SIEMENS

LMV5 Linkageless Burner Management System

Quick Start Guide

Rev 4 2011

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Section 1 Overview

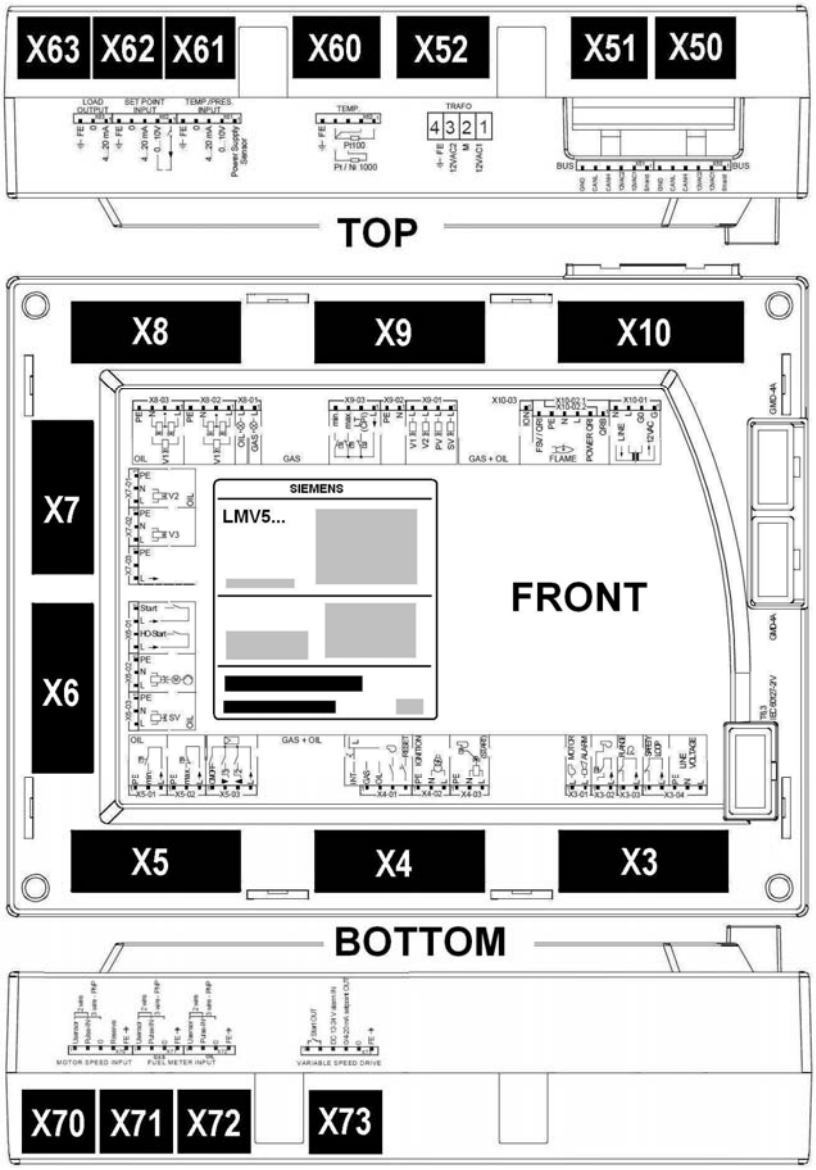
Introduction 1-1

The Siemens LMV5 Burner Management System (BMS) combines the functionalities of a flame safeguard and a fuel-air ratio control when it is used in it's most simple form.

This BMS is modular, and can be expanded to encompass features such as load control, integrated O2 trim, Variable Speed Drive (VSD), fuel usage monitoring, efficiency monitoring, simultaneous operation of 5 rotary actuators, Lead / Lag control, Touch Screen Human Machine Interfaces (HMI), ModBUS communications and other advanced features.

These features make the LMV5 extremely flexible, and ideally suited for use with most steam boilers, hot water boilers, thermal fluid heaters, and industrial burners.

Figure 1-1.1 Typical LMV5 Base Unit



Product Offering 1-2

Base Unit Options (All are 120VAC)

LMV51.040C1 The most basic unit contains:
A flame safeguard
Highly accurate fuel air ratio control
A floating-bumping external load controller is necessary for modulation (RWF40)
Actuators are connected on a CANbus
Can be wired to 4 actuators
Can run 3 actuators simultaneously
Minimun 2 actuators

LMV51.140C1 Same features as above, plus:
A load controller capable of reading temperature and / or pressure
Modulates according to setpoint
Thermal shock protection (low fire and / or ramping start)
Remote modulation function

LMV52.240B1 Same features as above, plus:
Integrated O2 trim with efficiency calculation
Closed loop VSD control
Fuel meter reading (gas and oil)
Can be wired to 6 actuators
Can run 5 actuators simultaneously

Display Options

AZL52.40B1 Backlit display connects to the base unit via a 9 pin cable using CANbus protocol and is required for operation of the base unit. ModBUS communication via an RJ45 female jack on the back of the display, using RS-232 protocol, is standard.

One AZL is necessary for each burner.

HMI (Human Machine Interface) Touch Screen display communicates to the required AZL5 via ModBUS communications.

The HMI can provide lead / lag control, trending, internet communications, and boiler room efficiency optimization in addition to many other advanced features.

One HMI can be used to interface with multiple AZL5s.
The HMI is not necessary for operation of the base unit.

Actuator Options

SQM45.291A9	27 in / lb of torque	10-120 seconds	10 mm round keyed shaft
SQM45.295A9	27 in / lb of torque	10-120 seconds	10 mm “D” shaped shaft
SQM48.497A9	177 in / lb of torque	30-120 seconds	14 mm round keyed shaft
SQM48.697A9	310 in / lb of torque	60-120 seconds	14 mm round keyed shaft

Note: All actuators offer:
The same footprint
Identical actuator mounting holes
Have a 90 degree operating range
Positioning accuracy of 0.1 degree
Rotate either clockwise or counterclockwise

Inquire about application guide

SCC actuator brackets and zero lash flexible couplings are available and highly recommended to ensure trouble-free actuator operation.

Couplings will accommodate up to 3^{o} angular and 0.06” parallel misalignment with no appreciable side load.

Note: SCC **never** recommends soild couplings.

Flame Detector Options and Accessories

(The LMV5 does not require a flame signal amplifier)

QRI2A2.B180B — Sensor is self checking, forward viewing (IR) detector (continuous use)

AGG2.110 — 3/4" threaded holder for QRI2A2. B180B forward viewing scanner, with a thermal barrier, and protective lens

QRI2B2.B180B — Sensor is self checking, side viewing (IR) detector (continuous use)

AGG2.120 — Conduit connection adapter for QRI 3/4" NPSM thread

QRA75.A17 — Self checking side viewing Ultra Violet (UV) flame detector (designed for continuous use)

AGM23U — 12 foot cable used with the QRA75

AGG16.U — QRA75 Right Angle Adapter, allows the side viewing UV scanner to be used on forward viewing applications
Female thread is 3/4”-14 NPT

THERMAL-1X75 — Optional thermal barrier for use with the AGG16.U
Male Thread 1"-11.5 NPSM, Female thread 3/4”-14 NPT
the LMV5 and utilize integral flame signal amplifiers.

Temperature / Pressure Sensor Options

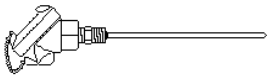
Notes: Sensors cannot be used with an LMV51.040xx (no load controller)
For 0-15 PSIG applications, 0-10 VDC is recommended
Water temperature sensor is needed for temperature based cold start

7MF1564xx.. Steam pressure sensors
Pressure connection is male 1/4" NPT
1/2" NPSM conduit connection, terminal connections

PSIG	4-20 mA	0-10 VDC
0-15	7MF15644 ***BB0*** 03EA1	7MF15644 ***BB1*** 03EA1
0-30	7MF15644 ***BE0*** 03EA1	7MF15644 ***BE1*** 03EA1
0-60	7MF15644 ***BF0*** 03EA1	7MF15644 ***BF1*** 03EA1
0-150	7MF15644 ***CA0*** 03EA1	7MF15644 ***CA1*** 03EA1
0-200	7MF15644 ***CB0*** 03EA1	7MF15644 ***CB1*** 03EA1
0-300	7MF15644 ***CD0*** 03EA1	7MF15644 ***CD1*** 03EA1
0-500	7MF15644 ***CE0*** 03EA1	7MF15644 ***CE1*** 03EA1

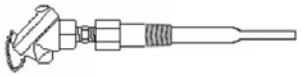
QAC22 **1000 ohm 2 wire nickel RTD**
Needed for **ambient temperature** and efficiency calculations
0.56 " opening, terminal connections
Range -20 to 125 ^{o}F

RBF195M482-010-00-8HN31
1000 ohm 2 wire platinum RTD, with aluminum weather head
Needed for **stack temperature** and efficiency calculations
1/2" NPT SS connection,10" insertion x 1/4" OD probe
3/4" NPT conduit connection, terminal connections
Range -40 to 900 ^{o}F

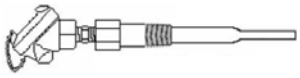


QAE2020.005 **1000 ohm 2 wire platnium RTD** (Replaces 556-541)
Needed for **ambient temperature** or **water temperature**
4" x 1/4" OD spring loaded probe, 4" long SS thermowell,
3/4" NPT conduit connection, 3" wire leads
Range -13 to 266 ^{o}F

RBF195M483- S4C05(1/2)09- SL-6HN31
1000 ohm 3 wire platinum RTD, with aluminum weather head
Needed for **water temperature**
4" insertion, spring loaded probe, 1/2" NPT SS thermowell
3/4" NPT conduit connection, terminal connections
Range -40 to 900 ^{o}F



R1T185M483- S4C05(1/2)09- SL-6HN31
100 ohm 3 wire platinum RTD, with aluminum weather head
Needed for **water temperature**
4" insertion, spring loaded probe, 1/2" NPT SS thermowell
3/4" NPT conduit connection, terminal connections
Range -40 to 900 ^{o}F



Oxygen Trim Accessories

Note : Only used with the LMV52
Cannot be used on heavy oil
In most cases, a 2nd transformer (AGG5.210) will be necessary with the O2 module

PLL52.110A100 O2 Module, CANbus module
Needed to connect the flue (stack) mounted O2 sensor (QGO20) to the LMV52.

Note: Sensors for flue temperature and ambient temperature, when used, are also wired to this module.

QGO20.000D17 Internally heated Zirconium Dioxide Oxygen sensor
Mounts into the flue gas collector (below)
(Measures the wet Oxygen content in the flue.)
Range 575^{o}F max flue gas temperature

Stainless Steel Flue Gas Collector

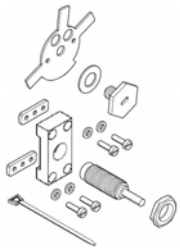
AGO20.001A 7-1/4" long for stack diameters up to 16”
AGO20.002A 10-1/2" long for stack diameters larger than 16”

C8120 (35) Wire for QGO to PLL52 connections
6 conductor, 18 AWG, shielded, 35 feet

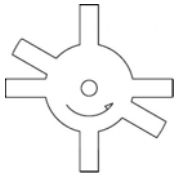
Variable Speed Drive (VSD) Accessories

Note : Only used with the LMV52. The sensor wheel normally mounts to the motor cooling fan on the back of the blower motor. This kit is much more difficult to use on “non TEFC” motors. “ODP” motor mounting is possible : Contact SCC Inc with questions.

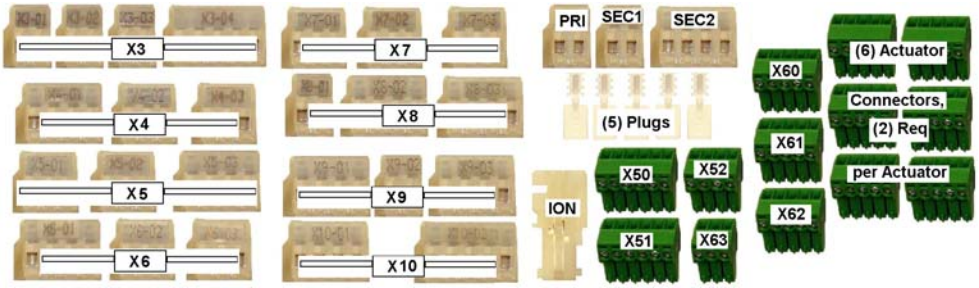
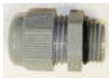
AGG5.310 VSD closed loop sensor kit is required for VSD control
Includes 3 finger speed wheel (Standard speed)
6 ft cable
Range 300 to 6300 RPM



ADPT-6F Optional 6 finger speed wheel (Low speed)
Used with the AGG5.310 kit above
Range 150 to 3150 RPM



General Accessories

AGG5.210	120 VAC to (3) 12VAC transformer At least one is required on each BMS Additional transformers may be necessary depending on the number of actuator / modules	
FUSE6.3A-SLOW FUSE4.0A-SLOW	6.3A 250V 5x20mm Slo-Blow Qty (10) LMV5 primary 4.0A 250V 5x20mm Slo-Blow Qty (10) LMV5 secondary	
AGG5.643	Special cable for use with the CANbus connections between the LMV5, actuators, and PLL52 module Supplied in a 500' roll	
AGG5.643(100)	Supplied in a 100' roll	
AGG5.635	A pre-made cable approximately 9 FT for connecting the AZL to the LMV5 (AGG5.110 CANbus strain relief included)	
AGG5.110	CANbus strain relief If AZL cable AGG5.635 is used only one is required	
P454-006	ACS450 Software cable, PC to AZL, 9 pin D M-F, null Modem	
AGG5.720	Base plug kit	
AGG5.721	Extension Plug kit	
1840382(5)	Replacement green 4 pin connector	 Qty 5
1840395(5)	Replacement green 5 pin connector	 Qty 5
7466200470	Cord grip, Adapter Nylon, M16 - CANbus cable	 Qty 1
7466201040	Conduit adapter, Nylon, M16 - 1/2" NPSM	 Qty 1
ADP-M16xE500(5)	Conduit adapter, Metal, M16 - 1/2" NPSM	 Qty 5

Note : Typical requirements are (2) M16 per (SQM4) Actuator, (6) M16 per O2 (PLL52)

Typical BMS system 1-3

Typical LMV51 BMS System

A typical LMV51 BMS system will include the following components :

LMV51.140xx	Basic unit with load controller
AZL52.xxxx	Display
SQM4x	Actuator for Gas metering valve
SQM4x	Actuator for Oil metering valve
SQM4x	Actuator for Air damper
SQM4x	Actuator for FGR (if equipped)
AGG5.210	Transformer (See CANbus Loading table, Section 3, Figure 3-1.4)
QRI2A2.B180B	Forward viewing IR flame scanner
AGG2.110	Flame scanner adapter
AGG2.120	Conduit connector
Temperature Sensor and /or Pressure Sensor (both can be used for cold start)	
AGG5.643	CANbus cable
AGG5.110	CANbus strain relief
AGG5.720	RAST 5 plug kit
AGG5.635	Pre-made CANbus cable for AZL
	Flexible zero lash actuator shaft couplings
	Actuator mounting brackets
	Cord grips or liquid tight conduit adapters

Typical LMV52 BMS System

A typical LMV52 BMS system will include all of the components of the LMV51 system with the exception of the LMV51.140xx base unit. The LMV52 unit can be used the same as a LMV51 BMS system is used, with the additional features disabled.

If the additional features are utilized, additional components typically include:

LMV52.240xx	LMV52 required for O2 Trim or VSD (Replaces the LMV51.140xx)

O2 Trim:

PLL52.110A100	O2 trim module
QGO20.000D17	O2 Sensor
	Depending on flue size:
AGO20.001A	Flue Gas Collector (up to 16” Dia)
AGO20.002A	Flue Gas Collector (over 16” Dia)
RBF195M482-010-00-8HN31	Flue Gas (Stack) PT-1000 sensor
QAC22	Ambient temperature sensor

VSD:	VSD unit (supplied separately)
AGG5.310	Closed loop VSD control kit (speed wheel and sensor
AGG5.210	Transformer (See CANbus Loading table, Section 3, Figure 3-1.4)
SQM4x	Actuators for additional valves / dampers
AGG5.721	Extension Plug kit (VSD, additional actuators, transformer, etc.)

Important Safety Notes 1 - 4

The LMV5 is a safety device. Under no circumstances should the unit be modified or opened. Siemens Building Technologies, Inc. will not assume responsibility for damage resulting from unauthorized modification of the unit.

After commissioning, and after each service visit, the flue gas values should be checked across the firing range.

All activities (mounting, installation, service work. etc.) must be performed by qualified staff.

Before performing any work in the connection area of the LMV5, disconnect the unit from the main supply (all-polar disconnection).

Protection against electrical shock hazard on the LMV5, and on all connected electrical components must be ensured through good wiring and grounding practices.

Fall or shock can adversely affect the safety functions of an LMV5. Such units must not be put into operation, even if they do not exhibit any apparent damage.

When the LMV5 is running in automatic mode, actuators are continuously monitored by the LMV5.

During commissioning, when the ratio-control curves are being set, the actuator positions are NOT continuously monitored by the LMV5.

The technician is solely responsible for verifying the correct position of each actuator during the ratio-control curve commissioning.

The coupling that is used between the actuator and the driven valve / damper is safety related, and must be of a robust and flexible design. Should this coupling fail during operation, the LMV5 will no longer have control of the burner’s combustion bringing about a hazardous condition.

Condensation and the entry of water into the unit must be avoided.

Approvals 1- 5

Table 1- 5.1 Standards and certificates

Conformity to EEC directives

- Electromagnetic compatibility EMC (immunity)	89 / 336 EEC
- Directive for gas appliances	90 / 396 EEC
- Low-voltage directive	73 / 23 EEC

ISO 9001: 2000
Cert. 00739

ISO 14001: 1996
Cert. 38233

		FM APPROVED		
LMV51.040C1	x	x	x	x
LMV51.140C1	x	x	x	x
LMV52.240B1	x	x	x	x

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Section 2 Mounting

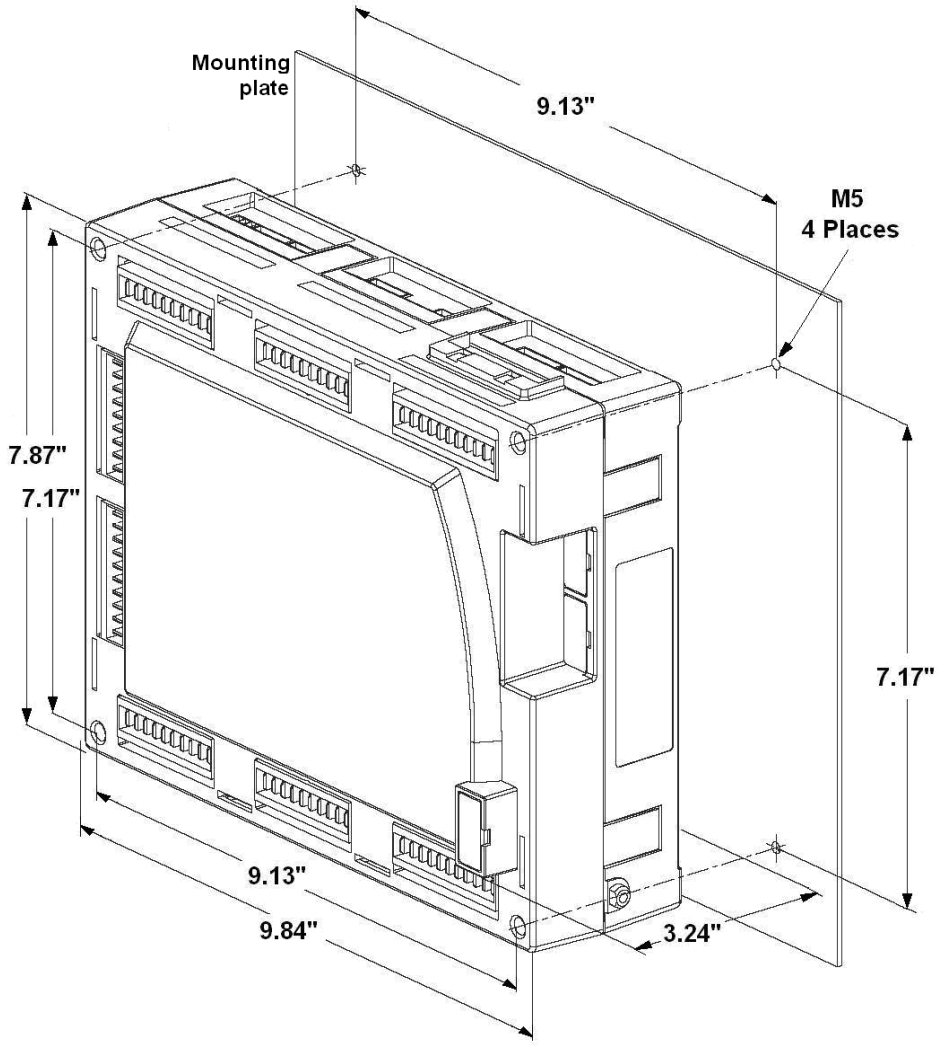
LMV5 Base Unit 2-1

The base unit should be mounted inside an enclosure that will protect the LMV5 from dirt and moisture. The unit is mounted by four screws that are captive in each corner, and have an **M5 thread**. The mounting plate that the unit sits on should be drilled and tapped to accommodate these screws. It should be noted that the mounting screws do not have excessive play, so the spacing of the mounting holes must be accurate. This can be easily achieved by placing the LMV5 in the desired position and turning each of the mounting screws to mark the plate that the LMV5 will be mounted to.

During the mounting process, consideration should also be given to the various plugs and wires that must be attached to the LMV5. Electrical connections are made via plugs that are located in the face, top and bottom of the unit. A space of at least two inches is recommended on the top of an LMV51, and the top and bottom of an LMV52.

Please see Section 10 for specifications.

Figure 2-1.1 LMV5 Base Unit Dimensions (inches)



AZL5 Display 2-2

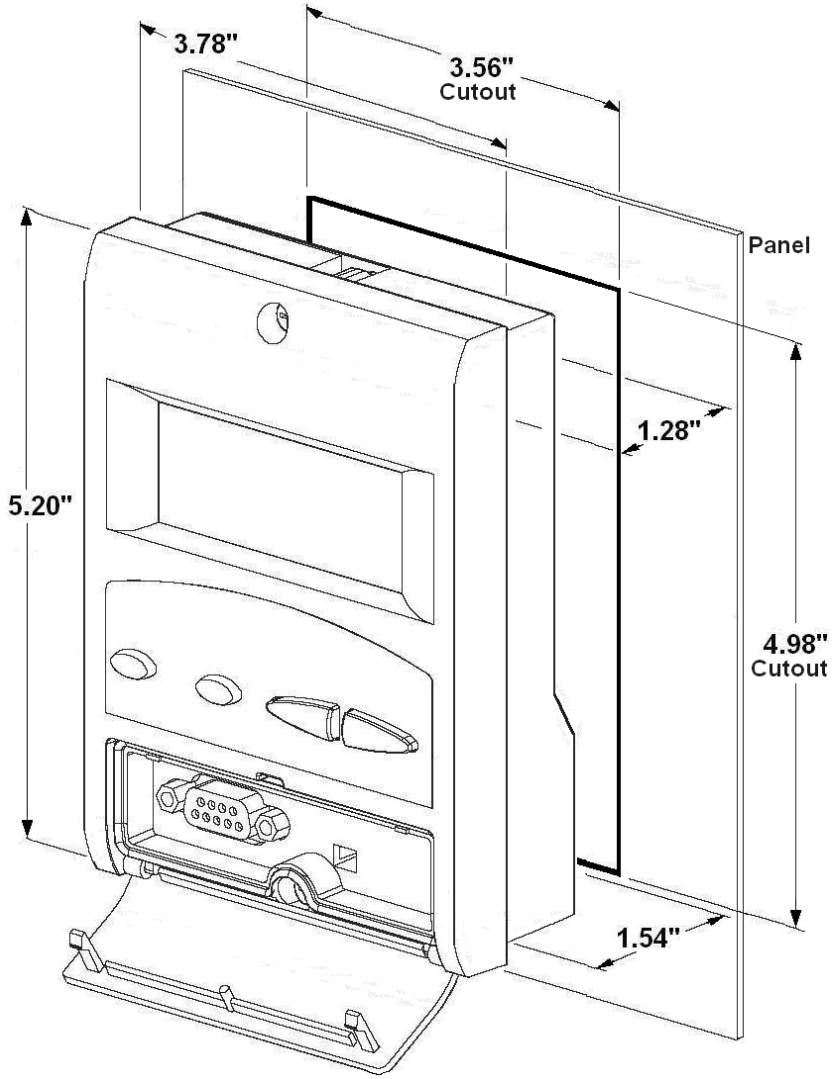
The AZL5 is designed to be mounted through the face of an electrical enclosure. This is accomplished by an accurate cut-out, which is usually in the door of the enclosure. The AZL5 has one screw on the top and one on the bottom that engage small plastic tabs that will swing out and pull to the front when the screw is tightened, and will retract and push to the back when loosened. This facilitates easy removal and replacement of the AZL5 since it is designed to be taken out of the enclosure face and held in the hands for set up / commissioning. When properly installed, the AZL5 will hold the sheet metal of the enclosure between the plastic tabs and ridge which holds the AZL5 to the enclosure gasket.

The connector shown in Figure 2-2.1 is for the connection of a laptop computer.

Note that the CANbus connector, (not shown) plugs into the bottom of the AZL5. The CANbus connector would not be seen from the front when the AZL5 is mounted, but does require approximately 2.5" below the bottom of the AZL5 to clear the connector and the CANbus cable.

Please see Section 10-1 for specifications.

Figure 2-2.1 AZL5 Dimensions (inches)



SQM4x Actuators 2-3

The SQM4x actuators that are driven by the LMV5 come in three basic torques and running times as described in the product offering. See Section 1-2.

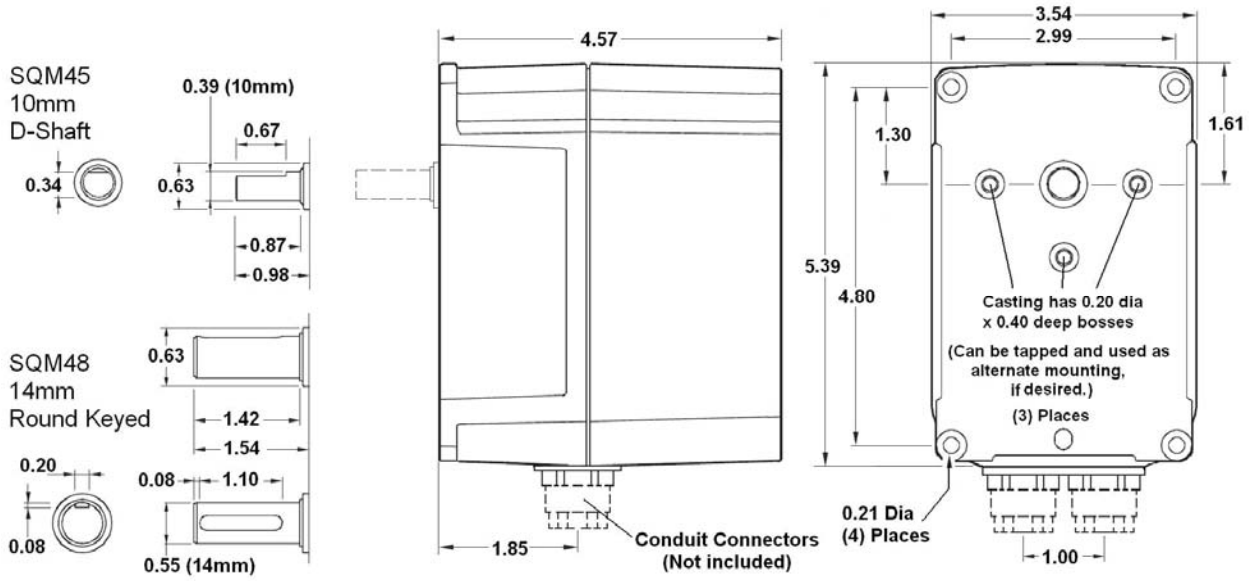
Actuators can rotate clockwise or counterclockwise depending upon programming in the LMV5.
All actuators share the same mounting hole pattern. The SQM48.4 and SQM48.6 both have 14mm keyed shafts, the SQM45's both have 10mm shafts, 291A9 is keyed, 295A9 is "D" shaped.

The actuator body should be rigidly attached to the driven valve or damper utilizing the supplied mounting holes. The actuator shaft should be attached to the valve or damper via an SCC Inc. **robust**, **zero lash flexible coupling**.

Shaft couplings are safety related, since a coupling failure could let the valve / damper spin freely of the actuator. **Brackets and couplings specifically designed to attach these actuators to valves and dampers are available, and are highly recommended**.
Please speak to a SCC Inc. sales representative concerning these brackets and couplings.

Please see Section 10-1 for specifications.

Figure 2-3.1 SQM4x Dimensions (inches)



IMPORTANT: Coupling set screws should not be tightened on the valve / damper shaft until:

1) Actuators are addressed and rotations are set in the LMV5

2) Each actuator is verified to be at zero degrees (closed)

   This verification should be done under:
   Parameters & Display > Ratio Control > Gas/Oil Settings > Curve Parameters.

3) Each valve / damper is verified to be closed, thus matching the indicated actuator position.

Accessories 2-4

AGG5.210 Transformer(s)

The AGG5.210 transformer supplies 12 VAC power to the LMV5 base unit, AZL5, actuators, and PLL52 (if equipped). This transformer should also be mounted in an enclosure that shields the transformer from dirt and water. At least one transformer is necessary for each LMV5 base unit. Depending upon how many devices are connected to the CANbus, (actuators, PLL52 module, etc) two AGG5.210 transformers may be necessary.

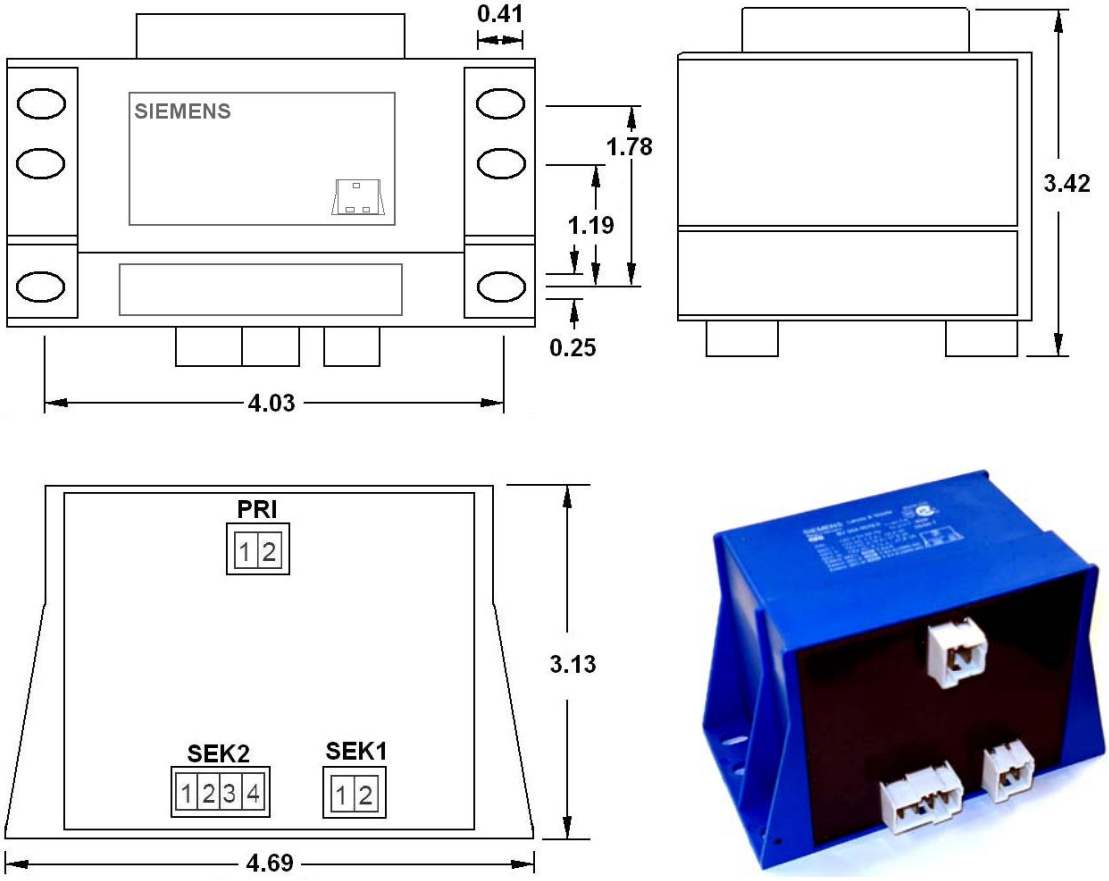
Note: If a second transformer is used, locate it as close as possible to the actuators / PLL52 that it powers.

Section 3-1, Figure 3-1.4 outlines when two transformers should be used.

Figure 2-4.1 gives the dimensions of a AGG5.210 transformer. The transformer may be mounted with the plugs facing downward or upward. Oval holes are provided for use with self tapping or machine screws.

Please see Section 10-1 for specifications.

Figure 2-4.1 AGG5.210 Dimensions (inches)



QRI Infrared Flame Scanners

The QRI series of self checking Infrared (IR) flame scanners typically mount via an adapter kit (AGG2.110). The flame scanner itself clamps into the adapter, and the adapter mounts the entire assembly with a 3/4" – 14 NPSM female thread. This adapter also features a heat insulator and a high quality lens.

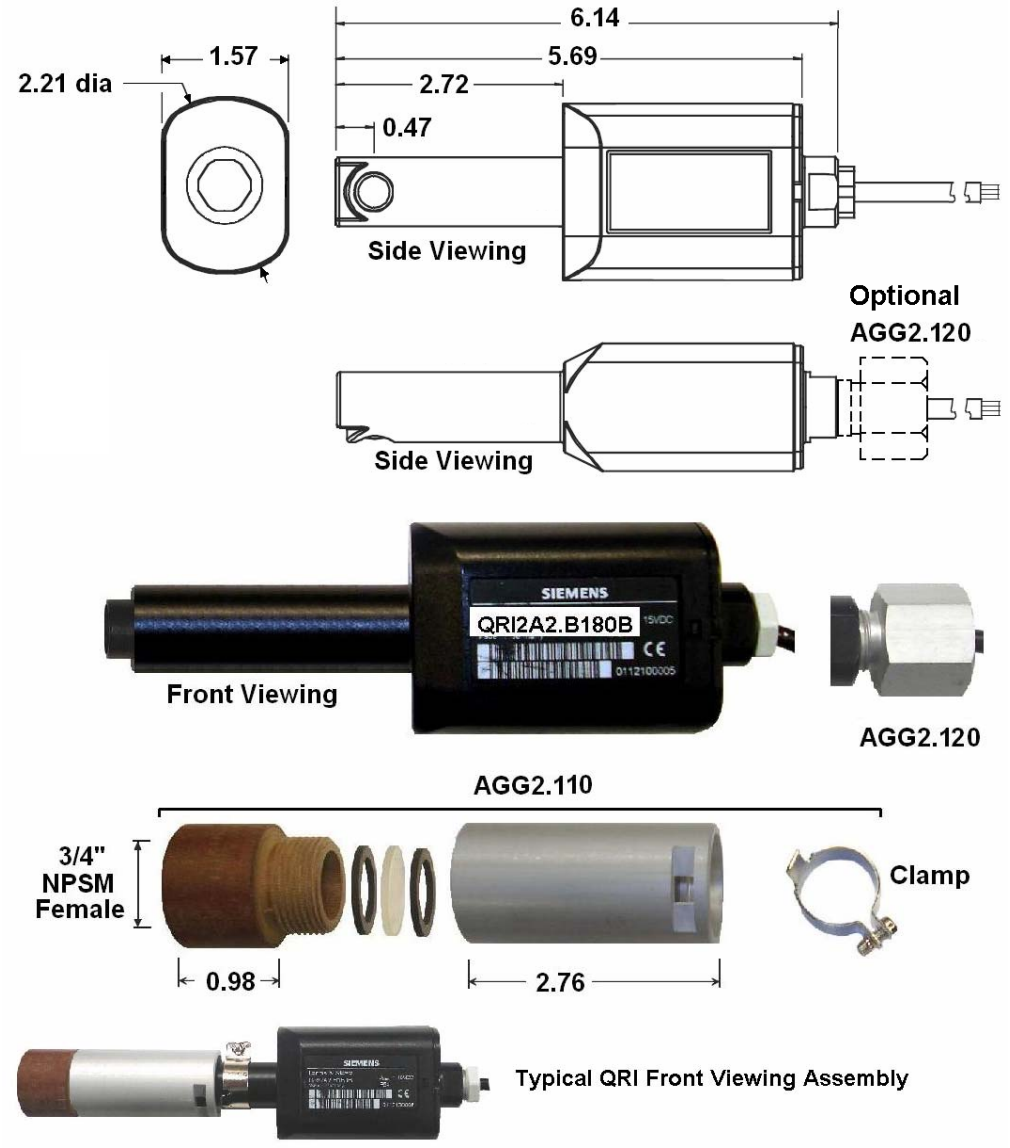
Typically the adapter is threaded onto a 3/4" NPT male thread that is on the end of a flame scanner tube. The flame scanner tube should be mounted so both the pilot flame and the main flame can be easily viewed.

The tube should also be sighted so that glowing refractory will not be viewed by the scanner.
If viewing glowing refractory with the scanner tube is unavoidable, then it is recommended that the optional UV scanner is used instead of the IR scanner.

Liquid tight conduit can be mounted to the back of the QRI scanner with adapter (AGG2.120).

Please see Section 10-1 for specifications.

Figure 2-4.2 QRI Dimensions (inches)



QRA75 UV Flame Scanner

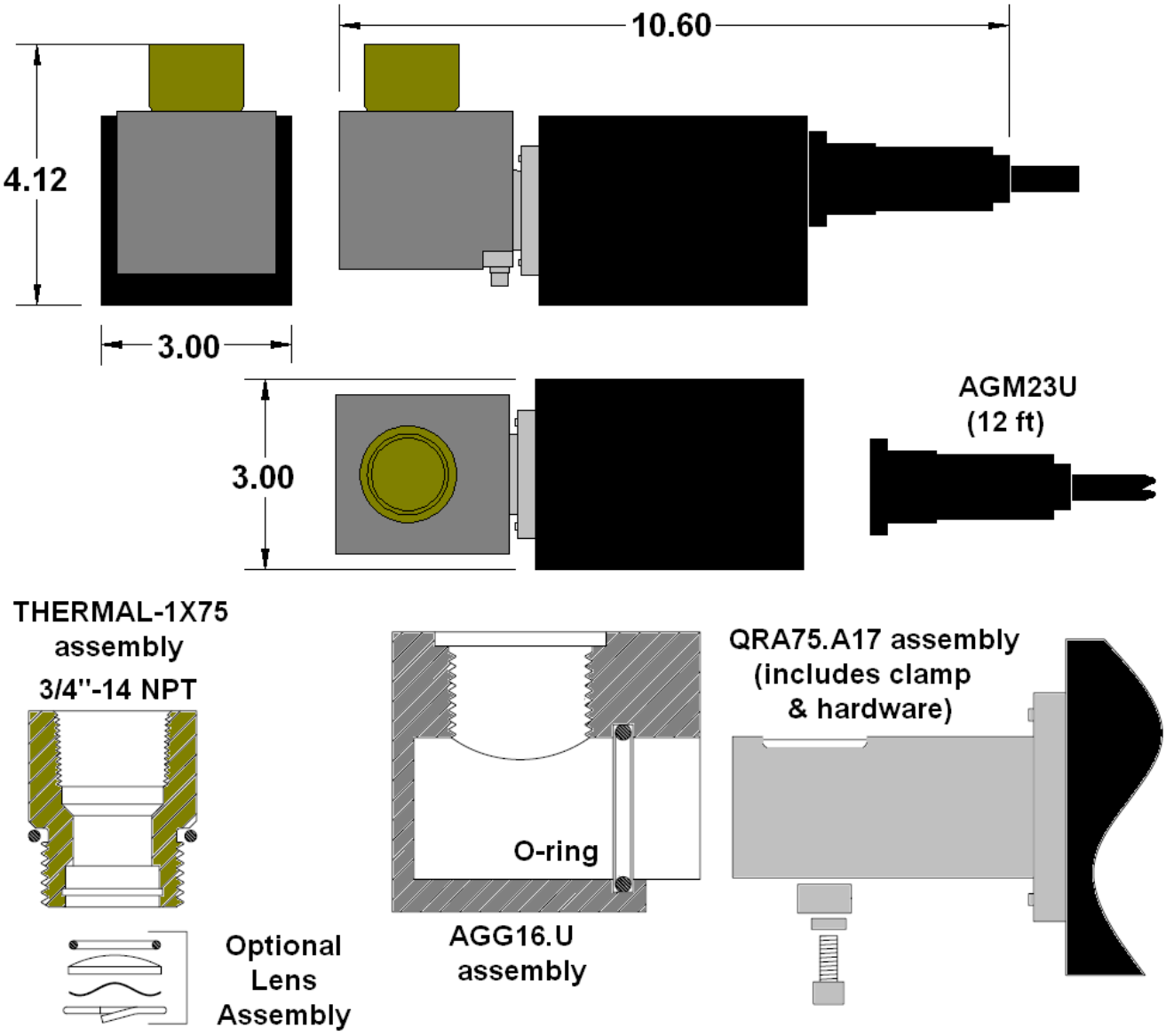
The QRA75 Ultraviolet (UV) flame scanner mounts with a 3/4” – 14 female thread.

The scanner is threaded onto an NPT male thread that is on the end of a flame scanner tube. The flame scanner tube should be mounted so both the pilot flame and the main flame can be easily viewed. Glowing refractory is well tolerated by the UV scanner.

A 12 ft pre-made cable must be used.

Please see Section 10-1 for specifications.

Figure 2-4.3 QRA75 Dimensions (inches)



7MF1564 Pressure Sensors

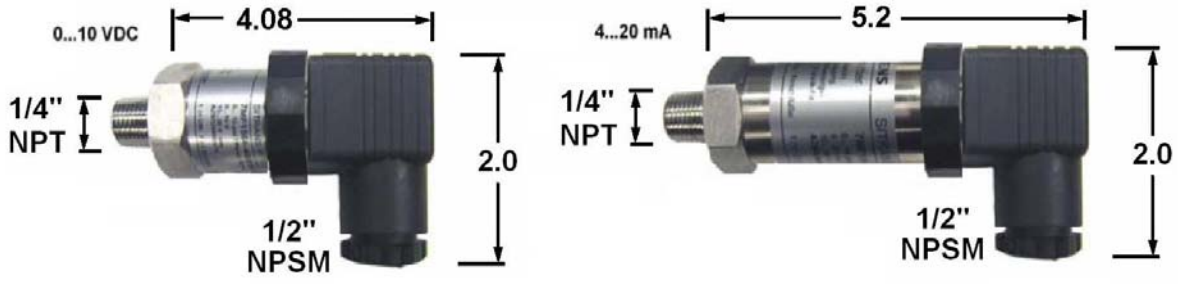
The 7MF1564 series of pressure sensors mount by their 1/4" NPT threads located on the "nose" of this pencil type of pressure sensor. The sensor can be mounted in any orientation, however the sensor must be mounted on a cold drip leg so that the sensor will detect pressure but will be isolated from high temperature steam. These sensors are typically used on steam boilers.

Note: Low range steam sensors (0-15psi and 0-30psi) 4-20mA sensors should not be used on boilers that are subjected to a vacuum condition after shutdown. For these applications, use a 0-10VDC sensor or a higher range 4-20mA sensor.

An electrical plug is included on the back of the sensor that will accept liquid-tight conduit fittings.

Please see Section 1, page 4 for part numbers.
Please see Section 10-1 for specifications.

Figure 2-4.4 7MF1564 Dimensions (inches)



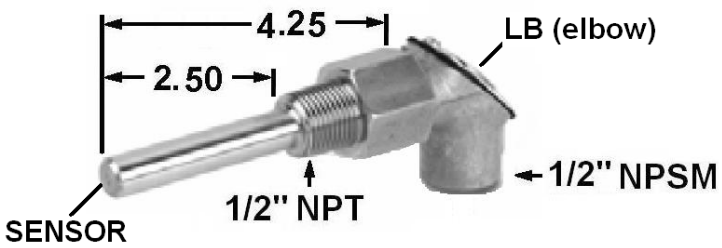
QAE2020.005 Temperature Sensors

The QAE2020.005 Nickel 1000 temperature sensors mount by their 1/2" NPT threads which are located on the 1/2" diameter thermowell. The thermowell should be completely immersed in the medium that it measuring. These sensors are typically used on hot water boilers up to 266 ^{o} F, and can also be used for ambient temperature, if desired. A small LB is included on the back of the sensor for connecting conduit and for making electrical terminations.

Note: The QAE2020.005 is a replacement for the discontinued 556-541.

Please see Section 10-1 for specifications.

Figure 2-4.5 QAE2020.005 Dimensions (inches)



Other Temperature Sensors

The ratings of these sensors are given in Section 1. Stack and ambient temperature sensors are necessary if the efficiency is monitored by the LMV52. A water jacket sensor is recommended if the LMV5's low fire hold functionality is used on a steam boiler.

Figure 2- 4.6 Stack Sensor Dimensions (inches)
RBF195M482-010-00-8HN31

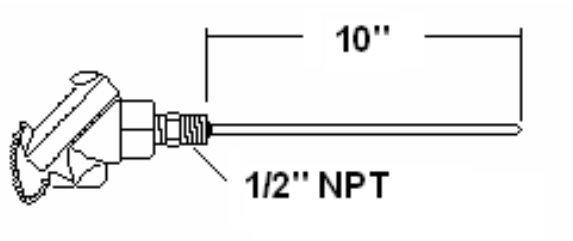
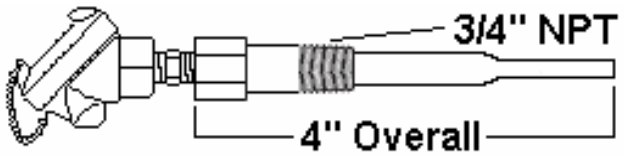


Figure 2- 4.7 Water Jacket Sensor Dimensions (inches)
RBF195M483- S4C05(1/2)09- SL-6HN31
R1T185M483- S4C05(1/2)09- SL-6HN31

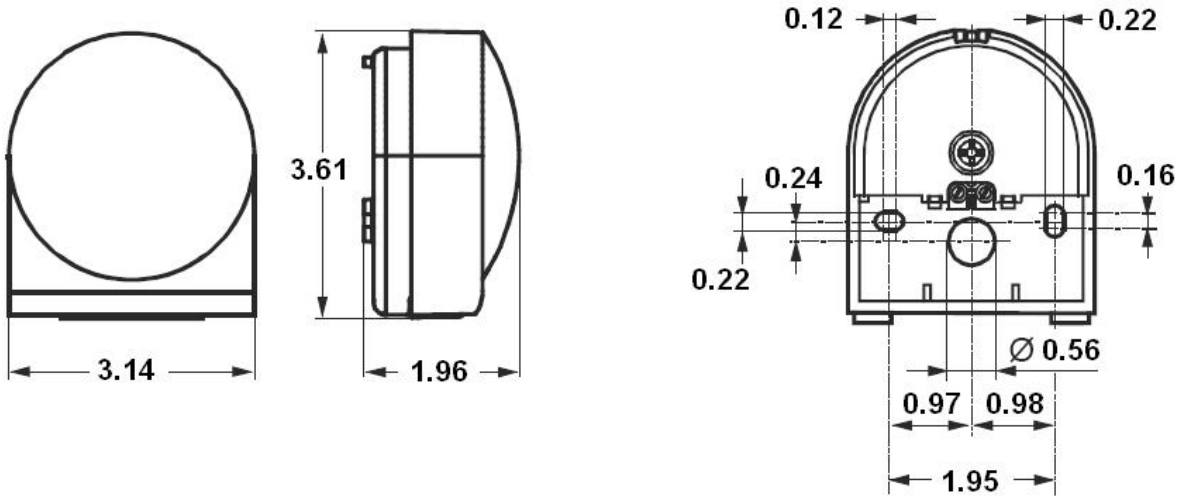


QAC22 Ambient Temperature sensors

The QAC22 Nickel 1000 temperature sensors are surface mount and are typically used to sense the ambient air temperature when the efficiency calculation function is used on the LMV52.

Please see Section 10-1 for specifications.

Figure 2-4.8 Temperature Sensor QAC22 Dimensions (inches)



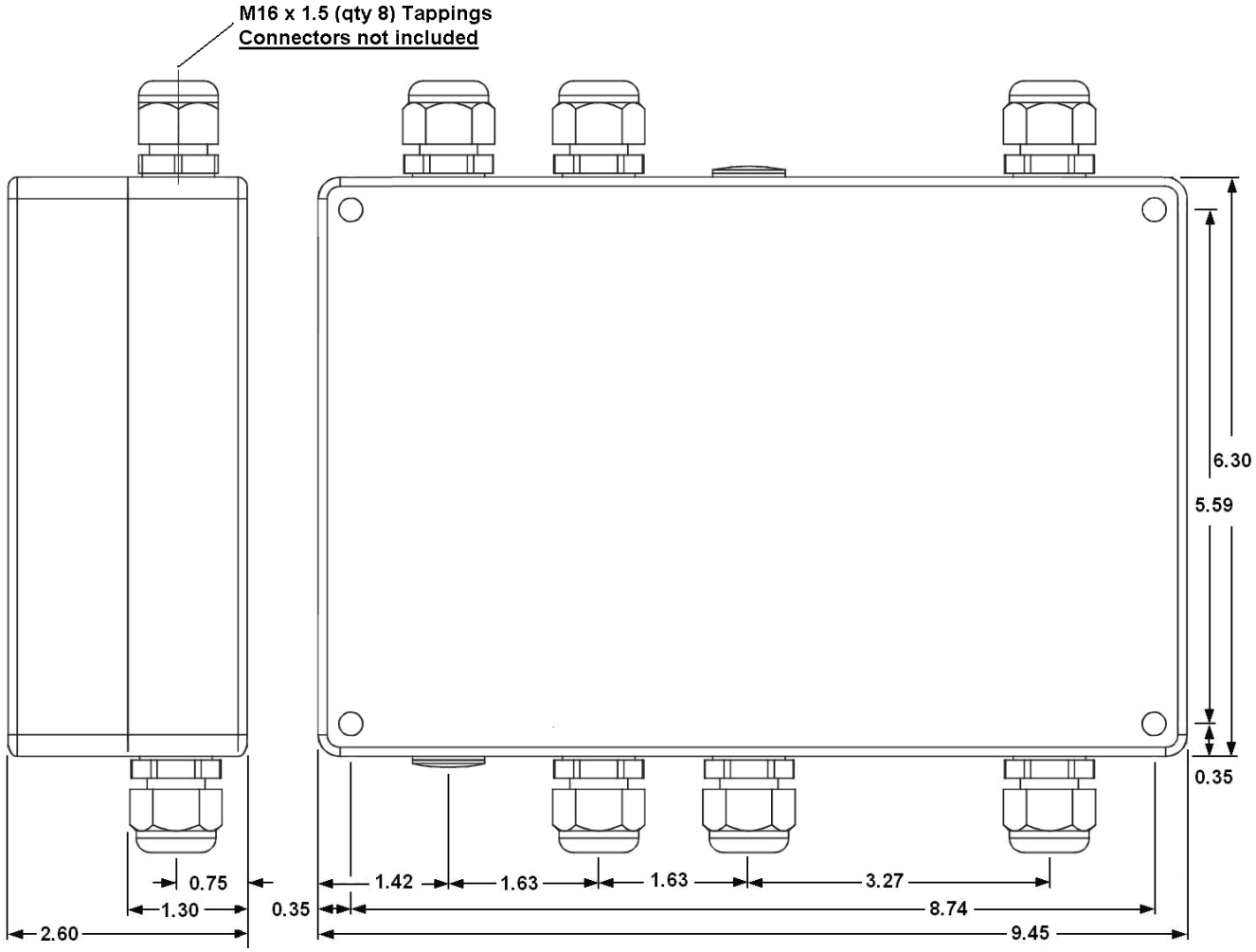
PLL52 O2 Module
(LMV52 only)

The PLL52 module serves as the CANbus interface for the QGO20 oxygen sensor, ambient temperature sensor, and flue gas temperature sensor.
This module is necessary if O2 trim is used.

The PLL52 module must be mounted so that the wire length from the O2 sensor to the PLL52 module does not exceed 25 feet. To mount, the lid of the module must first be removed. After the lid is removed, four holes will be available to use with self tapping or machine screws.

Please see Section 10-1 for specifications.

Figure 2-5.1 PLL52 O2 Module Dimensions (inches)

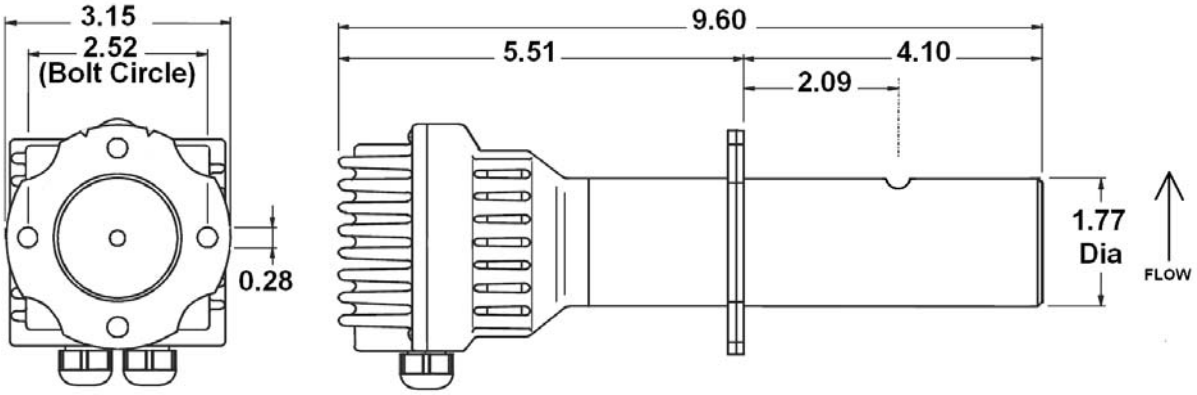


QGO20 O2 Sensor
(LMV52 only)

The QGO20 is a zirconium-oxide O2 sensor that resides in the flue of a burner / boiler. It measures the residual O2 in the flue on a wet basis enabling O2 control across the firing range.

Please see Section 10-1 for specifications.

Figure 2-5.2 QGO20 O2 Sensor dimensions (inches)



This sensor must be used with one of two available flue gas collectors detailed below. These stainless steel collectors are normally seal welded into the flue with their bevels pointed downward to collect flue gas.

NOTES : Notches (2) on the sensor, (1) on the collector flange pointed upward (upstream).
Do not weld the collector into the flue with the sensor bolted to the collector.

The collector must be mounted perpendicular to the flue gas flow. (See figure 2-5.4)
Both sets of holes (QGO20 and collector) must be inside the flue, at least 1/2" away from the inner surface of the flue.

After welding, the QGO20 can be inserted and bolted to the flue gas collector flange.

Please see Section 10-1 for specifications.

Figure 2-5.3 Flue Gas Collector dimensions (inches)

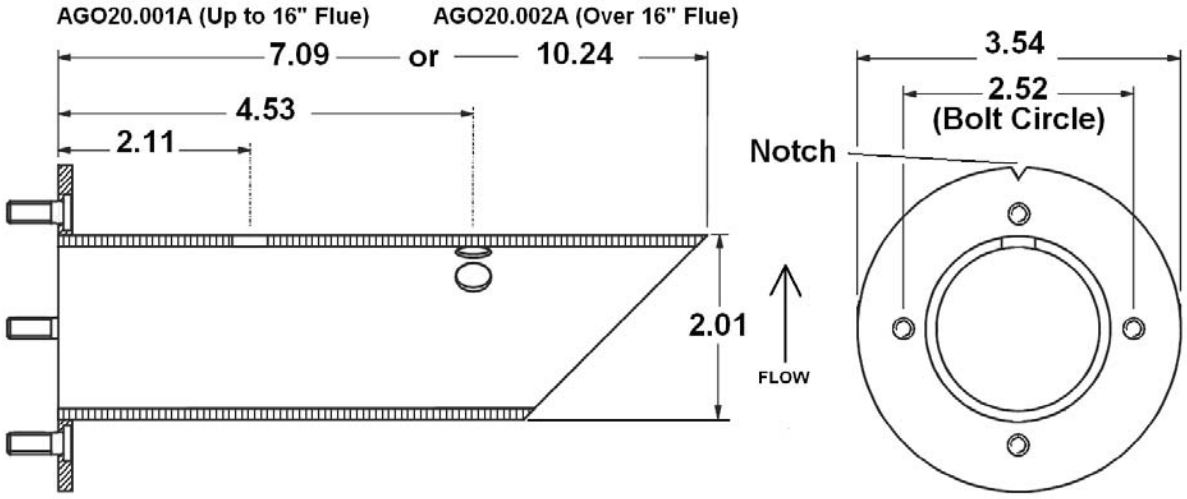
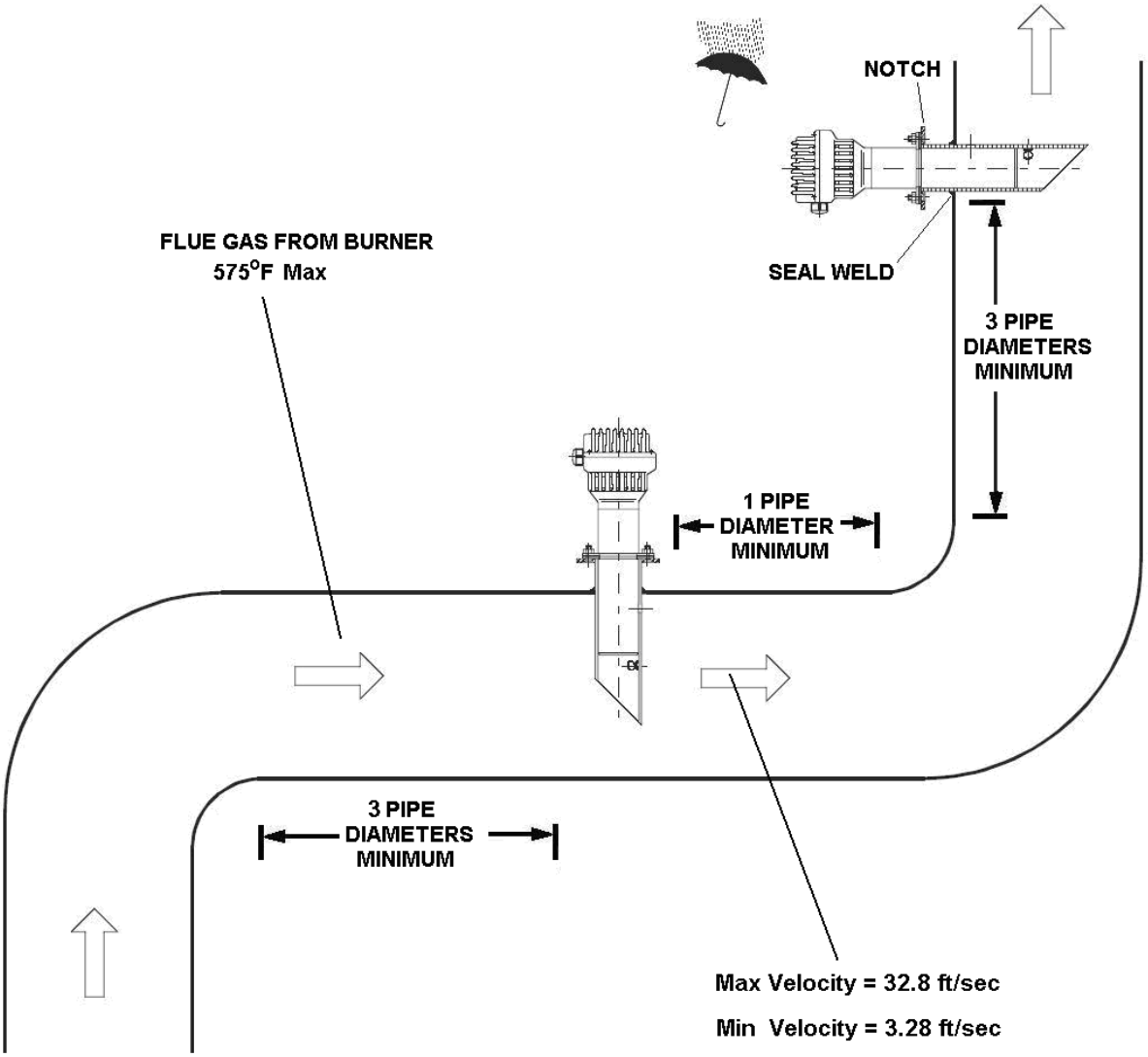


Figure 2-5.4 Allowable flue gas collector mountings



AGG5.310 Shaft – mounted speed sensor kit (LMV52 only)

The AGG5.310 shaft mounted speed sensor kit consists of a three fingered speed wheel and a sensor along with mounting hardware.

Please see Section 10-1 for specifications.

1.

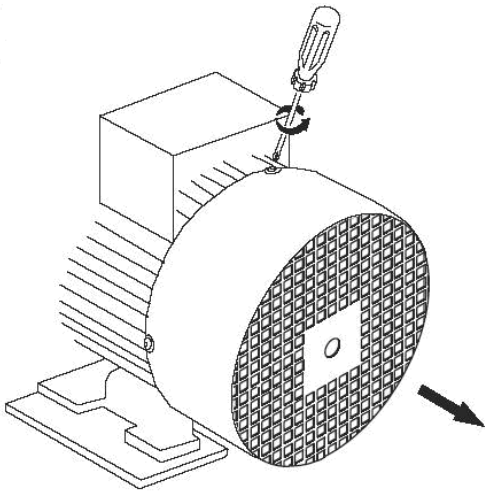


Figure 2-6.1
Speed wheel and sensor mounting

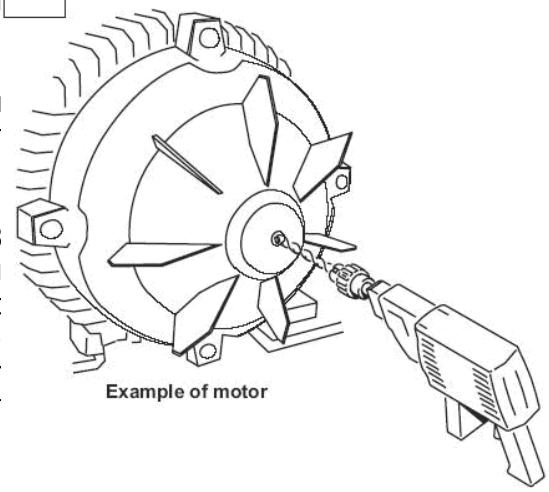
First, ensure that a section of shaft extends outboard of th rear bearing of the motor (fan cooled motor).

The installation will not be possible if the shaft does n extend outboard of the rear bearing.

Next, remove the fan cover.

The shaft must be drilled and tapped. It is possible to dr the shaft with a hand drill, but it is preferable to use a dr press before the motor is mounted.

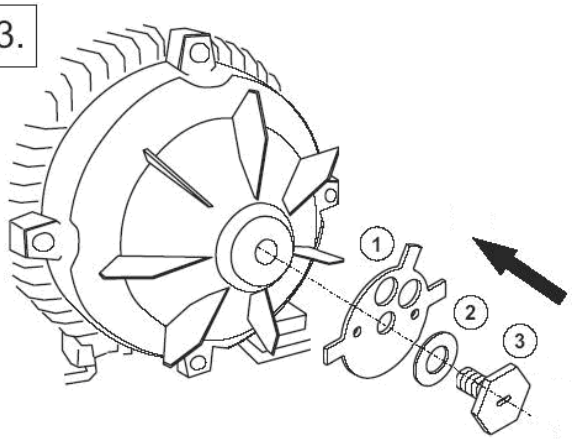
2.



If a hand drill is used, a guide should be utilized to ensu that the drilled hole is perpendicular and concentric to th end of the shaft.

The drilled hole must be a diameter of 6.8mm, and be 7/ deep. This is done to accommodate the M8 x 1.25 no bottoming tap. The thread engagement of the shoulder bo is approximately ½", so the tap should run to the bottom the drilled hole. The M8 x 1.25 tap is absolutely necessar but the hole can be drilled with a 17/64" drill bit ar satisfactory threads will result.

3.

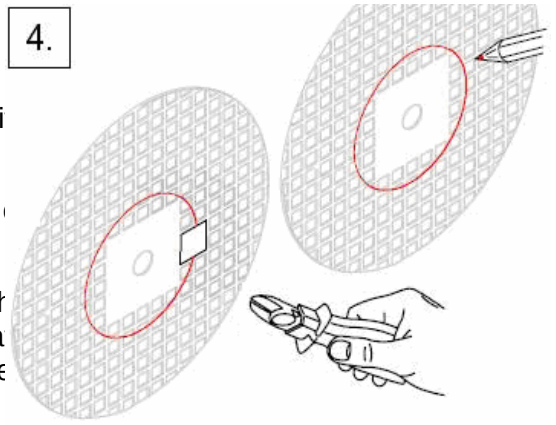


Install the speed wheel with the shoulder bolt and the larg spring washer.

The speed wheel can be reversed (flipped over) so that th arrow on the speed wheel points in the correct direction motor rotation.

The shoulder bolt should be tightened with about 50 in* (6 Nm) of torque.

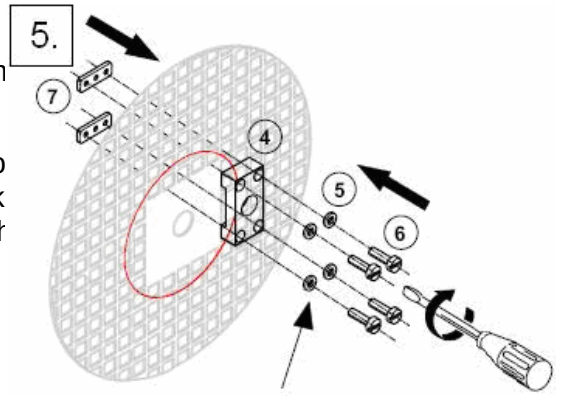
Figure 2-6.1
Speed sensor assembly mounting (continued)



Draw a circle concentric with the motor shaft having diameter of 3". This circle should also be concentric wi the motor fan cover.

Cut out a small window in the cover, about 3/4" x 3/4", large enough for the speed sensor to go through.

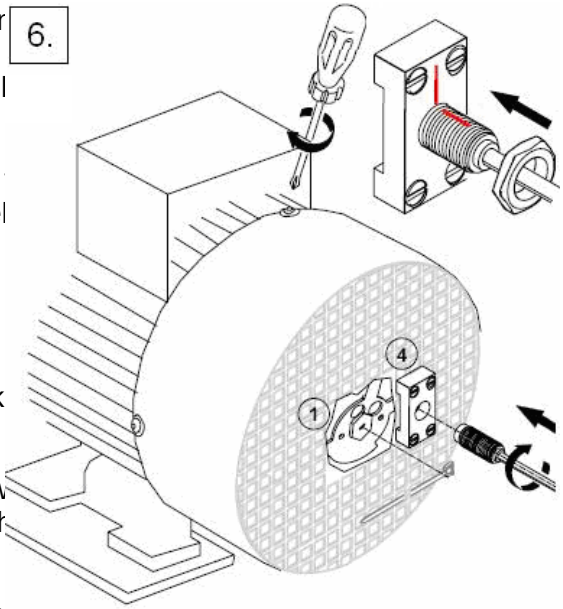
If all of this is correct, this arrangement would put th speed sensor about 1-1/2" from the center of the sha approximately in the center of the "fingers" of the spee wheel.



Attach the speed sensor mounting bracket as shown. On snug the screws.

Align the bracket so that it is roughly centered on the ho that was cut. The center of the sensor mounting brack hole should be approximately 1-1/2" from the center of th shaft (fan cover).

Replace the fan cover.



Thread the speed sensor into the speed sensor mountir bracket. The speed sensor should align so that it approximately in the center of one of the speed wheel "fingers".

If not, loosen the four screws on the bracket and move it achieve the proper radial alignment of the speed wheel speed sensor.

Tighten the screws when the correct alignment achieved.

To set axial alignment, thread the sensor into the brack until it touches one of the "fingers".

Next, back the sensor out two full revolutions. This w achieve an axial gap of approximately 1/16" which is th proper gap.

Matchmark the sensor, install the lockwasher and locknut, and tighten the locknut without rotating the sensor.

Zip tie the sensor wire to the motor, if desired.
(For wiring, see Section 3)

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Section 3 Wiring

Wiring Introduction 3-1

The LMV5 can be wired a number of different ways due to the flexibility of this Burner / Boiler Management System (BMS). The specific application dictates how the BMS is to be wired. This section details the most common applications.

The Parameter settings outlined in Section 4 can enable, disable or change the functionality of many terminals on the LMV5. Thus, wiring and parameter settings work together to make the LMV5 an extremely versatile BMS.

This section includes terminal descriptions (Section 3-2), and extensive wiring diagrams (Section 3-3), that detail applications of the LMV5 BMS.

Terminals

The connection terminals of the LMV5 are RAST 5 connectors (plugs). Line voltage plugs are made so that they will only fit into one socket of the LMV5 eliminating the possibility of inserting a plug into an incorrect socket.

Each plug is designed to connect one external device or a small group of external devices, such as gas valves, to the LMV5. This being the case, each group of plugs on the front of the LMV5 provide line voltage and grounds so that an additional terminal strip is not necessary.

Note: All protective earth grounds (PE), neutrals (N) and lines (L) are common inside the LMV5 .

Figure 3-1.1 Numbering scheme on *line voltage* (RAST 5) terminals of the base unit

X9-	01.	04
Plug Group	Plug Number in Group	Pin Number on Plug

Dashes or dots can be used interchangeably between the numbers shown above.

Figure 3-1.2 Numbering scheme on *low voltage* (RAST 2.5) terminals of the base unit

X62.	2
Plug Number	Pin Number

Terminal Descriptions (Section 3-2) provides a map outlining exactly where the line and low voltage plugs are located.

For each plug, Pin 1 is marked on the casing of the LMV5 as well as the PLL52 module.

Grounds

The LMV5 has three different types of grounds. They are:

Protective Earth	(marked as **PE** on the LMV5)
Functional Earth	(marked as **FE** on the LMV5)
Reference Ground	(marked as **0**, **M** or **GND** on the LMV5, hereafter referred to as **0**)

Protective Earth

Protective Earth (PE) or chassis ground should always be connected to the control panel grounding lug. One wire from the secondary side of the control panel's main step-down transformer should also be connected to the control panel grounding lug.

All of the PE terminals on the front of the LMV5 casing are common.

Functional Earth

Functional Earth (FE) connections are found on the CANBus terminals as well as other low voltage connections.

The sole purpose of the FE is for termination of low voltage cable shields.

The FE is bonded to the Reference Ground through capacitors on the LMV5 circuit board with the exception of the CANBus where it is bonded directly.

Reference Ground

The last type of ground is the Reference Ground. These are found on the low voltage connections.

The purpose of the Reference Ground is to serve as a datum to measure other voltages.

The Reference Ground is bonded to the FE on the CANBus circuit board through pins 2 and 3 on the AGG5 transformer.

Note: Pin 3 on the AGG5 transformer is also connected to the control panel grounding lug (PE), so that all three grounds are eventually bonded together.

Summary:

0 & PE are bonded together at the transformer (connect X52.4 & SEK2 pin 3 to panel ground)

FE is bonded to 0 & PE, for the CANBus ONLY, directly on the circuit board
FE is bonded to 0 & PE everywhere else through a capacitor on the circuit board

CANBus

The CANBus is a data bus not unlike a computer network. This data bus is used to connect actuators, the AZL5, and the PLL52 Module to the LMV5 base unit. Special shielded cable is used to connect all devices on the CANBus to the LMV5 base unit. This cable carries five wires, and a braided shield that is located underneath the plastic cable sheathing.

The two heavier gauge wires (16 AWG) are used for power transmission to the connected devices. These power wires are labeled 12VAC1 and 12VAC2, and carry 12 VAC each. These wires are powered by Pin 1 and Pin 4 of the AGG5.210 transformer's 4-pin plug, and are fused using fuse FU2 and FU3. These fuses are located under black covers on the right hand side of the LMV5. If measured, 12VAC1 and 12VAC2 should have a potential of approximately 12 VAC to reference ground and 24 VAC between 12VAC1 and 12VAC2.

The two lighter gauge (24 AWG) wires carry the digital data signal and are labeled CANL and CANH. The signal on these wires consists of 5 volt DC pulses.

Note: These data wires should never contact the 12VAC wires when the system is powered. LMV5 damage can result.

The termination resistor, which is located on each actuator and the PLL5 module is used to terminate CANH and CANL and should be moved to the bus termination position on the last CANBus device.

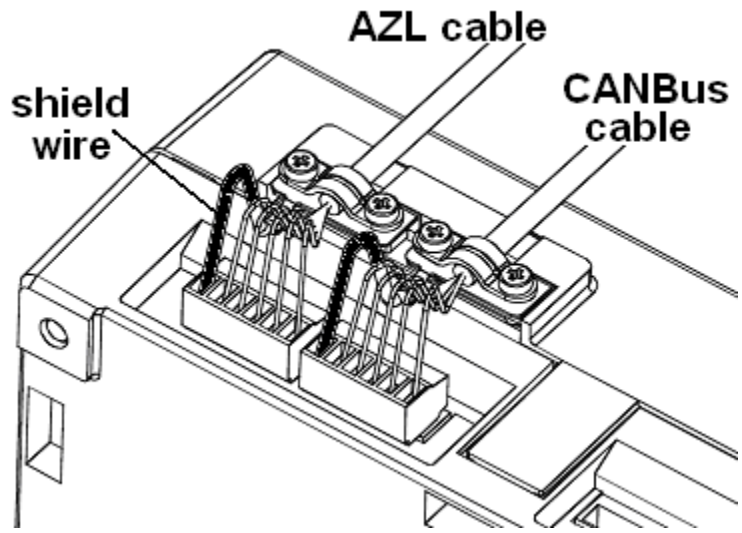
The last wire in cable is the reference ground and is marked GND. This is also connected to each device on the CANBus so that the LMV5 can monitor for voltage drops that might affect actuator operation.

Note: *It is extremely important that the shield of the CANBus cable is properly terminated.*

The shield of the CANBus cable is terminated to the LMV5 by using a special strain relief, part number AGG5.110.

This strain relief also has a wire that should be connected to the shield terminal on the LMV5. The installation of this clip as well as clip for the AZL5 cable is shown in Figure 3-1.3.

Figure 3-1.3 Installation of CANBus Strain Relief's



CANBus (Continued)

The shield of the CANBus cable must be connected on each cable segment (between LMV5 and actuators, PLL52 Module) so that the entire shield has continuity with terminal X51.1 which is the shield connection on the LMV5. This is achieved by clamping the shield on both cable segments with the metal clamps provided on the cable entry of each actuator. Clamps for the CANBus shield are also provided on the PLL52 module.

The current provided by one AGG5.210 transformer is usually sufficient to meet the demands of the LMV5 base unit, AZL5 and actuators on a typical burner/boiler without a PLL52 module.

However, situations occur when one AGG5.210 is not sufficient, and a second transformer must be used. The figure below outlines the number of transformers that should be used for different situations.

Figure 3-1.4 CANBus Loading

<table>
<tr><th colspan="2" rowspan="2">Number and type of actuators wired on the CANBus
moving concurrently.</th><th colspan="2">Permissible Total CANBus Cable Length including AZL5 (Feet).
Single Transformer</th></tr>
<tr><th>Actuators at 100% rated torque.</th><th>Actuators at 80% rated torque.</th></tr>
<tr><td>2 SQM45</td><td rowspan="4">0 SQM48</td><td>115</td><td>125</td></tr>
<tr><td>3 SQM45</td><td>85</td><td>95</td></tr>
<tr><td>4 SQM45</td><td>70</td><td>80</td></tr>
<tr><td>5 SQM45</td><td>2nd Transformer Req.</td><td>2nd Transformer Req.</td></tr>
<tr><td>1 SQM45</td><td rowspan="4">1 SQM48</td><td>85</td><td>95</td></tr>
<tr><td>2 SQM45</td><td>70</td><td>80</td></tr>
<tr><td>3 SQM45</td><td rowspan="2">2nd Transformer Req.</td><td>30</td></tr>
<tr><td>4 SQM45</td><td>2nd Transformer Req.</td></tr>
<tr><td>1 SQM45</td><td rowspan="3">2 SQM48</td><td rowspan="3">2nd Transformer Req.</td><td>30</td></tr>
<tr><td>2 SQM45</td><td rowspan="2">2nd Transformer Req.</td></tr>
<tr><td>3 SQM45</td></tr>
<tr><td>1 SQM45</td><td rowspan="2">3 SQM48</td><td rowspan="2">2nd Transformer Req.</td><td rowspan="2">2nd Transformer Req.</td></tr>
<tr><td>2 SQM45</td></tr>
<tr><td>1 SQM45</td><td>4 SQM48</td><td>2nd & 3rd Transformer Req.</td><td>2nd Transformer Req.</td></tr>
<tr><td rowspan="4">0 SQM45</td><td>2 SQM48</td><td>58</td><td>70</td></tr>
<tr><td>3 SQM48</td><td rowspan="2">2nd Transformer Req.</td><td rowspan="2">2nd Transformer Req.</td></tr>
<tr><td>4 SQM48</td></tr>
<tr><td>5 SQM48</td><td>2nd & 3rd Transformer Req.</td><td>2nd & 3rd Transformer Req.</td></tr>
</table>

Notes :

When two transformers are used the loading should be divided between the two transformers as equally as possible.

The 2nd transformer should be placed as close as possible to the actuators / PLL52 module that it powers due voltage drop considerations.

When adding a PLL52 module subtract 20 ft from the total length read from the chart.

Absolute maximum cable length is 300ft. (CANBus communication limitation)

Load Controller

The LMV51.140 and all LMV52 are equipped with a Load Controller (LC). The LC is very flexible and can read multiple sensors simultaneously. Typically, either a temperature sensor or pressure sensor is connected for burner modulation. Both a pressure and a temperature sensor can be used in conjunction for certain applications such as Cold Start Thermal Shock Protection.

The LC also has six different operational modes that can be changed by opening or closing a set of dry contacts. These six different modes of operation are outlined in Section 4-1. By using a dry contact between terminals X62.1 and X62.2, the mode and / or setpoint of the internal load controller can be changed by closing or opening the contact.

If the LC is in Mode 2, which is Internal Load Controller (Int LC), setpoint W1 will be used if the dry contact is open and setpoint W2 will be used if the dry contact is closed.

If the LC is in mode 1A, 1B, 3, 4, 5, or 6, and the dry contact is closed, the LMV5 will revert back to mode 2 and will use setpoint W1.

This feature is commonly used when switching the LMV5 from Mode 5 (direct modulation via a 4-20mA source wired into terminals X62.3 and X62.4) back to Mode 2 for local sensing and modulation of the burner.

Note: Please see Section 4-1 for more information on LC modes.

The LC also provides power for 4-20mA loop powered sensors or 0 -10 VDC externally powered sensors. The wiring of these sensors is covered in Section 3-3. Description of the LC is provided in Section 4, page 15.

Floating / Bumping and Multi-stage Oil

Terminals X5-03.02 and X5-03.03 can be used for floating / bumping or multistage oil. This can be done on all models of LMV5 and is typically done on LMV51.040 models.

Through the use of floating / bumping, the LMV5 can be driven to high fire by placing line voltage on terminal X5-03.02 and to low fire by removing line voltage from X5-03.02 and placing line voltage on X5-03.03. By alternating voltage on these terminals the firing rate of the LMV5 equipped burner can be increased or decreased. The floating / bumping type of modulation is typically what is used if the LMV5 is modulated with a RWF40.

A relay can be placed in the line connected to X5-03.02 if a low fire hold is desired.

If externally controlled multistage oil is selected terminal X5-03.02 can be energized with line voltage to put the burner in Stage 2, and terminal X5-03.03 can be energized with line voltage to put the burner in Stage 3. De-energizing these terminals takes the burner out of stage 2 or stage 3.

In all cases (unless terminal X5-03.01 is deactivated) energizing terminal X5-03.01 turns the burner on, and de-energizing terminal X5-03.01 turns the burner off.

Terminal Descriptions 3-2

Figure 3-2.1 LMV Front Layout

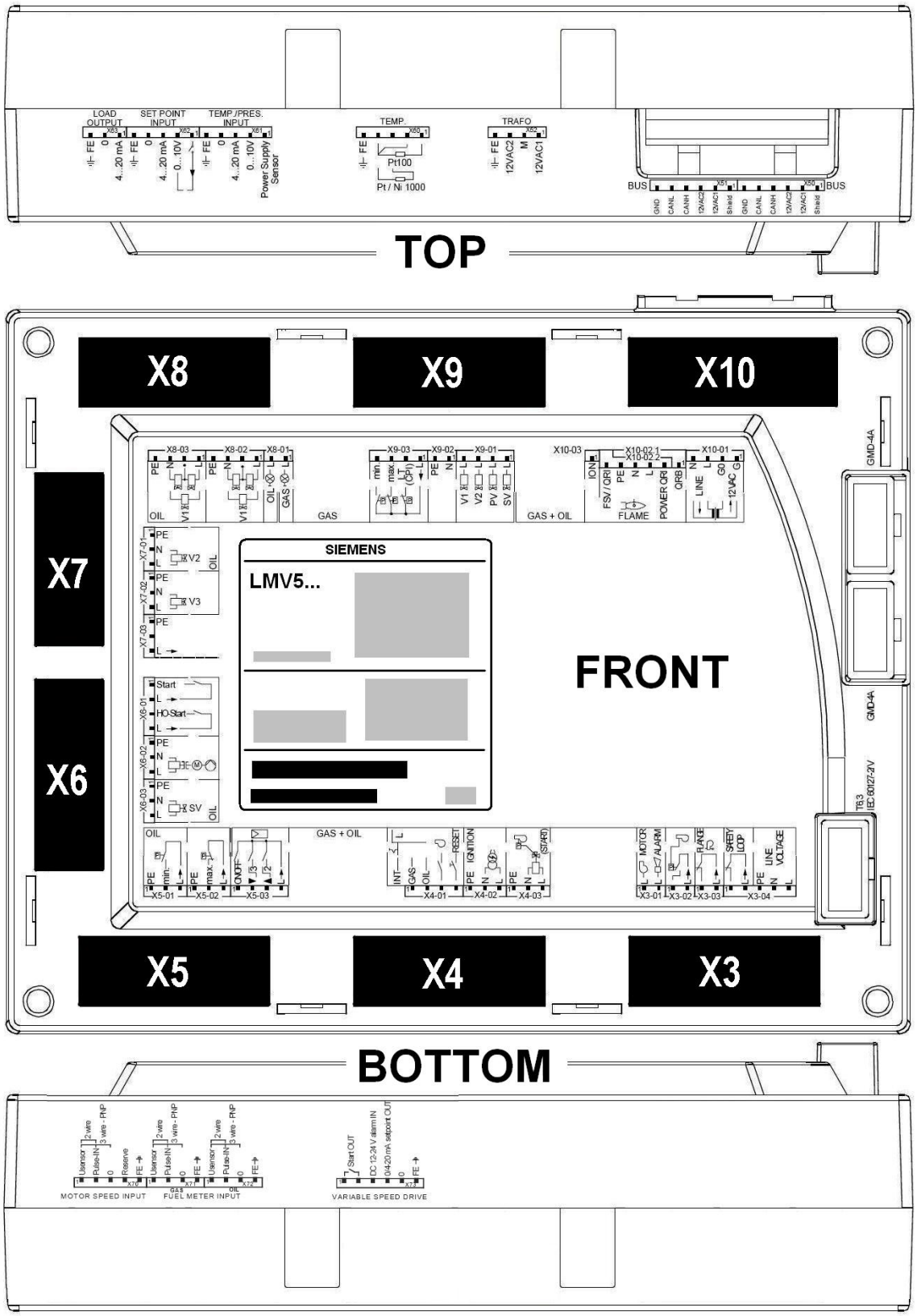


Figure 3-2.2 X3 and X4

LMV5x Terminal		Description / Notes *(related Parameter)*	Type	Rating
X3-01	Pin1	**Blower Motor Starter** Operation is not changed by the addition of a VSD Using a contactor is not recommended with a VSD (*ContinuousPurge, PostpurgeLockout*)	*Programable* Output	1A, 120V
	Pin2	**Alarm Horn** Can be de-energized with alarm silence on AZL (*AlarmStartPrev, Alarm act/deact*)		
X3-02	Pin 1	**Blower Air Pressure Switch** Must close, after the blower is started until a programmable period after the air actuator reaches purge position Must open, after the blower shuts off (*AirPressureTest, FanRunupTme*)	*Programable* Input	1.5mA, 120V
	Pin 2	**Line**	Line	500 mA, 120V
X3-03	Pin 1	**Burner Flange Limit Switch** (Part of safety loop) If not used jumper to X3-03 Pin 2	Input	5A, 120V
	Pin 2	Internally Jumpered to X3-04 Pin 1	Jumper	
X3-04	Pin 1	**Safety Loop** Encompasses: Low-Low water control, high limit, excess temp, etc… Internally Jumpered to X3-03 Pin 2	Input	5A, 120V
	Pin 2	**Line**	Line	
	Pin 3	**Protective Earth Ground (Chassis Ground)** Note: Internally connected to all PE pins to simplify wiring	PE	N/A
	Pin 4	**Neutral** Note: Internally connected to all Neutral pins to simplify wiring	N	
	Pin 5	**Main Power Line Voltage** Note: Internally fused (6.3A), supplies Line voltage to many LMV terminals, to simplify wiring (*MainsFrequency*)	*Programable* Line	6.3A, 120V
X4-01	Pin 1	**Fuel Select** Power X4-01 Pin 1 to *externally* select Gas Power X4-01 Pin 2 to *externally* select Oil If neither, X4-01 Pin 1 nor X4-01 Pin 2 is powered, fuel select is *internal,* via ModBus or AZL	Input	1.5mA, 120V
	Pin 2			
	Pin 3	**Blower Motor Starter Aux Contact** Typical is FCC, or FGR Pressure Switch FCC = Fan Contactor Contact (*FGR-PS/FCC*)	*Programable* Input	
	Pin 4	**Remote Reset** If in alarm, power will cause reset, if not in alarm, power will cause a manual lockout	Input	
X4-02	Pin 1	**Protective Earth Ground**	PE	N/A
	Pin 2	**Neutral**	N	
	Pin 3	**Ignition Transformer**	Output	1.6 A, 120V
X4-03	Pin 1	**Protective Earth Ground**	PE	N/A
	Pin 2	**Neutral**	N	
	Pin3	**Start Signal** Typical, to open outside air damper, or Air Pressure Switch Test, if direct start is used (*Start/PS-Valve, ContinuousPurge, NormDirectStart*)	*Programable* Output	0.5A, 120V

Note: Total combined load of all of all 120VAC outputs cannot exceed 5 amps.

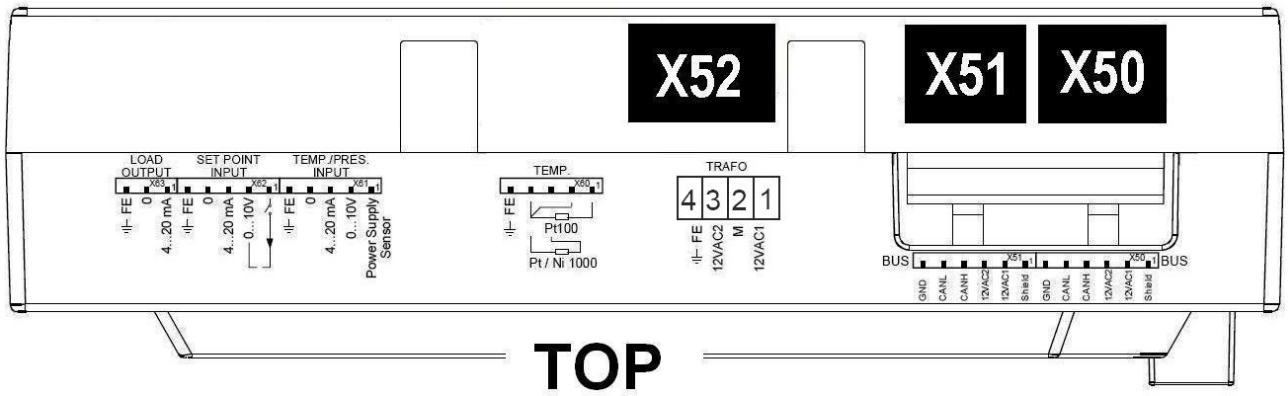
Figure 3-2.3 X5, X6, and X7

LMV5x Terminal		Description / Notes *(related Parameter)*	Type	Rating
X5-01	Pin 1	**Protective Earth Ground**	PE	N/A
	Pin 2	**Low Oil Pressure Switch** Opens on low oil pressure (*OilPressureMin*)	*Programable* Input	1.5 mA, 120V
	Pin 3	**Line**	Line	500 mA, 120V
X5-02	Pin 1	**Protective Earth Ground**	PE	N/A
	Pin 2	**High Oil Pressure Switch** Opens on high oil pressure (*OilPressureMax*)	*Programable* Input	1.5 mA, 120V
	Pin 3	**Line**	Output	500 mA, 120V
X5-03	Pin 1	**Burner ON / OFF Switch** If deactivated, ON / OFF via ModBus or AZL (*InputController*)	*Programable* Input	1.5 mA, 120V
	Pin 2	**Floating-Bumping Drive to Low Fire** (*LC_OptgMode*) modulation with RWF40 in floating bumping mode, or power to achieve Stage 3 with staged oil (*Operation Mode*)		
	Pin 3	**Floating-Bumping Drive to High Fire** (*LC_OptgMode*) modulation with RWF40 in floating bumping mode, or power to achieve Stage 2 with staged oil (*Operation Mode*)		
	Pin 4	**Line**	Line	500 mA, 120V
X6-01	Pin 1	**Start Release Oil** *(StartReleaseOil)* Typical: Atomizing Media Pressure Switch, closes on pressure	*Programable* Input	1.5 mA, 120V
	Pin 2	**Line**	Output	500 mA, 120V
	Pin 3	**Start Release Heavy Oil** Powered to release stages of Heavy Oil (*StartRelease*)	*Programable* Input	1.5 mA, 120V
	Pin 4	**Line**	Line	500 mA, 120V
X6-02	Pin 1	**Protective Earth Ground**	PE	N/A
	Pin 2	**Neutral**	N	
	Pin 3	**Oil Pump Motor Starter** (also known as Magnetic Clutch) (*OilPumpCoupling, IgnOilPumpStart, IgnOnTmeOilPump*)	*Programable* Output	1.6 A, 120V
X6-03	Pin 1	**Protective Earth Ground**	PE	N/A
	Pin 2	**Neutral**	N	
	Pin 3	Oil Outdoor Safety Valve Energizes phase 21 Typical: **Atomizing Air Compressor Motor Starter**	Output	1.6 A, 120V
X7-01	Pin 1	**Protective Earth Ground**	PE	N/A
	Pin 2	**Neutral**	N	
	Pin 3	**Main Oil Valve V2** Used for staged combustion on oil	Output	1.6 A, 120V
X7-02	Pin 1	**Protective Earth Ground**	PE	N/A
	Pin 2	**Neutral**	N	
	Pin 3	**Main Oil Valve V3** Used for staged combustion on oil	Output	1.6 A, 120V
X7-03 LMV52 Only	Pin 1	**Protective Earth Ground**	PE	N/A
	Pin 2	**CPI Oil** Typical, Configurable for: *deactivated, Start RelGas, CPI Oil, CPI Gas, or CPI Gas+OIL* **Note:** *CPI, Closed Position Indicator* = POC, Proof Of Closure *(StartReleaseGas)*	*Programable* Input	1.6 mA, 120V
	Pin 3	**Line**	Line	500mA, 120V

Figure 3-2.4 X8, X9, and X10

LMV5x Terminal		Description / Notes *(related Parameter)*	Type	Rating
X8-01	Pin 1	**Gas Indicator** Internally connected to X9-01.04	Output	1A, 120V
	Pin 2	**Oil Indicator** Internally connected to X8-02.01 and X8-03.01	Output	
X8-02	Pin 1	**Main Oil Valve V1** Internally connected to X8-03.1 Main oil valves can be connected to either, or both	Output	1.6 A, 120V
	Pin 2	**Wiring point** for main oil valves in series (typically not used)	Tie point	N/A
	Pin 3	**Neutral**	N	
	Pin 4	**Protective Earth Ground**	PE	
X8-03	Pin 1	**Main Oil Valve V1** See X8-02.01	Output	1.6 A, 120V
	Pin 2	**Wiring point** for main oil valves in series (typically not used)	Tie point	N/A
	Pin 3	**Neutral**	N	
	Pin 4	**Protective Earth Ground**	PE	
X9-01	Pin 1	Outdoor Gas Safety Valve Energizes in Phase 21 Typical use: **Gas Booster Motor Starter**	Output	1.6 A, 120V See Note: X9-01 Pin 4
	Pin 2	**Pilot Gas Valve**	Output	
	Pin 3	**Main Gas Valve V2** Downstream main gas valve	Output	
	Pin 4	**Main Gas Valve V1** Upstream main gas valve *Note:* If a non-Siemens gas valve is used, that draws more than 1.6A, a separate safety relay must be used to power the gas valve. If valve proving is used, V1 and V2 must be wired separately.	Output	
X9-02	Pin 1	**Neutral**	N	N/A
	Pin 2	**Protective Earth Ground**	PE	
X9-03	Pin 1	**Line**	Line	500mA, 120V
	Pin 2	**CPI GAS** Typical (*PS-VP/CP*) Configurable for: *CPI Gas, CPI Oil, CPI Gas+Oil, PS-VP (PressSw-ValveProve)* **Note:** *CPI(Closed Position Indicator)* = POC(Proof Of Closure)	*Programable* Input	1.5 mA, 120V
	Pin 3	**High Gas Pressure Switch** Opens on high pressure (*GasPressureMax*)	*Programable* Input	
	Pin 4	**Low Gas Pressure Switch** Opens on low gas pressure *(GasPressureMin)*	*Programable* Input	
X10-01	Pin 1	**12 VAC** Connect to Xfmr SEK1 Pin 2	Power	1.2 A, 12V
	Pin 2	**12 VAC** Connect to Xfmr SEK1 Pin 1		
	Pin 3	**Line** Connect to Xmfr PRI Pin 2	Line	1 A, 120V
	Pin 4	**Neutral** Connect to Xmfr PRI Pin 1	N	N/A
X10-02	Pin 1	**Flame Detector** QRB Signal	*Programable* Input	8 VDC
	Pin 2	**Flame Detector** Power Supply	Output	100mA, 21 VDC
	Pin 3	**Line**	Line	500mA, 120V
	Pin 4	**Neutral**	N	N/A
	Pin 5	**Protective Earth Ground**	PE	
	Pin 6	**Flame Detector** QRI Signal	*Programable Input*	5 VDC
X10-03	Pin 1	**Flame Rod** (Ionization Probe) or GN UV Scanner		0.5 mA

Figure 3-2.5 LMV5 Top Terminals X50 thru X52 Layout



LMV5x Terminal		Description / Notes	Type	Rating
X50	Pin 1	**CANbus Shield** (clamp to shielding of the cable)	FE	N/A
	Pin 2	**12VAC1** Power for the AZL	Power	12 VAC, 4A
	Pin 3	**12VAC2** Power for the AZL		
	Pin 4	**CANH** Communication Signal	Bus	5VDC
	Pin 5	**CANL** Communication Signal		
	Pin 6	**Reference Ground**	0 *	N/A
X51	Pin 1	**CANbus Shield** (clamp to shielding of the cable)	FE	N/A
	Pin 2	**12VAC1** Power for the actuators and the O2 Module	Power	12 VAC, 4A
	Pin 3	**12VAC2** Power for the actuators and the O2 Module		
	Pin 4	**CANH** Communication Signal	Bus	5VDC
	Pin 5	**CANL** Communication Signal		
	Pin 6	**Reference Ground**	0 *	N/A
X52	Pin 1	**LMV Input 12VAC1** Connect to Xfmr SEK 2 Pin 1	Power	12VAC
	Pin 2	**LMV Input Ref Gnd** Connect to Xfmr SEK 2 Pin 2	0 *	N/A
	Pin 3	**LMV Input 12VAC2** Connect to Xfmr SEK 2 Pin 4	Power	12VAC
	Pin 4	**LMV Input Funct Gnd** Connect to Xfmr SEK 2 Pin 3	FE	N/A

*** Note: All 0 are internally connected to simplify wiring.**

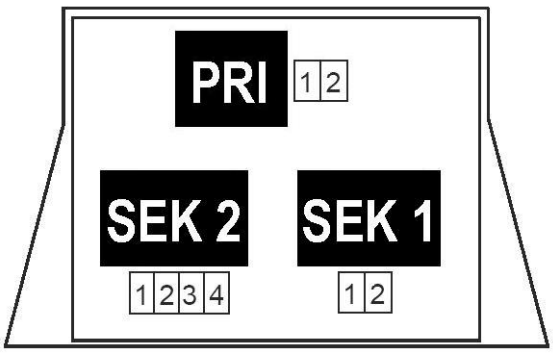
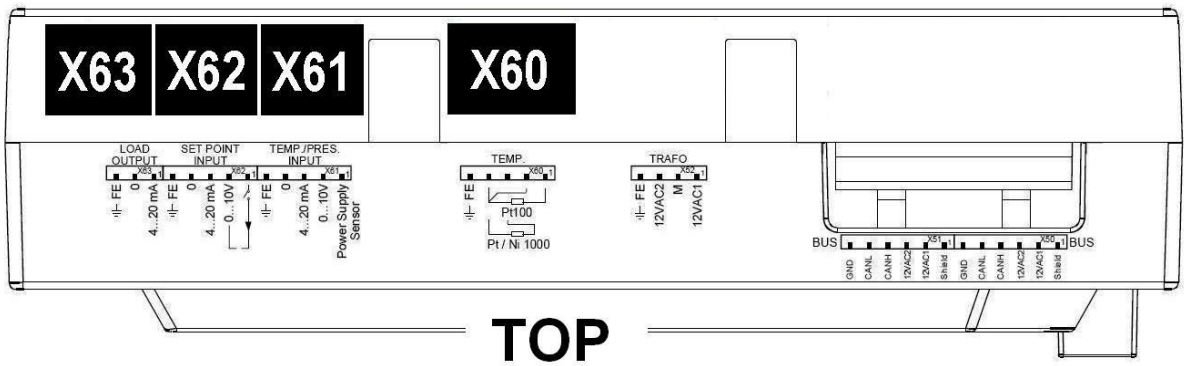


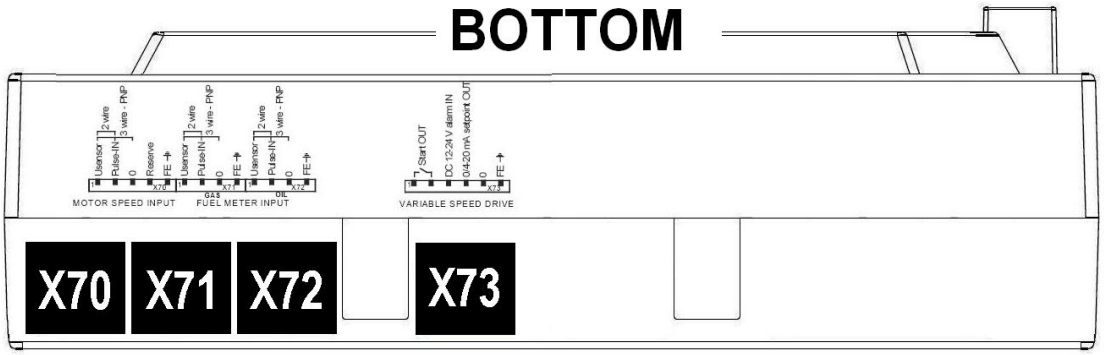
Figure 3-2.6 LMV5 Top Terminals X60 thru X63 Layout



LMV5x Terminal		Description / Notes *(related Parameter)*	Type	Rating
X60	Pin 1	**Temp Sensor** PT100 RTD (3 wire) Input 1 TEMP	*Programable* Input	N/A
	Pin 2	Temp Sensor PT100 RTD (3 wire) Line compensation		
	Pin 3	Temp Sensor PT / Ni 1000 RTD (2 wire) Input 4 TEMP		
	Pin 4	Temp Sensor Reference Ground PT / Ni 1000 (2 wire), or PT100 RTD (3 wire)	0 *	
	Pin 5	Temp Sensor Functional Ground for shield	FE	
	Temp Sensor *(Sensor Select, MeasureRangePtNi)*			
X61	Pin 1	**Press/Temp Transducer** Power supply	Power	20 VDC 25mA
	Pin 2	Press/Temp Transducer 0 to 10 VDC Input 2 (0 Min 10.5 Max V) If sensor power is required, wire to: X61 Pin 1(+) and Pin 2(-) If sensor power is not req, wire to: X61 Pin 2 (+) and Pin 4(-)	*Programable* Input	0 to10 VDC
	Pin 3	Press/Temp Transducer 0/4 to 20mA Input 2 (Min 3 Max 21 mA) If sensor power is required, wire to: X61 Pin 1(+) and Pin 3(-) If sensor power is not req, wire to: X61 Pin 3(+) and Pin 4(-)		0/4 to 20 mA
	Pin 4	Press/Temp Transducer, Reference ground	0 *	N/A
	Pin 5	Press/Temp Transducer, Functional ground for shield	FE	
	Press/Temp Transducer *(Ext Inp X61 U/I, MRange TempSens, Mrange PressSens)*			
X62	Pin 1	**Remote Setpoint / Direct Modulation** Power supply	Power	24 VDC, 2mA
	Pin 2	Remote Setpoint / Direct Modulation 0 to 10VDC Input 3 If sensor power is required, wire to: X62 Pin 1(+) and Pin 2(-) If sensor power is not req, wire to: X62 Pin 2(+) and Pin 4(-)	*Programable* Input	0 to10 VDC
	Pin 3	Remote Setpoint / Direct Modulation 4 to 20mA, Input 3 If sensor power is required, wire to: X62 Pin 1(+) and Pin 3(-) If sensor power is not req, wire to: X62 Pin 3(+) and Pin 4(-)		0 to 20 mA
	Pin 4	Remote Setpoint / Direct Modulation Reference ground	0 *	N/A
	Pin 5	Remote Setpoint / Direct Modulation Funct Gnd for shield	FE	
	Remote Setpoint / Direct Modulation *(Ext Inp X62 U/I, Ext MinSetpoint, Ext MaxSetpoint)*			
X63	Pin 1	**Analog Output** 0/4 to 20mA Wire X63 Pin 1(+) X63 Pin 2(-)	*Programable*	0/4-20mA
	Pin 2	Analog Output Reference ground	0 *	N/A
	Pin 3	Analog Load Output Functional ground for shield	FE	

*** Note: All 0 are internally connected to simplify wiring.**

Figure 3-2.7 LMV5 Top Terminals X70 thru X73 Layout



LMV5x Terminal		Description / Notes	Type	Rating
X70 LMV52	Pin 1	**Speed Sensor** Pulse Power supply	Power	10 VDC, 45mA
	Pin 2	Speed Sensor Pulse Max low 1.5VDC Min high 3VDC	*Programable* Input	10 VDC
	Pin 3	Speed Sensor Reference ground	0 *	N/A
	Pin 4	Speed Sensor Reserve extra terminal		
	Pin 5	Speed Sensor Functional ground for shield connection	FE	
X71 LMV52	Pin 1	**Gas Meter Pulse** Power supply	Output	10 VDC, 45mA
	Pin 2	Gas Meter Pulse Max low 1.5VDC Min high 3VDC	*Programable* Input	10 VDC
	Pin 3	Gas Meter Reference ground	0 *	N/A
	Pin 4	Gas Meter Functional ground for shield connection	FE	
X72 LMV52	Pin 1	**Oil Meter Pulse** Power supply	Power	10 VDC, 45mA
	Pin 2	Oil Meter Pulse Max low 1.5VDC Min high 3VDC	*Programable* Input	10 VDC
	Pin 3	Oil Meter Reference ground	0 *	N/A
	Pin 4	Oil Meter Functional ground for shield connection	FE	
X73 LMV52	Pin 1	**VSD** Dry Contact (Internal LMV) When the LMV closes this contact the VSD is in RUN mode	Output	AC / DC 24 V 2A
	Pin 2	When the LMV opens this contact the VSD is in STOP mode		
	Pin 3	VSD Alarm Input When powered LMV will alarm	Input	24 VDC
	Pin 4	VSD Analog Output 0 to 20mA or 4 to 20mA Maximum loop resistance to be less than 750 ohms Connect Positive (on VSD drive) to Pin 4 Connect Negative (on VSD drive) to Pin 5	*Programable* Output	0-20mA
	Pin 5	VSD Reference ground	0 *	N/A
	Pin 6	VSD Functional ground for shield connection	FE	

*** Note: All 0 are internally connected to simplify wiring.**

Figure 3-2.8 Layout of QGO20 and PLL52 (O2 Module)

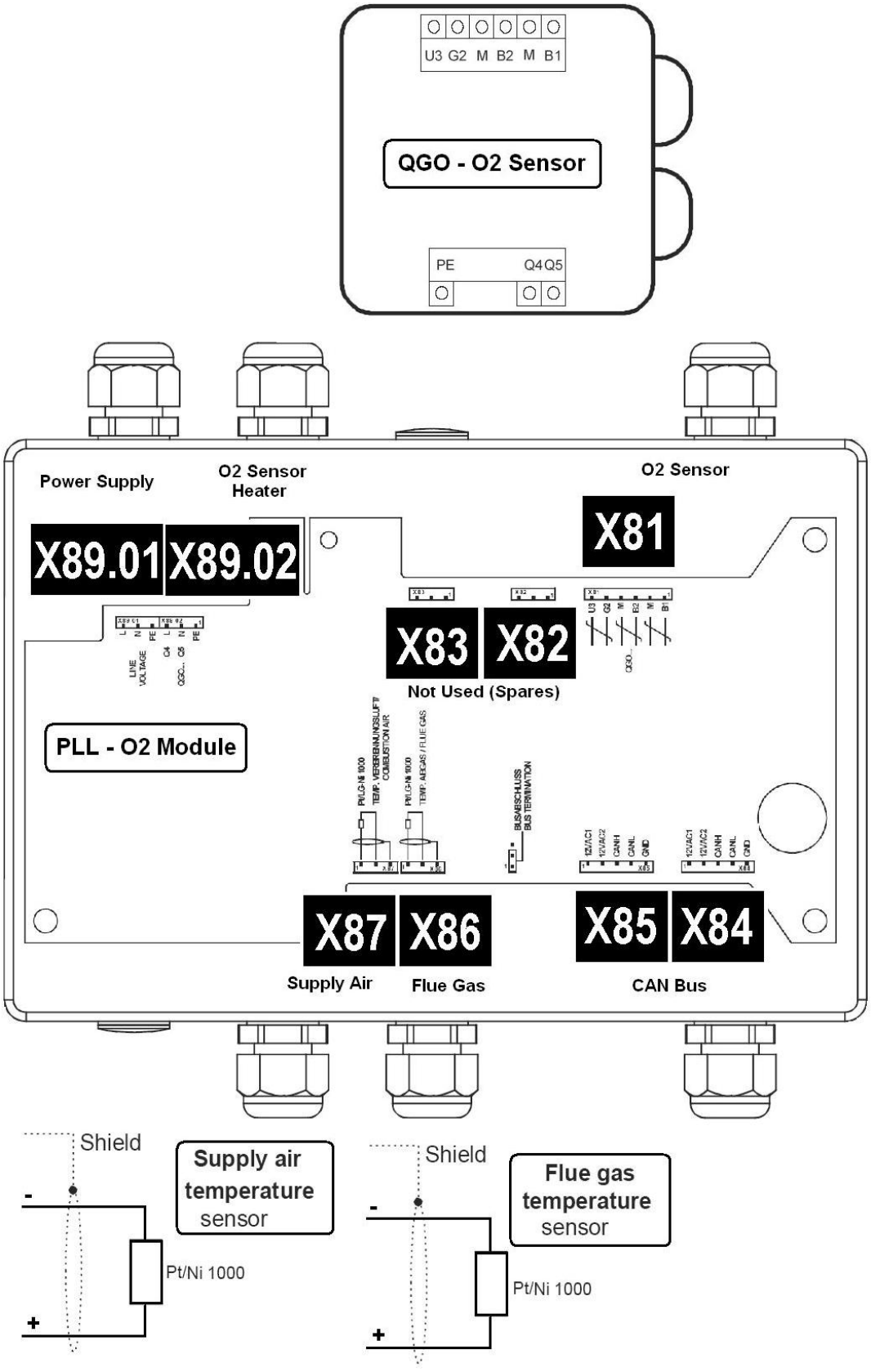
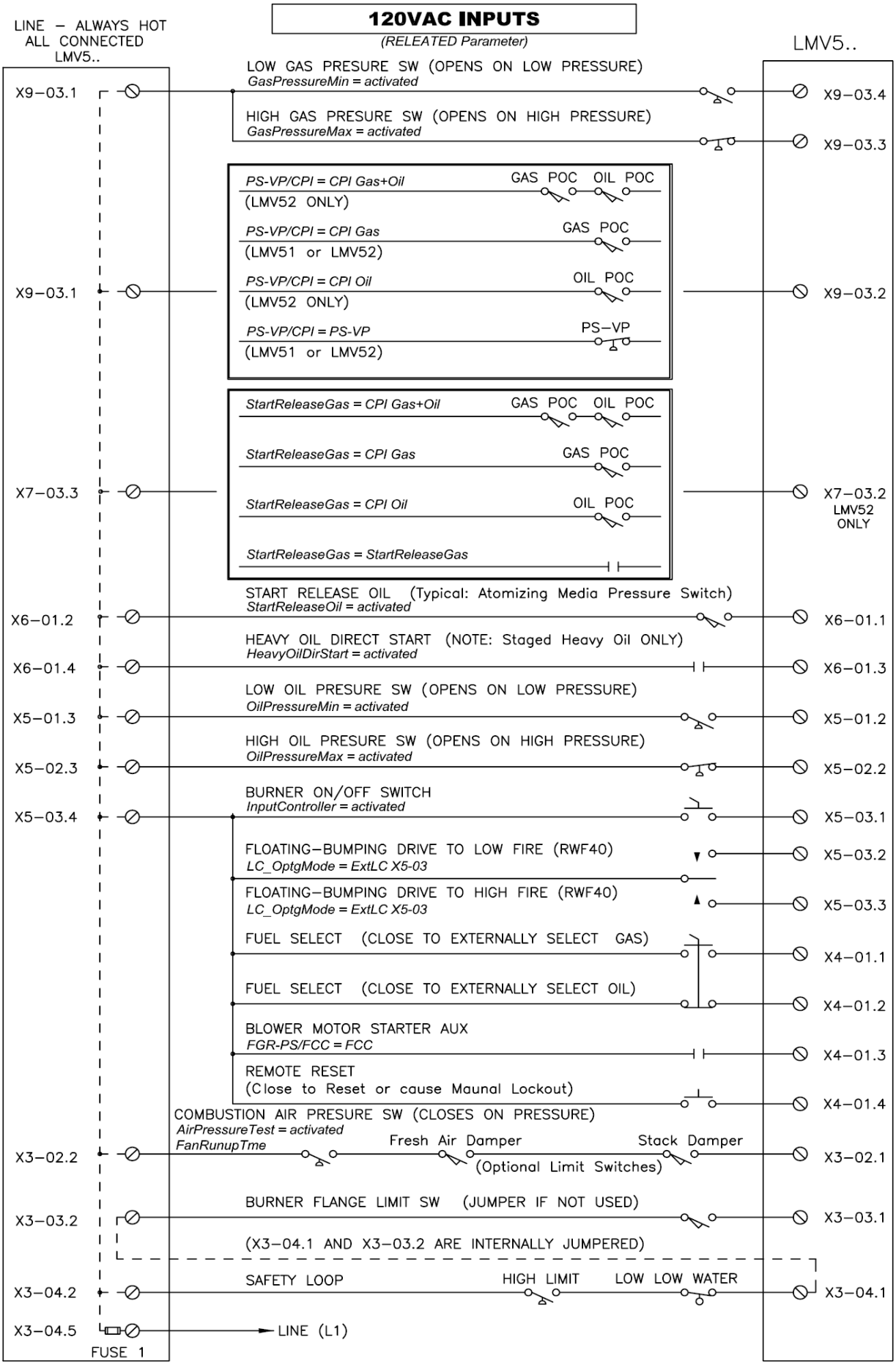
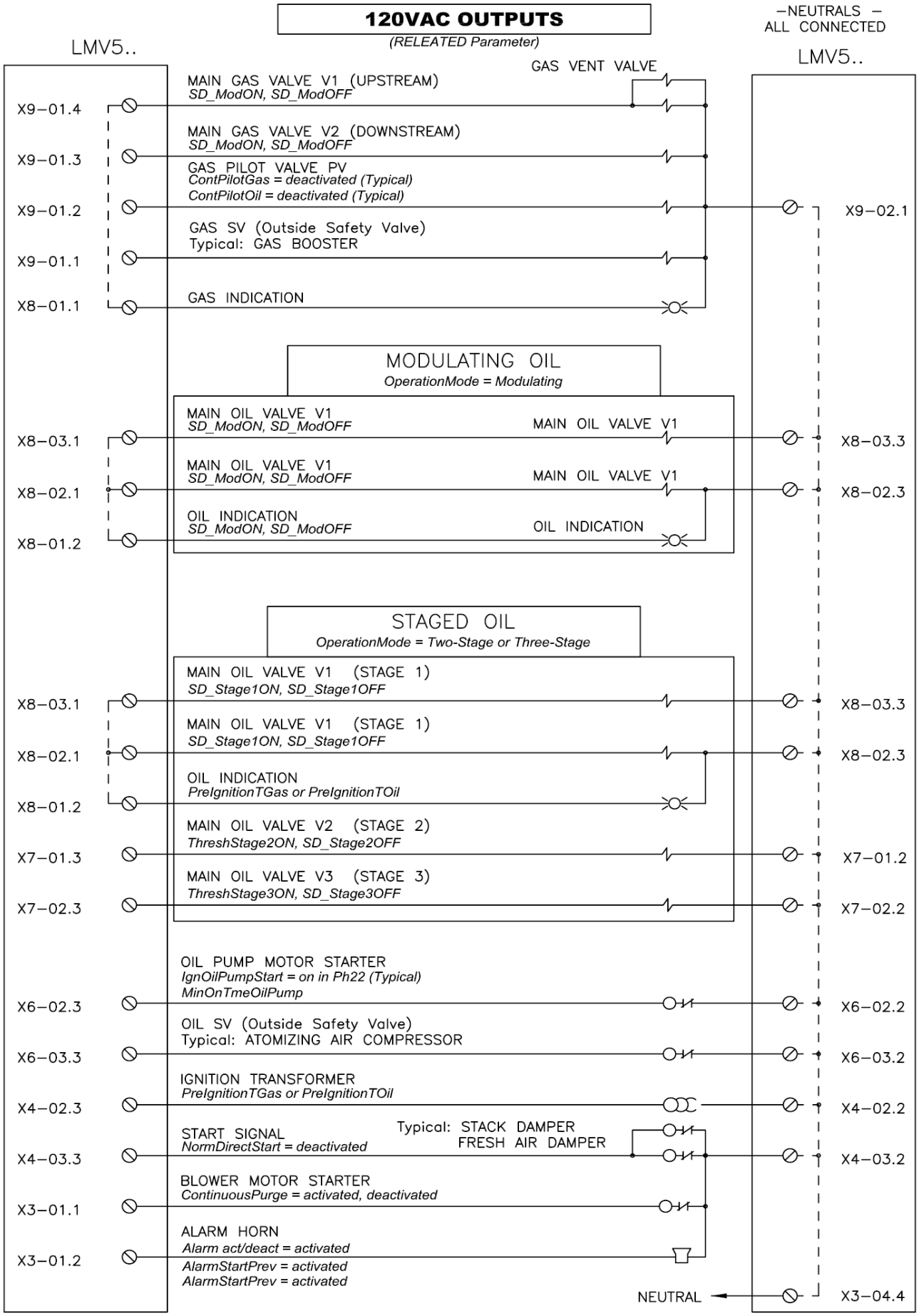


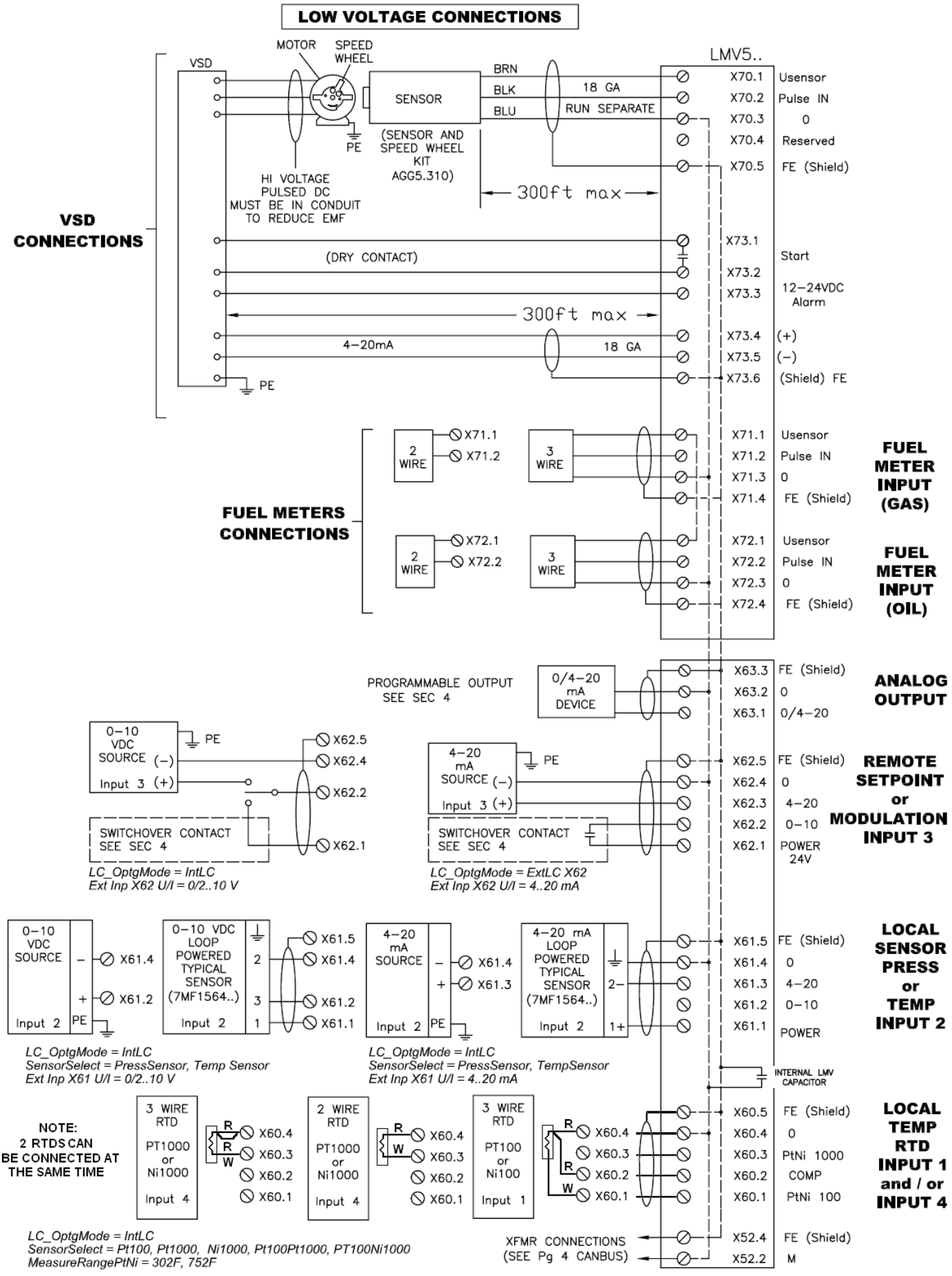
Figure 3-2.9 O2 Module Terminals X81 thru X89

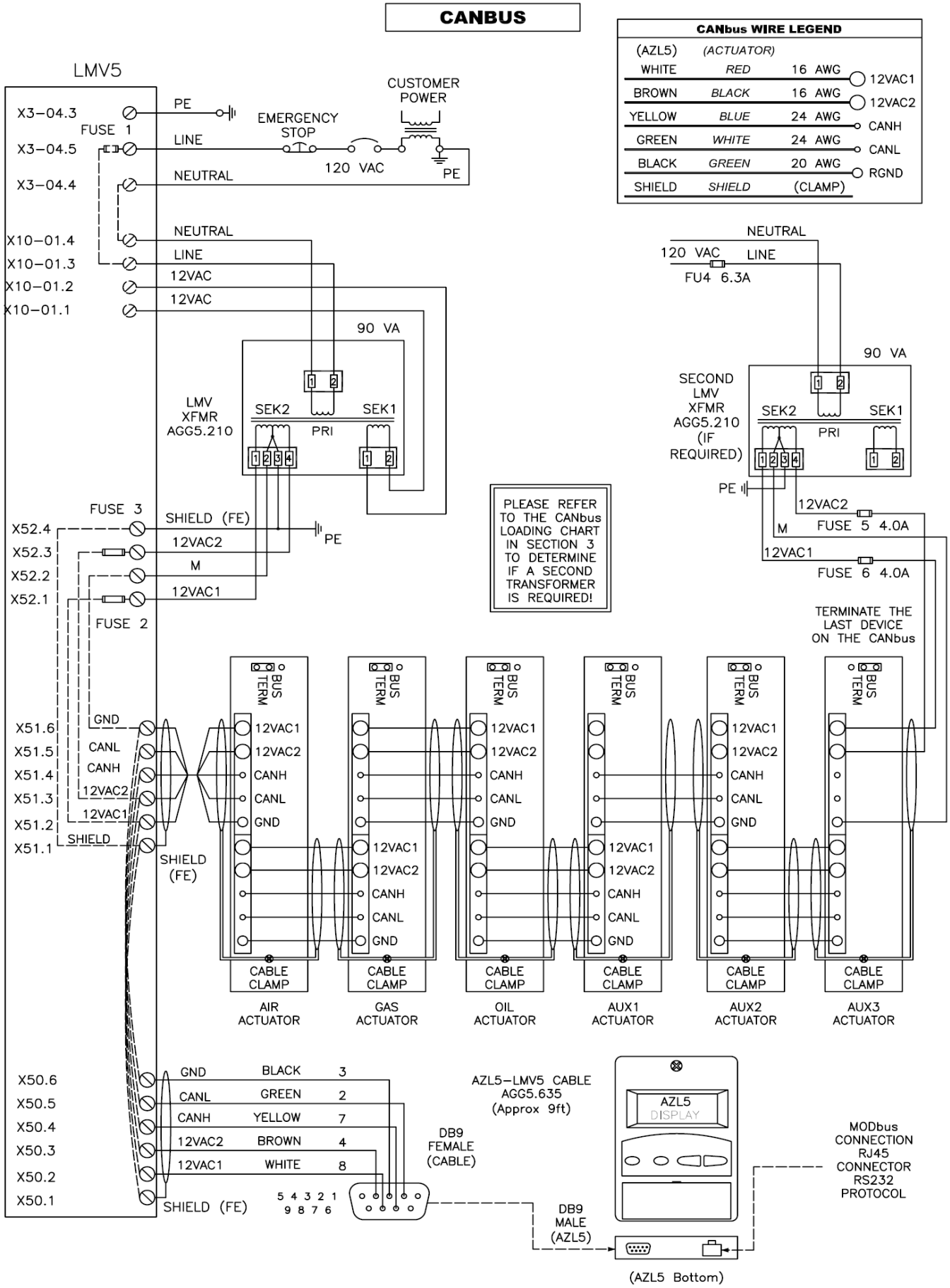
PLL52 Terminal		O2 Module Description / Notes	Type	Rating
X81	Pin1	**O2 Sensor** (Signal from O2 Sensor) Nernst Voltage Connect to O2 sensor terminal B1	Input	100mV DC
	Pin2	Ground Connect to O2 sensor terminal M	0 *	N/A
	Pin3	Thermocouple Connect to O2 sensor terminal B2	Input	0 to 33mV DC
	Pin4	Ground Connect to O2 sensor terminal M	0 *	N/A
	Pin5	Temp Connect to O2 sensor terminal G2	Output	20 VDC
	Pin6	Temp Compensation Connect to O2 sensor terminal U3	Input	4 VDC
X82		Spare (not used)		
X83		Spare (not used)		
X84	Pin 1	**12VAC1** Power for the O2 module	Power	12 VAC, 4A
	Pin 2	**12VAC2** Power for the O2 module		
	Pin 3	**CANH** Communication Signal	Bus	5VDC
	Pin 4	**CANL** Communication Signal		
	Pin 5	**CANbus Reference Ground**	0 *	N/A
Note: The PLL52 Module provides a ground clamp for connecting the shield on the CANbus cable				
X85	Pin 1	**12VAC1** Power for the O2 module	Power	12 VAC, 4A
	Pin 2	**12VAC2** Power for the O2 module		
	Pin 3	**CANH** Communication Signal	Bus	5VDC
	Pin 4	**CANL** Communication Signal		
	Pin 5	**CANbus Reference Ground**	0 *	N/A
X86	Pin 1	**Flue Gas Temp Sensor** PT or Ni 1000 ohm RTD Wire to X86 Pin 1(+) and X86 Pin 2(-)	Input	2 Wire RTD Temperature Sensor Inputs
	Pin 2	Reference Ground	0 *	
	Pin 3	For sensor cable shield	FE	
X87	Pin 1	**Ambient Temp Sensor** PT or Ni 1000 ohm RTD Wire to X87 Pin 1(+) and X87 Pin 2(-)	Input	
	Pin 2	Reference Ground	0 *	
	Pin3	For sensor cable shield	FE	
X89.02	Pin 1	Connect to O2 sensor, terminal PE (Protective Earth Ground)	PE	120VAC 2.5A
	Pin 2	Connect to O2 sensor, terminal Q5 (Neutral)	N	
	Pin 3	Regulated, Power to **O2 Sensor Heating Element** Connect to O2 sensor, terminal Q4 (Power)	Power	
X89.01	Pin 4	Protective Earth Ground	PE	
	Pin 5	Neutral	N	
	Pin 6	120 VAC Power to **PLL Module**, for O2 Sensor Heating Fuse @ 4 A	Power	

*** Note: All 0 are internally connected to simplify wiring.**

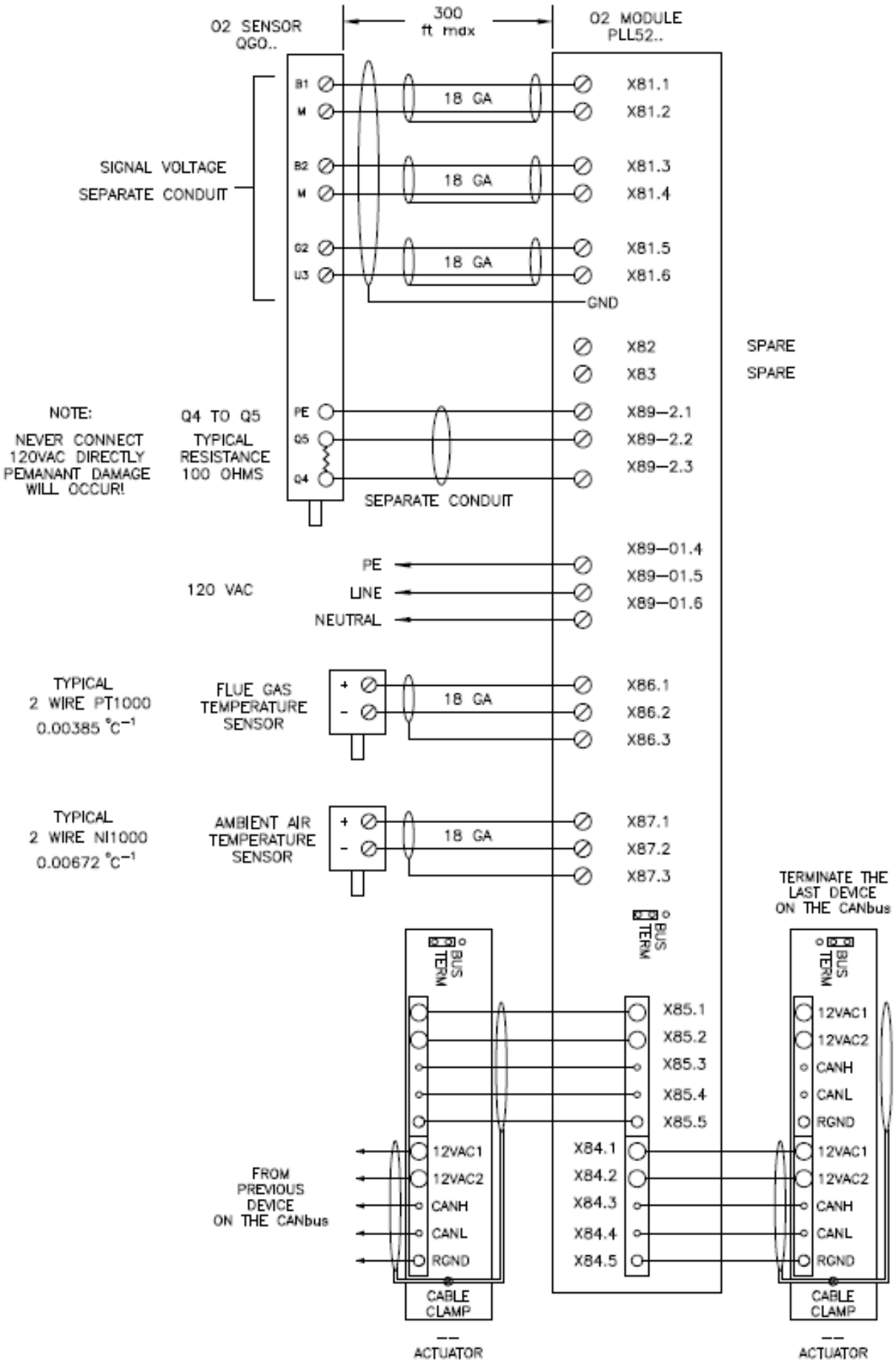

120VAC INPUTS
(RELEATED Parameter)
LINE – ALWAYS HOT
ALL CONNECTED
LMV5..
LMV5..
LOW GAS PRESURE SW (OPENS ON LOW PRESSURE)
GasPressureMin = activated
X9–03.1
X9–03.4
HIGH GAS PRESURE SW (OPENS ON HIGH PRESSURE)
GasPressureMax = activated
X9–03.3
PS-VP/CPI = CPI Gas+Oil
GAS POC OIL POC
(LMV52 ONLY)
PS-VP/CPI = CPI Gas
GAS POC
(LMV51 or LMV52)
PS-VP/CPI = CPI Oil
OIL POC
(LMV52 ONLY)
PS-VP/CPI = PS-VP
PS–VP
(LMV51 or LMV52)
X9–03.1
X9–03.2
StartReleaseGas = CPI Gas+Oil
GAS POC OIL POC
StartReleaseGas = CPI Gas
GAS POC
StartReleaseGas = CPI Oil
OIL POC
StartReleaseGas = StartReleaseGas
X7–03.3
X7–03.2
LMV52
ONLY
START RELEASE OIL (Typical: Atomizing Media Pressure Switch)
StartReleaseOil = activated
X6–01.2
X6–01.1
HEAVY OIL DIRECT START (NOTE: Staged Heavy Oil ONLY)
HeavyOilDirStart = activated
X6–01.4
X6–01.3
LOW OIL PRESURE SW (OPENS ON LOW PRESSURE)
OilPressureMin = activated
X5–01.3
X5–01.2
HIGH OIL PRESURE SW (OPENS ON HIGH PRESSURE)
OilPressureMax = activated
X5–02.3
X5–02.2
BURNER ON/OFF SWITCH
InputController = activated
X5–03.4
X5–03.1
FLOATING–BUMPING DRIVE TO LOW FIRE (RWF40)
LC_OptgMode = ExtLC X5-03
X5–03.2
FLOATING–BUMPING DRIVE TO HIGH FIRE (RWF40)
LC_OptgMode = ExtLC X5-03
X5–03.3
FUEL SELECT (CLOSE TO EXTERNALLY SELECT GAS)
X4–01.1
FUEL SELECT (CLOSE TO EXTERNALLY SELECT OIL)
X4–01.2
BLOWER MOTOR STARTER AUX
FGR-PS/FCC = FCC
X4–01.3
REMOTE RESET
(Close to Reset or cause Maunal Lockout)
X4–01.4
COMBUSTION AIR PRESURE SW (CLOSES ON PRESSURE)
AirPressureTest = activated
FanRunupTme
Fresh Air Damper
Stack Damper
(Optional Limit Switches)
X3–02.2
X3–02.1
BURNER FLANGE LIMIT SW (JUMPER IF NOT USED)
X3–03.2
X3–03.1
(X3–04.1 AND X3–03.2 ARE INTERNALLY JUMPERED)
SAFETY LOOP
HIGH LIMIT
LOW LOW WATER
X3–04.2
X3–04.1
X3–04.5
LINE (L1)
FUSE 1


120VAC OUTPUTS
(RELEATED Parameter)
–NEUTRALS – ALL CONNECTED
LMV5..
LMV5..
GAS VENT VALVE
MAIN GAS VALVE V1 (UPSTREAM)
SD_ModON, SD_ModOFF
X9–01.4
MAIN GAS VALVE V2 (DOWNSTREAM)
SD_ModON, SD_ModOFF
X9–01.3
GAS PILOT VALVE PV
ContPilotGas = deactivated (Typical)
ContPilotOil = deactivated (Typical)
X9–01.2
X9–02.1
GAS SV (Outside Safety Valve)
Typical: GAS BOOSTER
X9–01.1
GAS INDICATION
X8–01.1
MODULATING OIL
OperationMode = Modulating
MAIN OIL VALVE V1
SD_ModON, SD_ModOFF
MAIN OIL VALVE V1
X8–03.1
X8–03.3
MAIN OIL VALVE V1
SD_ModON, SD_ModOFF
MAIN OIL VALVE V1
X8–02.1
X8–02.3
OIL INDICATION
SD_ModON, SD_ModOFF
OIL INDICATION
X8–01.2
STAGED OIL
OperationMode = Two-Stage or Three-Stage
MAIN OIL VALVE V1 (STAGE 1)
SD_Stage1ON, SD_Stage1OFF
X8–03.1
X8–03.3
MAIN OIL VALVE V1 (STAGE 1)
SD_Stage1ON, SD_Stage1OFF
X8–02.1
X8–02.3
OIL INDICATION
PreIgnitionTGas or PreIgnitionTOil
X8–01.2
MAIN OIL VALVE V2 (STAGE 2)
ThreshStage2ON, SD_Stage2OFF
X7–01.3
X7–01.2
MAIN OIL VALVE V3 (STAGE 3)
ThreshStage3ON, SD_Stage3OFF
X7–02.3
X7–02.2
OIL PUMP MOTOR STARTER
IgnOilPumpStart = on in Ph22 (Typical)
MinOnTmeOilPump
X6–02.3
X6–02.2
OIL SV (Outside Safety Valve)
Typical: ATOMIZING AIR COMPRESSOR
X6–03.3
X6–03.2
IGNITION TRANSFORMER
PreIgnitionTGas or PreIgnitionTOil
X4–02.3
X4–02.2
Typical: STACK DAMPER
FRESH AIR DAMPER
START SIGNAL
NormDirectStart = deactivated
X4–03.3
X4–03.2
BLOWER MOTOR STARTER
ContinuousPurge = activated, deactivated
X3–01.1
ALARM HORN
Alarm act/deact = activated
X3–01.2
AlarmStartPrev = activated
AlarmStartPrev = activated
NEUTRAL
X3–04.4

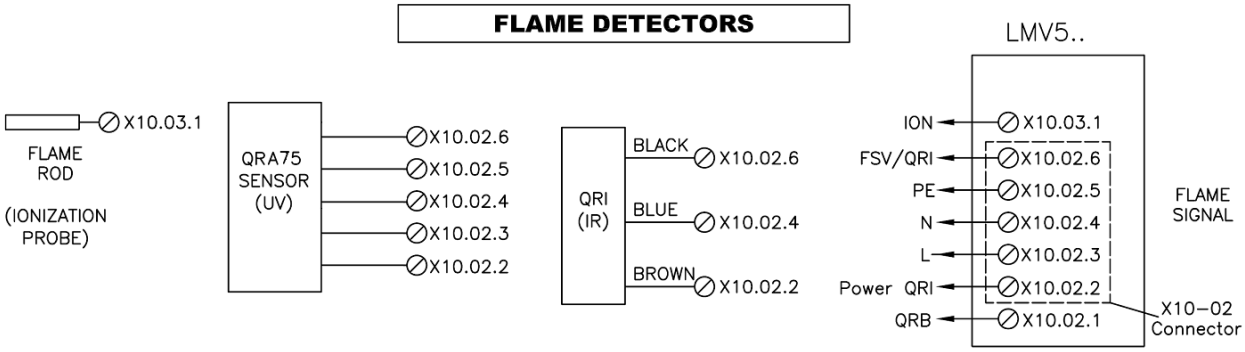

LOW VOLTAGE CONNECTIONS
VSD CONNECTIONS
MOTOR
SPEED WHEEL
VSD
SENSOR
BRN
BLK
BLU
18 GA
RUN SEPARATE
(SENSOR AND SPEED WHEEL KIT AGG5.310)
PE
HI VOLTAGE PULSED DC MUST BE IN CONDUIT TO REDUCE EMF
300ft max
LMV5..
X70.1 Usensor
X70.2 Pulse IN
X70.3 0
X70.4 Reserved
X70.5 FE (Shield)
(DRY CONTACT)
X73.1
X73.2
X73.3
Start
12–24VDC Alarm
4–20mA
18 GA
X73.4 (+)
X73.5 (–)
X73.6 (Shield) FE
FUEL METERS CONNECTIONS
2 WIRE
3 WIRE
X71.1
X71.2
X71.1 Usensor
X71.2 Pulse IN
X71.3 0
X71.4 FE (Shield)
FUEL METER INPUT (GAS)
X72.1
X72.2
X72.1 Usensor
X72.2 Pulse IN
X72.3 0
X72.4 FE (Shield)
FUEL METER INPUT (OIL)
PROGRAMMABLE OUTPUT SEE SEC 4
0/4–20 mA DEVICE
X63.3 FE (Shield)
X63.2 0
X63.1 0/4–20
ANALOG OUTPUT
0–10 VDC SOURCE (–)
Input 3 (+)
SWITCHOVER CONTACT SEE SEC 4
X62.5
X62.4
X62.2
X62.1
LC_OptgMode = IntLC
Ext Inp X62 U/I = 0/2..10 V
4–20 mA SOURCE (–)
Input 3 (+)
SWITCHOVER CONTACT SEE SEC 4
LC_OptgMode = ExtLC X62
Ext Inp X62 U/I = 4..20 mA
X62.5 FE (Shield)
X62.4 0
X62.3 4–20
X62.2 0–10
X62.1 POWER 24V
REMOTE SETPOINT or MODULATION INPUT 3
0–10 VDC SOURCE
Input 2
X61.4
X61.2
0–10 VDC LOOP POWERED TYPICAL SENSOR (7MF1564..)
X61.5
X61.4
X61.2
X61.1
LC_OptgMode = IntLC
SensorSelect = PressSensor, Temp Sensor
Ext Inp X61 U/I = 0/2..10 V
4–20 mA SOURCE
X61.4
X61.3
4–20 mA LOOP POWERED TYPICAL SENSOR (7MF1564..)
LC_OptgMode = IntLC
SensorSelect = PressSensor, TempSensor
Ext Inp X61 U/I = 4..20 mA
X61.5 FE (Shield)
X61.4 0
X61.3 4–20
X61.2 0–10
X61.1 POWER
LOCAL SENSOR PRESS or TEMP INPUT 2
INTERNAL LMV CAPACITOR
NOTE: 2 RTDS CAN BE CONNECTED AT THE SAME TIME
3 WIRE RTD
PT1000 or Ni1000
Input 4
2 WIRE RTD
PT1000 or Ni1000
Input 4
3 WIRE RTD
PT100 or Ni100
Input 1
X60.4
X60.3
X60.2
X60.1
X60.5 FE (Shield)
X60.4 0
X60.3 PtNi 1000
X60.2 COMP
X60.1 PtNi 100
LOCAL TEMP RTD INPUT 1 and / or INPUT 4
LC_OptgMode = IntLC
SensorSelect = Pt100, Pt1000, Ni1000, Pt100Pt1000, PT100Ni1000
MeasureRangePtNi = 302F, 752F
XFMR CONNECTIONS (SEE Pg 4 CANBUS)
X52.4 FE (Shield)
X52.2 M


CANBUS
CANbus WIRE LEGEND
(AZL5) (ACTUATOR)
WHITE RED 16 AWG 12VAC1
BROWN BLACK 16 AWG 12VAC2
YELLOW BLUE 24 AWG CANH
GREEN WHITE 24 AWG CANL
BLACK GREEN 20 AWG RGND
SHIELD SHIELD (CLAMP)
LMV5
X3-04.3
FUSE 1
X3-04.5
X3-04.4
PE
LINE
NEUTRAL
EMERGENCY STOP
CUSTOMER POWER
120 VAC
PE
X10-01.4
X10-01.3
X10-01.2
X10-01.1
NEUTRAL
LINE
12VAC
12VAC
90 VA
LMV XFMR AGG5.210
SEK2
SEK1
PRI
NEUTRAL
120 VAC
LINE
FU4 6.3A
90 VA
SECOND LMV XFMR AGG5.210 (IF REQUIRED)
SEK2
SEK1
PRI
PE
12VAC2
M
FUSE 5 4.0A
12VAC1
FUSE 6 4.0A
PLEASE REFER TO THE CANbus LOADING CHART IN SECTION 3 TO DETERMINE IF A SECOND TRANSFORMER IS REQUIRED!
TERMINATE THE LAST DEVICE ON THE CANbus
FUSE 3
X52.4
X52.3
X52.2
X52.1
FUSE 2
SHIELD (FE)
PE
12VAC2
M
12VAC1
BUS TERM
X51.6
X51.5
X51.4
X51.3
X51.2
X51.1
GND
CANL
CANH
12VAC2
12VAC1
SHIELD
SHIELD (FE)
12VAC1
12VAC2
CANH
CANL
GND
CABLE CLAMP
AIR ACTUATOR
GAS ACTUATOR
OIL ACTUATOR
AUX1 ACTUATOR
AUX2 ACTUATOR
AUX3 ACTUATOR
X50.6
X50.5
X50.4
X50.3
X50.2
X50.1
GND BLACK 3
CANL GREEN 2
CANH YELLOW 7
12VAC2 BROWN 4
12VAC1 WHITE 8
SHIELD (FE)
5 4 3 2 1
9 8 7 6
DB9 FEMALE (CABLE)
AZL5-LMV5 CABLE AGG5.635 (Approx 9ft)
AZL5 DISPLAY
DB9 MALE (AZL5)
(AZL5 Bottom)
MODbus CONNECTION RJ45 CONNECTOR RS232 PROTOCOL

O2 MODULE

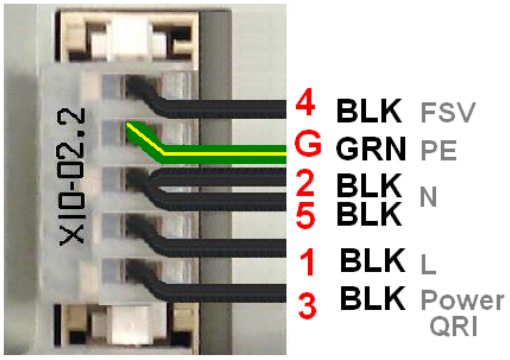

O2 SENSOR QGO..
300 ft max
O2 MODULE PLL52..
B1
M
B2
M
G2
U3
18 GA
SIGNAL VOLTAGE
SEPARATE CONDUIT
X81.1
X81.2
X81.3
X81.4
X81.5
X81.6
GND
X82
X83
SPARE
SPARE
NOTE:
NEVER CONNECT 120VAC DIRECTLY PEMANANT DAMAGE WILL OCCUR!
Q4 TO Q5
TYPICAL RESISTANCE 100 OHMS
PE
Q5
Q4
X89–2.1
X89–2.2
X89–2.3
SEPARATE CONDUIT
X89–01.4
X89–01.5
X89–01.6
120 VAC
PE
LINE
NEUTRAL
TYPICAL 2 WIRE PT1000 0.00385 °C⁻¹
FLUE GAS TEMPERATURE SENSOR
+
-
X86.1
X86.2
X86.3
TYPICAL 2 WIRE NI1000 0.00672 °C⁻¹
AMBIENT AIR TEMPERATURE SENSOR
X87.1
X87.2
X87.3
TERMINATE THE LAST DEVICE ON THE CANbus
BUS TERM
X85.1
X85.2
X85.3
X85.4
X85.5
12VAC1
12VAC2
CANH
CANL
RGND
X84.1
X84.2
X84.3
X84.4
X84.5
FROM PREVIOUS DEVICE ON THE CANbus
CABLE CLAMP
ACTUATOR

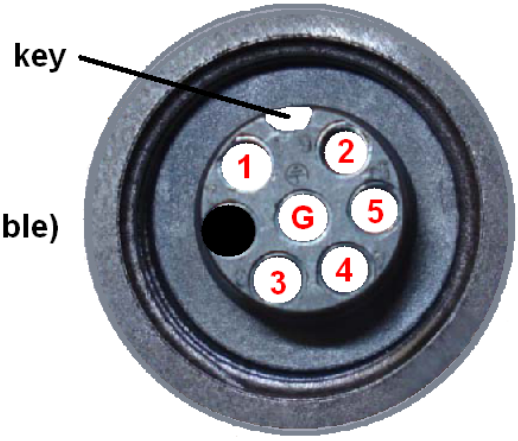
FLAME DETECTORS



QRI (IR)

QRA75 (UV)



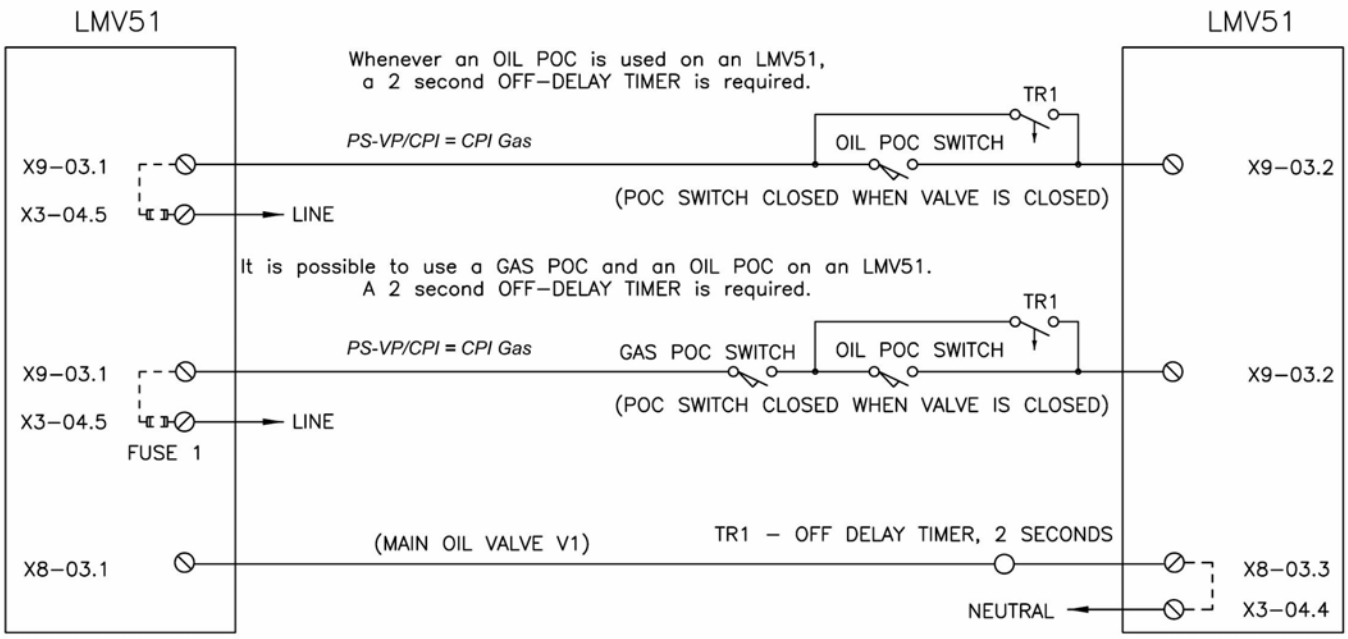


AGM23U (Cable)

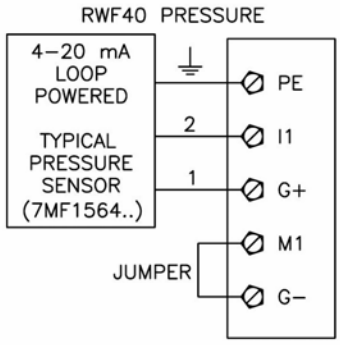
NOTE:
WIRE IS LABELED ALONG IT'S ENTIRE LENGTH (Below)

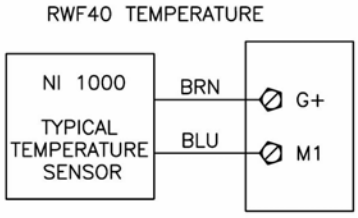
LMV51 OIL & OIL/GAS POC's

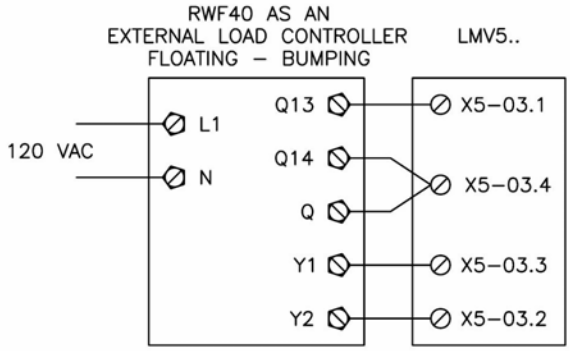
(RELEATED Parameter)

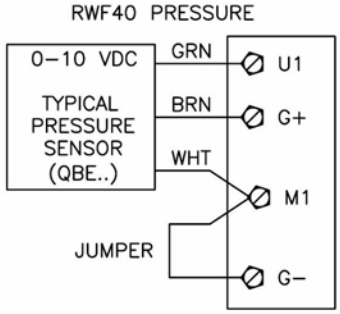


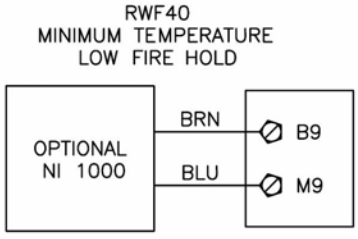
RWF40 - LMV5..

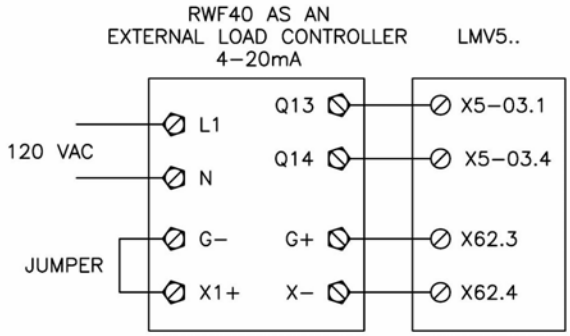












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Section 4 Parameters

Parameters Introduction 4-1

The Siemens LMV5 BMS has a number of parameters (settings) that can be adjusted to suit the wide variety of applications that exist in the burner / boiler and industrial heating market.

These parameters are broken up into three main groups by password access.

User Level access does not require a password, and encompasses all of the parameters that an end user might have to look at and / or adjust during the life of the burner / boiler.

Service Level access does require a password, and this level encompasses all of the user level, plus parameters that a service technician might need to access, to tune or maintain the burner / boiler.

OEM Level access requires a different password than the service level, and enables the OEM to access all parameters, including safety related parameters.

The parameters are accessed through the AZL5 in an outline-type structure that will be thoroughly illustrated on the following pages.

Notes:

1) Fault history and lockout history are ONLY stored in the AZL, and NOT in the LMV5.

2) These histories retain the last 9 lockouts and the last 21 faults, from whatever LMV5 they were on at the time, and cannot be purged.

3) These histories will remain in the AZL even when power is removed, or the AZL is moved to another LMV5.

4) Passwords are stored in the LMV5, and are part of a parameter set.

5) Any/all parameter changes made, are always done in the LMV5.

6) A **Backup** LMV5 > AZL makes a backup copy of a parameter set, from the LMV5 to the AZL.

7) A Backup AZL > LMV5 (technically a **Restore**) replaces a parameter set, from the AZL to the LMV5.

8) Backups and restore procedures are covered in more detail later in this section.

Typical Settings

Although the LMV5 has many parameters that can be adjusted, most burners / boilers only need a few parameters adjusted to operate properly.

If the burner / boiler has been shop tested, the number of parameters that must be adjusted is reduced even further.

The following table lists the parameters that must be set on an un-programmed LMV51 in order to operate most simple non-FGR burner / boiler safely.

Table 4-1.1 Necessary LMV51 Parameters

DUAL FUEL Example		
Common to Both Fuels	**Gas Burner**	**Light Oil Burner**
Auto/Manual/Off	*FuelTrainGas*	*FuelTrainOil*
1 AirActuator (address)	*2 GasActuator (address)*	*3 OilActuator (address)*
2 AirActuator (rotation direction)	*2 GasActuator (rotation direction)*	*3 Oil Actuator (rotation direction)*
IgnitionPosAir	*IgnitionPosGas*	*IgnitionPosOil*
PrepurgePosAir	*CurveParams Gas*	*CurveParams Oil*
OperatRampMod	*MinT_PrepurgeGas*	*MinT_PrepurgeOil*
SetLoad	*PrepurgeTmeGas*	*PrepurgeTmeOil*
LC_OptgMode	*SafteyTme1Gas*	*SafteyTme1Oil*
StandardParam	*SafteyTme2Gas*	*SafteyTme2Oil*
SD_ModOn	*PS-VP/ CPI*	*IgnOilPumpStart*
SD_ModOff		*OilPumpCoupling*
TimeNoFlame		*OilPressureMax*
ForcedIntermit		
SensorSelect		
MRangePressSens		
MRangeTempSens		
MeasureRangePtNi		
Ext Inp X61 U/I		
SetpointW1		
	Gas Burner	**Light Oil Burner**
	StartPointOp	StartPointOp
Hot water (not applicable to Steam)		
TL_Thresh_Off and TL_SD_On		

Note: The index at the beginning of Section 4-2 shows the above parameters in bold type.

Parameter Worksheet Legend

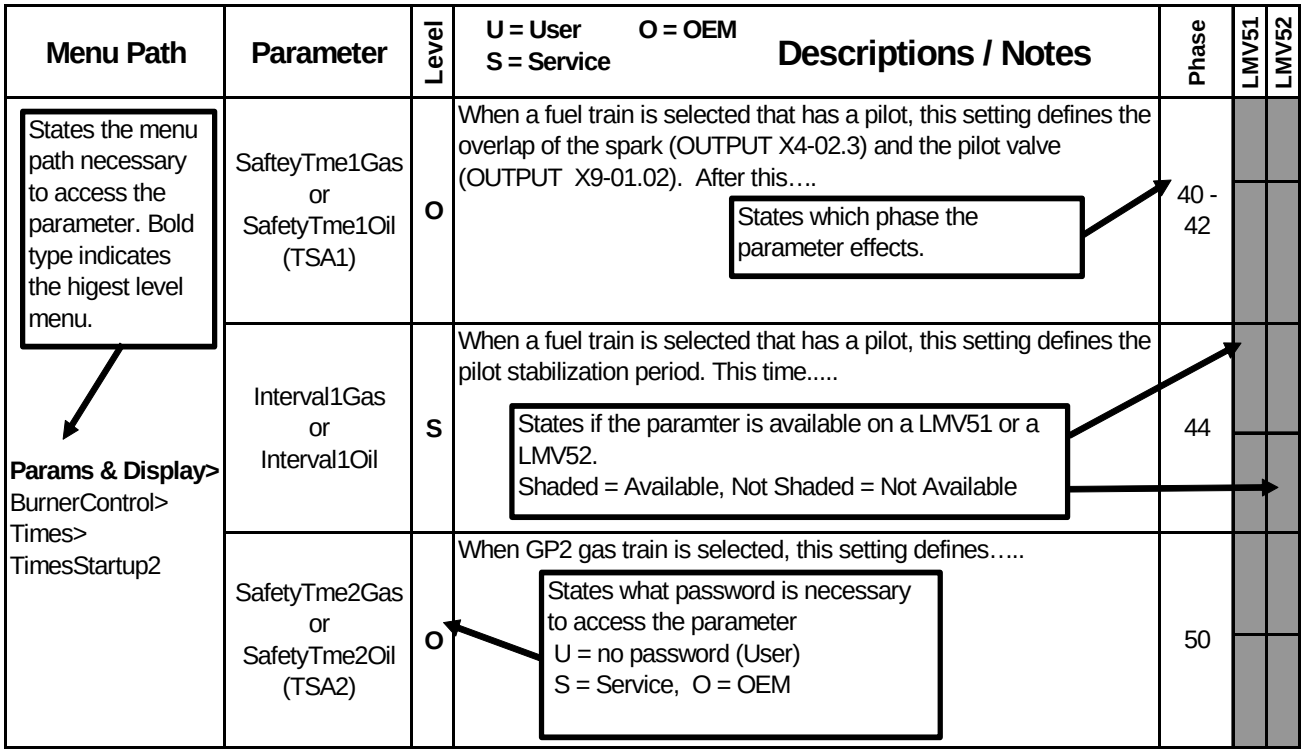
The parameters listed in Figure 4-1.1 outline the basic parameters that are necessary for a LMV51 on a simple burner / boiler.

The LMV51 has many more capabilities than what is listed above, and the LMV52 has many more capabilities than the LMV51.

In order to make its many features user friendly, an LMV5 Parameter worksheet was created.

This worksheet is Section 4-2 and carries all pertinent information concerning the parameters of the LMV5. A sample of the worksheet is explained below:

Figure 4-1.2 LMV5 Parameter worksheet legend



The parameter worksheet should be used the first few times an engineer / technician sets up a LMV5 since it provides the necessary information for each parameter in a concise manner.

Note: Not all gas parameters are available to set when the currently selected fuel is oil, and not all oil parameters are available to set when the currently selected fuel is gas.

BACKUP and RESTORE of entire Parameter Sets

Entire parameter sets can be BACKUP-UP or RESTORED between a PC, the AZL5 and the LMV5. This is particularly useful and timesaving if identical (or similar) burners / boilers are being commissioned. This can be accomplished in two different ways, with an AZL5 or with a PC having the ACS450 software loaded. (Refer to section 9 for ACS450 instructions)

Note: Do not connect an AZL51 to an LMV52 since incompatible memory exists between these two. If attempted, memory can be permanently damaged. An AZL52 can be used on any LMV5, (LMV51, LMV52) with no problems.

The parameter set that the LMV5 uses for operation is stored in the LMV5 itself. When a parameter is changed (via the AZL5 or ACS450), the actual change in memory (parameter set) occurs in the LMV5 and not the AZL5.

The AZL5 also stores a parameter set that may or may not be the same as the parameter set in the LMV5. If a parameter BACKUP (LMV5 >AZL), or a parameter RESTORE (AZL > LMV5) is performed, the parameter sets in the LMV5 and the AZL5 will be identical. Caution: If the LMV5 is reset during a BACKUP or RESTORE, a damaged parameter set will likely occur.

Fault history and lockout history are ONLY stored in the AZL. The passwords are part of the parameter set.

Procedure to use an AZL5 to transfer a parameter set from LMV5(Y) to LMV5(Z)

Overview:	**I. BACKUP**	**AZL5(Y)**	**parameters to**	**LMV5(Y)**
	II. Match *BurnerID*'s on	**LMV5(Y)**	**and**	**LMV5(Z)**
	Attach	**AZL5(Y)**	**to**	**LMV5(Z)**
	III. RESTORE	**LMV5(Y)**	**parameters to**	**LMV5(Z)**
	IV. Return	**AZL5(Y)**	**to**	**LMV5(Y)**
	and	**AZL5(Z)**	**to**	**LMV5(Z)**
	V. Modify	**LMV5(Z)**	***BurnerID***	

I. Match parameters on AZL5(Y) to LMV5(Y)

1) After setting the parameters (by using the AZL5 or ACS450), be sure that the parameter set stored in the AZL5(Y) completely matches the parameter set stored in the LMV5(Y). This can be accomplished in two different ways:

   a. Whenever the ESC key is used to back out of the *Params & Display* menu, and there has been a change in a parameter, the AZL5 will prompt the user with:
   "*Make Parameter Backup? ENTER: yes ESC: no*"
   pressing ENTER synchronizes the AZL5 and LMV5 parameter sets.

   b. The parameter *LMV5x -> AZL5,* (found under *Updating> ParamBackup)* can also be done at anytime so that the parameter set in the LMV5 will be written to the AZL5.
   When this method is used, the following text will be shown:
   "*Parameters being updated Cancel with ESC"*
   "Backup is made"
   WAIT for the next line of text / step. It may take up to 5 minutes!
   "*Parameters have been stored Continue with ESC"*

2) A current parameter set now exists on AZL5(Y).

II. Match *BurnerID*'s on LMV5(Y) and LMV5(Z)

1) On AZL5(Y) go to *Operation>* press Enter, scroll down to *BurnerID*, press Enter again, and record LMV5(Y)'s *BurnerID*. On AZL5(Z) go to *Operation>* press Enter, scroll down to *BurnerID*, press Enter again, and check LMV5(Z)'s *BurnerID*. If it's XXXX, LMV5(Z) is blank. If LMV5(Z) has a BurnerID, it must be changed to exactly match LMV5(Y). Go to Updating>, enter the Service or OEM level password, scroll down to *BurnerID*, press Enter and modify as needed.

III. Restore LMV5(Y) parameters to LMV5(Z)

1) Connect AZL5(Y) to the blank or *BurnerID* matched LMV5(Z).
   Input the Service or OEM password.
   Go to *Updating> Parambackup >,* select *AZL ->LMV5x,* and press Enter.
   The parameter set will be transferred from AZL5(Y) to LMV5(Z).
   The following text will be shown on the AZL5 during the transfer:

   "Parameters being updated Cancel with ESC"
   "Backup Restore is carried out"
   WAIT for the next line of text / step. Do not interrupt! It may take up to 5 minutes!
   "Backup Restore finished Parameter BC : Complete" **Or**
   "Backup Restore finished Parameter BC : Partial"

   Either of the above lines indicates that the parameter set transfer from the AZL5(Y) to the LMV5(Z) was successful and that the process is complete.

   Also, it is normal to get an alarm (!) during this process.

Note: It is VERY IMPORTANT that no interruptions occur when the parameters are transferred between the AZL5 and the LMV5. If an interruption occurs, a damaged parameter set will result. If this happens, backup the AZL5 to the LMV5 again.

IV. Return AZL5(Y) to LMV5(Y) and AZL(Z) to LMV5(Z)

1) After this is done, put the original AZL5(Y) back on the original LMV5(Y).
   Connect the AZL5(Z) to LMV(Z).
   Once again go to *Updating> Parambackup*, but this time select *LMV5x -> AZL*.
   Press Enter, and the parameter set will be written from LMV5(Z) to AZL5(Z).

Note: The AZL5(Z) does not need to be blank. The *BurnerID* in the LMV5 will overwrite it.
An LMV5 will always overwrite the *BurnerID* in the AZL5.
An AZL5 will never overwrite a *BurnerID* in an LMV5 that has a different *BurnerID*.
An AZL5 will write a *BurnerID* to a LMV5 that does not have a *BurnerID*.

V. Modify LMV5(Z) *BurnerID*

1) Change the *BurnerID* of LMV5(Z) to something unique, different from LMV5(Y).
   The *BurnerID* is typically set to the burner or boiler serial number.
   The OEM password is needed to access this.

Note: The *BurnerID* is a safety feature that identifies and matches a parameter set to a burner. It functions as a parameter set's name. Whenever a Restore is attempted, the *BurnerID* is verified in a programmed LMV5. This verification does not happen if the LMV5 is blank.

Setting Fuel Trains

A number of different fuel train options exist for the LMV5. There are several trains for gas and several trains for oil. The following schematics describe the various options available for parameters (FuelTrainGas and FuelTrainOil).

For gas, Pilot GP2 is normally used. For Light Oil, LO w Gasp is normally used.

Diagrams are also provided that outline fuel valve sequence during light off and operation.

Gas Fuel Trains:

Figure 4-1.3 Direct spark Ignition

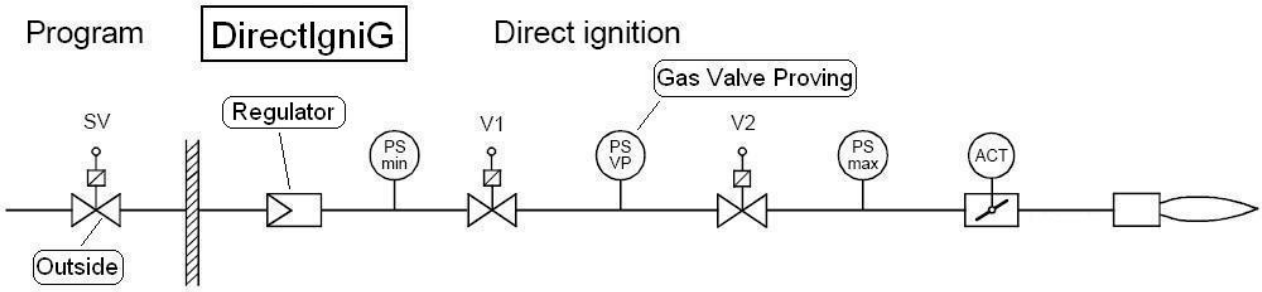


Figure 4-1.4 Pilot ignition (pilot from between main gas valves V1 and V2)

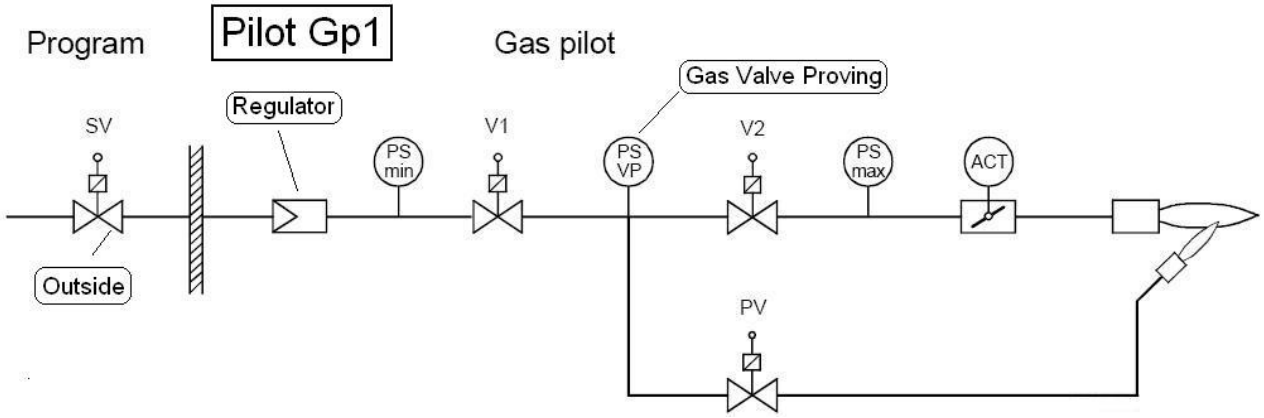
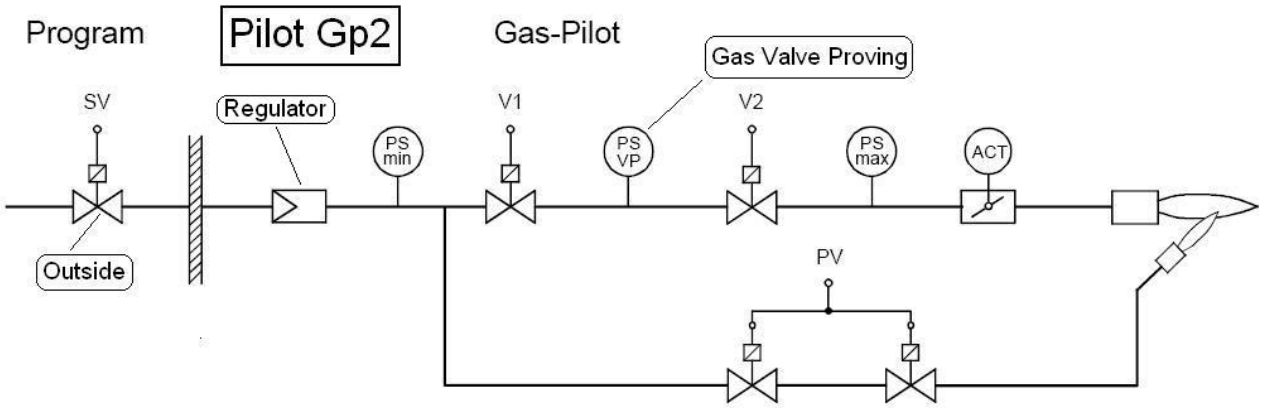


Figure 4-1.5 Pilot ignition (pilot before main gas valves V1 and V2)



Gas Fuel Train Nomenclature:

ACT = Actuator
V1 = Upstream gas valve (main)
V2 = Downstream gas valve (main)
PV = Pilot Valve
SV = Shutoff (Safety) valve
PS = Pressure switch
VP = Valve Proving

Figure 4-1.6 : Gas train sequences (shaded indicates energized)

	Terminal	Description	Drive to Ignition Pos.	Preignition (SPARK) = ON	Pilot Valve = ON	IGN (SPARK)= OFF	Interval 1 (Pilot Stabilization)	**Safety Time 2**	Interval 2 (Main Stabilization)	Drive to Low Fire Pos.
			36	**38**	**40**	**42**	**44**	**50**	**52**	**54**
					SAFETY TIME 1					
DirectIgniG	**X4-02.3**	Ignition		■	■					
	X9-01.4	Gas valve V1 (Main, up stream)			■	■	■	■	■	■
	X9-01.3	Gas valve V2 (Main, dwn. stream)			■	■	■	■	■	■
Pilot Gp1	**X4-02.3**	Ignition		■	■					
	X9-01.1	Gas valve SV (Usually Outdoor)	■	■	■	■	■	■	■	■
	X9-01.2	Gas valve PV (Pilot Valve)			■	■	■	■		
	X9-01.4	Gas valve V1 (Main, up stream)			■	■	■	■	■	■
	X9-01.3	Gas valve V2 (Main, dwn. stream)						■	■	■
Pilot Gp2	**X4-02.3**	Ignition		■	■					
	X9-01.1	Gas valve SV (Usually Outdoor)	■	■	■	■	■	■	■	■
	X9-01.2	Gas valve PV (Pilot Valve)			■	■	■	■		
	X9-01.4	Gas valve V1 (Main, up stream)						■	■	■
	X9-01.3	Gas valve V2 (Main, dwn. stream)						■	■	■

Oil Fuel Trains:

Figure 4-1.7: Direct spark ignition for light oil, single stage or multi-stage (other trains possible)

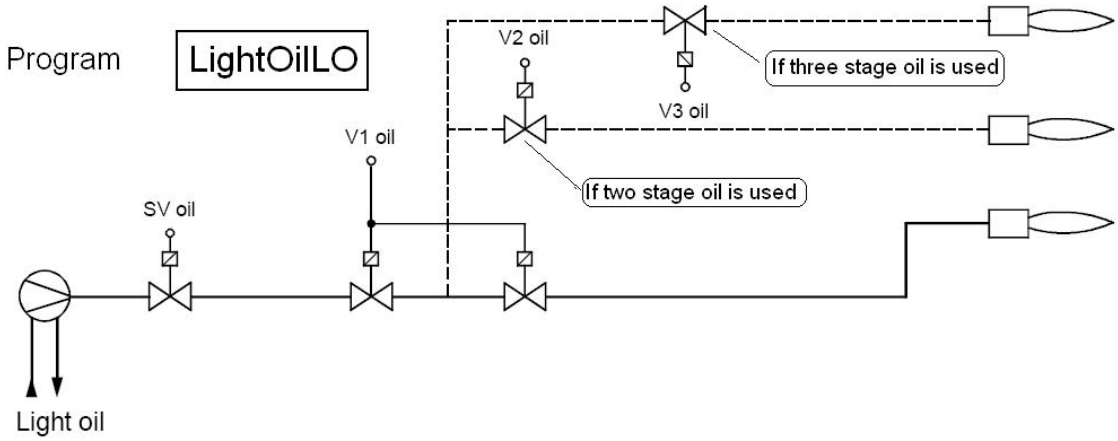


Figure 4-1.8 : Gas pilot ignition for light oil, staged or modulating (other trains possible)

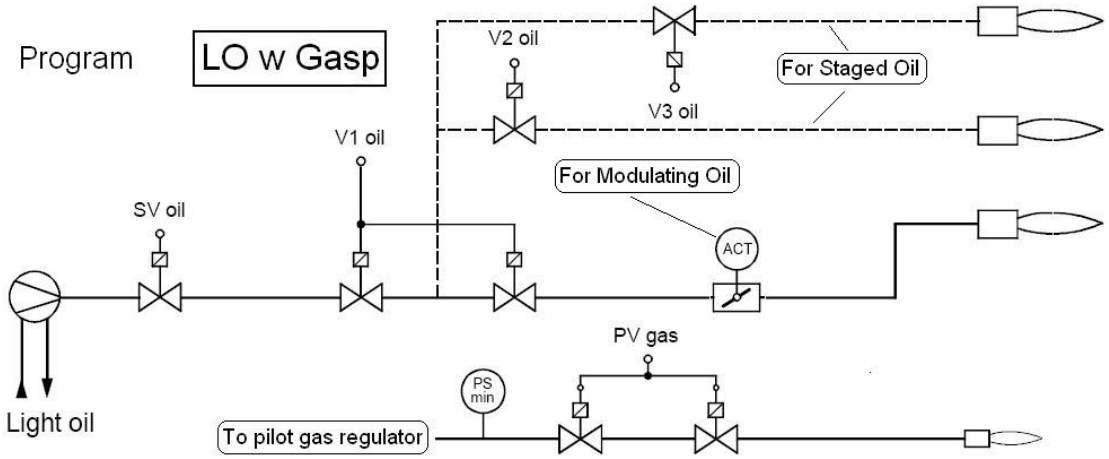
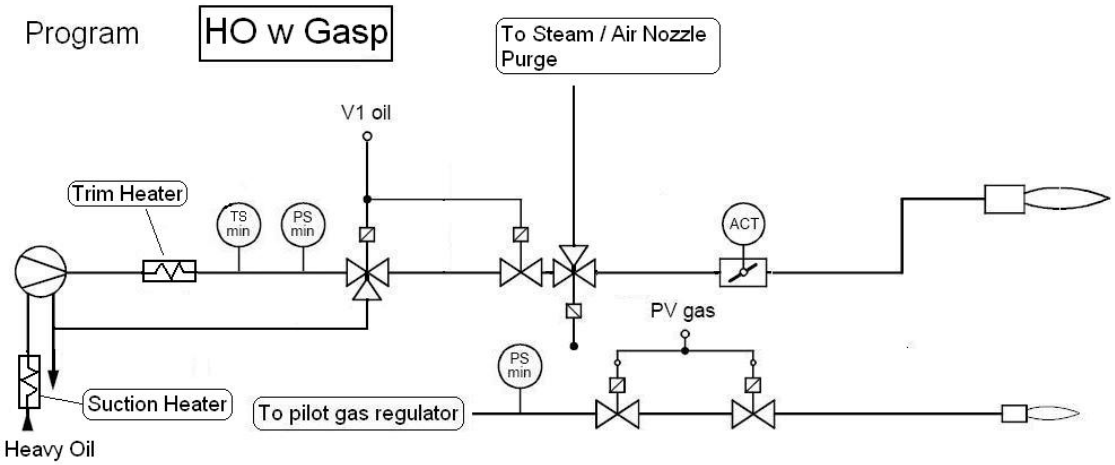


Figure 4-1.9 : Gas pilot ignition for Heavy oil, modulating (other trains possible)



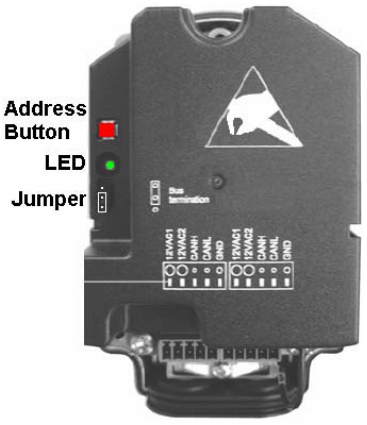
Oil Fuel Train Nomenclature:

ACT = Actuator
V1 = Oil Valves (main)
V2 = Stage 2 oil valve
V3 = Stage 3 oil valve
PV = Pilot Valve
SV = Shutoff (Safety) valve
PS = Pressure switch
TS = Temperature switch

Figure 4-1.10 : Oil train sequences (shaded indicates energized)

	Terminal	Description	Drive to Ignition Pos.	Preignition (SPARK) = ON	Pilot Valve = ON	IGN (SPARK)= OFF	Interval 1	**Safety Time 2**	Interval 2 (Main Stabilization)	Drive to Low Fire Pos.
			36	**38**	**40**	**42**	**44**	**50**	**52**	**54**
					SAFETY TIME 1					
LightOilLO	**X4-02.3**	Ignition								
	X8-02.1	Oil valve V1 (Main)								
	X8-03.1	Oil valve V1 (Main)								
LO w Gasp	**X4-02.3**	Ignition								
	X9-01.1	Gas valve SV (Usually Outdoor)								
	X9-01.2	Gas valve PV (Pilot Valve)								
	X8-02.1	Oil valve V1 (Main)								
	X8-03.1	Oil valve V1 (Main)								
							Safety Time 2 HO ONLY			
HO w Gasp	**X4-02.3**	Ignition								
	X9-01.1	Gas valve SV (Usually Outdoor)								
	X9-01.2	Gas valve PV (Pilot Valve)								
	X8-02.1	Oil valve V1 (Main)								
	X8-03.1	Oil valve V1 (Main)								

Addressing SQM4 Actuators



Before actuators can be operated by the LMV5 they must be addressed and the direction or rotation must be set if it was not previously set.

Depending on direction of rotation and home position set in the LMV5, the actuator may rotate as soon as it is addressed. **For this reason it is highly recommended that the actuator shaft be uncoupled from the valve / damper when the actuator is addressed.**

Addressing is accomplished by going under *Parameters & Display* > *Actuators* > *Addressing* and selecting the actuator to be addressed.

The AZL5 will then prompt the technician to press the red address button on a specific actuator (air, gas, aux1, etc...). The red address button is located under the plastic cover on the back of the actuator. After the red address button is pressed on a specific actuator, the AZL5 should indicate that the address assignment is successful.

The actuator's green LED should also blink a certain number of times after the actuator has been addressed. One blink means air actuator, 2 = Gas or Gas/Oil, 3 = Oil, 4 = Aux1, and so on. This is also outlined in the parameter worksheet (Section 4-2). A solid (non-blinking) LED on the actuator means that the actuator has power, but is not addressed.

Note: Actuator positions are stated in degrees (0 to 90^{o}), and the VSD is stated in percent (0 to 100%)

The addressing of any actuator can be erased (un-addressed) by holding down the red button on that actuator for approximately 8-10 seconds, until a solid, non-blinking green LED occurs. The actuator must be connected to power and CanBus to do this.

If an actuator is not addressed, and has power (12VAC1 and / or 12VAC2 connected) the green LED will remain solid (non-blinking). Only 12 VAC (one wire) is necessary to light the green LED, but 24 VAC is necessary (both wires) to have the actuator operate properly.

If an actuator has been addressed, and has correct power (12VAC1 and 12VAC2), but one of the CanBus wires is disconnected, the LED will not light. The LED my blink for a couple of seconds, but then will go blank if the CanBus wiring is not correct.

Checking Actuator Operation

After the actuators are addressed and the direction of rotation for each actuator is set, the actuator shaft can be coupled to the valve / damper that it will drive.

The direction or rotation for each actuator can be viewed / adjusted under *Parameters & Display* > *Actuators* > *DirectionRot*.

Standard rotation – Clockwise (CW) when the actuator shaft is pointed away from you or Counterclockwise (CCW) rotation when the shaft it pointed directly at you.

Reversed rotation – CCW when the when the actuator shaft is pointed away from you or CW rotation when the shaft is pointed directly at you.

IMPORTANT: Make absolutely certain that when the actuator is at 0 degrees the valve / damper that it is coupled to is in fact closed. The actuator position must be verified by reading the actuator position on the AZL5 display since this reading accounts for the programmed direction of rotation.

Actuator positions can be viewed under:

Params & Display > *Ratio Control* > *Gas (Oil) Settings* > *CurveParams*

Also, on an LMV52 only, by pressing enter key, while in “Normal Operation”

Actuators should be coupled to valve / dampers with robust, near zero lash flexible couplings to avoid binding due to minor shaft misalignment but still retain highly accurate valve / damper positioning.

After the actuators are properly coupled to the valve / damper that they are driving, they should be stroked through their normal range of operation to check for smooth operation.

Actuators with the coupled valve / damper can be stroked through their range of operation under:

Params & Display > *Ratio Control* > *Gas (Oil) Settings* > *CurveParams*

The actuators can be stroked with the burner off. This can be done by entering a point (typically point 1) and moving the actuators up and down individually. When finished verifying the stroke of the actuator, **do not** save the changes to the point.

Note: Check rotation of ALL actuators BEFORE commissioning combustion curves. This includes the oil actuator BEFORE commissioning the combustion curves on gas.

If the direction of rotation is changed for any actuator, ALL combustion curves (both fuels) MUST be deleted.

Setting Special Positions and Burner Light off

After actuators are addressed and coupled, the special positions can be set. These must be set before attempting to light the burner. The special positions are:

1) Home Position – sets the actuator positions when the LMV5 is in standby, Phase 12.
2) Prepurge Position – sets the actuator positions for prepurge, other than fuel actuators.
3) Ignition Position – sets the ignition position for actuators, can be different than low fire.
4) Postpurge Position – sets the postpurge position for all actuators, including fuel actuators.

Angular positions of all activated actuators and % for VSD are adjustable for each special position, except for the fuel actuator at the pre-purge position. The angular position of the fuel actuator remains unchanged from the home position during pre-purge. Please consult the parameter worksheet (section 4-2) for specific information about setting each one of these special positions. The service level password will be necessary to access these special positions.

After the special positions are set, the burner can be lit-off. Please see below for the recommended light off procedure.

The LMV5 can hold the burner in the pilot phase (Interval 1, phase 44) as well as a number of other phases with the "Program Stop" function. See parameter worksheet under *Params & Display > Ratio Control > ProgramStop*

IMPORTANT: Before lighting off a new burner for the first time it is recommended to shut the main gas (oil) manual shutoff valve. Next, set the program stop to Phase 44 so that the pilot can be adjusted and made to burn properly when the LMV5 stops its sequence in Phase 44. The air damper can also be adjusted when the LMV5 is stopped at ignition position in Phase 44.

After the pilot is tuned with the manual gas (oil) valve still shut, it is recommended to change the program stop to Phase 52. The LMV5 will open the automatic main gas (oil) valves and remove the pilot according to the start-up timings that were set. A flame failure should result. This procedure will verify that the main valves open when they should, and that the flame failure is recognized by the LMV5.

After the pilot is tuned and safety checks are done, the manual main gas (oil) valve can be opened and the program stop can be left at Phase 52. This program stop will hold the LMV5 at the ignition position and will enable the main fuel at the ignition position to be tuned the next time the LMV5 is started. Phase 52 program stop can also be used for boil-out if desired.

Note: Once the program stop is deactivated, the LMV5 is released to modulate if a Fuel-Air Ratio Curve is defined. Typically, a fuel air ratio curve is *not* defined by the burner / boiler OEM, and the LMV5 will sit at ignition position until the fuel air ratio curve is set up.

To remove the possibility that the LMV5 will modulate the burner on a fuel air ratio curve that was left in the LMV5, it is highly recommended that the LMV5 is put into manual load control. This is done by placing the LMV5 in "Burner ON" mode under: *Manual Operation> Auto / Manual / Off* and setting the load is set as low as possible under *Manual Operation> SetLoad.* This must be done before the program stop is deactivated in order to stop possible unwanted modulation.

Fuel-Air Ratio Curves (Combustion Curves)

On most new installations, the Fuel-Air ratio curves are not set by the burner OEM, and must be set at start-up. If this is the case, the LMV5 will automatically set Point 1 (low fire) to the ignition position that was previously set. Point 1 can be changed without changing the ignition position if a low fire different from ignition is desired.

The Fuel-Air ratio curves are programmed by defining points for each actuator / VSD across the firing range of the burner. These points (a maximum of 15 from low to high fire) are connected in a "connect the dots" fashion to construct the Fuel-Air ratio curves. The following paragraphs outline a method to define these points.

After selecting *curve params* on gas or *curve params > curve settings* on oil, select 'Point' by pressing Enter. The cursor will move below the word point. Select which point is to be adjusted by pressing the arrow keys. If no points exist, 'XXXX' will appear for the actuator positions.

Press Enter on the point to be adjusted. The AZL5 will prompt to change or delete the point. Press Enter to change the point. The AZL5 will then prompt for *followed* or *not-followed*. If *followed* is selected the actuators will move real-time when the point is adjusted so that the results of the adjustment can be seen on a combustion analyzer.

IMPORTANT: Using *not-followed* is possible but not recommended for most situations since the actuators are not moved in real time, so the results of changing the point cannot be seen real time on a combustion analyzer. When *followed* is selected, a carat ">" is shown when the actuator / VSD *is moving* to the displayed position. A colon ":" is shown when the indicated position is reached.

If the arrow key is pressed over to a point that is not defined yet (XXXX shown for the positions and load), pressing enter will put in values for the positions and load from the last point. The load / positions can then be adjusted for the new point by scrolling up or down with the arrows and pressing enter on the load / position to be adjusted. The cursor will move to the number, and the number can then be adjusted with the arrows, thus changing the position of an actuator / VSD.

Pressing Esc will bring the cursor back to the left, off of the numbers. Pressing escape again, while off the numbers, will bring up a prompt to ask if the point is to be stored (press enter) or the changes canceled (press escape). If store is selected, the LMV5 will take a few seconds to store the point. A bar will rotate on the left hand side of the AZL5 display while the point is being stored.

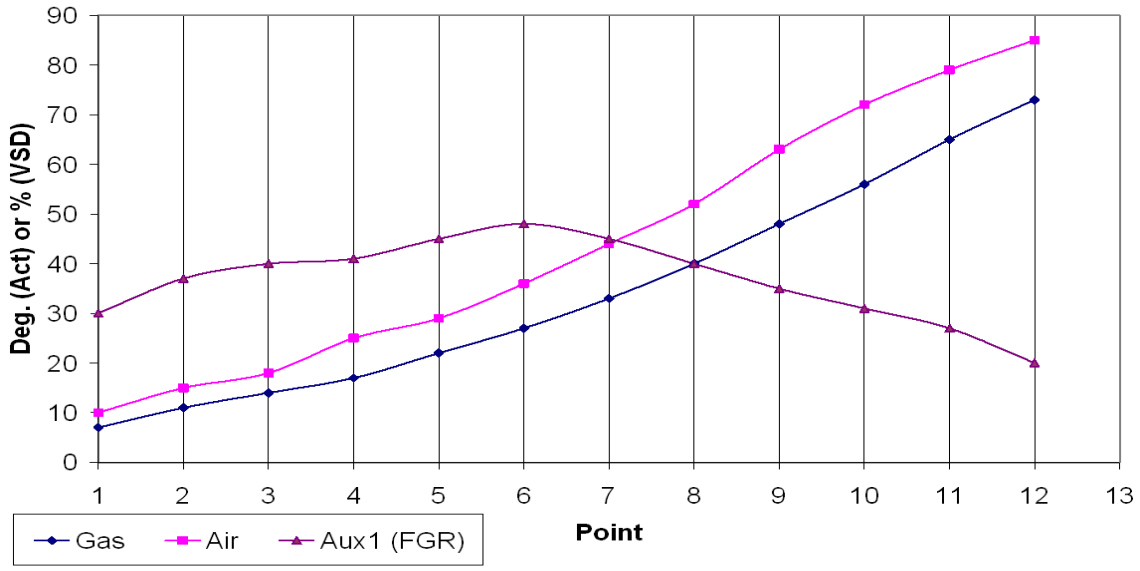
IMPORTANT: While the combustion curves are being set, the technician is solely responsible for maintaining safe combustion conditions for the burner since he / she is in direct control of the individual actuators. If an AZL5 arrow key is held down when adjusting an actuator position, the position will be changed at a progressively faster rate.

Fuel-Air Ratio Curves (Combustion Curves) continued..

The 'Load' is the label used to designate the fuel input (firing rate) of the burner at any point. The 'Load' number should be set based upon a fuel meter. If a fuel meter is unavailable, burner head pressures could be used to approximate fuel flow into the burner. A 10 to 1 turndown burner should have Point 1 set to 10% load, and Point (up to 15) set to 100% load. A spreadsheet is available to automatically calculate the numbers seen below for any given burner.

Figure 4-1.11 Example of Typical Combustion Curves

16 MM Btu/hr Gas Burner, 10 to 1 Turndown, FGR, Gas 1000 BTU /SCFH					
Point	Gas SCFH	Load %	Gas Deg	Air Deg	Aux 1 Deg
1	1600	10	7	10	30
2	2909	18	11	15	37
3	4218	26	14	18	40
4	5527	35	17	25	41
5	6836	43	22	29	45
6	8145	51	27	36	48
7	9455	59	33	44	45
8	10764	67	40	52	40
9	12073	75	48	63	35
10	13382	84	56	72	31
11	14691	92	65	79	27
12	16000	100	73	85	20



After a curve is set up, points can be added and subtracted to any location in the curve. The load that is selected for the additional point determines where it will be inserted. When the point is inserted, it will 'bump' the other point numbers over 1 number. For example if Point 5 is defined as 43% load, and Point 6 is defined as 51% load, and an additional point is added at 48% load, Point 5 will remain 43% load and Point 6 will now be 48% load. Point 7 will be 51 % load.

If points are deleted from an existing curve, the reverse of what was previously explained happens. Although not recommended, a curve could consist of two points. One point at low fire and one point at high fire. The LMV5 would simply draw a line between the two points and that would be the combustion 'curve'.

Typically at least 10 points are defined from low to high fire, and each point is set at optimum combustion. If O2 trim is being used, at least 10 points must be set for proper O2 trim functionality.

Load Controller

The LMV51.140 and LMV52 are equipped with an internal load controller. The load controller's primary purpose is to read a temperature or pressure sensor, compare the pressure or temperature value (known as the Process Variable PV) to the current setpoint, and control the burner load accordingly. Many different types and ranges of sensors can be wired (Section 3-3) and scaled (Section 4-2) to cover most temperature and pressure applications. The load controller also has a Cold Start function so that it can hold the burner at low fire, or slowly step the firing rate until a temperature or pressure is reached that completely releases the burner to modulate.

The load controller can be operated in six different modes, mode 1 having two different variations. Figure 4-1.12 details the different modes of the load controller, and what action is taken when a dry contact is closed between X62.1 and X62.2.

Note: If desired, Terminal X5-03.01 can be deactivated, in effect deactivating the local on/off switch on the burner. This can be done under parameter *InputController.* See Section 4-2.

Figure 4-1.12 Operating modes (LC_OptgMode) of LMV51.140 and LMV52 Load controllers

LC_OptgMode parameter is found under: *Parameters & Display>Load Controller>Configuration*

Mode	Label	Description	Typical Usage	Setpoint	Upon X62.1 - X62.2 Closure
1A	ExtLC X5-03	External Load Control, Floating / Bumping	When using a RWF 40 as the external load controller, or "toggle switch" low fire hold.	N/A	Change to Mode 2, Setpoint W1
1B	ExtLC X5-03	External Load Control, Staged Oil	Externally controlled 2 or 3 stage oil.	N/A	Change to Mode 2, Setpoint W1
2*	IntLC	Internal Load Control, Temp. or Press, sensor connected to LMV5…	Internal Load control with a Local setpoint. (Set through AZL)	W1 / W2	Remains in Mode 2, Change to W2 setpoint.
3	Int LC bus	Internal Load Control, Temp. or Press, sensor connected to LMV5…	Internal Load control with a remote setpoint via ModBUS.	W3	Change to Mode 2, Setpoint W1
4	Int LC X62	Internal Load Control, Temp. or Press, sensor connected to LMV5…	Internal Load control with a remote setpoint via analog input X62	Remote Setpoint	
5*	ExtLC X62	External Load Control, analog signal connected to X62	Remote Modulation control via analog signal	N/A	
6	ExtLC Bus	External Load Control via ModBUS	Remote Modulation control via ModBUS	N/A	

* Bumpless transfer (LMV5 will not cycle off) occurs, from Mode 5 > Mode 2, or Mode 2 > Mode 5.

Cold Start (Thermal Shock Protection)

All LMV5s with a load controller have a built in cold start function.
See **Parameter Worksheet**, *Params & Display>Load Controller>Cold Start* for specific details.

The cold start feature requires that the temperature or pressure of the boiler is measured by a sensor connected to the LMV5, and that load control is being operated in Mode 2, 3 or 4.

For a hot water boiler (temperature based modulation) the same temperature sensor that is used for modulation must be used for the cold start feature. For a steam boiler (pressure based modulation) the pressure sensor used for modulation can also be used for cold start or an additional temperature sensor can be added. Temperature sensors are generally recommended since pressure does not always represent temperature in a steam boiler, especially when a steam boiler is warming up. The paragraphs below will only mention temperature based cold start, but the same ideas also apply to pressure based cold start.

The cold start feature can be set-up to warm the boiler in **4** different ways:

1. **Low - fire hold**
   The LMV5 will be held at low fire until the threshold off temperature is reached,
   and then the LMV5 will be released to modulate.
   This "hold" will re-engage when the temperature falls below the threshold on value.
   ThresholdOn and *ThresholdOff* must be set to the desired temperatures.
   StageLoad must be set to 0.

2. **Temperature based stepping start**
   The LMV5 will be held at low fire until a certain temperature change is detected,
   and then a step up in burner output (load) will be taken.
   This will repeat until the threshold off temperature is reached.
   ThresholdOn and *ThresholdOFF* must be set and *StageLoad* must be set to a value greater than 0, since the step-up in load is determined by this parameter.
   StageSetp_Mod must also be set to determine how much temperature change triggers a step-up in load.
   MaxTmeMod should be set to a high number (30 min) so that it has no effect.

3. **Time based stepping start**
   The LMV5 will be held at low fire until a certain time elapses, and then a step-up in load will be taken. This continues until the ThresholdOFF value is reached.
   As the other two methods, *ThresholdON*, *ThresholdOFF,* and *StageLoad* must be set.
   However, now *StageSetp_Mod* is set to a high number (80%) so that it has no effect and,
   MaxTmeMod is set to determine how much time should elapse before the next load step is triggered.

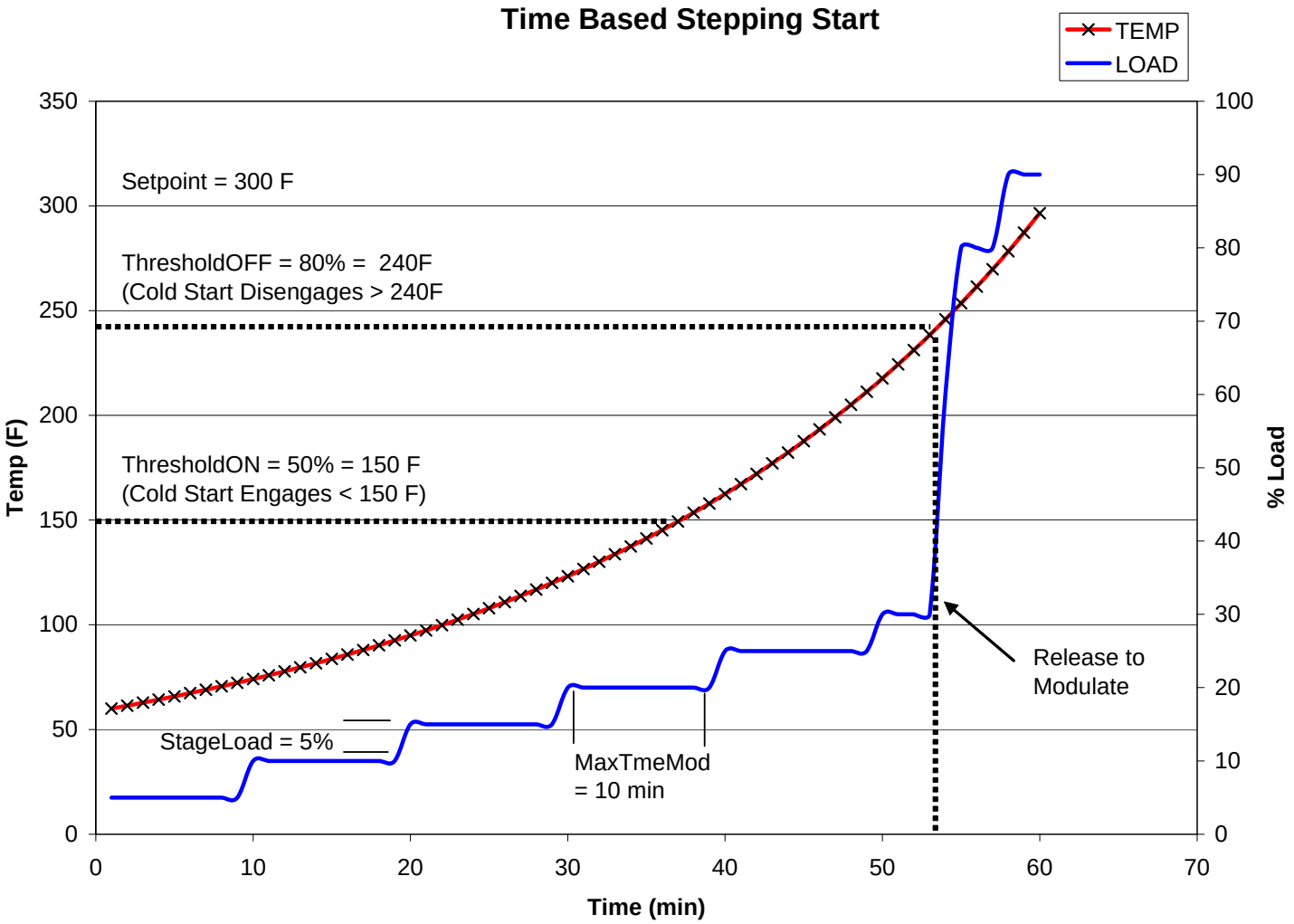
4. **Temperature / Time based stepping start**
   This is similar to method 2, however,
   now *MaxTmeMod* is set to have an effect (10 minutes for example).
   When this is done, the maximum time that a step-up in load will take is 10 minutes, regardless of the temperature change.
   If the temperature change defined by *StageSetp_Mod* happens before the 10 minutes elapses, then the temperature change will trigger the step-up in load.

   When this mode is used, time usually triggers the load steps at the start of boiler warming and temperature change usually triggers the load steps closer to the *ThresholdOff* temperature. This is due to the more rapid rise in boiler temperature at higher firing rates.

Note: Cold Start load step start 0% load, not low fire, Effect> 1st load step takes longer.

Figure 4-1.13 Example of a Time Based Cold Start Set-up

Parameter	%	Value	Notes
Boiler Setpoint or *Setp Add Sensor*	n/a	300° F	Current setpoint
ThresholdON (% of current setpoint)	50	150° F	Measured temperature must go below *ThresholdON* to engage Cold Start.
ThresholdOFF (% of current setpoint)	80	240° F	Cold Start will not disengage until *ThesholdOFF* is met.
StageSetp_Mod (% of current setpoint)	10	30° F	Defines necessary temperature change required to trigger a load step. (not used in graph below)
StageLoad	5	n/a	Determines the size of the load step.
MaxTmeMod	n/a	10 min	Determines max time per load step.



Special Features

In addition to the capabilities mentioned above, the LMV5 also has many special settings that are very useful in some situations. These special settings are detailed in the next section, section 4-2. This section details the special settings (parameters) that are used most frequently. These are:

NumFuelActuators Permits the LMV5 to run dual fuel with a single actuator.

MinTimeStartRel Permits the LMV5 to hold in phase 21 for a specified period of time.
Since the blower is energized in phase 22.
This can be used as a delay to let stack and/or fresh air dampers open.

PressReacTime Allows the LMV5 to disregard the high and low gas / oil pressure switches for a settable time period after the main gas / oil valves open.
This is used with automatic reset pressure switches so that pressure spikes due to the main valves opening will be ignored.
This also allows for a reduced delta between switch setpoints and normal operating pressures.
This time can also be reduced to 0.2 seconds, deactivating the feature.

AfterburnTme Permits the LMV5 to ignore a flame signal for a settable period of time after the main fuel valves close.
This setting is useful for oil nozzles that are purged with steam or air after the main fuel valves close.

NormDirectStart Permits the LMV5 to go from post-purge directly into prepurge without turning the blower off.
The blower air pressure switch is checked by using a 3-way solenoid valve.

StartReleaseGas On a LMV52, configures terminal X7-03.02 as a start release for gas, CPI gas (closed position indication) CPI oil, or CPI gas + CPI oil.

PS-VP/CPI On a LMV51/52, configures terminal X9-03.02. For a LMV51, options are PS-VP (Pressure Switch Valve Proving) or CPI gas.
Options for a LMV52 are PS-VP, CPI gas, CPI oil, or CPI gas + CPI oil.

ValveProvingType Enables gas valve proving on start-up or shutdown or both.
This type of testing ensures that the gas valves are closed, and that the valve's seats are in good condition.

ProgramStop Stops the LMV5 at a particular phase in the start-up or shutdown sequence.
This is particularly useful when set to phase 44 for tuning the pilot.

FGR-Mode On an LMV52, enables only the Aux 3 actuator to be held from modulating until a certain temperature or time after light off is met.
This is usually used to delay the use of FGR until a time or until a stack temperature is met.

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Catagory Index

Parameter Index

Note: The Parameters **shown in bold type** must be set in an unprogrammed LMV5. See section 4, table 4-1.1

typ -(Typical) Parameter occurs on pages: 34,51,52,54,55*

Menu Path	Parameter	Level	U = User O = OEM S = Service — Descriptions / Notes	Phase	LMV51	LMV52
Operational Stat	NormalOperation	U	In standby: Setpoint Act(ual) Value Fuel and status will be displayed. In run: pertinent information will be displayed. Faults and warnings will always appear on the AZL.	All		
	Status/Reset		Shows the current fault if there is one, or displays 'No Fault' if there is not. If a fault is present, it can be reset by pressing **Esc,** then **Enter**.			
	FaultHistory		Shows the History of the last 21 Fault messages with: Class, Fuel, (fault) code, Phase, Diag(nostic), Lo(a)d and Start No.			
	LockoutHistory		Shows the History of the last 9 Lockouts with: Date, Time of day, C:(class), D:(diagnostic code), P:(phase), Start No., Load, and fuel.			
	Alarm act/deact		Activates or deactivates OUTPUT X3-01.2 in the event of a fault or lockout. OUTPUT X3-01.2 automatically becomes re-activated if : a subsequent fault occurs, the system is reset or restarted. If the parameter AlarmStartPrev(ention) is activated, a start prevention will still occur even though the OUTPUT X3-01.2 is deactivated. Def / Typ = activated			
Operation> Boiler Setpoint	SetpointW1 SetpointW2		The LMV has 2 internal setpoints. **SetpointW1 is the normal** internal setpoint. **SetpointW2 is an alternate** internal setpoint. Changeover can be done with an external potential-free contact between OUTPUT X62.1 and INPUT X62.2. Contact open enables W1, contact closed enables W2. For this function, the LMV must have its load controller set to IntLC X62. Temp max = TL_Thresh_Off, Press max = MRange PressSens			
Operation> UserMaxload	UserMaxLoadMod		Used to limit the maximum load (firing rate) without a password. For modulating burners. Range 0 to 100%, Def / Typ = 100%	60		
	UserMaxLoadStg		Used to limit the maximum load (firing rate) without a password. For staged burners. Range S1 - S3, Default S3			
Operation> Fuel	CurrentFuel		Displays the current fuel selected. (Gas or Oil)	All		
	FuelSelect		If INPUT X4-01.1 and INPUT X4-01.2 are not powered, fuel selection is 'Internal' and can be set here or via ModBus. If INPUT terminal X4-01.1 is powered Gas is selected. If terminal INPUT terminal X4-01.2 is powered Oil is selected. If both terminals above are powered at the same time a fault occurs.			
Operation> Date/TimeOf Day> Display Clock	Date		Displays the Date.			
	TimeOfDay		Display the current time			
	Weekday		Displays the day of the week.			
Operation> Date/TimeOf Day> Set Clock	Date		Set the Date, 2 formats are offered MM-DD-YY (optional) DD.MM.YY (default) Select format at: *Params & Display>AZL>DateFormat*			
	TimeOfDay		Set the Time Of Day. 24 hour format : HH:MM			
	Weekday		Set the Weekday.			

Menu Path	Parameter	Level	U = User O = OEM S = Service — Descriptions / Notes	Phase	LMV51	LMV52
Operation> Hours Run	GasFiring	U	Hours run on gas. Reset / adjust: *Params & Display > HoursRun > GasFiring*	All		
	OilStage1/Mod		Hours run on OilStage1/Mod. Reset / adjust: *Params & Display > HoursRun > OilStag1/Mod*			
	OilStage2		Hours run on OilStage2. Reset / adjust at: *Params & Display > HoursRun > OilStage2*			
	OilStage3		Hours run on OilStage3. Reset/ adjust at: *Params & Display > HoursRun > OilStage3*			
	TotalHoursReset		Hours run, all fuels. Reset / adjust: *Params&Display > HoursRun > Reset >Total Hours Reset*			
	TotalHours		Displays the number of hours run on all fuels. Cannot be reset or adjusted.			
	SystemOnPower		Hours the system has been powered. Cannot be reset or adjusted.			
Operation> Start Counter	GasStartCount		Number of startups on gas. Reset / adjust: *Params & Display > StartCounter > GasStartCount*			
	OilStartCount		Number of startups on oil. Reset / adjust: *Params & Display > StartCounter > OilStartCount*			
	TotalStartCountR		Displays the number of Startups on all fuels. Reset / adjust at: *Params & Display > StartCounter > TotalHourR*			
	TotalStartCount		Displays the number of Startups on all fuels. Cannot be reset.			
Operation> Fuel Meter	Curr Flow Rate		Displays the current flow rate of fuel, Gas or Oil.			
	Volume Gas		Displays the total Volume of Gas that has entered the burner as calculated by the VSD module. Reset / adjust: *Params & Display > StartCounter > Volume Gas*			
	Volume Oil		Total Volume of Oil that has entered the burner as calculated by the VSD module. Reset / adjust: *Params & Display > StartCounter > Volume Oil*			
	Volume Gas R Volume Oil R		Displays the Volume of Gas or Oil that has entered the burner since the last reset. Pressing ENTER will cause these values to be reset.			
	Reset DateGas		Displays the Date when the Volume of Gas was last Reset. Cannot be changed.			
	Reset DateOil		Displays the Date when the Volume of Oil was last Reset. Cannot be changed.			
Operation	LockoutCounter		Displays the total number of Lockouts that have occurred.			
Operation> O2 Module	Current O2 Value		Current O2 Sensor Reading (Wet basis)			
	O2 Setpoint		O2 target value for the current load can be viewed here.			
	SupplyAirTemp		Combustion air temperature if equipped with the proper sensors. PLL Module necessary.			
	FlueGasTemp		Flue gas temperature if equipped with the proper sensors. PLL Module necessary.			
	CombEfficiency		A calculated value of the Combustion Efficiency based on the wet O2 value. Supply air temperature a O2 sensor and a flue gas temperature sensor are required for this feature.			
Operation	BurnerID		Burner Identification. (Mandatory) Adjust at: *Updating > BurnerID* (requires OEM password)			
Operation> OptgMode Select	InterfacePC		This places the AZL into the Interface mode making it able to communicate with a PC.			
	GatewayBASon		This enables or disables Com 2, the RJ45 jack on the back of the AZL, for ModBus or eBUS communication. This port uses RS-232 communications.			
	GatewayBASoff					
	Type of Gateway		This parameter configures the protocol of Com 2. Options are ModBus or eBUS			

Menu Path	Parameter	Level	U = User O = OEM S = Service — Descriptions / Notes	Phase	LMV51	LMV52
Operation	O2Ctrl activate	U	Activates the O2 Ctrl (Control). LMV52 & PLL52 (O2 trim module) required. If control automatically deactivates, reactivate here. Def = deactivated Typ = activated.	60-62		
Manual Operation	SetLoad		During manual operation, firing rate can be set between the min and max allowed by: *Params & Display > RatioControl > Gas/OilSettings > LoadLimits > Min/MaxLoadGas/Oil*			
	Autom/Manual/Off		**1) Automatic -** Enable the burner allowing it to respond to setpoints. **2) Burner off** - Manually turn the burner off, setpoints are ignored. **3) Burner on** - Manually turn the burner on **all setpoints are ignored**. For normal operation this should be placed in automatic. If terminal X5-03.01 is enabled (ON /OFF switch), this will override the (Burner on) setting. Version B and later.			
Params & Display> BurnerControl> Times> Times Startup1	MinTmeStartRel	O	When the LMV gets a call for heat, (phase 12), this defines the **minimum time the LMV will hold (in phase 21)** Start releases could be made, but the LMV will still hold for this period of time. Typical start release devices: outside air damper, low gas press, stack damper limit switch, ect... Start releases with their associated line voltage INPUT teminals are: LMV5x terminal X6-01.1 can be used for start realease oil (atomizing media press. switch) LMV52 terminal X7-03.2 can be used for start release gas as well as other functions. LMV51 terminal X7-03.2 has no function. LMV52 terminal X9-03.4 is used for the low gas pressue switch only. LMV51 terminal X9-03.4 can be used for the low gas pressure switch and also Start Release Gas - switches must be wired in series. Range = 0.2 - 63 sec, Def / Typ = 1 sec Also see: *Params & Display > Burner Control > Times > Times General MaxTmeStartRel*	21		
	FanRunupTme	S	Time allowed to let the fan get up to speed before the actuators start driving to prepurge. Only used for *non-continuous* fan applications. Time depends on inertia of fan wheel. Range = 0.2 to 63 sec, Def /Typ = 2 sec. *See Params & Display > Burner Control > Times > Config Genera > Continuous Purge*	22		
	PrepurgeTmeGas or PrepurgeTmeOil		Time begins when the air actuator has reached it's specified purge position. Setting cannot be set less than MinT_PrepurgeGas (Oil) below. Set for 5-10 air exchanges of combustion chamber volume. Range = longer than MinT PrepurgeGas (Oil) to 63 min. Def = 20 sec Gas, 15 sec oil. Typ = 60 sec.	30		
	MinT_PrepurgeGas or MinT_PrepurgeOil	O	Sets a minimum allowable time for PrepurgeTmeGas (Oil) above. This parameter should be set by the OEM for 5-10 air exchanges of combustion chamber volume. Range = 0.2 to 63min Def = 20 sec Typ = By OEM			
	PrepurgeSafeGas or PrepurgeSafeOil		After a safety related shutdown of the LMV, instead of the normal *PrepurgeTmeGas (Oil),* this prepurge time is used for the next LMV start-up. Range = longer than MinT_PrepurgeGas (Oil) to 63min Def = 20 sec Typ = By OEM			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> BurnerControl> Times> Times Startup1	PrepurgePt1Gas or PrepurgePt1Oil	S	If a Aux3 actuator is used, this defines the purge time that the air actuator or VSD is at purge position and the Aux3 actuator is at home (closed) position. If a Aux3 actuator is not used, this setting has no effect. Range = 0.2 to 630 sec Def = 0.2 sec Typ = 0.2 sec	30		
	PrepurgePt3Gas or PrepurgePt3Oil		If a Aux3 actuator is used, this defines the purge time that the air actuator or VSD is at purge position and the Aux3 actuator is at purge (open) position. If a Aux3 actuator is not used, this setting has no effect. Range = 0.2 to 630 sec Def / Typ = 0.2 sec	34		
	PreIgnitionTGas or PreIgnitionTOil		This defines the time the ignition transformer (OUTPUT X4-02.03) is energized before the pilot valve (OUTPUT X9-01.02) or main valves (for direct spark fuel trains) become energized. Range = 0.2 to 63sec Def / Typ = 2sec	38		
	MinOnTmeOilPump		When LO w Gasp (Light Oil with Gas pilot) is selected, this is the minimum time the oil pump can run (OUTPUT terminal X6-02.3) before the LMV attempts to light the pilot, (OUTPUT terminal X9-01.2). Time starts when air actuator reaches the pre-ignition position, phase 22, and will hold in phase 36 until this parameter times out (if the time setting is sufficiently long). Range = 0 to 63 sec Def / Typ =1 sec	22 - 36		
Params & Display> BurnerControl> Times> TimesStartup2	SafteyTme1Gas or SafetyTme1Oil (TSA1)	O	When a fuel train is selected that has a pilot, this setting defines the overlap of the spark (OUTPUT X4-02.3) and the pilot valve (OUTPUT X9-01.02). After this time expires, spark is de-energized but the PV remains open if a flame is present. If a flame is not sensed, a lockout occurs. Can be thought of as the first half of PTFI. (Pilot Trial For Ignition) Shorter times are more safe. Range = 0.2 to 10 sec, 15 sec for oil Def = 3 sec Typ = 5 sec	40 - 42		
	Interval1Gas or Interval1Oil	S	When a fuel train is selected that has a pilot, this setting defines the pilot stabilization period. This time begins after SafteyTme1Gas (Oil) expires. During this period, only the pilot valve is open. The spark is de-energized. Can be thought of as the second half of PTFI. Range = 0.2 to 63 sec. Def = 2 sec. Typ = 5 sec.	44		
	SafetyTme2Gas or SafetyTme2Oil (TSA2)	O	When GP2 gas train is selected, this setting defines the overlap of the PV (pilot OUTPUT X9-01.02) and the main gas valves, V1 & V2, (OUTPUT X9.01.04 and X9.01.03 respectfully) After this time expires the PV is de-energized, if continuous pilot is not selected. Can be thought of as the first half of MTFI. When LO w Gasp oil train is selected, this setting defines the overlap of the PV energized (pilot) and the main oil valves, V1 & V1, (OUTPUT terminals X8.02.01 and X8.03.01) After this time expires, the PV is de-energized, if continuous pilot is not selected. **Most critical safety time** other than prepurge. Shorter times are more safe. Range = 0.2 to 10 sec, 15 sec for oil Def = 3 sec Typ = 5 sec	50		

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> BurnerControl> Times> TimesStartup2	Interval2Gas or Interval2Oil	**S**	Defines the main flame stabilization period before modulation. This time begins after SafteyTme2Gas(Oil) expires. During this period, only the main fuel valves are open. The PV (Pilot valve) is de-energized, (unless continuous pilot is selected). Can be thought of as the second half of MTFI. (Main flame Trial For Ignition) Range = 0.2 to 630 sec. Def = 2 sec. Typ = 5 sec.	52		
	PressReacTme	**O**	Reflects the time that the LMV will "ignore" the high and low gas pressure switches after the main gas valves open. This is done so that normal pressure peaks and valleys caused by the valve opening do not cause erroneous alarms on a properly adjusted high or low gas pressure switches. Does not work with manual reset switches. (switch stays tripped) Range = 0.2 to 10 sec Def / Typ =2 sec	50		
Params & Display> BurnerControl> Times> Times Shutdown	MaxTmeLowFire	**S**	Outlines the allowable time to let the LMV modulate to low fire when there is no longer a call for heat. This is done so that the main gas valves will not close at mid to high fire, and create pressure spikes upstream in the gas piping. Does not effect fuel valve closing in the event of a safety related shutdown. Usually set for full modulation time of burner, (parameter OperatrampMod) Note: A setting of 0.2 seconds deactivates the feature. Range = 0.2 to 630 sec. Def / Typ = 35 sec	62		
	AfterburnTme		Defines the permissible time for a flame to be detected after the main fuel valves are closed without causing a startblock or alarm. This is especially useful for air postpurged oil nozzles. Range = 0.2 to 63 sec Def / Typ = 8 sec	70		
	PostpurgeT1Gas or PostpurgeT1Oil		Defines the mandatory postpurge period. Even if the direct start option is selected and a call for heat exists, the LMV will only go into prepurge after this period times out. Range = 0.2 to 63 min Def = 0.2 sec Typ = 15 sec	74		
	PostpurgeT3Gas or PostpurgeT3Oil		Defines an optional postpurge period. If the direct start option is selected and a call for heat exists, the LMV will go directly into prepurge after PostpurgeT1Gas (Oil). Range = 0.2 to 63 min. Def = 5 sec. Typ = 0.2 sec.	78		
	MinTmeHomeRun	**O**	Defines the minimum amount of time that the actuators must remain at rest, in their specified home positions. (Phase 10) Range = 0.2 to 63 sec Def / Typ = 1 sec.	10		
	DelayLackGas		If there is a lack of gas pressure (low gas pressure switch open) then the LMV will wait this period of time before attempting to relight, provided that the repetition Counter (RepetitCounter) for gas is set for more than one (not done in the US). This time period will double after the first relight attempt. This doubling would occur if the RepetitCounter were set to 3 or greater. Range = MinTmeHomeRun to 63sec Def / Typ = 10 sec	21		

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> BurnerControl> Times> TimesGeneral	AlarmDelay	S	If a condition exists that does not open the safety loop but does prevent the LMV from starting when there is a call for heat, this specifies the period of time that can elapse with this condition before the alarm is energized. If AlarmStartPrev (alarm in the case of start prevention) is disabled, setting this time has no effect. Range = 0.4 to 630 sec. Def / Typ = 1 sec. See Section 5 under "Other common errors"	12 - 20		
	DelayStartPrev		Delay Start Prevention: Period of time before a start prevention is displayed on the AZL. When there is a call for heat, and a start prevention occurs that does not open the safety loop but does prevent the LMV from starting, this specifies the period of time that can elapse before the condition is displayed on the AZL. Range = 0.4 to 630 sec. Def = 35 sec. Typ = 1 sec.See Section 5 under "Other common errors"	12 - 20		
	PostpurgeLockout	**S**	If a lockout condition occurs, and the combustion air fan was running (OUTPUT terminal X3-01.01) it will continue running in the lockout phase (Phase 00) for this period of time. **This time replaces the postpurge time in the event of a lockout.** If the combustion air fan was not running the fan will remain off for the rest of the lockout phase. Range = 0.2 to 63min Def / Typ = 2 min	00		
	MaxTmeStartRel	**O**	When the LMV gets a call for heat, this is the maximum time the LMV will hold (in phase 21) waiting for a start release to make. If this time expires and the start release is not made, the LMV will go into alarm. Range = 0.2 to 63 sec, Def = 120 sec, Typ = 30 sec. See: *Params & Display > Burner Control > Times >Times Startup1 > MinTmeStartRel*	21		
Params & Display> BurnerControl> Configuration> ConfigGeneral	AlarmStartPrev	**S**	Alarm Start Prevention - Determines if the alarm (Terminal X3-01.02) will be energized in the event of a start prevention. DelayStartPrev defines how long the LMV will wait before alarming. Def = deactivated, Typ = activated.	20-22		
	ShutdwnStbyOnErr	**O**	If this is set to activated, an alarm will occur if the safety loop is opened in Phase 12 (Standby) if deactivated, the safety loop can be open when the LMV is in Phase 12. Def / Typ = deactivated	12		
	NormDirectStart	**S**	Determines if the LMV can eliminate the optional postpurge (T3) time, and go directly into prepurge if there is a call for heat during postpurge. If set to DirectStart, a 3-way valve (on OUTPUT X4-03.03) must be used to check the fan air switch. Def / Typ = NormalStart	78		
	OilPumpCoupling	**S**	Combined with IgnOilPumpStart determines the behavior of the oil pump motor starter (OUTPUT X6-02.03) during oil firing. Magnetcoupl - the output will energize, in either phase 22 or 38, depending on the setting of IgnOilPumpStart. De-energizes as soon as V1 & V1 are closed (in a cycle off situation). Directcoupl - the output will energize at the same time as the fan, and de-energizes 15 seconds after the fan is deenergized. Def / Typ = Magnetcoupl	22-38, 62		
	IgnOilPumpStart	**O**	When Magnetcoupl is selected, this setting determines when terminal X6-02.03 is energized. Def = on in Ph22, Typ = on in Ph38, Note: If a direct spark oil train is selected, spark will occur during prepurge if set to Ph22.	22-38		

Menu Path	Parameter	Level	U = User O = OEM S = Service — Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> BurnerControl> Configuration> ConfigGeneral	ForcedIntermit	**S**	When activated, this setting forces the LMV to shut the burner down, every 23 Hours 50 minutes. The burner will automatically restart. The purpose of this is to check and cycle safety devices. Also, if a QRB flame scanner is used, this setting must be activated. Def = activated, Typ = deactivated	60-62		
	Skip Prepurge Gas		If activated, prepurge for gas will be skipped. Def / Typ = deactivated	30		
	Skip Prepurge Oil	**O**	If activated, prepurge for oil will be skipped. Def / Typ = deactivated			
	ContinuousPurge	**S**	When activated, purges continuously (runs the fan) in all phases. Typically used to prevent return heat from coming back into the burner, in multiple burner applications. A 3-way valve OUTPUT terminal X4-03.3 must be used to check the fan air switch function. Def / Typ = deactivated	00-21		
	FuelTrainGas or FuelTrainOil		Selects the fuel train (s) Default is "invalid", which means not assigned or configured. For North America; Gas Trains are usually set to GP2, which is gas with gas pilot ignition. Oil Trains are usually set to LO w Gasp, (Light Oil with Gas pilot ignition). See Section 4-1 for schematics.	38-50		
Params & Display> BurnerControl> Configuration> ConfigGeneral> FuelTrainReset	FuelTrainGas or FuelTrainOil		Resets the fuel train to a value of "invalid" (means not configured). This allows removal a fuel train previously configured, if it is not longer used, or to allow a different fuel train to be selected.	All		
Params & Display> BurnerControl> Configuration> ConfigGeneral	ContPilotGas or ContPilotOil	**O**	Activates or deactivates a continuous pilot. Each fuel can be configured separately. Def / Typ = deactivated	60-62		
	MainsFrequency		Set to the local power frequency. Def / Typ = 60 Hz (North America)	All		
Params & Display> BurnerControl> Configuration> ConfigIn/Output	StartReleaseGas		INPUT X7-03.02 has multiple functions, depending upon how this parameter is set. It could be used as a start release for gas that is expected to be made in Phase 21-62. This input can also be programmed as CPI (proof of closure) for gas, oil, gas plus oil, or the input can be deactivated. **Usually configured for CPI (proof of closure) on oil valves**. Def = StartRelGas, Typ = CPI Oil **NOTE : This terminal has no function on a LMV51.**	21-62		
	StartReleaseOil		When firing oil, this INPUT X6-01.01 is used to release the LMV5x to start. It is required to be energized in Phase 21, and if it de-energizes at any time after, it will cause a lockout. This is usually wired to a atomizing media pressure switch. A temperature switch may also be placed here for heavy oil. Can be deactivated. Def / Typ = Activated	20-21		

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> BurnerControl> Configuration> ConfigIn/Output	AirPressureTest	O	Enables or disables INPUT X3-02.01, the air pressure switch (fan air switch), during any phase that the fan is running. Enable for forced or induced draft burners. Def / Typ = Activated	22-78		
	PS-VP/CPI		INPUT X9-03.02 has multiple functions, depending upon how this parameter is set. **An LMV51** options are CPI (proof of closure for gas), or PS-VP, (Pressure Switch for gas Valve Proving). Default : PS-VP Oil proof of closure switches are not intended to be wired to this terminal on a LMV51. **An LMV52** options are PS-VP, CPI oil, CPI gas, or CPI gas and oil. Typically configured for **CPI gas** (proof of closure on gas valves). Def = PS-VP Set at: *Params & Display > BurnerControl > ValveProving > Config_PM-VP/ CPI*	52-70 80-83		
	FGR-PS/FCC		Enables or disables INPUT X4-01.03, checking the status of fan motor starter, or a flue gas recirculation pressure switch. (checked on both gas and oil firing) Phase affected is any phase when the fan is running. Range: FGR-PS, FCC, deactivated Usually set to monitor auxiliary fan motor starter contacts (FCC) Def = FCC	22 - 24		
	InputController		This can be used with the internal load controller as a overall enable / disable, even if the internal load controller is calling for heat. In other words, the ON /OFF switch. **Activated**, the LMV **requires power** on INPUT terminal X5-03.01 to begin its operating sequence. A traditional "string" of switches, including the on /off switch could be wired in between line voltage to X5.03.01, and the LMV would begin when these switches are made. Activate if the burner has a hard wired on / off switch. **Deactivated**, the LMV **does not need require power** on INPUT terminal X5-03.01 to begin its sequence. This may be done if the burner is controlled via ModBus. Def / Typ = Activated	12 - 20		
	GasPressureMin		Determines the function of INPUT terminal X9-03.04. In **Activated** mode, a signal is expected on this terminal when firing gas, or when using any oil train that requires a pilot. Thus, when in Activated mode, with a piloted oil train, this terminal can be used for a general start release, like a fresh air damper. **Deact x OGP** mode, a signal is expected only when firing gas, so a start release specific to gas can be wired in series with the low gas pressure switch. Can also be deactivated. Def = Activated ***Deact x OGP*** is only offered on the LMV52.	12-20		
	GasPressureMax		Activates or deactivates (INPUT X9-03.03) for a high gas pressure switch. Most gas fired installations require high a gas pressure switch. Def = Activated			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> BurnerControl> Configuration> ConfigIn/Output	OilPressureMin	O	Activates or deactivates (INPUT X5-01.02) for a low oil pressure switch. If this is set to (act from ts) the LMV will look for this switch to be made in phase 40. When set to (activated), the LMV will look for the switch to be made in phase 38. Def = Activated	38 - 62		
	OilPressureMax		Activates or deactivates INPUT X5-02.02 as a input for the high oil pressure switch. Def = Activated, Typ = Deactivated	22-62		
	HeavyOilDirStart		This activates or deactivates INPUT X6-01.03 for a Heavy Oil Stage release contact. If this terminal has power, it releases the LMV for stage 2 heavy oil. Not intended for running interlocks, such as oil temperature. Def = activated, however this setting has no effect unless HOgp (Heavy Oil with a gas pilot) fuel train is configured.	38		
	Start/PS-Valve	S	Setting controls the behavior of OUTPUT terminal X4-03.03. Def / Typ = **StartSignal** **StartSignal** mode, X4-03.03 energizes in phase 21 with the fan, as would be suited to open an outside air damper or stack damper. Note: If **ContinuousPurge** is activated, this terminal will be energized as long as the fan in running. **PS Relief** mode, this output energizes a 3-way valve, used to check the fan air press switch. The valve is energized, venting the air press switch to atmosphere during Phase 79. **PS Relief_inv** mode, this output energizes a 3-way valve, used to check the fan air press switch. The valve is energized, exposing the air press switch to fan pressure in every phase <u>except</u> Phase 79.	21 - 30 or 79		
Params & Display> BurnerControl> Configuration> Config FlameDet	ReacExtranLight	O	Setting determines what action the LMV should take in the event of a unexpected flame signal. The LMV does not expect to "see" a flame when the pilot valve, and the main fuel valves are closed. The LMV will also ignore a flame signal for the afterburn time. If a flame is seen other than at these times, provided that the extraneous light test is activated then either a startblock or a lockout will occur, depending upon this setting. Def / Typ= Startblock	70		
	ExtranLightTest		Activates or deactivates the extraneous light check during the start sequence and during standby. **NOTE : This setting is intended to be used with applications such as waste incinerators. DO NOT deactivate for boiler burners.** Def = Activated	All		

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> BurnerControl> Configuration> Config FlameDet> FlameSignal	Standardize	O	Sets a datum for a "normal" flame, so that a "normal" flame can be displayed as 100% flame signal on the OperationalStat screen. If a 82.3% flame is present and the flame standarization is performed, what was displayed as 82.3% is now displayed as 100% It does not actually affect when, the LMV will lockout due to a poor flame signal. This re-datum operation should be performed when a stable, normal flame exists at the burner. Normally this value does not need to be adjusted.	40-70		
	StandardFactor		Can be viewed to see what raw flame signal will result in 100% flame, being displayed on the 'OperationalStat' screen. If the flame signal is not stanandardized, XXXX % will be displayed indicating that the raw signal is the displayed signal. The LMV will lock out on low flame signal at about 16% raw flame signal. Standardization does not affect the lockout point.			
	FlameSig QRI_B	U	This can be viewed to see what raw flame signal (in %) is being sent to the LMV by the flame scanner. This parameter only exists on the LMV52. The LMV will alarm when this value is less than about 16%. This signal refers to INPUT terminals X10-01.01 or (X10-02.02) Not adjustable.	All		
	FlameSigION		This can be viewed to see what raw flame signal (in %) is being sent to the LMV by the ionization probe (flame rod) or UV sensor on terminal X10-03.01. This parameter only exists on the LMV52. The LMV will alarm when this value is less than about 16%. Not adjustable.			
	Flame signal range is 0-100% Flame failure is at 16% (raw) Extraneous light is at 4% (raw)					

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> BurnerControl> Configuration> Config FlameDet	SensExtranlGas	O	For the LMV52, this defines how the combustion chamber will be supervised during the period when the fuel valves are closed (gas firing). Def / Typ = 1 sensor. The choices for supervision during this phase are as follows: **1) 1 sensor** Either a flame rod (ION) or scanner can be connected and used. Both cannot be connected. **2) QRI_B / ION** Both sensors can be connected. A flame signal on either will cause a signal to be registered. **3) QRI_B & / ION** Both sensors can be connected. Flame must be detected by QRI_B and not ION. **4) QRI_B** Both sensors can be connected. Only QRI_B is used. **5) ION &/ QRI_B** Both sensors can be connected. Flame must be detected by ION and not QRI_B. **6) ION** Both sensors can be connected. Only ION is used.	10-38, 72-83		
	SensPilotPhGas		For the LMV52, this defines how the pilot for gas firing is supervised. Options 1 thru 6 as described in parameter SenExtranlGas also apply to this parameter. Additionally, there is one additional option added for this parameter. This option is **7) QRI_B and ION** Both sensors can be connected. Both sensors must detect a flame at the same time or a flame failure will occur. Def = 1 Sensor	40-44		
	SensOperPhGas		For the LMV52, this defines how the main flame for gas firing is supervised. Options 1 thru 7 as described in parameter SensExtranlGas and SensPilotPhGas also apply to this parameter. Def = 1 Sensor	60-62		
	SensExtranlOil		For the LMV52, this defines how the combustion chamber will be supervised during the period when the fuel valves are closed. (oil firing) Options 1 thru 6 as described in parameter SensExtranlGas apply to this parameter. Def =1 Sensor	10-38, 72-79		
	SensPilotPhOil		For the LMV52, this defines how the pilot for oil firing is supervised. Options 1 thru 6 as described in parameter SenExtranlGas also apply to this parameter. Additionally, there is one additional option added for this parameter. This option is **7) QRI_B and ION** Both sensors can be connected. Both sensors must detect a flame at the same time or a flame failure will occur. Def = 1 Sensor	40-44		
	SensOperPhOil		For the LMV52, this defines how the main flame for oil firing is supervised. Options 1 thru 7 as described in parameter SensExtranlGas and SensPilotPhGas also apply to this parameter. Def = 1 Sensor	60-62		

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> BurnerControl> Configuration> RepititCounter	LossOfFlame	**O**	Sets the numer of recycles in the event of a flame failure. Range = 1 or 2. Def / Typ = 1	60-62		
	HeavyOil	**S**	Sets how many times the LMV will attempt to proceed past Phase 21 if a start release for heavy oil is not met. After this number if tries, a lockout will occur. Range = 1 to 16 Def / Typ = 1	< 21		
	StartRelease		Sets how many times the LMV will attempt to proceed past Phase 21 if a general start release is not met, such as a fresh air damper or low gas pressure on INPUT terminal X9-03.04. After this number if tries, a lockout will occur. Range = 1 to 16 Def / Typ = 1	< 21		
	SafetyLoop		This parameter should always be set to 1. Def = 1	All		
Params & Display> BurnerControl> ValveProving	ValveProvingType	**O**	This determines if gas valve proving (leak testing) will be performed. Gas valve proving can be performed on start-up, shutdown, or both. If "No VP" is selected, valve proving will not be performed. Range = VP shutdown, VP Startup, No VP, VP Stup/shd, Def / Typ = No VP	80-83, 10-52		
	Config_PM-VP/CPI		INPUT X9-03.02 has multiple functions, depending upon how this parameter is set. On a LMV51 it can be set for either CPI (proof of closure) **for gas** or PS-VP, which is a pressure switch for gas valve proving. Oil proof of closure switches are not intended to be wired to this terminal on a LMV51. On a LMV52, options are PS-VP, CPI oil, CPI gas, or CPI gas and oil. **Usually configured for CPI (proof of closure) on gas valves**. Access to this same parameter is also available under : *Params & Display> BurnerControl> Configuration> ConfigIn/Output> PS-VP/CPI.*			
	VP_EvacTme		If valve proving is activated, this specifies the time that the downstream valve (V2) is energized, OUTPUT X9-01.03.This will evacuate any gas that might exist between the gas valves. Note: If gas valve proving is used, opening times of the gas valves must be less than the maximum value for this parameter. Range = 0.2 to 10 sec Def / Typ = 3 sec	80		
	VP_TmeAtmPress		If valve proving is enabled, this is the time that both the upstream and downstream valves are closed. If the pressure rises between the valves during this period (enough to open the N.C. pressure switch), then the upstream valve is leaking and the LMV will lockout. A longer time period will produce a more sensitive test. Range = 10 to 63 sec, Def / Typ = 10 sec	81		
	VP_FillTme		If valve proving is activated, this specifies the time that the upstream valve (V1) is energized (OUTPUT X9.01.04). This will fill the volume between the main gas valves to line pressure. Note: If gas valve proving is to be used, opening times of the gas valves must be less than the maximum value for this parameter. Range = 0.2 to 10 sec, Def / Typ = 3 sec	82		
	VP_Tme_GasPress		If valve proving is enabled, this is the time that both the upstream and downstream valves are closed. If the pressure falls between the valves during this period (enough to close the N.C. pressure switch), then the downstream valve is leaking and the LMV will lockout. A longer time period will produce a more sensitive test. Range = 10 to 63 sec, Def / Typ =10 sec	83		

Menu Path	Parameter	Level	U = User O = OEM S = Service — Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> Burner Control> Product ID	ASN	U	Product version identification.	All		
	ProductionDate		Date LMV unit was produced.			
	SerialNumber		Serial number of unit.			
	ParamSet Code		Parameter set code.			
	ParamSet Vers		Version (revision) of the tagged parameter set.			
Params & Display> Burner Control	SW Version		LMV software version.			
Params & Display> RatioControl> Gas/Oil Settings> Special Positions> HomePos	HomePosGas or HomePosOil	S	Sets the home position of the fuel actuator(s). The fuel actuator(s) will also stay in this position during prepurge. Each fuel can have its own setting. Range = 0º - 90º, Def = 0º. Typ = 2º from valve / damper mechanical stop.	10-12		
	HomePosAir		Sets the home position of the air actuator. Each fuel can have its own setting. Range = 0º - 90º, Def = 0º Typ = 2º from valve / damper mechanical stop.			
	HomePosAux1		Sets the home position of the aux1 actuator. Each fuel can have its own setting. Range = 0º - 90º, Def = 0º Typ = 2º from valve / damper mechanical stop.	10-12		
	HomePosAux2		Sets the home position of the aux2 actuator. Each fuel can have its own setting. Range = 0º - 90º, Def = 0º Typ = 2º from valve / damper mechanical stop.			
	HomePosAux3		Sets the home position of the aux3 actuator. Each fuel can have its own setting. Range = 0º - 90º, Def = 0º Typ = 2º from valve / damper mechanical stop.			
	HomePosVSD		Sets the home position of the VSD. Each fuel can have its own setting. Range = 0 to 100 %, Def = 0 Typ = 0			
Params & Display> RatioControl> Gas/Oil Settings> Special Positions> PrepurgePos	PrepurgePosAir		Sets the prepurge position of the air actuator. Range = 0º - 90º Def = 90º Typ = 60º to 85º.	24		
	PrepurgePosAux1		Sets the prepurge position of the aux1 actuator. Range = 0º - 90º Def = 90º Typ = at least 2º from valve / damper mechanical stops.			
	PrepurgePosAux2		Sets the prepurge position of the aux2 actuator. Range = 0º - 90º Def = 90º Typ = at least 2º from valve / damper mechanical stops.			
	PrepurgePosAux3		Sets the prepurge position of the aux3 actuator. Range = 0º - 90º Def = 90º Typ = at least 2º from valve / damper mechanical stops.			
	PrepurgePosVSD		Sets the prepurge position of the VSD. Range = 10 to 100% Def = 100% Typ = At least 60%.			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> RatioControl> Gas/Oil Settings> Special Positions> IgnitionPos	IgnitionPosGas or IgnitionPosOil	S	Sets ignition position of the fuel actuator(s). If one fuel actuator is connected to both the gas and oil valve, it can still have independent ignition positions for gas and oil. Setting is independent low fire. Range = 0º - 90º Def = XXXX (not set) Typ = 3º.	38		
	IgnitionPosAir		Sets ignition position of the air actuator. Setting is independent of the low fire position. Range = 0º - 90º Def = XXXX (not set) Typ = 5º.			
	IgnitionPosAux1		Sets ignition position of the aux1 actuator. Setting is independent of the low fire position. Range = 0º - 90º Def = XXXX (not set) Typ = 5º.			
	IgnitionPosAux2		Sets ignition position of the aux2 actuator. Setting is independent of the low fire position. Range = 0º - 90º Def = XXXX (not set) Typ = 5º.			
	IgnitionPosAux3		Sets ignition position of the aux3 actuator. Setting is independent of the low fire position. Range = 0º - 90º Def = XXXX (not set) Typ = 5º.			
	IgnitionPosVSD		Sets ignition position of the VSD. Setting is independent of the low fire position. Range = 0 to 100% Def = XXXX (not set) Typ = 50%			
Params & Display> RatioControl> Gas/Oil Settings> Special Positions> PostpurgePos	PostpurgePosGas or PostpurgePosOil		Sets the postpurge position of the fuel actuator(s). Range = 0º - 90º Def = 15 deg Typ = 5º.	74-78		
	PostpurgePosAir		Sets the postpurge position of the air actuator. Range = 0º - 90º Def = 15 deg Typ = 30º.			
	PostpurgePosAux1		Sets the postpurge position of the aux1 actuator. Range = 0º - 90º Def = 25 deg Typ = 25º.			
	PostpurgePosAux2		Sets the postpurge position of the aux2 actuator. Range = 0º - 90º Def = 25 deg Typ = 25º.			
	PostpurgePosAux3		Sets the postpurge position of the aux3 actuator. Range = 0º - 90º Def = 25 deg Typ = 25º.			
	PostpurgePosVSD		Sets the postpurge position of the VSD. Range = 0 to 100% Def = 50% Typ = 50%			
Params & Display> RatioControl> Gas/Oil Settings> Special Positions	ProgramStop		For gas or oil firing, this parameter will stop the sequence in the selected phase. This is useful for service work, such as; adjusting pilots, measuring prepurge, etc. The LMV can be held (program stopped) in the following phases: 24 prepurge, 32 Prepurge FGR, 36 Ignition position, 44 Interval 1 (pilot stabilization), 52 Interval 2 (Main flame Stabilization), 72 Postpurge position, 76 Postpurge FGR Def = deactivated Typ = deactivated (for normal operation)	Varies		

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> Ratio Control> Gas/Oil Settings> Special Positions> ResetIgnitPos	IgnitionPosGas or IgnitionPosOil	S	Resets the ignition position of the actuator to an invalid value.	38		
	IgnitionPosAir		Resets the ignition position of the air actuator to a invalid value.			
	IgnitionPosAux1		Resets the ignition position of the aux1 actuator to a invalid value.			
	IgnitionPosAux2		Resets the ignition position of the aux2 actuator to a invalid value.			
	IgnitionPosAux3		Resets the ignition position of the aux3 actuator to a invalid value.			
	IgnitionPosVSD		Resets the ignition position of the VSD to a invalid value.			
Params & Display> Ratio Control> Gas/Oil Settings>	CurveParams		This is where actuator curves (fuel air ratio) are set from low to high fire. For an LMV 52, five actuators and one VSD can be set at every point. Fifteen points can be set from low to high fire. **Colons(:)** indicate that the actuator is at the indicated position, and a (**>**) indicates the actuator is seeking a new position. If a O2 sensor is attached and activated, (LMV52) the O2 value will also be displayed on the screen. When a specific point is selected (Point 2 for example) the LMV5 will prompt if the point is to be changed or deleted. If change is selected, then the LMV5 will prompt the user to select followed or not followed. If followed is selcted, the LMV5 will drive the actuators / VSD to the point, and themthe point can be changed. If not followed is selected, the LMV5 will not drive to the point, but the point can still be changed. **NOTE : When not followed is selected, the effect of actuator changes cannot seen on a combustion anaylizer. If not followed is selected, extreme caution must be used.**	60-62		
Params & Display> Ratio Control> **Oil Settings>**	Operation Mode	**O**	Mode for firing oil. Range = Two-stage, Three-stage, Modulating Def = Modulating			
Params & Display> Ratio Control> Gas/Oil Settings> LoadLimits	MinLoad	**S**	Sets the low fire load. During normal operation the burner will not modulate below this point. Should be set to reflect low fire fuel input. On a 10:1 turndown burner, set at 10%. Range = 0 to 100% Def = 0% Typ = 10-40%			
	MaxLoad		Sets the high fire load. During normal operation the burner will not modulate above this point. Range = 0 to 100% Def = 0% Typ = 100%			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> Ratio Control> Gas/Oil Settings> Load mask out	LoadMaskLowLimit	**S**	These settings allow a masking of a particular load range. This is useful for combustion resonances that occur at a particular load (firing rate). For example: if LoadMaskLowLimit is set to 32% and LoadMaskHighLimit is set to 42%, the LMV5 will modulate from 32% to 42% without stopping. Def Low = 0%, High = 0% (No masking)	60-62		
	LoadMaskHighLimit					
Params & Display> Ratio Control> Gas/Oil Settings	Air Actuator	**O**	The first six parameters appear under both fuels ***GasSettings*** , and ***OilSettings.*** Each fuel can have a different settings. One of the last two parameters will appear depending on which fuel is currently selected. **1. activated** - This activates the specific actuator. **2. deactivated** - This de-activates the specific actuator. **3. air influen**(ced) - This means that the actuator (VSD) will respond, to achieve an oxygen level in the stack. This setting is only for O2 sensor equipped LMV52. O2 control must also be activated. Fuel actuators **cannot** be set to air influenced. Note : Any actuator (VSD) can be activated or deactivated on a LMV52. The only actuator that can be changed on LMV51 is the Aux Actuator. **StartPoint Op** - This parameter controls what curve point the LMV5 drives to in Phase 54. The LMV releases to this curve point, typically point 1 Range is 0-15 (or the highest point on the curve), Default is xx (or highest point) AZL software version 4.50 or higher is needed to view or change this parameter.	All		
	AuxActuator 1					
	AuxActuator 2					
	AuxActuator 3					
	VSD					
	StartPoint Op					
	(GasSettings >) GasActuator					
	(OilSettings >) Oil Actuator					
Params & Display> RatioControl	Autom/Manual/Off	**U**	**1) Automatic -** Enable the burner allowing it to respond to setpoints. **2) Burner off** - Manually turn the burner off setpoints are ignored. **3) Burner on** - Manually turn the burner on setpoints are ignored. (See ManualOperation>SetLoad) For normal operation this should be placed in automatic. Def = Automatic This parameter is also available under *Manual Operation> Autom/Manual/Off*	`		
Params & Display> Ratio Control> Times	OperatRampMod	**S**	Controls the speed at which the Actuators / VSD will ramp during normal operation (fuel valves open). **Do not set to less than** the slowest actuator. Range = 30-120sec Def / Typ = 30s **(SQM 45 - 10 sec, SQM 48.4 - 30 sec, SQM 48.6 -60 sec)**	60-62		
	OperatRampStage		Controls the speed at which the LMV will ramp in multistage operation. Range =10-60sec Def / Typ =10sec			
	TimeNoFlame		Controls the speed at which the actuators / VSD will ramp when the fuel valves are closed. **Do not set less than** the slowest actuator. Range = 30-120sec Def = 10 sec Typ = 30 sec	**Not** 60-62		

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> RatioControl	NumFuelActuators	**O**	It is possible, though not recommended, to configure the LMV for 1 fuel actuator, and link that single actuator to a gas valve AND an oil valve. Also useful if firing 2 gaseous fuels Range = 1, 2 Def / Typ = 2	All		
	ShutdownBehav	**S**	Controls the position of the Actuators when a lockout occurs. Range = HomePos, PostpurgeP, Unchanged Def / Typ = HomePos	0		
	ProgramStop		For gas or oil firing, this parameter will stop the sequence, in the selected phase. This is useful for service work, such as; adjusting pilots, measuring prepurge, etc. The LMV can be held (program stopped) in the following phases: 24 prepurge, 32 Prepurge FGR, 36 Ignition position, 44 Interval 1 (pilot stabilization), 52 Interval 2 (Main flame Stabilization), 72 Postpurge position, 76 Postpurge FGR Def = deactivated, Typ = deactivated (for normal operation)	Varies		
Params & Display> O2ContrGuard> Gas/Oil Settings	OptgMode		4 choices for each fuel. The default is man deact. **1. man deact** - O2 trim controller AND O2 monitor are de-activated. Burner runs on the Ratio Curve (fuel lean) **2. O2 Limiter** - (also called O2 Guard) Only the O2 monitor is activated. Any O2 fault , including low O2 levels in the stack will cause a burner shutdown.(O2 guard curve or "rich" curve must be input for this function.) **3. O2 Control** - O2 trim controller AND O2 monitor are activated. Any O2 fault will cause a burner shutdown.(O2 guard curve or "rich" curve, and O2 setpoint or curve must be input for this function.) **4. conAutoDeact** configured to Automatically Deactivate the O2 trim controller AND O2 monitor if any O2 fault occurs. Burner runs on the Ratio Curve (fuel lean) when O2 guard/control deactivates. This is the best choice to keep the burner on-line and avoid any shutdowns due to any O2 system fault, including O2 sensor not being up to temperature. Note: auto deact - This status will appear when the O2 control deactivates itself, due to an operating fault or componenent malfunction. If the control goes into auto deact, it has to be reactivated under: *Operation > O2Ctrl activte* .			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> O2ContrGuard> Gas/Oil Settings	O2 Control	**S**	This is where the O2 setpoint curve or "trim" curve is input. NOTE : The ratio curve and O2 guard curve must be set before this curve is entered. The O2 setpoints are set at each point on the ratio curve that was set previously. It is highly recommended that at least 10 points be input on the ratio curve prior to setting the O2 setpint curve. When O2 trim is used, the ratio cuve should be set about 2% O2 leaner that it would be normally. The LMV52 will drive to the point on the ratio control curve when it is selected, and the technican will have to press enter when the O2 value stabilizes. This is done to measure the gas velocity from the burner to the sensor at that specific point. The technican will then have to back the air actuator down its curve (while the fuel actuator does not move) by increasing the StandVal number. When the technican achieves the desired O2 level, the point can be saved. This point must be 0.5% O2 above the O2 Monitor curve and 1.0% O2 below the O2 lean curve.	60-62		
	O2 Monitor		This is where the O2 Monitor curve or "rich" curve is input. This can be thought of as a low O2 alarm point. NOTE : The ratio curve must be set before this curve is entered. The O2 Monitor points are set at each point on the ratio curve that was set previously. This is usually set as rich as the burner can safely operate. As a general guideline, the burner should not be smoking or having CO higher than 400ppm at any of the O2 Monitor points. The O2 Monitor points can be directly input as a %O2 (at O2-MinValue) or the burner can be "probed" by starting at a point on the ratio control curve and backing the air actuator down its curve while holding the fuel actuator constant. This is done by increasing P-air man. After a lower than normal but still safe O2 value is achieved, the point can be stored.			
Params & Display> O2ContrGuard> Gas/Oil Settings> Control Param	P Low-Fire	**S**	These six O2 parameters make up the Low-Fire and the High-Fire PID control response parameters of the O2 trim (Tau is essentially D). These parameters are all automatically adjusted during the O2 setup procedure. While it is possible to manually adjust some of these parameters, it is not recommended to do so. P Low-Fire - Range = 3 to 500%, Def = invalid I Low-Fire - Range = 0 to 500 sec, Def = invalid Tau Low-Fire - Range = 1 to 27 sec, Def = invalid (must be set automatically) Tau Low-Fire OEM - Range = 1 to 27 sec, Def = invalid (can be set manually) P High-Fire - Range = 3 to 500%, Def = invalid I High-Fire - Range = 0 to 500 sec, Def = invalid Tau High-Fire - Range = 1 to 27 sec, Def = invalid (must be set automatically) Tau Low-Fire OEM - Range = 1 to 27 sec, Def = invalid (can be set manually)			
	I Low-Fire					
	Tau Low-Fire OEM	**O**				
	Tau Low-Fire	**U**				
	P High-Fire	**S**				
	I High-Fire					
	Tau High-Fire OEM	**O**				
	Tau Low-Fire	**U**				

Menu Path	Parameter	Level	U = User O = OEM S = Service — Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> O2ContrGuard> Gas/Oil Settings	O2 CtrlThreshold	S	This is the minimum load for O2 Control. If the load drops below this value, the O2 trim control de-activates. 5% above this load setting O2 control will reactivate. Typically set to the same load value as Point 2. Range = 0 to 100 %, Def = 0%, Typ = 20%	60-62		
	LowfireAdaptPtNo		Sets the point that Tau low fire is automatically measured. In effect, this sets the "autotune" point for low fire. This value must be defined prior to completing the O2 Curves. Def = xx (undefined), Typ = 2. The "autotune" point for high fire is done at the last point, typically point 10.			
	Type of Fuel		**Gas Settings** This enables the user to pick what type of fuel will be burnt with the O2 Control / Guard. Options : user defined, naturalgasH (at or above 960 Btu/SCF), naturalgasL(below 960 Btu/SCF), propane, butane. These choices appear when gas is the current fuel selected.			
			Oil Settings This enables the user to pick what type of fuel will be burnt with the O2 Control / Guard. Options : user defined, Oil EL, oil H. Default is Oil EL. Oil EL should be used for #2 fuel oil. These choices appear when oil is the current fuel selected.			
Params & Display> O2ContrGuard> Gas/Oil Settings> Fuel User Def	V_Lnmin		For user-defined fuels, this represents the amount of air needed for stoichiometric combustion of the fuel. For gas, this is cubic meters of air per cubic meter of gas, and for oil this is cubic meters of air per kg of oil. Range = 0 to 90 Def / Typ = 9.90			
	V_afNmin		For user defined fuels, this represents the quantity of flue gas generated (wet basis) when either one cubic meter (for gases) or one kg (for oil) of fuel is combusted at stoichiometric conditions. Range = 0 to 40 Def / Typ = 10.93			
	V_atrNmin		For user defined fuels, this represents the quantity of flue gas generated (dry basis) when either one cubic meter (for gases) or one kg (for oil) of fuel is combusted at stoichiometric conditions. Range = 0 to 40 Def / Typ = 8.89			
	A2		Adjustable constants for calculating the combustion efficiency when firing gas. A2 -- Range = 0.40 to 80 Def = 0.65 Typ = 0.65 B/1000 -- Range = 1 to 20 Def / Typ = 9			
	B / 1000					

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> O2ContrGuard> Gas/Oil Settings	O2 Content Air	**O**	Defines the O2 content of the combustion air. The LMV52 must see this value during purge. This value can be adjusted if O2 enriched air is used. Range = 0 to 30%, Def = 20.9%.	60-62		
	Type ofAirChange	**S**	When firing gas select **like P air** (change in airflow ***does*** affect gas flow) When firing oil select **like theory** (change in airflow ***does not*** affect oil flow) Def= like theory			
	O2 OffsetGas or O2 OffsetOil		During a load change, this offset temporaily increases the O2 setpoint. When the change in load is completed, the O2 setpoint will revert to the O2 control curve. Range = 0-5% Def / Typ = 0%. However, if the burner tends to go below the O2 Monitor curve during load changes, then this setting can be increased (0.5% or more) to eliminate O2 readings below the O2 Monitor curve.			
	LoadCtrlSuspend		During a load change, the O2 trim control will lock, meaning that it will "remember" where the air influenced actuators (usually just the air actuator) tracked the last time the burner went through a similar load change. When locked, the O2 trim will not be making real time adjustments. This locking during load changes is referred to as precontrol. This setting enables adjustment of what the LMV52 considers as a load change that will lock the O2 trim. Adjustment is generally not recommended, however reducing this setting can help deactivation in some circumstances. Range = 0-25% Default & Typ = 5%			
	FilterTimeLoad		After a load change that locks the O2 trim control, a time factor is applied that makes the LMV wait to unlock the trim control. This setting adjusts the unlocking time. Adjustment is generally not recommended, however increasing this setting can help deactivation in some circumstances. Range = 4-10 Def /Typ = 5			
Params & Display> O2ContrGuard> Gas/Oil Settings> Process Data	CombEfficiency	**U**	Calculated Combustion Efficiency, based on wet O2 levels in the stack, combustion air temperature, and flue gas temperature.			
	ManVar O2 Ctrl		This value represents how much the O2 control is trimming from the base O2 Ratio control curve. When this value is decreasing it means that the LMV is closing the air influenced actuators to compensate for a higher than setpoint O2 value in the stack. When this value is increasing, the LMV is opening the air damper approaching the O2 ratio control curve. When the LMV has compensated as much as possible for a lean condition, value will be about 15%, and as much as possible for a rich condition, value will be about 52%.			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> O2ContrGuard> Gas/Oil Settings> Process Data	State O2 Ctrl	U	This displays what mode the O2 trim control is in. The modes with the definitons are: **0 = Deactivated** - the trim is manually or automatically deactivated. **1 = Locked** - the starting sequence of the trim is stopped. See "Diag Reg State" for more information. **2 = LockTStart** - this signifies that the trim is waiting to engage. The trim will engage 10 * tau LF (tau LF is a time delay that is typically auto set at low fire) after the burner sucessfully lights off. **3 = InitContr** - after the trim engages, this is the large reducton in air rate (closing the air damper or slowing the VSD) that is done after the 10 * tau time expires. **4 = LockTLoad** - signifies that the O2 trim is engaged but not actively trimming due to a load change. **5 = active** - the O2 trim is active and adjusting the air rate in small steps to achieve the O2 setpoint. **6 = LockTCAct** - a increase and then pause of the air rate due to the measured O2 being below the O2 setpoint. The length of the pause is 5* tau	60-62		
	Air-related Load		This is the load-position that any of the air-influenced Actuators are at when the O2 trim on the LMV is trimming. The load position of the fuel Actuators always matches the load displayed on the normal operation screen. The air related load can be the same or less than the fuel related load (on the normal operation screen) but can never be greater. This is because the air influenced Actuators always move back down their respective curves.			
	Diag Reg State		If "State O2 Ctrl" reads "locked", this diagnostic code reveals other information. These diagnostic codes are: 0 = load is below load limit set in parameter O2 CtrlThreshold. 1 = the load controller is in auto-tune 2 = the O2 sensor is being tested for response (the LMV5 does this periodically during operation) 3 = the fuel air ratio curves or the O2 trim curves are being programmed. 4 = the measured % O2 is below the %O2 set in the O2 Monitor curve (rich curve). 5 = Error in the PLL52 module 6 = Error in the Precontrol			

Menu Path	Parameter	Level	U = User O = OEM S = Service — Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> Load Controller> Controller Param> ContrlParam List	StandardParam	U	These are "canned" values for the PID loop in the internal load controller as well as and option to use values found during adaptation (autotune). Adaptation (autotune) is not performed with this parameter, but the PID results of an adaptation (autotune) can be used by selecting adaptation. Values are labeled: **very slow, slow, normal, fast,** and **very fast.** When any one is selected "canned" values will be assigned to P I and D that will determing how the load controler responds. Note that every time this parameter is viewed, current will be shown as "XXX" and new will show "very slow". This does not mean that the load controller is using very slow PID values. The "StandardPararm" screen just shows "very slow" since it the first option in line. When very slow is selected, the P value is small (small proportional band), and values for I and D are longer (greater number of seconds), meaning there is less intergral and derivitive action. If very fast is selected, the P value is large and the I and D are short, meaning that the propotional band is large and there is a large amount of intergral and derivitive action. Recommendations: **normal** will work well for most situations **very slow** P = 3.4 % I = 273 seconds D = 48 seconds **normal** P = 6.4 % I = 136 seconds D = 24 seconds **very fast** P = 42.5 % I = 68 seconds D = 12 seconds	60-62		
	P-Part		**P part of the PID loop,** is the proportional band around the setpoint, in % units. This % is based on the measured range or span of attached sensor. If normal response was selected above, then this will be 6.4%. If "canned" values are not used, 10% is usually a good starting point. Range = 2 to 500% Def = 15% Typ = 6.4%			
	I-Part		**I part of the PID loop,** is the integral function that is applied to the behavior of the process variable (boiler temp. or press). Basically it counteracts fast decreases in the process variable by increasing boiler load even faster than the P alone. If normal response was selected above, this will be 136 seconds. This can also be deactivated by setting this to 0 sec. If "canned" values are not used, 80 seconds is usually a good starting point. Range = 0 to 2000sec Def = 320sec Typ = 136 sec			
	D-Part		**D part of the PID loop.** D is the derivative function that is applied to the behavior of the process variable (boiler temp. or press). Basically it counteracts fast increases in the process variable by decreasing boiler load even faster than the P alone. If normal response was selected above this will be 24 seconds. This setting must always be at least 1/5 of the setting for I or the PID loop may be unstable. Setting this to 0 sec is also possible, deactivating this part of the loop and leaving a PI loop. If "canned" values are not used 15 seconds is usually a good starting point. Range = 0 to 1000sec Def = 40sec Typ = 24sec			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> LoadController> ControllerParam	MinActuatorstep	**U**	This controls the resolution of the load controller. If the PID loop requires a load change and the load change is less than this value, the load will not actually change and the actuators will not move. In short, a deadband adjustment for actuator movement or a deadband for the output of the PID loop. Increasing this setting can reduce actuator "hunting" during normal operation. Range = 0.5 to 10% Def / Typ = 1%	60-62		
	SW_FilterTmeCon		S/W filter time constant in seconds. This is a filter which is applied to the pressure or temperature that the LMV is reading. Basically a filter for the input of the PID loop. Range = 1-10, Def = 3			
	SetpointW1		W1 is the normal setpoint of the boiler, in units of temperature or pressure depending on the sensor attached to the LMV. Also access at: *Operation > Boiler setpoint.* Range = 0 to range of Pressure or Temp sensor. Def / Typ = 0			
	SetpointW2		W2 is an alternate setpoint of the boiler, in units of temperature or pressure depending on the sensor attached to the LMV. Also access at: *Operation > Boiler setpoint.* If the LMV is in Internal load controller mode 2 this setpoint can be switched to W2 (from W1) by closing a contact between X62.1 and X62.2. Usually used for a setpoint setback. Range = 0 to range of Pressure or Temp sensor. Def / Typ = 0			
	SD_ModOn		Determines what Temp / Press a modulating burner will cycle on. Can be set at a positive or negative %, either above or below the current setpoint respectively. The % is based from the current setpoint. Range = -50% to +50%. Def / Typ = 1% If current setpoint = 200, and this is set to -3%, then the burner will cycle back on at 194.			
	SD_ModOff		Determines what Temp. / Press. a modulating burner will cycle off. Set at a positive % so that the burner will turn off a set % above the current setpoint. The % is based from the current setpoint. Range = 0 to +50%. Def / Typ = 10%			
	SD_Stage1On		Determines what Temp. / Press staged oil combustion burner will engage stage1. Set at a negative %, so that the burner will turn on stage1 at a set % below the current setpoint. The % is based on the current setpoint. Range = -50 to +50%, Def / Typ = -2%			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> LoadController> ControllerParam	SD_Stage1Off	**U**	Determines what Temp. / Press. a staged oil combustion burner, will disengage stage1. Set at a positive % so that the burner will turn off stage1 oil at a set % above the current setpoint. The % is based on the current setpoint. Range = 0 to +50%, Def / Typ =10%	60-62		
	SD_Stage2Off		Determines what Temp. / Press, a staged oil combustion burner, will disengage stage 2. Set at a positive % so that the boiler will turn off stage 2 oil at a set % above the current setpoint. The % is based on the current setpoint. Range = 0 to +50%. Def / Typ = 8%			
	SD_Stage3Off		Determines what Temp. / Press. a staged oil combustion burner, will disengage stage 3. Set at a positive % so that the boiler will turn off stage 3 oil at a set % above the current setpoint. The % is based from the current setpoint. Range = 0 to +50%. Def / Typ = 6%			
	ThreshStage2On		This value is the integral of a control deviation multiplied by time. This serves to not call on stage 2 unless the pressure / temperature deviates from the desired setpoint for a length of time and/or by a large margin. Range = 0 to 1000. Def / Typ = 300			
	ThreshStage3On		This value is the integral of a control deviation multiplied by time. This serves to not call on stage 3 unless the pressure / temperature deviates from the desired setpoint for a length of time and/or by a large margin. Range = 0 to 1000. Def / Typ = 600			
Params & Display> LoadController> TempLimiter (Temperature ONLY)	TL_Thresh_Off	**S**	If a temperature sensor is used, (connected to input X60) this parameter controls at what temperature the burner goes into alarm, and shutdown, due to an over temperature situation. LMV5 faults, and does NOT lockout. LMV5 re-starts when temperature goes below TL_SD_On. This is normally used to prevent hot water boilers from exceeding their design temperatures. **Setting does NOT APPLY to STEAM/PRESSURE**, Range = 0 to 2000º F. Def / Typ = 203º F.			
	TL_SD_On		Creates a negative dead band for the temperature limiter function. If the temperature reaches the threshold off value (previous parameter), the burner will shut off with a alarm. This setting controls what temperature under the threshold off value the burner can be restarted. **Setting does NOT APPLY to STEAM/PRESSURE,** Range = -50 to 0%. Def / Typ = -5%			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> LoadController> Cold Start	ColdStartOn	S	Activates or deactivates cold start thermal shock protection (low fire hold or ramping cold start), based on Temp. or Press. for a steam boiler, and Temp for a hot water boiler.	60-62		
	ThresholdOn		This is the temp / press below which cold start will engage. The value is a % of the current setpoint and it will float up or down with the setpoint. Range = 0 to 100%, Def / Typ = 20% **Note:** If the burner is turned on and the temp / press is above this setting, it will immediately modulate to achive setpoint.			
	StageLoad		This sets the % load of the "load step" for a stepping cold start. If the burner is to be held at low fire (low fire hold) until the ThresholdOff value is reached, set at 0%. Range = 0-100%, Def / Typ =10%			
	StageSetp_Mod		For modulating burners, this is how much the temp / press must go up before the next load step is triggered. This is a % of the current setpoint. Can be set "up, out-of-the-way" if a burner is to be stepped by time only. Range = 0 to 100%, Def / Typ = 5%			
	StageSetp_Stage		For staged burners, this is how much the temp. / press must go up before the next burner stage is released. This is a % of the current setpoint. Range = 0-100%, Def / Typ = 5%			
	MaxTmeMod		For modulating burners, this is maximum allowable time for each load step. If the temp. / press. does not rise enough to trigger the next load before this times out, the next load step will be taken anyway. Can be set "up, out-of-the-way" if to be ramped on temp. / press. only. Range = 1 to 63min Def = 3min Typ = 5min			
	MaxTmeStage		For staged burners, this is how much time can be spent in each stage. As in modulation, this overrides the boiler temperature / pressure, setting StageSetp_mod. Range = 1 to 63min Def = 3min Typ = 5min			
	ThresholdOff		If ColdStartOn is activated, this is the temp. / press. when the LMV is released to moulate. The value is a % of the current setpoint and it will float up or down with the setpoint. Range = 0 to 100% Def / Typ = 80%			
	AdditionalSens		If the additional temp. sensor is used on a steam boiler for cold start (recommended) the type of sensor must be selected and attached to INPUT terminal X60. Range = Pt100, Pt1000, Ni1000			
	Temp ColdStart	U	Displays the temperature being read by the additional sensor. Typically, an additional temperature sensor is used on a steam boiler for cold start.			
	Setp AddSensor	S	If a temperature sensor is used on a steam boiler for cold start, a temperature setpoint must be selected to take the place of the current setpoint (usually Setpoint W1) ThresholdOn, and ThresholdOff percentages will be based on this value (instead of W1). Range = 0 to 842 degrees F Def = 140 Typ = 300			
	Release Stages		For staged burners, this enables or disables stages (other than the first stage) to be released during a cold start.			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> Load Controller> Configuration	LC_OptgMode	**U**	Note -"Load Controller not active..." is displayed go to: SystemConfig > LC_OptgMode 1) External load controller X5-03 - use with a floating bumping type of universal controller such as a RWF40. Internal load controller not required. 2) Internal load controller- use with a directly connected pressure or temperature sensor. Setpoint W1 is normally used with this mode. 3) Internal load controller BUS- same as 2 except setpoint W3 can be changed via BUS connection. 4) Internal load controller X62 - same as 2 except setpoint can be changed by using a external analog signal on terminal X62. 5) External load controller X62 - LMV can be modulated directly by an analog signal on terminal X62. 6) External load controller BUS - LMV can be modulated directly via a BUS connection. Note: Modes 3 thru 6 can be switched back to mode 2 by closing a contact between X62.1 and X62.2. When in mode 2 this contact closure can be used to switch between setpoint W1 and W2.	60-62		
	Sensor Select	**S**	Defines the type of sensor that will be used for the internal load controller. 1) **Pt100, Pt1000, Ni1000** - Temperature sensors (RTD) wired into terminals X60. The internal temperature limiter is active when any of these three are selected. 2) **TempSensor, PressureSensor** - Temperature or Pressure sensor wired to terminals X61. Can be 0 to 10VDC or 4-20mA. 3) **Pt100Pt1000, Pt100Ni1000** - Redundant Temperature Sensors wired to terminals X60. Pt100 used for load controller and temperature limiter, redundant sensor also used for temperature limiter. 4) **No Sensor** - Selected if LMV5x being remotely modulated, no sensor for the load controller or the temperature limiter.	All		
	MeasureRangePtNi		Sets the end of measurement range for standard platinum or nickel temperature sensors connected to terminals X60. Range = 302 F, 752 F, 1562 F Def / Typ = 302 F			
	Var. RangePtNi		Sets the end of measurement range for non-standard platinum or nickel temperature sensors connected to terminals X60. Range = 0 to 1562 F Def / Typ = 1562 F			
	Ext Inp X61 U/I		Configuration of terminals X61. This input can be configured for 4 to 20mA, 2 to 10VDC, or 0 to 10VDC. Set to the type of signal expected on X61. **NOTE** : The limits on this terminal are 3mA to 21mA, 10.5 VDC. Signals not in this range will cause a alarm.	All		
	MRange TempSens		Sets the end of the scale for a temperature sensor connected to terminals X61. Also, this serves to scale input X62 if used for remote temperature setpoints. Range = 0 to 3632 F Def / Typ = range of X61 temp sensor			
	MRange PressSens		Sets the end of the scale for a pressure sensor connected to terminals X61. This value would correspond to the pressure senor output (mA or V) at rated pressure. Also, this serves to scale input X62 if used for remote pressure setpoints. Range = 0 to 1449 psi Def = 29 psi, Typ = range of connected pressure sensor			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> Load Controller> Configuration	Ext Inp X62 U/I	S	Configuration of INPUT terminals X62. This input can be configured for 4 to 20mA, 0 to 20mA, 2 to 10VDC, or 0 to 10VDC. This terminal is usually used for remote setpoint or remote modulation. This input signal is scaled by parameter Mrange TempSense or Mrange PressSens. **NOTE** : The limits on this terminal are 3mA to 21mA, 10.5 VDC. Signals not in this range will cause a alarm.	All		
	Ext MinSetpoint		Establishes the minimum external setpoint that can be input via terminals X62. Range = 0 to 100% Def = 0 Typ = 10	60-62		
	Ext MaxSetpoint		Establishes the maximum external setpoint that can be input via terminals X62. Range = 0 to 100% Def = 60 Typ = 100			
Params & Display> Load Controller> Configuration> AnalogOutput	OutValueSelection		This selects the process value associated with analog output X63. The selected process value will be transmitted from X63 with either a 0 to 20mA or a 4 to 20mA signal. The choices for this output are: 1) **Load** - The current load of the burner using 4-20mA. Parameters CurrMode 0/4mA ,Scale 20mA and Scale 0/4mA have no effect on this choice. 2) **Load 0 -** The currnet load of the burner using 4-20mA or 0-20mA. 3) **O2** - The percent O2 curenntly read by the stack O2 sensor. 4) **Pos Air** - The current position of the air actuator in angular degrees. 5) **Pos Fuel** - The current position of the fuel actuator in angular degrees. 6) **Pos Aux 1** - The current position of the Aux 1 actuator in angular degrees. 7) **Pos Aux 2** - The current position of the Aux 2 actuator in angular degrees. 8) **Pos Aux 3** - The current position of the Aux 3 actuator in angular degrees. 9) **Speed VSD** - The current speed of the VSD motor in percent. 10) **Flame** - The current raw flame signal 11) **TempPT1000** - The temperature read by the PT1000 sensor on terminal X60. 12) **TempNi1000** - The temperature read by the Ni1000 sensor on terminal X60. 13) **TempPt100** - The termperature read by the PT100 sensor on terminal X60. 14) **Temp X61** - The tempearture read by the temperature transducer on terminal X61 15) **Press X61** - The pressure read by the pressure transducer on terminal X61.	All		
	CurrMode 0/4mA		Selects the output signal to be either a 0 to 20mA signal or a 4 to 20mA signal. Range = 0 to 20mA or 4 to 20mA Def = 0 to 20mA Typ = 4 to 20mA			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> Load Controller> Configuration> AnalogOutput	Scale20mA perc	S	Scales the analog output for the percent values (other than Load). Specifically, this parameter defines what percentage of Pos Air, Load 0, Speed VSD, Flame, etc.. will output 20mA. Range = 0 to 999%, Def / Typ = 100%	All		
	Scale20mA temp		Scales the analog output for the temperature values. Specifically, this parameter defines what temperature (read by Temp Pt1000, Temp Ni1000, etc..) will output 20mA. Range = 0 to 3632 F, Def = 1562 F, Typ = 400 F			
	Scale20mA press		Scales the analog output for the pressure value. Specifically, this parameter defines what pressure (read by Press X61) will output 20mA. Range = 0 to 1449 psi, Def = 2 psi, Typ = 150 psi			
	Scale20mA angle		Scales the analog output for the actuators. Specifically, this parameter defines what angular degrees will output 20mA. Range = 0 to 90 deg, Def = 90, Typ = 90			
	Scale 0/4mA		Sets the start of the scale for every process value other than **Load**. (The start of the scale **Load 0** can be set here, but if **Load** is selected above this parameter has not effect.) For example : If Parameter "OutValueSelection" is set to Pos Air, "CurrMode 0/4mA" is set to 4mA, "Scale 20mA angle" is set to 90°, and "Scale 0/4mA" is set to 0%, then 12 mA will be output when the air actuator is at 45 degrees, and 20mA will be output at 90 degrees. If all other values are unchanged and "Scale 0/4mA" is now set to 50%, then 4 mA will be output when the air actuator is 45 degrees, and 20mA will be output when the actuator is at 90 degrees. Range = 0 to 999% Def = 0 Typ = 0			
Params & Display> LoadController> Adaption	StartAdaption	U	This starts the Adaption process. During the Adaption process the LMV will determine the thermal response of the system (burner / boiler and attached thermal users). Values for PID will be calculated based on this information. The LMV does this by modulating to minimum load letting the system "settle" to a particular pressure or temperature. After this "settling" period the LMV will modulate up to the Adaption Load and see how long it takes for the system temperature / pressure to respond. Based off of this response the LMV will choose values for P I and D. These calculated values are implemented by choosing Adaption under *StandardParam.* Note : Adaption has to be started when the burner is running and a representitve load exists on the system.	60-62		
	AdaptionLoad		This load is used to determine the thermal response of the system during Adaption only. LMV will travel to this load during the heating phase of the Adaption. Range = 40 to 100% Def / Typ =100			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> Load Controller	SW Version	**U**	Software version of the load controller			
Params & Display> AZL> Times	PasswordTime	**O**	Sets the length of time for the password to time out. Range =10 to 400 min. Def = 120 min.			
	Sum/WinterTime		**Automatic:** Daylight savings automatically, **Manual:** Disables daylight savings time feature.			
	Time EU/US		Daylight savings time schedule. **US setting** START: 1st Sun in Apr END: last Sun in Oct.			
Params & Display> AZL	Language		Select the language you want the AZL to display. Default is English.			
	DateFormat		Date format has 2 Choices: MM-DD-YY (US) or DD.MM.YY (European) Default is US.			
Params & Display> AZL	PhysicalUnits		Either °C / bar or °F / psi can be chosen. Def = °F / psi.			
Params & Display> AZL> Ebus	Address		Sets the LMV address for Ebus (job specific…) Range = 1 to 8 Def = 1			
	SendCycleBU		Sets the cycle time for the LMV to send data to the BAS (job specific…) Range = 10 to 60 sec Def = 30 sec	All		
Params & Display> AZL> ModBus	Address	**U**	Sets the LMV address for Modbus (job specific…) Range = 1 to 247 Def = 1			
	Baudrate		Sets the baud rate of the ModBus port, which is an RJ45 jack located on the underside of the AZL. NOTE: To use ModBus, it must be activated at: *Operation > Optgmodeselect.* Def = 9600			
	Parity		This sets the parity of the ModBus port. Range = Parity , No Parity Def = no parity.			
	Timeout		If no communication occurs for this period, the AZL considers the ModBus to be unavailable. If the AZL considers the Modbus to be unavailable, then it will make setpoint W1 the current setpoint. Other ModBus values will remain what they were previous to the unavailability, and or be overwritten by input though the AZL. Range = 0 to 7200s Def / Typ = 30 s			
	Lokal / Remote		This enables or disables the use of a ModBus conveyed setpoint, setpoint W3. **Lokal:** (local) W3 will not be observed. **Remote:** there is no timeout condition and the remote operating mode is automatic then setpoint W3 will be observed.			
	Remote Mode		View the ModBus "Remote Mode" status: **Automatic, On, Off**			
	W3		W3 is the ModBus conveyed setpoint. Range = 0 to 3632 degrees F or 1500 PSIG			
Params & Display> AZL	Display Contrast		Change with **< >** keys store with **Enter** key, cancel with the **Esc** key.			

Menu Path	Parameter	Level	U = User O = OEM S = Service — Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> AZL> ProductID	ASN	**U**	Information concerning the AZL.	All		
	ProductionDate					
	SerialNumber					
	ParamSet Code					
	ParamSet Vers					
Params & Display> AZL	SW Version		Software Version on the AZL			
Params & Display> Actuators> Addressing	1 AirActuator	**S**	Enables addressing of the actuators. Select one of the actuators and press enter. The AZL will then serve as a guide through the rest of the procedure. This procedure involves pressing a red button (hold about 1 sec.) on the selected actuator. The actuators can be wired and addressed in any order. The green LED will be on when the actuator is powered and not addressed, and it will blink then pause after it has been addressed. 1 blink = Air, 2 blinks = gas or gas(oil), 3 blinks = oil, 4 blinks = aux1, 5 blinks = aux2, 6 blinks = aux3 Holding the red button on the actuator down for approx 10 seconds will clear the addressing on that actuator.	0		
	2 GasActuat(Oil)					
	3 OilActuator					
	4 AuxActuator1					
	5 AuxActuator2					
	6 AuxActuator3					
	DeleteCurves		This deletes the ratio control (fuel / air) curves. Curves must be deleted if the direction of rotation on any actuator is changed.	12		
Params & Display> Actuators> DirectionRot	1 AirActuator	**O**	Sets the direction of rotation for each actuator, regardless of which fuel is selected. If you are looking at the actuator with the shaft pointed directly at you, **Standard Rotation** would be counterclockwise, **Reversed Rotation** would be clockwise. These descriptions are opposite if viewed from the cover end of the actuator. (shaft pointing away from you) Range = Standard, Reversed Def = Standard	All		
	2 GasActuat(Oil)					
	3 OilActuator					
	4 AuxActuator1					
	5 AuxActuator2					
	6 AuxActuator3					

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params& Display> Actuators> ProductID> 1 Air Actuator	ASN	U	Information concerning the currently addressed air actuator.	All		
	ProductionDate					
	SerialNumber					
	ParamSet Code					
	ParamSet Vers					
Params& Display> Actuators> ProductID> 2 Gas Actuator(Oil)	ASN		Information concerning the currently addressed gas(oil) actuator.			
	ProductionDate					
	SerialNumber					
	ParamSet Code					
	ParamSet Vers					
Params& Display> Actuators> ProductID> 3 Oil Actuator	ASN		Information concerning the currently addressed oil actuator.			
	ProductionDate					
	SerialNumber					
	ParamSet Code					
	ParamSet Vers					
Params& Display> Actuators> ProductID> 4 Aux Actuators 1	ASN		Information concerning the currently addressed aux1 actuator.			
	ProductionDate					
	SerialNumber					
	ParamSet Code					
	ParamSet Vers					
Params& Display> Actuators> ProductID> 5 Aux Actuators 2	ASN		Information concerning the currently addressed aux2 actuator.			
	ProductionDate					
	SerialNumber					
	ParamSet Code					
	ParamSet Vers					
Params& Display> Actuators> ProductID> 6 Aux Actuator 3	ASN		Information concerning the currently addressed aux3 actuator.			
	ProductionDate					
	SerialNumber					
	ParamSet Code					
	ParamSet Vers					
Params& Display> Actuator> SW Version	1 Air Actuators		Information concerning the software versions of the attached actuators.			
	2 Gas Actuator(Oil)					
	3 Oil Actuators					
	4 Aux Actuators 1					
	5 Aux Actuators 2					
	6 Aux Actuators 3					

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params& Display> VSD Module > Configuration	ReleaseContctVSD	**S**	This sets the behavior of the run / stop dry contact (terminals X73.1 and X73.2). If set to closed, then this dry contact will stay closed from posturge (phase 78) into phase 10 when the VSD is driving to home position, which is typically set at 0 % (0 RPM). If set to open, the blower will freewheel after phase 78. Typ = open	78-10		
	TolQuickShutdown	**O**	This sets the percentage of speed deviation from the desired fan speed that will cause an immediate shut down the burner. Typically does not need to be adjusted. Range = 0 to 100% Def / Typ = 10%	22-78		
Params & Display> VSD Module> Configuration> Speed	Num Puls per R	**S**	This sets the expected number of pulses per motor revolution. This setting depends upon what type of speed wheel is used. Range = 3 or 6. Def = 3			
	Standardization		This starts the standardization process for the motor driven by the VSD. When activated, it will ramp the VSD up and then down with the air damper open. During this time, the LMV52 will correlate a milliamp signal to the peak motor RPM.			
	StandardizedSp		Shows the motor speed corresponding to 19.5 mA input to the VSD / motor combination. This is automatically set when the VSD / motor is standardized. It can be set manually, but this is not recommend in most cirumstances.			
	Absolute Speed	**U**	This displays the real time speed of the blower motor in RPM (tachometer).			
	Setpoint Output	**S**	This sets what the output signal will be to the VSD. It can be set to 4 to 20mA or 0 to 20mA. Typically this is set to 4-20mA. Def = 4-20mA.			
	Settling Time	**O**	This sets a filter time or a delay time between when a speed is read from the speed wheel to when the LMV52 attempts to correct the speed by varying the 4-20mA signal to the VSD. Adjust if VSD isoscillating or "hunting" Time is multiplied by 25 milliseconds, so a setting of 16 yields 400ms or 0.4 seconds. Range = 200 to 5000ms. Def =16, or 400ms			
Params & Display> VSD Module> Configuration> Fuel Meter	PulseValueGas	**S**	This sets the number of pulses per unit of gas flow (for use with gas meters having a pulsed output, such as a modern turbine gas meter) Can be set for cubic meters or cubic feet. Range = 0 to 999.99999 pulses / (cubic feet) Def / Typ = meter specific	60-62		
	PulseValueOil		This sets the number of pulses per unit of oil flow (for use with oil meters having a pulsed output) Can be set for liters or gallons. Range = 0 to 999.99999 pulses / (gal) Def / Typ = meter specific			
Params & Display> VSD Module> Process Data	Max Stat Dev	**U**	Maximum motor speed deviation from setpoint during steady state operation (steady load) during a run period. Range = 0 to 100%	22-78		
	Max Dyn Dev		Maximum motor speed deviation from setpoint during an acceleration or deceleration of the motor(changing load) during a run period. Range = 0 to 100%			
	Num Dev >0.3%		The number of speed deviations exceeding 0.3% of the speed setpoint during a VSD run period.			
	Num Dev >0.5%		The number of speed deviations exceeding 0.5% of the speed setpoint during a VSD run period.			
	Absolute Speed		This displays the real time speed of the blower motor in RPM (tachometer).			

Menu Path	Parameter	Level	U = User O = OEM S = Service — Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> VSD Module> Product ID	ASN	U	Information concerning the VSD board (pieces internal to the LMV)	All		
	ProductionDate					
	SerialNumber					
	ParamSet Code					
	ParamSet Vers					
Params & Display> VSD Module	SW Version		Software version of the VSD.			
Params & Display> O2 Module> Configuration	O2 Sensor	S	This defines what O2 sensor is used with the PLL52 module. QGO20 Max. flue gas temp 572 deg F Range = No sensor, QGO20, Def = No Sensor, Typ = QGO20			
	SupAirTempSens		This sensor connects to the PLL module and is necessary for the boiler efficiency calculation. Range = No sensor, Ni1000, Pt1000, Def / Typ = Ni1000			
	FlueGasTempSens		This sensor connects to the PLL module and is necessary for the boiler efficiency calculation. Range = No sensor, Ni1000, Pt1000, Def / Typ = Pt1000 NOTE : If configured for Pt1000, any 1000 ohm Platinum RTD having a temperature coefficient of 385 will be accurate. Resistance of the correct RTD is 1000 ohms @ 32F.			
	MaxTempFlGasGas or MaxTempFlGas/Oil		Maximum flue temperature setpoint for each fuel. A warning will appear if temperatures exceed this setting. PLL52 module must have a flue gas sensor wired in for this function. Range = 32 deg F to 752 deg F Def = 32 def F, Typ = boiler specific			
Params & Display> O2 Module> Displayed Values	Actual O2 Value	U	This displays the current wet O2 values in the flue.			
	O2 Setpoint		This displays the O2 setpoint at any operating point. This is the target for the O2 trim.	60-62		
	SupplyAirTemp		This displays the current ambient air temperature.	All		
	CombEfficiency		This displays the current combustion efficiency. If the O2 sensor is deactivates, this number will not be displayed. Also the flue and ambient temperatures are needed for this number to display.	60-62		
	FlueGasTemp		This displays the current flue gas temperature.	All		
	QGO SensorTemp		This displays the current O2 Sensor temperature. Absolute minimum operating temperature = 1202 ^{o}F	All		
	QGO HeatingLoad		This displays the current heating load for the O2 Sensor. The PLL regulates the heating voltage to the QGO20 sensor. Maximum heating load is 60%.			
	QGO Resistance		This measures the resistance of the O2 sensor. As a sensor is used, the resistance increases. New sensors have a resistance of 0 ohms. When this value exceeds 100 ohms, sensor should be replaced the next time the burner is serviced. Absolute maximum is 150 ohms.			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> O2 Module> ProductID	ASN	**U**	Information concerning the currently attached O2 sensor.	All		
	ProductionDate					
	SerialNumber					
	ParamSet Code					
	ParamSet Vers					
Params& Display> O2 Module	SW Version		Software version of the O2 module.			
Params& Display> Flue Gas Recirc.	FGR-Mode	**S**	Sets the mode of the FGR hold for the Aux 3 actuator. This can be time or temperature based. The Aux 3 actuator can be made to release to its normal fuel-air ratio curve position after a certain length of time, or after a certain temperature (typically stack temperature) is reached. This serves to let the boiler to warm before admitting FGR to the burner. This will not stop the other actuators (fuel, air, aux 1, etc...) from driving to whatever load is defined by the load controller. Range = deactivated, time, temperature Def = deactivated	60-62		
	FGR-Sensor		Selection of the temperature sensor if the temperature based FGR hold is used. Options are a Pt1000 connected to the PLL module (O2 trim module) or a Pt1000, Ni 1000 connected directly to the load controller. Def = PLL_Pt1000			
	actTmpFGR-sensor	**U**	The actual temperature read by the selected sensor can be viewed at this parameter.	All		
	ThresholdFGR Gas	**S**	For gas firing, this sets the temperature that must be achieved to release the Aux 3 actuator to modulate. Has no effect if parameter "FGR-Mode" is set to time. Range = 32 to 1562 F Def = 752F Typ = 320F	60-62		
	DelaytimeFGR Gas		For gas firing, this sets the time that must elapse before the Aux 3 actuator is released to modulate. Has no effect if parameter "FGR-Mode" is set to temperature. Range = 0 to 63 minutes. Def = 300 sec Typ = 30 min			
	ThresholdFGR Oil		For oil firing, this sets the temperature that must be achieved to release the Aux 3 actuator to modulate. Has no effect if parameter "FGR-Mode" is set to time. Range = 32 to 1562 F Def = 752 F Typ =320 F			
	DelaytimeFGR Oil		For oil firing, this sets the time that must elapse before the Aux 3 actuator is released to modulate. Has no effect if parameter "FGR-Mode" is set to temperature. Range = 0 to 63 minutes. Def = 300 seconds. Typ = 30 minutes			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> System Config	LC_OptgMode	**U**	Current operating mode of the LMV. Can also be changed at: *Params&Display>Loadcontroller>Configuration>LC_OptgMode* . Note - if "Load Controller not active..." message was seen under: *Params & Display > Load Control > LC_OptgMode* , adjust this parameter to some internal mode before returning to the Load Controller menu.)	All		
	Ext Inp X62 U/I	**S**	See: *Params & Display > LoadController > Configuration > Ext Inp X62 U/I*	60-62		
Params & Display> System Config> Temp Limiter	TL_Thresh_Off		See: *Params & Display > LoadController > Controller Params > Temp Limiter > L_Thresh_Off*			
	TL_SD_On		See: *Params & Display > LoadController > Controller Params > Temp Limiter > TL_SD_On*			
	Sensor Select		See: *Params & Display > LoadController > Configuration > Sensor Select*			
	MeasureRangePtNi		See: *Params & Display > LoadController > Configuration > Inp1/2/4Sel*			
Params & Display> System Config	O2Ctrl/LimitrGas or O2Ctrl/LimitrOil		See: *Params & Display > O2 Contr/Guard > GasSettings > OptgMode*			
	LC Analog Output		See: *Params & Display > LoadController > Configuration > Analog Output > OutValueSelection*	All		
	allowed Pot.Diff		Sets the allowable differernce between channels A and B of the Actuator's Potentiometer. Range = 10 to 15. Def / Typ = 10			

Menu Path	Parameter	Level	U = User O = OEM S = Service — Descriptions / Notes	Phase	LMV51	LMV52
Params & Display> Hours Run>	GasFiring	U	These values can be adjusted at this point. Range = 0 to 999999 Reset at: *Params & Display > Hours Run > Reset* Also view at: *Params & Display > Hours Run, and at: Operation > Hours Run*	All		
	OilStage1/Mod					
	OilStage2					
	OilStage3					
	TotalHoursReset					
	TotalHours		These values CANNOT be adjusted or reset. Read Only			
	SystemOnPower					
Params & Display> Hours Run> Reset	GasFiring		These values can be RESET at this point.			
	OilStage1/Mod					
	OilStage2					
	OilStage3					
	TotalHoursReset					
Params & Display> System Config> Start counter	GasStartCount		These settings set and reset various hours run. See Operation > Start Counter.			
	OilStartCount					
	TotalStartCountR					
	TotalStartCount		These values CANNOT be adjusted or reset. Read Only			
Params & Display> System Config> Start Counter> Reset	GasStartCount		These values can be RESET at this point.			
	OilStartCount					
	TotalStartCountR					
Params & Display> Fuel Meter	Curr Flow Rate		These settings set/ reset/ and record quantities of fuel used. See *Operation > Fuel Meter* .			
	Volume Gas					
	Volume Oil					
	Volume Gas R		These settings set/ reset/ and record quantities of fuel used. See *Operation > Fuel Meter* .			
	Volume Oil R					
	Reset DateGas		This displays the DATE of the last RESET.			
	Reset DateOil					
Updating> Passwords	ServicePassword	O	The service level password can be changed here. Range = 3 to 8 characters. Def = 9876			
	OEM Password		The OEM level password can be changed here. Range = 4 to 8 characters. Def = START			
Updating	Burner ID		Burner ID must be set here. The burner ID can only be changed if be changed with OEM Access. Generally, the burner / boiler serial number is used. Range = 4-15 char ,Def = Invalid			

Menu Path	Parameter	Level	U = User O = OEM S = Service Descriptions / Notes	Phase	LMV51	LMV52
Updating> ParamsBackup> BackupInfo	Date	U	This displays the date of the last back-up.	All		
	TimeOfDay		This displays the time of day of the last back-up.			
	BU included?		This states if the Basic Unit (LMV) was included in the last back up.			
	AZL included?		This states if the AZL was included in the last back up.			
	LC included?		This states if the LC (Load controller) was included in the last back up.			
	ACT1 included?		This states if the Act 1 (Actuators 1) was included in the last back up.			
	ACT2 included?		This states if the Act 2 (Actuators 2) was included in the last back up.			
	ACT3 included?		This states if the Act 3 (Actuators 3) was included in the last back up.			
	ACT4 included?		This states if the Act 4 (Actuators 4) was included in the last back up.			
	ACT5 included?		This states if the Act 5 (Actuators 5) was included in the last back up.			
	ACT6 included?		This states if the Act 6 (Actuators 6) was included in the last back up.			
	VSD included?		This states if the VSD (Variable Speed Drive) was included in the last back up.			
	O2 included?		This states if the O2 module was included in the last back up.			
Updating> Param Backup	LMV5x -> AZL	S	Transfers a parameter set from the LMV5x to the AZL.			
	AZL -> LMV5x		Transfers a parameter set from the AZL to the LMV. Useful for transferring parameter sets to identical burners. NOTE : Each burner must have a UNIQUE burner ID for safety purposes. NOTE : When transferring parameter sets from the AZL to the LMV5, do not stop the transfer until "Backup Restore Finished Parameter BC : complete or BC : partial" is shown on the AZL screen. This could take up to 5 minutes. "backup restore is carried out" means that the back-up restore is in progress. Do not disturb the LMV5 while the back-up restore is in progress.			
Updating	Load_SW_from_PC		Enables software updates on the AZL5x with a PC tool			
PW Login	Access w-out PW	**U**	Access w-out PW (with-out PassWord). Also called **User level**.			
	Access Serv	**S**	Obtaining access rights requires the correct **Service Level** password			
	Access OEM	**O**	Obtaining access rights requires the correct **OEM Level** password			
PW Logout	PW Logout	**S**	Selection reduces access to **Access w-out PW**, also called **User level.**			
SafetyCheck Funct	LossFlameTest	**U**	Enables testing of the flame sensor input on the LMV by momentarily interrupting the flame signal.	60-62		
	SLT Test		This enables the testing of the safety limits. Range = activated, deactivated. activated - The internal load controller's setpoint AND switch-off threshold will be ignored, allowing a test of a separate high limit control or pressure relief valve. deactivated - normal operation.			
	SLT-Testload Mod		Load for the SLT test in modulating operation. Range = 0 to 100% Def = 100% Typ = 50%			
	SLT-Testload Stg		This sets the load for the SLT test in staged operation. Range = S1, S2, S3 Def = S3, Typ = S2			

Notes	
Contrast Adjust	In: *Operational Stat* > *Normal Operation* , the AZL display contrast can be adjusted. To do this, keep the Enter button depressed, and at the same time press either Select button, < or >.
Shutdown function	**Manual Lockout - A lockout can be initiated by pressing Enter and Esc simultaneously.** This functions as a built-in E-stop (emergency-stop). Lockout will be stored in the AZL .
Quick Access to Normal Operation	To go back out of the menu and check burner operation, press the 2 Select buttons, < and > simultaneously. This will take the cursor to Normal Operation, so the normal operation screen can be viewed by pressing Enter. This can be done anywhere in the menu, as long as a single parameter is not currently displayed on the screen. Pressing Esc after pressing the two select buttons will take the cursor back "in" to where it was.
Actuator positions (Only on LMV52)	When the: *Operational Stat* > *Normal Operation* screen is displayed, the Enter key can be pressed, one additional time, so that the actuator positions of all devices (O2 module VSD etc..) will be displayed.

Sequence Diagrams 4-3

The Siemens LMV5 BMS can perform a number of different burner sequences based upon how certain parameters are set. Although there are a number of parameters that affect small aspects of the burner sequence, the main parameters that affect the sequence are parameters *FuelTrainGas* or *FuelTrainOil*.

These parameters set the framework of the sequence, and are based upon the fuel train diagrams in Section 4-1. The OEM has the option of selecting one of three different gas trains with their associated sequence diagrams, and one of three different oil trains with their associated sequence diagrams.

The sequence diagrams and fuel train diagrams for Direct Spark ignition with Heavy oil have been omitted. The sequence diagrams in Section 4-3 illustrate when input and output terminals are expected to be energized or de-energized. A legend on the bottom of each page describes the various symbols used in the diagrams. The last diagram describes what positions the attached actuators are expected to achieve at the various phases. This diagram also outlines the method that is used to check the actuators position during each phase.

Notes:

1) Only one fuel select terminal can be energized. If both terminals are energized, the LMV5… will go into Lockout.
   If no terminals are energized, fuel selection is internal, though the AZL5 (*FuelSelect*) or through the ModBUS.

2) The burner on / off switch can be disabled with parameter *InputController*.
   If activated, this terminal needs to be energized to have the LMV5.. start its sequence.

3) If a LMV51 is used, the only options are CPI (Closed Position Indication) Gas and PS-VP. CPI oil is possible through the use of a time delay relay. (See Section 3-3) With an LMV52.., PS-VP, CPI gas, CPI oil, or CPI gas + CPI oil are possible.

4) The alarm can be silenced through the AZL. This alarm silence resets when the LMV5 is reset or restarted.

5) When using an LMV52.., continuous pilot is possible (*ContPilotGas/ContPilotOil*).

6) If parameter *GasPressureMin* is set to activated, the low gas pressure switch is expected to remain closed during phase 21-50 of *LO w Gasp*, ensuring adequate gas pressure for the pilot. If *GasPressureMin* is set to *Deact x OGP* mode, the low gas pressure switch is expected to remain closed only when firing gas. The *Deact x OGP* feature is only offered on the LMV52.

7) If parameter *OilPumpCoupling* is set to *Magnetcoupl*, the output for the oil pump can be energized in Phase 22 or in Phase 38, depending upon how parameter *IgnOilPumpStart* is set. If parameter *OilPumpCoupling* is set to *DirectCoupl*, the output will energize with the blower and de-energize 15 seconds after the blower de-energizes.

8) If gas valve proving is performed on startup (immediately after phase 30) the actuators will be in prepurge position. If gas valve proving is performed on shutdown (immediately after phase 62), the actuators will be in the same position as they were in phase 62. The actuators will not move during valve proving.

9) Shortly after post purge is complete, the air pressure switch must open causing input (terminal X3-02.1) to de-energize. The LMV5 will wait about 30 seconds in phase 10 (driving to home position) for the switch to open before the LMV5 goes into alarm. This done to check for welded contacts in the air pressure switch. If air pressure switch alarms are encountered in phase 10, Increasing the setpoint of the air pressure switch typically cures this problem.

10) The LMV5 can be configured for different reactions to extraneous light (a flame signal when there should not be one). Depending on how parameters *ReacExtranLight* and *ExtranLightTest* are configured, the LMV5 can lockout, block the start, or ignore extraneous light altogether.

11) If direct start is enabled and there is a call for heat after phase 62, the LMV5… will omit phase 78 and will go to phase 79. In Phase 79, the LMV5… will check the blower air pressure switch with the blower still running by using a three-way solenoid valve (APS checking). If the switch checks out the LMV5… will then proceed directly to Phase 24, driving to prepurge.

12) Safety Time 1 is defined as the overlap of the ignition spark and pilot valve. Safety Time 2 is defined as the overlap of the pilot valve and the main fuel valves. Interval 1 and Interval 2 are stabilization times for the pilot and main flames, respectively.

13) Continuous purge can be used for multiple burner applications where return heat may be a problem.

14) Actuator position is checked by using one of three methods. The method depends upon the phase of the sequence. Position Required to Proceed means that the actuators must achieve and hold a certain position for the sequence to proceed. Dynamic Position Checking means that the actuator is evaluated by a “time and distance from target” algorithm. The further the actuator is away from its target, the less time the actuator is permitted to be in that position. Run -Time Position Checking means that the actuator is expected to be at a certain point in a certain amount of time (based off of the run-time of the actuator).

15) For direct spark oil fuel trains, spark (ignition) can occur during prepurge if *IgnOilPumpStart* is set to Phase 22.

IMPORTANT: The Extraneous Light Test should ALWAYS be enabled for gas / oil fired boilers.
The only time parameter *ExtranLightTest* should be set to deactivated are for applications such as waste incineration.

Gas Train : DirectIgniG

		Parameter ProgramStop									**PS**			**PS**		**PS**					**PS**		**PS**							**PS**			**PS**							
				Lockout Phase	**Safety Phase**	**Home Run Pos.**	**Burner Standby**	**Safety Relay = ON**	**Release of startup, SV=ON**	**Comb. Fan = ON**	**Drive to Purge Pos.**	**Prepurge**		**Prepurge (Aux 3 drive to preP)**	**Prepurge 2 (Aux 3 FGR)**	**Drive to Ignition Pos.**	**Preignition (SPARK) = ON**		**IGN (SPARK)= OFF**	**Interval 1 (Pilot Stabilization)**		**Interval 2 (Main Stabilization)**	**Drive to Low Fire Pos.**	**Operation 1 (Norm. Operation)**	**Operation 2 (Driving to L. Fire)**		**Afterburn Time**	**Driving to Postpurge Pos.**	**Mandatory Postpurge 1**		**Optional Postpurge 3**	**Direct start**		**Evacuate**	**Atmospheric Test**	**Fill**	**Pressure test**
		Phase		**00**	**01**	**10**	**12**	**20**	**21**	**22**	**24**	**30**		**32**	**34**	**36**	**38**	**40**	**42**	**44**	**50**	**52**	**54**	**60**	**62**		**70**	**72**	**74**	**76**	**78**	**79**		**80**	**81**	**82**	**83**
								START-UP																**OPER-ATION**		**SHUTDOWN**							**GAS VALVE PROVING**			
	Terminal	**Description**										**PURGE**						**SAFETY TIME 1**																				
INPUTS	**X4-01.1**	Fuel Select Gas	Note 1				**M**						See Sequence diagram Phases 80 to 83														See Sequence diagram Phases 80 to 83											
	X3-04.1	Safety Loop (Limits)																																				
	X5-03.1	ON / OFF Switch	Note 2																																			
	N/A	Flame Signal	Note 10			**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**M**									**F**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**
	X3-02.1	Blower Air SW (APS)	Note 9			**F**		**X**	**X**		**M**																											
	X4-01.3	Blower Aux. Contact (FCC)					**X**	**X**	**X**		**M**																											
		FGR Press. SW (instead of FCC)					**X**	**X**	**X**		**M**																											
	X9-03.2	POC SW Gas (CPI)	Note 3																			**F**	**X**	**X**	**X**		**M**											
		POC SW Oil (CPI) LMV52																																				
		POC SW Gas +Oil (CPI) LMV52																				**F**	**X**	**X**	**X**		**M**											
		Press. SW Valve Proving																																		**F**	**X**
	X9-03.4	Low Gas Press SW							**M**																													
	X7-03.2 LMV52	POC SW Gas (CPI)																				**F**	**X**	**X**	**X**		**M**											
		POC SW Oil (CPI)																																				
		POC SW Gas +Oil (CPI)																				**F**	**X**	**X**	**X**		**M**											
		Start release Gas							**M**																													
	X9-03.3	High Gas Pressure SW																																				
OUTPUTS	**X3-01.1**	Fan		Continuous Purge (if used)									Start -up Valve Proving, if used.														Shut -down Valve Proving, if used.											
	X4-02.3	Ignition		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**			**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**
	X4-03.3	Start Signal		**X**	**X**	**X**	**X**	**X**																														
		3 Way Valve (APS checking)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**			**X**	**X**	**X**	**X**
		3 Way Valve (APS checking) INV.				**X**	**X**	**X**	**X**																								**X**					
	X3-01.2	Alarm	Note 4		**X**	**X**		**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**
	X9-01.1	Gas valve SV (Usually Outdoor)		**X**	**X**	**X**	**X**	**X**																			**X**	**X**	**X**	**X**	**X**	**X**					
	X8-01.1	Main fuel indicator (Gas)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**										**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**		**X**
	X9-01.4	Gas valve V1 (Main, up stream)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**										**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**		**X**
	X9-01.3	Gas valve V2 (Main, dwn. stream)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**										**X**	**X**	**X**	**X**	**X**	**X**			**X**	**X**	**X**

Legend :
- Energized
- Energized or De-energized
- **X** De-energized
- **M** Must be Energized by end of Phase
- **F** Must be De-energized by end of Phase

See the first pages of Section 4-3 for notes.

Gas Train : Pilot Gp1

		Parameter *ProgramStop*									**PS**			**PS**			**PS**					**PS**		**PS**						**PS**										
				Lockout Phase	**Safety Phase**	**Home Run Pos.**	**Burner Standby**	**Safety Relay = ON**	**Release of startup, SV=ON**	**Comb. Fan = ON**	**Drive to Purge Pos.**	**Prepurge**		**Prepurge (Aux 3 drive to preP)**	**Prepurge 2 (FGR)**	**Drive to Ignition Pos.**	**Preignition (SPARK) = ON**	**Pilot Valve = ON**	**IGN (SPARK)= OFF**	**Interval 1 (Pilot Stabilization)**	**Safety Time 2**	**Interval 2 (Main Stabilization)**	**Drive to Low Fire Pos.**	**Operation 1 (Norm. Operation)**	**Operation 2 (Driving to L. Fire)**		**Afterburn Time**	**Driving to Postpurge Pos.**	**Mandatory Postpurge 1**		**Optional Postpurge 3**	**Direct start**		**Evacuate**	**Atmospheric Test**	**Fill**	**Pressure test**
		Phase		**00**	**01**	**10**	**12**	**20**	**21**	**22**	**24**	**30**		**32**	**34**	**36**	**38**	**40**	**42**	**44**	**50**	**52**	**54**	**60**	**62**		**70**	**72**	**74**	**76**	**78**	**79**		**80**	**81**	**82**	**83**
								START-UP																**OPER-ATION**			**SHUTDOWN**								**GAS VALVE PROVING**			
	Terminal	**Description**										**PURGE**						**SAFETY TIME 1**																				
INPUTS	**X4-01.1**	Fuel Select Gas	Note 1				**M**						Start -up Valve Proving, if used. See Sequence diagram Phases 80 to 83													Shut -down Valve Proving, if used. See Sequence diagram Phases 80 to 83											
	X3-04.1	Safety Loop (Limits)																																				
	X5-03.1	ON / OFF Switch	Note 2																																			
	N/A	Flame Signal	Note 10			**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**M**									**F**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**
	X3-02.1	Blower Air SW (APS)	Note 9			**F**		**X**	**X**		**M**																										
	X4-01.3	Blower Aux. Contact (FCC)					**X**	**X**	**X**		**M**																										
		FGR Press. SW (instead of FCC)					**X**	**X**	**X**		**M**																										
	X9-03.2	POC SW Gas (CPI)	Note 3																			**F**	**X**	**X**	**X**		**M**										
		POC SW Oil (CPI) LMV52					`																														
		POC SW Gas +Oil (CPI) LMV52																				**F**	**X**	**X**	**X**		**M**										
		Press. SW Valve Proving																																		**F**	**X**
	X9-03.4	Low Gas Press SW							**M**																												
	X7-03.2 LMV52	POC SW Gas (CPI)																				**F**	**X**	**X**	**X**		**M**										
		POC SW Oil (CPI)																																			
		POC SW Gas +Oil (CPI)																				**F**	**X**	**X**	**X**		**M**										
		Start release Gas							**M**																												
	X9-03.3	High Gas Pressure SW																																			
OUTPUTS	**X3-01.1**	Fan		Continuous Purge (if used)																																	
	X4-02.3	Ignition		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**			**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**
	X4-03.3	Start Signal		**X**	**X**	**X**	**X**	**X**																													
		3 Way Valve (APS checking)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**			**X**	**X**	**X**	**X**
		3 Way Valve (APS checking) INV.				**X**	**X**	**X**	**X**																												**X**
	X3-01.2	Alarm	Note 4		**X**	**X**		**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**
	X9-01.1	Gas valve SV (Usually Outdoor)		**X**	**X**	**X**	**X**	**X**																													
	X9-01.2	Gas valve PV (Pilot Valve)	Note 5	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**					**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**
	X8-01.1	Main fuel indicator (Gas)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**										**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**		**X**
	X9-01.4	Gas valve V1 (Main)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**										**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**		**X**
	X9-01.3	Gas valve V2 (Main)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**							**X**	**X**	**X**	**X**	**X**	**X**			**X**	**X**	**X**

Legend :

- Energized
- Energized or De-energized
- **X** De-energized
- **M** Must be Energized by end of Phase
- **F** Must be De-energized by end of Phase

See the first pages of Section 4-3 for notes.

Gas Train : Pilot Gp2

		Parameter *ProgramStop*									**PS**			**PS**		**PS**					**PS**		**PS**							**PS**			**PS**							
				Lockout Phase	**Safety Phase**	**Home Run Pos.**	**Burner Standby**	**Safety Relay = ON**	**Release of startup, SV=ON**	**Comb. Fan = ON**	**Drive to Purge Pos.**	**Prepurge**		**Prepurge (Aux 3 drive to preP)**	**Prepurge 2 (FGR)**	**Drive to Ignition Pos.**	**Preignition (SPARK) = ON**	**Pilot Valve = ON**	**IGN (SPARK)= OFF**	**Interval 1 (Pilot Stabilization)**	**Safety Time 2**	**Interval 2 (Main Stabilization)**	**Drive to Low Fire Pos.**	**Operation 1 (Norm. Operation)**	**Operation 2 (Driving to L. Fire)**		**Afterburn Time**	**Driving to Postpurge Pos.**	**Mandatory Postpurge 1**		**Optional Postpurge 3**	**Direct start**		**Evacuate**	**Atmospheric Test**	**Fill**	**Pressure test**
		Phase		**00**	**01**	**10**	**12**	**20**	**21**	**22**	**24**	**30**		**32**	**34**	**36**	**38**	**40**	**42**	**44**	**50**	**52**	**54**	**60**	**62**		**70**	**72**	**74**	**76**	**78**	**79**		**80**	**81**	**82**	**83**
								START-UP																**OPER-ATION**		**SHUTDOWN**							**GAS VALVE PROVING**			
	Terminal	**Description**										**PURGE**						**SAFETY TIME 1**																			
INPUTS	**X4-01.1**	Fuel Select Gas	Note 1				**M**						See Sequence diagram Phases 80 to 83																			See Sequence diagram Phases 80 to 83						
	X3-04.1	Safety Loop (Limits)																																					
	X5-03.1	ON / OFF Switch	Note 2																																				
	N/A	Flame Signal	Note 10			**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**M**								**F**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**
	X3-02.1	Blower Air SW (APS)	Note 9			**F**		**X**	**X**		**M**																												
	X4-01.3	Blower Aux. Contact (FCC)					**X**	**X**	**X**		**M**																												
		FGR Press. SW (instead of FCC)					**X**	**X**	**X**		**M**																												
	X9-03.2	POC SW Gas (CPI)	Note 3																			**F**	**X**	**X**	**X**		**M**												
		POC SW Oil (CPI) LMV52					`																																
		POC SW Gas +Oil (CPI) LMV52																				**F**	**X**	**X**	**X**		**M**												
		Press. SW Valve Proving																																			**F**	**X**
	X9-03.4	Low Gas Press SW							**M**																														
	X7-03.2 LMV52	POC SW Gas (CPI)																				**F**	**X**	**X**	**X**		**M**												
		POC SW Oil (CPI)																																					
		POC SW Gas +Oil (CPI)																				**F**	**X**	**X**	**X**		**M**												
		Start release Gas							**M**																														
	X9-03.3	High Gas Pressure SW																																					
OUTPUTS	**X3-01.1**	Fan		Continuous Purge (if used)																																			
	X4-02.3	Ignition		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	Start -up Valve Proving, if used.	**X**	**X**	**X**			**X**	**X**	**X**	**X**	**X**	**X**	**X**	Shut -down Valve Proving, if used.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
	X4-03.3	Start Signal		**X**	**X**	**X**	**X**	**X**																															
		3 Way Valve (APS checking)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**								**X**	**X**	**X**	**X**
		3 Way Valve (APS checking) INV.				**X**	**X**	**X**	**X**																								**X**					
	X3-01.2	Alarm	Note 4		**X**	**X**		**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
	X9-01.1	Gas valve SV (Usually Outdoor)		**X**	**X**	**X**	**X**	**X**																			**X**	**X**	**X**	**X**	**X**	**X**				
	X9-01.2	Gas valve PV (Pilot Valve)	Note 5	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**					**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
	X8-01.1	Main fuel indicator (Gas)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**							**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**
	X9-01.4	Gas valve V1 (Main, up stream)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**							**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**
	X9-01.3	Gas valve V2 (Main, dwn. stream)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**							**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**

Legend :

- Energized
- Energized or De-energized
- **X** De-energized
- **M** Must be Energized by end of Phase
- **F** Must be De-energized by end of Phase

See the first pages of Section 4-3 for notes.

Oil Train : LightOilLO

	Terminal	Description		Lockout Phase	Safety Phase	Home Run Pos.	Burner Standby	Safety Relay = ON	Release of startup, SV=ON	Comb. Fan = ON	Drive to Purge Pos.	Prepurge	Prepurge (Aux 3 drive to preP)	Prepurge 2 (FGR)	Drive to Ignition Pos.	Preignition (SPARK) = ON	Pilot Valve = ON	IGN (SPARK)= OFF	Interval 1 (Pilot Stabilization)	Safety Time 2	Interval 2 (Main Stabilization)	Drive to Low Fire Pos.	Operation 1 (Norm. Operation)	Operation 2 (Driving to L. Fire)	Afterburn Time	Driving to Postpurge Pos.	Mandatory Postpurge 1		Optional Postpurge 3	Direct start
		Parameter *ProgramStop*									PS		PS		PS				PS		PS					PS			PS	
		Phase		00	01	10	12	20	21	22	24	30	32	34	36	38	40	42	44	50	52	54	60	62	70	72	74	76	78	79
								START-UP															OPER-ATION		SHUTDOWN					
												PURGE					SAFETY TIME 1													
INPUTS	X4-01.2	Fuel Select Oil	Note 1				M																								
	X3-04.1	Safety Loop (Limits)																													
	X5-03.1	ON / OFF Switch	Note 2																												
	N/A	Flame Signal	Note 10			X	X	X	X	X	X	X	X	X	X	X	M								F	X	X	X	X	X
	X3-02.1	Blower Air SW (APS)	Note 9			F		X	X		M																				
	X4-01.3	Blower Aux. Contact (FCC)					X	X	X		M																				
		FGR Press. SW (instead of FCC)					X	X	X		M																				
	X9-03.2	POC SW Gas (CPI)	Note 3																												
		POC SW Oil (CPI) LMV52																			F	X	X	X	M						
		POC SW Gas +Oil (CPI) LMV52																			F	X	X	X	M						
	X7-03.2 LMV52	POC SW Gas (CPI)																													
		POC SW Oil (CPI)																			F	X	X	X	M						
		POC SW Gas +Oil (CPI)																			F	X	X	X	M						
	X6-01.1	Start Rel. Oil (Atom. Media PS)							M																						
	X5-02.2	High Oil Press SW							M																						
	X5-01.2	Low Oil Press SW														M															
OUTPUTS	X3-01.1	Fan		Continuous Purge (if used)																											
	X4-02.3	Ignition		X	X	X	X	X	X	See Note 15								X	X	X	X	X	X	X	X	X	X	X	X	X
	X6-02.3	Oil Pump Motor Starter		X	X	X	X	X	X	See Note 7															X	X	X	X	X	X
	X4-03.3	Start Signal		X	X	X	X	X																							
		3 Way Valve (APS checking)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		3 Way Valve (APS checking) INV.				X	X	X	X																						X
	X3-01.2	Alarm	Note 4		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	X6-03.3	Oil valve SV (or Atom. Media)		X	X	X	X	X																		X	X	X	X	X
	X8-01.2	Main fuel indicator (Oil)		X	X	X	X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	X
	X8-02.1	Oil valve V1 (Main)		X	X	X	X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	X
	X8-03.1	Oil valve V1 (Main)		X	X	X	X	X	X	X	X	X	X	X	X	X									X	X	X	X	X	X
	X7-01.3	Oil valve V2 (Staged, load depen.)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
	X7-02.3	Oil valve V3 (Staged, load depen.)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X

Legend :

- Energized
- Energized or De-energized
- X — De-energized
- M — Must be Energized by end of Phase
- F — Must be De-energized by end of Phase

See the first pages of Section 4-3 for notes.

Oil Train : LO w Gasp

	Terminal	Description		Lockout Phase	Safety Phase	Home Run Pos.	Burner Standby	Safety Relay = ON	Release of startup, SV=ON	Comb. Fan = ON	Drive to Purge Pos.	Prepurge	Prepurge (Aux 3 drive to preP)	Prepurge 2 (FGR)	Drive to Ignition Pos.	Preignition (SPARK) = ON	Pilot Valve = ON	IGN (SPARK)= OFF	Interval 1 (Pilot Stabilization)	**Safety Time 2**	Interval 2 (Main Stabilization)	Drive to Low Fire Pos.	Operation 1 (Norm. Operation)	Operation 2 (Driving to L. Fire)	Afterburn Time	Driving to Postpurge Pos.	Mandatory Postpurge 1		Optional Postpurge 3	Direct start
	Parameter ***ProgramStop***										**PS**		**PS**		**PS**				**PS**		**PS**					**PS**			**PS**	
	Phase		**00**	**01**	**10**	**12**	**20**	**21**	**22**	**24**	**30**	**32**	**34**	**36**	**38**	**40**	**42**	**44**	**50**	**52**	**54**	**60**	**62**	**70**	**72**	**74**	**76**	**78**	**79**
							START-UP															**OPER-ATION**		**SHUTDOWN**					
											PURGE					**SAFETY TIME 1**														
INPUTS	**X4-01.2**	Fuel Select Oil	Note 1				**M**																							
	X3-04.1	Safety Loop (Limits)																												
	X5-03.1	ON / OFF Switch	Note 2																											
	N/A	Flame Signal	Note 10			**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**M**								**F**	**X**	**X**	**X**	**X**	**X**
	X3-02.1	Blower Air SW (APS)	Note 9			**F**		**X**	**X**		**M**																			
	X4-01.3	Blower Aux. Contact (FCC)					**X**	**X**	**X**		**M**																			
		FGR Press. SW (instead of FCC)					**X**	**X**	**X**		**M**																			
	X9-03.2	POC SW Gas (CPI)	Note 3																											
		POC SW Oil (CPI) LMV52																		**F**	**X**	**X**	**X**	**M**						
		POC SW Gas +Oil (CPI) LMV52																		**F**	**X**	**X**	**X**	**M**						
	X9-03.4	Low Gas Press SW	Note 6						**M**																					
	X7-03.2 LMV52	POC SW Gas (CPI)																												
		POC SW Oil (CPI)																		**F**	**X**	**X**	**X**	**M**						
		POC SW Gas +Oil (CPI)																		**F**	**X**	**X**	**X**	**M**						
	X6-01.1	Start Rel. Oil (Atom. Media PS)						**M**																						
	X5-02.2	High Oil Press SW						**M**																						
	X5-01.2	Low Oil Press SW													**M**															
OUTPUTS	**X3-01.1**	Fan		Continuous Purge (if used)																										
	X4-02.3	Ignition		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**			**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
	X6-02.3	Oil Pump Motor Starter		**X**	**X**	**X**	**X**	**X**	**X**	See Note 7															**X**	**X**	**X**	**X**	**X**	**X**
	X4-03.3	Start Signal		**X**	**X**	**X**	**X**	**X**																						
		3 Way Valve (APS checking)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
		3 Way Valve (APS checking) INV.				**X**	**X**	**X**	**X**																					**X**
	X3-01.2	Alarm	Note 4		**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
	X6-03.3	Oil valve SV (or Atom. Media)		**X**	**X**	**X**	**X**	**X**																		**X**	**X**	**X**	**X**	**X**
	X9-01.1	Gas valve SV (Usually Outdoor)		**X**	**X**	**X**	**X**	**X**												**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
	X9-01.2	Gas valve PV (Pilot Valve)	Note 5	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**				**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
	X8-01.2	Main fuel indicator (Oil)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**						**X**	**X**	**X**	**X**	**X**	**X**
	X8-02.1	Oil valve V1 (Main)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**						**X**	**X**	**X**	**X**	**X**	**X**
	X8-03.1	Oil valve V1 (Main)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**						**X**	**X**	**X**	**X**	**X**	**X**
	X7-01.3	Oil valve V2 (Staged, load depen.)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
	X7-02.3	Oil valve V3 (Staged, load depen.)		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**

Legend :

- Energized
- Energized or De-energized
- **X** De-energized
- **M** Must be Energized by end of Phase
- **F** Must be De-energized by end of Phase

See the first pages of Section 4-3 for notes.

Oil Train : HO w Gasp

	Terminal	Description		Lockout Phase	Safety Phase	Home Run Pos.	Burner Standby	Safety Relay = ON	Release of startup, SV=ON	Comb. Fan = ON	Drive to Purge Pos.	Prepurge	Prepurge (Aux 3 drive to preP)	Prepurge 2 (FGR)	Drive to Ignition Pos.	Preignition (SPARK) = ON	Pilot Valve = ON	IGN (SPARK)= OFF	Interval 1 (Pilot Stabilization)	Safety Time 2	Interval 2 (Main Stabilization)	Drive to Low Fire Pos.	Operation 1 (Norm. Operation)	Operation 2 (Driving to L. Fire)	Afterburn Time	Driving to Postpurge Pos.	Mandatory Postpurge 1		Optional Postpurge 3	Direct start
		Parameter *ProgramStop*									PS		PS		PS				PS		PS					PS			PS	
			Phase	00	01	10	12	20	21	22	24	30	32	34	36	38	40	42	44	50	52	54	60	62	70	72	74	76	78	79
								START-UP															OPER-ATION		SHUTDOWN					
												PURGE					SAFETY TIME 1													
INPUTS	X4-01.2	Fuel Select Oil	Note 1				M																							
	X3-04.1	Safety Loop (Limits)																												
	N/A	Internal Temperature Limit																												
	X5-03.1	ON / OFF Switch	Note 2																											
	N/A	Flame Signal	Note 10			X	X	X	X	X	X	X	X	X	X	X	M								F	X	X	X	X	X
	X3-02.1	Blower Air SW (APS)	Note 9			F		X	X		M																			
	X4-01.3	Blower Aux. Contact (FCC)					X	X	X		M																			
		FGR Press. SW (instead of FCC)					X	X	X		M																			
	X9-03.2	POC SW Gas (CPI)	Note 3																											
		POC SW Oil (CPI) LMV52																			F	X	X	X	M					
		POC SW Gas +Oil (CPI) LMV52																			F	X	X	X	M					
	X9-03.4	Low Gas Press SW	Note 6						M																					
	X7-03.2 LMV52	POC SW Gas (CPI)																												
		POC SW Oil (CPI)																			F	X	X	X	M					
		POC SW Gas +Oil (CPI)																			F	X	X	X	M					
	X6-01.1	Start Rel. Oil (Atom. Media PS)							M																					
	X5-02.2	High Oil Press SW							M																					
	X5-01.2	Low Oil Press SW														M														
OUTPUTS	X3-01.1	Fan		Continuous Purge (if used)																										
	X4-02.3	Ignition		X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X
	X6-02.3	Oil Pump Motor Starter		X	X	X	X	X	X	See Note 7															X	X	X	X	X	X
	X4-03.3	Start Signal		X	X	X	X	X																						
		3 Way Valve (APS checking)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		3 Way Valve (APS checking) INV.				X	X	X	X																					X
	X3-01.2	Alarm	Note 4		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	X6-03.3	Oil valve SV (or Atom. Media)		X	X	X	X	X																		X	X	X	X	X
	X9-01.1	Gas valve SV (Usually Outdoor)		X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X
	X9-01.2	Gas valve PV (Pilot Valve)	Note 5	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X
	X8-01.2	Main fuel indicator (Oil)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	X
	X8-02.1	Oil valve V1 (Main)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	X
	X8-03.1	Oil valve V1 (Main)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	X
	X7-01.3	Oil valve V2		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	X	X	X
	X7-02.3	Oil valve V3 (Staged, load depen.)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X

Legend :

- Energized
- Energized or De-energized
- X — De-energized
- M — Must be Energized by end of Phase
- F — Must be De-energized by end of Phase

See the first pages of Section 4-3 for notes.

Actuators

Parameter *ProgramStop*										PS			PS		PS				PS		PS						PS			
	Lockout Phase	Safety Phase	Home Run Pos.	Burner Standby	Safety Relay = ON	Release of startup, SV=ON	Comb. Fan = ON	Drive to Purge Pos.	Prepurge		Prepurge 2 (FGR)	Drive to Ignition Pos.	Preignition (SPARK) = ON	Pilot Valve = ON	IGN (SPARK)= OFF	Interval 1 (Pilot Stabilization)	Safety Time 2	Interval 2 (Main Stabilization)	Drive to Low Fire Pos.	Operation 1 (Norm. Operation)	Operation 2 (Driving to L. Fire)	Afterburn Time	Driving to Postpurge Pos.	Mandatory Postpurge 1		Optional Postpurge 3	Direct start	Evacuate	Atmospheric Test	Fill	Pressure test
Phase	00	01	10	12	20	21	22	24	30	32	34	36	38	40	42	44	50	52	54	60	62	70	72	74	76	78	79	80	81	82	83
					START-UP															OPER-ATION		SHUTDOWN						GAS VALVE PROVING			
									PRE-PURGE					SAFETY TIME 1										POST-PURGE							
Air, Aux 1 and 2, VSD																															
Expected Position		U			H			T	PrP			T		I					T	M	T	S	T	PsP				Note 8			
Position Required to Proceed			■	■	■	■	■		■				■	■	■	■	■	■						■			■	■	■	■	■
Dynamic Position Checking																				■											
Run-Time Position Checking								■				■							■		■					■					
Gas / Oil or Oil																															
Expected Position		U			H							T		I					T	M	T	S	T	PsP				Note 8			
Position Required to Proceed			■	■	■	■	■		■	■	■		■	■	■	■	■	■						■	■		■	■	■	■	■
Dynamic Position Checking																				■											
Run-Time Position Checking								■				■							■		■					■					
Aux 3																															
Expected Position		U			H					T	PrP	T		I					T	M	T	S	H	T	PsP			Note 8			
Position Required to Proceed			■	■	■	■	■		■		■		■	■	■	■	■	■					■	■		■	■	■	■	■	■
Dynamic Position Checking																				■											
Run-Time Position Checking								■		■		■							■		■	■			■						

Legend :

- ■ Position Checked by stated method
- □ Position not checked
- **U** Undefined Position
- **H** Home Position
- **T** Actuators Transitioning
- **PrP** Prepurge Position
- **I** Ignition Position
- **M** Actuators Modulating
- **S** Actuators Stopped
- **PsP** Postpurge Position

See the last pages of section 4-1 for notes.

Section 5 Troubleshooting

Common Problems 5-1

The most frequent source of problems concerning the LMV5 is wiring errors, followed closely by parameter setting errors.

This section details the most commonly seen problems, along with the most common solutions to these problems. Section 5-2 includes a list of error codes that have associated corrective actions.

CANBus Wiring

The majority of all wiring errors are related to the CANBus.

The CANBus system includes: the AGG5.210 transformer, the two 12VAC fuses in the LMV5, the AZL5, the special CANBus cable, the actuators, additional transformers (if required), and the O2 module (if equipped).

If an error occurs with any CANBus connected device, the following 5 items should be checked:

1) The wiring on the AGG5.210 transformer, specifically how the four pin connector X52 is wired to the LMV5. Most problems occur on Pins 3 and 4 of the transformer. Pin 3 on the transformer and terminal X52.4 on the LMV5 should be wired to PE (Protective Earth or Panel Ground). Pin 4 on the transformer should be wired to X52.3. (See Wiring, Section 3)

2) The CANBus connection between the AZL and the LMV5 is factory pre-made, has different color wires, and is 9 foot long. The CANBus connection between the LMV5 and any actuator or PLL module is: 12VAC1 Red 16 AWG, 12VAC2 Black 16 AWG, CANH Blue 24 AWG, CANL White 24 AWG, GND Green 20 AWG, and shield. Ensure that no wire strands from adjacent pins on the CANBus plugs make contact. No conductors, only insulation should be visible when viewing a properly terminated CANBus green plug.

3) The shielding of the special CANBus cable. The shielding of this cable is immediately under the plastic sheathing of the cable and the shielding encircles all the conductors. All shielding, on all segments, of the CANBus cable must have continuity with terminals X51.1 (for the actuators, O2 module) or X50.1 (for the AZL). This can be checked with a multi-meter connecting one probe on the shielding clip attached to terminal X50.1, and one probe on the last device of the CANBus. Shielding clips (AGG5.110) are required (one for X51 and if not using a pre-made AZL cord, one for X50) to mount and terminate the shield of the CANBus cable on the LMV5 end. The continuity of the shield is maintained thru each of the actuators and / or O2 module by using the metal shielding clamps provided on each device.
(See wiring, Section 3)

4) CANBus fuses, FU2 and FU3, located on the right hand side of the LMV5. Check that these fuses are not blown. If any are blown, check the wiring for incorrect terminations. Also check the area of the cable where the sheathing was stripped. It is possible that a knife was used to cut the sheathing, and that the knife penetrated through the cable sheath, the shielding, and the insulation on 12VAC1 or 12VAC2. If the shield makes contact with either 12VAC1 or 12VAC2 a short will result. This will blow fuses, and can damage actuators or O2 module.

5) Electrical loading of the CANBus. The 12VAC1 and 12VAC2 power is supplied by the AGG5.110 transformer connected to the LMV5. The output of one transformer is sufficient for many applications, but some may require two transformers. CANBus loading can be determined useing of the CANBus loading table, found in Section 3-1.
Wiring of the second transformer can be found in Section 3-3.

CANBus Wiring "*AZL not on Bus*"

When the AZL5 displays "*AZL not on Bus*", or is stuck in "*System Test*", this is typically means that there is a voltage problem on the CANBus. This usually does not mean that the AZL5 needs to be replaced. Make sure that the neutral and chassis ground are bonded, meaning having no electrical potential (voltage) between them. The 5 points mentioned on the previous page should also be checked, especially points 1, 2 and 4.

It is possible that one or more actuators are being overloaded and are consuming too much power from the CANBus. Voltage should be checked by probing the CANBus terminals.

There should be 12 volts AC between 12VAC1 and GND.
There should also be 12 volts AC between 12VAC2 and GND.
Voltage between 12VAC1 and 12VAC2 should measure 24VAC.
If the voltage is significantly less than these values, the CANBus is overloaded, a short exists, a fuse is blown, or some part of the CANBus is improperly wired.

It is much easier to troubleshoot the CANBus in pieces rather than all devices at once.

When a CANBus problem is discovered, all actuators and the O2 module can be disconnected, so that ONLY the AZL5 is connected to the LMV5.
The actuators / O2 Module can then be connected one by one, to see when the CANBus fault appears. This method is easy to perform since the actuators / O2 Module have plugs that can be connected and disconnected with ease.

Grounding

The second largest category of wiring problems concerns the grounding and the shielding of LMV5 components.

The LMV5 has three different types of ground, each with a different function. The three types are:

1) **Protective earth or chassis ground (PE)**
2) **Functional Earth or Shield (FE)**
3) **Reference Ground (Labeled as 0, M, or GND, hereafter labeled as 0)**

All PE's that exist on the forward facing plugs (white plugs) of the LMV5 are bonded together.

All 0's that exist (green plugs) are internally bonded.

FE's are bonded to one another on the individual internal circuit boards of the LMV5, and are then bonded to the 0's with capacitors on each individual board.

At the 12VAC transformer's 4 pin SEK2 plug, Pins 2 and 3 are tied together, thus connecting 0 and FE directly on the circuit board that has the CANBus connectors. It is highly recommended that SEK2 Pin 3 on the transformer, and X52.4 are connected to chassis ground (PE), effectively connecting 0 to chassis ground (PE). This also connects 0 and PE directly to FE, on the CANBus board only. FE on other boards is isolated from 0 with capacitors.

In short, FE are exclusively for cable shields, 0 is the reference ground for all low voltage sensors, and PE should be connected to the main grounding lug (main chassis ground).

Note: The main step down (480VAC to 120 VAC) transformer must have the neutral and chassis ground bonded together on the low voltage (120VAC) side.

All other devices connected to the LMV5 (such as a VSD and blower motors) must also be grounded to chassis ground.

Load Controller Modes & Sensors

The LMV51.140 and LMV52 both have a load controller that can read press / temp directly.
The LMV51.040 must be used with a floating/bumping external load controller, such as a RWF40.

When the LMV5 load controller is configured, different inputs are expected on different terminals:

If an analog press/temp sensor is used, Input 2, Term X61.2 or X61.3 is required.
If remote setpoint / remote modulation is used, Input 3, Term X62.2 or X63.3 is required.
If RTD temp sensor(s) are used, Input 1, Term X60.1, or Input 4 Term X60.3 is required.

If an analog signal does not exist on the previously motioned terminals when the mode is selected (0 mA when 4-20mA is selected, for example) the LMV5 will fault. See section 3-3 for wiring.

If the incorrect mode of load controller is selected for the connected instrumentation or analog signal, the LMV5 will fault.

Figure 5-1.1 details which terminals should have sensors wired for the given load controller mode.

Figure 5-1.1 Required sensors for Load Controller mode

Mode	Label	Description	Expected Input Terminals (See Section 3-3)
1	ExtLC X5-03	External Load Control Floating / Bumping	X5-03.02 and X5-03.03
2	IntLC	Internal Load Control Temp. or Press. sensor connected to LMV5	Temperature X60.1, X60.2, X60.3, X60.4 **OR** Pressure X61.1, X61.2, X61.3, X61.4
3	Int LC bus	Internal Load Control Temp. or Press sensor connected to LMV5 remote setpoint via Modbus	Temperature X60.1, X60.2, X60.3, X60.4 **OR** Pressure X61.1, X61.2, X61.3, X61.4 **ALSO** Modbus Connection
4	Int LC X62	Internal Load Control Temperature or Pressure sensor connected to LMV5 remote setpoint via analog input	Temperature X60.1, X60.2, X60.3, X60.4 **OR** Pressure X61.1, X61.2, X61.3, X61.4 **ALSO** Analog input X62.2, X62.3, X62.4
5	ExtLC X62	External Load Control analog signal connected to X62	Analog input X62.2, X62.3, X62.4
6	ExtLC Bus	External Load Control via ModBus	Modbus Connection

On a steam boiler, a temperature sensor can be used in addition to the pressure sensor, for the cold start function.

In this case, an input is expected for both, a pressure sensor and a temperature sensor in modes 2 thru 4.

Load Controller General

If faults occur with the load controller, first consult Figure 5-1.1 to ensure that there are not mode sensor or signal conflicts.

1) Next, check to see that the wiring of the sensors is in accordance with Section 3-3.
2) If this fails to cure the problem, verify the analog signal to the LMV5.
3) Replace the sensors if necessary.

Note: On older LMV5's, in mode 5 or mode 6 (ExtLC modes), parameter path: *Params&Display>Load Controller>Controller >Configuration>LC_OptgMode* **is not accessable**. To change the load controller settings, use: *Params&Display>System Config>LC_OptgMode.*

Flame Detector

The flame detector wiring is typically another frequent source of wiring errors. These errors are due a misunderstanding of the markings on plug X10-02, and the LMV5 terminals.

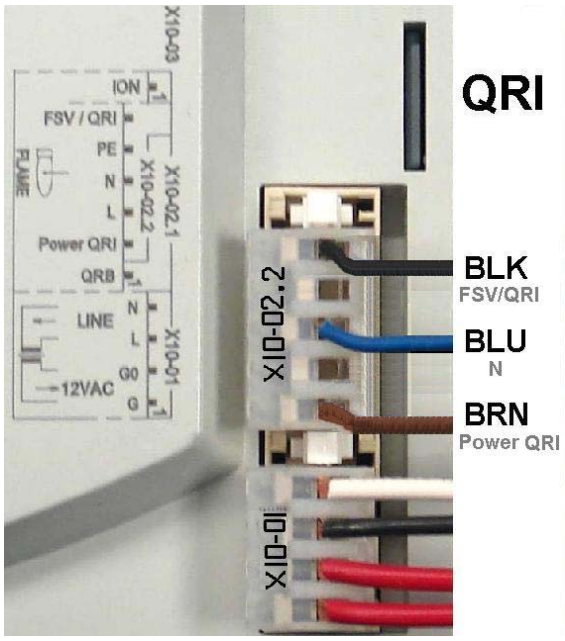
The plug that is typically furnished with the LMV5 only covers terms X10-02.2 to X10-02.6. Terminal X10-02.1 and terminal X10-03.1 are not included in the X10-02.2 plug.

There are 2 open terminals, X10-02.1 and X10-03.1.

Never subject the QRI flame scanner to line voltage.

If Pin 6 QRI SIG, is subjected to line voltage, it will destroy the QRI, and it will damage the LMV5, and must to be replaced. Also see Section 3-3.

Figure 5-1.2 Plug X10-02.2 as it would be seen plugged into an LMV5



Safety loop

1) The safety loop wired between terminals X3-04.2 and X3-04.1 is meant for safety limits only, such as auxiliary low water cut out and the high limit.

2) On occasion, operating (cycling) switches are wired into this loop - this is incorrect. If a cycling switch is placed in this loop, and cycles off, the LMV5 will lockout.

3) If an external load controller (such as a RWF40) is used, or the LMV5 load controller is in any external load controller modes (*ExtLC* modes 1, 5, 6), then a cycling switch should be put in series with the burner on /off switch wired to X5-03.1.

4) If any of the internal load controller modes are used (*IntLC* modes 2, 3, 4) then a cycling switch wired to X5-03.1 is not necessary, since this is done automatically in the LMV5.

5) The parameter *InputController* can activate or deactivate terminal X5-03.1. See section 4-2

6) If a burner flange (oil drawer) switch is not used, a jumper must be placed between terminals X3-03.1 and X3-03.2. If this is not done, a fault will occur stating that the safety loop is open.

Other Common Errors

LMV5 will not start (stays in phase 12).

1) Verify that ignition positions are defined for all activated actuators, including the VSD.

2) Verify the following:

Parameter Note: Refer to section 4-2		Safety Loop	Flange	Alarm	Burner switch				***SD_ModOn*** vs Act Value	
Terminal >		**X3-04.1**	**X3-03.1**	**X4-01.4**	**X5-03.1**					
Parameter >	***LC_ OptgMode***				***Input Controller***		***Auto/Manual/Off***		***SD_ ModOn***	**Act Value**
Value >					**activated**	**deactivated**	**Automatic**	**Burner on**		
(external)	**ExtLC X5-03**	120 VAC	120 VAC	0 VAC	120 VAC	120 VAC	120 VAC	120 VAC	Don't care	
(W1 setpoint)	**IntLC**	120 VAC	120 VAC	0 VAC	120 VAC	Don't care	120 VAC	Don't care	***Setpoint*** + ***SD_ModOn*** above Act Value	
(bus setpoint)	**IntLC bus**	120 VAC	120 VAC	0 VAC	120 VAC	Don't care	120 VAC	Don't care	***Setpoint*** + ***SD_ModOn*** above Act Value	
(X62 setpoint)	**IntLC X62**	120 VAC	120 VAC	0 VAC	120 VAC	Don't care	120 VAC	Don't care	***Setpoint*** + ***SD_ModOn*** above Act Value	
(external)	**ExtLC X62**	120 VAC	120 VAC	0 VAC	120 VAC	120 VAC	120 VAC	120 VAC	Don't care	
(external)	**ExtLC Bus**	120 VAC	120 VAC	0 VAC	120 VAC	120 VAC	120 VAC	120 VAC	Don't care	

3) If a low or high gas pressure fault occurs every time the gas valves attempt to open, it is possible that the commons to the high and low gas pressure switches are wired through the proof of closure switches on the gas valves. Thus, power will be removed from the high and low gas pressure switch commons when the gas valves open.

4) If terminal X4-01.4 (alarm) is energized when a fault does not exist on the LMV5, this will cause a manual lockout of the LMV5.

5) If indication of the gas and / or oil valve is desired, terminals X8.01.1 (gas) and X8.02.2 (oil) must be used for this function. Indicator lamps and other devices must not be wired directly to the gas valve and / or oil valve terminals.

6) If a single lamp is used such as “main burner on”, a relay (or switch) must be used that changes state with the fuel selector switch, so that **only** X8.01.1 is connected to the indicator when firing gas and **only** X8.01.2 is connected to the indicator when firing oil.

LMV5 will not modulate properly

1) Check the PID settings, as a too small for P (Proportional band) can cause this.

2) Check the load mask parameters (under each fuel) .
Default values are: *LoadMaskLow* = 0%, *LoadMaskHigh* = 0%.

3) If the LMV5 goes to high fire in phase 52, check parameter StartPointOp (under each fuel).
Default value = xx, and should be typically set to = 1 (Low fire) Requires AZL ver 4.50.

Oxygen Monitor / Trim / Efficiency Calculation

The LMV52 has the capability of integrated O2 trim and / or O2 monitoring. The O2 trim system includes the PLL52 module and the QGO20 O2 sensor as well as optional stack / ambient temperature sensors that can be used for an efficiency calculation. Common problems and the related solutions include:

O2 sensor is not reading

Displayed as "XXXX" on the AZL screen, or is reading incorrectly check the following:

1) Ensure that the QGO20 O2 sensor is activated.
   This can be done under:
   Params & Display > O2 Module > Configuration > O2 sensor.

2) If the QGO20 is activated, check the temperature of the QGO20 sensor.
   The sensor will not sense % O2 if the sensor is below 1202 ^{o}F (650 ^{o}C).

   The PLL52 module controls the QGO20 sensor's heater to achieve a sensor temperature of approximately 1292 ^{o}F.
   The temperature can be checked under:
   Params & Display > O2 Module > Displayed Values > QGO SensorTemp.
   The sensor heating load can also be viewed under the Displayed Values menu.

   QGO Maximum heating load is 60%. If the heating load is at 60% and the QGO20 is not at least above 1202 ^{o}F after initial heat up, stack velocity may be too high, thus cooling the sensor. Maximum stack velocity is 33 ft / second.

   (See Section 2 for mounting restrictions on the QGO20 Sensor)

Note: The QGO20 sensor can take up to two hours to achieve operating temperature on the first start-up.
Anytime the LMV5 system / PLL52 has power and parameter O2 sensor is set to activated, the PLL52 will try to maintain the QGO20 at approximately 1292 ^{o}F.

O2 sensor reading grossly high or low

Check the following:

1) The milli-volt signal from the QGO20 to the PLL52 could have interference.
   Ensure that the high and low voltages wires that run from the PLL52 to the QGO20 are in separate conduits.

2) The wires for the QGO20 heating element are high voltage (120 VAC),
   and the wires for the O2 signal and thermocouples are very low voltage (200 mV max).
   Interference is almost sure to result if the high and low voltages are run in the same conduit.

Note: The QGO20 sensor reads %O2 wet.

Most combustion analyzers read %O2 dry, so the O2 number that appears on the AZL5 is typically at least 1% O2 lower than the combustion analyzer.

See table in Section 6 for approximate values.

O2 sensor reads but responds very slowly

Check the following:

1) Ensure that the QGO20 sensor is clean. This can be done by shutting off the power to the LMV52, and removing the QGO20 from the stack.

2) **Be Careful !!** The sensor is likely to be very hot.
   After the QGO20 is removed from the stack,
   let it cool for at least an hour (it will cool with power off to the LMV52).

   After this time, the sensor can be blown out using low pressure
   (less than 15 PSIG) compressed air.
   If this blowout is done when the QGO20 senor is hot,
   the ceramics inside the senor will most likely be cracked
   and the sensor will need to be replaced.

3) Check the orientation of the QGO20 sensor and the collector.
   The one notch on the collector's flange should be between the two notches
   on the sensor's flange.

   Also, ensure that the bevel of the collector is pointed into the flow.
   (See Section 2 for details on proper sensor / collector orientation)

4) Check the internal resistance of the QGO20 sensor.
   This can be read under:
   Params & Display > O2 Module > Displayed Values > QGO Resistance

   This value increases as the sensor ages. As the internal resistance increases, the response time of the sensor also increases. Absolute maximum resistance is 140 ohms.

Temperature sensor(s) reading incorrectly or not at all

If one or both of the temperature sensors wired into the PLL52 module for the ambient temperature and stack temperature are not reading,
(displayed as "XXXX" on the AZL screen) or the sensor are reading incorrectly.

Check the following:

1) Ensure that the sensors wired into the PLL52 module correctly,
   and are two wire 1000 ohm RTD.

   The Supply air temperature and the stack gas temperature sensor,
   are configurable for 1000 ohm platinum RTD and 1000 ohm Nickel RTD.

   Typically a platinum 1000 Ohm RTD is used in the stack,
   and a Nickel 1000 ohm RTD is used for the supply air.

2) Check to see that the sensors are activated and properly configured under:
   Params & Display > O2 Module > Configuration > SupAirTempSens or FlueGasTempSens

Note: The supply air temperature sensor and the stack gas temperature sensor are not necessary for O2 trim.

However, if one input or both inputs are configured for a sensor,
(set to Ni1000 or PT1000) and that sensor is not wired in or is not reading,
the O2 trim will not activate.

O2 Module not active or not Available

When attempting to go under:
Params & Display > O2 Module,
the following is displayed "*O2 Module not active or not Available*".

Check the CANBus wiring to the PLL52 Module.
If this wiring is not correct the LMV5 will not auto detect the PLL52 Module.

Point must lie 0.5 % O2 above O2 Monitor Curve

When setting the O2 Control Curve, messages are received that say "*Point must lie 0.5 % O2 above O2 Monitor Curve*" or "*Point must lie 1.0% O2 below Ratio Control Curve*".

Check the following:

1) Ensure that there is an absolute minimum of 1.6 % O2 between the O2 monitor curve and the O2 ratio control curve.

2) Also ensure that the %O2 that is to be set is at least 0.5% O2 above the O2 Monitor Curve and 1.0% O2 below the O2 ratio control curve.

3) In practice, it is much easier to make the %O2 gap between the curves larger than the absolute minimum.

   Depending on the burner characteristic, doing this may also lead to more trouble free operation.

4) If possible:

   It is preferable to have a 1 to 1.5% gap,
   between the O2 Monitor curve and the O2 Control Curve.

   It is also preferable to have a 1.5% gap,
   between the O2 Ratio control curve and the O2 Control Curve.

5) Please see Section 6 for more information in these curves.

Note: When setting up the three O2 curves,
these curves must be set using the %O2 values displayed on the AZL5.

These values are %O2 on a wet basis.

A separate combustion analyzer (which typically measures dry %O2)
is useful for reference and to monitor CO and NOx production,
but should not be used to set the three O2 curves.

Measurement of Delay time Unsuccessful

When setting low fire point, or the high fire point, on the O2 control curve, messages are received that say words to the effect of: ***Measurement of Delay time Unsuccessful***.

Check the following:

1) Verify that ***OptgMode*** is set to ***man deact***.
   Verify that ***LowfireAdaptPt*** is set to **2** (combustion curve point 2) or higher if desired.
   The high fire point cannot be changed from the highest point in your combustion curve.
2) This typically occurs at low fire when the velocity of the combustion gasses through the boiler is relatively slow. The ***Delay time*** is defined as the length of time it takes a change in the air damper position to be detected by the O2 sensor. This time is longer at low fire and shorter at high fire due to gas velocity.

   When the points on the O2 control curve are set, the LMV5 will prompt at every point with ***press enter after the O2 value has stabilized***. Pressing enter then sets the %O2 for the O2 ratio control curve.

   This problem is typically cured by waiting at least 30 seconds after the LMV5 asks ***press enter after the O2 value has stabilized***, since the problem is typically caused by a non-representative %O2 value for the O2 ratio control curve.

   Please see Section 6 for additional information.

O2 trim automatically deactivated

The LMV5 gives warnings that the O2 trim has been automatically deactivated.
There are many different problems that can cause an auto deactivation of the O2 trim system.

The most common are:

1) Go into the fault history. If the LMV5 faulted on error code B5 diagnostic code 01, this states that the sensed % O2 value has gone below the O2 Monitor curve for more than 3 seconds and the trim deactivated.

   The most common solutions to this problem are increasing the % O2 gap between the O2 control curve and the O2 monitor curve at and around the point (can be determined by the load-stamp on the fault) where the fault occurred.

   Also, Parameters O2 Offset Gas or O2 offset Oil can be increased in 0.5% increments. Parameter LoadCtrlSuspend can also be decreased in 1% increments.

   See Section 4-2 for more information on these parameters
2) If the LMV5 faulted on error code AB diagnostic code 15 or 16, check the configuration of the ambient (supply air) sensor and the stack (flue) gas sensor.

   If these sensors are activated and are not wired in or are not functioning correctly, the O2 trim will automatically deactivate immediately after it is reactivated.
3) If the LMV5 faulted on error code AB, diagnostic code 20, check the temperature of the QGO20 sensor.
   This can be found under:
   Params & Display > O2 Module > Displayed Values > QGO SensorTemp.

   The temperature should be at least 1202 ^{o}F.

   If the temperature falls below this value during prepurge or anytime during operation, the QGO20 sensor may be mounted improperly, or gas velocity may be too high or too low. See Section 2 for proper QGO20 mounting

VSD Control

The LMV52 has the ability to control different types of VSD (variable speed drive).
The most common type of VSD used with the LMV52 is the VFD (variable frequency drive), and the most common type of motor used with the VFD is the so called “synchronous” AC induction motor.

For a more in depth overview of this application, please see the fist few pages of Section 7-1.
Common problems and the related solutions include:

VFD will not operate

If the VFD will not operate the blower (blower will not spin) when the LMV52 parameter standardize is activated. Consider the following:

1) Verify that the following:
    a. The 0 / 4-20mA signal from the LMV52 to the VFD is wired correctly (LMV52 terminals X73.4 and X73.2).
    b. The run / stop contact is wired to the VFD correctly (LMV52 terminals X73.1 and X73.2)
    c. The VFD parameters are set for the motor that it driving.
    d. The VFD is spanned so that 0 or 4mA equals 0Hz and 20mA = 63Hz (60 Hz grid frequency). The reason for this is explained in Section 7.
    e. VFD is in remote mode so that it looks for a 0 / 4-20mA signal, and run / stop contact. Closing the contact should cause the VFD to operate the motor.
    f. Verify that the three-phase wiring between the VFD and motor is correct.
2) Disconnect the analog signal and run / stop contact wires between the VFD and the LMV52. Use a handheld 0 / 4-20mA source and a toggle switch to verify that the VFD responds to a contact closure and a varying 0 / 4-20mA signal.

    If the VFD does not respond, check / correct the configuration of the VFD.

    If the VFD responds to the contact closure and the varying 0 / 4-20mA signal, then go to the next step.
3) With the wires between the LMV52 and VFD still disconnected, use a multi-meter to verify that the LMV52 outputs about 19.5mA during the standarization, (see note below) and that the run-stop contact (dry contact) in the LMV52 closes, and remains closed during the standardization.

    If there is no analog signal, and the contact does not close, verify that the VSD is set to activated under : *Params & Display > Ratio control > Gas / Oil settings VSD*.
    Also ensure that the safety loop (X3-04 Pin 1 and Pin 2), and the burner flange (X3-03 Pin 1 and 2) are closed.
    The LMV5 will not standardize if an alarm is present.

Note: When standarization is activated in the LMV52, the air actuator should drive to prepurge position before the run / stop contact closes and the LMV52 puts out 19.5mA. This is done so that the blower motor has a representative load (blower moves air) during standardization.

If this does not happen automatically, make sure that the air actuator is set to air influenced and the safety loop is closed.
Depending upon what air actuator is used and what parameter “*TimeNoFlame*” is set to, the actuator could take up to 120 seconds to reach prepurge position.

4) If the VFD responds to a contact closure and a 0 / 4-20mA source, the VFD should be configured correctly.
If the LMV52 closes the run / stop contact and produces 19.5mA when put into standardize mode, then the LMV52 should be configured correctly.
Thus, the LMV52 / VFD / motor combination should operate properly, and standardize when wired back together.

VSD Standardizing

A successful standarization can be done under:
Params & Display > VSD Module >Configuration > Standardized Sp

If a number is recorded under this parameter that is close to the full speed of the motor (typically 3585 RPM, +/- 100 RPM), the standarization is successful.

If the VFD operates the blower during standardization but does not standardize successfully, consider the following:

1) Verify the following:
   a. The speed wheel is installed on the blower motor correctly (see Section 2) and the gap between the inductive sensor and the speed wheel is correct.

   b. The inductive sensor is wired to the LMV52 correctly, on terminals (X70.1, X70.2 and X70.3)

   c. The yellow LED on the back of the inductive sensor should blink every time a speed wheel “finger” passes by the nose of the sensor. If it does not blink, the sensor is wired incorrectly or is defective.

   d. If everything is correct with the speed sensor, the real time RPM can be read under:
      Params & Display > VSD Module > Absolute Speed

      For troubleshooting purposes, the RPM can be read here during the standarization process.

2) Check to ensure that the air damper opens when the standardization is activated. If this does not happen automatically, make sure that the air actuator is set to air influenced, the safety loop is closed, and that the LMV52 is not in an alarm.

3) Check the ramp time on the LMV52 and the VFD.
   The ramp time on the VFD must be faster than the ramp rate on the LMV52.
   If the VFD ramp time is set at 30 seconds, the LMV52 ramp time should be set at least 40 seconds.
   The LMV52 ramp rates can be found under:
   Params & Display > Ratio Control > Times

   Both the *TimeNoFlame* parameter and the *OperatRampMod* parameter should be set to at least 40 seconds for a VFD ramp time of 30 seconds.

   In general, the VFD ramp time should be set about 25% faster than the LMV52 ramp time.

4) Monitor the RPM of the blower motor during the standarization process.
   After standardization is activated, the real time RPM can be read under:
   Params & Display > VSD Module > Absolute Speed

   During standarization, the indicated RPM should rise up to a peak value and hold steady at that value for a few seconds, and then drop back to zero or near zero.

   This peak value that is seen should be recorded automatically under:
   Params & Display > VSD Module >Configuration > Standardized Sp

   If this doesn’t happen, it’s likely that there’s a problem with the VFD or the speed wheel.

Fan speed not reached* or *Control range limitation VSD Module

Typically, if the LMV52 / VFD / Motor standardize successfully this system will operate correctly. However, if the standarization is successful but problems are encountered during burner operation, consider the following:

1) Ramp times. Faster ramp times on both the VFD and the LMV52, create a more demanding application for the VFD. Simply put, a faster ramp time (20 seconds instead of 40 seconds) will cause the VFD to draw or absorb much more amperage for a given change in blower speed, since the change in speed occurs more quickly.

   Ramp times that are faster than the VFD can handle can lead to over current faults on the VFD as well as error messages on the LMV52 stating "*Fan speed not reached*" or "*Control range limitation VSD Module*".
   Increasing ramp times typically helps these problems.

   Please see the next point for details on these two most common LMV52 error messages.

2) If "*Fan speed not reached* " or "*Control range limitation VSD Module*" frequently appear on the AZL5, this indicates that the LMV52 has shifted the 0 / 4-20mA as far as possible from the standardized signal and the RPM of the blower motor as read by the speed wheel is still to low or too high.

   "*Fan speed not reached*" indicates that the blower speed is still to low, even though the LMV52 has increased the 0 / 4-20mA signal as far as possible.

   This shows up as a warning on the AZL5 for the first 2 seconds, and if it the blower speed does not increase in this time a lockout will occur.

   Conversely, "*control range limitation VSD Module*" indicates that the blower speed is too high even though the LMV52 has decreased the 0 / 4-20mA signal as far as possible.

   This also shows up as a warning on the AZL5 for about 5 seconds, and if the blower speed does not decrease in this time a lockout will occur.

   If *"Fan speed not reached*" occurs when the blower is ramping up, and *"control range limitation VSD Module*" occurs when the blower is ramping down, there is a good chance that the VFD is not able to accelerate or decelerate the blower wheel quickly enough for the given ramp times.

   As was previously mentioned, extending the ramp times will help this situation.

3) Inertia of the rotating assembly (blower motor wheel and motor armature).
   As the mass and inertia of the blower wheel and motor armature increase, the power needed to accelerate (increase RPM) and decelerate (decrease RPM) increases.

   Large blower motors connected to large heavy blower wheels, typically require longer ramp times and / or VFD with high over current capability, so that "*Fan speed not reached*" or "*Control range limitation VSD Module*" lockouts do not occur.

4) The alarm input into the LMV52 from the VFD.

   The LMV52 has an alarm input terminal from the VFD, so that if the VFD is having a problem, the LMV52 can sense this and shut the burner down.

   If an Error code A9 Diagnostic code 0C is encountered, then this means that the VFD caused the LMV52 to alarm by energizing terminal X73.3 on the LMV52 with 24 VDC.

   Typically, this happens due to an over current in the VFD itself.

VSD faults Phase 10

If VSD faults are occurring in Phase 10 (home position), check the setting of Parameter “ReleaseContctVSD”.

If this is set to open, the LMV52 will simply open the run / stop contact after postpurge is complete.

If this is set to closed, the LMV52 will keep the run / stop contact closed after postpurge is complete.

1) Depending on how the VFD is configured, opening the run / stop contact after postpurge could engage a DC brake in the VFD to slow down the blower rapidly.

   If the VFD does not have this capability, opening the run / stop contact will let the blower freewheel and coast down after postpurge is complete.

   If the run / stop contact is kept closed after postpurge is complete, the VFD should bring the bower RPM down to the home position in a controlled manor.

2) Whichever option is selected, the goal is to have the blower motor RPM correct at home position, which is phase 10. Typically, home position is set to 0% VSD. If this is the case, this means that the blower must be spinning at less than 8% of the standardized RPM by the end of Phase 10 (8% of 3585 RPM = 287 RPM). The LMV52 will wait approximately 20 seconds in Phase 10 for the proper speed (if set to a percent grater than 0 % VSD) or the less than 8% speed (if set to 0 % VSD) to be reached before locking out.

3) If this problem is occurring, verify that “ReleaseContctVSD” is set to closed.

   If this does not help, reducing the blower speed and / or opening the air damper further in postpurge will help slow the blower.

   If the problem is still encountered, setting “ReleaseContctVSD” to open and adding DC braking on the VFD typically cures the problem.

Random error codes or AZL not on bus

If random error codes occur or if “*AZL not on bus*” problems occur when operating the VFD, check the following:

1) Ensure that the LMV52, the VFD, and the three phase motor are grounded to chassis ground.

   Also ensure that Pin3 of the AGG5.210 transformer and Pin X52.4 of the LMV52 are grounded to chassis ground.

2) Ensure that the wires between the VFD and the blower motor are in some type of metal conduit (flex or hard conduit).

   This is important since these wires are a rich source of EMF (Electromagnetic Field) and can adversely affect the LMV52, causing many different error codes.

   Metal conduit will contain the vast majority of the EMF.

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
				Fault with Base Unit (LMV5)	
01	01	LMV5	Internal Fault Basic Unit	ROM error	**Electromagnetic compatibility (EMC)** Improving EMC is avoiding electrical interference effects Typically this means: 1) Check grounding (most often the cause) 2) Check shielding 3) Check for loose connections 4) Check for wiring that is too close to high voltage
02	Any #	LMV5	Internal Fault Basic Unit	RAM error	
	01			RAM error in register bank 0 (LMV51...)	
	02			RAM error in IDATA area (LMV51...)	
	03			RAM error in XDATA area (LMV51...)	
	04			RAM error of variables used	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	05			RAM error variable consistency	
	06			RAM error reading back test pattern	
	07			Error RAM test code run	
03	Any #			Error in connection with data comparison (internal communication) between µC1 and µC2	
	01			TimeOut during program run synchronization prior to data transmission	
	02			TimeOut during data transmission	
	03			CRC error during data transmission	
	05			TimeOut during program run synchronization with initialization	
	10			Error counter "Flame intensity outside tolerance" has elapsed	Check flame detector signal. If ok, and fault re-occurs, replace LMV5
	11			Error counter "Target phase unequal" has elapsed	If fault occurs continously, replace LMV5
	12			Error counter "Reset-lockout input unequal" has elapsed	
	40			Fuel train unequal	
	41			Relay control word unequal	
	42			ROM-CRC signature unequal	
	43			Phase unequal	
	44			(Key + main loop counter) unequal	
04				Unsuccessful synchronization of the 2 µCs	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Flame scanner (QRI) or Base Unit (LMV5)					
05	Any #	LMV5 / Flame Dect.	Fault Flame Detector Test	Fault during test of the flame signal amplifier	If fault occurs sporadically: Improve shielding / isolation of flame detector wires. High LMV5 temperatures can also cause this fault. If fault occurs constantly: Lower LMV5 temperature, replace flame detector or replace LMV5
	01			Fault during test of the flame signal amplifier	
	02			Crosstalk fault between test pin and flame signal amplifier channel (with LMV52 FSVchannel QRI... / QRB...)	
	03			Crosstalk fault between test pin and FSV channel ION (Only LMV52)	
Fault with Base Unit (LMV5)					
06	Any #	LMV5	Internal Fault Basic Unit	Fault internal hardware tests	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	01			Fault during test of the ignition relay	
	02			Fault during test of the safety relay	
	03			Fault during voltage supervision test	
	04			Relay voltage not switched off after reset	
Fault with devices or wiring connected to the Base Unit (LMV5)					
10	Any #	Devices conn. To LMV5	Internal Fault Basic Unit	Basic unit has detected an improper circuit at one of the outputs, a faulty diode, or a short-circuit in the power supply of the contact feedback network. The diagnostic codes indicates the input affected	1) Check connections of the neutrals to all of the connected switches, valves, etc... 2) Check for capacitive loads that cause voltage to be present on the terminal after the LMV deenergizes the terminal. If voltage exists on an output terminal, such as a fuel valve, after the LMV denergizes the terminal, this will cause a fault. Voltage must drop to zero on the terminal within about 10 ms after the terminal is de-energized.
	01			Load controller on / off	
	02			Fan contact	
	03			Selection of oil-firing	
	04			Selection of gas-firing	
	05			Reset	
	06			Pressure switch oil maximum	
	07			Pressure switch oil minimum	
	08			Pressure switch valve proving	
	09			Safety valve oil feedback	
	0A			Fuel valve 1 oil feedback	
	0B			Fuel valve 2 oil feedback	
	0C			Fuel valve 3 oil feedback	
	0D			Safety valve gas feedback	
	0E			Fuel valve 1 gas feedback	
	0F			Fuel valve 2 gas feedback	
	10			Fuel valve 3 gas feedback	
	11			Safety chain burner flange	
	12			Safety relay feedback	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with devices or wiring connected to the Base Unit (LMV5)					
10	13			Pressure switch gas minimum	1) Check connections of the neutrals to all of the connected switches, valves, etc... 2) Check for capacitive loads that cause voltage to be present on the terminal after the LMV deenergizes the terminal. If voltage exists on an output terminal, such as a fuel valve, after the LMV denergizes the terminal, this will cause a fault. Voltage must drop to zero on the terminal within about 10 ms after the terminal is de-energized.
	14			Pressure switch gas maximum	
	15			Ignition transformer feedback	
	16			Fan pressure switch	
	17			Start release oil	
	18	Devices conn. To LMV5	Internal Fault Basic Unit	Heavy oil direct start	
	19			Load controller open	
	1A			Load controller closed	
	1B			Start release gas	
11	01			Basic unit has detected a short-circuit in the contact feedback network	
Fault with Connected actuators or VSD					
15	Any #	Act. / VSD Control	Fault Positioning Actuator or Fan Speed not reached	LMV5 has detected a positioning error on one or several actuators. Could also be the VSD module if equipped	**If error occurs on one actuator only** : 1) Ensure torque requirements of dampers / valves is less than Actuator output. 2) Verify that no damper / valve is bound. 3) If 1 and 2 do not solve the problem: Replace actuator. **If error occurs on multiple actuators (01-3F) :** 1) Verify that the CanBus wiring is correct. 2) Verify that shields (screens) on CanBus cable are connected properly. I**f error occurs on VSD :** 1) Check speed sensor on motor for correct installation, especially gap between sensor and wheel. 2) Check for filters, damping and or delays on the input signal to the VSD. The VSD should respond to the input signal in a linear fashion. Extend VSD and LMV5 ramp times.
	01-3F		Fault Positioning Actuator	The diagnostic value is made up of the following faults or their combinations (the individual diagnostic codes are added up in hexadecimal format) Indicated that more than one actuator / VSD has problems.	
	01	Air Act.		Positioning fault air actuator	
	02	Fuel Act.		Positioning fault fuel actuator	
	04	Aux1 Act.		Positioning fault auxiliary actuator 1	
	08	Aux2 Act.		Positioning fault auxiliary actuator 2	
	10	VSD module	Fan Speed Not Reached	The fan in combination with the VSD has not reached the required speed	
	20	Aux3 Act.	Fault Positioning Actuator	Positioning fault auxiliary actuator 3	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Base Unit (LMV5) Ratio Control, O2 Trim, VSD					
16	Any #	LMV5	Internal Fault Basic Unit	Basic unit has detected a plausibility fault in the ratio control system.The diagnostic code describes the cause of the fault.	
	00			Ratio curve of the air actuator is not fully defined	Insure that actuators that are addressed and activated have their positions defined. Check curve points to see if correct values have been entered for the actuator or VSD. Readjust the ratio curve, if required
	01			Ratio curve of the fuel actuator is not fully defined	
	02			Ratio curve of auxiliary actuator 1 is not fully defined	
	03			Ratio curve of auxiliary actuator 2 is not fully defined	
	04			Ratio curve of auxiliary actuator 3 is not fullydefined	
	05			VSD curve is not fully defined	
	0A			Calculated P-part outside the permissible range	Check parameters (P Low-Fire, I Low-Fire, Tau Low Fire, P High-Fire, I High-Fire, Tau High-Fire) These values nomally self-set when the delay time is measured. Check the values of these parameters against the maximum and minimum ranges. Readjust O2 control curve if necessary.
	0B			Calculated I-part outside the permissible range	
	0C			Calculated system delay time outside the permissible range	
	0D			Calculated O2 setpoint outside the permissible range	The O2 control curve must be 1% O2 lower than the % O2 measured at the ratio control curve, and 0.5% above the O2 guard curve. Readjust curves.
	0E			Calculated O2 min. value outside the permissible range	
	0F			Calculated O2 ratio value outside the permissible range	
	03			The load / point number predefined by the AZL… lies outside the permissible range	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	14			Calculated standardized value lies outside the permissible range	Check if the correct values have been entered for the standardized values. Readjust O2 trim control, if required, or repeat the settings
	20			With hysteresis compensation: Permissible target positioning range exceeded	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	21			The load / point number predefined by the AZL… lies outside the permissible range	
	22			With a switch instruction, none of the defined cases was satisfied	
	23			With the switch instruction, no defined ratio control phase has been identified	
	40			Unplausible target positions	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Base Unit (LMV5)					
17	Any #	LMV5	Internal Fault Basic Unit	(Internal) communication error of ELV	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	3F			Detection of different data when making the data comparison	
	01			Timeout with program synchronization prior to data transmission	
	02			Timeout with data transmission	
	03			CRC fault during data transmission	
18	Any #		Invalid Curve Data	Corruption in the combustion curve data	Vaules on curve should be within 0.0 % - 100.0 % for load and VSD, 0.0° - 90.0° for actuators. If possible, adjust curve values back into the valid range. If this fault occurs on a unit that was functioning correctly after commisioning, replace LMV5
Fault with Actuator or CANBus cabling					
19	Any #	Act.	Internal Fault Actuator	Basic unit (ratio control system) has detected a fault when comparing potentiometer channels A and B. Diagnostic code shows on which actuator the fault occurred. See diagnostic code	1) If fault occurs constantly: Replace actuator according to diagnostic code. After actuator(s) are replaced, make sure that the actuators do not "hunt" during operation. This can be done by adjusting Paramter "MinActuatorStep" and the PID loop.
	01..2F			The diagnostic value is made up of the following faults or their combinations (the individual diagnostic codes are added up in hexadecimal format)	
	01	Air Act.		Fault occurred on the indivudual actuator (see diagnostic code) when comparing potentiometer channels A and B	
	02	Active Fuel Act.			
	04	Aux 1 Act.			
	08	Aux 2 Act.			
	20	Aux 3 Act.			

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Actuator (VSD) Positioning, Actuator (VSD) Run Time					
1A	01	LMV5	Slope too steep	A section of actuator curve is too steep.	Check maximum slope sections of actuator curves. Maximum allowabe slopes are as follows: - 3.6° per 0.1 % Load (30 sec ramp) - 1.8° per 0.1 % Load (60 sec ramp) - 0.9° per 0.1 % Load (120 sec ramp) If these maximums are exceeded, adjust curve section below these maximum slopes.
1B	Any #		Operation in Parameter Setting Mode Quit	Curve Parameters (actuator curves) programming mode is still active in Phase 62 (drive to low fire and shutdown) and the target positions (normal operation) have not been reached.	When setting the curve parameters, the plant should be operated in manual mode with “Burner on“. This prevents the internal load controller from triggering the change to shutdown. Response of the internal Temperature Limiter can trigger this same fault. However, the curve point currently being set can still be stored in standby or lockout.
1C	Any #		Ignition Pos not defined	Ignition positions for activated actuators (or VSD) have not been set. See diagnostic code to indicate the faulted actuator.	Set the ignition position of the actuator(s). The ignition positions for each fuel are independent, and the positions are also independent of the low fire position.
	01..3F			The diagnostic value is made up of the following faults or their combinations (the individual diagnostic codes are added up in hexadecimal format)	
	01			Ignition position for air actuator not set.	
	02			Ignition position for active fuel actuator not set.	
	04			Ignition position for aux1 actuator not set.	
	08			Ignition position for aux2 actuator not set.	
	10			Ignition position for VSD not set.	
	20			Ignition position for aux3 actuator not set.	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Actuator (VSD) Positioning, Actuator (VSD) Run Time					
1D	Any #	LMV5/ Act./ VSD	Fault Running Time	Running time fault of actuators or VSD.	1) Check parameters (TimeNoFlame) and (OperatRampMod). These should be set to values greater than the ramping timeof the attached actuators or VSD. 2) Check connected actuators to determine if their torque rating is being exceed (stuck damper or valve etc...) 3) Check the two 12V fuses located under black covers on the right side of the LMV5 4) Check the CANBus power supply (blue or black transformer) Pin 1 and Pin 4 should have 12VAC to reference ground which is pin 2. Voltage betwen Pin 1 and Pin 4 should be 24VAC.
	01..3F			The diagnostic value is made up of the following faults or their combinations (the individual diagnostic codes are added up in hexadecimal format)	
	01	Act. / LMV5	Fault Running Time Air Actuator	Running time fault of air actuator	
	04		Fault Running Time Aux Actuator	Running time fault of auxiliary actuator 1	
	08		Fault Running Time Aux Actuator	Running time fault of auxiliary actuator 2	
	10	VSD / LMV5..	Fault Running Time VSD	Running time fault of VSD	
	20	Act. / LMV5	Fault Running Time Aux Actuator	Running time fault of auxiliary actuator 3	
1E	Any #	Act. / LMV5.. / VSD	Special Pos not reached	Basic unit has detected that 1 / several actuators (incl. VSD module) has / have not reached the special position pertaining to the Phase	1) Check connected actuators to determine if their torque rating is being exceed (stuck damper or valve etc...) 2) Check the two 12V fuses located under black covers on the right side of the LMV5 3) Check the CANBus power supply (blue or black transformer) Pin 1 and Pin 4 should have 12VAC to reference ground which is pin 2. Voltage betwen Pin 1 and Pin 4 should be 24VAC. 4) If a VSD is being used, check for filters, damping and or delays on the input signal to the VSD. The VSD should respond to the input signal in a linear fashion. See Error Code 15
	01..3F	Act.		The diagnostic value is made up of the following faults or their combinations (the individual diagnostic codes are added up in hexadecimal format)	
	01			Positioning fault of air actuator	
	02			Positioning fault of fuel actuator	
	04			Positioning fault of auxiliary actuator 1	
	08			Positioning fault of auxiliary actuator 2	
	10	VSD Sys.		VSD has not reached the speed	
	20	Act.		Positioning fault of auxiliary actuator 3	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with VSD Module					
1F	Any #	VSD Sys.	Code for VSD Module Fault	Basic unit has detected a fault in connection with the VSD module	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	01	VSD Module	Speed Acquisition faulty	Internal VSD module test was not successful	
	02	VSD Sys.	Wrong Direction of Rotation	Fan rotates in the wrong direction	1) Check to see if the motor's direction of rotation is correct. Reverse if necessary 2) Check to see if the arrow on the speed wheel points in the correct direction of rotation. Reverse if necessary.
	03		Speed Acquisition faulty	Pulse sequence and length at the speed input were different from those anticipated	1) Check and or adjust the gap between the speed wheel and the sensor. The gap shold be about 1/16" of an inch (2mm) or about two turns out. 2) Check the wiring of the speed sensor. Ensure reference ground is connected.
	04		Standardization canceled because of VSD	Fan was not able to keep the standardized speed at a constant level	
	05		Standardization canceled because of Air Actuator	Air actuator (or air influenced actuator) has not reached the prepurge position. For this reason, speed standardization is not possible	1) Check to see if all air-influencing actuators travel to the prepurge position and remain in that position for the VSD standardization. 2) Ensure torque requirements of air influencing dampers / valves is less than Actuator output. 3) Verify that no air influencing damper / valve is bound. 4) Check CanBus power suppy and CanBus fuses (FU 2 and FU3)
	06		Speed Test was not successfully completed	Internal VSD module speed test was not successful (Set parameter ***Settling Time*** to 16)	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5.
Fault with devices or wiring connected to the Base Unit (LMV5)					
21	Any #	Devices conn. To LMV5	Safety Loop open	Limit switches wired into the saftey loop have opened (such as low water or High Limit)	Check all switches wired into the saftey loop circuit. This also includes the burner flange circuit.
22	Any #		Internal Temp Limiter has responded	Internal TL has switched off because; Params&Display>Load Controller>TempLimiter>**TL_Thresh_Off** value has been exceeded.	Check the burner / boiler temperature, sensor located on Input 1 and / or Input 4, Terminal X60

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with devices or wiring connected to the Base Unit (LMV5)					
23	Any #	LMV5 / Flame Dect.	Extraneous Light on Startup	Basic unit has detected extraneous light during startup	1) Ensure that the source of extraneous light is not a flame. If it is a flame, take corrective action immediately. 2) If the QRI scanner is used, ambient light can cause an extraneous light error. Ensure sensor is viewing a dark area such as the inside of a boiler. 3) If the QRI scanner is used, check for glowing refractory. If glowing refractor is the cause, the afterburn time may need to be lengthened or a UV scanner may have to be used.
	00		Extraneous Light on Startup	Basic unit has detected extraneous light during startup	
	01… 03		Extraneous Light on Startup	(LMV52 only) Basic unit has detected extraneous light during startup 0 = QRI, 1 = ION or UV, 2 = Both	
24	Any #		Extraneous Light on Shutdown	Basic unit has detected extraneous light during shutdown	
	00		Extraneous Light on Shutdown	Basic unit has detected extraneous light during shutdown	
	01… 03		Extraneous Light on Shutdown	(LMV52 only) Basic unit has detected extraneous light during shutdown 0 = QRI, 1 = ION or UV, 2 = Both	
25	Any #	Devices conn. To LMV5/ Flame Detect.	No Flame at End of Safety Time	No flame detected at the end of safety time TSA1	1) With a piloted gas train, this means that the pliot did not light. Check wiring of ignition transformer and pilot valve. 2) Check manual shutoff valves for the pilot gas. 3) Check position of air damper. Close further if necessary. Pilot may be blowing out. 4) Check flame detector for signal in the presence of flame using a flame source. Replace if detector does not generate the anticipated signal.
	00		No Flame at End of Safety Time	No flame detected at the end of safety time TSA1	
	01… 03		No Flame at End of Safety Time	(LMV52 only) No flame detected at the end of the safety time. 0 = QRI, 1 = ION or UV, 2 = Both	
26	Any #		Loss of Flame	Loss of flame during normal operation (Phase 60-62)	1) Check flame detector for signal in the presence of flame using a flame source. Replace if detector does not generate the anticipated signal. 2) Check for flame signal "decay" as burner refractory heats up. If this happens a UV scanner may be needed.
	00			Loss of flame during normal operation (Phase 60-62)	
	01… 03			(LMV52 only) Loss of flame during operation detected. 0 = QRI, 1 = ION or UV, 2 = Both	
27	Any #	Devices conn. To LMV5 / LMV5	Air Pressure on	Air pressure = on, but should have been off	1) Make sure blower starts in Phase 22, Shuts off in Phase 78 or 83. (See sequence diagrams) 2) Check setpoint on air pressure switch. Raise setpoint if necessary. Swich should open after Postpurge. 3) If a FCC fault occurs in Phase 70, call a siemens representitive. A quecharc may be necessary.
28			Air Pressure off	Air pressure = off, but should have been on	
29			Fan Contactor Contact is on	FCC signal = on, but should have been off	
2A			Fan Contactor Contact is off	FCC signal = off, but should have been on	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with devices or wiring connected to the Base Unit (LMV5)					
2B	Any #	Devices conn. To LMV5	Flue Gas Recirculation Pressure Switch on	FGR-PS = on, but should have been off	1) Check setpoint on FGR pressure switch. Adjust if necessary. 2) If a FGR-PS fault occurs in Phase 70, call a siemens representitve.
2C			Flue Gas Recirculation Pressure Switch off	FGR-PS = off, but should have been on	
2D	Any #		Valve not open	Closed Position Indicator (CPI) = on, but should have been off	1) Check wiring to the fuel valves. With manual shutoff valves closed, ensure that the fuel valves are opening in the proper phase (see sequence diagrams) 2) Ensure CPI (POC) switches are opening when the valve opens. If this does not happen check wiring, adjust switch, or replace fuel valve actuator.
	00				
	01			(Only LMV52) CPI via terminal StartRelease_Gas Closed Position Indicator (CPI) = on, but should have been off	
2E	Any #		Valve or Closed Position Indicator (CPI) open	Closed Position Indicator (CPI) = off, but should have been on	1) Check wiring to the fuel valves. Ensure fuel valves are wired to the correct terminal (see wiring diagram) With manual shutoff valves closed, ensure that the fuel valves are opening in the proper phase (see sequence diagrams). 2) Check wiring of the CPI (POC) switches. See wiring diagram.
	00				
	01			(Only LMV52) CPI via terminal StartRelease_Gas Closed Position Indicator (CPI) = off, but should have been on	
2F	Any #		Gas Pressure has dropped below minimum Limit	Low Gas Pressure switch is open	1) Check gas supply and / or manual shutoff valves. 2) Check setpoint and or wiring of Low Gas Presure Switch.
30			Gas Pressure has exceeded maximum Limit	High Gas Pressure switch is open	1) Check pressure regulators for ruptured diaphrams. 2) Check setpoint and / or wiring of High Gas Presure Switch.

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
FAULT WITH DEVICES OR WIRING CONNECTED TO THE BASE UNIT (LMV5)					
31	Any #	Devices conn. To LMV5	Gas Pressure w Valve proving: Valve on Gas Side leaking	PS(M)-VP (Pressure Switch Valve Proving) has detected pressure between the gas valves during the atmospheric test. Switch opened when should have been closed.	1) Bubble test gas valve to ensure that the upstream valve is not leaking. If leaking, replace. 2) Ensure that the setpoint of the PS(M)-VP is 50% of the pressure upstream of V1 (upstream valve)
32			No Gas Pressure Valve Proving: Valve on Burner Side leaking	PS(M)-VP (Pressure Switch Valve Proving) has detected the absence of pressure between the gas valves during the pressure test. Switch closed when should have been open.	1) Bubble test gas valve to ensure that the downstream valve is not leaking. If leaking replace. 2) Ensure that the setpoint of the PS(M)-VP is 50% of the pressure upstream of V1 (upstream valve)
33			Oil Pressure on although Oil Pump off	Low oil pressure switch is closed when oil pump is not running.	1) Configure oil train so that low oil pressure switch is off when the oil pump is not running. 2) Check to ensure switch is wire Normally Open.
34			Oil Pressure below Minimum	Low oil pressure switch is open when oil pump is running.	1) Ensure oil pressure exists at the switch when the oil pump is running. Adjust pressure reg. if needed. 2) Check to ensure switch is wired Normally Open. Check setpoint of switch.
35			Oil Pressure above Maximum	High Oil Pressure switch is open.	1) Ensure excess oil pressure is not present at the switch. Adjust pressure reg. if needed. 2) Check to ensure switch is wired Normally Closed. Check setpoint of switch.
36			No Start Release for Oil	Switches wired to the start release oil terminal (typically the atomizing media PS) are not closed when anticipated	1) Check setpoint of switches. 2) Ensure switches are closing and opening at the correct times (see sequence diagram)
37			No direct Heavy Oil Start	Switches wired to the direct start heavy oil terminal are not closed when anticipated	
38			Lack of Gas Program	Shortage-of-gas program in progress	1) If repition counter enabled (outside north america) the LMV is wating for gas pressure to return.
FAULT WITH BASE UNIT (LMV5)					
39	Any #	LMV5	Internal Fault Basic Unit	Parameter of max. safety time faulty	If fault occurs continously, replace LMV5
	01			Fault with timer1	
	02			Fault with timer2	
	03			Fault with timer3	
3A	Any #		No Burner ID defined	No burner identification defined	Enter a unique burner Identification. Typically the burner SN.
3B	Any #		No Service Password defined	No service password defined	Enter a valid service password

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
				Fault with Base Unit (LMV5)	
40	Any #	LMV5	Internal Fault Basic Unit	Wrong contact position of SR relay	If fault occurs sporadically: Improve EMC
41	Any #			Wrong contact position of ignition	Check wiring on igniton transformer
42	Any #			Wrong contact position of BV relay	
	01..FF			The diagnostic value is made up of the following faults or their combinations (the individual diagnostic codes are added up in hexadecimal format)	1) Check to see if any source is feeding back voltage onto the input. If so eliminate the voltage source. 2)Check for switches in the saftey loop that are opening and closing again very quickly. This could be a pressure switch or a low water cut-out that is on the edge of opening and is "chattering". All outputs are powered through the saftey loop, so the microprocessor that monitors the outputs can detect this, resulting in a fault.
	01			Contact position fault SV-oil	
	02			Contact position fault V1-oil	
	04			Contact position fault V2-oil	
	08			Contact position fault V3-oil	
	10			Contact position fault SV-gas	
	20			Contact position fault V1-gas	
	40			Contact position fault V2-gas (also caused by loose neutral)	
	80			Contact position fault V3-gas	
43	Any #	LMV5	Internal Fault Basic Unit	Fault in connection with plausibility check. For cause of fault, refer to diagnostic code	If fault occurs sporadically: Improve EMC
	01			No fuel selection	Select a fuel externally (by energizing or de-energizing terminals) or selct a fuel through the AZL.
	02			No defined fuel train parameterized or undefined type of fuel	Select the proper fuel trains for gas and or oil (see section 4)
	03			Variable "Train" not defined	Select a fuel externally (by energizing or de-energizing terminals) or selct a fuel through the AZL.
	04			Variable "Fuel" not defined	
	05			Operating mode with LC not defined	
	06			Prepurge time gas too short	The time defined by PrepurgeTmeGas(Oil) is less than the time defined by parameter MinT_PrepurgeGas(Oil). Change so that PrepurgeTmeGas(Oil) is longer than MinT_PrepurgeGas(Oil). See section on settings.
	07			Prepurge time oil too short	
	08			Safety time 1 gas too long	The time defined by Max SafteyTGas(Oil) is less than the time defined by parameter SafteyTmeGas(Oil). Parameter Max SafteyTGas(Oil) can only be changed by Siemens. Lengthen SafteyTmeGas(Oil).
	09			Safety time 1 oil too long	
	0A			Ignition off time > TSA1 gas	If fault occurs sporadically: Improve EMC
	0B			Ignition off time > TSA1 oil	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with devices or wiring connected to the Base Unit (LMV5) / or Base Unit (LMV5)					
43	0C	LMV5	Internal Fault Basic Unit	Safety time 2 gas too long	The time defined by Max SafteyTGas(Oil) is less than the time defined by parameter SafteyTmeGas(Oil). Parameter Max SafteyTGas(Oil) can only be changed by Siemens. Lengthen SafteyTmeGas(Oil).
	0D			Safety time 2 gas too long	
44	Any #			Fault at deactivated inputs	Check inputs according to the diagnostic code. Disconnect wires or activate inputs for the specific application. Information concering the configuration of the terminals can be found in section 4.
	01		Controller connected but deactivated	Controller input (burner on / off switch) connected but deactivated, Terminal X5-03.01	
	02		Air Press Switch connected but deactivated	APS connected but deactivated, Terminal X3-02.01	
	03		FCC / FGR – APS connected but deactivated	FCC / FGR – PS connected but deactivated, Terminal X4-01.03	
	04		Gas Pressure min connected but deactivated	Low gas pressure switch connected but deactivated, Terminal X9-03.04	
	05		Gas Pressure max connected but deactivated	High gas pressure switch connected but deactivated, Terminal X9-03.03	
	06		Oil Pressure min connected but deactivated	Low oil pressure switch connected but deactivated, Terminal X5-01.02	
	07		Oil Pressure max connected but deactivated	High oil pressure switch connected but deactivated, Terminal X5-02.03	
	08		Start Signal Oil connectedbut deactivated	Start release oil connected but deactivated, Terminal X6-01.01	
	09		HO Start connected but deactivated	HO start connected but deactivated, Terminal X6-01.03	
	0A		Start Signal Gas connected but deactivated	Start signal gas connected but deactivated, Terminal X7-03.01	
45	Any #		Locked by SLT	Shutdown via SLT test	SLT was activated and safety shutdown was triggered (usually by the Saftey Loop Opening)

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Base Unit (LMV5)					
46	Any #	LMV5	Programstop active	Program stop was activated. System has stopped at the parameterized position	Deactivate the program stop if no longer required.
	01			Program stop in Phase 24 (driving to Prepurge position) active.	
	02			Program stop in Phase 32 (Prepurge) active	
	03			Program stop in Phase 36 (Ignition position) active	
	04			Program stop in Phase 44 (Interval 1) active	
	05			Program stop in Phase 52 (Interval 2) active	
	06			Program stop in Phase 72 (driving to Postpurge position) active	
	07			Program stopin Phase 76 (Pospurge) active	
47	Any #		No Start Release for Gas	Start release gas = off	Check the configuration of Terminal X7-03.02. Deactivate terminal if not used. See section 4 as a guide for configuration of the terminal.
48			2 Flame Signals with 1 Detector Operation	System parameterized for 1-detector operation but 2 flame signals present	Check flame detector wiring. If two detector operation is desired, configure the LMV52 for this type of operation. See section 4.
50			Internal Fault Basic Unit	Fault during key value check	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	00..07			Number of time block in which the fault was detected	
51	Any #			Time block overflow	
	00..07			Number of time block in which the fault was detected	
52	Any #			Stack error	
	01			Stack overflow	
	02			Value dropped below preset minimum limit	
	03			Test values in stack range exceeded	
53	01			Faulty reset state has occurred	
58	Any #		Parameter Set damaged	Internal communication (µC1 <> µC2)	1) Reset the LMV5 2) If fault occurred after changing a parameter, check the parameters that were last changed. 3) If fault cannot be rectified by the reset: Restore parameters form the AZL to the LMV5 4) Replace the LMV5
59				After initialization, EEPROM page is on ABORT (last parameterization was possibly interrupted due to a power failure)	
59				Page number	
5A				CRC error of a parameter page	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Base Unit (LMV5)					
5A	Any #	LMV5	Parameter Set damaged	Page number	1) Reset the LMV5 2) If fault occurred after changing a parameter, check the parameters that were last changed. 3) If fault cannot be rectified by the reset: Restore parameters form the AZL to the LMV5 4) Replace the LMV5
5B				Page is on ABORT	
5B				Page number	
5C			Parameter Backup Restore	Page is on WR_RESTO. A backup restore was made	1) Reset the LMV5
				Page number	
5D			Internal Fault Basic Unit	Page open too long	1) Reset the LMV5 2) If fault occurred after changing a parameter, check the parameters that were last changed. 3) If fault cannot be rectified by the reset: Restore parameters form the AZL to the LMV5 4) Replace the LMV5
				Page number	
5E				Page has an undefined status	
				Page number	
5F			Parameter Set damaged	Last backup restore invalid (was interrupted)	Repeat parameter set download (from AZL to LMV5)
60			Internal Fault Basic Unit	Fault when copying a parameter page	1) Reset the LMV5 2) If fault occurred after changing a parameter, check the parameters that were last changed. 3) If fault cannot be rectified by the reset: Restore parameters form the AZL to the LMV5 4) Replace the LMV5
				Number of parameter page	
61				Fault in connection with EEPROM initialization	
	01			Fault during initialization of EEPROM	
	02			Number of write attempts exceeded	
	10			EEPROM was busy when accessed	
	11			Comparison of EEPROM and RAM area revealed dissimilarity	
	12			Page area of EEPROM exceeded during write process	
	13			Access conflict µC1 <> µC2 (aritation)	
	20			Fault when calling the "ParAccess()" function	
	21			Written EEPROM block unequal RAM block	
	22			CRC of page is faulty	
	23			Matching fault µC1, µC2 when saving the error page	
70	Any #			Fault during restoring of lockout information	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	01			When reading from EEPROM (initialization)	
	02			When test writing in the initialization	
	03			No write access to error page in init.	
	04			Rep. counter "Internal fault" has elapsed	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Base Unit (LMV5)					
71	Any #	LMV5	Manual Lockout	Lockout was made manually via contact	This lockout occurs when escape and enter on the AZL are pressed simutanously. This lockout also occurs when the remote reset X4-01.4 is energized when a alarm condition does not exist.
72			Internal Fault Basic Unit	Plausibility fault in connection with fault entry	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	01			Fault in "seterr()"	
	02			Fault in "seterr()"	
	03			Fault in "error_manager()"	
	04			Fault in "storeerr()"	
Fault with Connected actuators					
80	Any #	Aux 3 Act.	Fault Feedback Aux Actuator 3	Basic unit has detected wrong state of the Aux 3 actuator	1) This fault occurs when a un-addressed actuator is connected to the CANBus. It is normal to see this fault when a un-addressed actuator is connected to the CANBus. Addressing the actuator should eliminate the fault. 2) Check CANBus cabling. Ensure that all cable shields (screens) which are located in the cable sheath are terminated correctly at each actuator, O2 module, and at the LMV5x... 3) Check each CANBus Connector to ensure proper termination (no conductors exposed on the back of the plug) 4) If fault occurs sporadically: Improve EMC. 5) If fault occurs constantly: Replace actuator according to diagnostic code.
	01			CRC error	
	02			Key error main loop counter	
	03			No feedback for max. number	
81	Any #	Air Act.	Fault Feedback Air Actuator	Basic unit has detected wrong state of the air actuator	
	01			CRC error	
	02			Key error main loop counter	
	03			No feedback for max. number	
82	#	Gas / Oil Act.	Fault Feedback Gas (Oil) Actuator	Basic unit has detected wrong state of the gas actuator	
	01			CRC error	
	02			Key error main loop counter	
	03			No feedback for max. number	
83	Any #	Oil Act.	Fault Feedback Oil Actuator	Basic unit has detected wrong state of the oil actuator	
	01			CRC error	
	02			Key error main loop counter	
	03			No feedback for max. number	
84	Any #	Aux 1 Act.	Fault Feedback Aux Actuator 1	Basic unit has detected wrong state of the auxiliary actuator	
	01			CRC error	
	02			Key error main loop counter	
	03			No feedback for max. number	
85	Any #	Aux 2 Act.	Fault Feedback Aux Actuator 2	Basic unit has detected wrong state of the auxiliary actuator	
	01			CRC error	
	02			Key error main loop counter	
	03			No feedback for max. number	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Base Unit (LMV5) or AZL5					
86	Any #	LMV5	Fault Feedback Load Controller	Basic unit has detected wrong state of the internal load controller	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	01			CRC error	
	02			Key error main loop counter	
	03			No feedback for max. number	
87	Any #	AZL5	Fault Feedback AZL	Basic unit has detected wrong state of the AZL…	1) Check CANBus cabling. Ensure that all cable shields (screens) which are located in the cable sheath are terminated correctly at each actuator, O2 module, and at the LMV5 2) Check each CANBus Connector to ensure proper termination (no conductors exposed on the back of the plug) 3) If fault occurs sporadically: Improve EMC. 4) Replace AZL5...
	01			CRC error	
	02			Key error main loop counter	
	03			No feedback for max. number	
88	Any #	All		Plausibility fault NMT	If fault occurs constantly: Replace defective AZL5…(see diagnostic code) or basic unit
	01	Air Act.	Fault Feedback Actuator	Undefined fault class of SA	
	02	LMV5	Fault Feedback Load Controller	Undefined fault class of LC	
	03	AZL5	Fault Feedback AZL	Undefined fault class of AZL	
	04	VSD module	Fault Feedback VSD Module	Undefined fault class of VSD module	
	05	O2 Mod.	Fault Feedback O2 Module	Undefined fault class of O2 module	
Fault with Connected actuators					
90	Any #	Aux 3 Act.	Fault Feedback Aux Actuator 3	Basic unit has detected a ROM-CRC error on the air actuator when checking its feedback signal	1) Check CANBus cabling. Ensure that all cable shields (screens) which are located in the cable sheath are terminated correctly at each actuator, O2 module, and at the LMV5x... 2) Check each CANBus Connector to ensure proper termination (no conductors exposed on the back of the plug) 3) If fault occurs sporadically: Improve EMC. 4) If fault occurs constantly: Replace actuator according to diagnostic code.
91		Air Act.	Fault Feedback Air Actuator	Basic unit has detected a ROM-CRC error on the air actuator when checking its feedback signal	
92		Gas / Oil Act.	Fault Feedback Gas (Oil) Actuator	Basic unit has detected a ROM-CRC error on the gas actuator when checking its feedback signal	
93		Oil Act.	Fault Feedback Oil Actuator	Basic unit has detected a ROM-CRC error on the oil actuator when checking its feedback signal	
94		Aux 3 Act.	Fault Feedback Aux Actuator 1	Basic unit has detected a ROM-CRC error on the auxiliary actuator when checking its feedback signal	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Connected actuators, Base Unit (LMV5), or AZL					
95	Any #	Aux 3 Act.	Fault Feedback Aux Actuator 3	Basic unit has detected a ROM-CRC error on the auxiliary actuator when checking its feedback signal	1) Check CANBus cabling. Ensure that all cable shields (screens) which are located in the cable sheath are terminated correctly at each actuator, O2 module, and at the LMV5x... 2) Check each CANBus Connector to ensure proper termination (no conductors exposed on the back of the plug) 3) If fault occurs sporadically: Improve EMC. 4) If fault occurs constantly: Replace actuator or AZL5. according to diagnostic code.
96		LMV5	Fault Feedback Load Controller	Basic unit has detected a ROM-CRC error on the load controller when checking its feedback signal	
97		AZL5	Fault Feedback AZL	Basic unit has detected a ROM-CRC error on the AZL… when checking its feedback signal	
98		All	Fault two equal Addresses	There are several components with the same address on the CAN bus (CAN overflow)	Check to see if two actuators are addressed identically. If so, erase the address on the incorrect actuator (hold red button down about 10 seconds) and re-address
99			Internal Fault Basic Unit	CAN is in bus off	1) Check CANBus cabling. Ensure that all cable shields (screens) which are located in the cable sheath are terminated correctly at each actuator, O2 module, and at the LMV5x... 2) Check each CANBus Connector to ensure proper termination (no conductors exposed on the back of the plug) 3) If fault occurs sporadically: Improve EMC. 4) If fault occurs constantly: Replace AZL5.., LMV5
9A	Any #			CAN warning level. Fault probably occurred when connecting or disconnecting a CAN bus user	
9B				CAN queue overrun	
	01			Overrun of RX queue	
	02			Overrun of TX queue	
A0	See A1				
A1	Any #	Air Act.	Internal Fault Air Actuator	Air actuator has detected own fault and reported it to the basic unit. Type of fault: See diagnostic code	1) Check CANBus cabling. Ensure that all cable shields (screens) which are located in the cable sheath are terminated correctly at each actuator, O2 module, and at the LMV5x... 2) Check each CANBus Connector to ensure proper termination (no conductors exposed on the back of the plug) 3) If fault occurs sporadically: Improve EMC. 4) If fault occurs constantly: Replace air actuator
	01			CRC fault during ROM test	
	02			CRC fault during RAM test	
	04			Fault during key value check	
	05			Error code for time block overflow	
	07			Sync fault or CRC fault	
	08			Error code for main loop counter	
	09			Fault during stack test	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Connected actuators					
A1	0C	Air Act.	Overtemperature Air Actuator	Temperature warning and shutdown	Check the housing temperature of the Air actuator. Max housing temperature 140 F
	0D		Internal Fault Air Actuator	Actuator turns in the wrong direction	Verify that the air damper is not bound. A bound air damper will cause the actuator to trip on overcurrent. During this short trip the actuator can be momentarily pushed backwards by torsional effects.
	0E		Ramp time too short Air Actuator	Actuator operates with too short a ramp time, or with an angular rotation that is too long for the ramp time	1) Match ramp time to the slowest connected actuator (SQM48.4 30 sec, SQM48.6 60sec.) 2) Check the CanBus power supply. Verify fuses FU2 and FU3 are ok. Verify CanBus is not overloaded. (See Section 3)
	10		Internal Fault Air Actuator	Timeout during A/D conversion	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace Air Actuator.
	11			Fault during ADC test	
	12			Fault during A/D conversion	
	13		Position Fault Air Actuator	Actuator is outside the valid angular rotation (0-90°) or linearization data are faulty	Check to see if actuator is within the valid positioning range (0-90°) When the actuator is not powered, it could be moved out of the valid positioning range. Take power off the actuator and position shaft back within the valid positioning range.
	15		Internal Fault Air Actuator	CAN fault	1) Check CANBus cabling. Ensure that all cable shields (screens) which are located in the cable sheath are terminated correctly at each actuator, O2 module, and at the LMV5x... 2) Check each CANBus Connector to ensure proper termination (no conductors exposed on the back of the plug)
	16			CRC fault of a parameter page	
	17			Page too long open	1) Reset the LMV5 2) If fault occurred after changing a parameter, check the parameters that were last changed. 3) If fault cannot be rectified by the reset: Restore parameters form the AZL to the LMV5 4) Replace the LMV5
	18			Page disrupted	
	19			Invalid parameter access	
	1B			Fault during copying of parameter page	
	1E			External plausibility fault. This type of fault covers possible faults occurring due to invalid presettings in the drive commands. In response, the presettings will be ignored	1) Check the paramters related to special positions. The special positions of each activated actuator should be programmed between 0 to 90 degrees.
	1F			Internal plausibility fault. This type of fault covers possible faults that can occur due to strong EMC impact	1) If fault occurs sporadically: Improve EMC.

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Connected actuators					
A2	See diagnostic codes for A1 error codes. These dianostic codes are identical, except they apply to the Gas / Oil Actuator.				
A3	See diagnostic codes for A1 error codes. These error codes are identical, except they apply to the Oil Actuator.				
A4	See diagnostic codes for A1 error codes. These error codes are identical, except they apply to the Aux 1 Actuator.				
A5	See diagnostic codes for A1 error codes. These error codes are identical, except they apply to the Aux 2 Actuator.				
Fault with Base Unit (LMV5) Internal Load Controler					
A6	Any #	LMV5 Load Cont. Mod.		Internal load controller has detected a fault. Type of fault: See diagnostic code	
	10		No actual Value Slope at End of Identification		If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	12		Adaption invalid	Invalid XP identified	
	13			Invalid TN identified	
	14			TU longer than identification time	
	15			Invalid TN identified	
	16		Timeout with Adaption	Timeout during observation time	PV (Process Varible) is not changing in response to firing rate during the adaption time. Adaption times out due to lack of change in the measured PV. Check sensor and thermal system.
	17		Cold Start thermal Shock Protection active	A warning indicating that the Cold Start Thermal Shock Protection (CSTP) is activated	This can be deactivated, if desired. See parameters concerning the load controller in section 4.
	18		Timeout with Adaption	Timeout during delivery of adaption rate and while process is being watched	PV (Process Varible) is not changing in response to firing rate during the adaption time. Adaption times out due to lack of change in the measured PV. Check sensor and thermal system.
	22		Setpoint Temp Controller above maximum Limit	The current setpoint (W1, W2, W3) is above the value of the Internal temperature limiter.	Raise the value of the internal temperaure limiter or decrease current setpoint.
	30		Internal Fault Load Controller	EEPROM does not respond within the expected period of time	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	31			Max. number of EEPROM attempts exceeded	
	32			Fault during opening of page	
	33			Invalid CRC when reading a page	Reset the unit. Restore parameters from AZL.
	34			Page cannot be set to FINISH	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	35			No access to PID after identification	
	36			No access to PIDStandard after identification	
	37			No reading of EEPROM write access for PID possible	
	38			No EEPROM write access for PID possible	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Base Unit (LMV5) Internal Load Controler					
A6	39	LMV5 Load Cont. Mod.	Internal Fault Load Controller	No EEPROM write access for PIDStandard possible	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	3A			No access if reception via COM	
	3B			Invalid page access	
	40			Page too long open	1) Reset the LMV5 2) If fault occurred after changing a parameter, check the parameters that were last changed. 3) If fault cannot be rectified by the reset: Restore parameters form the AZL to the LMV5 4) Replace the LMV5
	41		Internal Fault Load Controller	Invalid phase during parameterization of the safety-related page P_TW	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	42			Invalid phase during parameterization of the safety-related page P_STATUS	
	43			Invalid phase during parameterization of the safety-related page P_SYSTEM	
	44		Parameter Set damaged	Page has been set to ABORT	1) Reset the LMV5 2) If fault occurred after changing a parameter, check the parameters that were last changed. 3) If fault cannot be rectified by the reset: Download parameters form the AZL to the LMV5 4) Replace the LMV5
	45		Parameter Backup Restore	Page has been set to RESTO	
	46		Internal Fault Load Controller	Page has an invalid status	
	4A			CAN error	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	4B			CAN error	
	4C			CAN error	
	4D			CAN error	
	4E			CAN error	
Fault with Sensors Connected to Internal Load Controller, in Base Unit (LMV5)					
A6	50	LMV5 Load Cont. Mod.	Short-circuit Pt100 Sensor	Short-circuit sensor PT100 Terminals X60.1, X60.4	Check temperature sensors connected to X60 terminals.Check wiring and sensor. Re-wire or replace sensors if necessary.
	51		Open-circuit Pt100 Sensor	Open-circuit sensor PT100 Terminals X60.1 X60.4	
	52		Open-circuit Pt 100 Sensor (Line Compens)	Open-circuit compensation line of sensor PT100 Terminals X60.2 X60.4	
	53		Short-circuit Pt1000 Sensor	Short-circuit sensor PT1000 Terminals X60.3, X60.4	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Sensors Connected to Internal Load Controller, in Base Unit (LMV5)					
A6	54	LMV5 Load Cont. Mod.	Open-circuit PT1000 Sensor	Open-circuit sensor PT1000 Terminals X60.3, X60.4	Check temperature sensors wired to X60, and pressure sensors wired to X61.Check wiring and sensor. Re-wire or replace sensors if necessary.
	55		Short-circuit Ni1000 Sensor	Short-circuit sensor Ni1000 Terminals X60.3, X60.4	
	56		Open-circuit Ni1000 Sensor	Open-circuit sensor Ni1000 Terminals X60.3, X60.4	
	57		Overvoltage at Input 2	Overvoltage at input 2 Terminals X61	
	58		Open-circuit / Short-circuit at Input 2	Open-circuit / short-circuit input 2 Terminals X61 Boiler sensor (7MF) could be seeing a vacuum	
	59		Overvoltage at Input 3	Overvoltage at input 3 Terminals X62	
	5A		Open-circuit / Short-circuit at Input 3	Open-circuit / short-circuit input 3 Terminals X62	
Fault with Base Unit (LMV5) Internal Load Controler					
A6	60	LMV5 Load Cont. Mod.	Internal Fault Load Controller	Timeout during calibrate_ADC	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	61			Timeout during read_conversion	
	62			Timeout during calibrate_ADC	
	63			Fault during RedInv reading from A/D converter	
	64			Fault internal A/D converter	
	65			Gain register has been changed	
	66			Offset register has been changed	
	67			Too great / small gain for self-calibration of A/D converter	
	68			Too great / small offset for self-calibration of A/D converter	
	69			Fault internal A/D converter	
	6A			Fault during PWM test	
	6B			Faulty reference voltage	
	6C			Fault transmitter power supply	
	6D			Fault analog output, voltage deviation too great	
	6E			Fault during resistance test PT100 input (X60)	
	6F			Fault during diode test PT100 input	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Sensors Connected to Internal Load Controller, in Base Unit (LMV5)					
A6	70	LMV5 Load Cont. Mod.	External Fault Load Controller	Measured value varies too much: PT100 sensor (Terminals X60)	1) Check wiring and sensor. Re-wire or replace sensors if necessary. 2) Use shielded cable on sensor wiring. 3) Make sure that sensor wiring is not run next to high voltage AC wiring. 4) If the diagnostic code indicates excsssive voltage, check input with meter. Trace voltage source.
	71			Measured value varies too much: PT100 line (Terminals X60)	
	72			Measured value varies too much: PT1000 (Terminals X60)	
	73			Measured value varies too much: PWM	
	74			Measured value varies too much: Voltage measurement input 2 (Terminals X61)	
	75			Measured value varies too much: Voltage measurement input 2 (Terminals X61)	
	76			Measured value varies too much: Voltage measurement input 3 (Terminals X62)	
	77			Measured value varies too much: Current measurement input 3 (Terminals X62)	
	78			Excessive voltage value or wrong polarity PT100 sensor (Terminals X60)	
	79			Excessive voltage value or wrong polarity PT100 line (Terminals X60)	
	7A			Excessive voltage value or wrong polarity PT1000 (Terminals X60)	
	7B			Excessive voltage value or wrong polarity PWM	
	7C			Excessive voltage value or wrong polarity voltage measurement input 2 (Terminals X61)	
	7D			Excessive voltage value or wrong polarity current measurement input 2 (Terminals X61)	
	7E			Excessive voltage value or wrong polarity voltage measurement input 3 (Terminals X62)	
	7F			Excessive voltage value or wrong polarity current measurement input 3 (Terminals X62)	
	80		Internal Fault Load Controller	Fault during internal muliplexer test PT100 sensor	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	81			Fault during internal multiplexer test PT100 line	
	82			Fault during internal multiplexer test PT100	
	90			Number of maximum sync failures exceeded	
	91			Wrong CRC during SYNC message	
	92			Wrong CRC during PDO message	
	93			Main loop counter does not agree with basic unit	
	96			Fault during multiplexer test	
	97			Paraccess with FINISH unsuccessful	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Base Unit (LMV5) Internal Load Controler					
A6	9B	LMV5 Load Cont. Mod.	Internal Fault Load Controller	Fault PageAccess, invalid access status	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	9C			Fault voltage monitor test	
	9E			Fault during readout of PDO message	
	A0			XP smaller than min. value	
	A1			XP larger than max. value	
	A2			TN smaller than min. value	
	A3			TN larger than max. value	
	A4			TV smaller than min. value	
	A5			TV larger than max. value	
	A6			Parameter outside the permissible range	
	A7		Inadmissible Selection aux Sensor Cold Start	Inadmissible selection of the auxiliary sensor	When using the auxiliary temperature sensor for cold start, a temperature sensor must be selected at input 1 or 4
	B0		Internal Fault Load Controller	Red/Inv fault with float variables	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	B1			Red/Inv fault of a Red/Inv variable	
	B2			Fault during key value check	
	B4			Fault in fault routine	
	B5			Step to invalid interrupt vector	
	B6			Time block too long: Time block 0	
	B7			Time block too long: Time block 1	
	B8			Time block too long: Time block 2	
	B9			Time block too long: Time block 3	
	BA			Time block too long: Time block 4	
	BB			Time block too long: Time block 5	
	BC			Time block too long: Time block 6	
	BD			Time block too long: Time block 7	
	C0			CRC fault in page	
	E0			Identpower	
	E1			Controller parameter KP	
	E2			Scanning time	
	EA			Invalid branch in eeprom module()	
	EB			Invalid branch in eeprom module()	
	EC			Invalid branch in eeprom module()	
	ED			Invalid branch in eeprom module()	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Base Unit (LMV5) Internal Load Controller					
A6	EE	LMV5 Load Cont. Mod.	Internal Fault Load Controller	Invalid branch in eeprom module()	If fault occurs sporadically improve EMC. If fault occurs continously, replace LMV5
	EF			Invalid branch in eeprom module()	
	F0			Fault during ROM test	
	F1			Fault during RAM test	
	F2			Fault during RAM test, register bank 0	
	F3			Fault during RAM test, IDATA range	
	F4			Fault during RAM test, XDATA range	
	F5			Stack pointer does not point at stack	
	F6			Stack overflow	
	FE			Fault messages in fault management	
	FF			Fault messages in fault management	
Fault with AZL5...					
A7	Any #	AZL	Internal Fault AZL	AZL5…has detected a fault.	1) Check CANBus cabling. Ensure that all cable shields (screens) which are located in the cable sheath are terminated correctly at each actuator, O2 module, and at the LMV5x... 2) Check each CANBus Connector to ensure proper termination (no conductors exposed on the back of the plug) 3) If fault occurs sporadically: Improve EMC. 4) If fault occurs constantly: Replace AZL5...
	01			CRC fault during ROM test	
	02			CRC fault during RAM test	
	04			Fault during key value check	
	05			Time block overflow	
	07			Sync fault or CRC fault	
	08			Fault main loop counter	
	09		Manual Lockout AZL	Fault message for emergency off function via AZL…	This message is dispayed if escape and enter on the AZL are pressed simulaneously, causing a manual lockout. Can be reset normally.
	0A		Internal Fault AZL	Invalid AZL5… page	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace AZL5…
	0B		>250,000 startups, service required	250,000 Cycles have been exceeded. Internal parts in the LMV5.. Are close to the end of their life.	Replace LMV5
	0C		Internal Fault AZL	Save fault parameter	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace AZL5…

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
				Fault with AZL5...	
A7	0D	AZL	Menu for Oil. Current Fuel is Gas	Fuel changeover from oil to gas when a "oil only" menu is being viewed.	Escape out of currnet menu, or change the fuel that is selected.
	0E		Menu for Gas. Current Fuel is Oil	Fuel changeover from gas to oil when a "gas only" menu is being viewed.	
	15		Internal Fault AZL	CAN queue fault	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace AZL5…
	16			CAN overflow fault	
	17			CAN busoff	1) Check CANBus cabling. Ensure that all cable shields (screens) which are located in the cable sheath are terminated correctly at each actuator, O2 module, and at the LMV5x... 2) Check each CANBus Connector to ensure proper termination (no conductors exposed on the back of the plug) 3) Check the wiring of the CANBus power supply (12 VAC Transformer). Ensure that Fuses FU2 and FU3 are not blown. Ensure that the CANBus power supply is not overloaded (too many actuators on CanBus)
	18			CAN warning level	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace AZL5…
	1A			EEPROM fault	
	1B		No valid Parameter Backup	Fault during copying of a parameter page	1) Back up LMV5 pararmeters to AZL. A prompt for this comes up when exiting the parameters & display menu.
	1C		Internal Fault AZL	Page in EEPROM was disrupted, has been restored	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace AZL5…
	20			Display fault	
	22			RTC is locked, permanently busy	
	24			Buffer for page copies too small	
	28			Time stamp could not be sent	
	30		Fault Communication eBUS	Fault in connection with eBUS communication	Check wiring on RJ45 connector, located on the underside of the AZL5..
	38		Internal Fault AZL	Interface mode could not be terminated	Reset the unit.

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with AZL5...					
A7	40		Communication AZL with PC tool	Parameterization fault PC tool. Disclosed by key value check in AZL	Check cable between AZL and PC. A null modem adapter must be used on the 9 pin connector if the cable does not have this internally. A USB to serial adapter is OK to use when connecting the AZL to a laptop.
	88		Internal Fault AZL	RAM fault with redundant inverse variables	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace AZL5…
	89	AZL		Program run fault, execution of program code that will probably never be executed	
	8A	AZL		Unintentional watchdog reset	
Fault with Base Unit (LMV5) VSD Module					
A9	Any #	LMV5 VSD module			
	01		Internal Fault VSD Module	CRC fault during ROM test	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace LMV5
	02			CRC fault during RAM test	
	04			Fault during key value check	
	05			Error code for time block overflow	
	07			Sync fault or CRC fault	
	08			Error code for main loop counter	
	09			Fault during stack test	
	0A			Max IRQ speed reached	1) Possibly interference on the line to the speed sensor, check cable routing, use shielded cable. 2) If fault occurs sporadically: Improve EMC. 3) If fault occurs constantly: Replace VSD Module.
	0C		Alarm from VSD	Fault has been triggered by the VSD.	1) This indicates that a fault has been relayed to the LMV5 from the VSD via the VSD alarm input terminal. This indicates a fault in the VSD, not the LMV5. Thus, check the VSD error codes and take action based on those codes. 2) Check VSD settings (ramps, motor settings), increase ramp time on VSD and basic unit, if necessary. 3) Check Motor and VSD for proper sizing.

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Base Unit (LMV5) VSD Module					
A9	0D	LMV5 VSD module	Control Range Limitation VSD Module	VSD module could not offset speed differential within its control limits	1) This indicates that that the LMV5 has decreased its signal to the VSD as much as possible and the motor RPM is still to high. Increase VSD / LMV52 ramp times. Also increase VSD braking if possible. 2) Re-standardize the speed. Ensure that the air damper is at purge position for the standardization (should do this automatically if the air damper is set to air-infulencing) 3) Be sure to check combustinon after the re-standardization
	0E	VSD module	Internal Fault VSD Module	Fault during the speed calculation test	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace LMV5
	15			CAN bus fault, disturbed CAN bus transmissions	1) Check CANBus cabling. Ensure that all cable shields (screens) which are located in the cable sheath are terminated correctly at each actuator, O2 module, and at the LMV5x... 2) Check each CANBus Connector to ensure proper termination (no conductors exposed on the back of the plug) 3) Check terminating resistors for correct position.
	16			CRC fault of a parameter page	1) Reset the LMV5 2) If fault occurred after changing a parameter, check the parameters that were last changed. 3) If fault cannot be rectified by the reset: Restore parameters form the AZL to the LMV5 4) Replace the LMV5
	17			Page too long open	
	18			Page disrupted	
	19			Invalid access to parameters	
	1B			Fault when copying a parameter page	
	1E		Internal Fault VSD Module	External plausibility fault. This type of fault covers possible faults occurring due to invalid presettings in the drive commands. In response, the presettings will be ignored.	Check the special positions for valid value range (0-100 %)
	1F		Internal Fault VSD Module	Internal plausibility fault. This type of fault detects faults that cannot practically occur...	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace LMV5
Fault with O2 Module (PLL5..)					
AB	Any #	PLL5..	Fault O2 Module	The PLL5… has detected a fault.	
	01		Internal Fault O2 Module	CRC fault during ROM test	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace PLL5..
	02			CRC fault during RAM test	
	04			Fault during key value check	
	05			Error code for time block overflow	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with O2 Module (PLL5..) or Oxygen Sensor (QGO2..)					
AB	07	PLL5..	Internal Fault O2 Module	Sync fault or CRC fault	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace PLL5..
	08			Error code for main loop counter	
	09			Fault during stack test	
	0A			Feedback values invalid	
	10		Unplaus Value Nernst Voltage O2 Module	Nernst voltage outside the valid range	1) Check the wiring between the O2 Module and the O2 sensor. Ensure high and low voltage are in seperate conduits. 2) Check the power supply to the O2 Module 3) Check fuse in the O2 Module 4) Check the heating control on the O2 Sensor 5) Check the temperature inside the O2 Sensor terminal box. Should be between -13 and 248^{o} F 5) If fault occurs constantly, Replace O2 Sensor and / or Module.
	12		Unplaus Value Thermocouple O2 Module	Thermocouple voltage outside the valid range	
	13		Unplaus Value Compensation Element	Compensation element voltage outside the valid range	
	15		Unplaus Value Flue Gas Temp O2 Module	Temperature of combustion air sensor outside the valid range (-20...+400 °C)	1) Check the wiring between the O2 Module and the O2 sensor. 2) Check the ambient / Flue gas temperature. Compare to valid range.
	16		Unplaus Value Flue Gas Temp O2 Module	Temperature of flue gas sensor outside the valid range (-20...+400 °C)	
	17		Internal Fault O2 Module	Fault during combustion air temperature sensor test	1) Check the wiring between the O2 Module and the O2 sensor. 2) If fault occurs constantly, Replace O2 Sensor and / or Module
	18			Fault during thermocouple test	
	19			Fault during compensation element test	
	1A			Fault during channel comparison of O2 signal	
	1B			Fault ADC test voltages	
	20		O2 Sensor Temp too low	Temperature of QGO measuring cell too low	1) Check the temperature of heated sensor (can be viewed on AZL) Minimum operating termperature is 1202 F, Maximum 1382 F. If the O2 sensor could take up to 20 minutes to reach temperature. 2) Ensure O2 sensor is installed properly (see section 2) and that stack gas velocity is correct. Min =3.2 ft / sec Max = 32 ft/ sec. 3) Check the power supply to the O2 Module 4) Check fuse in the O2 Module
	21		O2 Sensor Temp too high	Temperature of QGO measuring cell too high	
	22		Internal Fault O2 Module	Fault during calculation test	If fault occurs constantly, Replace O2 Sensor and / or Module

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with O2 Module (PLL5..) or Oxygen Sensor (QGO2..)					
AB	23	PLL5..	Unplaus Value Ri 02 Measuring Cell	Measured internal resistance of the QGO measuring cell is smaller than 5 Ohm or greater than 150 Ohm	1) Check the wiring between the O2 Module and the O2 sensor. 2) O2 Sensor may have reached the end of its service life (Check Resistance through AZL) If greater than 140 - 150 ohms, replace sensor.
	24		Response Time O2 Measuring Cell too long	Measured response time of the QGO measuring cell exceeds 5 seconds (completely electronic)	1) Check mounting position / oirentation of O2 sensor. 2) Check to see if O2 sensor is dirty. Do Not blow out with compresed air when hot! Cool, then blow out with low pressure compressed air. 3) O2 Sensor may have reached the end of its service life (Check Resistance through AZL) If greater than 140 - 150 ohms, replace sensor.
	25		O2 Sensor Test aborted by O2 Module	Fault occurred during O2 sensor test	Check (through the AZL) to see if the measured O2 value is fluctuating.
	30		Internal Fault O2 Module	CAN fault	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace PLL5..
	31			CRC fault of a parameter page	1) Reset the LMV5 2) If fault occurred after changing a parameter, check the parameters that were last changed. 3) If fault cannot be rectified by the reset: Restore parameters form the AZL to the LMV5 4) Replace the LMV5
	32			Page too long open	
	33			Page disrupted	
	34			Invalid access to parameters	
	38			Fault during copying of a parameter page	
	3E			External plausibility fault. This type of fault covers possible faults occurring due to invalid presettings in the drive commands. In response, the presettings will be ignored.	
	3F			Internal plausibility fault. This type of fault detects faults that cannot practically occur...	
Fault with Base Unit (LMV5)					
B0	Any #	LMV5..	Internal Fault Basic Unit	Fault during test of port outputs	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace LMV5
	01			Fault when resetting the set outputs	
	02			Fault during ZR test	
B1	01			Fault during short-circuit test between inputs and outputs	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Base Unit (LMV5) or Oxygen Sensor (QGO2..)					
B5	Any #	LMV5..		O2 monitor	
	01		Below O2 Min Value	O2 value has dropped below O2 min. value	1) Check the %O2 between the O2 guard curve and the O2 setpoint curve. Increase the %O2 "gap" between these two curves at the load point where the the fault is occuring. 2) Check for mechanical lash (slop) between actuators and dampers / valves. Also check dampers for worn bearings. Change to zero lash flexible couplings if necessary. 3) If necessary, adjust parameters O2 OffsetGas(oil) and / or O2CtrlThreshold
	02		O2 Min Values undefined	Invalid O2 min. value	Set a point for the O2 min Value curve (or O2 Guard Curve) for each point set up on the ratio control curve (12 points on ratio control = 12 points on O2 min Value curve)
	03		O2 Setpoints undefined	Invalid O2 setpoint	Set a point for the O2 setpoints curve (or O2 Control Curve) for each point set up on the ratio control curve (12 points on ratio control = 12 points on O2 setpoints curve)
	04		O2 Delay Time undefined	Invalid O2 delay time	The dealy time has not been measured sucessfully at Point 2 or the highest curve point. See Section 5-1 under O2 trim for possible causes.
	05		Actual O2 Value invalid	No valid actual O2 value in operation for >= 3 s	1) Check the wiring between the O2 Module and the O2 sensor. 2) Check the power supply to the O2 Module
	06		O2 Value Prepurging not reached	During prepurging, the parameterized air oxygen content of +-2 % was not reached	1) Check the parameter "O2 content air". This %O2 must be reached within +/- 2% during prepurge. 2) Check prepurge time. The time that is set may not be long enough to completely purge the boiler. 3) Sensor may be dirty. Do Not blow out with compresed air when hot! Cool, then blow out with low pressure compressed air. 4) O2 Sensor may have reached the end of its service life (Check Resistance through AZL) If greater than 140 - 150 ohms, replace sensor.

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Base Unit (LMV5) or Oxygen Sensor (QGO2..)					
B5	07	LMV5..	O2 Value in Operation too high	O2 value of 15 % in operation was exceeded	1) Check mounting of O2 sensor. Ensure no air in entering the stack upstream of the sensor. 2) Verivy that the O2 level in the stack is not 15% during operation.
BA	01		O2 Sensor Test aborted	O2 sensor test was not successful. E.g. reset of O2 module during probe test	If fault occurs constantly: Replace PLL5..
BF	Any #		O2 Control and Limiter automatic deactivated	Fault occurred in connection with O2 trim control or with the O2 monitor. It led to automatic deactivation of O2 trim control or the O2 monitor	See B5 Error codes. The will detail the reason for the automatic deactivation.
Fault with Base Unit (LMV5) or Connected Components					
C5	Any #	#	Version Conflict	When comparing the versions of the individual units, the AZL5... has detected old versions	Before replacing any units, start the system and wait about 1 minute (until, after entering the parameter level, the display “Parameters will be updated“ disappears). Then, reset. Replace the unit only if the fault message does not disappear. Replace the relevant units by new versions
	01..2F	#		The diagnostic value is made up of the following faults or their combinations (the individual diagnostic codes are added up in hexadecimal format)	
	01	LMV5..		Software of the basic unit too old	Replace the unit(s) called out in the diagnostic code. Be sure that the new unit has up to date software.
	02			Software of the load controller too old	
	04	AZL		Software of the AZL5... too old	
	08	Actuator		Software of 1 or several actuators too old	
	10	LMV5..		Software of VSD module too old	
	20	PLL5..		Software of O2 module too old	
D1	Any #	LMV5..	Fault Feedback VSD Module	Basic unit has detected a wrong state of the VSD module. Corresponds to the "8x"-faults with the other CAN users	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace LMV5 3)Check CANBus cabling. Ensure that all cable shields (screens) which are located in the cable sheath are terminated correctly at each actuator, O2 module, and at the LMV5x... 4) Check each CANBus Connector to ensure proper termination (no conductors exposed on the back of the plug)
	01			CRC error	
	02			Key error main loop counter	
	03			No feedback for max. number	
D3	Any #	PLL5..	Fault Feedback O2 Module	Basic unit has detected a wrong stage of the O2 module	
	01			CRC error	
	02			Key error main loop counter	
	03			No feedback for max. number	

Error code	Diag. code	Device	Display	Meaning for the LMV5x system	Corrective action
Fault with Base Unit (LMV5) or Connected Components					
E1	Any #	PLL5..	Fault Feedback O2 Module	Basic unit has detected a ROM-CRC fault in the VSD module when checking its feedback signal	1) If fault occurs sporadically: Improve EMC. 2) If fault occurs constantly: Replace LMV5
E3	---			Basic unit has detected a ROM-CRC fault in the O2 module when checking its feedback signal	
F0	---	LMV5..	Internal Fault Basic Unit	Plausibility fault during calculation of interpolation values	
F1	Any #			Internal fault during calculation of precontrol	1) Check to make sure that all curves (Ratio control, O2 Guard and O2 control) are defined at every point in the firing range. If the ratio control curve has 12 points, the O2 guard and the O2 trim must also have 12 points.
	01				
	02				
	03				
	04				
	05				
	06			Internal fault calculation of precontrol. Undefined value in the curves used for the calculation	
	07				
F2	Any #			Code for faulty temperature values from O2 module when calculating the air rate change	
	07			O2 module has delivered invalid value	If fault occurs constantly: Replace LMV5
	08		Flue Gas Temp too high	Flue gas temperature outside the permissible value range	Check flue gas temperature to ensure that it is in the permissible range. Range is 32 to 752 F
	0A		QGO in Heating-up Phase	QGO probe not yet sufficiently heated up	Check the termperature of the O2 Sensor (can be viewd through the AZL). The sensor needs to be a minumum of 1202 F to operate prooperly. Wait up to 20 minutes for sensor to reach operating termpeature.

Section 6 O2 Trim

Introduction and Principle of Operation 6-1

The LMV52 features an integrated O2 trim functionality that enables the LMV52 to monitor the percentage of O2 in the stack and adjust the positions of actuators when the burner is in operation (Phase 60). When the system is trimming, the LMV52 will move the actuators that are designated as “air influencing” independently of the fuel actuator(s) in an effort to achieve an optimal percentage of O2 in the stack. Typically, only the air actuator is set to be air influencing, but the VSD (if equipped) and other actuators (Aux 1,2,3) can also be set to air influencing if the dampers that the other actuators are connected to are also to be adjusted in accordance with the percentage of O2 in the stack.

As the name implies, the O2 trim functions to regulate the amount of oxygen and therefore the amount of air entering the combustion process. Since this is the case, the LMV52 O2 trim system does not and cannot affect the position of the fuel actuator for a given load. In other words, if the LMV52 senses an O2 level in the stack that is above setpoint, it will react by slowly closing the actuators that are set to air influencing until the O2 in the stack is at the desired setpoint. The LMV52 will not close the fuel actuator to reduce the O2 level in the stack. Also, the LMV52 will not open any of the air influenced actuators further than they were open on the original Fuel-Air ratio curve to achieve an O2 setpoint.

When setting up the O2 trim curves, a total of three curves are set having to do with the measured percentage of O2 in the stack. The three curves (in order lean to rich) are:

1) **O2 Ratio Control (Fuel Lean Curve)** – This is the percentage of O2 read at the stack sensor when the actuators are at the positions that were defined on the original Fuel-Air Ratio Curves. In other words, this is the measured O2 corresponding to each point set in Section 4-1, Figure 4-1.11.

2) **O2 Control (Trim to Curve)** – This is the O2 setpoint that the LMV52 will try to achieve by backing actuators designated as air influencing down their respective curves.

   This may also be referred to as the “O2 setpoint” curve.

3) **O2 Monitor (Fuel Rich Curve)** – This curve serves as a lower limit or an alarm curve. If the measured O2 drops below this value at a certain point, the LMV52 will either deactivate the O2 trim and operate on the normal combustion curves, or it will lockout depending on what the LMV52 is set to do.

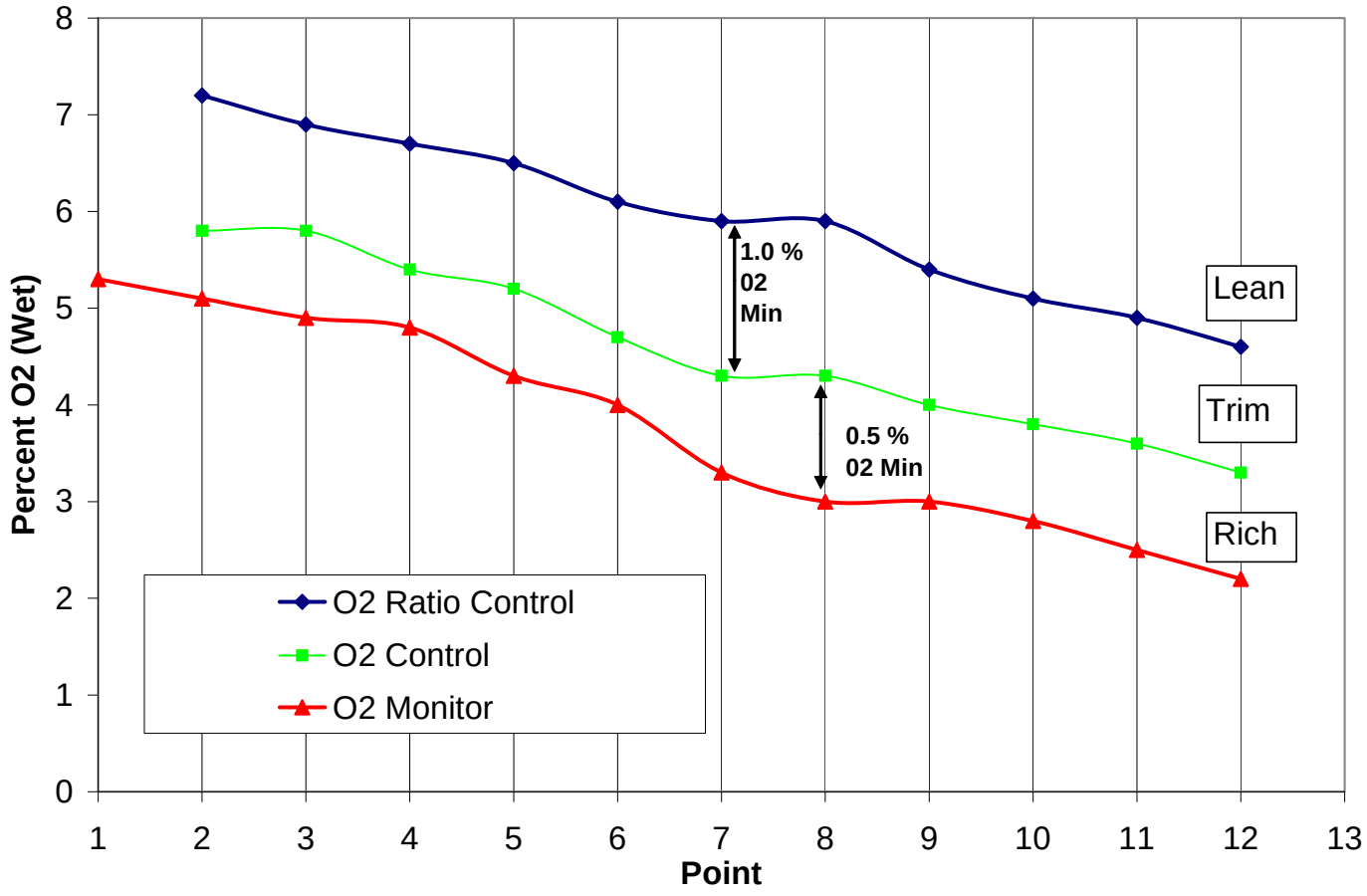
   This may also be referred to as the “O2 Guard” curve.

Figure 6-1.1 illustrates how these O2 curves might look after they have been set. Notice that for each of the three curves, a certain percentage of O2 is set and actuator positions (in degrees) or VSD % are not *directly* set during the O2 trim commissioning. The actuator positions in degrees or VSD% were directly set when the Fuel-Air ratio curves were commissioned. See section 4-1 for details on that procedure.

Figure 6-1.1 also shows that the O2 curves must be set at every point that was defined when the Fuel-Air Ratio Curves were set. For example : If 12 points were entered during the Fuel-Air Ratio Curve commissioning, then it will be necessary to enter 12 points for the O2 Monitor, 11 points for the O2 control and 11 points for the O2 Ratio Control. The LMV52 does not trim on Point 1, and this is the reason that the O2 Control and O2 Ratio Control curves cannot be set on Point1.

Figure 6-1.1 Fuel-Air Ratio Curve, O2 Ratio Control, O2 Control, and O2 Monitor Curves

16 MM Btu/hr Gas Burner, 10 to 1 Turndown, FGR, Gas 1000 BTU /SCFH								
Set During Fuel-Air Ratio Curve Commissioning						**Set During O2 Trim Commissioning**		
Point	Gas SCFH	Load %	Gas Deg	Air Deg	Aux1 Deg	% O2 Ratio Control (wet)	% O2 Control (wet)	% O2 Monitor (wet)
1	1600	10	7	10	30	**Cannot trim on Point 1**		5.3
2	2909	18	11	15	37	7.2	5.8	5.1
3	4218	26	14	18	40	6.9	5.8	4.9
4	5527	35	17	25	41	6.7	5.4	4.8
5	6836	43	22	29	45	6.5	5.2	4.3
6	8145	51	27	36	48	6.1	4.7	4
7	9455	59	33	44	45	5.9	4.3	3.3
8	10764	67	40	52	40	5.9	4.3	3
9	12073	75	48	63	35	5.4	4	3
10	13382	84	56	72	31	5.1	3.8	2.8
11	14691	92	65	79	27	4.9	3.6	2.5
12	16000	100	73	85	20	4.6	3.3	2.2



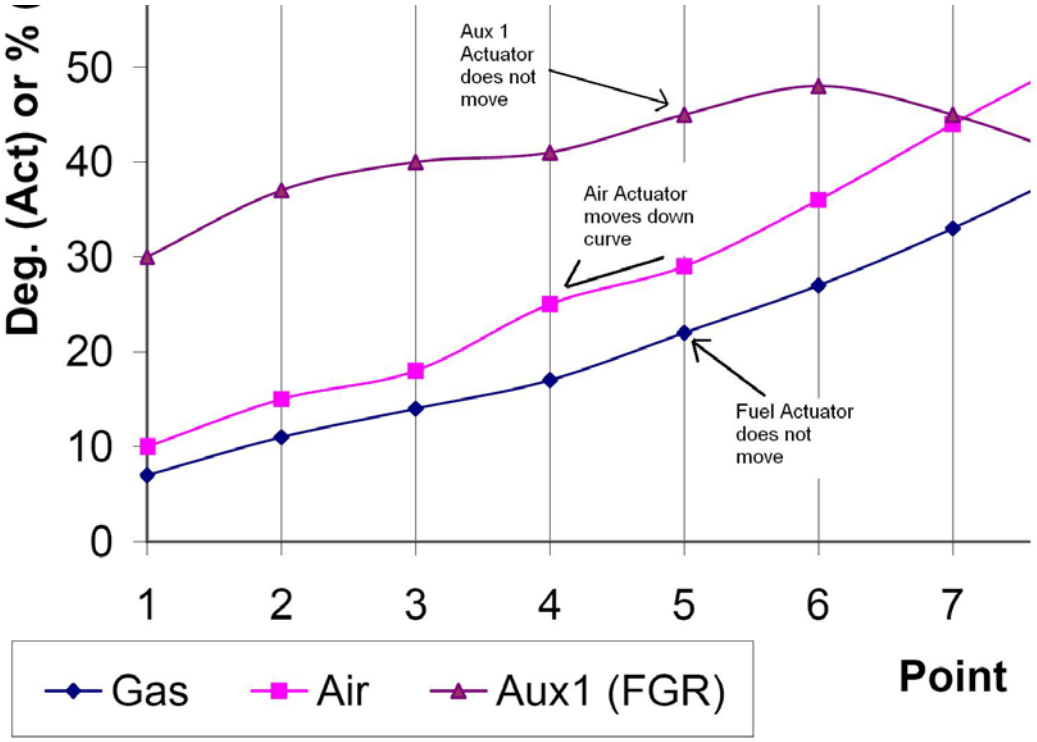
Two additional requirements of the O2 trim are that there is at least a 0.5% O2 gap between the O2 Monitor curve and the O2 Control curve, and that there is at least a 1.0% O2 gap between the O2 Control Curve and the O2 Ratio Control curve.

The LMV52 will not allow the O2 curve points to be entered if they do not meet these minimum gap requirements. These requirements should be kept in mind when commissioning the Fuel-Air Ratio Curve since the Fuel-Air Ratio Curve will usually have to be set at least 1.0 % O2 leaner than on a non-O2 trim system.

As was briefly mentioned earlier, the O2 trim is only able to move the actuators that are designated as ***air influen***(ced) back on their individual curves. Figure 6-1.2 illustrates this action by detailing a small piece of the same Fuel-Air Ratio curves that were shown back in Figure 4-1.11. For this example the air actuator is the only actuator designated as ***air influen***(ced) and the Fuel and Aux1 actuators are at Point 5.

In Figure 6-1.2 the O2 trim is responding to a measured O2 value that is higher than the O2 Control curve at Point 5. Thus, the LMV52 is moving the air actuator back down its curve to lower the %O2 that is being sensed in the stack.

Figure 6-1.2 Actuator movement in response to high measured O2 values



It should also be noted that the LMV52 cannot open any ***air influen***(ced) actuator farther than the point the fuel actuator is at.

For Example : If the LMV52 was held at Point 5 (or 43 percent load in this example, see 6-1.1) the air actuator could never open up beyond its Fuel-Air Ratio Curve position at Point 5 of 29 degrees, even if the %O2 measured in the stack was below the O2 Control curve at Point 5. If the %O2 in the stack went lower than the O2 Monitor curve, then the O2 trim would deactivate and / or cause a lockout, depending on how parameter ***OptgMode*** is set.

If this parameter is set to ***conAutoDeact***, the LMV52 will only deactivate the O2 trim, and will continue to function. If the O2 trim automatically deactivates, the actuators will operate on the Fuel-Air Ratio curves that were defined during the Fuel-Air Ratio Control commissioning.

Step by Step Commissioning of the O2 Trim System 6-2

After verifying that the PLL52 Module, QGO20 Oxygen sensor, and ambient / stack temperature sensors (if used) are wired correctly, and that lean-tuned Fuel-Air Ratio Curves have been entered across the firing range, the O2 trim system can be commissioned and activated.

The following steps will serve as a guide for the commissioning process:

Note: A combustion analyzer is required to measure CO when setting the O2 Guard curve. Most combustion analyzers read dry %O2, whereas the QGO20 Sensor reads wet O2. The dry value will always be a higher % than the wet value.
Always use the %O2 displayed on the AZL52 for setting up the O2 trim.

1) Verify that lean-tuned Fuel-Air Ratio Control curves have been set across the firing range for the fuel that will be trimmed. Both gas and oil can be O2 trimmed, or one and not the other. Typically, gas is trimmed and oil is monitored since oil is usually the back-up fuel. For either fuel, verify that the Fuel-Air Ratio curve has at least 10 points equally distributed across the firing range.

2) Verify that the load percentage on each Fuel-Air Ratio control point accurately represents the fuel flow into the burner. This is critical to the O2 trim function. A fuel flow meter or a manometer to measure burner pressure will be required to do this.

   With the LMV52 in standby (Phase 12):
   a. Set all relevant O2 trim parameters.
      Complete explanations for all O2 trim parameters the can be found in two different areas of Section 4-2:
      Parameters & Display> ***O2 Module****, and*
      Parameters & Display> ***O2 ContrGuard***.
   b. Under *Parameters & Display* > *O2 Module*, set ***O2 sensor*** to ***QGO20.***
   c. Under *Parameters & Display* > *O2 Module*, set the ***supply air temperature sensor*** and the ***flue gas temperature sensor*** to the type of sensor that is being used, if any.
      These sensors are not necessary for the O2 trim operation but are necessary for the efficiency calculation.
      If they are configured and not connected, the O2 trim will not activate.
   d. Under *Parameters & Display* > *Ratio Control*, set which actuators or VSD are to be ***air influenced***. Typically, this is only the Air Actuator.
      These parameters have to be set for both fuels if O2 trim is to be used for both fuels.
   e. Under *Parameters & Display* > *O2 Contr/Guard* > *Gas/Oil Settings*, set ***OptgMode*** to ***man deact***.
   f. If the O2 trim is being commissioned on gas, under *Parameters & Display*> *O2 Contr/Guard*> *Gas/Oil Settings*>***Type ofAirChange*** set to ***Like P air***.
      For light oil, set ***Type ofAirChange*** to ***like theory***.
   g. If the O2 trim is being commissioned on gas, under *Parameters & Display* > *O2 Contr/Guard* > *Gas/Oil Settings* > ***Type of Fuel*** is set to ***naturalGasH*** (above 960 Btu / Scfh) or ***naturalGasL*** below 960 Btu / Scfh).
      For light oil, ***Type of Fuel*** , ***Oil EL*** should be selected.
   h. Under *Parameters & Display* > *O2 Contr/Guard* > *Gas/Oil Settings* set ***O2 CtrlThreshold*** to the load value (%) of Point 2 or higher if desired.
   i. Under *Parameters & Display* > *O2 Contr/Guard* > *Gas/Oil Settings* set ***LowfireAdaptPtNo*** 2 (combustion curve point 2) or higher if desired.

Step by Step Commissioning of the O2 Trim System 6-2 continued…

3) Allow time for the QGO20 (O2 sensor) to heat up to temperature. The QGO20 will heat the entire time the LMV52 and PLL52 are powered. For the initial heat-up, allow O2 sensor to heat-soak for about 2 hours. This ensures the most accurate ***Actual O2 Value*** during commissioning. The ***QGO Sensor Temp*** as well as other PLL52 related values can be read under *O2 Module > Displayed Values*. The ***QGO Sensor Temp*** should heat up to a minimum of 1290 ^{o}F. The O2 sensor will no longer read O2 values if the ***QGO Sensor Temp*** drops below about 1202 ^{o}F (650 ^{o}C). Readings will return at around 1290 ^{o}F.

4) Turn the burner on. Verify that the ***Actual O2 Value*** is reading 20.9% O2 (+/- 0.6%) by the end of pre-purge. If not, extend the prepurge time. The burner should light off and proceed to Phase 60, which is normal operation.

Note : There should be at least 10 points in the Fuel-Air Ratio Control curves from low to high fire, and these should be tuned at least 1.0% O2 leaner than normal. If this is not done, please redo the Fuel-Air Ratio control curves before attempting to set up the O2 curves. Verify that the load percentage on each Fuel-Air Ratio control point accurately represents the fuel flow into the burner. This is critical to the O2 trim function. A fuel flow meter or a manometer to measure burner pressure will be required to do this.

Three O2 curves must be set: ***O2 Monitor*** , ***O2 Ratio Control*** , and ***O2 Control***

Set the *O2 Monitor* curve

1) This is found under: *Parameters & Display > O2 Contr/Guard > Gas/Oil Settings >* ***O2 Monitor****.* This value must be set at every point that was defined in the Fuel-Air Ratio control (combustion) curves from low to high fire.

There are two methods for setting this curve.

a. If the minimum safe O2 values are known across the firing rate, then values for this curve can be input directly as a %O2. When this is done, the LMV52 will not actually drive the actuators to the point in question.
b. If the minimum safe O2 values are not known, the burner can be driven to the point in question by displaying the point, pressing enter, and then scrolling down to ***P air man***.

When the ***P air man*** value is increased, the air influenced actuators will be slowly driven back down their curves (closed) and the minimum safe %O2 value can be effectively "probed". Increasing the ***P Air Man*** value will start closing the air influenced actuators and should decrease the O2 measured in the stack. At some point, smoke or a dramatic spike in the CO production will occur as the air influenced actuators are closed. When this is found, the value of ***P Air Man*** should be reduced slightly (opening the actuators, more air) until a somewhat rich but safe combustion is achieved. After this, *enter* can then be pressed moving the cursor to the left of ***P Air Man*** and saving the point. Next, press *escape* to exit the point. After this, arrow over to the next point, or press *escape* once more to exit ***O2 Monitor*** altogether.

Note : Point 1 on the O2 Monitor curve must be entered using method a. A safe % O2 can be found (probed) at point 2, and then entered in for Point 1 using method a.

2) Repeat this process using Method a or b for every point that was defined in the Fuel-Air Ratio control curves. A curve resembling the O2 Monitor curve shown in Figure 6-1.1 should result.

The O2 Monitor curve is now complete.

Set the O2 Ratio Control and the O2 Control Curves

3) These are both found under:
Parameters & Display > *O2 Contr/Guard* > *Gas/Oil Settings* > ***O2 Control***.
First, the **O2 Ratio Control** needs to be set for point 2. Under parameter ***O2 control***, **Point 2** should appear, since it is not possible to trim on **Point 1**.

4) Press the *enter* key while **Point 2** is displayed, and the LMV52 will drive the actuators / VSD to **Point 2** on the Fuel-Air Ratio Curve. The AZL5 will then prompt the operator to press *enter* again when the displayed % O2 value has stabilized.

Note: This stabilization will be slower at low fire (average of 15-30 seconds after the actuators / VSD have driven to the point) and faster at high fire.
If the *enter* key is pressed prematurely, the recorded %O2 will NOT accurately represent the %O2 for the point on the O2 ratio control point. If this happens, delay time will NOT be measured accurately in a later step and this will cause faults during operation.

5) Once the *enter* key is pressed, the % O2 shown on the AZL5 is locked in to be the % O2 for the O2 ratio control point (actuators / VSD are at their Fuel-Air Ratio Control positions). The % O2 for the **O2 Ratio Control** is now set for **Point 2**.

6) Next, the **O2 Control** needs to be set for point 2. This is done by increasing the ***Standard Val*** value, which drives the air influenced actuators back down their curves (closed), and should decrease the %O2 read on the AZL5. Once the desired %O2 is achieved, Point 2 can be saved by pressing the enter key to the left of the Standard Val, pressing escape once, and then pressing the enter key to finally store the point.

Note: The O2 control point must be at least 1% O2 below the %O2 value entered for the ratio control curve, and at least 0.5% O2 above %O2 entered for the O2 Monitor curve. Thus, the lean to rich band must be at least 1.5 %O2. In practice, the O2 system is easier to commission and operate on most burners if the %O2 between the O2 Control and the O2 Monitor is 1.0% O2 or more.
The % O2 for the **O2 Control** is now set for **Point 2**.

7) Once *enter* is pressed to save the point, delay time is automatically measured. Delay time is typically measured on point 2 or whatever the value is for ***LowfireAdaptPtNo*** is and at high fire (the highest point number). This is done so that the LMV52 can "learn" the response time of the boiler / burner at low and high fire. To achieve this, the LMV52 drives the actuators from their position at the O2 control curve point back to their position at the ratio control point. The LMV52 then measures how long it takes for the %O2 in the stack to climb back up to the approximate %O2 that was locked in for the ratio control curve.
If the measured %O2 value in the stack approaches the %O2 that was locked in on for the O2 ratio control curve in less than 28 seconds, a successful delay time measurement should result. If the delay time measurement is unsuccessful, the probable cause is an unrepresentative %O2 value for the O2 Ratio control curve, or parameter ***OptgMode*** is not set to ***Man Deact***. Also see the above note pertaining to delay time.

8) Repeat the process outlined above for every point that was defined in the Fuel-Air Ratio curve. Delay time will also be measured a second time at high fire, which is typically highest numbered point.

9) After this is completed, the O2 trim can put into operation. This is done under parameter ***OptgMode***. Typically, this is set to ***Con Auto Deact***, but other settings are possible. Section 4-2 explains the different choices for this parameter.

Note: If necessary, see section 5 for additional troubleshooting information.

The PLL52 and the QGO20 Oxygen Sensor 6-3

The PLL52 in combination with the QGO20 O2 sensor is the heart of the O2 trim system.

The QGO20 produces millivolt signals that are read by the PLL52.

On the low voltage side the PLL52 translates these millivolt signals and sends the information back to the LMV52 digitally over the CANbus.

On the high voltage side, the PLL52 regulates the heating element amperage to the QGO20 in an effort to keep the QGO20 sensing element at approximately 1290 ^{o}F.

Three millivolt signals originate in the QGO20:

Nernst Voltage from the zirconium oxide O2 cell	terminals B1 and M
O2 cell thermocouple signal	terminals B2 and M
Temperature compensation element	terminals G2 and U3

These three signals produce an accurate, Wet %O2 value. The thermocouple signal is also used to control the PLL52's output to the QGO20. Amperage and therefore the heat output of the QGO20's heating element are varied by changing the resistance on the high voltage side of the PLL52 module.

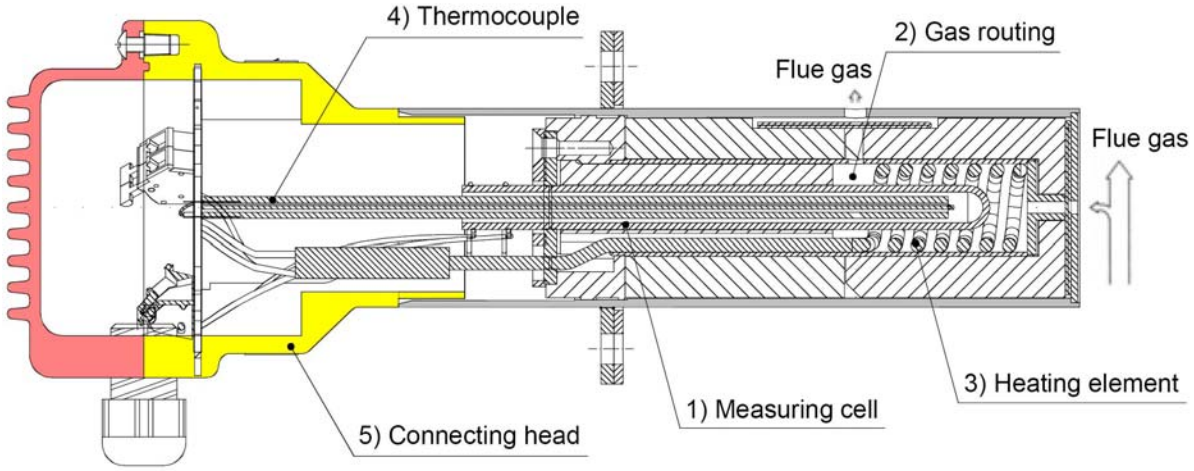
The low voltage wires from the QGO20 to the PLL52 should always be run separate from the high voltage heating element wires that also run from the PLL52 to the QGO20.

Separate shielded cables or separate conduits for the high and low voltage wires going to the sensor must be used.

Also, the PLL52 must be installed within 25 feet of the QGO20.

Figure 6-3.1 shows a cut-away of the QGO20 sensor.

Figure 6-3.1 Cut-away view of the QGO20 sensor



As previously mentioned, the QGO20 is only capable of measuring %O2 wet. This is true since it is an in-situ oxygen sensor, not needing any type of water trap, desiccant, or filter.

Most hand-held combustion analyzers measure %O2 dry, and therefore will be considerably different from the %O2 wet measured by the QGO20 sensor.

Figure 6-3.2 shows these approximate differences along with the raw millivolt signal from the zirconium oxide O2 cell.

As one would expect, the raw millivolt signal varies with sensor temperature, but this variance is compensated by the PLL52 module so the LMV52 is fed an accurate, compensated O2 value.

Figure 6-3.1 Conversion Table, %O2 Wet / Dry, Nernst Voltage (Approximate)

%O2 Wet (QGO20)	%O2 Dry (Nat Gas)	%O2 Dry (#2 Oil)	%O2 Dry (100% Methane)	Output Voltage (mV)@ 1292 F	Output Voltage (mV)@ 1320 F
0.1	0.1	0.1	0.1	111.79	113.59
1.0	1.2	1.1	1.2	63.61	64.63
1.5	1.8	1.7	1.8	55.12	56.01
2.0	2.4	2.3	2.4	49.10	49.90
2.5	2.9	2.8	3.0	44.43	45.15
3.0	3.5	3.4	3.6	40.62	41.27
3.5	4.1	3.9	4.1	37.39	38.00
4.0	4.6	4.5	4.7	34.60	35.16
4.5	5.2	5.0	5.3	32.13	32.65
5.0	5.7	5.5	5.8	29.93	30.41
5.5	6.3	6.1	6.4	27.93	28.39
6.0	6.8	6.6	6.9	26.11	26.54
6.5	7.3	7.1	7.5	24.44	24.83
7.0	7.9	7.6	8.0	22.89	23.26
7.5	8.4	8.2	8.5	21.44	21.79
8.0	8.9	8.7	9.0	20.09	20.42
8.5	9.4	9.2	9.6	18.83	19.13
9.0	9.9	9.7	10.1	17.63	17.91
10	10.9	10.7	11.1	15.43	15.67
11	11.9	11.7	12.1	13.43	13.65
12	12.9	12.7	13.0	11.61	11.80
13	13.9	13.6	14.0	9.94	10.10
14	14.8	14.6	14.9	8.38	8.52
15	15.7	15.6	15.8	6.94	7.05
16	16.6	16.5	16.7	5.59	5.68
17	17.5	17.4	17.6	4.32	4.39
18	18.4	18.3	18.5	3.13	3.18
19	19.3	19.2	19.3	1.99	2.03
20	20.1	20.1	20.2	0.92	0.94
20.9	20.9	20.9	20.9	0.00	0.00

Section 7 VSD Control

Overview of VSD / VFD / AC Induction motors 7-1

The LMV52 features an integrated, closed loop VSD (Variable Speed Drive) controller that is typically used to vary the speed of the combustion air blower.

Since the LMV52 has a VSD control, it is capable of controlling many different types of drives and Motors. Both DC drives and motors as well as AC drives and motors can be controlled with the LMV52.

By far the most common type of drive and motor that is used with the LMV52 VSD control is the VFD (Variable Frequency Drive) driving an AC induction motor.

This section will focus on the unique characteristics of a VFD driving an AC induction motor and will also explain the effects of a centrifugal blower on this arrangement.

Throughout this section the terminology VSD control is used since it is a more generic term, and is also the terminology used on the AZL52.

A VFD is basically a specific type of VSD.

Most modern VFD's operate in basically the same way. They take 3 phase AC power, rectify this power to DC, and then they output pulsed DC to an AC motor.

Thus, pulsed "square wave" DC is used to approximate a sine wave on each of the motors three phases. This approximation of a sine wave is adequate to run the motor.

As one might expect, the frequency and the amplitude of the square waves is controlled by the VFD microprocessor, and can be regulated to control the speed of a synchronous motor.

The motors that are used on most burner blowers are AC induction motors. These motors are called induction motors since they do not have slip rings or brushes to power the electromagnets in the rotor.

Instead, AC induction motors use principles of induction to power the electromagnets in the rotor. Induction is very attractive since this means that there are no slip rings or brushes to wear out, and the only part of the AC induction motor that really wears are the rotor (shaft) bearings.

The slight disadvantage of using induction motors is a phenomenon called slip.
In the absence of slip, an AC motor supplied with 60 Hz (Hertz) three phase power having:

two poles per phase would turn at exactly 3600 RPM
four poles per phase would turn at exactly 1800 RPM.

These two hypothetical "non slip" motors are called synchronous motors since they exactly synchronize themselves with the frequency of power they are supplied with.

In contrast to no-slip synchronous motors, AC induction motors have slip, so they are only semi-synchronous.

Furthermore, the amount of slip depends upon how heavily the motor is loaded. Slip will increase as the motor's load increases.

For example, a real life 2 pole three phase AC induction motor fed 60 Hz 3 phase power under no load will turn very close to 3600 RPM, most likely in the neighborhood of 3585 RPM.

As load is applied to the motor shaft, the RPM will drop (slip will increase), and the amperage on all three phases will increase.

The same 2 pole three phase AC induction motor that was turning 3585 RPM @ 60 Hz, when subjected to heavy loads, may drop down to 3510 RPM or lower, even though it is still being fed power @ 60 Hz.

For a fixed motor input frequency, slip can be thought of as a spring that compresses when loaded and the height of the spring can be thought of as the RPM of the motor.

In summary, a VFD can control the amplitude and frequency of the simulated three phase power (pulsed, square wave DC) that they produce very accurately.

Unfortunately, this accuracy does not translate into accurate control of the motor RPM due to induction motor slip.

To further distort the situation, these AC induction motors typically drive centrifugal blowers which have highly un-linear characteristics.

The horsepower requirement of centrifugal blowers increases by the cube (x^3) of the speed ratio, so the load on the motor and therefore the slip increase dramatically with increasing blower RPM.

As one may conclude these factors can lead to inaccuracies in blower speed and therefore air delivery to the burner.

For these reasons, as well as the element of safety that verifying the speed of the blower ensures, are why the LMV52 has a **closed loop VSD control**.

Another point worth mentioning is the effect that accelerating and de-accelerating the blower wheel has on the VFD.

Most blower wheels, especially on larger burners tend to be heavy and have a large moment of inertia.

Since this is quite typically the case:

faster VFD and LMV52 **ramp rates** require:

more VFD power and
more braking capability,

just like heavier trucks require:

more powerful engines and
more braking capability

to achieve the same acceleration and deceleration as lighter trucks.

Setting ramp rates will be discussed later in this section.

Introduction and Principle of Operation 7-2

The LMV52 VSD controller is typically used to vary the speed of the combustion air blower.

In most cases, the blower RPM is decreased at low fire and increased to maximum or near maximum when the burner is at high fire. The primary advantages of this capability are less noise and reduced power consumption especially at low to mid fire.

As previously mentioned the VSD control in the LMV52 is an **active closed loop control**.

A speed wheel and sensor mounted to the motor / blower shaft provides a pulse feedback to the LMV52 so that the speed of the blower can be constantly monitored and corrected if necessary.

Since the speed wheel is asymmetrical, the LMV52 can also determine the direction of blower rotation.

The VSD control in the LMV52 regards the VSD / motor / speed wheel combination much the same way as the LMV5 regards an air or fuel actuator.

With an air or fuel actuator, the LMV5 sends the actuator a command over the CANBus to move to a certain position. The actuator then rotates, and this change is verified and fine tuned with the feedback potentiometer that is mounted on the actuator's shaft.

Similarly, the LMV52 VSD control sends out a command in the form of an analog signal (typically 4-20mA) to a VSD. The VSD / blower motor then increases or decreases speed in accordance with the 4-20mA signal and the change is verified and fine tuned using the speed wheel feedback that is mounted on the blower shaft.

In ether case if the feedback from the potentiometer or speed wheel is out of range a lockout will result.

The SQM4 actuators are calibrated (standardized) before they leave the factory. During this process, the output of the shaft mounted potentiometer is matched to the position of the actuator shaft. Thus a relationship of ohms per degree is established.

Much like the SQM4 actuator, the VSD / motor combination must be calibrated to the LMV52 before they are put into operation. This procedure is called ***Standardization*** and involves the LMV52 ramping the VSD / motor combination up, automatically recording the peak RPM, and ramping the VSD back down. This establishes a linear milliamp to pulse relationship that is correct for the VSD motor combination that is being used with the LMV52 VSD control.

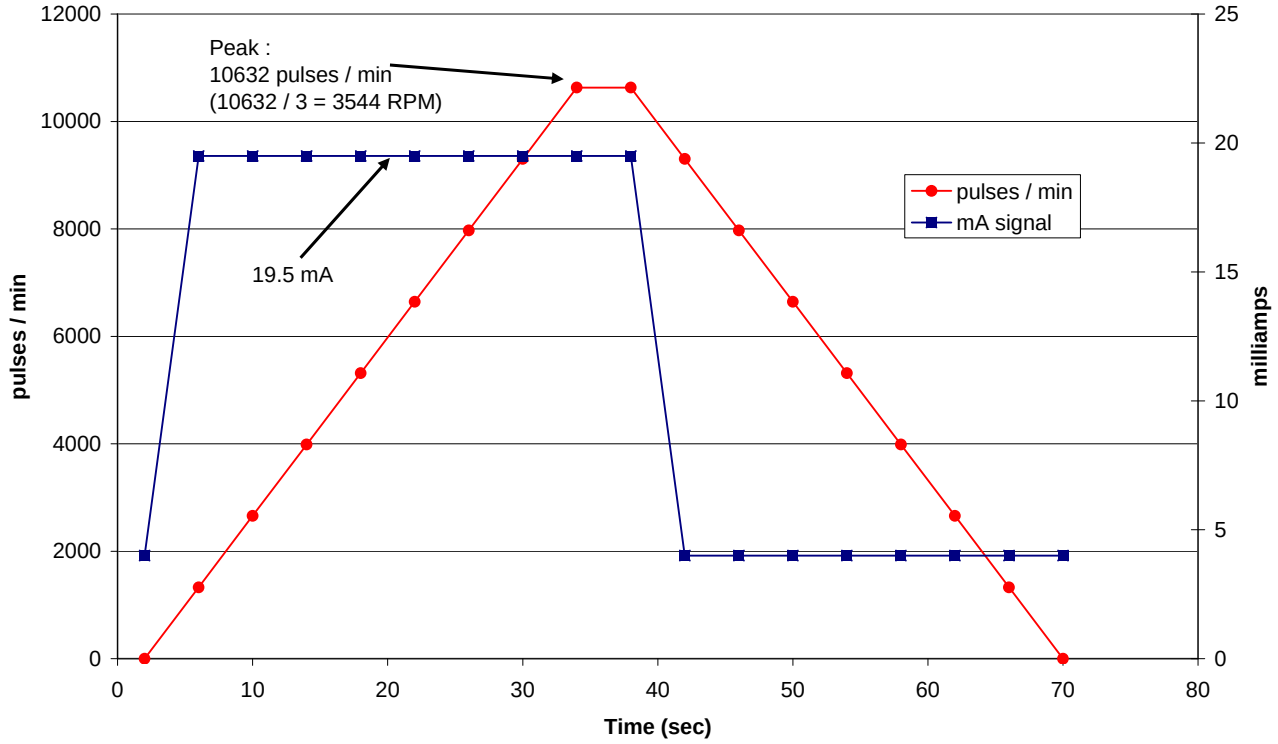
For the standard three fingered speed wheel, three pulses per revolution are produced.
For the special six fingered speed wheel, six pulses per revolution are produced.

The standardization process for a three fingered speed wheel is illustrated in Figure 7-2.1. The process for the six fingered speed wheel is the same, except that the pulses per minute would be divided by six instead of three to figure out the RPM.

Typically, the six fingered speed wheel is only used where the blower RPM would be less than 300 RPM.
Absolute minimum RPM for operation is 170 RPM with the six fingered speed wheel.

Figure 7-2.1 Typical Standardization

Time (sec)	LMV52 output to VSD (mA)	Blower Shaft Speed (RPM)	Feedback from speed wheel (pulses / min)	VFD output Freq. (Hz)
2	4	0	0	0
6	19.5	443	1329	7.5
10	19.5	886	2658	15.0
14	19.5	1329	3987	22.5
18	19.5	1772	5316	30.0
22	19.5	2215	6645	37.5
26	19.5	2658	7974	45.0
30	19.5	3101	9303	52.5
34	19.5	3544	10632	60.0
38	19.5	3544	10632	60.0
42	4	3101	9303	52.5
46	4	2658	7974	45.0
50	4	2215	6645	37.5
54	4	1772	5316	30.0
58	4	1329	3987	22.5
62	4	886	2658	15.0
66	4	443	1329	7.5
70	4	0	0	0.0



Note: The standardization time of 70 seconds was used as an example, but it may be longer or shorter depending upon VSD / LMV5 ramp rates.

The goal of the standardization process is to find the pulses per minute, and therefore blower RPM that corresponds to a 95% (19.5 mA) signal to the VSD.

Once the LMV52 detects the peak motor RPM associated with 19.5mA, it linearly scales the motor RPM to the 4-19.5 mA signal.
More specifically for the standardization in Figure 7-2.1, it associates 4 mA with 0 RPM and 19.5mA with 3544 RPM and performs a two-point linear interpolation.

If the standardization shown if Figure 7-2.1 were performed on a LMV52, and parameter ***Num Puls per R*** is set to 3 for a three fingered speed wheel, the LMV52 would automatically set parameter ***Standardized Sp*** to 3544 RPM.
Manual setting of the ***Standardized SP*** parameter is possible,but not recommended.

The useful result of standardization is a base line for LMV52 that is custom tailored to the VSD / motor that is being used with the LMV52. This base line has **three** main components:

VSD Control %, Blower Shaft RPM, and Output mA signal to VSD.

During normal operation, the LMV52 can increase or decrease the milliamp signal to the VSD to maintain a certain RPM.
There are limits on how much correction the milliamp signal to the VSD can be altered, off of the base line, in response to a RPM that is too low or too high.

Figure 7-2.2 illustrates the results of the typical standardization performed in Figure 7-2.1. Figure 7-2.2 also shows the approximate corection limits of how much the VSD control's output signal can be altered in response to a measured RPM that is too low or too high.

Figure 7-2.2 Results of Standardization, VSD Control Output Signal Variation

Results of Standardization			Approximate Correction Limits	
Standardized VSD Control %	Standardized Blower Shaft RPM	Standardized Output mA Signal to VSD	Maximum signal to correct for low RPM (mA)	Minimum signal to correct for high RPM (mA)
10	355	5.6	7.92	4.05
15.0	533	6.4	8.69	4.82
20.0	710	7.1	9.46	5.59
25.0	888	7.9	10.24	6.37
30.0	1066	8.7	11.01	7.14
35.0	1244	9.5	11.78	7.91
40.0	1421	10.2	12.55	8.68
45.0	1599	11.0	13.33	9.46
50.0	1777	11.8	14.10	10.23
55.0	1954	12.5	14.87	11.00
60.0	2132	13.3	15.64	11.77
65.0	2310	14.1	16.41	12.54
70.0	2488	14.9	17.19	13.32
75.0	2665	15.6	17.96	14.09
80.0	2843	16.4	18.73	14.86
85.0	3021	17.2	19.50	15.63
90.0	3199	18.0	20.28	16.41
95.0	3376	18.7	21.05	17.18
100.0	3554	19.5	21.82	17.95

After viewing Figures 7-2.1 and 7-2.2, the keen observer most likely notices some numbers that do not make immediate sense.

Specifically, these numbers are the milliamp signal used for standardization, the 60 Hz VFD output frequency corresponding to 19.5 mA input, and a signal greater than 20 mA.

The next couple of paragraphs will explain why these and other numbers associated with the VSD have the values that are shown.

When ***standardized***, the LMV52 VSD control only outputs 19.5 mA to the VFD and the resulting motor RPM (read by the speed wheel) is recorded for the standardization.

The reason 19.5 mA is output for the standardization instead of 20mA is so that there is additional room to increase the signal to the VFD if the motor RPM drops due to increased motor load.

For similar reasons, the VFD should be spanned so that:

4mA input signal = 0 Hz and a
20mA input signal = 62.5 or 63 Hz.

This means that at a 19.5 mA signal to the VFD, the frequency output of the VFD should be about 60 Hz.

This is all done in an effort to have some reserve built into the control system so that the blower can make rated speed under all environmental conditions.

The VSD control appears as another actuator when commissioning the fuel air ratio curves.

The only main difference is that the:
SQM4 actuator are in degrees and have a range of 0 to 90 degrees, while the VSD control is in percent and has a range of 10 to 100 percent.

When a particular percentage of VSD is saved for a point, the RPM corresponding to that percentage is maintained by varying the milliamp signal to the VFD.

The limits of this control range are shown in Figure 7-2.1.

On the top end, the LMV52 VSD control will output up to almost 22 mA if the blower RPM is low at 100% load.

However, this typically does not happen if the VFD is spanned as described above.

If the upper control range limit is reached and the blower RPM is still low, a message will be displayed on the AZL that states "*Fan speed not reached*".

If the lower control range limit is reached and the blower RPM is still high, a message will be displayed on the AZL that states "*Control range limitation VSD Module*".

Fan speed not reached results in an immediate lockout,
and *Control range limitation VSD Module* will result in a lockout if the blower RPM does not come into range in about 5 seconds after the warning is displayed.

Step by Step Commissioning of the VSD Control 7-3

After verifying that the wiring from the LMV52 to both the speed wheel and the VFD are correct and all system components are grounded properly the VSD can be set-up, and commissioned.

Note: Verify that the arrow on the speed wheel points in the desired direction of rotation. If not, the wheel can be turned over and re-mounted so that the speed wheel arrow is in the correct direction.

1. Set / Check the relevant parameters in the LMV52. All parameters related to the LMV52 VSD control are outlined in Section 4-2 of the Quick Start Guide.
   The following parameters should be checked for most applications:

   a. Under *Ratio Control* > *Gas / Oil settings* > *VSD*, ***activate*** the VSD.
   If the burner is dual fuel, the VSD must be ***activated*** for gas and oil.

   b. Also set the air actuator to ***air influen***. (under gas and oil)

   c. Under *Ratio Control* > *Times*, set the ramp times.
   Both ***OperatRampMod*** and ***TimeNoFlame*** should be set to at least 10 seconds longer than the ramp rate programmed into the VFD.
   Typically the VFD is 30 seconds, so these should be set to 40 seconds.

   d. Under *VSD Module* > *Configuration* > *Speed* > ***Num Puls per R***,
   change ***Num Puls per R*** to ***6*** if a six fingered speed wheel is used.
   (The default setting of ***Num Puls per R*** is ***3***.)

   e. Under *VSD Module* > *Configuration* > *Speed* > *Setpoint Output*,
   verify that ***Setpoint Output*** signal is set to ***4-20mA*** instead of ***0-20mA***.

2. Set / Check the relevant VFD parameters. (on the VFD drive itself)
   Many parameters must be set in the VFD for the specific application such as motor HP, max / min motor speed, number of motor poles, service factor, etc..

   Although the names of the actual VFD parameters may change by manufacturer, VFD settings specific to using a LMV52 VSD control with a VFD are:

   a. Span the VFD input signal so that 4mA = 0 Hz and 20mA = 62.5 or 63 Hz.

   b. Set the VFD so that it starts and runs on a contact closure. The dry contact that closes in the LMV52 is rated 24 VDC, on terminals X73.1 and X73.2.

   c. Set the VFD ramp rate so that it is able to ramp more quickly than the LMV52. A ten second differential (as explained in step 1) works well for most applications. Also note that faster VFD ramp rates will generate higher amperage for both the motor and the VFD.

   d. Set the VFD so that it sends an alarm signal to the LMV52 in the event of a VFD problem, such as over-current.
   The 12-24 VDC alarm input is terminal X73.3 on the LMV52.

   e. Make sure that no PID loops or filtering exist on the VFD input signal, so that 19.5 mA input directly produces a 60 Hz VFD output, an 11.7 mA input directly produces a 30 Hz output etc… The LMV52 VSD control already contains an application-tuned PID loop, and “stacked” PID loops do not provide accurate control. In short, the VFD needs to be programmed as a slave device.

3. After both the LMV52 and the VFD are wired and configured properly, then the ***standardization*** can be performed.

   As was mentioned earlier, this is when the LMV52 “learns” the specific characteristics of VFD / motor that is connected to.

   This procedure is automatic, but does have some prerequisites. These are:

   a. If working on an un-configured LMV52, ensure that:

      the ***Burner ID*** is set,
      the ***fuel train*** is defined,
      the actuators are ***addressed***,
      actuator ***DirectionRot*** (ation) are correct and
      that all the actuator ***special positions*** are set.

      The pre-purge position of the air actuator should be close to, (within +/- 15 degrees) to the expected high fire air actuator position.

   b. Make sure The LMV52 ***safety loop*** is energized (closed), including the ***burner flange*** section.

      The safety loop can be open in Phase 12 and not cause an alarm, but the LMV52 will not ***Standardize*** if the safety loop is open.

      Standardization is possible even while the LMV52 is in an alarm condition, as long as the alarm is not due to an open safety loop.

   c. Under *VSD Module>Configuration>Speed>****Standardization***, select a***ctivate***.

      The air actuator should open to the purge position and the VFD / blower motor should ramp up and then ramp back down.

      After the ramp down is complete, ***Standardization*** returns to ***deactivated***.

   d. Parameter ***StandardizedSP*** should read close to full speed RPM of the blower motor.

      For most 3600 RPM blowers, it should be 3500 +/- 100 RPM.

   e. If the LMV52 does not have O2 trim, set the air actuator back to ***activated*** instead of ***air influen***.

4. The LMV52 VSD control set-up is now complete, and the blower speed can be set:

   at each ***special position,*** and
   at each ***fuel air ratio control point***. (Combustion curve)

Section 8 Modbus

Master-slave principle

Communication between Modbus users takes place according to the master-slave principle. The AZL... always works as a slave.

Data transmission

Transmission mode (RTU)

– The transmission mode used is RTU (Remote Terminal Unit)
– Data are transmitted in binary format (hexadecimal) with 8 bits
– The LSB (least significant bit) is transmitted first
– ASCII operating mode is not supported

Structure of data blocks

All data blocks use the same structure:

Data structure

Slave address	Function code	Data field	Checksum CRC16
1 byte	1 byte	x byte	2 bytes

Every data block contains 4 fields:

Slave address Device address of a certain slave

Function code Function selection (reading / writing words)

Data field Contains the following information:
- Word address
- Number of words
- Word value

Checksum Identification of transmission errors

Checksum (CRC16)

The checksum (CRC16) is used to detect transmission errors. If, during evaluation, an error is detected, the relevant device will not respond.

Calculation scheme

```
CRC = 0xFFFF
    CRC = CRC XOR ByteOfMessage
    For (1 through 8)
        CRC = SHR (CRC)
        if (flag shifted at right = 1)
        then                    | else
        CRC = CRC XOR 0xA001    |
while (not all ByteOfMessage handled)
```

The low-byte of the checksum is transmitted first.

Example

Data query: Reading 2 words from address 6 (CRC16 = 0x24A0)

0B	03	00	06	00	02	A0	24
						CRC16	

Reply: (CRC16 = 0x0561)

0B	03	04	00	00	42	C8	61	05
			Word 1		Word 2		CRC16	

Mapping words

B0	B1	B2	B3	B4	B5	B6	B7
Byte High							

B8	B9	B10	B11	B12	B13	B14	B15
Byte Low							

Transmission mode: The LSB (least significant bit) is transmitted first.

Mapping long values

Byte High	Byte Low	Byte High	Byte Low
Word Low		Word High	

Communication process

Start and end of a data block are characterized by transmission pauses. The maximum permissible time between 2 successive characters is 3.5 times the time required for the transmission of once character.
The character transmission time is dependent on the Baud rate and the data format used.

Having a data format of 8 data bits, no parity bit and one stop, the character transmission time is calculated as follows:

Character transmission time [ms] = 1000 * 9 bits / Baud rate

And with other data formats:

Character transmission time [ms] = 1000 * 10 bits / Baud rate

Process

Data query from the master
Transmission time = n characters * 1000 * x bits / Baud rate

Marking for end of data query
3.5 characters * 1000 * x bits / Baud rate

Data query handling by the slave

Reply of slave
Transmission time = n characters * 1000 * x bits / Baud rate

Marking for end of reply
3.5 characters * 1000 * x bits / Baud rate

Example

Marking for data query or end of reply with data format 10 / 9 bits

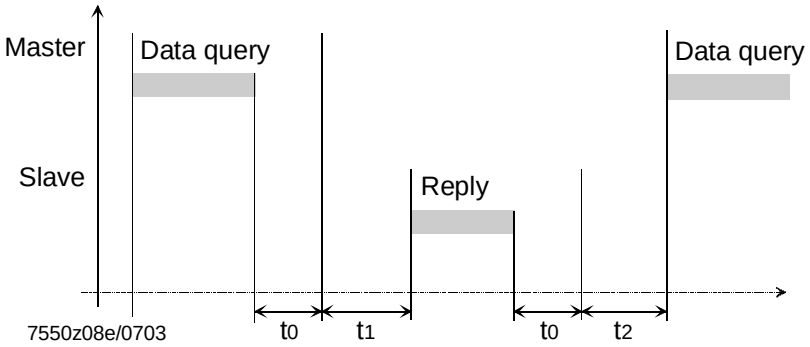
Waiting time = 3.5 characters * 1000 * x bits / Baud rate

Baud rate [Baud]	**Data format** [bit]	**Waiting time** [ms]
9600	10	3.125
	9	2.813

Data query process

Time diagram

A data query is made according to the following time diagram:



where:

t0 Marking for end = 3.5 characters (time is dependent on the Baud rate)

t1 This time is dependent on internal handling; the maximum handling time is dependent on the data type (internal and external data) and on the number of data; for more detailed information, see below!

t2 $t2 \geq 20$ ms
This time is required by the device to switch from transmitting back to receiving; this time must be observed by the master before a new data query is made; it must always be observed, even if a new data query to some other device is made

Communication during the slave's internal handling time

During the slave's internal handling time, the master is not allowed to make any data queries. The slave ignores data queries made during this period of time.

Communication during the slave's reply time

During the slave's reply time, the master is not allowed to make any data queries. Data queries made during this period of time cause all data on the bus at this instant to be deleted.

Number of messages

The number of addresses per message are limited:

- 20 addresses of the size of one word when reading
- 6 addresses of the size of one word when writing

Reply time of AZL... to a message from the master

1. Reading data from the LMV5... system:

1...3 addresses	25...75 ms
4...9 addresses	75...125 ms
10...15 addresses	125...175 ms
16...20 addresses	175...225 ms

Note

These periods of time are defined from the complete writing of the message from the master to sending the first byte by the AZL...

2. Writing data to the LMV5... system:

1 address	25...75 ms
2...3 addresses	75...125 ms
4...5 addresses	125...175 ms
6 addresses	175...225 ms

Modbus functions

The following Modbus functions are supported:

Function number	**Function**
03 / 04	Reading n words
06	Writing 1 word
16	Writing n words

For more information about the Modbus protocol, refer to www.modbus.org.

Table of addresses

Function	Address	Number of words	Data designation	Access	Data format	Data type / coding	Range	Updating rate
03/04	0	1	Phase	R	U16		0...255	Fast
03/04	1	1	Position of currently active fuel actuator	R	S16	PT_WINKEL	-3... 93°	Fast
03/04	2	1	Position of gas actuator	R	S16	PT_WINKEL	-3...93°	Fast
03/04	3	1	Position of oil actuator	R	S16	PT_WINKEL	-3...93°	Fast
03/04	4	1	Position of air actuator	R	S16	PT_WINKEL	-3...93°	Fast
03/04	5	1	Position of auxiliary actuator 1	R	S16	PT_WINKEL	-3...93°	Fast
03/04	6	1	Position of auxiliary actuator 2	R	S16	PT_WINKEL	-3...93°	Fast
03/04	7	1	Position of auxiliary actuator 3	R	S16	PT_WINKEL	-3...93°	Fast
03/04	8	1	Manipulated variable for variable speed drive	R	S16	PT_PROZENTFU	0…100 %	Fast
03/04	9	1	Current type of fuel	R	U16	0= Gas 1= Oil	0...1	Fast
03/04	10	1	Current output	R	U16	PT_LEISTUNG	0…100 %	Fast
03/04	11	1	Current setpoint / temperature / pressure	R	U16	PT_TEMP_ DRUCK		Medium
03/04	12	1	Actual value / temperature / pressure Unit: See address 18 / 19	R	U16	PT_TEMP_ DRUCK	0…2000 °C 0…100 bar	Medium
03/04	13	1	Flame signal	R	U16	PT_PROZENT01	0…100 %	Medium
03/04	14	1	Current fuel throughput	R	U16	0..65534		Fast
03/04	15	1	Current O2 value (LMV52...)	R	U16	PT_PROZENT01	0…100 %	Fast
03/04	16	1	Volume unit of gas	R	U16	0= m^3 1= ft^3	0…1	Slow
03/04	17	1	Volume unit of oil	R	U16	0= l 1= gal	0…1	Slow
03/04	18	1	Unit of temperature	R	U16	0= °C 1= °F	0…1	Slow
03/04	19	1	Unit of pressure	R	U16	0= bar 1= psi	0…1	Slow
03/04	20	1	Sensor selection	R	U16	0=Pt100 1=Pt1000 2=Ni1000 3=temp. sensor 4=press. sensor 5=Pt100Pt1000 6=Pt100Ni1000 7=no sensor	0…7	Slow
03/04	21	2	Startup counter total	R	S32		0…999999	Slow
03/04	23	2	Hours run counter	R	S32		0…999999	Slow
03/04	25	1	Current error: Error code	R	U16		0...0x FF	Fast
03/04	26	1	Current error: Diagnostic code	R	U16		0…0x FF	Fast
03/04	27	1	Current error: Error class	R	U16		0...5	Fast
03/04	28	1	Current error: Error phase	R	U16		0...255	Fast
03/04	29	1	Temperature limiter OFF threshold, in degrees Celsius / Fahrenheit (in address 129: Temperature limiter switching differential ON)	R	U16		0…2000 °C 32…3632 °F	Slow
03/04	30	1	Supply air temperature, in degrees Celsius / Fahrenheit (LMV52...)	R	U16		-100…+923 °C -148..+1693 °F	Slow
03/04	31	1	Flue gas temperature, in degrees Celsius / Fahrenheit (LMV52...)	R	U16		-100...+923 °C -148...+1693 °F	Slow
03/04	32	1	Combustion efficiency (LMV52...)	R	U16	PT_Prozent01	0...200 %	Slow

Function	Address	Number of words	Data designation	Access	Data type / coding	Range	Updating rate
03/04	35	1	**Inputs**	R	U16	-	Medium

Coding: 0 → inactive 1 → active

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0

B8	Safety loop	B0	Controller ON/OFF
B9		B1	Fan contactor contact
B10	Pressure switch-min-gas	B2	Fuel selection oil
B11	Pressure switch-max-gas	B3	Fuel selection gas
B12		B4	
B13	LP	B5	Pressure switch-max-oil
B14	Start release oil	B6	Pressure switch-min-oil
B15	Heavy oil immediate start	B7	Pressure switch – valve proving

Function	Address	Number of words	Data designation	Access	Data type / coding	Range	Updating rate
03/04	37	1	**Outputs**	R	U16	-	Medium

Coding: 0 → inactive 1 → active

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0

B8	Fuel valve SV oil	B0	Alarm
B9	Fuel valve V1 oil	B1	
B10	Fuel valve V2 oil	B2	
B11	Fuel valve V3 oil	B3	
B12	Fuel valve SV gas	B4	Ignition
B13	Fuel valve V1 gas	B5	Start signal / DW valve
B14	Fuel valve V2 gas	B6	Fan
B15	Fuel valve PV gas	B7	Oil pump / magnetic coupling

Function	Address	Number of words	Data designation	Access	Data format	Data type / coding	Range	Updating rate
R 03/04 W 06/16	38	1	Program stop	R/W*	U16	0=deactivated 1=24 PrePurgP 2=32 PrePFGR 3=36 IgnitPos 4=44 Interv 1 5=52 Interv 2 6=72 PostPPos 7=76 PostPFGR	0...7	Slow
R 03/04 W 06/16	39	1	Operating mode with load controller	R/W*	U16	0=ExtLR X5-03 1=IntLR 2=IntLR Bus 3=IntLR X62 4=ExtLR X62 5=ExtLR Bus	0…5	Slow
R 03/04	40	1	Selection of manual or automatic operation	R	U16	0=automatic 1=burner on 2=burner off	0…2	Fast
R 03/04 W 06/16	41	1	Modbus mode: Local / Remote	R/W	U16	0 = Local 1 = Remote	0…1	Slow

Function	Address	Number of words	Data designation	Access	Data format	Data type / coding	Range	Updating rate
R 03/04 W 06/16	42	1	Modbus downtime: Max. time with no communication. When this time has elapsed, automatic changeover from Remote to Local takes place	R/W*	U16		0…7200 s	Slow
R 03/04 W 06/16	43	1	Operating mode in Remote mode. Auto, Remote ON, Remote OFF	R/W	U16	0 = Auto 1 = ON 2 = OFF	0…2	Fast
R 03/04 W 06/16	44	1	External setpoint W3 Unit: See address 18 / 19	R/W	U16	PT_TEMP_ DRUCK	See ”Data types” on page 15	Fast
R 03/04 W 06/16	45	1	Predefined output mod. / multistage	R/W	U16	PT_LEISTUNG	See ”Data types” on page 15	Fast
R 03/04 W 06/16	46	1	Fuel selection AZL...	R/W*	U16	0 = Gas 1 = Oil	0…1	Slow
R 03/04 W 06/16	47	1	Setpoint W1	R/W	U16	PT_TEMP_ DRUCK	See ”Data types” on page 15	Slow
R 03/04 W 06/16	48	1	Setpoint W2	R/W	U16	PT_TEMP_ DRUCK	See ”Data types” on page 15	Slow
R 03/04 W 06/16	49	1	Weekday	R/W	U16	0 = Sunday 1 = Monday ...	0…6	Slow
R 03/04 W 16	50	3	Date	R/W	U16[3]	Data structure Date		Slow
R 03/04 W 16	53	3	Time of day	R/W	U16[3]	Data structure Time of day		Slow
R 03/04 W 16	56	2	Hours run gas (adjustable)	R/W*	S32		0...999999 h	Slow
R 03/04 W 16	58	2	Hours run oil stage 1 or modulating (adjustable)	R/W*	S32		0...999999 h	Slow
R 03/04 W 16	60	2	Hours run oil stage 2 or modulating (adjustable)	R/W*	S32		0...999999 h	Slow
R 03/04 W 16	62	2	Hours run oil stage 3 or modulating (adjustable)	R/W*	S32		0...999999 h	Slow
R 03/04 W 16	64	2	Hours run total (can be reset)	R/W*	S32		0...999999 h	Slow
03/04	66	2	Hours run total (read only)	R	S32		0...999999 h	Slow
03/04	68	2	Hours run device connected to power (read only	R	S32		0...999999 h	Slow
R 03/04 W 16	70	2	Startup counter gas (adjustable)	R/W*	S32		0...999999	Slow
R 03/04 W 16	72	2	Startup counter oil (adjustable)	R/W*	S32		0...999999	Slow
R 03/04 W 16	74	2	Startup counter total (can be reset)	R/W*	S32		0...999999	Slow
03/04	76	2	Startup counter total (read only)	R	S32		0...999999	Slow
03/04	78	2	Fuel volume gas (read only) (resettable from AZL5... version V4.10) 0…199999999.9 m^3 0…1999999999 ft^3	R/W*	S32		See ”Data types” on page 15	Slow

Function	Address	Number of words	Data designation	Access	Data format	Data type / coding	Range	Updating rate
03/04	80	2	Fuel volume oil (read only) (resettable from AZL5... version V4.10) 0…199999999.9 l 0…199999999.9 gal	R/W*	S32		See "Data types" on page 15	Slow
03/04	82	1	Number of lockouts	R	U16		0…65535	Slow
03/04	83	1	Extra temperature sensor (from AZL5... version V4.10)	R	U16	°C: *1 °F: *1	0..2000 °C 32..3632 °F	Slow
Parameters 84...137 are available from AZL5... version V4.20								
03/04	84	8	AZL5... ASN	R	U8[16]	String		Constant
03/04	92	1	AZL5... parameter set code	R	U16			Constant
03/04	93	1	AZL5... parameter set version	R	U16			Constant
03/04	94	3	AZL5... identification date	R	U16[3]	Date		Constant
03/04	97	1	AZL5... identification number	R	U16			Constant
03/04	98	8	Burner control ASN	R	U8[16]	String		Constant
03/04	106	1	Burner control parameter set code	R	U16			Constant
03/04	107	1	Burner control parameter set version	R	U16			Constant
03/04	108	3	Burner control identification date	R	U16[3]	Date		Constant
03/04	111	1	Burner control identification number	R	U16			Constant
03/04	112	1	Software version AZL5...	R	U16	Hexadecimal		Constant
03/04	113	1	Software version burner control	R	U16	Hexadecimal		Constant
03/04	114	1	Software version load controller	R	U16	Hexadecimal		Constant
03/04	115	8	Burner identification	R	U8[16]	String		Upon reset
03/04	123	1	Min-output gas	R	U16	PT_LEISTUNG	0...100 %	Slow
03/04	124	1	Max-output gas	R	U16	PT_LEISTUNG	0...100 %	Slow
03/04	125	1	Min-output oil	R	U16	PT_LEISTUNG	0...100 % 1001...1003	Slow
03/04	126	1	Max-output oil	R	U16	PT_LEISTUNG	0...100 % 1001...1003	Slow
R 03/04 W 16	127	1	Load limitation enduser (modulating)	R/W*	U16	PT_LEISTUNG	0...100 %	Slow
R 03/04 W 16	128	1	Load limitation enduser (multistage)	R/W*	U16	0: S1 1: S2 2: S3	0...2	Slow
03/04	129	1	Temperature limiter switching differential ON (in address 29: Temperature limiter OFF threshold, in degrees Celsius / Fahrenheit)	R	S16	PT_Prozent1	-50...0 %	Slow
03/04	130	1	Measuring range temperature sensor	R	U16	0: 150°C / 302°F 1: 400°C / 752°F 2: 850°C / 1562F	0...2	Slow
03/04	131	1	Adaption active / inactive	R	U16	0: Inactive 1: Active	0...1	Fast
03/04	132	1	Adaption state	R	U16	PT_ADAPTION	0...12	Slow
R 03/04 W 16	133	1	Start adaption	R/W	U16	0: Reset value 1: Start 2: Abort	0...2	Slow
R 03/04 W 16	134	1	Adaption output Permissible values: 40 %, 50 %, 60 %, 70 %, 80 %, 90 %, 100 %	R/W*	U16	PT_Prozent1	40...100 %	Slow
R 03/04 W 16	135	1	P-value	R/W*	U16	PT_Prozent01	2...500 %	Slow
R 03/04 W 16	136	1	I-value	R/W*	U16	Seconds	0...2000 s	Slow

Function	Address	Number of words	Data designation	Access	Data format	Data type / coding	Range	Updating rate
R 03/04 W 16	137	1	D-value	R/W*	U16	Seconds	0...1000 s	Slow
03/04	400	16	Lockout history (current lockout)	R	U16/U32 []			Fast
03/04	416	16	Lockout history (current lockout -1)	R	U16/U32 []			Fast
03/04	432	16	Lockout history (current lockout -2)	R	U16/U32 []			Fast
:	:	:	:	:	:			
03/04	528	16	Lockout history (current lockout -8)	R	U16/U32 []			Fast
03/04	544	8	Error history (current error)	R	U16/U32 []			Fast
03/04	552	8	Error history (current error -1)	R	U16/U32 []			Fast
:	:	:	:	:	:			
03/04	704	8	Error history (current error -20)	R	U16/U32 []			Fast

* These parameters need not be continually written since they are stored in EEPROM, which only permits a limited number of write accesses over its lifecycle (< 100,000)

Data structures

Date	U16	Year Month Day
Time of day	U16	Hour Minute Second
Lockout history	U16	Error code Error diagnostics Error class Error phase Fuel Output Date: Year Date: Month Date: Day Time of day: Hours Time of day: Minutes Time of day: Seconds
	U32	Startup counter total Hours run total
Error history	U16	Error code Error diagnostics Error class Error phase Fuel Dummy Output
	U32	Startup counter total

Legend to address table

Access	R	Value can only be read
	R / W	Value can be read and written
Data format	U16	16 bit integer, not subject to sign
	S32	32 bit integer, subject to sign Note: In the AZL..., this data type is also used to mark an invalid or non-available value by using the value of «-1»
[ ]		Data array

[1]) Refer to section «Data structures»

* These parameters need not be continually written since they are stored in EEPROM, which only permits a limited number of write accesses over its lifecycle (< 100,000)

Data types

TYPE	Phys.	Int. range	Resolution	Conversion int. / phys.
PT_PROZENT01	0...100 %	0...1000	0.1 %	/ 10
PT_PROZENTFU	0...110 %	0...1100	0.1 %	/ 10
PT_WINKEL	-3.0...93.0°	-30...930	0.1°	/ 10
PT_TEMP_ DRUCK	0...2000° 32...3632 °F 0...100 bar 0...1449 psi	0...2000 32...3632 0...1000 0...1449	1 °C 1 °F 0.1 bar 1 psi	1 1 / 10 1
PT_LEISTUNG	Modulating operation: 0...100 % Multistage operation: 1001 = stage 1 1002 = stage 2 1003 = stage 3	0...1003	Modulating operation: 0.1 % Multistage operation: 1	Modulating operation: / 10 Multistage operation: - 1000
PT_ADAPTION	0: Undefined 1: Identification completed, parameter determined 2: Undefined 3: Adaption aborted by user 4: Temperature differential too small, temperature will be lowered with low-fire 5: Monitoring time running 6: Delivery of identification load set 7: Error during identification (path) 8: Error during identification (internally) 9: Monitoring time running 10: Changeover from modulating to multistage during an identification 11: Timeout monitoring time 12: Timeout heating output on path with monitoring			

The routine used for identifying the path in the integrated load controller (termed “adaption“ here) of the LMV5... system can be controlled and monitored via Modbus.

In principle, the general conditions are the same as those used when making adaptions with the AZL52... (refer to subsection 6.4.2 *Self-setting of control parameters (adaption*)) in the Basic Documentation of the LMV5... system (P7550).

The terms *Start adaption*, *Adaption active / inactive* and *Adaption state* indicate the respective Modbus addresses (refer to ”Table of addresses”).

Start the adaption via *Start adaption* and change the value from ≠ 1 to = 1.
Starting the adaption has no impact on adaption processes already under way (*Adaption active / inactive* = 1).

If *Adaption active / inactive* = 1, the process can be monitored via *Adaption state* (refer to data type PT_ADAPTION).
When *Adaption active / inactive* = 0, the adaption process is completed.
On completion of the process, the result can be read out via *Adaption state*.

To complete the adaption process prematurely, the value at *Start adaption* must be changed from ≠ 2 to = 2.

Updating rate of AZL5

Fast	System data that have already been updated automatically by the system process are available on request, at a typical repetition rate of 200 ms.
Medium	These data are cyclically queried in the system by the AZL... The typical updating rate here is 5 seconds, depending on system load.
Slow	These data are cyclically queried in the system by the AZL... The typical updating rate that can be expected here is 25 seconds, depending on system load.
Constant	These data are updated in the system by the AZL5... upon each *Power On* or reset. When making a query, the updated data will be available after 25 seconds. Data that cannot be changed (e.g. the production date, etc.) – neither with the AZL5... nor via the ACS450 – can be identified by the value of *0* in the first Byte of the strings.
Upon reset	Same as constant data, but these data can be changed in the system.

Error handling

Error codes

When there are faulty telegrams (CRC errors, etc.), the AZL… does not send any exception code. It does not respond to this kind of message.

Reason: Usually, the commercially available Modbus drivers do not respond to exception codes.

Selection menus in the AZL5

Activation of Modbus operation

Activation takes place via menu
«Operation» → «OptgModeSelect» → «GatewayDDCon».

Having made the selection, the menu item can be quit via ESC. The setting is retained until «Operation» → «OptgModeSelect» → «GatewayDDCoff» is selected via the AZL… menu.

When «GatewayDDCon» is activated, plant operation and diagnostics via the AZL... are still possible.

Deactivation takes place via menu
«Operation» → «OptgModeSelect» → «GatewayDDCoff».

Slave address

Selection is made via menu
«Params & Display» → «AZL» → «Modbus» →«Address».

According to Modicon specifications, addresses between 1...247 can be selected. The slave address is filed in nonvolatile memory of the AZL...

Transmission parameters

Transmission rate

The setting is made via menu
«Params & Display» → «AZL» → «Modbus» → «Baud Rate»
There is a choice of 9600 bit/s or 19200 bit/s.

Parity

Using the AZL... menu
«Params & Display» → «AZL» → «Modbus» → «Parity», parity can be set to «none», «even» or «odd».

Timeout communication failure

When there is no Modbus communication, this timeout defines the period of time on completion of which the AZL… changes automatically from Remote to Local.

The setting is made via menu
«Params & Display» → «AZL» → «Modbus» → «Downtime».

Local «-» Remote mode

This setting defines whether the AZL… shall work in Local or Remote mode.

Remote mode

Display of «Remote Auto», «Remote On», «Remote Off» mode. A change can only be made via Modbus.

AZL5 interface

General

The AZL... serves the Modbus via its COM2 port (8-pole Western jack RJ45). The port is assigned to the functional low-voltage range.

Assignment of RJ45 pins:

PIN	
1	TXD (RS-232 level or V28)
2	Not used
3	RXD (RS-232 level or V28)
4	GND
5	U1 (typically +8.2V)
6	GND
7	U2 (typically -8.2V)
8	Not used

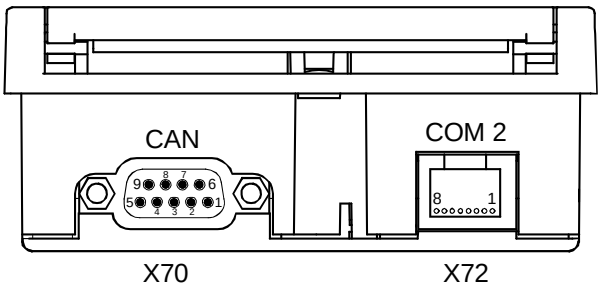
When preparing and fitting a connecting cable between the AZL... and a converter, it is to be noted that PIN 5 and PIN 7 can deliver a current of 5 mA each. Adequate insulation against other potentials must be ensured.

The maximum permissible data line length between COM2 and a converter is 3 m. In exceptional cases, this data line length can be exceeded, depending on environmental conditions (electrical interference) and the type of cable used – without Siemens assuming responsibility.

To ensure protection against electric shock hazard, it must be made certain that AC 230 V / AC 120 V lines are strictly separated from the functional low-voltage area.

CAN X70

PIN	
2	CAN L
3	GND
4	VAC 2
7	CAN H
8	VAC 1

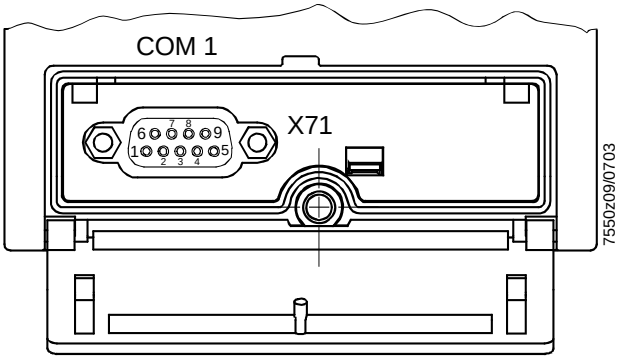


COM2 X72

PIN	
1	TXD
3	RXD
4, 6	GND
5	U 1
7	U 2

COM1 X71

PIN	
2	RXD
3	TXD
5	GND



Note

COM1 (PC port) ad COM2 cannot be active at the same time!

Converter RS-232 – RS-485

This converter converts a V.24 / RS-232 port into an RS-485 port.

Technical requirements

– Code transparency, that is, data must remain unchanged
– When using the RS-485 interface as a bus, control of the transmitting section on the RS-485 side must be ensured by the transmitter power of the AZL...
– The interfaces must be galvanically separated to improve EMC

Commercially available converters

The technical specification provided by the suppliers of the converters must be observed when doing planning work. Some of them do not meet the specifications of the LMV5... system (e.g. operating temperatures). If required, technical measures must be taken (e.g. suitable location).
The following types of converters have been tested by us with respect to function and immunity (voltage surges):

- Supplier: Hedin Tex
  Type reference: H-4

  Contact address in Germany:
  Hedin Tex GmbH
  Am Herrkamp 14
  D-24226 Heikendorf
  www.hedintex.de

- Supplier: IPC CON
  Type reference: I-7520

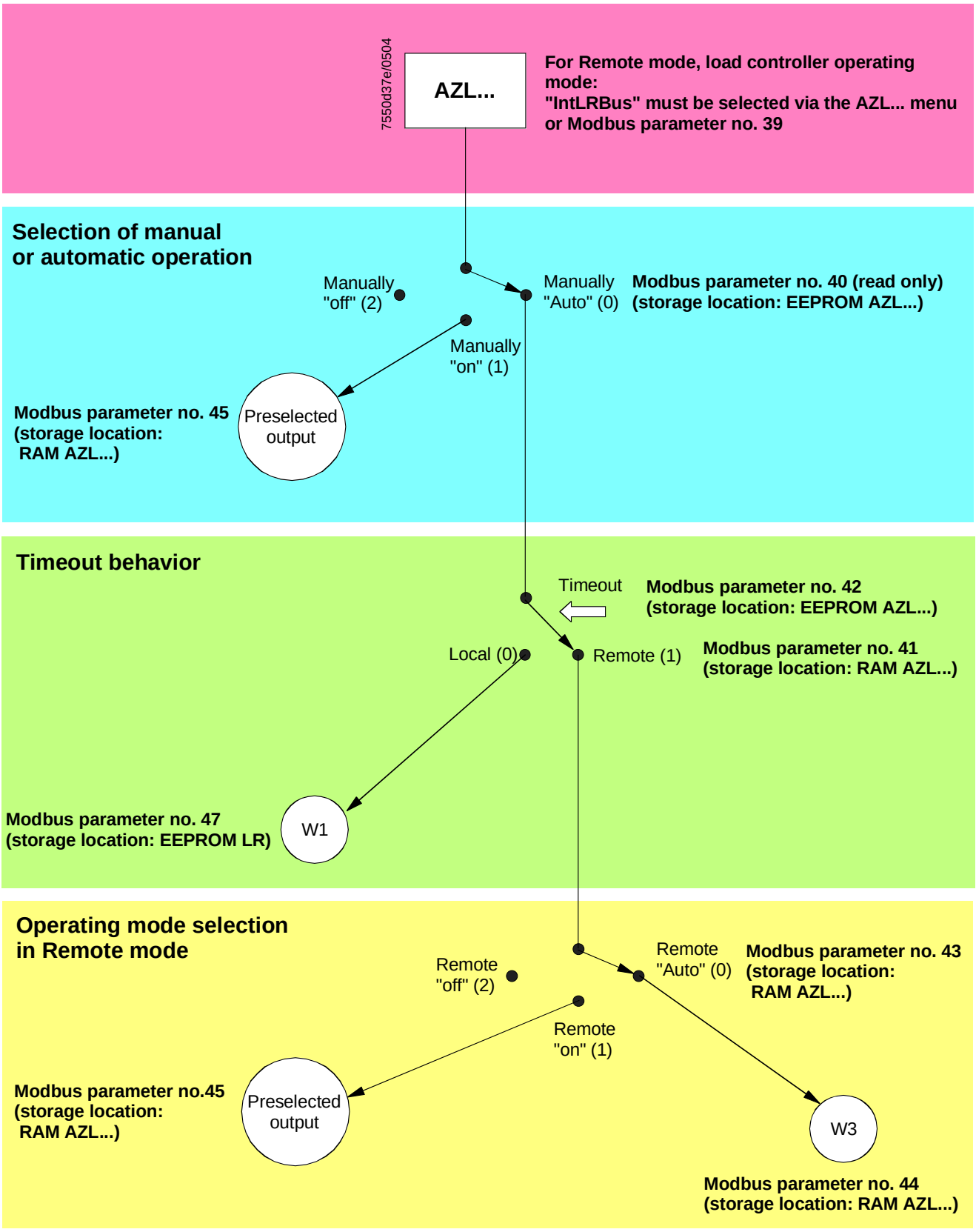
  Contact address in Germany:
  Spectra Computersysteme GmbH, Humboldtstraße 36
  D-70771 Leinfelden-Echterdingen
  *www.spectra.de

Connection example: Connecting cable for interface converter type Hedin Tex H4/M4

AZL COM2 8-pole Western		Cable	Hedin Tex interface converter X1 RS-232	
			H4	M4
1	TxD		21	2
2	—		—	—
3	RxD		22	3
4	GND		16	7
5	U1		(only for eBus adapter)	
6	GND		—	—
7	U2		(only for eBus adapter)	
8	—		—	—

7550t05e/0703

Overview of «Operating mode changeover of controller»



Notes on operating modes

Modbus downtime

When there is no more communication between DDC and AZL..., the Modbus downtime is used to switch over from Remote mode to the preselected setpoint in Local mode. The timer will be activated when changing from Local to Remote. With every permissible Modbus communication to this slave (AZL...), the timer will be reloaded.
Should the timer lapse, the DDC must again set the Remote mode, if required. The timer value will be retained in EEPROM and will also be retained after power off.

Note: When deactivating the «Gateway DDC» mode (menu item «OptgModeSelect» → «GatewayDDCoff»), automatic changeover to Local takes place, that is, preselected output «W1» will apply.

Changeover of operating mode via parameter 43

This changeover was introduced primarily because of the requirements of boiler sequence control.
In that case, the individual boiler can be operated at low output via manually «On». When switching to «Auto» via sequence control, preselected output «W3» will be used.

Default parameter settings

Parameter	Address	Storage location	Preselection	Choices for making changes
Setpoint W1	47	EEPROM	See Basic Documentation «Menu and parameter lists»	• On the AZL... (menu) • Preselection via Modbus
Setpoint W2	48	EEPROM	See Basic Documentation «Menu and parameter lists»	• On the AZL... (menu) • Preselection via Modbus
External setpoint W3	44	RAM	«0» will be reinitialized when resetting the AZL...	• On the AZL... (menu) • Preselection via Modbus
Set target load mod / multistage	45	RAM	«0» will be reinitialized when resetting the AZL...	• On the AZL... (menu) • Preselection via Modbus
Local / Remote	41	RAM	«Local»	• Via Modbus • On the AZL... (menu) • Via lapse of timer «Communication failure» from Remote to Local
Selection of manual or automatic operation	40	EEPROM	See Basic Documentation «Menu and parameter lists»	• On the AZL... (menu)
Operating mode: Remote ”off” / remote “on” / W3	43	RAM	«Auto» will be reinitialized when resetting the AZL...	• Preselection via Modbus
Operating mode with load controller	39	EEPROM	See Basic Documentation «Menu and parameter lists»	

Note: An AZL5 reset will be triggered when switching power on, or in the event of severe system errors.

Section 9 ACS 450 PC Tool

Introduction 9-1

The LMV5 system can be completely set-up (parameters adjusted and combustion / O2 trim curves set) buy using the AZL5 or by using a PC with ACS450 software. Most people find that using the AZL5 is more convenient than the ACS450 for a “manual” set-up of the LMV5 parameters. However, the ACS450 has additional capabilities that are not available with the AZL5 / LMV5 alone. These additional, valuable capabilities are:

1) Saving and / or printing out all LMV5 settings, combustion curves, and information in a report format. This provides a convenient, comprehensive start-up report.

2) Saving and / or uploading entire LMV5 parameter sets to or from a PC.

3) Updating AZL5 software.

4) The ability to view and save trends (particularly useful for tuning PID loops)

5) A “dashboard” to view all of the LMV5 inputs and outputs as well as the operating state.

The pages following the installation and set-up procedure will explain how to execute these additional functions that the ACS450 offers.

Since most people prefer to use the AZL5 to set parameters and combustions curves, the procedure to do this with ACS450 will not be covered in detail.

Document number CC1J7550en covers setting parameters and combustion curves with the ACS450 in greater detail.

Before the ACS450 can be used, it must be installed on the PC and the correct cables obtained. The next few pages will describe the installation and set-up in detail.

Note: ACS450 <u>can</u> be used with the following PC operating systems:

Microsoft Windows 98

Microsoft Windows 2000

Microsoft Windows xp

ACS450 <u>cannot</u> be used with:

Windows Vista

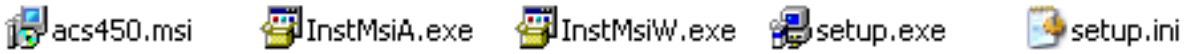
ACS450 <u>can</u> be used with:

Windows 7 32 bit, Windows 7, Professional Version

Installation and Set-up Procedure 9-2

The following steps outline the procedure for installing the ACS450 software on a PC.
This procedure is valid for AZL5 software up to, and including version 4.20.

1) If installing from an email attachment, or a series of email attachments, ensure that the following files are in the same folder on your computer: (If using the CD, skip to step 2.)



2) Click on the setup.exe file. This should start the installation. Pick the desired options as the installation prompts.

3) After the installation is complete, most of the files necessary for the ACS450 should be on the computer under C:\Program Files\ACS450. Notice that there are files such as **para_nr_0170.cod** in this directory. On some software installs (older versions), these .cod files only go up to **para_nr_0390.cod**. If the latest version of software is installed, the .cod files will go up to **para_nr_0450.cod.**

4) If the files only go up to 0390.cod some additional .cod files are necessary so that the ACS450 is compatible with the latest AZL5 software. Copy and paste the additional, necessary .cod flies under C:\Program Files\ACS450.

5) At this point, the ACS450 is ready to run. The first time ACS450 is started it will prompt for a license code. When prompted, type the following license code: **041028000703GH.**

6) Next, the PC can be connected to the AZL5 through the RS232 (9 pin) port on the front of the AZL5 (under the small plastic door). If the computer has a serial port a male to female 9 pin (commonly referred to as RS232) null modem cable is needed to connect the computer to the AZL5. A plain male / female cable could also be used with a null modem adapter. If the computer only has USB ports available, a USB to serial adapter will be necessary with a null modem adapter on the 9 pin end of the USB to serial adapter.

7) In order to connect, the AZL5 must be put into InterfacePC mode. This selection is found under the AZL5 menu: *Operation* > *Optgmodeselect* > *InterfacePC*.

8) Once the AZL5 is in interface mode, attempt to connect with the ACS450 on the user level. If the connection is successful, then this means that the cord connections are correct and the com ports are assigned correctly. If the connection is not successful on the user level, check the connection cord and / or try to use a different com port. The com port for the ACS450 can be changed under the ACS450 drop down menu, *System LMV5x* > *Options.*

9) After the connection at the user level is successful, disconnect from the AZL5 and then reconnect at the service or OEM level, if desired. Remember that a password will be necessary to access the LMV5 on a service or OEM level, and that the password is case sensitive.

Note: If a fault window appears, it is not necessary to close the fault window. It can be moved to the side and temporarily ignored. Most tasks, such as saving parameter sets, can be done with the fault window open. If the fault window is closed and the fault is not cleared, the fault window will reappear in a few seconds.

Creating a LMV5 Start-Up Report 9-3

The following steps outline the procedure for saving, viewing and printing out a start-up report (.mdb file) to a PC.

Saving the .mdb file

1) Ensure that the ACS 450 software is open, and the PC is connected to the AZL5 at the user, service, or OEM level. See installation and set-up 9-2 if necessary. A full report will be saved at any password level. The report can be filtered by password level when it is viewed.

2) Go to the ACS450 System LMV5x dropdown menu, and select *Backup for offline mode*.

3) The ACS450 will then read the parameters on the LMV5, and compose the report. The status of the backup (report) will be indicated on the backup window. The backup process may take up to 10 minutes. This report will be automatically saved in C:\Program files\ ASC450 \ daten.

4) After the backup process is complete, go to the ACS450 System LMV5x dropdown menu, and select *Disconnect*. A window will appear that asks *Do you want to store parameters for offline mode?.* Since this was just done is Step 3, it is not necessary to repeat. Click *no*.

5) The ACS450 is now disconnected from the LMV5, and the .mdb file is saved. Once disconnected, the .mdb file can be viewed or printed with the ACS450 software.

Viewing and printing the .mdb file contents

6) Ensure that the ACS 450 software is open, and **not connected** to the LMV5. Go to the *File* dropdown menu, and select *Show Parameters*. When this is selected a window will appear. Select the .mdb file to be opened. The default location for the .mdb files is C:\Program files\ ASC450 \ daten. Once the file is selected, another window will appear for the access level. Any level can be chosen to view and print the parameter list without needing a password. The level chosen will affect what parameters appear, so selecting the OEM level will show all parameters available in the .mdb file. Once the access level is selected a list of the parameters and their settings should appear.

7) Once the parameter list is visible on the screen, it can be viewed and / or printed. The fault and lockout history can also be viewed and / or printed. To access the fault and lockout history, go to the *Parameters* dropdown menu and slide the cursor to *Operating State*. The options of *Fault History* and *Lockout History* should appear. Click on either to view.

Note: Many people prefer to create the start-up report in a more universal document format, such as a .pdf file type. This can be done with various Adobe ® software that has a writer function. To create the .pdf files, simply print the desired pieces of the .mdb file to the .pdf writer instead of an actual paper and toner printer. Most people prefer to .pdf the parameter list, fault history, and lockout history. These pieces together provide a very inclusive LMV5 start-up report.

Saving and Uploading Parameter Sets 9-4

The following steps outline the procedure for saving parameter sets from a LMV5 to a PC and also uploading parameter sets from a PC to a LMV5.

Saving the .par file

1) Ensure that the ACS 450 software is open, and the PC is connected to the AZL5 at the service or at the OEM level. See installation and set-up 9-2 if necessary.

2) To save a LMV5 parameter set to a PC, go to the *ACS450 System LMV5x* dropdown menu, and select *Back-up LMV > PC*.

3) A window will appear titled *Backup Info*, and will have a message at the bottom stating the *status*. The *Status* will start as "*1*" and will proceed to saying *Input file name*. From the time the window appears to when the message states *Input file name* could take up to three minutes, but is usually less.

4) A comment can be typed in if desired. If not, click on *Save in file* and another window will come up. In this window, type the file name (a name containing the burner ID is recommended) and select an appropriate folder to save the file. Click on *Save*.

5) When being saved, the message on the backup info window should state *Reading parameters*. When saving is completed successfully, the message should say *Success,* press *Close*. The .par file is now stored on the PC in the specified location.

Note: The default location for .par file storage is C:\Program files\ ASC450 \ daten.

The .par file is stored in machine language, so it is not useful as a start-up report. The .mdb file (a window will appear to save this when *disconnect* is selected) contains text that is useful as a start-up report.
Creation of the .mdb is covered in section 9-3.

Uploading the .par file

6) Ensure that the ACS 450 software is open, and the PC is connected to the AZL5 at the service or at the OEM level. See installation and set-up 9-2 if necessary.

7) To upload a parameter set from the PC to the LMV5, go to the ACS450 *System LMV5x* dropdown menu, and select *Restore PC > LMV*.

8) A prompt will appear, asking for the desired .par file (parameter set). Select the desired .par file (parameter set) and click on *Open*. **This .par (parameter set) will overwrite the parameter set on the LMV5 and will determine the behavior of the LMV5. Be sure that the correct .par file is selected.**

9) A window will appear titled *Restore PC > LMV*. If the message on the bottom of the window states *Burner ID ok*, or *New base unit* the proceed to step 9. If the message states *Burner ID is different* proceed to the next step.

10) If the burner ID contained in the .par file (parameter set) is different than the burner ID on the LMV5, ACS450 will **not** permit the .par file to be uploaded to the LMV5. The exception to this is if the burner ID on the LMV5 is blank. If the burner ID is blank, then the upload is permitted. If the burner ID is different, two options are available. The next two steps (11 and 12) detail these options.

11) Change the burner ID on the LMV5 to match the burner ID contained in the .par file. This can be done via the ACS450 or though the AZL5 directly. The OEM password is required to do this with either method.

    a. If using the ACS450 – Once connected at the OEM level, go to the *System LMV5x* dropdown menu. The path is *Operation* > *Burner ID*. Change the Burner ID in the dropdown menu.

    b. If using the AZL5 - Disconnect the PC. Once disconnected, the path through the AZL5 is *Updating* > *Burner ID*. A prompt will appear for the password when Updating is selected on the AZL5.

12) Reset and then initialize the LMV5 using the ACS450.

    a. Connect to the LMV5 with the ACS450 at the Service or OEM level. After connecting successfully, go to the *System LMV5x* dropdown menu and select *Reset BU*. A reset window will appear that states the burner ID and fuel train will be deleted.

    b. Click *Reset*, and the LMV5 will be reset (burner ID and fuel train). An alarm window will immediately appear that states *No Fuel Train Defined*. This alarm window does not need to be closed. The alarm window can be moved out of the way. Click on *Close* to close the reset window.

    c. The burner ID and fuel train are now erased. Go under the *System LMV5x* dropdown menu and select *Disconnect*. A window will appear that asks *Do you want to store parameters for offline mode?.* Click *No* if a backup (.mdb file) file is not necessary. If *Yes* is clicked, the ACS450 will create an .mdb file. The .mdb file creation can take up to 10 minutes. Creating an .mdb file is discussed in section 9-3.

    d. Next, go to the *System LMV5x* dropdown menu and select *Init BU*. A window will appear and the ACS450 will begin reading the parameters. This will take a few minutes. After this is complete, a window will appear that asks for a .par file. Select the .par file that contains the parameters set to be uploaded. **This parameter set (.par) will overwrite the parameter set on the LMV5 and will determine the behavior of the LMV5. Be sure that the correct .par file is selected.**

13) A window titled *Restore PC* > *LMV* will appear. The message at the bottom of the window should state *New base unit* (if burner ID was previously erased by *Reset BU*) or *Burner ID ok* if the burner ID matches. Click on *Store in LMV*. This will start the upload process.

14) The messages should appear on the *Restore PC* > *LMV* window. These messages are (in order): *Function Succeeded*, *Transferring Parameters*, *Status =1*, *Status = 2*, *Status = 3*, *Parameter Transfer Succeeded*. The upload process my take up to five minutes to complete. Also, an alarm may occur during the upload. This alarm is normal, and is to alert the technician that the new parameter set has been uploaded to the LMV5.

15) Once the *Parameter Transfer Succeeded* message is shown on the *Restore PC* > *LMV* window, click on *Close*. The alarm resulting from the upload can also be reset at this time. The upload is now complete.

Updating AZL5 Software 9-5

The AZL5 contains two sectors of flash memory. One is used to store parameter sets and the other contains the AZL5's software. The software portion of the memory can be loaded with updated software if necessary. Updated AZL5 software is required if the AZL5 indicates *Version Conflict* when the AZL5 / LMV5 is connected and powered.

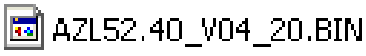
The following steps outline the procedure for checking the software version on the AZL5 and re-flashing the AZL5 with new software if needed. Obviously, if the AZL52 displays *Version Conflict* immediately, the AZL52 software will need updated, and the current software version does not need to be checked. If *Version Conflict* appears on the AZL52 screen, skip down to Step 2. At the time of publication, the latest software version for the AZL52 is 4.20.

1) Go to the topmost menu on the AZL5, and scroll down to *Parameters & Display*. The path needed to check the software ver. is: *Parameters & Display> Access w-out PW> AZL > SW Version*. Select *SW Version* and press *Enter* on the AZL52. If the software version reads *Curr : 0420* then no updating is needed. This indicates version 4.20 software. If this is not the case, proceed to Step 2.

2) Ensure that ACS450 is installed on the computer that will be used to re-flash the AZL52. If the latest version of ACS450 is not necessary to re-flash the AZL52, but is necessary for other functions, such as backing up parameters. See installation and set-up 9-2 if necessary.

Note: Prior to attempting an AZL5 software update, deactivate the Modbus port (RJ45) on the back of the AZL5 if it is being used. Also, physically unplug the Modbus cable. The port can be deactivated under: *Operation* > *OptgModeSelect* > *GatewayBASoff*.

3) Locate the correct .bin file. The ACS450 will prompt for the file later in this procedure. The .bin file that is necessary for the update is shown below. Contact Siemens to obtain the .bin file if the correct file is not available on the PC.



4) Connect the 9 pin cable or USB to serial adapter from the computer to the AZL52. The requirements of this connection are outlined in Section 9-2.

5) On the topmost menu in the AZL52, scroll down to *Updating*. When enter is pressed, a password prompt will appear. Either the service or the OEM level password will be necessary. After access is gained, scroll down to *Load_SW_from_PC* and press enter. This screen will state *Start Process with ENTER*. Press *Enter*.

Note: If the AZL52 displays *Version Conflict*, Esc can be pressed on the AZL52 in order to get to the main menu that contains the *Updating* menu. When the AZL52 is in a *Version Conflict*, **only** the service password will grant access to the *Load_SW_from_PC* option.

6) Open up the ACS450 on the computer, go to *System LMV5x*, and select *Update AZL flash*. The ACS450 will then ask for the .bin file. Locate and open the .bin file.

7) The AZL5 screen should say *SW-Update* on the top. If everything is working properly, the AZL5 should say *clearing flash* and then it should say *programming*. During the process. There should be a horizontal bar on the AZL5 screen and also on the computer screen that slowly fills in from the left to the right. The update procedure takes at least 5 minutes. When everything is finished, the ACS450 should say *Transfer finished, press cancel* and the AZL should say *SW_Update OK FLASH :V04.20 Cancel : left key* .

8) Press *Escape* on the AZL5. It will go into *System Test* and then come up normally. The AZL5 flash update is now complete.

Saving and Viewing Trends 9-6

The ACS450 can also be used to view and save trends. Trending enables the technician to easily view and quantify system behavior over time. This feature is particularly useful for setting up PID loops since “hunting” can be easily recognized on a trend. The following steps outline the procedure for viewing and saving trends with the ACS450.

1) Connect to the AZL5 at any access level. See installation and set-up 9-2 if necessary. After the connection is established, go to the *System LMV5x* dropdown menu and select *Record Trending*. A window will appear, asking where the trending flies are to be saved. Type a appropriate name in front of the .tbd extension. Thus a valid name would look like : siemens.tdb Notice that the * is no longer in the name.

2) After the name is typed in, click on *Open*. Also click on *Yes* when the window appears asking if you would like to create the file. The trending screen should now appear.

3) The trending screen will trend all the variables that are checked on the right hand side of the screen. These can be turned off and on by clicking on the check. The variables can be identified and pen colors changed by clicking in the box to the right of each variable.

4) The title and measurement interval for the trend can be changed in the measurement box. Triggers can also be set to start the trending automatically.

5) After the trending screen is set-up, trends can be recorded. To start recording a trend manually, click on *Start*. The state window should indicate that the measurement has started.

6) Trends will be buffered until *Stop* is clicked. When *Stop* is clicked, the trends will be saved under the previously defined .tbd file.

7) Trends can be viewed when the ACS450 is disconnected from the AZL5. To view trends, go to the *File* dropdown menu and select *Show Trending*. A window will appear prompting for the correct .tbd file. Select the .tbd file that contains the trends to be viewed and / or exported.

8) Select the trend to be viewed or exported. If *Ok* is clicked then the trend can be seen in ACS450. If *Export* is clicked, a .csv file can be created that can be opened with MS Excel.

Viewing the LMV5x “Dashboard” 9-7

When connected to the AZL5, the ACS450 can provide an overview screen or “Dashboard”. This provides an useful summary of the LMV5 inputs and outputs, as well as the operating state of the LMV5. The following steps outline the procedure for viewing the ACS450 “Dashboard”.

1) Connect to the AZL5 at any password level. This is covered in the installation and set-up section 9-2.

2) Once connected, go to the *Parameters* drop down menu, followed by the *Operating State* menu . Click on *Normal Operation*, and the “Dashboard” should appear detailing the operating state of the LMV5.

Section 10-1 Component Specifications

LMV5 Base Unit (120volt)

Category	Description	Units	Value
Power Requirements	Mains Voltage (max)	Volts AC	132
	Mains Voltage (min)	Volts AC	102
	Mains Frequency (min)	Hz	47
	Mains Frequency (max)	Hz	63.6
	Typ. Power Consumption	Watts	30
Fuses	Fuse FU1 Rating 5 x 20 mm 250 volt Slow-Blow	Amps	6.3
	Fuse FU2 Rating 5 x 20 mm 250 volt Slow-Blow	Amps	4
	Fuse FU3 Rating 5 x 20 mm 250 volt Slow-Blow	Amps	4
Maximum ratings for Mains Voltage Outputs	Total Current to all outputs, thru safety loop (X3-04.1 / X3-04.2) and burner flange (X3-03.2 / X3-03.1) at any given time	Amps	5
	Fan motor contactor (X3-01.1)	Amps	1
	Alarm (X3-01.2)	Amps	1
	Ignition transformer (X4-02.3)	Amps	1.6
	Pilot Valve (X9-01.2)	Amps	1.6
	Gas Valve 1 (X9-01.4)	Amps	1.6
	Gas Valve 2 (X9-01.3)	Amps	1.6
	Gas Valve SV (X9-01.1)	Amps	1.6
	Oil Valve1 (X8-02.1)	Amps	1.6
	Oil Valve1 (X8-03.1)	Amps	1.6
	Oil Valve 2 (X7-01.3)	Amps	1.6
	Oil Valve 3 (X7-02.3)	Amps	1.6
	Oil Valve SV (X6.03.3)	Amps	1.6
	Oil pump contactor (X6-02.3)	Amps	1.6
	Oil Indicator (X8-01.2)	Amps	1
	Gas Indicator (X8-01.1)	Amps	1
	Start Signal, (X4-03.3)	Amps	0.5
	Power signals for switches, flame detector	Amps	0.5
Maximum ratings for Low Voltage Outputs	12VAC1 for CANbus power, 12 VAC (X50.2, X51.2)	Amps	4
	12VAC2 for can bus power, 12 VAC (X50.3, X51.3)	Amps	4
	Power supply for pressure / temp transducers, 20 VDC	mA	25
	Power supply for QRI flame detector 14 / 21 VDC	mA	100
Weight	Chassis weight	lb	3
Environmental	Ambient Temperature (min)	^{o}F	-4
	Ambient Temperature (max)	^{o}F	140
	Maximum humidity	% R.H.	95
Enclosure	IP rating (first number objects, second water)	N/A	IP20
Mounting	All Orientations	N/A	N/A

Notes : Ingress of water and ice are not permitted.
Use wire suitable for maximum terminal ratings
For CANBus wiring, use specified cable only.

AZL52 Display

Category	Description	Units	Value
Power Requirements	Voltage (max)	Volts AC	26.4
	Voltage (min)	Volts AC	20.4
	Typ. Power Consumption	Watts	5
Replacement Back -up batteries	VARTA CR-2430 (LF-1 / 2 W)		
	DURACELL DL 2430		
	SAYNO ELECTRIC CR 2439 (LF-1 / 2 W)		
	RENATA CR 2430		
Weight	Weight of AZL5	lb	0.5
Environmental	Ambient Temperature (min)	^{o}F	-4
	Ambient Temperature (max)	^{o}F	140
	Maximum humidity	% R.H.	95
Enclosure	IP rating front (first number objects, second water)	N/A	IP54
	IP rating rear, mounted (first number objects, second water)	N/A	IP00
Mounting	All Orientations	N/A	N/A

SQM4 Rotary Actuators

Category	Description	Units	Value
Power Requirements	Voltage (max)	Volts AC	26.4
	Voltage (min)	Volts AC	20.4
	Typ. Power Consumption (SQM45)	VA	15
	Typ. Power Consumption (SQM48)	VA	34
Torque Output	SQM45	in-lb	27
	SQM48.4	in-lb	177
	SQM48.6	in-lb	310
Run Time (90^{o} Stroke)	SQM45	sec	10-120
	SQM48.4	sec	30-120
	SQM48.6	sec	60-120
Rotation	Clockwise or Counterclockwise	N/A	N/A
Duty Cycle	Percentage of time moving @ nominal torque	%	50
	Maximum continuous run time @ nominal torque	min	3
Weight	SQM45	lb	2.2
	SQM48	lb	3.5
Environmental	Ambient Temperature (min)	^{o}F	-4
	Ambient Temperature (max)	^{o}F	140
	Maximum humidity	% R.H.	95
Enclosure	IP rating (first number objects, second water)	N/A	IP54
Mounting	All Orientations	N/A	N/A

Notes : Ingress of water and ice are not permitted.
For CANBus wiring, use specified cable only.

QRI Infrared Flame Scanner

Category	Description	Units	Value
Power Requirements	Operating Voltage (max)	Volts DC	14.7
	Operating Voltage (min)	Volts DC	13.3
	Test Voltage (max)	Volts DC	22.05
	Test Voltage (min)	Volts DC	19.95
	Typ. Power Consumption	Watts	0.5
Signal	Analog output signal	Volts DC	0 to 5
Weight	Scanner weight	lb	0.4
Cable	Supplied cable length	in	70
Environmental	Ambient Temperature (min)	^{o}F	-4
	Ambient Temperature (max)	^{o}F	140
	Maximum humidity	% R.H.	95
Enclosure	IP rating (first number objects, second water)	N/A	IP54
Mounting	All Orientations	N/A	N/A

Notes : Ingress of water and ice are not permitted.

QRA75 UV Flame Scanner

Category	Description	Units	Value
Power Requirements	Operating Voltage (max)	Volts AC	132
	Operating Voltage (min)	Volts AC	102
	Test Voltage (max)	Volts DC	22.05
	Test Voltage (min)	Volts DC	19.95
	Typ. Power Consumption	Watts	0.5
Signal	Analog output signal	Volts DC	0 to 5
Weight	Scanner weight	lb	1.5
Cable	Supplied cable length (AGM23U)	ft	12
Environmental	Ambient Temperature (min)	^{o}F	-4
	Ambient Temperature (max)	^{o}F	140
	Maximum humidity	% R.H.	95
Enclosure	IP rating (first number objects, second water)	N/A	IP65
Mounting	All Orientations	N/A	N/A

Notes : Ingress of water and ice are not permitted.

7MF1564 Pressure sensors

Category	Description	Units	Value
Signal	Analog Amperage	mA	4 to 20
	Analog Voltage	Volts DC	0 to 10
Measurement Range	Maximum for highest range sensor	PSIG	300
	Minimum (vacuum prohibited for low range 4-20mA sensors)	PSIG	0
Accuracy	Percent of full scale @ 77 ^{o} F	%	0.25
Fluid Temperature	Maximum fluid temperature @ process connection	^{o}F	248
	Minimum fluid temperature @ process connection	^{o}F	-22
Ambient Temperature	Maximum Ambient temperature	^{o}F	185
	Minimum fluid temperature @ process connection	^{o}F	-13
Weight	Sensor weight	lb	0.55
Diaphragm	Diaphragm material	Aluminum Oxide	
Gasket	Gasket material	Viton	
Process Conn.	Size of process connection	1/4" NPT	
Environmental	Ambient Temperature (max)	^{o}F	185
	Ambient Temperature (min)	^{o}F	-13
	Maximum humidity	% R.H.	95
Enclosure	IP rating (first number objects, second water)	N/A	IP65

QAE 2020.005 1000 ohm Nickel RTD temp sensor

Category	Description	Units	Value
Signal	Resistance @ 32 ^{o} F	ohms	1000
Measurement Range	Maximum	^{o}F	266
	Minimum	^{o}F	-13
Accuracy	Accuracy over entire measurement range	%	0.46
Max fluid Temperature	Maximum fluid temperature @ process connection	^{o}F	266
Max fluid Pressure	Maximum fluid pressure @ 266 ^{o}F	PSIG	400
Weight	Sensor weight	lb	1.6
Process Conn.	Size of process connection (Thermowell)	1/2" NPT	
Environmental	Ambient Temperature (max)	^{o}F	180
	Ambient Temperature (min)	^{o}F	-40
	Maximum humidity	% R.H.	95
Enclosure	IP rating (first number objects, second water)	N/A	IP65
Wire Gauge	Copper Wire gauge for up to a 300 ft loop (150 ft segment)	AWG	14
	Copper Wire gauge for up to a 100 ft loop (50 ft segment)	AWG	20

QAC22 Ambient Temperature sensor

Category	Description	Units	Value
Signal	Resistance @ 32 ^{o} F	ohms	1000
Measurement Range	Maximum	^{o}F	122
	Minimum	^{o}F	-31
Accuracy	Accuracy over entire measurement range	%	0.46
Weight	Sensor weight	lb	0.26
Environmental	Ambient Temperature (max)	^{o}F	122
	Ambient Temperature (min)	^{o}F	-31
	Maximum humidity	% R.H.	100
Enclosure	IP rating (first number objects, second water)	N/A	IP43
Wire Gauge	Copper Wire gauge for up to a 300 ft loop (150 ft segment)	AWG	14
	Copper Wire gauge for up to a 100 ft loop (50 ft segment)	AWG	20

RBF195M482-010-00-8HN31 Stack Temperature

Category	Description	Units	Value
Signal	Resistance @ 32 ^{o} F	ohms	1000
Measurement Range	Maximum	^{o}F	900
	Minimum	^{o}F	-40
Accuracy	Accuracy over entire measurement range	%	0.46
Weight	Sensor weight	lb	1.15
Process Conn.	Size of process connection	1/2" NPT	

RBF195M483- S4C05(1/2)09- SL-6HN31 Water Temperature

Category	Description	Units	Value
Signal	Resistance @ 32 ^{o} F	ohms	1000
Measurement Range	Maximum	^{o}F	900
	Minimum	^{o}F	-40
Accuracy	Accuracy over entire measurement range	%	0.46
Max fluid Temperature	Maximum fluid temperature @ process connection	^{o}F	900
Max fluid Pressure	Maximum fluid pressure @ 900 ^{o}F	PSIG	1000
Weight	Sensor weight	lb	1.6
Process Conn.	Size of process connection (Thermowell)	1/2" NPT	

R1T185M483- S4C05(1/2)09- SL-6HN31 Water Temperature

Category	Description	Units	Value
Signal	Resistance @ 32 ^{o} F	ohms	100
Measurement Range	Maximum	^{o}F	900
	Minimum	^{o}F	-40
Accuracy	Accuracy over entire measurement range	%	0.46
Max fluid Temperature	Maximum fluid temperature @ process connection	^{o}F	900
Max fluid Pressure	Maximum fluid pressure @ 900 ^{o}F	PSIG	1000
Weight	Sensor weight	lb	1.6
Process Conn.	Size of process connection (Thermowell)	1/2" NPT	

Temperature Sensor General (on this page)

Enclosure	IP rating (first number objects, second water)	N/A	IP65
Wire Gauge	Copper Wire gauge for up to a 300 ft loop (150 ft segment)	AWG	14
	Copper Wire gauge for up to a 100 ft loop (50 ft segment)	AWG	20
Environmental	Ambient Temperature (max)	^{o}F	180
	Ambient Temperature (min)	^{o}F	-40
	Maximum humidity	% R.H.	95

PLL52 Oxygen Trim Module

Category	Description	Units	Value
Power Requirements	Voltage, CANBus (max)	Volts AC	26.4
	Voltage, CANBus (min)	Volts AC	20.4
	Typ. Power Consumption, CANBus	Watts	4
	Mains Voltage (max)	Volts AC	132
	Mains Voltage (min)	Volts AC	102
	Mains Frequency (min)	Hz	57
	Mains Frequency (max)	Hz	63.6
Environmental	Ambient Temperature (min)	^{o}F	-4
	Ambient Temperature (max)	^{o}F	140
	Maximum humidity	% R.H.	95
Enclosure	IP rating (first number objects, second water)	N/A	IP54
Connections	M16 thread conduit connections	N/A	N/A
Mounting	All Orientations	N/A	N/A

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QGO20 Oxygen Sensor

Category	Description	Units	Value
Power Requirements	Mains Voltage, heating element (max)	Volts AC	132
	Mains Voltage, heating element (min)	Volts AC	102
	Mains Frequency (min)	Hz	47
	Mains Frequency (max)	Hz	63.6
	Max Power Consumption	VA	90
	Typ. Power Consumption	VA	35
Maximum Flue Temperatures (W/O high temp kit)	Sensor Flange temperature	^{o}F	482
	Flue gas temperature	^{o}F	572
	Connection head (electronics)	^{o}F	158
Measurement Range	Minimum O2 reading	%	0.2
	Maximum O2 reading	%	20.9
Cell Operation Temperature	Minimum O2 cell temperature	^{o}F	1202
	Maximum O2 cell temperature	^{o}F	1382
Weight	Sensor weight	lb	2.1
Type of Fuel	Fuel oil or Natural Gas	N/A	N/A
Environmental	Ambient Temperature (min)	^{o}F	-13
	Maximum humidity	% R.H.	95
Enclosure	IP rating (first number objects, second water)	N/A	IP40

Notes : Ingress of water and ice are not permitted.

AGG5.210 Transformer

Category	Description	Units	Value
Power Requirements (Primary)	Mains Voltage (max)	Volts AC	132
	Mains Voltage (min)	Volts AC	102
	Mains Frequency (min)	Hz	47
	Mains Frequency (max)	Hz	63.6
	Typ. Power Consumption	VA	110
Power Output (SEC1)	Voltage (max)	Volts AC	14.2
	Voltage (min)	Volts AC	11
	Power Output	VA	14.4
Power Output (SEC2)	Voltage, Pin 1 to 4 (max)	Volts AC	28.2
	Voltage, Pin 1 to 4 (min)	Volts AC	21.77
	Power Output	VA	75.6
Weight	Transformer Weight	lb	4.8
Environmental	Ambient Temperature (min)	^{o}F	-4
	Ambient Temperature (max)	^{o}F	140
	Maximum humidity	% R.H.	95
Enclosure	IP rating (first number objects, second water)	N/A	IP20
Mounting	All Orientations	N/A	N/A

Notes : Ingress of water and ice are not permitted.
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