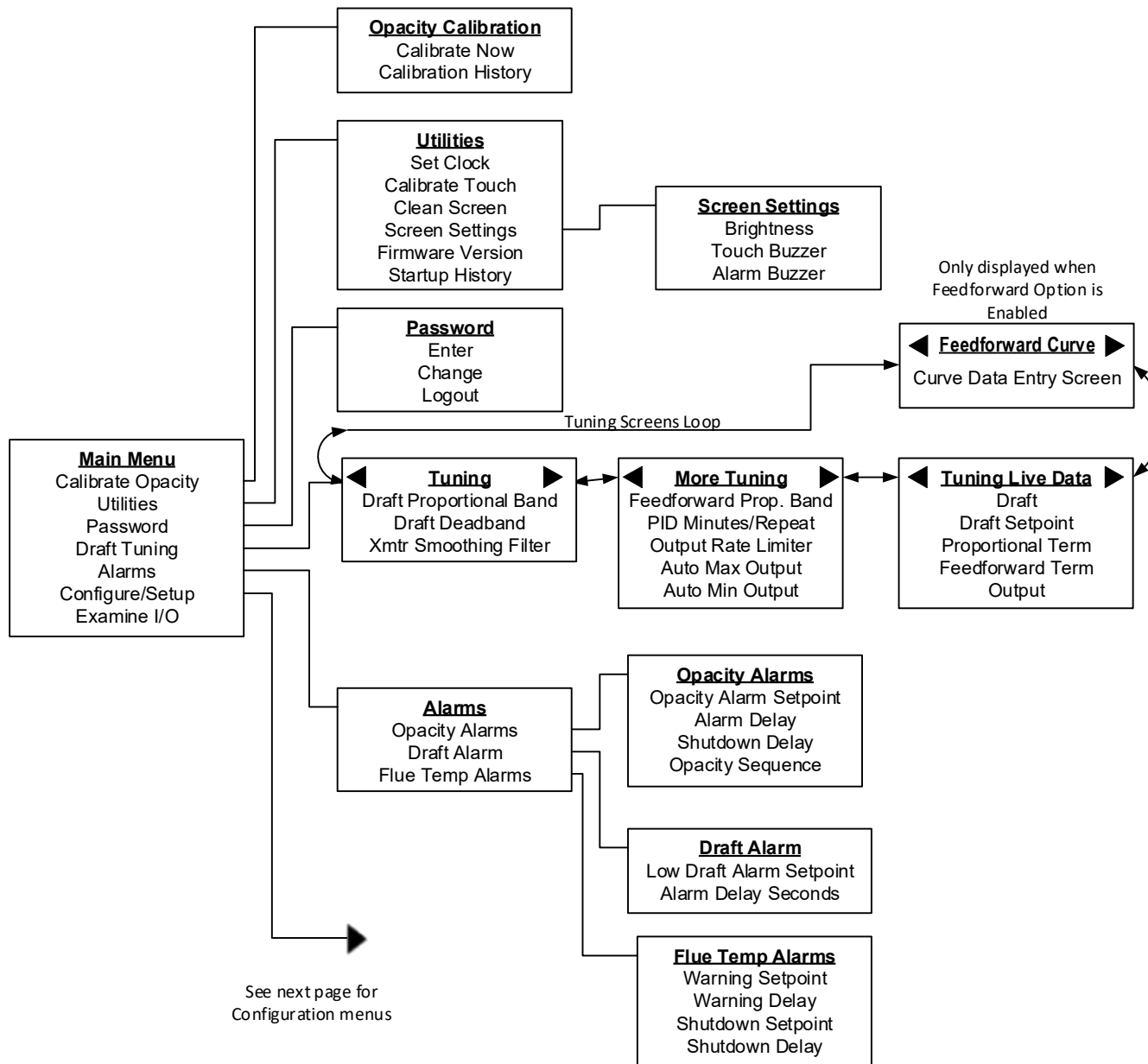


Opacity and Flue Temperature Wiring

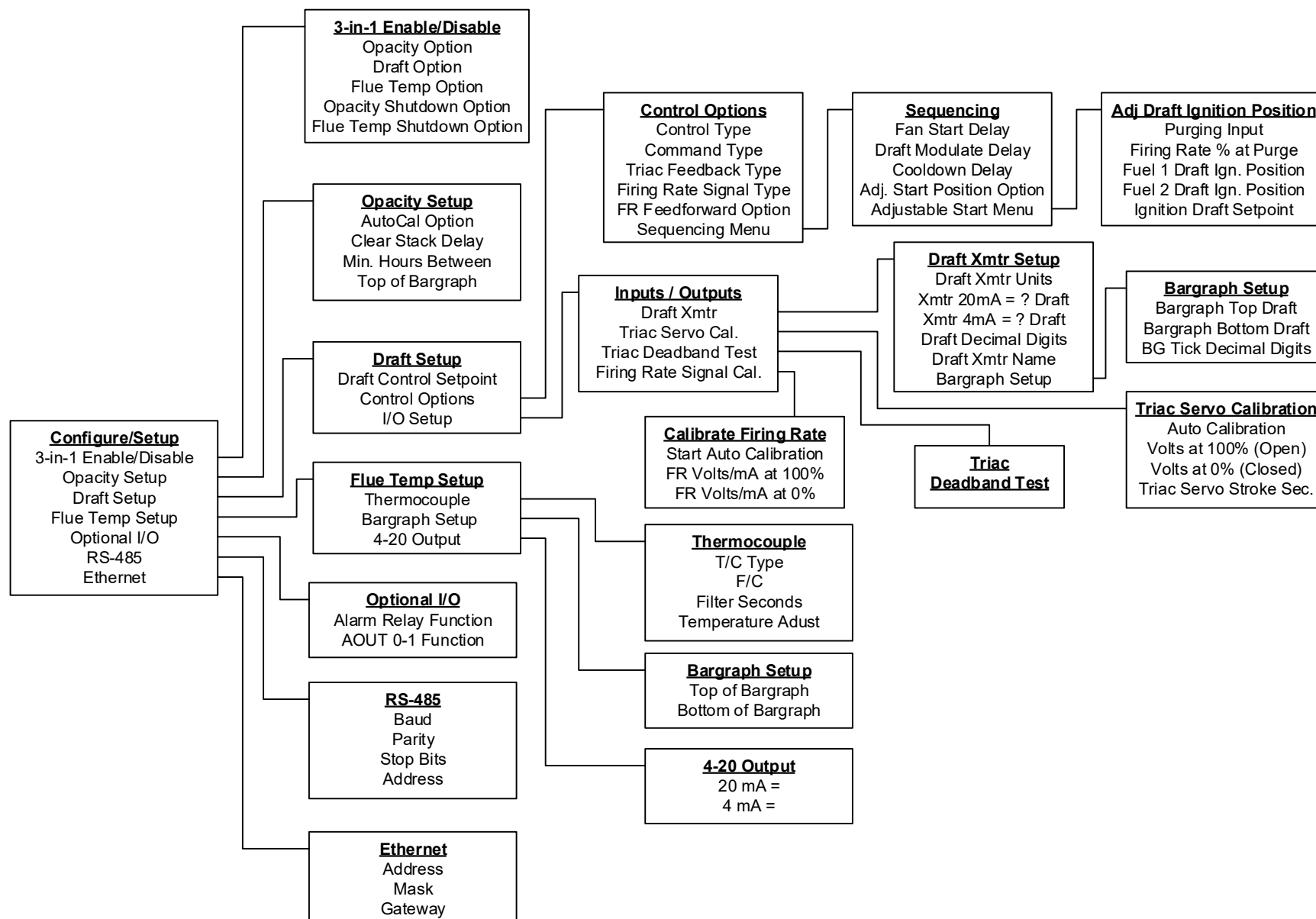


Parameters / Menu Map

From the Home screen, touch **Menu** to display the Main Menu.



Menu Map (Continued)



Parameters

Screen Settings

Parameter	Default	Max.	Min.	Go to: Menu > Utilities > Screen Settings
1	Disable	Enable	Disable	Touch Buzzer Enable Activates faceplate Tone when a screen item is touched
2	Disable	Enable	Disable	Alarm Buzzer Enable Activates faceplate Tone when an Alarm is triggered.

Flue Temp Alarm Setpoint Parameters

Parameter	Default	Max.	Min.	Goto: Menu > Alarms > Flue Temp Alarms
3	400	2000	100	Warning Setpoint (degrees) This Setpoint is used for the Warning Alarm logic.
4	30	1200	1	Warning Delay (seconds) The Common Alarm relay energizes when the Temperature has been above the Alarm Setpoint for more than 'Warning Delay' seconds. Once the Warning Alarm has been triggered, the temperature must drop 5 degrees below the Setpoint before the Warning Alarm de-activates.
5	490	2000	200	Shutdown Setpoint (degrees) This Setpoint is used for the Shutdown Alarm logic.
6	15	300	1	Shutdown Delay (seconds) The Shutdown relay de-energizes when the Temperature has been above the Shutdown Setpoint for more than 'Shutdown Delay' seconds. The temperature must drop 5 degrees below the Shutdown Setpoint and the Operator must press the RESET button in order to re-energize the Shutdown relay.

Flue Temp Configure/Setup Parameters

Thermocouple

Parameter	Default	Max.	Min.	Goto: Menu > Configure / Setup > Flue Temp Setup > Thermocouple
7	J	J	K	T/C Type Type J thermocouple: -40 F to 1200 F (-40 C to 649 C) Type K thermocouple: -40 F to 1700 F (-40 C to 927 C)
8	F	C	F	UNITS Fahrenheit or Centigrade.
9	2.0	30.0	0.5	Filter Seconds Dampens (smooths) rapid temperature display variations. Larger values = more damping. Smaller values = less damping.
10	0	+10	-10	Temperature Adjust (degrees) The displayed value is offset from the measured value by this amount for all temperatures. Used to calibrate out minor temperature differences due to sensor errors. The units are F or C, as selected above.

Bargraph Range

Parameter	Default	Max.	Min.	Goto: Menu > Configure / Setup > Flue Temp Setup > Bargraph
11	500	2000	0	Top of Bargraph This is the temperature value at the top of the bargraph. The units are F or C, as selected above.
12	100	2000	0	Bottom of Bargraph This is the temperature value at the bottom of the bargraph. The units are F or C, as selected above.

4-20 mA Output

Parameter	Default	Max.	Min.	Goto: Menu > Configure / Setup > Flue Temp Setup > 4-20 Output
13	1000	2000	100	20 mA = This is the temperature value for 20 mA output.
14	0	1900	0	4 mA = This is the temperature value for 4 mA output.

Opacity Alarms

Parameter	Default	Max.	Min.	Goto: Menu > Alarms > Opacity Alarms
20	20	50	5	Alarm Setpoint (% Opacity) This Setpoint is used for the Warning Alarm logic. Note: In the NYC-BAR Sequence, the Setpoint can be greater than 20%.
21	20	120	0	Warning Delay (seconds) The Common Alarm relay energizes when the Opacity has been above the Alarm Setpoint for more than 'Warning Delay' seconds. Once the Warning Alarm has been triggered, the Opacity must drop 1% below the Setpoint before the Warning Alarm de-activates. Note: In the NYC-BAR Sequence, this Delay is forced to 0 seconds.
22	120	180	0	Shutdown Delay (seconds) The Shutdown relay de-energizes when the Opacity has been above the Shutdown Setpoint for more than 'Shutdown Delay' seconds. The Opacity must drop 1% below the Shutdown Setpoint and the Operator must press the RESET button in order to re-energize the Shutdown relay. Note: In the NYC-BAR Sequence, this Delay can't be greater than 120 seconds.
23	Std.	NYC-BAR	Std.	Alarm Sequence (Standard, NYC-BAR) See Alarm Sequence descriptions on page 5

Opacity Configure/Setup

Parameter	Default	Max.	Min.	Goto: Menu > Configure / Setup > Opacity Setup
27	Enable	Enable	Disable	AutoCal Option Enable See description on pages 6-7 If the fan starter energizes when an AutoCal is in progress, the AutoCal aborts.
28	30	600	30	Clear Stack Delay (seconds) Seconds from Fan Starter de-energizing and start of Auto-Cal. Allows time for fan to coast down, Dampers to close, and for dust in ducts to settle in order to provide an accurate 0% Opacity Calibration.
29	24	168	0	Min Hours Between AutoCal's (hours) 0-168 hours. 0 hrs means an AutoCal attempt will occur every time the burner fan starter de-energizes. 1 hr means an AutoCal will occur at most once per hour. However, if after the clear stack delay, the Opacity (soot) is greater than 1/2 of the Alarm Setpoint value, an AutoCal (if enabled) will occur regardless of the "Min Hours Between AutoCal's setting". This avoid nuisance Opacity Alarms and Shutdowns.
30	40	100	20	Top of Bargraph (% Opacity) This is the % Opacity value at the top of the bargraph.

Draft Control Setpoint

Parameter	Default	Max.	Min.	Go to: Menu > Configure / Setup > Draft Setup
40	-0.10	+200.00	-200.00	Draft Control Setpoint See: Draft Xmtr Setup for the Units

Tuning

Parameter	Default	Max.	Min.	Go to: Menu > Tuning
41	0.25	25.00	0.025	Draft Proportional Band Expressed in the same units/scaling of the Draft Xmtr (see Draft Xmtr Setup menu) Smaller values cause more aggressive control action. Larger values cause less aggressive control action.
42	0.030	1.500	0.003	Draft Deadband Expressed in the same units/scaling of the Draft Xmtr (see Draft Xmtr Setup menu) If the draft pressure is with +/- Draft Deadband of the setpoint, the damper stops. Smaller Deadband increases damper movement and allows for tighter control. Setting the deadband too low can cause draft damper oscillation/hunting Larger values decrease damper movement but limit control precision.
43	2.0	5.0	0.5	Xmtr Smoothing Filter (seconds) Smooths out normal combustion pressure pulsations. Smaller values reduce smoothing (Too small can cause damper hunting). Larger values cause more smoothing. (Too large can cause overshoot oscillations).
44	125	1000	75	Feedforward Prop. Band Determines how the Damper/VSD responds to a change in the Burner Firing Rate. Smaller proportional band will cause more aggressive Feedforward action. Larger proportional band will cause less aggressive Feedforward action.
45	0.50	4.00	0.12	PID Minutes/Repeat Proportional Band responds instantly to a Draft disturbance. After that, PID "Repeats" ramps the damper back to the Draft Setpoint. Smaller minutes/repeat will cause faster ramping (Too small causes oscillation). Larger minutes/repeat will cause slower ramping.
46	30	75	25	Output Rate Limiter Sec./100% Only affects Floating control mode. Prevents the damper from moving too fast. Smaller Sec/100% allows damper to move faster. Larger Sec/100% limits the damper speed. This value should always be set to longer than the actuator 0-100% stroke time.
47	100.0	100.0	0.0	Auto Max Output When Released to Modulate AND in AUTO, this is the maximum damper opening. This prevents "Reset Windup". Otherwise, the Damper can stroke the full 0-100%. Auto Max Output must be greater than: (Auto Min Output + 25)
48	0.0	100.0	0.0	Auto Min Output When Released to Modulate AND in AUTO, this is the minimum damper opening. This prevents "Reset Windup". Otherwise, the Damper can stroke the full 0-100%. Auto Min Output must be Less than: (Auto Max Output - 25)

Draft Alarm

Parameter	Default	Max.	Min.	Go to: Menu > Alarms > Draft Alarms
52	2.00	250.0	-250.0	Alarm Setpoint Draft Alarm will only activate when the boiler is released to modulate. Alarm activates when Draft is more positive than this Setpoint for longer than the Alarm Delay. Example: Draft = -0.10", Alarm SP = -0.20", Alarm activates after Delay.
53	8	60	1	Alarm Delay (seconds) Draft Alarm time delay, see Alarm Setpoint description.

Control Options

Parameter	Default	Max.	Min.	Go to: Menu > Configure / Setup > Draft Setup > Control Options
55	Floating	PID	Floating	Control Type Options: PID or Floating See pg 9 Compatibility chart
56	Triac	4-20mA	Triac	Actuator or VSD Command Type Options: Triac / 4-20mA / 0-20mA With an external resistor, 0-20mA can drive 0-5V or 0-10V devices. See pg 9 Compatibility chart
57	None	Pot.	None	Triac Feedback Type Options: None / Potentiometer See pg 9 Compatibility chart
58	Disable	0-10V	Disable	Firing Rate Signal Type Options: Disabled / 4-20mA / Potentiometer / 0-5V / 0-10V Firing rate signal input is required for the Feedforward control option.
59	Disable	Enable	Disable	Firing Rate Feedforward Option Options: Disable / Enable See pg 9 Compatibility chart

Sequencing

Parameter	Default	Max.	Min.	Go to: Menu > Configure / Setup > Draft Setup > Sequencing
65	15	60	1	Fan Start Delay Seconds When the Operating Limits input makes: the draft damper starts to drive fully open and the timer starts timing. The JC-23D2 Fan Start Delay Relay energizes at the end of the delay and energizes the FSG Operating Limits input. This delay allows the Draft damper to get enough open to prevent pressurizing the boiler when the burner FD fan starts. This delay prevents a nuisance Draft Cutout Lockout during startup.
66	15	60	0	Draft Modulate Delay Seconds This sets the delay after the fuel valves are opened before the draft damper can begin to start modulating. If the adjustable start position option is being used, the modulate delay must be set for at least as long as the MTFI.
67	0	900	0	Cooldown Delay Seconds This keeps the damper wide open for the selected seconds after a burner shutdown. Note: The cooldown delay will only activate if the burner had been released to modulate for at least 60 seconds.
68	Disable	Enable	Disable	Adjustable Start Position Option Options: Disable / Enable The JC-23D2 must have either a firing rate input or FSG purge position input to use the adjustable start position option. See additional Code required Interlock, see page 13-14. The Adj. Start parameters are in the next Menu screen.

Adjustable Start Menu

Parameter	Default	Max.	Min.	Go to: Menu > Configure / Setup > Draft Setup > Sequencing > Adjustable Start Menu
70	AIN 5	AIN 5	AC_DIN1	Burner Purging Input Options: AC_DIN 1 / DC_DIN 2 / AIN 5 This signal indicates when the burner is at the Purge position. See page 9 description.
71	90	95	50	Firing Rate % at Purge If AIN 5 is selected as the Burner Purging Position input and the signal is greater than this parameter, the Adj. Start sequence detects that the burner is Purging. See page 9 description.
72	35	50	10	Fuel 1 Draft Ign. Position When the JC-23D2 Fuel 2 input is de-energized, the draft damper will go to this position before checking adjustable start draft. See page 9 description.
73	35	50	10	Fuel 2 Draft Ign. Position When the JC-23D2 Fuel 2 input is energized, the draft damper will go to this position before checking adjustable start draft. See page 9 description.
74	-0.25	-0.1	-8.0	Ignition Draft Setpoint Once the damper has reached the adjustable start position, If required, the damper will slowly jog open Draft is more negative than this setpoint. See page 9 description.

Draft Xmtr.

Parameter	Default	Max.	Min.	Go to: Menu > Configure / Setup > Draft Setup > Inputs / Outputs > Draft Xmtr
80	In. wc	kPa	In. wc	Draft Xmtr Units Options: in. wc / cm wc / mm wc / kPa This is the Units <u>text</u> used on various screens. Changing the Units does NOT change, or re-calculate, or any other parameter's numeric value...such as the Control setpoint, Alarm setpoint, etc...
81	-1.0	250.0	250.0	Xmtr 20 mA = ?? Draft Draft transmitter 20 mA calibration value. Fail Safe design for a xmtr or field wiring fault, typically means the xmtr 20 mA calibration should correspond to the more negative value .
82	1.0	250.0	-250.0	Xmtr 4 mA = ?? Draft Draft transmitter 4 mA calibration value. Fail Safe design for a xmtr or field wiring fault, typically means the xmtr 4 mA calibration should correspond to the more positive value .
83	2	3	1	Draft Decimal Digits The number of digits displayed on the screen to the right of the decimal point.
84	Draft	Econ Outlet	Draft	Draft Xmtr Name Options: Draft / Furnace / Outlet / Econ Outlet

Bargraph Setup

Parameter	Default	Max.	Min.	Go to: Menu > Configure / Setup > Inputs / Outputs > Draft Xmtr > Bargraph Setup
87	1.00	250.0	-250.0	Draft at Bargraph Top This sets the scale at the top of the bargraph.
88	-1.00	250.0	-250.0	Draft at Bargraph Bottom This sets the scale at the bottom of the bargraph.
89	2	3	1	BG Tick Decimal Digits The number of decimal digits displayed at the bargraph 0%, 25%, 50, 75%, and 100% marks.

Control Options

Parameter	Default	Max.	Min.	Go to: Menu > Configure / Setup > 3-in-1 Enable / Disable
90	Enabled	Enabled	Disabled	Opacity Option Set to Disabled if opacity monitoring is not being used.
91	Enabled	Enabled	Disabled	Draft Option Set to Disabled if draft control is not being used.
92	Enabled	Enabled	Disabled	Flue Temp Option Set to Disabled if flue temperature monitoring is not being used.
93	Enabled	Enabled	Disabled	Opacity Shutdown Set to Disabled if the high opacity shutdown option is not being used.
94	Disabled	Enabled	Disabled	Flue Temp Shutdown Set to Disabled if the high flue temperature shutdown option is not being used.

Commissioning

Triac Servo Calibration

Menu > Configure/Setup > Draft Setup > Inputs/Outputs > Triac Servo Cal.

A Triac servo with a feedback pot must be stroked and the 0% and 100% feedback voltages must be stored before the draft controller is run in automatic.

Initially this screen is in **Manual** and the damper servo can be opened/closed in order to check rotation, and to set the travel limit switches. Verify that there is no linkage or damper binding, and that the servo stops before the damper hits a hard stop at both ends of travel. Verify that the Pot voltages at full Open and Closed are in the ranges shown on the screen (if needed, correct the Pot wiring).

After the Manual checks are completed, press Manual to change to **Auto** mode. **To prevent injury: Verify that no one is near the servo or damper.**

Triac Servo Calibration		
+0.802	Vdc Pot	11.9 % Open
Seconds/100% Stroke 25.3		
xx) Feedback Pot Vdc at 100% 1.903		
xx) Feedback Pot Vdc at 0% 0.653		
<div>Manual Start Open Close</div>		
Check 0% & 100% Vdc with Open/Close. Rqmts: 100%: 0.70-2.25; 0%: 0.25-1.80 100% V > 0% V: (100%-0%) > 0.3V When OK, change to AUTO to proceed		
<div>Silence Back Home</div>		

Triac Servo Calibration		
+0.653	Vdc Pot	0.0 % Open
Seconds/100% Stroke 25.3		
xx) Feedback Pot Vdc at 100% 1.903		
xx) Feedback Pot Vdc at 0% 0.653		
<div>Auto Start Open Close</div>		
WARNING START moves servo without Warning. Keep away from moving parts !!! Press START to begin Auto-calibration		
Full Closed		
<div>Silence Back Home</div>		

Press **Start** to initiate the automated Calibration cycle. The Start button then changes to **Stop**. Press Stop at any time to stop servo movement (which also aborts the cycle). The automated calibration cycle is:

- Close output energizes. The closed limit switch stops the servo, Pot voltage settles, 0% Pot Vdc is stored.
- Open output energizes. The open limit switch stops the servo, Pot voltage settles, 100% Pot Vdc is stored.
- Close output energizes. The seconds to move 100% -> 0% is measured and stored.
- Mode changes to **Manual**

Triac Deadband Test

Menu > Configure / Setup > Draft Setup > Inputs / Outputs > Triac Deadband Test

Place the Servo Command in **Manual**. During the following observe how close the servo comes to the command, and whether the servo hunts before finally stopping.

Set the command to 30%, then 20%, then 10%, then 20%, then 30%, etc...

Reduce the deadband and repeat until:

Deadband is at the minimum value or the servo hunts

If the servo hunts, increase the deadband gradually until the hunting stops, then test again.

Triac Servo Deadband Test		
+0.172	Draft	+0.150 Setpoint
Triac Servo Deadband % 0.4		
11.6 % Servo Position		
11.9 %	Servo Command	Manual
In Manual, jog Servo Up/Down 10%. Reduce Deadband until Servo hunts. Then Increase Deadband 0.2% - 0.4%.		
Manual		
<div>Silence Back Home</div>		

Firing Rate Signal Calibration

Menu > Configure / Setup > Draft Setup > Inputs / Outputs > Firing Rate Signal Cal

The Firing Rate input can NOT be calibrated when:

The burner is firing **AND** (Feedforward is Enabled **OR** Adj. Start Position is Enabled)

Firing Rate CAN be calibrated when firing **IF** (Feedforward **and** Adj. Start are both disabled).

To calibrate the firing rate input:

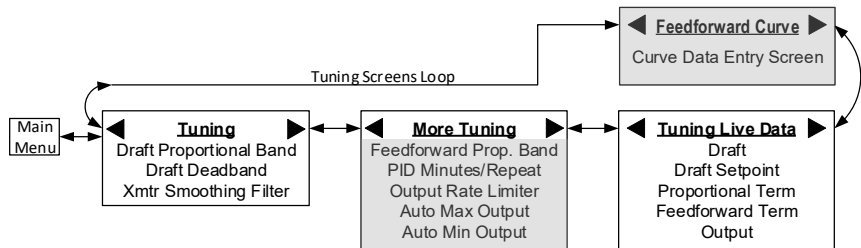
- Use the burner firing rate controls to position the burner at Low Fire.
When the signal settles, press "Save 0% Signal".
- Use the burner firing rate controls to position the burner at High Fire.
When the signal settles, press "Save 100% Signal".
- Use the burner firing rate controls to gradually move the burner from 100% to 0%.
If the JC-23D2 displayed "% Firing Rate" does not approximately track the burner, trouble shoot the wiring and/or the firing rate sensor.

Firing Rate Signal Calibration		
+0.95	Firing Rate Signal	Vdc/mA
24	% Firing Rate	
1.90	Vdc/mA at 100% Firing Rate	
0.65	Vdc/mA at 0% Firing Rate	
<div>Save 100% Signal</div>		
<div>Save 0% Signal</div>		
1) Set burner to 0% Firing Rate, when Signal settles, press Save 0%		
2) Set burner to 100% Firing Rate, when Signal settles, press Save 100%		
Manual		
<div>Silence Back Home</div>		

Controller Tuning Screens

Tuning Screen Loop

The tuning screens are in a loop to allow you to change a value and then to quickly get to the “Live Data” screen to watch how the controller responds. Use the right/left arrows in the title bar to move through the loop.



The “More Tuning” and/or “Feedforward” screens are skipped over if the related options are Disabled.

See the descriptions for each of the tuning parameters, and how it affects the tuning, on page 13.

Firing Rate Feedforward Curve Screen

With a Tech level password, Feedforward Curve data can be manually entered/edited at any time (burner firing, or not firing), just touch one of the feedforward values. When Released to Modulate, the Store button method or the manual method can be used to enter curve data.

Store Button method (Tech Password required and Draft is Released to Modulate)

- When the Manual/Auto button is in Auto, the controller moves the damper until the Draft is within the Setpoint Deadband. In Manual the User enters the “% Damper” value.
- Put the Burner controller in Manual and position the burner at any firing rate within +/- 2% of any Curve Firing Rate, and keep the burner fixed at that firing rate.
- ** is displayed when within +/-2%. --- is displayed when NOT within +/-2%
- When the Draft is near the Draft Setpoint, change the Auto/Manual button to Manual to hold the draft damper at a fixed position
- Press Store to save that damper position in the curve
- Repeat

Firing Rate Feedforward

+0.172 Draft
+0.150 Setpoint

71% Damper/VSD
Manual

59% Firing Rate

Firing Rate	Feedforward (Fuel 1)
0	6
10	8
20	12
30	16
40	22
60**	37
80	56
100	82

Store

Manual

Silence
Back
Home

Live Tuning Data Screen

This screen allows you to watch how the Proportional, Integral (aka “Reset”) and feedforward settings affect the Draft control. See the descriptions for each of the tuning parameters, and how it affects the tuning on page 13.

After making a tuning value change these two methods should both be used to test the draft control tuning:

- Leave the Draft in Auto and make the burner firing rate change (at a realistic ramp rate).
- Put the draft in Manual, open the damper 5-15% for 10-15 sec, and then put the Draft in back in Auto.

If control is sluggish control (slow return to Setpoint without overshoot), gradually decrease the Proportional Band.

If control is overly aggressive control (Draft overshoots the setpoint and cycles excessively before settling), gradually increase the Proportional Band.

If the burner firing rate is not changing, and the damper is hunting, gradually increase the Deadband.

If the burner firing rate is not changing and the draft Damper is in Manual (not moving), and the draft xmtr signal is jumping excessively, increase the filter seconds gradually. If the draft signal is not jumping much at all, the Filter Seconds must be decreased because excessive Filter seconds will cause the controller to overshoot.

Tuning Live Data

Draft +0.113

Setpoint +0.150

Error -0.037

Deadband/Gap +/-0.030
Auto

Proportional -14.8
Command 32

Firing %40

Feedforward +17.6

Integral +29.5

Control Output 100.3

Modulate

Silence
Back
Home

I/O Examine – Draft Control Troubleshooting

The I/O Examine screen shows the current values for all JC-23D2 inputs and outputs and is very useful for detecting wiring and sequencing problems.

Verify that JC-23D2 “N” is connected to Flame Safeguard “N”

Check the Alarms screen to verify that there are no Configuration Errors.

Correct Errors (see Compatibility Chart on page 5)

The damper will not open/close when: JC-23D2 is in Manual and I/O screen shows: Start Limits=Off, Fan=Off, Fuel Valve=Off

For Triac actuators:

To test, change to Floating Control and “No Feedback”.

Check the 2A fuse

Check the actuator (or VSD) wiring, page 10.

Damper doesn't Open for Purge when burner Operating Limits Make

Use I/O screen to verify: Start Limits = ON.

If Off, check wiring, see page 9. Verify that JC-23D2 “N” is connected to Flame Safeguard “N”

Burner won't start

Use I/O screen to verify: Start Limits = ON and that the Fan Start Relay = ON after the Fan Start Delay timer expires.

Then check wiring, see page 9. Verify that JC-23D2 “N” is connected to Flame Safeguard “N”

The damper opens for Purge, stays wide open and will not modulate when the burner is firing

Check the I/O screen to verify: Fuel valve = ON

If I/O shows fuel valve is OFF:

Check the wiring.

Verify that the JC-23D2 120 Vac Neutral is wired to the Flame Safeguard Neutral.

If Fuel valve input = ON, with the JC-23D2 in Manual, can the Damper be Closed and Opened?

If NO:

Check the Close Triac wiring to the actuator, page 10.

If YES:

Is the Draft Setpoint more Negative than the Draft?

If YES, the damper should stay wide open, there is no problem.

Examples of “More Negative”: SP = -0.2”, Draft = -0.1” and SP = +0.15, Draft = +0.2”

Damper closes before burner Post Purge is completed

Check the I/O screen to verify: Fan Run Command = ON during Post Purge

Flue Temperature Troubleshooting

The displayed temperature is not what you expected:

- Verify that the Red wire is connected to the Red (‘-’) terminal of the thermocouple and to terminal 33 of the JC-23D2.
 - Verify that there is NO wiring on terminals 36 or 38. This can cause incorrect readings, or a false “Open T/C” Alarm.
 - Verify that the INPUT TYPE and DISPLAY UNITS are set correctly in the DISPLAY MENU.
 - Remove the thermocouple wire from JC-23D2 terminals 33 & 34. Jumper terminal 33 to terminal 34 with copper wire. The JC-23D2 should display the ambient temperature near the JC-23D2 terminal blocks.
 - If the ambient temperature is displayed with the jumper installed, then the problem is in the interconnecting wiring, or the thermocouple is the wrong type.
 - Verify that the wiring from the thermocouple to the JC-23D2 is the correct type of thermocouple wire (and not copper wire). The standard color code is red and white for type J, and red and yellow for type K.
 - Move the tip of the thermocouple within the duct to determine if the temperature changes.
- Check for loose splices in the field wiring. Check for shields touching ground.

Opacity Troubleshooting

Normal Operation:

Lamp is ON, and NOT blinking

190851S Light Source power input, terminals 10(+) to 12(-): 17 - 26 Vdc range

190851S Lamp On/Off command input, terminal 23(+) to 12(-):

Lamp ON command: approx. 1.5 Vdc. Lamp OFF command: Greater than 2.7 Vdc

Detector to Light Source 4-20mA, terminal 28, meter in-series: 3.8 – 22 mA
3.8-4.3 mA with Detector lens totally blocked.

Light Source to JC-23D2 Monitor mA, Terminal 38 meter in series 3.8 – 22 mA
Should exactly match mA signal into Light Source Terminal 28

Light Source Lamp is Blinking

These following errors are detected by the Light Source processor during the Auto Ranging portion of the Calibration cycle. Correct the problem and then start another Calibration cycle to stop the Lamp Blinking.

1 Blink

Detector output (terminal 28) is near 0 mA, should be approx. 4 mA when Lamp is Off.

Check Light Source to Light Detector Wiring, Terminals 27 and 28. Wires might be swapped.

2 Blinks

Detector output (terminal 28) is greater than 20 mA, should be approx. 4 mA when Lamp is Off.

Check Light Source to Light Detector Wiring, Terminals 28 and 29. Wires might be swapped.

Light Source Lamp is Blinking (continued)

3 Blinks

The AutoRanging data in the Light Source is invalid. Do a Calibration to correct the data.

Either this light source has never been AutoRanged/calibrated before or Electrical noise corrupted the data.

4 Blinks

The Lamp Brightness command is Out of Range. Do a Calibration to correct the data.

Electrical noise could cause this.

5 Blinks

The Detector Gain setting is invalid. Do a Calibration to correct the data.

Electrical noise could cause this.

Light Source Auto Ranging Error Messages

Wiring Detector Plus: See 1 blink above

Wiring Gain: See 2 blinks above

Bad CRC: See 3, 4, 5 blinks above

Source Too Close: With the Lamp at the lowest Brightness setting, the Detector Intensity was higher than 22.6 mA.
The Light Source is too close to the Light Detector or the Detector is seeing Ambient Light.

Gain Relay: The Light Source changed the Detector Gain relay command (term. 29), but Detector mA didn't change.
Terminal 29 wire is open circuit, or the Detector is defective, or the Source is defective.

Bad Monitor: The Lamp Brightness sensor signal is too low when the Lamp is at max brightness.
Could be a dim LED Lamp, a dirty sensor, or a bad Light Source

Low Detector: With max Lamp brightness and High Det. Gain, the Detector signal is below 8.1 mA.
Windows/lens are very dirty, or bad alignment, or Detector is too far from Source.

Timeout: Auto Ranging did not complete in less than 3 minutes

Opacity Calibration Error Messages

Calibration Aborted by Fan: The burner fan energized during Calibration.

Clear Stack Failed to Settle: With the Lamp ON, Detector mA signal never stabilized. Fan running without starter wired to JC-23D2, Soot/dust in optical path, vibration shaking Source/Detector, or Electrical Noise.

Clear Stack Over 23 mA Too Much Light: Ambient light sensed by the Detector drove the Detector too high. A 190713 Light Shield over the Detector might be needed to block nearby bright lights or bright sun light.

Clear Stack Under 8 mA Not Enough Light: Detector signal was very low. Very dirty windows or lens or Source/Detector got knocked out of alignment.

Opaque Stack Failed to Settle: With the Lamp OFF, Detector mA signal never stabilized. A 190713 Light Shield over the Detector might be needed to block nearby bright lights or bright sun light or Electrical Noise.

Opaque Over 4.7 mA Too Much Light: Lamp is OFF. A 190713 Light Shield over the Detector might be needed to block nearby bright lights or bright sun light.

Opaque Under 3.3 mA: Wiring Error, or possible bad Detector.

Other

If Pressure Caps are installed; Warming up a Natural Gas fired boiler can cause nuisance alarms due to condensate on the window. Use purge air that is below the dew point to prevent this nuisance alarm

LED Lamp Replacement

- Remove 120 Vac power from the JC-23D2 (Note: This will cause the burner Shutdown relay to de-energize).
- Remove the 190851S Light Source rear cover plate.
- Remove the 4 screws the hold the 190799 Lamp PC Board in place.
- Un-plug the old Lamp board, plug-in the new 190799 Lamp, and re-install the 4 screws and the read cover.
- Apply 120 Vac power to the JC-23D2.
- Wait for Lamp Warmup to complete.
- The new LED Lamp will not have the same optical alignment, or brightness, as the old LED Lamp.
- Re-calibrate the JC-23D2 from the CALIBRATE Menu as described above in the Calibration section.

Modbus

RS485: Baud: 4800, 9600, 19200, 38400, 57600 Parity: Odd, Even, None Stop Bits: 1, 2
 Ethernet: 10/100 Mb/s
 Protocol: RTU, TCP/IP
 Address: 1-247
 Register Formats: 16 bit Signed Integer
 32 bit Floating Point (register below = High bytes (exponent), register+1 = Low bytes (mantissa))
 Modbus Commands: 01 Read Coils, 03 Read Registers, 05 Write Single Coil, 06 Write Single Register,
 16 Write Multiple Registers (2 registers max)
 Max Poll Size: 120 coils or registers (except Code 16)

Coil		0 =	1 =	Description
98	WO		Alarm Silence	Remote Alarm Silence
99	RO	No Alarm	Alarm	Common Alarm
100	RO		Warning	Flue Temp Warning Alarm
101	RO		Shutdown	Flue Temp Shutdown Alarm
102	RO	No Alarm	Alarm	High Opacity Alarm
103	RO	No Alarm	Alarm	High Opacity Shutdown
104	RO	Not Dirty	Dirty	Lens is Dirty
105	RO		Stray Light	Stray Light
106	RO		Offline	Measurement Offline
107	RO	Cal. Inactive	Cal. Active	Calibration In Progress
108	RO	Overfire Inactive	Overfire Active	Opacity Overfire Air
109	RO	Fan OFF	Fan ON	Burner Fan Starter
110	RO	No Alarm	Alarm	High Draft Alarm
111	RO	Auto	Manual	Auto/Manual
112	RO	Fan OFF	Fan ON	Fan Energized Input
113	RO	De-Energized	Energized	Fuel Valve Energized Input
114	RO	Limits OFF	Limits ON	Start Limits Input
115	RO	De-Energized	Energized	Burner Start Delay Relay
Register		Type		Description
40100	RO	FLOAT		Flue Temperature
40106	RO	FLOAT		Flue Temp Shutdown Setpoint
40110	RO	FLOAT		Filtered Draft PV
40112	RO	FLOAT		Draft Control Setpoint
40114	RO	FLOAT		Actuator Position Command
40116	RO	FLOAT		Opacity
40118	RO	SINT16		Opacity Alarm Setpoint

Parts List

Part Number	Description
JC-23D2	3-in-1 Flue Temp, Opacity, Draft Controller
16740-2S	Fuse, 2 A, Slo-Blo, 250 V, 5x20mm
16740-3.15S	Fuse, 3.15 A Slo-Blo, 250 V, 5x20mm
90437-KIT	JC-xxD2 Panel Mounting Clip (2)
90434	JC-xxD2 Panel Mounting Gasket
92791	8 pt Terminal Block, line voltage, 5.08mm
92794	5 pt Terminal Block, line voltage, 5.08mm
92795	10 pt Terminal Block, low voltage, 3.81mm
92799	2 pt Terminal Block, line voltage, 5.08mm
92800	10 pt Terminal Block, line voltage, 5.08mm
96059-KIT	RC Snubber (for AC electrical noise reduction)
JC-22XMTR-HPCO	+1" to -1" 4-20mA Draft Transmitter with 4 sec High Pressure Cutout (Positive Setpoint)
JC-22XMTR-LDCO	+1" to -1" 4-20mA Draft Transmitter with 4 sec Low Draft Cutout (Negative Setpoint)
JC-22-HDPCO-8	+0.05" to +9", Draft Cutout Switch, 8 Second Delay
JC-22-HDPCO-8	-0.05" to -9", Draft Cutout Switch, 8 Second Delay
190388-xx	10" thru 48" dia, E-Link Draft Damper assy with Triac actuator and JC-22XMTR-HPCO.
107362-D2-1	JC-xxD2 Single Unit, Wall Mount Enclosure, 12h x10w x 8d
107362-D2-2	JC-xxD2 Dual Unit, Wall Mount Enclosure, 14h x12w x 8d
107362-D2-3	JC-xxD2 Three Unit, Wall Mount Enclosure, 14h x16w x 8d
190751-D2	JC-xxD2 or TG-EL-D4B Adapter Plate, Panel Cutout: 7.5" X 7.6"
190753-D2	JC-xxD2 or TG-EL-D4B Adapter Plate, Panel Cutout: 8.00" X 10.75"
190851S	Opacity Light Source
190851D	Opacity Light Detector
190799	LED Lamp
107226P	Pressure Caps (2) with Purge Air Ports
190275A	Pressure Caps (2) with 1" wc 120V Blowers
SDA-VB	Audible/Visual External Alarm
SDA-B6	6" Alarm Bell, 120V, 85 db
104087D	20" Type J Thermocouple, ½" MNPT process connection
104087E	12" Type J Thermocouple, ½" MNPT process connection

Specifications

Mechanical:

Enclosure: Nema 12 Faceplate, Indoor Locations
Bezel: 3 7/8 w x 8 h x 1 d
Rear Case: 3 1/2 w x 7 9/16 h x 4 7/8 d
Panel Cutout: 3.61 w x 7.65 h
Weight: 2 lbs
Ambient: 32-131 F (0-55 C)
Altitude: 6560 feet (2000 meters)

Electrical:

Input Power: 120Vac +/-15%, 50/60 Hz, 26 VA
Output Power: 24 Vdc, 300mA max combined load
Terminals: 31,35,37,40,42

Analog Inputs

(3) 16 bit, 5 samples/sec, 50/60Hz filter: -90db
Draft: 4-20 mA
Feedback Pot: 0.15 - 2.29 Vdc
Burner Firing Rate: 4-20mA, 0-2.3V, 0-5V, 0-10V
field selected

Flue Temp Sensor: Type J or K thermocouple
(field selectable J/K and F/C deg.)
0.1 deg F resolution
0.5 F linearity
Upscale Break Protection

Light Intensity: 3.7 - 23 mAdc

Analog Output

(1) 16 bit, 4-20mA, max 650 ohm load
Servo/VSD Command

AC Discrete Inputs

(5) 120 Vac, 13 mA typ/ch., opto-isolated
Oper. Limits, Fan Running, Fuel Valve, Fuel 2 Select,
Burner at Purge

DC Discrete Inputs

(2) Sinking, 33k / 24V internal pull-up
Remote Alarm Silence, Burner at Purge

Relay Outputs

(2) SPDT, (2) SPST, 120Vac, 10 A
Alarm, Fan Start Delay, At Adj. Start

Triac Outputs

(2) 24-120 Vac, 2A fuse, opto-isolated
Actuator Open, Close

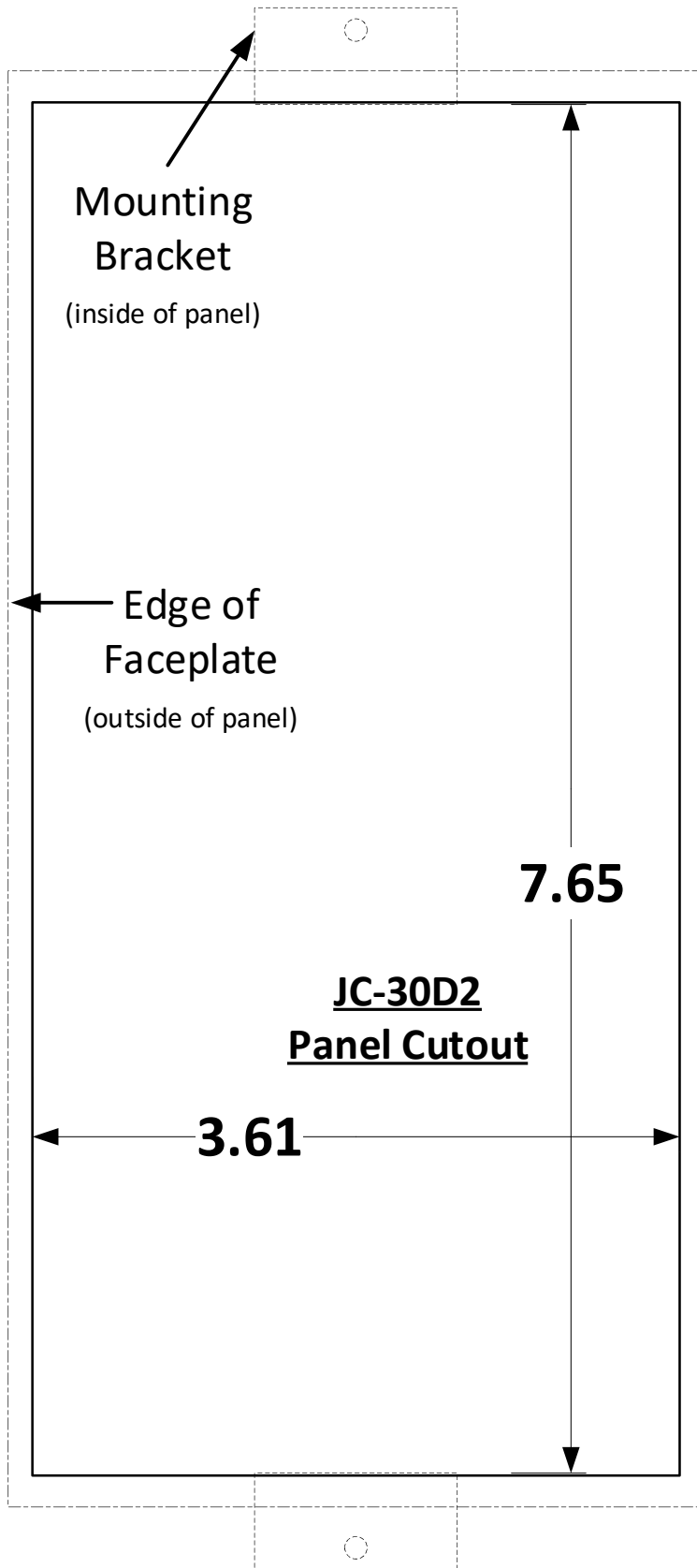
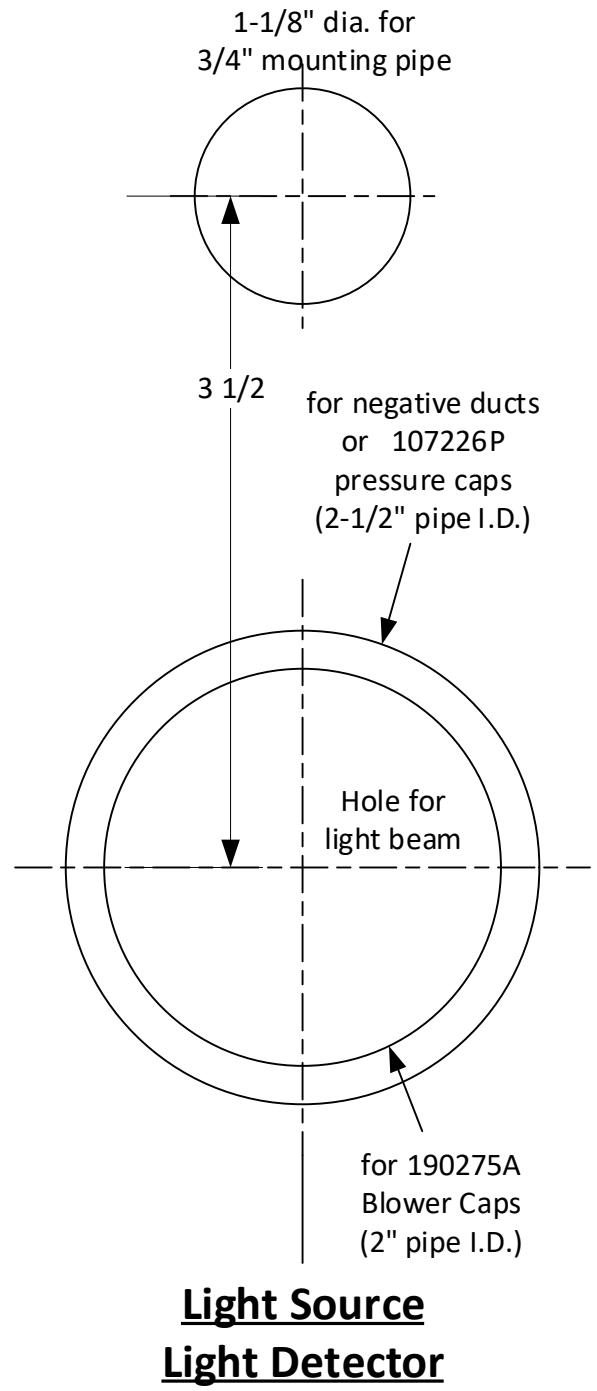
Communications

USB: JC_TG_Edit config & Firmware Flashing
RS485: Isolated, 4.8 - 57.6k baud, Modbus RTU
Ethernet: 10/100 Mb/s, Modbus/TCP

Light Source and Detector

Calibration: Automatic, Off-Line
Spectral: Photopic, peak and mean
within 500-600 nm
Response Time: < 10 seconds for 95% change
Sighting Distance: 3 - 10 ft optical path length
Wiring Distance: 500 ft max.
Ambient Temp.: +32° to 149° F
Enclosure: NEMA 1
Size: 6w x 5d x 8.5h
Mounting: 3/4" pipe, 3.5" centers

Full Size Cutout Template



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