SCC Inc.

Technical Instructions

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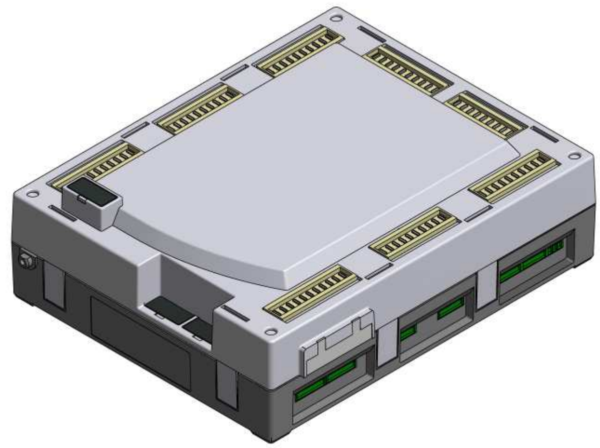
July 9, 2014

LMV5 Application Guide



Description

The LMV5 Application Guide includes programming, wiring, and operation examples of the control system for the most common applications.

Table of Contents

Table of Contents (continued)

Direct Start

Introduction

Direct start accelerates the startup sequence of the burner. If the LMV5 is configured for direct start, the following cases enable this feature:

- A call for heat is received during shutdown (phases 62-78)
- A fuel changeover is requested while the burner is in operation (phase 60) or shutdown (phases 62-78)

The LMV5 skips the remainder of postpurge and proceeds to prepurge without turning the blower off.

On every startup, the LMV5 tests the blower air switch for proper operation. The switch contacts are required to open during standby of the boiler and close during blower operation. With direct start, the blower does not turn off before startup begins. A 3-way solenoid valve must be installed using direct start to briefly divert air pressure to functionally test the blower air switch.

Procedure

1. Install and wire a 3-way solenoid valve as shown in Figure 1.

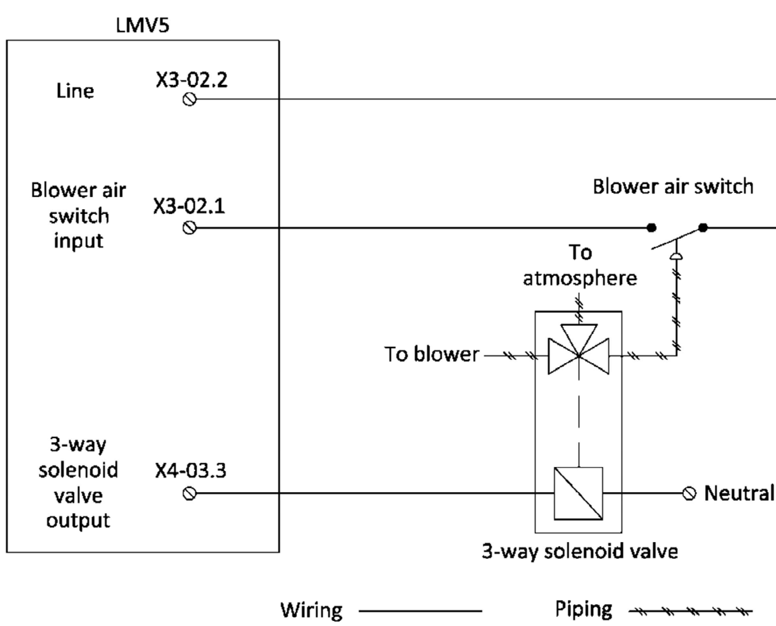


Figure 1: Wiring a 3-way Solenoid Valve for Direct Start

Direct Start (continued)

2. Program the LMV5 to utilize direct start through the following menu path:

   Params & Display > BurnerControl > Configuration > ConfigGeneral > NormDirectStart = **DirectStart**

3. Configure "Start/PS-Valve" (output terminal X4-03.3) to energize the 3-way solenoid valve that diverts air pressure away from the blower air switch. This can be programmed two different ways:

   PS Relief – The solenoid valve is energized to divert air pressure away from the blower air switch in phase 79.

   PS Relief_inv – The solenoid valve is energized to expose the blower air switch to air pressure in every phase <u>except</u> phase 79.

   Program the "Start/PS-Valve" parameter through the following menu path:

   Params & Display > BurnerControl > Configuration > ConfigIn/Output > Start/PS-Valve

4. When using direct start, the postpurge time of the boiler is split into two stages:

   PostpurgeT1Gas(Oil) – Defines the mandatory postpurge time (phase 74). If the direct start option is selected and a call for heat exists, the LMV5 will postpurge for this minimum amount of time.

   PostpurgeT3Gas(Oil) – Defines the optional postpurge time (phase 78). If the direct start option is selected and a call for heat exists, the LMV5 will skip this postpurge time and go directly into prepurge after the functional test of the blower air switch.

   By minimizing the mandatory postpurge time, PostpurgeT1Gas(Oil), the full benefits of direct start are achieved. Even with direct start enabled, the LMV5 retains a full prepurge before opening the fuel valves and starting up. The optional postpurge time, PostpurgeT3Gas(Oil), is the time required for the proper amount of air exchanges on a normal shutdown. Both of these postpurge times can be set through the following menu path:

   Params & Display > BurnerControl > Times > Times Shutdown

Direct Start (continued)

Operation

Direct start accelerates the startup sequence in the following instances:

- The LMV5 loses the call for heat (terminal X5-03.1), and regains it before or during postpurge (phase 62-78)
- The LMV5 receives a fuel changeover request (terminal X4-01.1 or X4-01.2) during burner operation (phase 60) or shutdown (phases 62-78)

If either of these situations occurs, the LMV5:

1. Drives to low fire (phase 62) and shuts the fuel valves.
2. Ensures the flame signal drops out during the afterburn time (phase 70).
3. Drives to postpurge position (phase 72) and performs its mandatory postpurge (PostpurgeT1Gas(Oil), phase 74).
4. Proceeds to phase 79 and either powers on or off the 3-way solenoid valve dependent upon the setting of parameter “Start/PS-Valve”. The LMV5 verifies the operation of the blower air switch via input terminal X3-02.1 during phase 79.
5. Drives directly to prepurge position (phase 24) and proceeds to startup as normal.

Hot Standby on a Steam Boiler with an RWF50 or RWF55

Introduction

Hot standby is recommended on multi-boiler systems to maintain one or more backup boilers close to operating temperature. Hot standby can be accomplished on an LMV5 with an RWF5x controller. The procedure and operation will be described for the following two methods:

- LMV5 with an RWF5x for hot standby control only
- LMV5 with an RWF55 for hot standby and load control

Table 2 describes the six different load controller operating modes in the LMV5.

Table 2: Description of LMV5 Load Controller Operating Modes

Label	Description	Setpoint	Upon X62.1 – X62.2 Contact Closure
ExtLC X5-03	External load control, firing rate from 3-position input	N/A	Change to “IntLC”, setpoint W1
IntLC	Internal load control, setpoint set locally on LMV5	W1	Remain in “IntLC”, setpoint W2
IntLC Bus	Internal load control, setpoint from Modbus command	W3	Change to “IntLC”, setpoint W1
IntLC X62	Internal load control, setpoint from analog signal on terminal X62	Remote setpoint	
ExtLC X62	External load control, firing rate from analog signal on terminal X62	N/A	
ExtLC Bus	External load control, firing rate from Modbus command	N/A	

If any operating mode other than “IntLC” is used, a contact closure between terminals X62.1 and X62.2 will cause the LMV5 to revert back to operating mode “IntLC”. This is necessary to achieve hot standby on an LMV5 using the RWF5x to control the hot standby only.

Hot Standby on a Steam Boiler with an RWF50 or RWF55 (continued)

LMV5 with an RWF5x for Hot Standby Control Only

Procedure

1. Wire the RWF5x to the LMV5 as shown in Figure 2.

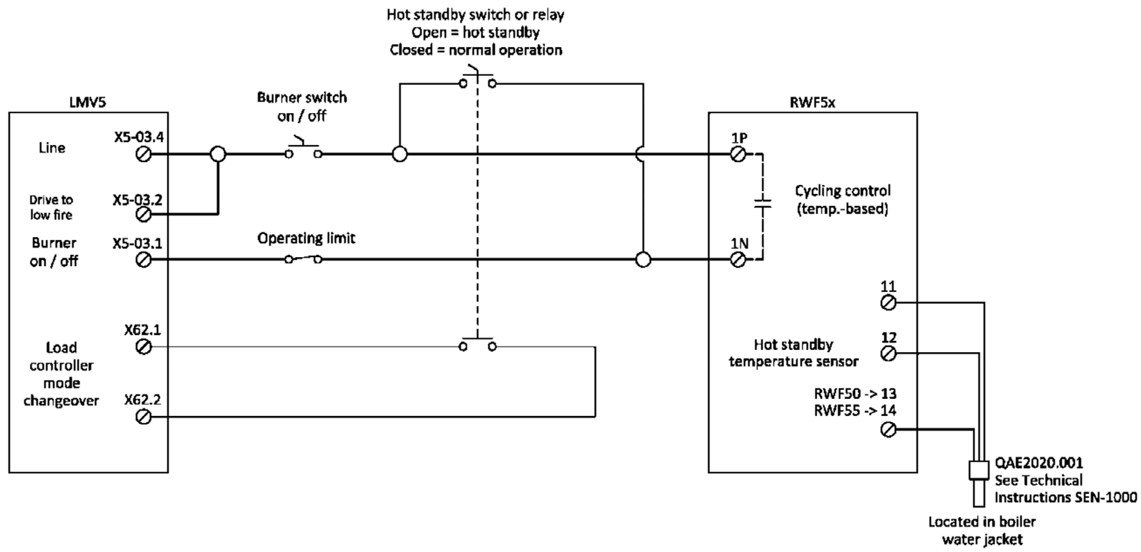


Figure 2: LMV5 to RWF5x Hot Standby Only Wiring

2. Set the LMV5 for load controller operating mode "ExtLC X5-03" through the following menu path:

   Params & Display > LoadController > Configuration > LC_OptgMode = **ExtLC X5-03**

3. Set the following parameters in the RWF5x controller. For more information, obtain Siemens Document No. U7866 for the RWF50 or Document No. U7867 for the RWF55 at www.scccombustion.com.

   ConF > Cntr > SPL = setpoint range lower limit
   ConF > Cntr > SPH = setpoint range upper limit
   OPr > SP1 = hot standby setpoint
   PArA > HYS1 = burner on for hot standby
   PArA > HYS3 = burner off for hot standby
   ConF > InP > InP1 > Sen1 = temperature sensor type

Hot Standby on a Steam Boiler with an RWF50 or RWF55 (continued)

Operation

1. When the hot standby switch is open, the LMV5 system is in hot standby mode. The burner will turn on and off based on the limits set in the RWF5x controller. The contact between X62.1 and X62.2 will be open. The LMV5 will be in operating mode "ExtLC X5-03" and looking for a 3-position input for its firing rate command. Since line power from terminal X5-03.4 has been directly connected to the terminal that decreases the firing rate (X5-03.2), the LMV5 will stay at low fire until the burner turns off based on the burner off point set in the RWF5x (PArA > HYS3).

2. When the hot standby switch is closed, the system is in normal operation and not in hot standby. The contact between X62.1 and X62.2 will close, causing the LMV5 to change to operating mode "IntLC". The burner will be controlled based on the limits set in the LMV5.

Important Notes

1. Any RWF5x controller model will suffice for this hot standby option.

2. The RWF5x is operating only during hot standby mode.

3. The internal load controller of the LMV5 is used during normal operation.

Hot Standby on a Steam Boiler with an RWF50 or RWF55 (continued)

LMV5 with an RWF55 for Hot Standby and Load Control

Procedure

1. Wire the RWF55 to the LMV5 as shown in Figure 3.

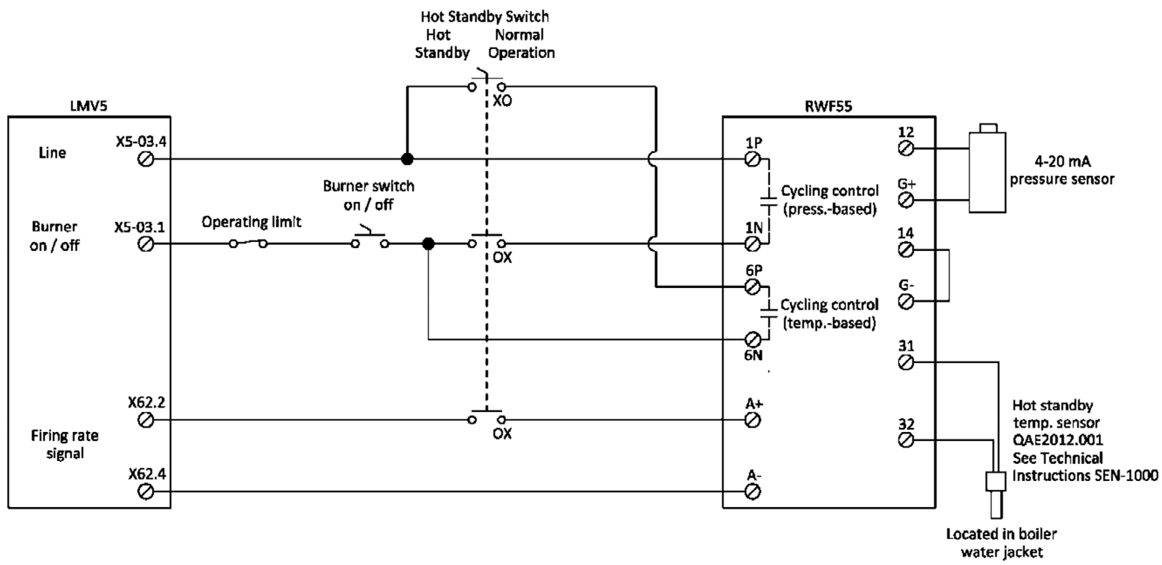


Figure 3: LMV5 to RWF55 Hot Standby and Load Control Wiring

2. Set the LMV5 for load controller operating mode “ExtLC X62” through the following menu path:

   Params & Display > LoadController > Configuration > LC_OptgMode = **ExtLC X62**

3. Set the load control input signal for 0-10 Vdc through the following menu path:

   Params & Display > LoadController > Configuration > Ext Inp X62 U/I = **0..10 V**

Hot Standby on a Steam Boiler with an RWF50 or RWF55 (continued)

4. Set the following parameters in the RWF55 controller. For more information, obtain Siemens Document No. U7867 for the RWF55 at www.scccombustion.com.

    ConF > Cntr > CtYP = 2
    ConF > Cntr > SPL = setpoint range lower limit
    ConF > Cntr > SPH = setpoint range upper limit
    OPr > SP1 = normal operation setpoint
    PArA > HYS1 = burner on for normal operation
    PArA > HYS3 = burner off for normal operation
    ConF > InP > InP1 > Sen1 = pressure sensor type
    ConF > InP > lnP1 > SCL1 = 0
    ConF > InP > InP1 > SCH1 = high end of the range of the pressure sensor
    ConF > InP > InP3 > Sen3 = temperature sensor type
    ConF > AF > FnCt = 12
    ConF > AF > AL = hot standby setpoint
    ConF > AF > HYSt = burner on / off for hot standby
    ConF > OutP > SiGn = 2

Operation

1. When the hot standby switch is set for hot standby, the LMV5 system is in hot standby mode. The burner will turn on and off based on the temperature limits set in the RWF55 controller for hot standby (ConF > AF). Since the signal to LMV5 terminal X62 is broken by the hot standby switch, the LMV5 stays at low fire until the burner turns off based on the burner off point set in the RWF55.

2. When the hot standby switch is set for normal operation, the system is in normal operation mode and not in hot standby. The burner will turn on and off based on the pressure limits set in the RWF55 controller for normal operation (PArA > HYS1 and PArA > HYS3). The signal to LMV5 terminal X62 determines the firing rate of the burner.

Important Notes

1. An RWF55 controller must be used for this hot standby option (not RWF50).

2. The RWF55 is operating as the load controller during normal operation as well as controlling the hot standby.

Low Fire Hold with a Temperature Switch

Introduction

Low fire hold assists in preventing boiler damage from thermal shock. A simple low fire hold with an LMV5 is accomplished through the use of a temperature switch. A temperature switch closes a contact which allows the burner to release to modulation. With proper wiring and parameter setup, this simple device will create an effective low fire hold with an LMV5 controller.

Table 3 describes the six different load controller operating modes in the LMV5.

Table 3: Description of LMV5 Load Controller Operating Modes

<table>
<tr><th>Label</th><th>Description</th><th>Setpoint</th><th>Upon X62.1 – X62.2 Contact Closure</th></tr>
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<tr><td>IntLC Bus</td><td>Internal load control, setpoint from Modbus command</td><td>W3</td><td rowspan="4">Change to “IntLC”, setpoint W1</td></tr>
<tr><td>IntLC X62</td><td>Internal load control, setpoint from analog signal on terminal X62</td><td>Remote setpoint</td></tr>
<tr><td>ExtLC X62</td><td>External load control, firing rate from analog signal on terminal X62</td><td>N/A</td></tr>
<tr><td>ExtLC Bus</td><td>External load control, firing rate from Modbus command</td><td>N/A</td></tr>
</table>

If any operating mode other than “IntLC” is used, a contact closure between terminals X62.1 and X62.2 will cause the LMV5 to revert back to operating mode “IntLC”. This concept is necessary to achieve a low fire hold with a temperature switch.

Low Fire Hold with a Temperature Switch (continued)

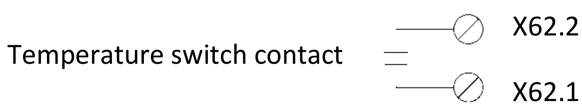
Procedure

1. Set the LMV5 for load control operating mode "ExtLC X5-03" through the following menu path:

   Params & Display > LoadController > Configuration > LC_OptgMode = **ExtLC X5-03**

2. Wire a jumper between terminals X5-03.4 and X5-03.2 on the LMV5. Terminal X5-03.4 outputs 120 Vac at all times. When the LMV5 is in operating mode "ExtLC X5-03" and 120 Vac is on terminal X5-03.2, the LMV5's firing rate decreases.

3. Wire the temperature switch contact between terminals X62.1 and X62.2 on the LMV5. This needs to be a normally-open contact that closes once the temperature of the boiler rises above the temperature setting on the temperature switch.



Operation

1. When the temperature of the boiler is below the temperature switch setting, the contact between X62.1 and X62.2 will be open. The LMV5 will be in operating mode "ExtLC X5-03", waiting for a 3-position input for its firing rate command. Since line power from terminal X5-03.4 has been directly connected to the terminal that decreases the firing rate (X5-03.2), the LMV5 will remain at low fire.

2. Once the temperature rises above the temperature switch setting, the contact between X62.1 and X62.2 closes. The LMV5 changes to operating mode "IntLC" and modulates to maintain setpoint W1.

Low Fire Hold with an RWF55

Introduction

Low fire hold assists in preventing boiler damage from thermal shock. If an RWF55 is the external load controller with the LMV5, a low fire hold can be easily incorporated. With an RWF55, a low fire hold is accomplished by breaking the increase load signal to the LMV5. The wiring and setup for four cases will be described:

- Steam boiler with an RWF55 with analog output
- Hot water boiler with an RWF55 with analog output
- Steam boiler with an RWF55 with 3-position output
- Hot water boiler with an RWF55 with 3-position output

Table 4 describes the six different load controller operating modes in the LMV5.

Table 4: Description of LMV5 Load Controller Operating Modes

<table>
<tr><th>Label</th><th>Description</th><th>Setpoint</th><th>Upon X62.1 – X62.2 Contact Closure</th></tr>
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<tr><td>IntLC</td><td>Internal load control, setpoint set locally on LMV5</td><td>W1</td><td>Remain in “IntLC”, setpoint W2</td></tr>
<tr><td>IntLC Bus</td><td>Internal load control, setpoint from Modbus command</td><td>W3</td><td rowspan="4">Change to “IntLC”, setpoint W1</td></tr>
<tr><td>IntLC X62</td><td>Internal load control, setpoint from analog signal on terminal X62</td><td>Remote setpoint</td></tr>
<tr><td>ExtLC X62</td><td>External load control, firing rate from analog signal on terminal X62</td><td>N/A</td></tr>
<tr><td>ExtLC Bus</td><td>External load control, firing rate from Modbus command</td><td>N/A</td></tr>
</table>

When executing a low fire hold with the RWF55, either “ExtLC X5-03” or “ExtLC X62” may be chosen for the LMV5’s operating mode. The wiring and setup of the RWF55 differs slightly depending on the mode selected as shown on the following pages.

Low Fire Hold with an RWF55 (continued)

Procedure – Steam Boiler with an RWF55 with Analog Output

In the case of steam boilers, temperature sensors located in the boiler water jacket are recommended. Technical Instructions SEN-1000 provides additional information on temperature sensors.

1. Set the following parameters in the LMV5:

   Params & Display > LoadController > Configuration > LC_OptgMode = **ExtLC X62**
   Params & Display > LoadController > Configuration > Ext Inp X62 U/I = **0..20 mA**

2. Set the following parameters in the RWF55:

   ConF > Inp > Inp1 > SEn1 = signal type of pressure sensor
   ConF > Inp > Inp1 > SCL1 = 0
   ConF > Inp > Inp1 > SCH1 = high end of the range of the pressure sensor
   ConF > Inp > Inp3 > SEn3 = type of RTD being used for a belly sensor
   ConF > Cntr > CtYP = 2
   ConF > AF > FnCt = 11
   ConF > AF > AL = temperature to enable low fire hold
   ConF > AF > HYSt = deadband around low fire hold temperature
   ConF > OutP > FnCt = 4
   ConF > OutP > SiGn = 0

3. Wire the LMV5 and RWF55 as shown in Figure 4:

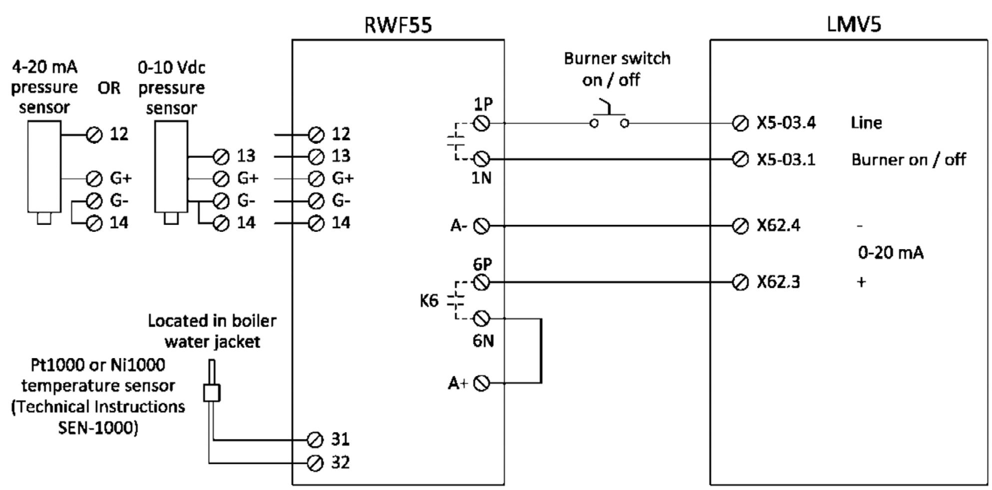


Figure 4: Low Fire Hold via Analog Output on a Steam Boiler

See page 19 for an example of the low fire hold operation.

Low Fire Hold with an RWF55 (continued)

Hot Water Boiler with an RWF55 with Analog Output

1. Set the following parameters in the LMV5:

   Params & Display > LoadController > Configuration > LC_OptgMode = **ExtLC X62**
   Params & Display > LoadController > Configuration > Ext Inp X62 U/I = **0..20 mA**

2. Set the following parameters in the RWF55:

   ConF > Inp > Inp1 > SEn1 = type of RTD being used for temperature sensor
   ConF > Cntr > CtYP = 2
   ConF > AF > FnCt = 7
   ConF > AF > AL = temperature to enable low fire hold
   ConF > AF > HYSt = deadband around low fire hold temperature
   ConF > OutP > FnCt = 4
   ConF > OutP > SiGn = 0

3. Wire the LMV5 and RWF55 as shown in Figure 5:

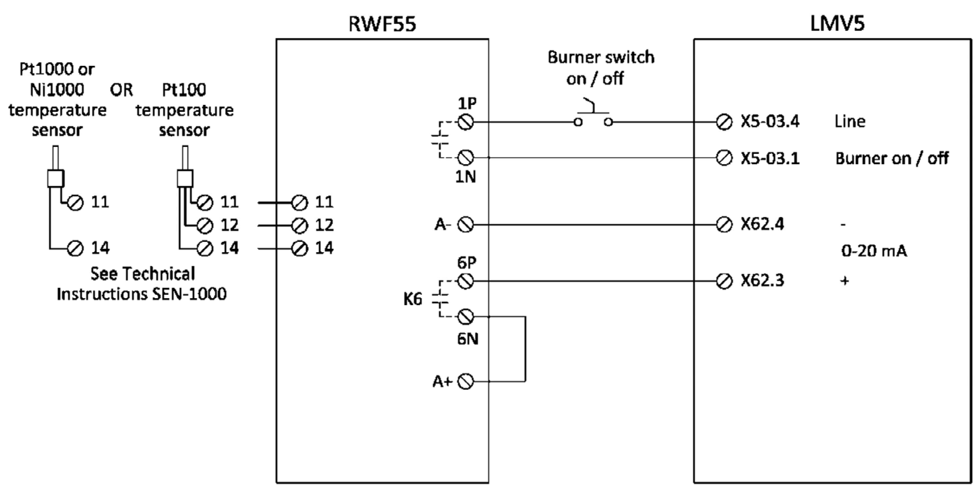


Figure 5: Low Fire Hold via Analog Output on a Hot Water Boiler

See page 19 for an example of the low fire hold operation.

Low Fire Hold with an RWF55 (continued)

Steam Boiler with an RWF55 with 3-position Output

In the case of steam boilers, temperature sensors located in the boiler water jacket are recommended. Technical Instructions SEN-1000 provides additional information on temperature sensors.

1. Set the following parameters in the LMV5:

   Params & Display > LoadController > Configuration > LC_OptgMode = **ExtLC X5-03**

2. Set the following parameters in the RWF55:

   ConF > Inp > Inp1 > SEn1 = signal type of pressure sensor being used
   ConF > Inp > Inp1 > SCL1 = 0
   ConF > Inp > Inp1 > SCH1 = high end of the range of the pressure sensor
   ConF > Inp > Inp3 > SEn3 = type of RTD being used for a belly sensor
   ConF > Cntr > CtYP = 1
   ConF > AF > FnCt = 11
   ConF > AF > AL = temperature to enable low fire hold
   ConF > AF > HYSt = deadband around low fire hold temperature

3. Wire the LMV5 and RWF55 as shown in Figure 6:

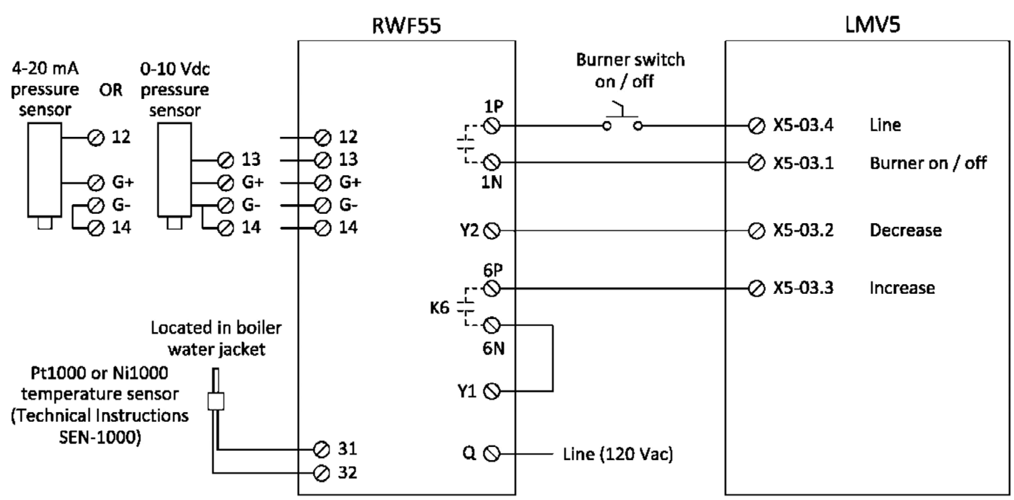


Figure 6: Low Fire Hold via 3-position Output on a Steam Boiler

See page 19 for an example of the low fire hold operation.

Low Fire Hold with an RWF55 (continued)

Hot Water Boiler with an RWF55 with 3-position Output

1. Set the following parameters in the LMV5:

   Params & Display > LoadController > Configuration > LC_OptgMode = **ExtLC X5-03**

2. Set the following parameters in the RWF55:

   ConF > Inp > Inp1 > SEn1 = type of RTD being used for temperature sensor
   ConF > Cntr > CtYP = 1
   ConF > AF > FnCt = 7
   ConF > AF > AL = temperature to enable low fire hold
   ConF > AF > HYSt = deadband around low fire hold temperature

3. Wire the LMV5 and RWF55 as shown in Figure 7:

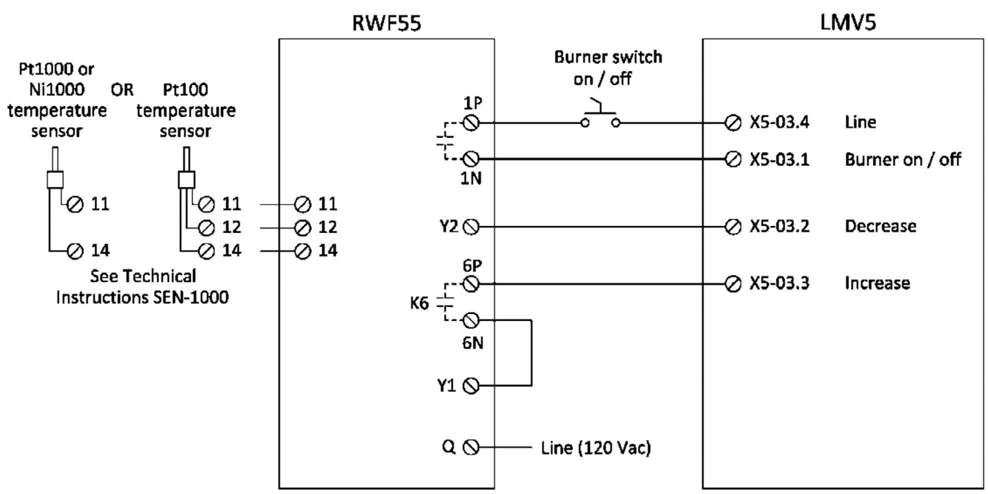


Figure 7: Low Fire Hold via 3-position Output on a Hot Water Boiler

See page 19 for an example of the low fire hold operation.

Low Fire Hold with an RWF55 (continued)

Operation

1. When the boiler temperature falls below the low fire hold temperature threshold (AL - 1/2 HYSt), contact K6 opens and prevents the LMV5 from increasing the firing rate. This is the case for either analog or 3-position output from the RWF55.

2. Once the boiler warms up above the low fire hold threshold (AL + 1/2 HYSt), contact K6 closes and the burner modulates according to the PID settings of the RWF55.

Example

Low fire hold threshold settings:

AL = 180
HYSt = 10

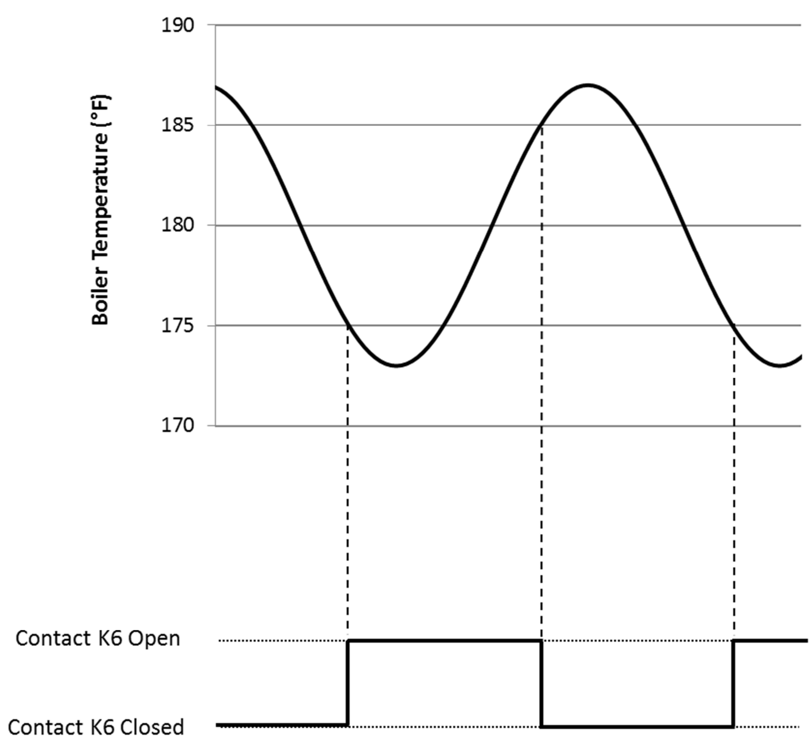


Figure 8: Behavior of Contact K6 when Using an RWF55 for Low Fire Hold

Pilot Valve Proving

Introduction

Valve proving detects if the main gas valves in a gas train are leaking. In addition to checking the main gas valves, the pilot valves may be tested for leakage as well. There are three options for performing pilot valve proving:

- Option 1: On Startup with SKP25's on both the Pilot and Main Gas Trains
- Option 2: On Startup, SKP25 on the Main Gas Train, Solenoid Valves on the Pilot Train
- Option 3: Pilot Valve Proving on Startup and Main Valve Proving on Shutdown

On the LMV5, valve proving of the main gas valves can be performed during startup, during shutdown, or during both startup and shutdown of the boiler. If pilot valve proving is added using Option 1 or Option 2, valve proving must be performed during startup of the boiler only. If pilot valve proving is added using Option 3, valve proving must be performed during both startup and shutdown of the boiler.

Pilot valve proving can be performed on any LMV52. Pilot valve proving can be performed on any LMV51 with a date code of 140131xxxx (Jan 31, 2014) or later.

Procedure

1. The valve proving type can be set in the LMV5 through the following menu path:

   Params & Display > BurnerControl > ValveProving > ValveProvingType

   For Option 1 or Option 2, this must be set for "VP startup". For Option 3, this must be set for "VP stup/shd".

2. In addition to setting the valve proving type, input terminal X9-03.2 must be set for a valve proving pressure switch input. This can be done through the following menu path:

   Params & Display > BurnerControl > ValveProving > Config_PS-VP/CPI = **PS-VP**

Pilot Valve Proving (continued)

3. The times for each of the four stages of valve proving need to be set. To do so, use the following menu paths in the LMV5:

   Params & Display > BurnerControl > ValveProving > VP_EvacTme
   Params & Display > BurnerControl > ValveProving > VP_TmeAtmPress
   Params & Display > BurnerControl > ValveProving > VP_FillTme
   Params & Display > BurnerControl > ValveProving > VP_Tme_GasPress

   "VP_EvacTme" is the time that the downstream valve is energized in order to evacuate the chamber between the upstream and downstream valves (phase 80). This is typically set to 3 seconds, but should not be set any less than the opening time of the valves.

   "VP_FillTme" is the time that the upstream valve is energized in order to pressurize the chamber between the upstream and downstream valves (phase 82). This is typically set to 3 seconds, but should not be set any less than the opening time of the valves.

   "VP_TmeAtmPress" is the time that both the upstream and downstream valves are closed to test the leakage rate of the upstream valve (phase 81). "VP_Tme_GasPress" is the time that both the upstream and downstream valves are closed to test the leakage rate of the downstream valve (phase 83). Both of these times should be set to the same value. These times can be calculated using the following equation:

$$t_{test} = \frac{(P_i - P_{set}) \times V \times 3600}{P_{atm} \times Q_{leak}}$$

   t_{test} = Time for setting parameters "VP_TmeAtmPress" and "VP_Tme_GasPress" in seconds
   P_i = Inlet gas pressure (pressure upstream of both valves) in PSIG
   P_{set} = Gas pressure setting on pressure switch in PSIG (should be set for half of P_i)
   P_{atm} = Atmospheric pressure downstream of both valves in PSIA (typically 14.7 PSI)
   V = Volume between the gas valves to be tested in ft^3
   Q_{leak} = Allowable leakage rate in ft^3/hr

   For Option 3, these times should be calculated independently for the pilot and main valves, and the larger of the calculated times should be used as the parameter setting.

4. Parameter "PreIgnitionTGas" should be set for its default of 2 seconds. This parameter can be found at the following menu path in the LMV5:

   Params & Display > BurnerControl > Times > TimesStartup1 > PreIgnitionTGas

Pilot Valve Proving (continued)

Option 1: On Startup with SKP25's on both the Pilot and Main Gas Trains

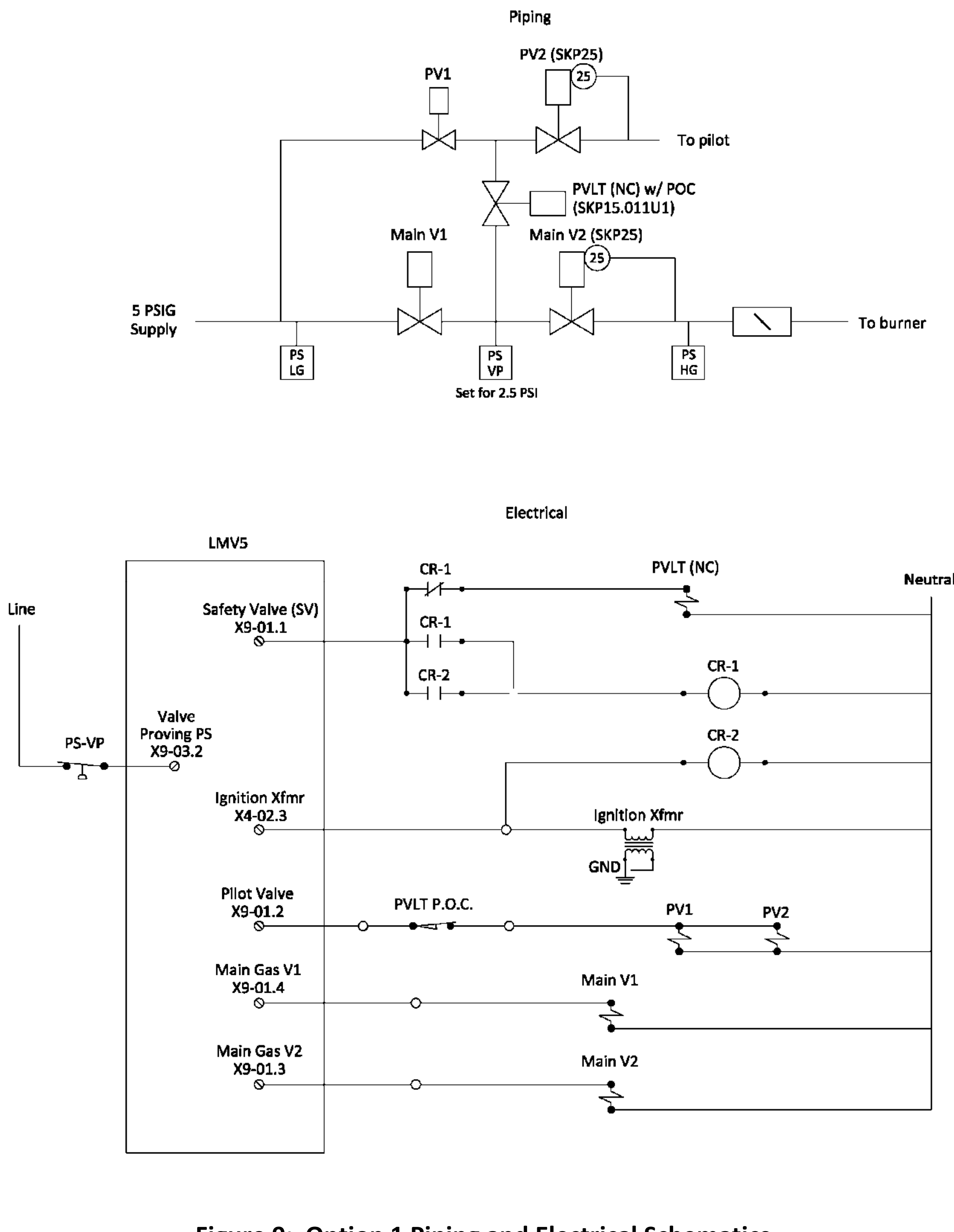


Figure 9: Option 1 Piping and Electrical Schematics

Pilot Valve Proving (continued)

Option 1 Sequence of Operation

1. The LMV5 is in standby. All valves are closed and all relay contacts are as shown in the electrical schematic.

2. The LMV5 receives a call for heat. The SV terminal (X9-01.1) energizes before the blower, energizing the PVLT (Pilot Valve Leak Test). The PVLT opens, and connects the volumes between the pilot valves and main valves. The PVLT POC switch also opens, preventing the operation of the pilot valves.

3. During prepurge, the main valve proving sequence takes place as normal. The PS-VP (Pressure Switch - Valve Proving) is wired to terminal X9-03.2 as normal. The setpoint of the PS-VP should be set for half of the inlet pressure.

4. The LMV5 drives to ignition position. The ignition transformer output (X4-02.3) energizes, thereby energizing the CR-1 coil, and latching the coil from the power supplied from X9-01.1. At the same time, one of the CR-1A contacts opens, thereby closing the PVLT valve and closing the PVLT POC switch. Note that the PVLT POC switch must be closed before the pilot valves open.

5. The LMV5 continues light off and runs as normal, with the CR-1 coil latched in and the PVLT valve closed.

6. Upon shutdown, the SV terminal (X9-01.1) de-energizes, which un-latches the circuit. The PVLT valve remains closed until the next start up.

Option 1 Important Notes

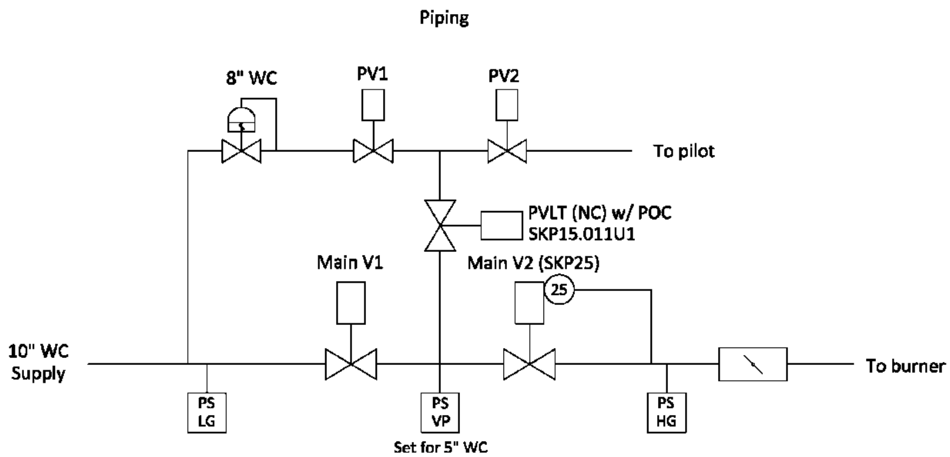
1. The proof of closure switch on the PVLT ensures that gas is unable to flow between the pilot and main valves before the pilot attempts to light.

2. All four valves are tested at the inlet pressure, which is the pressure that they normally operate at. The PS-VP should be set for half of the inlet pressure which provides a valid test for all four valves.

3. Valve proving must be done on startup only.

Pilot Valve Proving (continued)

Option 2: On Startup, SKP25 on the Main Gas Train, Solenoid Valves on the Pilot Train



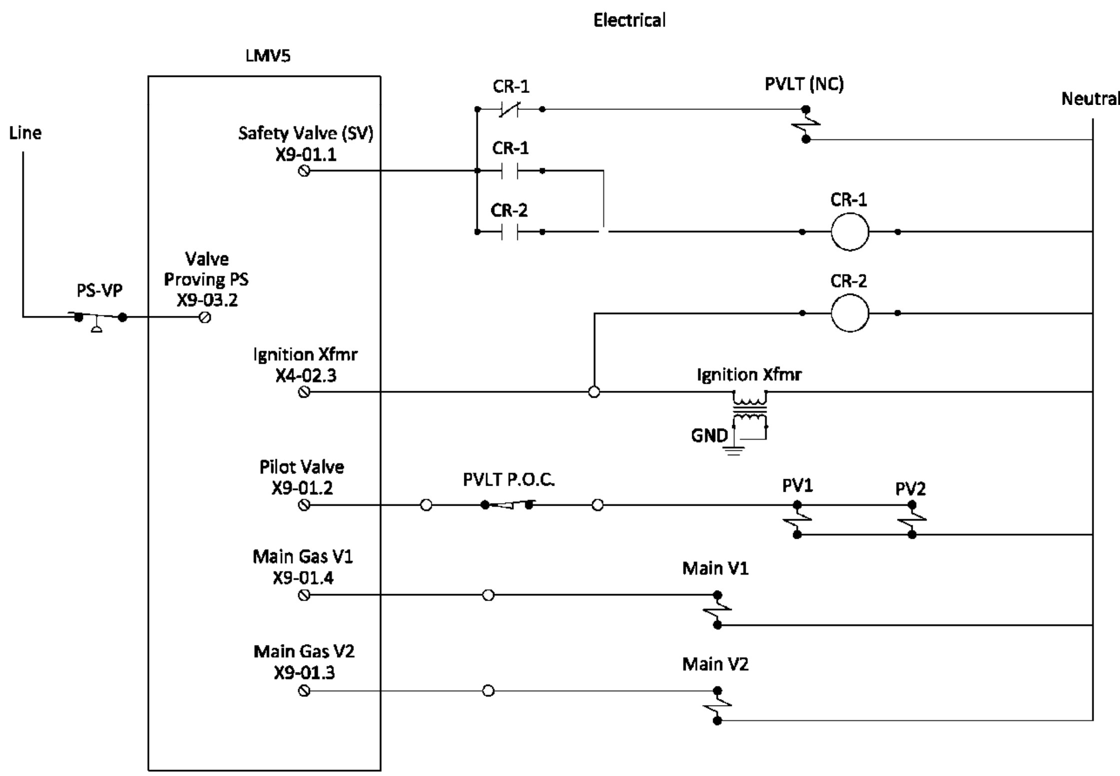


Figure 10: Option 2 Piping and Electrical Schematics

Pilot Valve Proving (continued)

Option 2 Sequence of Operation

1. The LMV5 is in standby. All valves are closed and all relay contacts are as shown in the electrical schematic.

2. The LMV5 receives a call for heat. The SV terminal (X9-01.1) energizes before the blower, energizing the PVLT (Pilot Valve Leak Test). The PVLT opens, and connects the volumes between the pilot valves and main valves. The PVLT POC switch also opens, preventing the operation of the pilot valves.

3. During prepurge, the main valve proving sequence takes place as normal. The PS-VP (Pressure Switch - Valve Proving) is wired to terminal X9-03.2 as normal. The setpoint of the PS-VP should be set for half of the inlet pressure.

4. The LMV5 drives to ignition position. The ignition transformer output (X4-02.3) energizes, thereby energizing the CR-1 coil, and latching the coil from the power supplied from X9-01.1. At the same time, one of the CR-1A contacts opens, thereby closing the PVLT valve and closing the PVLT POC switch. Note that the PVLT POC switch must be closed before the pilot valves open.

5. The LMV5 continues light off and runs as normal, with the CR-1 coil latched in and the PVLT valve closed.

6. Upon shutdown, the SV terminal (X9-01.1) de-energizes, which un-latches the circuit. The PVLT valve remains closed until the next start up.

Option 2 Important Notes

1. The proof of closure switch on the PVLT ensures that gas is unable to flow between the pilot and main valves before the pilot attempts to light.

2. Inlet pressure and pilot pressure must be similar (within ~30%) to have a valid test for all four valves.

3. Valve proving must be done on startup only.

Pilot Valve Proving (continued)

Option 3: Pilot Valve Proving on Startup and Main Valve Proving on Shutdown

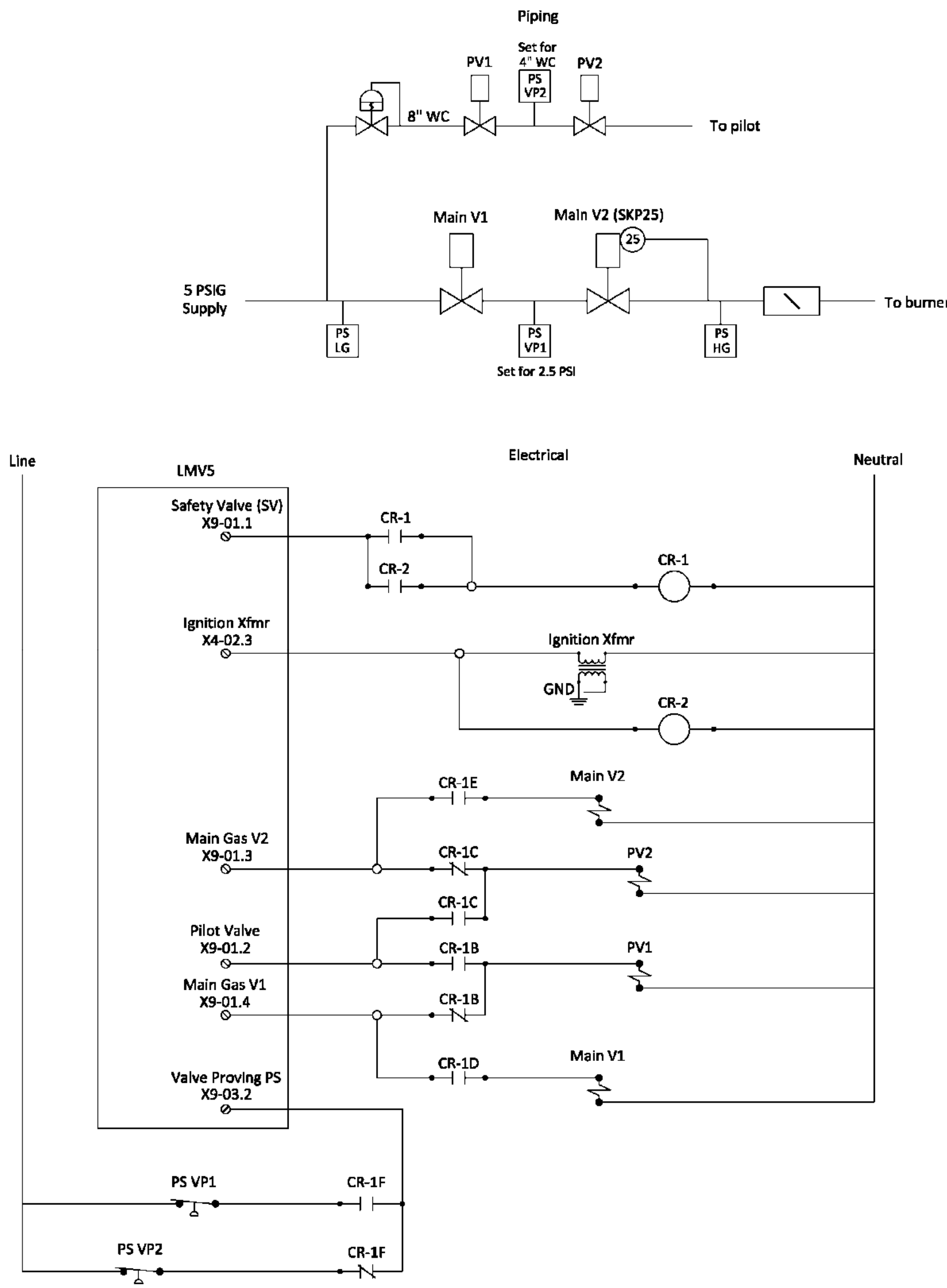


Figure 11: Option 3 Piping and Electrical Schematics

Pilot Valve Proving (continued)

Option 3 Sequence of Operation

1. The LMV5 is in standby. All valves are closed and all relay contacts are as shown in the electrical schematic. Main gas valve V1 terminal X9-01.4 is effectively connected to PV1, and main gas valve V2 terminal X9-01.3 is effectively connected to PV2.

2. The LMV5 receives a call for heat. The SV terminal (X9-01.1) energizes before the blower, which has no effect. The LMV5 drives to prepurge position.

3. During prepurge, the valve proving sequence takes place on the pilot valves only. PS-VP2 (the Pressure Switch Valve Proving between the pilots) is effectively connected to the valve proving terminal (X9-03.2). The setpoint of PS-VP2 should be set for half of the inlet pressure to the pilot valves.

4. The LMV5 drives to ignition position. The ignition transformer output (X4-02.3) energizes, thereby energizing the CR-1 coil, and latching the coil from the power supplied from X9-01.1. The main gas valve V1 terminal (X9-01.4) is connected to main gas valve V1, and the main gas valve V2 terminal (X9-01.3) is connected to main gas valve V2. The pilot valve terminal (X9-01.2) is connected to both PV1 and PV2. Also, PS-VP1 is now connected to the valve proving terminal (X9-03.2).

5. The LMV5 continues to light off and runs as normal, with the CR-1 coil latched in.

6. Upon shutdown, the LMV5 proceeds directly into valve proving on shutdown. The SV terminal (X9-01.1) is still energized, so the main valves will go through valve proving using PS-VP1. The setpoint of PS-VP1 should be set for half of the main inlet pressure.

7. After valve proving on shutdown is complete, the SV terminal (X9-01.1) de-energizes and the CR-1 circuit unlatches.

Option 3 Important Notes

1. Separate pressure switches for the pilot valves and main valves are required.

2. All four valves are tested independently.

3. Valve proving must be done on both startup and shutdown of the boiler.

Purge Proving

Introduction

Purge proving verifies either a differential air pressure switch or an air damper end switch is in the correct position before purge begins. This can be accomplished in two different ways:

- A differential pressure switch to verify proper air flow through the boiler. Once the proper differential pressure is achieved, the prepurge position has been verified and the purge begins.
- An end switch on the air damper. Once the air damper has moved to its fully open position, the end switch closes and the purge begins.

The following procedure for purge proving on the LMV5 uses an additional two-pole relay with either a differential pressure switch or an air damper end switch.

NOTE: Do not perform purge proving if using direct start on the LMV5!

Procedure

The following procedure uses either a differential pressure switch or an air damper end switch for purge proving on the LMV5. For the rest of this procedure, either switch will be referred to as a “proving switch”.

1. Wire the LMV5, proving switch, and two-pole relay as shown below in Figure 12.

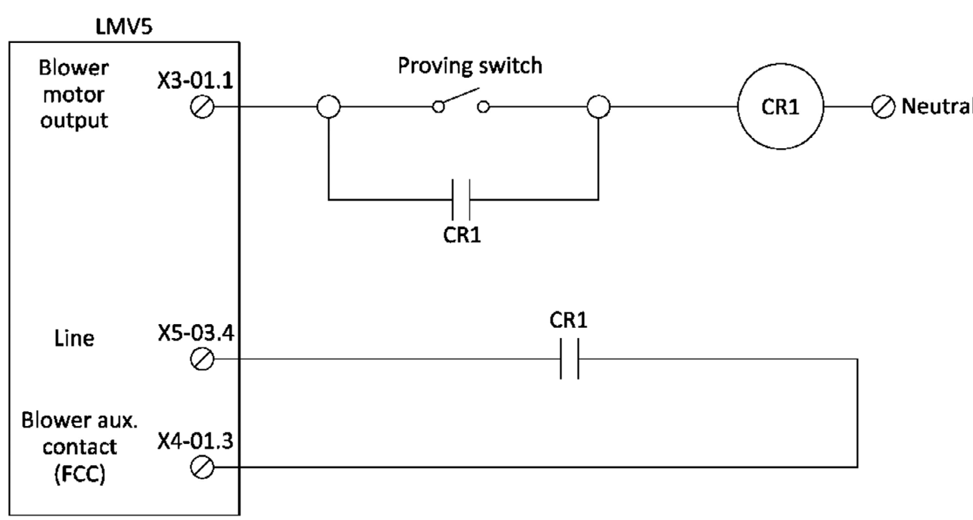


Figure 12: LMV5 Purge Proving Wiring Diagram

Purge Proving

2. Input X4-01.3 on the LMV5 must be configured for a blower auxiliary contact. This can be set through the following menu path in the LMV5:

   Params & Display > BurnerControl > Configuration > ConfigIn/Output > FGR-PS/FCC = **FCC**

Operation

1. In phase 22, the blower motor output (X3-01.1) energizes, powering the common side of the proving switch. **Note: Since the blower motor may never turn off when using direct start, purge proving cannot be used in conjunction with direct start on the LMV5.**

2. By the end of phase 24, the blower auxiliary contact input (X4-01.3) must be energized or the LMV5 will lockout on a “fan contactor contact” (FCC) fault.

3. Once the proving switch makes, relay CR1 energizes and the two normally-open contacts close.

4. The contact wired in parallel with the proving switch latches power to relay CR1 as long as the blower is on.

5. The other contact wired off of line terminal X5-03.4 completes the circuit to the blower auxiliary contact input (X4-01.3). At this point, the purge proving is complete and the LMV5 will progress to phase 30 (prepurge).

Remote Setpoint

Introduction

The LMV5 can be configured to accept either a local setpoint or a remote setpoint. A remote setpoint takes an analog input and converts it into a setpoint. On the LMV5, terminal X62 can be wired and configured to accept a variety of signals for a remote setpoint. The following steps describe the procedure for setting up a remote setpoint on the LMV5.

Procedure

1. Log in to the LMV5 with either the service or OEM level password.

2. The LMV5 must be set for a load controller operating mode of "IntLC X62". The LMV5 will utilize the internal PID loop, but will also respond to a remote setpoint from an analog signal on terminal X62. To set the load controller operating mode to "IntLC X62", use the following menu path:

   Params & Display > LoadController > Configuration > LC_OptgMode = **IntLC X62**

3. Configure the type of analog signal which will be input to terminal X62. Four options are available: 0-10 Vdc, 2-10 Vdc, 0-20 mA, or 4-20 mA. Use the following menu path to set the input type for terminal X62:

   Params & Display > LoadController > Configuration > Ext Inp X62 U/I

   NOTE: For the remainder of this section, all examples will use a 4-20 mA signal.

4. The analog input must be scaled appropriately depending on the desired setpoint limits for the remote setpoint. The LMV5 predefines what setpoint a 4 mA signal indicates. Conversely, the LMV5 must be programmed with the desired setpoint for a 20 mA signal. Then, the setpoint will be scaled linearly for any signal between 4 and 20 mA.

   <u>Low Setpoint Scaling</u>
   When operating on pressure, a 4 mA signal **always** translates to a 0 psi setpoint.
   When operating on temperature, a 4 mA signal **always** translates to a 32°F setpoint.

   <u>High Setpoint Scaling</u>
   The high end of the setpoint scaling depends on the sensor type wired to terminals X60 or X61. There are three possibilities for sensor type: a pressure sensor wired to terminal X61, a temperature sensor wired to terminal X60, or a temperature transmitter wired to terminal X61.

Remote Setpoint (continued)

Pressure Sensor Wired to Terminal X61
When operating on pressure, a 20 mA signal translates to the value programmed into parameter “MRange PressSens”. Parameter “MRange PressSens” can be accessed through the following menu path:

Params & Display > LoadController > Configuration > MRange PressSens

This value should not be changed as it is used to scale the high end of the pressure sensor connected to terminal X61. This should simply be noted for later calculations.

Temperature Sensor Wired to Terminal X60
When operating on temperature via an RTD wired on terminal X60, a 20 mA signal translates to the value programmed into parameter “MeasureRangePtNi”. This parameter can be set for 302°F, 752°F, or 1562°F. It is recommended for best resolution that this is set to 302°F unless a setpoint over 302°F is desired. Note that if “MeasureRangePtNi” is exceeded, a temperature sensor fault will occur. Parameter “MesaureRangePtNi” can be accessed through the following menu path:

Params & Display > LoadController > Configuration > MeasureRangePtNi

Temperature Transmitter Wired to Terminal X61
When operating on temperature via an analog input on terminal X61, a 20 mA signal translates to the value programmed into parameter “MRange TempSens”. Parameter “MRange TempSens” can be accessed through the following menu path:

Params & Display > LoadController > Configuration > MRange TempSens

This value should not be changed as it is used to scale the high end of the temperature sensor connected to terminal X61. This should simply be noted for later calculations.

5. Finally, upper and lower setpoint limits can be programmed using parameters “Ext MinSetpoint” and “Ext MaxSetpoint”. These parameters are percentages of the range from the low setpoint limit to the high setpoint limit. As a formula, these parameters should be set using the following method:

$$Ext\ MinSetpoint = \frac{Desired\ Low\ Setpoint - Low\ Setpoint\ Scale}{High\ Setpoint\ Scale - Low\ Setpoint\ Scale}$$

$$Ext\ MaxSetpoint = \frac{Desired\ High\ Setpoint - Low\ Setpoint\ Scale}{High\ Setpoint\ Scale - Low\ Setpoint\ Scale}$$

Remote Setpoint (continued)

“Ext MinSetpoint” and “Ext MaxSetpoint” are found through the following menu path:

Params & Display > LoadController > Configuration

These parameters do not re-scale the input, but provide hard upper and lower limits on the setpoint. The following is an example on how these parameters may be utilized.

Example: Pressure Sensor Wired to Terminal X61

LC_OptgMode = IntLC X62
Ext Inp X62 U/I = 4..20 mA
MRange PressSens = 200 psi
Desired remote setpoint range = 100-150 psi

A 4-20 mA signal on terminal X62 scales the setpoint from 0-200 psi. Parameters “Ext MinSetpoint” and “Ext MaxSetpoint” need to be utilized to get the appropriate setpoint range.

$$Ext\ MinSetpoint = \frac{100\ psi - 0\ psi}{200\ psi - 0\ psi} = \frac{100}{200} = 50\%$$

$$Ext\ MaxSetpoint = \frac{150\ psi - 0\ psi}{200\ psi - 0\ psi} = \frac{150}{200} = 75\%$$

With these parameters set, the following input signals will scale the setpoint accordingly:

4 - 12 mA = 100 psi (limited by “Ext MinSetpoint”)
12 - 16 mA = 100 - 150 psi
16 - 20 mA = 150 psi (limited by “Ext MaxSetpoint”)

Remote Setpoint (continued)

Example: Temperature Sensor Wired to Terminal X60

LC_OptgMode = IntLC X62
Ext Inp X62 U/I = 4..20 mA
MeasureRangePtNi = 302 °F
Desired remote setpoint range = 180-270 °F

A 4-20 mA signal on terminal X62 scales the setpoint from 32-302 °F. Parameters “Ext MinSetpoint” and “Ext MaxSetpoint” need to be utilized to get the appropriate setpoint range.

$$Ext\ MinSetpoint = \frac{180°\mathrm{F} - 32°\mathrm{F}}{302°\mathrm{F} - 32°\mathrm{F}} = \frac{148}{270} = 55\%$$

$$Ext\ MaxSetpoint = \frac{270°\mathrm{F} - 32°\mathrm{F}}{302°\mathrm{F} - 32°\mathrm{F}} = \frac{238}{270} = 88\%$$

With these parameters set, the following input signals will scale the setpoint accordingly:

4 – 12.8 mA = 180 °F (limited by “Ext MinSetpoint”)
12.8 – 18.1 mA = 180 - 270 °F
18.1 - 20 mA = 270 °F (limited by “Ext MaxSetpoint”)

Remote Setpoint (continued)

Example: Temperature Transmitter Wired to Terminal X61

LC_OptgMode = IntLC X62
Ext Inp X62 U/I = 4..20 mA
MRange TempSens = 300 °F
Desired remote setpoint range = 200-240 °F

A 4-20 mA signal on terminal X62 scales the setpoint from 32-300 °F. Parameters “Ext MinSetpoint” and “Ext MaxSetpoint” need to be utilized to get the appropriate setpoint range.

$$Ext\ MinSetpoint = \frac{200°\mathrm{F} - 32°\mathrm{F}}{302°\mathrm{F} - 32°\mathrm{F}} = \frac{168}{270} = 62\%$$

$$Ext\ MaxSetpoint = \frac{240°\mathrm{F} - 32°\mathrm{F}}{302°\mathrm{F} - 32°\mathrm{F}} = \frac{208}{270} = 77\%$$

With these parameters set, the following input signals will scale the setpoint accordingly:

4 – 13.9 mA = 200 °F (limited by “Ext MinSetpoint”)
13.9 – 16.3 mA = 200 - 240 °F
16.3 - 20 mA = 240 °F (limited by “Ext MaxSetpoint”)

VFD Bypass

Introduction

When using an LMV52 with a variable frequency drive (VFD), it may be beneficial to bypass the VFD and run the motor at full speed. There are typically two reasons for doing this:

- On a single fuel system, it is desired to have the ability to run without the VFD, typically in the event of a VFD malfunction.
- On a dual fuel system, it is desired to use the VFD with one fuel (typically gas) but not the other fuel (typically oil).

The following pages provide the information to apply a VFD bypass on either a single or dual fuel system. For the single fuel system, the fuel is assumed to be gas. For the dual fuel system, it will be assumed that the main fuel is gas and the secondary fuel is oil.

VFD Bypass (continued)

To bypass the VFD on a single fuel system, both gas and oil settings in the LMV52 need to be utilized. One fuel will be set up to run with the VFD, while the other fuel is set up to run without the VFD. For the rest of this procedure, it will be assumed that a VFD is being used when running gas and not being used when running oil. Since only one fuel (gas) is being operated on both gas and oil settings, the AGM60 switching module will be used to change over all necessary inputs and outputs when the LMV52 switches between fuels.

Single Fuel Procedure

1. Wire the VFD and motor contactor contacts as shown in Figure 13.

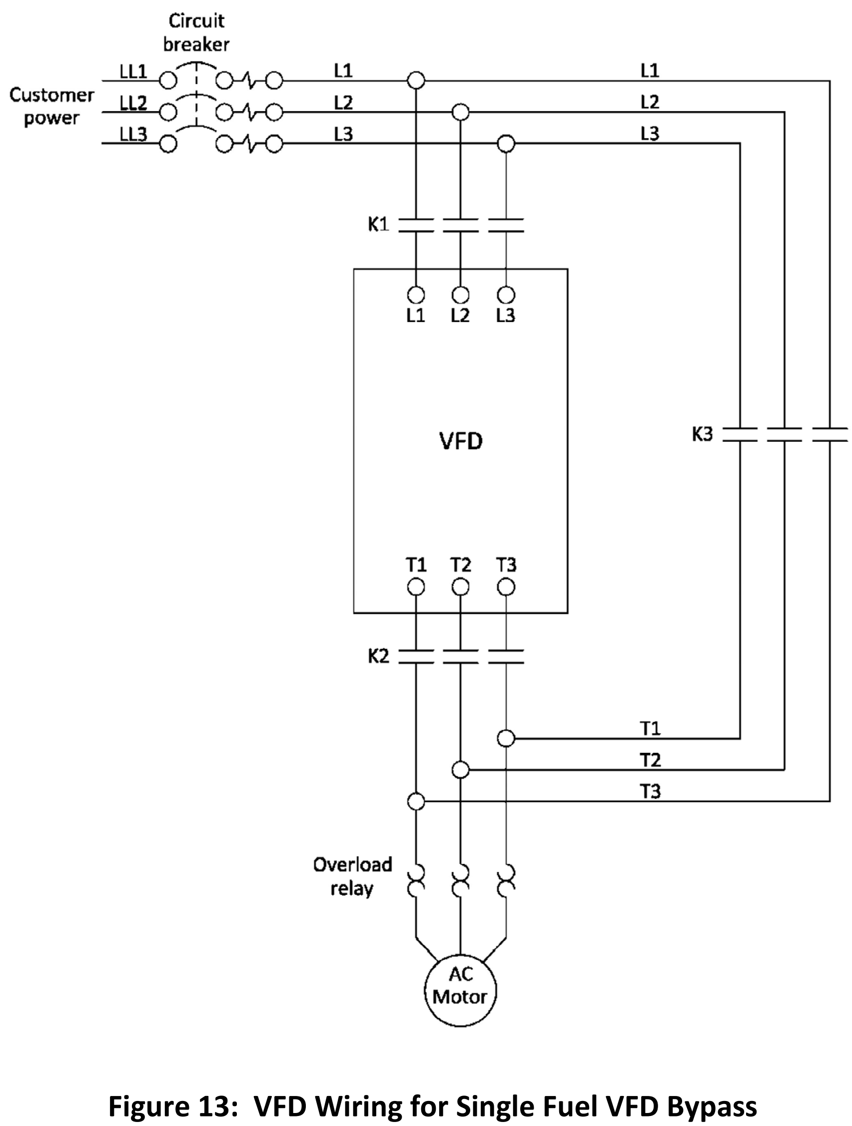


Figure 13: VFD Wiring for Single Fuel VFD Bypass

VFD Bypass (continued)

2. Wire the LMV52, AGM60, and motor contactor coils as shown in Figure 14.

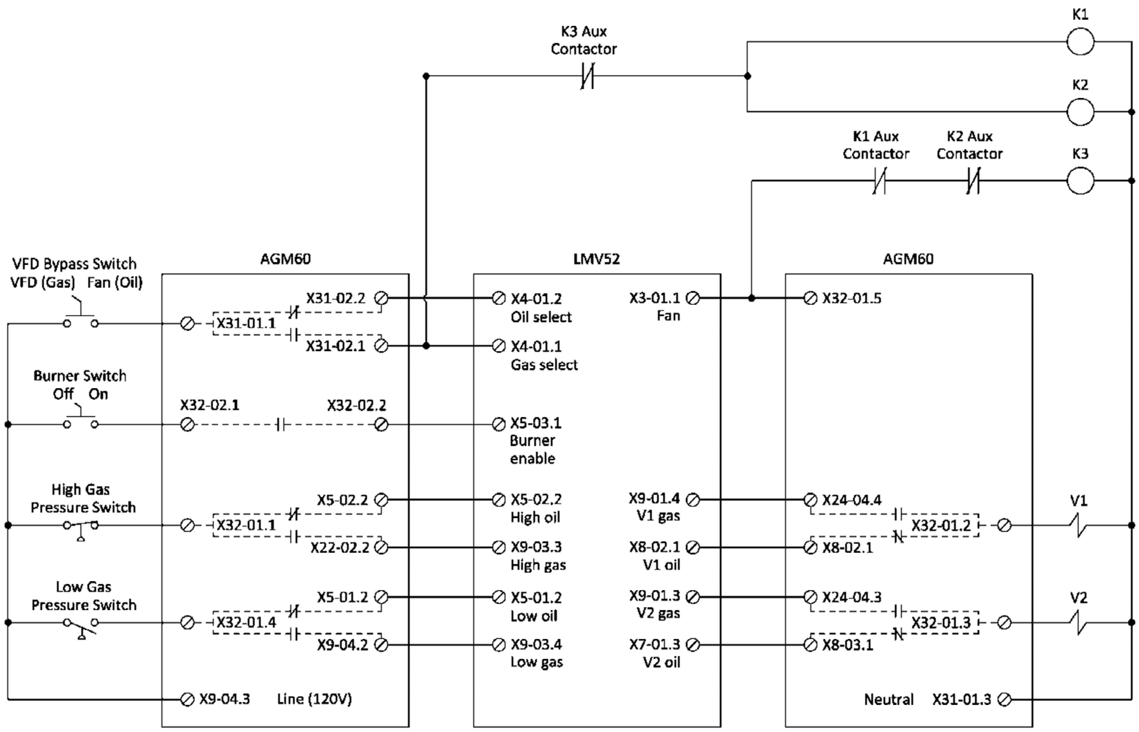


Figure 14: LMV52 and AGM60 Wiring for Single Fuel VFD Bypass

3. Set parameter “NumFuelActuators” to 1 since only one actuator will be used to operate both fuels. This parameter can be set using the following menu path:

   Params & Display > RatioControl > NumFuelActuators = **1**

4. Ensure the VFD is activated on gas, and deactivated on oil. This can be done through the following menu paths:

   Params & Display > RatioControl > Gas Settings > VSD = **activated**
   Params & Display > RatioControl > Oil Settings > VSD = **deactivated**

5. Ensure the LMV52 is not set up for continuous purge. This can be done through the following menu path:

   Params & Display > BurnerControl > Configuration > ConfigGeneral > ContinuousPurge = **deactivated**

VFD Bypass (continued)

6. Set parameters "FuelTrainGas" and "FuelTrainOil" for the fuel train being used. These parameters can be found through the following menu path:

   Params & Display > BurnerControl > Configuration > ConfigGeneral

   If running direction ignition, set these parameters as stated below:

   FuelTrainGas = **DirectIgniG**
   FuelTrainOil = **LightOilLO**

   If running a gas pilot, set these parameters as stated below:

   FuelTrainGas = **Pilot GP2**
   FuelTrainOil = **LO w Gasp**

Single Fuel Operation

1. When the "VFD Bypass Switch" is in VFD mode, motor contactors K1 and K2 are energized. Power flows through the VFD to the motor. Bypass contactor K3 remains de-energized. The fuel select terminal (X31-01.1) on the AGM60 is de-energized, so the LMV52 runs gas. All inputs and outputs are connected through the AGM60 to the LMV52 gas terminals.

2. When the "VFD Bypass Switch" is in Fan mode, motor contactors K1 and K2 are de-energized and no power flows to the VFD. Power runs directly to the motor through bypass contactor K3 once the fan output (X3-01.1) is energized in phase 22. The fuel select terminal (X31-01.1) on the AGM60 is energized, so the LMV52 runs oil. All inputs and outputs are connected through the AGM60 to the LMV52 oil terminals.

3. If the "VFD Bypass Switch" is switched during operation, the LMV52 immediately loses its call for heat and goes through its shutdown sequence. When the fan output (X3-01.1) de-energizes after phase 78, terminal X32-01.5 on the AGM60 becomes de-energized, causing the switchover of all inputs and outputs connected through the AGM60 and the motor contactors.

   Note: Even though this is a single fuel system running gas, the LMV52 display will state it is running oil when the "VFD Bypass Switch" is in Fan mode.

VFD Bypass (continued)

Dual Fuel Procedure

1. Wire the LMV52, VFD, and motor contactors as shown in Figure 15.

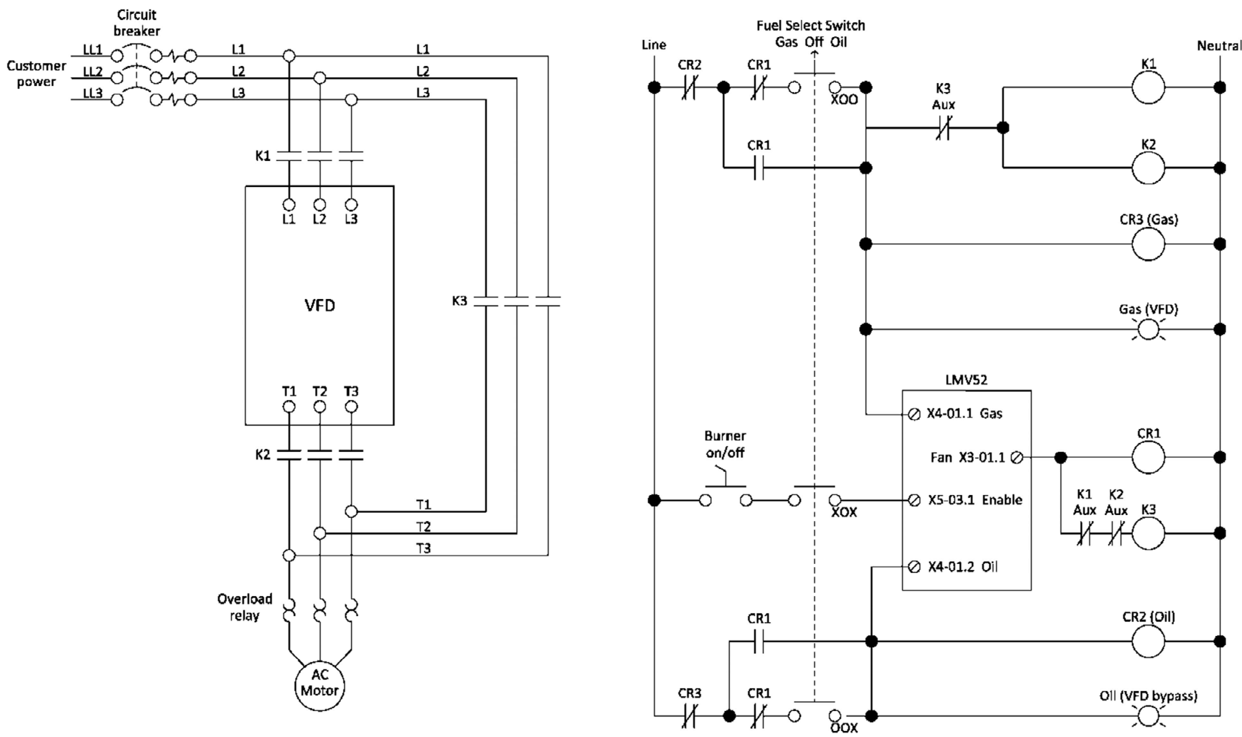


Figure 15: Wiring for a Dual Fuel VFD Bypass

2. Ensure the VFD is activated on gas, and deactivated on oil. This can be done through the following menu paths:

   Params & Display > RatioControl > Gas Settings > VSD = **activated**
   Params & Display > RatioControl > Oil Settings > VSD = **deactivated**

3. Ensure the LMV52 is not set up for continuous purge. This can be done through the following menu path:

   Params & Display > BurnerControl > Configuration > ConfigGeneral > ContinuousPurge = **deactivated**

VFD Bypass (continued)

Dual Fuel Operation

1. When the “Fuel Select Switch” is in gas mode, the coil for CR3 is energized, preventing the LMV52 from running oil. Motor contactors K1 and K2 are energized and power flows through the VFD to the motor. Auxiliary contactors on K1 and K2 prevent motor contactor K3 from energizing. The gas select terminal (X4-01.1) on the LMV52 is energized, and the LMV52 operates on gas.

2. When the “Fuel Select Switch” is in oil mode, the coil for CR2 is energized which prevents the LMV52 from running gas. Motor contactors K1 and K2 are de-energized and no power flows to the VFD. Power runs directly to the motor through bypass contactor K3 once the fan output (X3-01.1) is energized in phase 22. An auxiliary contactor on K3 prevents motor contactors K1 and K2 from energizing. The oil select terminal (X4-01.2) on the LMV52 is energized, and the LMV52 operates on oil.

3. When the “Fuel Select Switch” is in off mode, terminal X5-03.1 is de-energized, preventing the LMV52 from running.

4. Once the fan turns on in phase 22 while running either fuel, the coil for CR1 is energized. The normally open contacts for CR1 close, latching the current fuel in place until the fan turns off after phase 78.

5. If direct start is activated and a fuel changeover is required, turn the “Fuel Select Switch” to off. Wait for the LMV52 to get back to standby (phase 12). Switch the “Fuel Select Switch” to the desired fuel.