SIEMENS

LMV50… / LMV51... / LMV52…
Burner management system for forced draft burners with the main functions:
- Burner control
- Fuel-air ration control
- Boiler controller / load controller

LMV50…
with specific functions for industrial applications

LMV52...
with additional O2 trim control

Basic Documentation

The LMV5 and this Basic Documentation are intended for OEMs which integrate the burner controls in their products!

Based on the following software versions:

LMV50... :	V10.30
LMV51... :	V05.20
LMV51.3… :	V05.20
LMV52.2.. :	V05.20
LMV52.4... :	V10.30
Int. LR module:	V02.10
Int. VSD module:	V01.50
AZL52...:	V05.10
PLL52...:	V01.50

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Smart Infrastructure

Supplementary documentation

Type of product	Type of documentation	No. of documentation
AZL5	User Documentation	A7550
LMV5	User Manual Basic diagram of LMV5 for 2 types of gas	A7550.1
LMV5	User Manual Basic diagram of LMV5 for 2 types of liquid fuel	A7550.3
LMV5	User Manual Assembly of VKF41.xxxC gas damper with ASK33.4 mounting kit to the SQM45.295A9 actuator	A7550.4
LMV52	User Manual COx supervision and control	A7550.5
LMV5	Setting Lists (parameter and error list)	I7550
ACS450	Installation Guide	J7550
LMV5	Installation Guide	J7550.1
LMV5	Data Sheet	N7550
LMV5	Product Range Overview This document contains a complete overview	Q7550
AZL52 / LMV51	User Manual	U7550
AZL52 / LMV51	User Manual	U7550.1
AZL52 / LMV52	User Manual	U7550.2
AZL52 / LMV52	User Manual	U7550.3
AZL52 / LMV50	User Manual	U7550.4
AZL52 / LMV50	User Manual	U7550.5
SQM45 / SQM48	Data Sheet	N7814
SQM9	Data Sheet	N7818
QGO20	Data Sheet	N7842
QGO20	Basic Documentation	P7842

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1 Safety notes

1.1 Warnings

To avoid injury to persons, damage to property or the environment, the following warning notes must be observed!

The LMV5 is a safety device! Do not open, interfere with or modify the unit. Siemens will not assume responsibility for any damage resulting from unauthorized interference!

The chapters to the LMV50, LMV51.3 and LMV52 documentation contain additional warning notes which should also be observed when using these system versions. After commissioning and after each service visit, check the flue gas values across the entire load range.

Risk of explosion!
Incorrect configuration can lead to excessive fuel supply which might cause an explosion! Operators must be aware that incorrect settings made on the AZL5 and incorrect settings of the fuel and/or air actuator positions can lead to dangerous burner operating conditions.

The present Basic Documentation describes a wide choice of applications and functions and shall serve as a guideline. The correct functioning is to be checked and proven with the help of function tests on a test rig or on the plant itself!

- All activities (mounting, installation and service work, etc.) must be performed by qualified personnel
- Degree of protection IP40 as per DIN EN 60529 for burner controls must be ensured through adequate mounting by the burner or boiler manufacturer
- Before making any wiring changes in the connection area of the LMV5, completely isolate the plant from mains supply (all-polar disconnection). Ensure that the plant cannot be inadvertently switched on again and that it is indeed dead. If not observed, there is a risk of electric shock
- Protection against electrical shock on the LMV5... and on all connected electrical components must be ensured through adequate mounting
- Each time work has been carried out (mounting, installation and service work, etc.), check to ensure that wiring is in an orderly state, that the parameters have been correctly set and make the safety checks as described in chapter *Commissioning notes*
- Fall or shock can adversely affect the safety functions. Such units must not be put into operation even if they do not exhibit any damage
- In programming mode, the position check of the actuators and – if installed – the VSD (checking electronic fuel-air ratio control) is different from the check made during automatic operation. Like in automatic operation, the actuators are still jointly driven to their required positions. If an actuator does not reach the required position, corrections are made until that position is reached. However, in contrast to automatic operation, there are no time limits to these corrective actions. The other actuators maintain their positions until all actuators have reached the positions currently required. This is essential for setting fuel-air ratio control. This means that during the time the ratio control curves are programmed, the person making the plant settings must continuously watch the quality of the combustion process (e.g. by means of a flue gas analyzer). Also, if combustion levels are poor, or in the event of dangerous situations, the commissioning engineer must take appropriate action (e.g. switching the system off manually)

To ensure the safety and reliability of the LMV5, the following points must also be observed:

- Condensation and ingress of humidity must be avoided. Should such conditions occur, make sure that the unit will be completely dry before switching on again!
- Static charges must be avoided since they can damage the unit's electronic components when touched. **Recommendation:** Use ESD equipment

1.2 Mounting notes

- Ensure that the relevant national safety regulations are complied with
- In the geographical areas where DIN regulations apply, the requirements of VDE must be satisfied, especially the standards DIN/VDE 0100, 0550, and DIN/VDE 0722
- M5 fixing screws in the LMV5 housing with a maximum tightening torque of 2 Nm. The thread of the mounting plate should be checked with regard to the maximum tightening torque in the application or defined accordingly.

Notes on mounting the LMV5

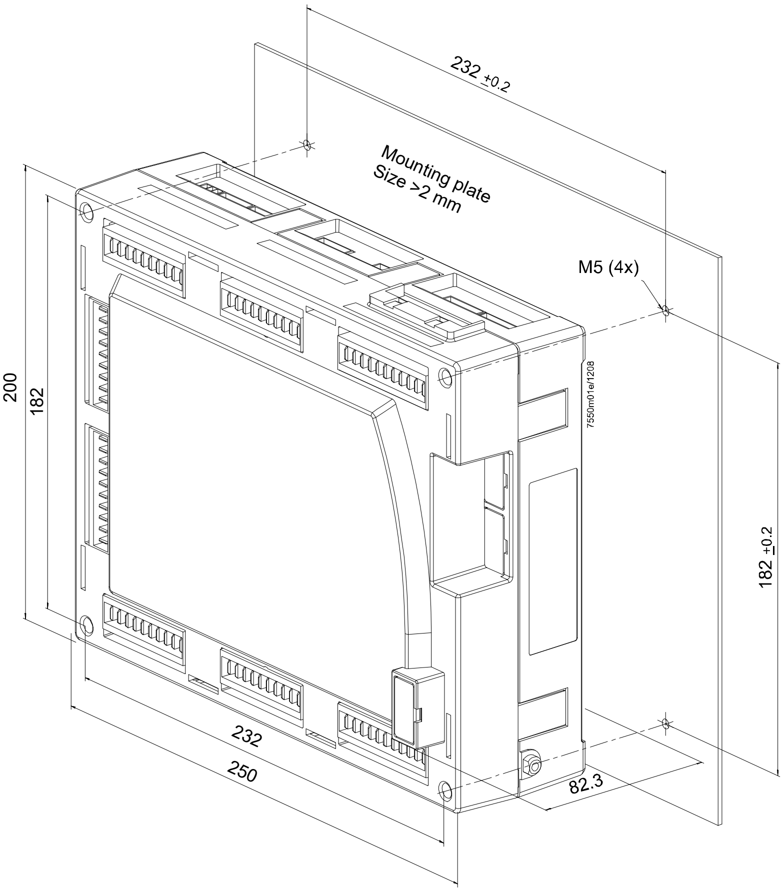


Figure 1: Mounting the LMV5

Notes on mounting the AZL5

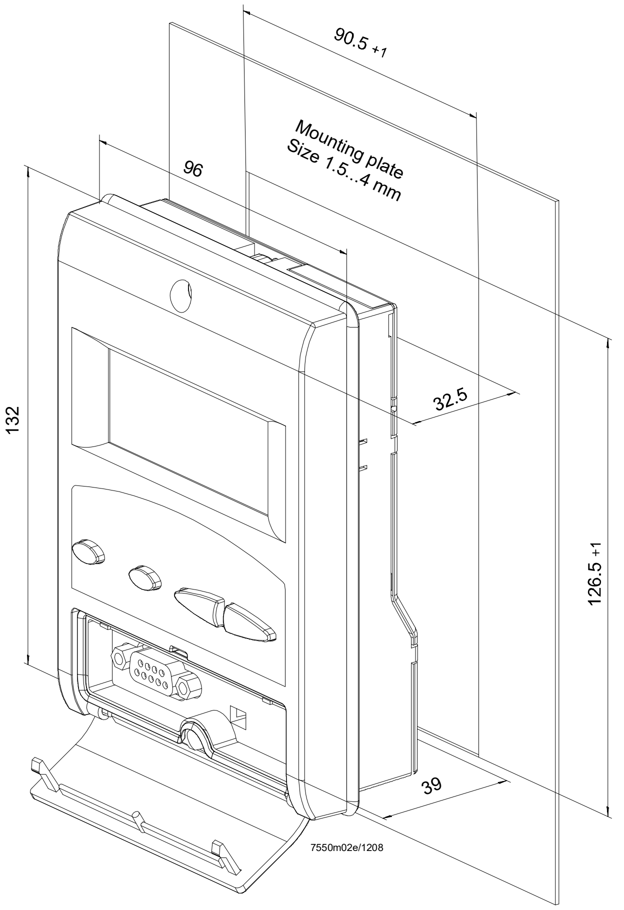


Figure 2: Mounting the AZL5

1.3 Installation notes

- Ensure that the electrical wiring inside the boiler is in compliance with national and local safety regulations
- Do not mix up live and neutral conductors
- Make certain that strain relief of the connected cables is in compliance with the relevant standards (e.g. as per DIN EN 60730 and DIN EN 60335)
- Ensure that spliced wires cannot get into contact with neighboring terminals. Use adequate ferrules
- Always run high-voltage ignition cables separately while observing the greatest possible distance to the unit and to other cables
- 120 V~/230 V~ mains connections that are not used must be protected by dummy plugs fitted by the burner manufacturer (refer to chapter *Suppliers of other accessory items*)
- When wiring the unit, ensure that AC 230 V mains cables run strictly separate from extra low-voltage cables to warrant protection against electrical shock
- Once the LMV5 has been installed in the equipment, a check must be carried out to ensure compliance with the EMC emission requirements
- If grounded PELV signals are connected to the SELV terminals on the LMV5, the SELV terminals are then also PELV voltages (in accordance with EN 60730-1, chapter 11.2.7, EN 298 chapter 9.2.d)
- Isolating transformers grounded on one side must be used if the circuitry uses a mains supply circuit without a grounded conductor or if the mains supply takes place between the phases (in accordance with EN 298-1, chapter 9.2.d)
- To prevent high-energy coupling through magnetic induction or capacitive coupling, observe the recommendations in the installation guidelines (J7550) regarding shielding, grounding and routing (in accordance with EN 13611)
- Test torque of the screws RAST5 connectors: 0.5 Nm
- Test torque of the screws RAST3.5 connectors: 0.25 Nm
- This equipment has been tested and found to comply with the limits for a **Class A digital device**, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and – if not installed and used in accordance with the Instruction Manual – may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user is required to correct the interference at his expense
- This equipment has been tested and found to comply with the limits for a **Class B digital device**, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by 1 or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between equipment and receiver
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio / TV technician for help

1.4 Electrical connection of ionization probe and flame detector

It is important to achieve practically disturbance- and loss-free signal transmission:

- Never run the detector cables together with other cables
  – Line capacitance reduces the magnitude of the flame signal
  – Use a separate cable
- Observe the permissible cable lengths
- The ionization probe is not protected against electrical shock. The mains-powered ionization probe must be protected against accidental contact
- **Locate the ignition electrode and the ionization probe such that the ignition spark cannot arc over to the ionization probe (risk of electrical overloads)**

1.5 Commissioning notes

- When commissioning the plant, or when doing maintenance work, make the following safety checks:

	Safety checks to be carried out	Expected response
a)	Start the burner with the flame detector darkened	Lockout at the end of the safety time
b)	Start the burner with the flame detector exposed to extraneous light, e.g. to incandescent light with detectors for infrared or visible radiation (with QRI, interrupted at about 20 Hz), quartz-halogen bulb or cigarette lighter flame with detectors for UV radiation (QRA7)	Lockout at the end of the prepurge time
	☞	Note: Only when supervision of extraneous light is activated!
c)	Simulate loss of flame during operation. For that, darken the flame detector in the operating position and maintain that state	Lockout or restart, depending on the burner control's configuration
d)	Check the plant's response time with loss of flame during operation. For that purpose, manually disconnect the fuel valves from power and check the time from this moment the burner control requires to switch off power to the valves	Burner control turns off power to the valves within the period of time permitted for the respective type of plant

- There is no absolute protection against incorrect use of the RAST5 connectors. For this reason, prior to commissioning the plant, check the correct assignment of all connectors
- Electromagnetic emissions must be checked on an application-specific basis
- Make a loss-of-flame test using the AZL5 of the LMV5

1.6 Setting and parameterization notes

- When adjusting the electronic fuel-air ratio control system integrated in the LMV5, allow for sufficient amounts of excess air since – over a period of time – the flue gas settings will be affected by a number of factors (e.g. density of air, wear of actuating devices, etc.). For this reason, the flue gas values initially set must be checked at regular intervals
- To provide protection against inadvertent or unauthorized parameter transmission between the parameter backup memory of the AZL5 and the LMV5, the OEM (burner or boiler manufacturer) must enter an **individual burner identification** (ID) for every burner. Compliance with this regulation is mandatory to ensure that the LMV5 will prevent parameter sets from other plant (with unsuited and possibly dangerous parameter values) to be transmitted to the LMV5 via the backup memory of the AZL5 (also refer to the description of burner identification in chapter *Display and operating unit AZL5*)

- With the LMV5, it is to be noted that the unit's characteristics are determined primarily by the specific parameter settings rather than by the type of unit. This means that, among other things, each time a plant is commissioned, the parameter settings must be checked, and the LMV5 must not be transferred from one plant to another without adapting the parameter settings to the new plant
- In the case of dual-fuel burners and oil-firing, the short preignition (phase 38), parameter *IgnOilPumpStart,* is to be selected and a magnetic clutch is to be used, ensuring that there will be no oil pressure until this phase is reached. When using a burner for oil alone, the magnetic clutch is not required; in that case, the long preignition (from phase 22) must be parameterized
- When using the ACS450 PC software, the safety notes given in the relevant Operating Instructions (CC1J7550) must also be observed
- A password protects the parameter setting level against unauthorized access. The OEM allocates individual passwords to the setting levels it can access. The standard passwords used by Siemens must be changed by the OEM. These passwords are confidential and may only be passed on to persons authorized to access such setting levels
- The responsibility for setting the parameters lies with the person who – in accordance with his access rights – has made changes to the respective setting level

In particular, the OEM will assume responsibility for the correct parameter settings in compliance with the standards covering the specific applications (e.g. EN 676, EN 267, EN 1643, etc.).

1.7 Standards and certificates

Applied directives:

- Low-voltage directive 2014/35/EC
- Directive for gas-fired appliances 2009/142/EC
- Electromagnetic compatibility EMC (immunity) *) 2014/30/EC
- Gas Appliances Regulation (EU) (EU) 2016/426

*) The compliance with EMC emission requirements must be checked after the burner management system is installed in equipment

Compliance with the regulations of the applied directives is verified by the adherence to the following standards / regulations:

- Automatic burner control systems for burners and appliances burning gaseous or liquid fuels DIN EN 298
- Safety and control devices for gas burners and gas burning appliances - Valve proving systems for automatic shut-off valves DIN EN 1643
- Gas/air ratio controls for gas burners and gas burning appliances
  Part 2: Electronic types DIN EN 12067-2
- Safety and control devices for gas burners and gas burning appliances - General requirements DIN EN 13611
- Temperature control devices and temperature limiters for heat generating systems DIN EN 14597
- Safety and control devices for gas and/or oil burners and gas and/or oil appliances -- Particular requirements
  Part 1: Fuel-air ratio controls, electronic type ISO 23552-1
- Automatic electrical controls for household and similar use
  Part 2-5:
  Particular requirements for automatic electrical burner control systems DIN EN 60730-2-5

The relevant valid edition of the standards can be found in the declaration of conformity!

Note on **DIN EN 60335-2-102**
Household and similar electrical appliances - Safety - Part 2-102:
Particular requirements for gas, oil and solid-fuel burning appliances having electrical connections.
The electrical connections of the LMV5 and the PLL52 comply with the requirements of EN 60335-2-102.

EAC Conformity mark (Eurasian Conformity mark)

ISO 9001:2015
ISO 14001:2015
OHSAS 18001:2007

China RoHS
Hazardous substances table:
http://www.siemens.com/download?A6V10883536

	Europe				Eurasia	USA			Australia	Ships	
Type	TÜV	TÜV CERT	DIN Geprüft	DVGW	EAC	UL	CSA C US	FM APPROVED	The Australian Gas Association	Lloyd's Register	GL
LMV50.320B2	●	●	●	●	●	---	---	---	---	●	●
LMV51.000C2	●	●	●	●	●	---	---	---	●	●	●
LMV51.040C1	●	---	●	●	●	●	●	●	●	●	---
LMV51.100C1	●	●	●	●	●	●	---	---	●	●	●
LMV51.100C2	●	●	●	●	●	---	---	---	●	●	●
LMV51.140C1	●	---	---	---	●	●	●	●	●	●	---
LMV51.300B1	●	●	●	●	●	●	---	---	●	●	●
LMV51.300B2	●	●	●	●	●	---	---	---	●	●	●
LMV51.340B1	●	---	---	---	●	●	●	●	●	●	---
LMV52.200B1	●	●	●	●	●	●	---	---	●	●	●
LMV52.200B2	●	●	●	●	●	---	---	---	●	●	●
LMV52.240B1	●	---	●	●	●	●	●	●	●	●	---
LMV52.240B2	●	---	●	●	●	---	---	---	●	●	---
LMV52.400B2	●	●	●	●	●	---	---	---	●	●	●
LMV52.440B1	●	---	---	---	●	●	●	●	●	●	---
LMV5 system components:											
AZL52	●	●	●	●	●	●	●		---	●	●
SQM45/SQM48	●	●	●	●	●	●	●		●	●	●
SQM9	●	●	●	●	●	●	●		---	---	---
QRI2	●	●	●	●	●	●	●		●	●	●
QRA7	●	●	●	●	●	●	●		---	●	●
PLL52	●	●	●	●	●	●	●		●	---	---
QGO20	●	●	●	●	●	●	●		---	---	---

☞ Note!
When using the LMV5 in Australia, we strongly recommend that you use a *BASE PAR GAS.par* file to adapt the parameter set to the specific requirements of the Australian market. Please direct any queries to Siemens Australia.

☞ Note!
With regard to the use of the LMV5 in safety-related systems up to SIL3, a manufacturer's declaration from Siemens AG is available.

1.8 Service notes

If fuses are blown, the complete unit must be returned to Siemens.

Notes!
Only authorized persons may replace the fuse (in accordance with EN 298-1, chapter 9.2.r).

1.9 Life cycle

The LMV5 burner control has a designed lifetime* of 250,000 burner startup cycles which, under normal operating conditions in heating mode, correspond to approx. 10 years of usage (starting from the production date given on the type field).
This is based on the continuous tests specified in standards EN 230/EN 298.
A summary of the conditions has been published by the European Control Manufacturers Association (afecor - www.afecor.org).

The designed lifetime is based on use of the burner control according to the manufacturer's Data Sheet and Basic Documentation. After reaching the designed lifetime in terms of the number of burner startup cycles, or the respective time of usage, the burner control is to be replaced by authorized personnel.

* The designed lifetime is not the warranty time specified in the Terms of Delivery

Note!
The total startup counter counts up with each burner startup cycle.
This also occurs if the start attempt is aborted.
For details, refer to chapter on *End of life cycle function*.

1.10 Disposal notes

The unit contains electrical and electronic components and must not be disposed of together with domestic waste. Legal and currently valid legislation must be observed.

2 General
2.1 Brief description

The LMV5 is a microprocessor-based burner management system with matching system components for the control and supervision of forced draft burners of medium to high capacity.

The following components are integrated in the LMV5:
- Burner control with gas valve proving system
- Electronic fuel-air ratio control for:
  - A maximum of 4 actuators for LMV50 / LMV51
  - A maximum of 6 actuators for LMV52
- Optional PID temperature or pressure controller (boiler controller / load controller)
- Optional VSD module

The system components (AZL5, actuators, PLL52, etc.) are interconnected via a bus system. Communication between the bus users takes place via a safety-related, system-bound data bus (for safety reasons, integration of the bus into external CAN bus systems is not possible). All safety-related digital outputs of the system are permanently monitored via a contact feedback network.
For flame supervision in connection with the LMV5 and continuous operation, the QRI infrared flame detector, the QRA7 flame detector, or an ionization probe can be used and, for intermittent operation, the optical flame detectors of type QRB / QRA2 / QRA4 / QRA10 with AGQ1 (120 V~/230 V~ mains connection).

Basic diagram

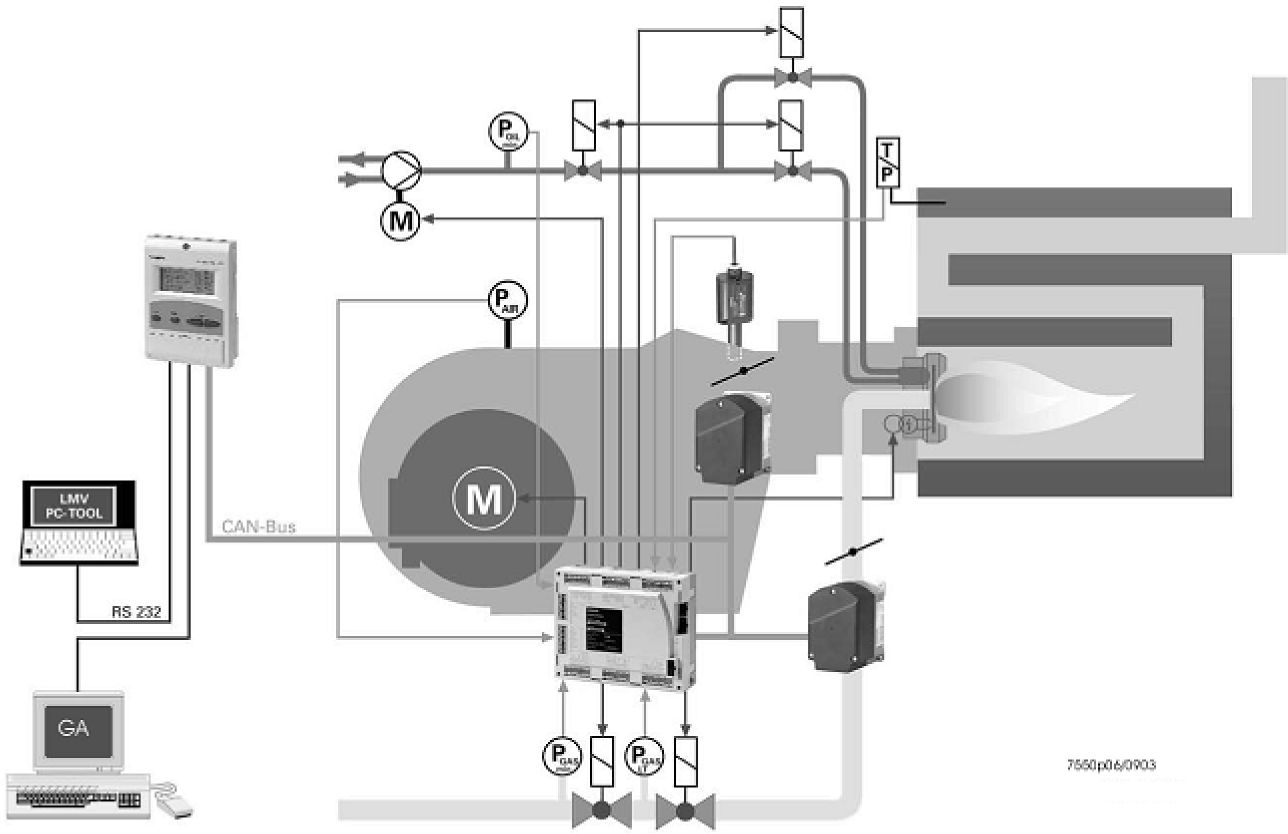


Figure 3: Basic diagram

Example:
Dual-fuel burner
- Gas: Modulating
- Oil: 2-stage

The LMV5 is operated and programmed with the help of the AZL5 or a PC software. The AZL5 with LCD clear text and menu-driven operation affords straightforward operation and targeted diagnostics.
For making diagnostics, the LCD shows the operating states, the type of fault and the point in time the fault occurred.
The parameter setting levels for the burner / boiler manufacturer and heating engineer are password-protected to prevent unauthorized access.
Basic settings that the plant operator can make on site do not require a password.
Also, the AZL5 is used as an interface for superposed systems such as a building automation and control system (BACS), or for a PC using the ACS450 PC software. Among other features, the unit affords convenient readout of settings and operating states, parameterization of the LMV5, and trend recording.
When replacing the LMV5, all parameters can be saved in a backup memory of the AZL5 to be loaded back into the LMV5.
This means that reprogramming is not required.

When designing the fuel trains, the burner / boiler manufacturer can choose from a total of 7 valve families. The large number of individual parameterization choices (program times, configuration of inputs / outputs, etc.) enable him to make optimum adaptions to the specific application.

The universal SQM4 / SQM9 actuators are driven by stepper motors and can be positioned with high resolution. The characteristics and settings of the actuators are defined by the LMV5.

2.2 Block diagram of inputs / outputs

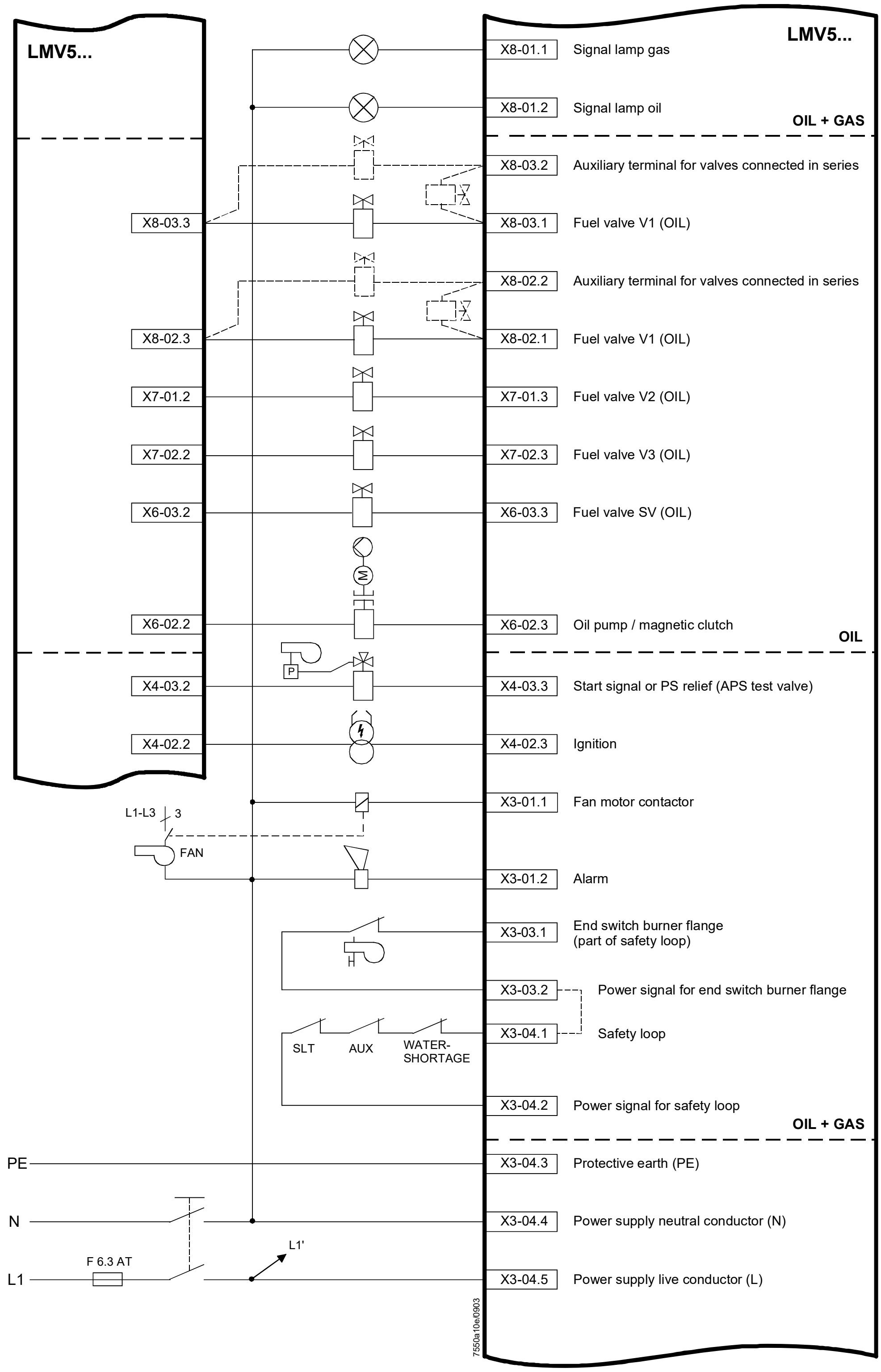


Figure 4: Block diagram – inputs / outputs

Block diagram (cont'd)

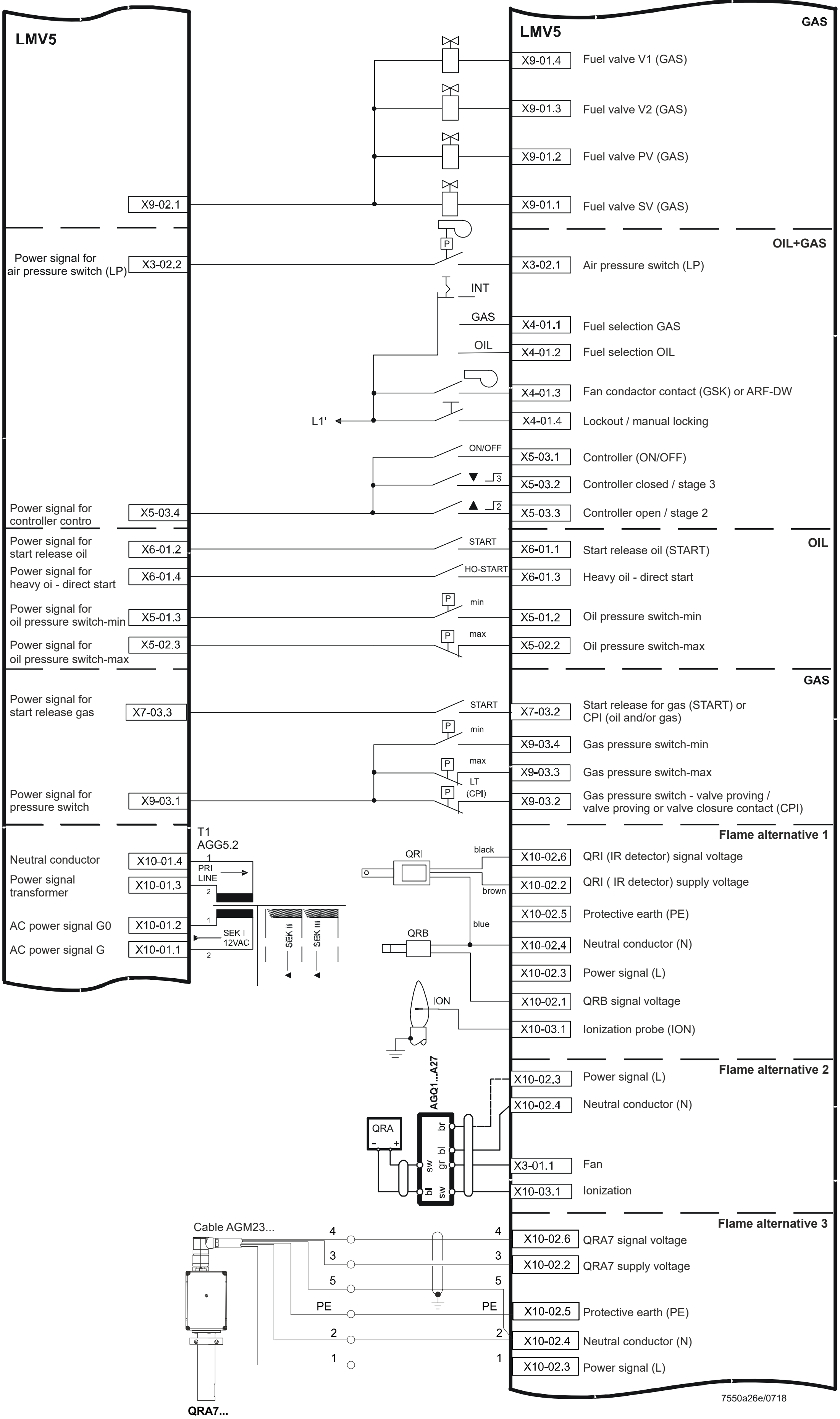


Figure 5: Block diagram –inputs / outputs

Block diagram (cont'd)

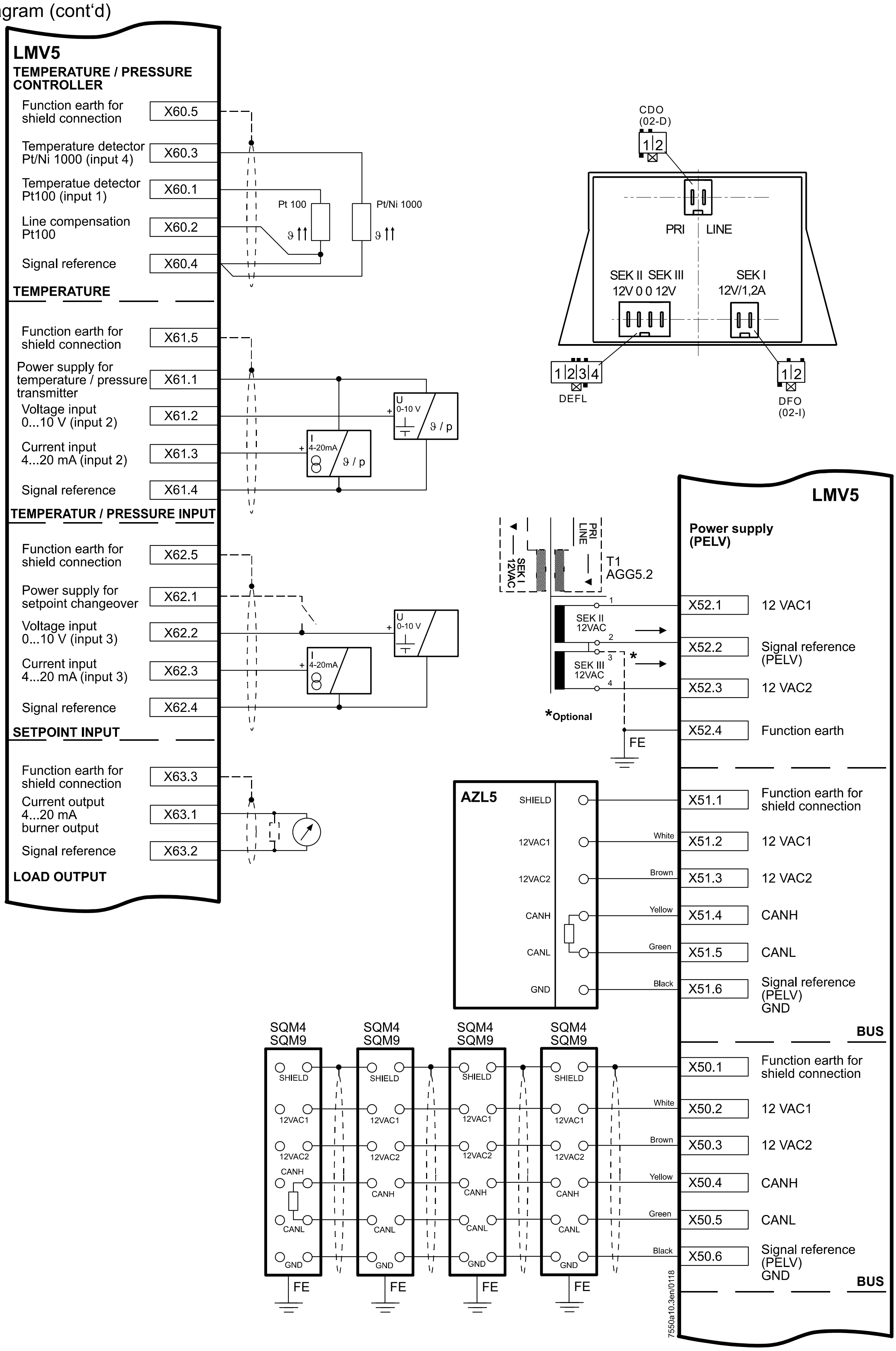


Figure 6: Block diagram – inputs / outputs

3 Fuel train (examples)

Gas direct ignition

Program **G** Direct ignition

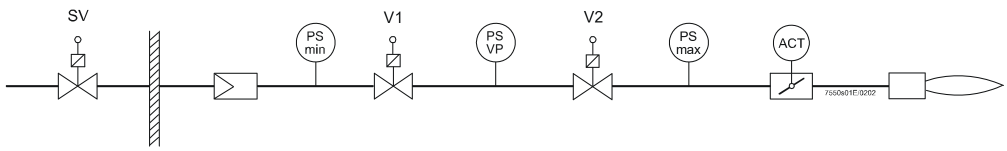


Figure 7: Fuel train application – gas direct ignition

Gas pilot ignition 1

Program **Gp1** Gas pilot

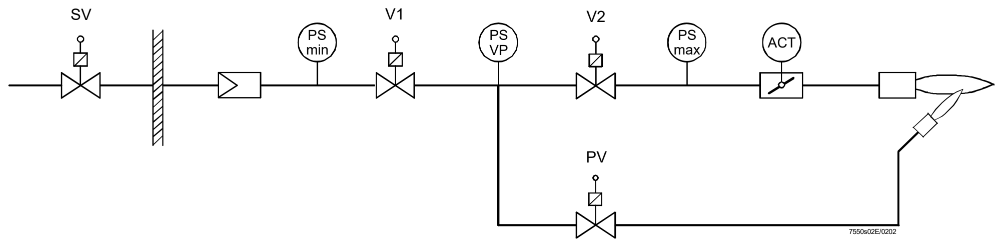


Figure 8: Fuel train application – gas pilot ignition 1

Gas pilot ignition 2

Program **Gp2** Gas-Pilot

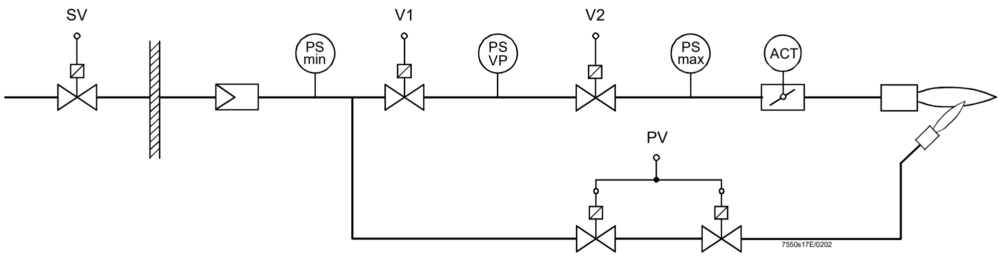


Figure 9: Fuel train application – gas pilot ignition 2

Fuel valve control

Gas (always modulating)

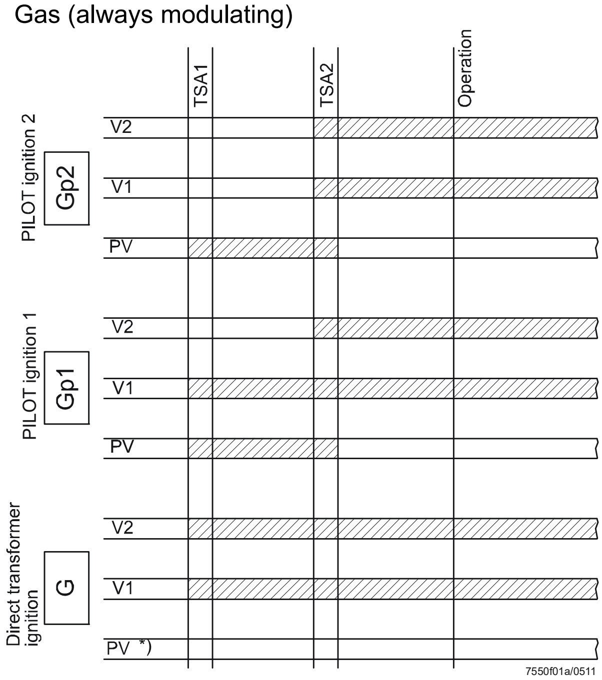


Figure 10: Fuel train application – fuel valve control

Legend to fuel trains:

- *) Not used
- 1) Preheating device
- V Fuel valve
- DK Gas valve proving
- DW Pressure switch
- HE Heating element
- HO Heavy oil
- LO Light oil
- SA Actuator
- NO **N**ormally **O**pen
- SV Shutoff valve (outside the building)
- PV Pilot valve

Fuel train applications
(cont‘d)

Direct ignition with light oil, multistage

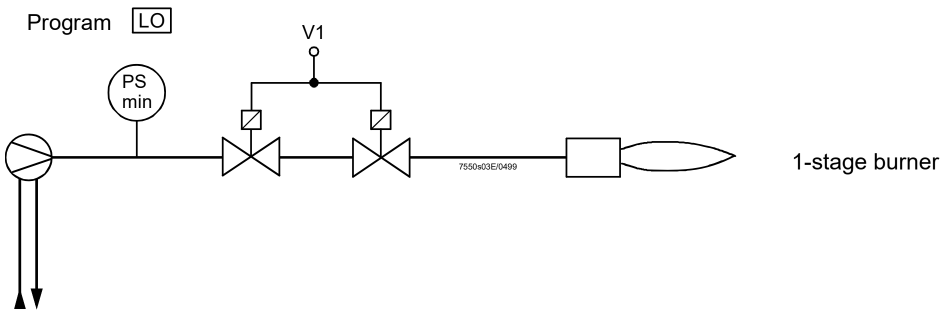


Figure 11: Fuel train application – light oil direct ignition, 1-stage

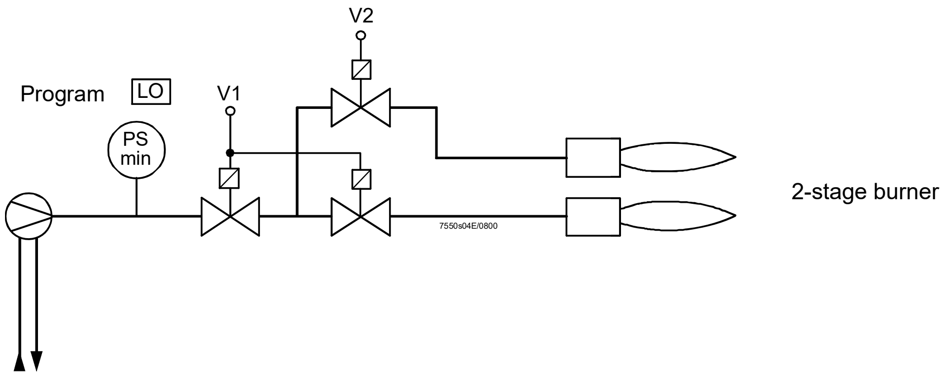


Figure 12: Fuel train application – light oil direct ignition, 2-stage

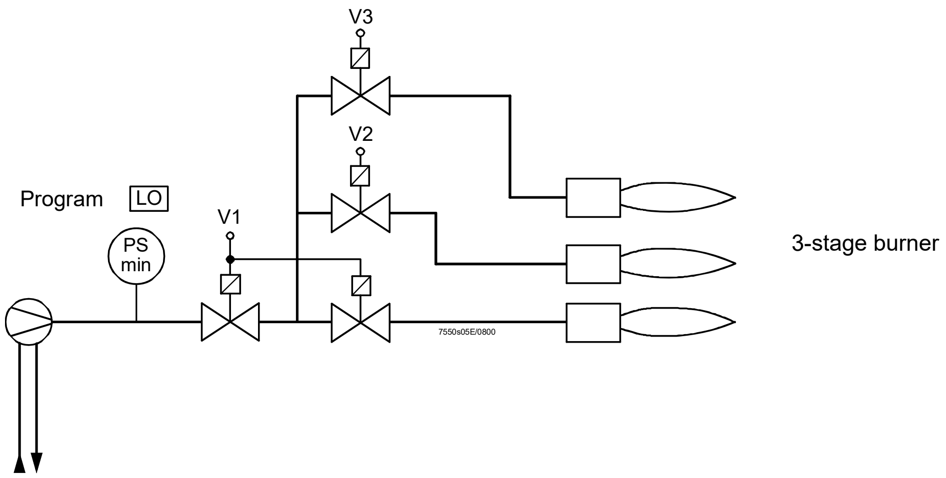


Figure 13: Fuel train application – light oil direct ignition, 3-stage

Direct ignition with light oil, modulating

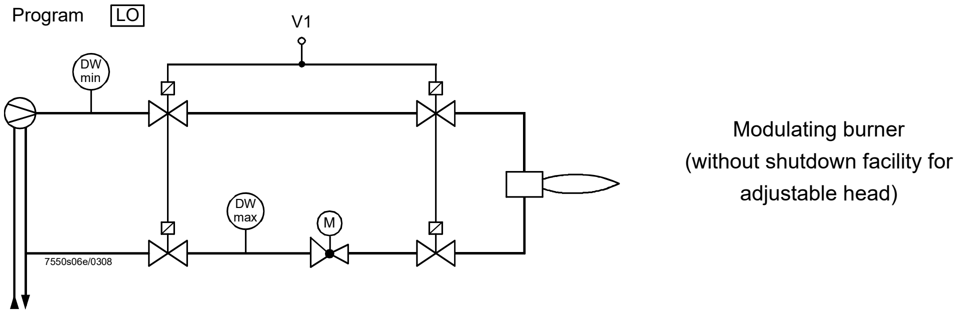


Figure 14: Fuel train application – light oil direct ignition, modulating, without shutdown facility for adjustable head

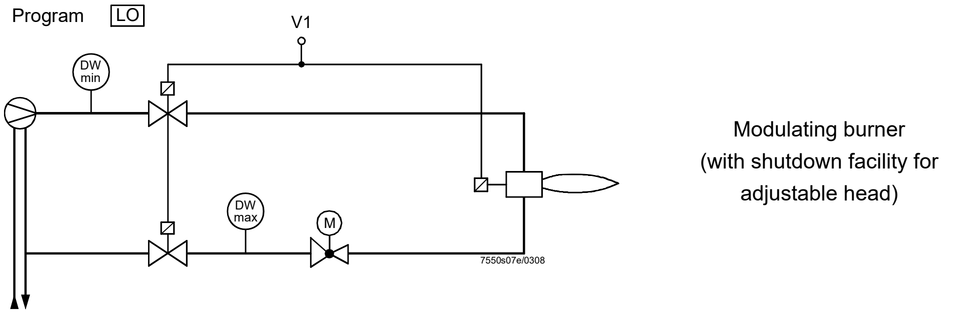


Figure 15: Fuel train application – light oil direct ignition, modulating, with shutdown facility for adjustable head

Fuel valve control

Light oil (direct transformer ignition)

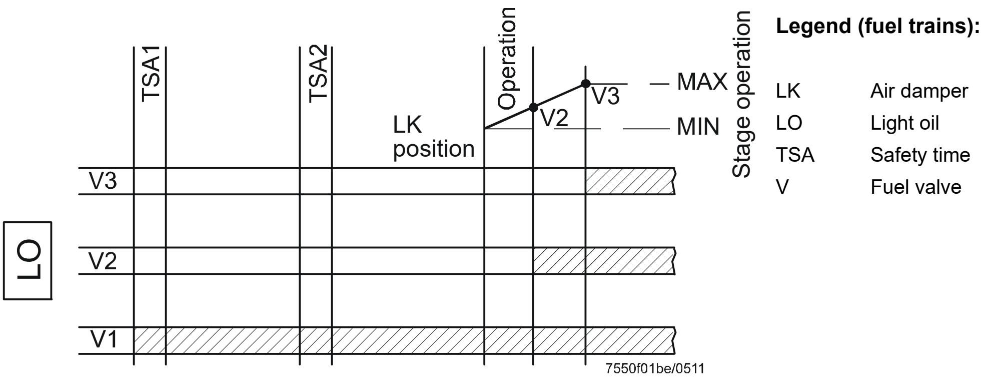
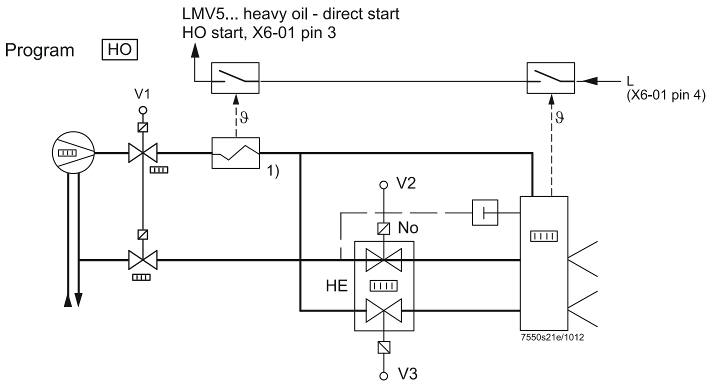


Figure 16: Fuel train application – fuel valve control

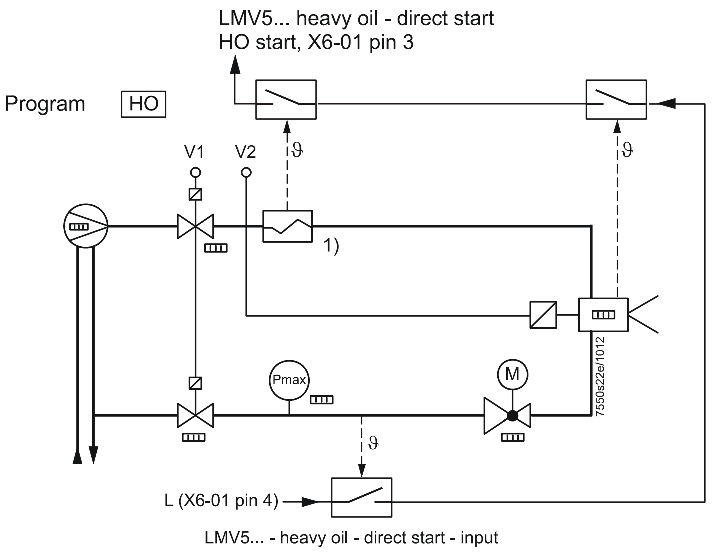
Direct ignition with heavy oil, multistage



2-stage burner

Figure 17: Fuel train application – heavy oil direct ignition, 2-stage

Direct ignition with heavy oil, modulating



Modulating burner

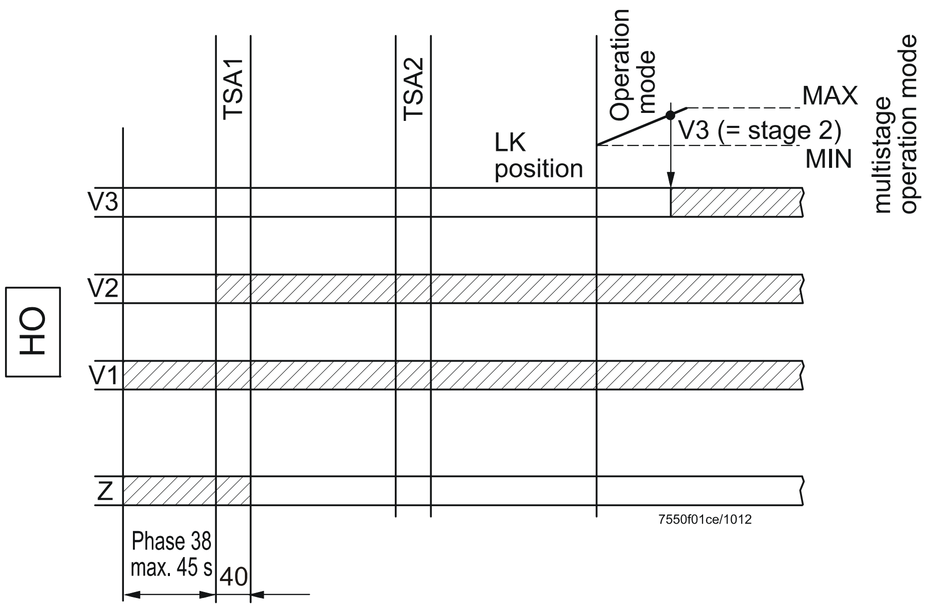
Circulation from phase 38, max. 45 s, as soon as heavy oil direct start = ON in phase 38:
→ phase change in phase 40

Heavy oil direct start = OFF at the end of phase 38
→ repetition (max. 3 times in total)

Figure 18: Fuel train application – heavy oil direct ignition, modulating

Fuel valve control

Heavy oil (direct transformer ignition)



Legend (fuel trains)

HO	Heavy oil
LK	Air damper
TSA	Safety time
V	Fuel valve
Z	Ignition

Figure 19: Fuel train application – fuel valve control

Note on dual-fuel burner!
Gas trains **G**, **Gp1** and **Gp2** 1) can be randomly combined with oil trains **LO** and **HO** for operation with dual-fuel burners since these fuel trains operate independently.

Caution!
Oil trains LOgp and HOgp are designed for ignition with a gas pilot. They must only be combined with a special gas train Gp2 for operation with a dual-fuel burner.

1) With **Gp2** permitted with hardware 01.C0 and software V01.40 or higher

Dual-fuel burner gas / light oil with gas pilot ignition

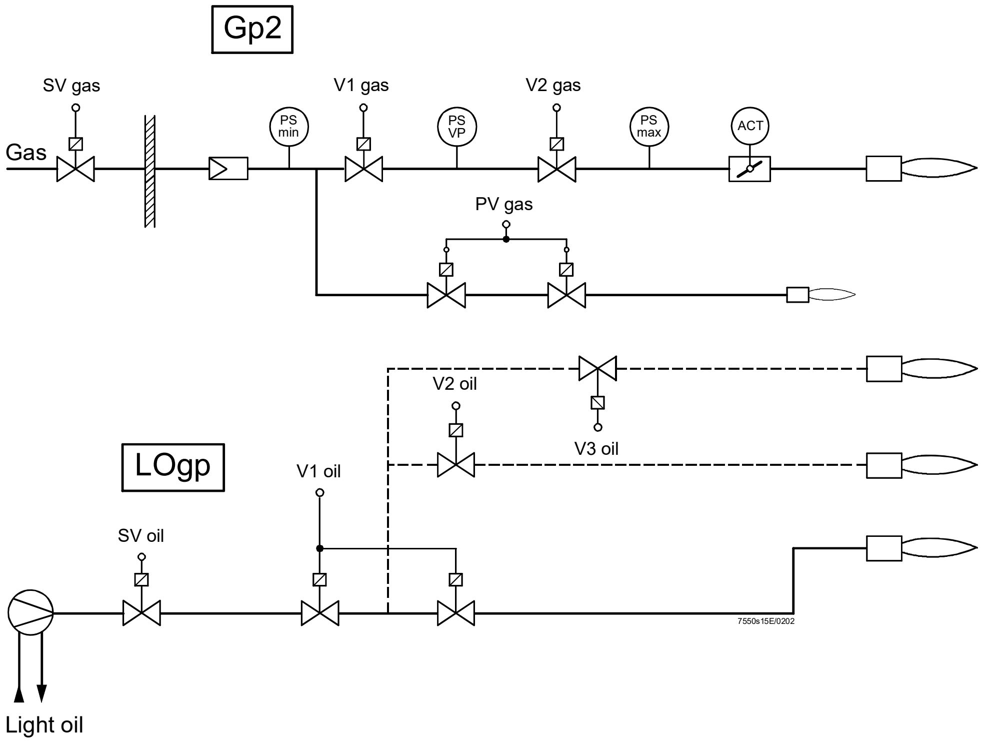
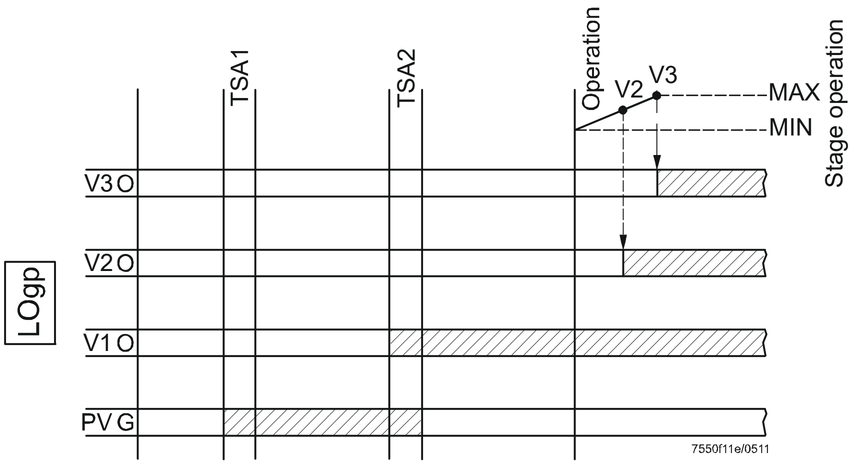


Figure 20: Fuel train application – dual-fuel burner gas / light oil, with gas pilot ignition

Fuel valve control

Light oil (with gas pilot ignition)



Legend (fuel trains)

LO	Light oil
TSA	Safety time
PV	Pilot valve
V	Fuel valve

Figure 21: Fuel train application – fuel valve control

Dual-fuel burner gas / heavy oil with gas pilot ignition

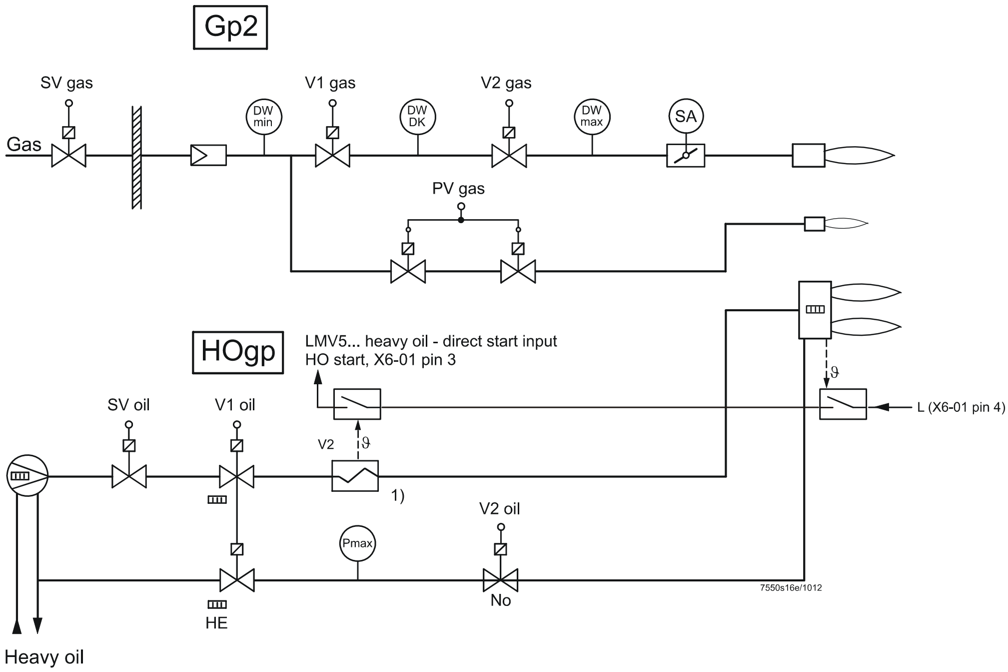
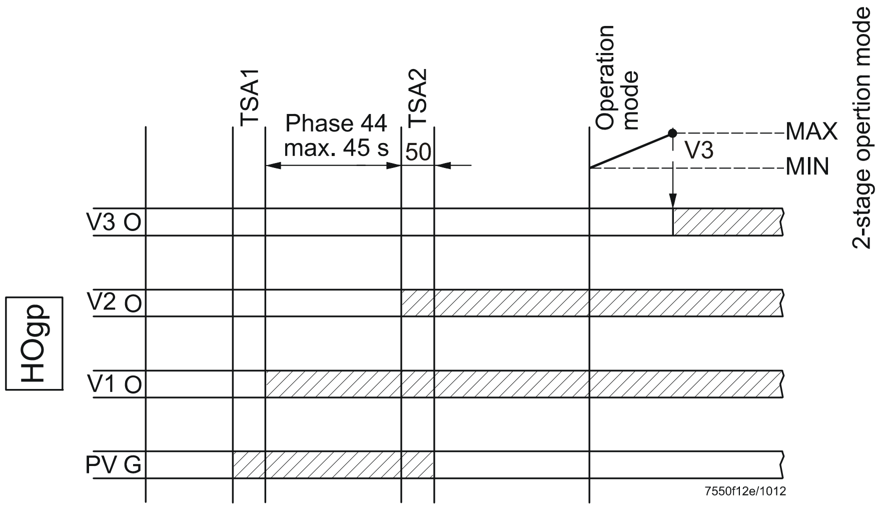


Figure 22: Fuel train application – dual-fuel burner gas / light oil, with gas pilot ignition

Fuel valve control

Heavy oil (with gas pilot ignition)



Legend (fuel trains):

HO	Heavy oil
PV	Pilot valve
TSA	Safety time
V	Fuel valve

Circulation from phase 44, max. 45 s as soon as heavy oil direct start = ON in phase 44:
→ phase change in phase 50

Heavy oil direct start = OFF at the end of phase 44
→ repetition (max. 3 times in total)

Figure 23: Fuel train application – fuel valve control

4 Burner control

4.1 Description of inputs and outputs

This chapter describes the basic characteristics of the burner control's inputs and outputs. For the valuation of inputs and the activation of outputs, refer to *Sequence diagrams*.

4.1.1 Flame signal input and flame detector

Flame signal input and flame detector X10–01 and X10–03

The following connection facilities are provided:

- QRI (infrared flame detector) for continuous or intermittent operation
- Ionization probe for continuous or intermittent operation
- QRB flame detector for intermittent operation only
- QRA2 / QRA4 / QRA10 flame detector with AGQ1 for intermittent operation at AC 120 V / AC 230 V
- QRA7 for continuous or intermittent operation

Caution!
Continuous operation with the QRA2/QRA4/QRA10 with AGQ1 and QRB is not possible!

Caution!
Do not use terminal X10-02 pin 1. This also applies to the connection of idle lines if the LMV5 is used for continuous operation!

Caution!
The response time of flame detector leads to a prolongation of the second safety time!

4.1.1.1 Self-test function LMV5 / QRI / QRA7

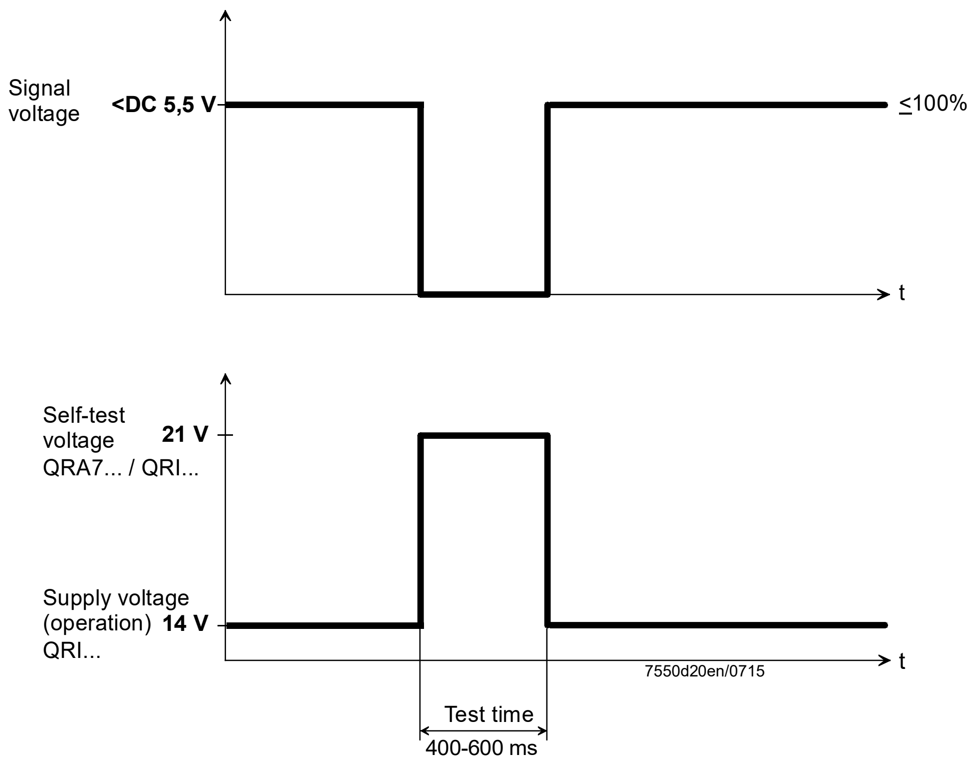


Figure 24: Self-test function LMV5 / QRI / QRA7

The self-test function of the QRI / QRA7 is triggered by increasing the supply voltage to the level of self-test voltage. During the following test time, the signal voltage at the output of the QRI / QRA7 changes to zero so that the LMV5 will receive the anticipated flame OFF signal as a response to the test. If the behavior is correct, operation is continued until the next test cycle is reached.

4.1.1.2 **Separate flame supervision** (only LMV50 / LMV52)

The flame signals to 2 channels (channel «A» for QRI / QRA7 or QRB, and channel «B» for ION). As an alternative for ionization current supervision – using the AGQ1 – the QRA2 / QRA4 or QRA10 can be connected to the ionization input of the LMV5 The connection / processing of the individual flame signals are selected via 6 parameters (*Pilot phase*, *Operating phase*, *Extraneous light* – each for gas- and oil-firing). The pilot phase covers phases 40 through 50 and operating phase 52 through 62. In all the other phases, the flame signal(s) is (are) evaluated via parameter *SensExtranl...*

The parameters offer the following setting choices:

- *Single-detector operation* (corresponding to the LMV51, plus error message if 2 flame detectors are connected)
- *QRI_B or ION* (parallel operation of QRI / QRA7 / QRB and ION, flame signal if 1 of the 2 channels indicates a flame)
- *QRI_B and not ION* (parallel operation of QRI / QRA7 / QRB and ION, flame signal if only the QRI / QRA7 / QRB indicates a flame)
- *QRI_B* (flame signal if the QRI / QRA7 / QRB indicates a flame; ION is not evaluated)
- *ION and not QRI_B* (parallel operation of QRI / QRA7 / QRB and ION, flame signal if only ION indicates a flame)
- *ION* (parallel operation of QRI / QRA7 / QRB and ION, flame signal if ION indicates a flame; the QRI / QRA7 / QRB will not be evaluated)
- *QRI_B and ION* (both must indicate a flame; this selection is not available with the *Extraneous light* block)

☞ Note!
To use the setting *QRI_B and not ION* or *ION and not QRI_B* in phases for extraneous light detection is not permitted.

Application example

Selective monitoring of the pilot ignition with ionization without continuous pilot: Which means that the ionization probe only detects the pilot flame. The main flame is supervised with the QRI / QRA7.

Implementation

Parameter *SensExtranl...* must be set to *QRI_B | ION*, which means that extraneous light is detected if 1 of the 2 flame detectors indicates that a flame is present. Parameter *SensOperPhGas* must be set to *ION*, which means that in the pilot phases (phases 40 through 50), only ION is evaluated (QRI / QRA7 don't care). Parameter *SensOperPhGas* or *SensOperPhOil* must be set to *QRI_B&/ION*, which means that in the operating phases (phases 52 through 62) only the QRI / QRA7 may deliver a flame signal. With these parameter settings, a flame signal via ION in the operating phases leads to safety shutdown due to *Loss of flame* in operation.

Technical data, flame supervision

Note!
All measured voltages refer to connection terminal N (X10–02 pin 4).

4.1.1.3 **QRI** (suited for continuous operation)

Supply voltage operation / test at terminal POWER QRI (X10–02 pin 2)	Approx. DC 14 / 21 V
Required signal voltage at terminal FSV / QRI (X10–02 pin 6)	Min. DC 3.5 V Display flame approx. 50% (with factory setting of the parameter *StandardFactor*)
Permissible signal voltage during extraneous light test	Max. DC 0,3 V
Possible signal voltage terminal flame signal amplifier / QRI (X10-02 pin 6)	Max. DC 5,5 V Display flame approx. 100% (with factory setting of the parameter *StandardFactor*)

Connection diagram

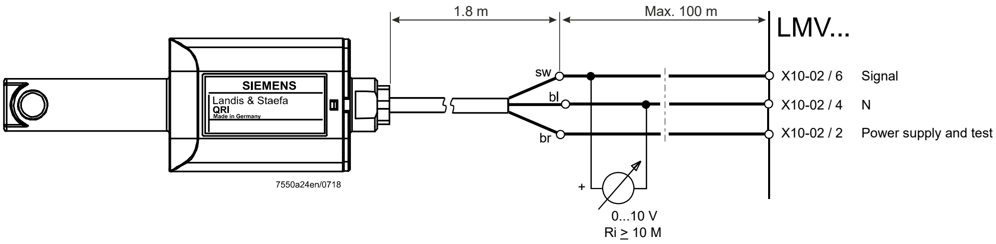


Figure 25: Connection diagram QRI

For detailed information, refer to Data Sheet N7719.

4.1.1.4 **Ionization** (suited for continuous operation)

No-load voltage at terminal ION (X10–03 pin 1)	Approx. U_{Mains}

Caution!
The ionization probe must be installed such that protection against electrical shock is ensured!

Short-circuit current	Max. AC 0.5 mA
Required detector current	Min. DC 6 µA, display flame approx. 50% (at factory setting of *StandardFactor*) parameter)
Possible detector current	Max. DC 85 µA, display flame approx. 100% (at factory setting of *StandardFactor*) parameter)
Permissible detector current during extraneous light test	Max. DC 0,3 µA
Permissible length of detector cable (laid separately)	100 m (wire-earth 100 pF/m)

Note!
The greater the detector cable capacitance (cable length), the lower the voltage at the ionization probe and, therefore, the lower the detector current. In the case of extensive cable lengths and high-resistance flames, it may be necessary to use low-capacitance cables (e.g. ignition cable).
The electronic circuit is designed such that impacts of the ignition spark on the ionization current are largely eliminated. Nevertheless, it must be ensured that the minimum detector current required will already be reached during the ignition phase. If that is not the case, the connections of the ignition transformer on the primary side must be changed and/or the location of the electrodes also.

4.1.1.5 QRA2 / QRA4 / QRA10 with AGQ1 (for intermittent operation only)

Note!
AGQ1 is only available for AC 230 V mains voltage.

QRA

Power supply in operation	DC 280…325 V
Power supply in test mode	DC 350…450 V

Attention!
In order to ensure that a higher voltage is supplied to the UV cell for the extraneous light test in phase 21 (via fan output X3-01 pin 1), parameter *MinTmeStartRel* (minimum time for phase 21) must be parameterized to at least 5 seconds.

For more detailed information about QRA2 / QRA10, refer to Data Sheet N7712.

For more detailed information about QRA4, refer to Data Sheet N7711.

Caution!
Flame detectors QRA2 / QRA4 / QRA10 must not be used when extraneous light suppression is activated since detector tests are not made in that case (parameter *ExtranLightTest* = deactivated)

LMV5

Possible ionization current	Max. DC 10 µA Display flame approx. 100% (with factory setting of the parameter *StandardFactor*)
Ionization current required	Min. DC 6 µA Display flame approx. 50% (with factory setting of the parameter *StandardFactor*)
Permissible ionization current during extraneous light test	Max. DC 0,3 µA

AGQ1.xA27

In connection with the LMV5, ancillary unit AGQ1.xA27 must be used.

Power supply	AC 230 V
Possible current	Max. 500 µA
Current required	Min. 200 µA

Connection diagram

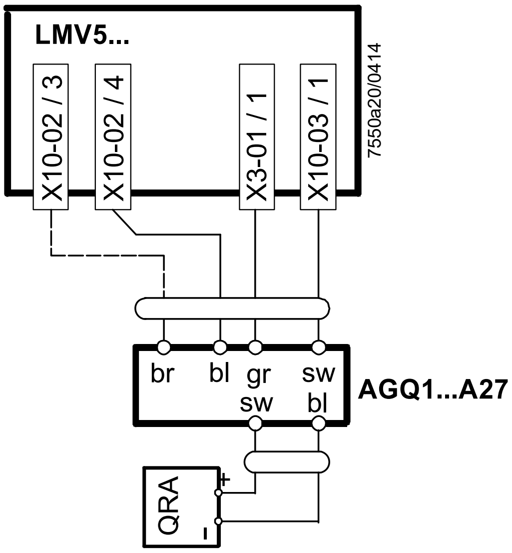


Figure 26: Connection diagram QRA

Assignment of LMV5terminals:

X10-02 pin 3	L
X10-02 pin 4	N
X10-03 pin 1	Ionization
X3-01 pin 1	Fan

Color code:
br = brown
bl = blue
sw = black
gr = gray (old: rd = red)

When laid together with other cables (e.g. in a cable duct), the length of the 2-core cable between QRA and AGQ1 must not exceed 20 m.
A maximum cable length of 100 m is permitted if the 2-core cable is run at a distance of at least 5 cm from other live cables.
The length of the 4-core cable between AGQ1 and LMV5 is limited to 20 m.
A maximum cable length of 100 m is permitted if the signal line (ionization / black) is not run in the same cable but separately at a distance of at least 5 cm from other live cables.

4.1.1.6 **QRA7** (suited for continuous operation)

Supply voltage - QRA73A17 / QRA75A17 - QRA73A27 / QRA75A27	 AC 120 V AC 230 V
Power supply for test via increasing the power supply for QRA7 (X10-02 pin 2)	From DC 14 V up to DC 21 V
Required signal voltage (X10-02 pin 6)	Min. DC 3,5 V Display flame approx. 50% (with factory setting of the parameter *StandardFactor*)
Possible signal voltage (X10-02 pin 6)	Max. DC 5,5 V Display flame approx. 100% (with factory setting of the parameter *StandardFactor*)
Permissible signal voltage during extraneous light test (X10-02 pin 6)	Max. DC 0,3 V
Perm. length of detector cable - 6 wire cable - Signal cable no. 3, 4 and 5	 Max. 10 Max. 100 m (laid separately from L, N and PE as shielded cable)

Connection diagram

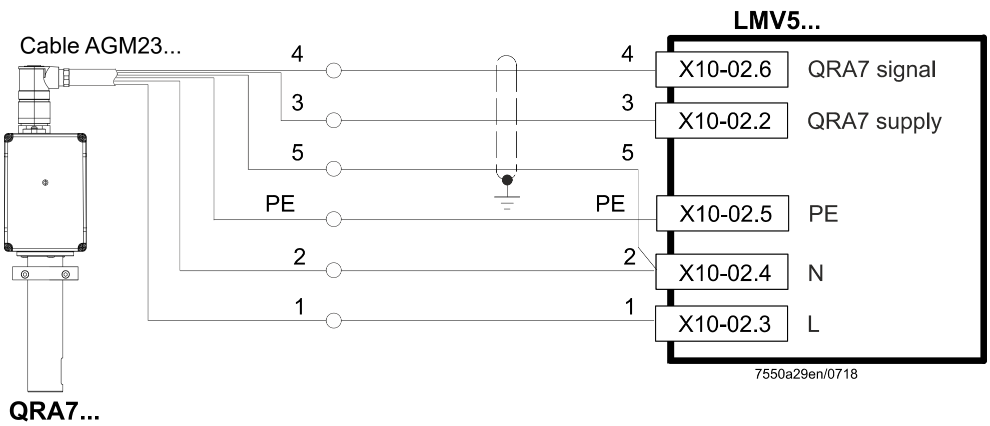


Figure 27: Connection diagram QRA7 with cable AGM23

For more detailed information about QRA7, refer to Data Sheet N7712.

4.1.1.7 **QRB** (for intermittent operation only)

No-load voltage at the QRB terminal (X10-02 pin 1)	Approx. DC 8 V
Required detector current required (with flame)	Min. DC 30 µA, display flame 35% (at factory setting of *StandardFactor*) parameter)
Permissible detector current during extraneous light test	Max. DC 5 µA
Possible detector current	Max. DC 70 µA, display flame approx. 100% (at factory setting of *StandardFactor*) parameter)
Permissible length of QRB detector cable (laid separately)	100 m (wire-wire 100 pF/m)

Note!
A detector resistance value of RF <5 kΩ is identified as a short-circuit and, in operation, will lead to safety shutdown as if loss of flame had occurred.
Measurement of the voltage at terminal QRB during burner operation gives a clear indication: If the voltage drops below 1 V, safety shutdown will probably be initiated.
For that reason, before using a highly sensitive photoresistive flame detector (QRB1B or QRB3S), it should be checked whether such a detector is really required!
Increasing line capacitance between the QRB terminal and mains live «L» adversely affects the sensitivity and increases the risk of damaged flame detectors due to mains overvoltages.
Separate routing of detector cables as specified in Data Sheet 7714 must be observed.

For more detailed information, refer to Data Sheet N7714.

Caution!
Flame detectors QRB must not be used when extraneous light suppression is activated since detector tests are not made in that case (parameter *ExtranLightTest* = deactivated)!

Notice!
Observe the relevant standards and regulations (e.g. extra supervision of the combustion chamber temperature)!

4.1.2 Standardization of flame signal display AZL5

The flame signal display on the AZL5 can be standardized; this means that a display value of 100% can be assigned to any flame signal.
This function is used for plants where the maximum flame signal has not reached a display of 100% in order to increase the display to 100% by means of standardization. The actual flame signal remains unchanged!

As soon as the flame signal to be standardized is stable, standardization can be performed by selecting and confirming the following options in the AZL5menu:
Params & Display ➔ BurnerControl ➔ Configuration ➔ ConfigFlameDet ➔ FlameSignal ➔ Standardize.

During standardization, a standardization factor *StandardFactor* is determined, which can be displayed and reset.

Parameter	*StandardFactor*

The accuracy of the display is a maximum of ±10%, depending on the tolerances of the components.
It should also be noted that, for physical reasons, there is no linear relationship between the display and the detector signal values. This is especially obvious with ionization current supervision.

For more detailed information, refer to Data Sheet N7714.

4.1.2.1 Configuration extraneous light

This parameter can be used to deactivate the extraneous light test in exceptional cases.

Caution!
Observe the relevant standards and regulations!

Parameter	*ExtranLightTest (deactivated / activated)*
	ReacExtranLight (Lockout / Startblock)

4.1.3 External flame supervision (LMV50 / LMV52)

Flame supervision can be performed by means of an external, approved (failsafe / self-checking) flame safeguard.
The external flame safeguard must issue the flame signal (mains voltage ON/OFF) via a switching contact.
The flame signal is evaluated at LMV5 input X6-01 pin 3 (*HeavyOilDirStart*). To do this, the input must be configured to *ext.FlameGd*.
A mains voltage signal at the input results in a flame signal.
The entire system is then only suitable for continuous operation if the external flame safeguard being used has been approved for continuous operation.

Parameter	*HeavyOilDirStart (ext.FlameGd) (deactivated / activated)*

If necessary, a second switching contact (redundancy contact) can also be used for the external flame safeguard.

This must always be inverse to the first switching contact:
- Mains voltage present = no flame
- Mains voltage not present = flame

This contact can be connected to input X6-01 pin 1 (start release oil) if the input has been parameterized to *HT/FG-RedCo*.

Parameter	*StartReleaseOil (HT/FG-RedCo) (deactivated / activated)*

Setting and determination of safety time during operation is defined in the section *Reaction time for loss of flame / safety time in operation*.

Attention!

- **Please be aware that the reaction time of the external flame safeguard and that of the LMV5 must be added together. The reaction time of the LMV5 is minimum 1.2 seconds.**
  A *extinction safety time during operation* in accordance with EN 676 of a maximum of 1 second is therefore not possible with an external flame safeguard
- **When using an external flame safeguard, no flame detector must be connected to X10**

4.1.4 High temperature supervision (only LMV50)

Temperature supervision for high-temperature plants >750° to DIN EN 746-2.
Replacement of flame supervision by supervising the combustion chamber wall temperature by means of an external safety limit thermostat to DIN EN 14597.

The external safety limit thermostat must issue the high-temperature signal (mains voltage ON/OFF) via a switching contact.
The signal is evaluated at LMV5 input X6-01 pin 3 (*HeavyOilDirStart).* To do this, the input must be configured to *HeavyOilDirStart*.

Parameter	*HeavyOilDirStart (deactivated / activ 38/44 / 38/44..62 / act 21..62 / HTempGuard / ext.FlameGd)*

During a burner start with temperatures <750 °C, conventional flame supervision using a flame detector suitable for continuous operation at LMV5 input X10 is performed.
The startup includes an extraneous light test as well as prepurging and valve proving function, if necessary.
During operation, conventional flame supervision is ended as soon as the high-temperature signal (temperature >750 °C) of the external safety limit thermostat is present at LMV5 input X6-01 pin 3.
If the high-temperature signal is no longer present during operation, conventional flame supervision is performed.

If the high-temperature signal is present during standby and during the startup sequence no conventional flame supervision is performed (no extraneous light test).
In addition, prepurging and the valve proving phases are skipped (jump from phase 22 to phase 36).
Conventional flame supervision is then not performed during operation.

If a high-temperature signal is present during shutdown, conventional flame supervision does not take place.

A second switching contact (redundancy contact) can also be used for the external safety limit thermostat.

This must always be inverse to the first switching contact:
- Mains voltage present = no flame
- Mains voltage not present = flame

This contact can be connected to input X6-01 pin 1 (start release oil) if the input has been parameterized to *HT/FG-RedCo*.

Parameter	*StartReleaseOil (HT/FG-RedCo)*

Attention!
Flame detectors (QRI, QRA7, ionization probes) that are suitable for continuous operation must be used in conjunction with high-temperature supervision

4.1.5 Digital inputs

4.1.5.1 **Safety loop / burner flange** (X3-04 pin 1 / X3-03 pin 1)

Note!
All digital inputs are safety-related inputs. Using a contact feedback network (CFN), these contacts are read back by the microcomputers and checked for their correct positions.

This input serves for including the safety loop. The special feature of this input is that all signal source contacts connected in series here directly switch off the power supply to the fuel valves and ignition.

Typically, the following contacts are included in the safety loop:
- External burner switch ON/OFF
- Safety limit thermostat / safety pressure limiter (SLT / SPL)
- External temperature limiter / pressure switch, if required
- Water shortage switch

Caution!
Temporarily switching contacts (<1 s, push-buttons or similar) must not be included in the safety loop!

FLANGE
X3-03 pin 1

- End switch burner flange (component of safety loop)

For diagnostics, the signal source contacts are combined for delivering the *Safety loop* message. If no signal is received, the burner will at least be shut down. What follows is a number of repetitions that can be parameterized.

Parameter	*SafetyLoop*

4.1.5.2 Manual lockout / reset

Manual lockout

The system can be manually locked by simultaneously pressing the **Esc** and **Enter** buttons on the AZL5. This function allows the user to lock the system from the operating level. This means that the user can trigger an unchangeable lockout. Due to the system make-up, this is not an emergency stop function.

For a reset, the following actions are carried out:
- The alarm relay and the fault display are switched off
- The lockout position is canceled
- The unit will reset and then change to standby

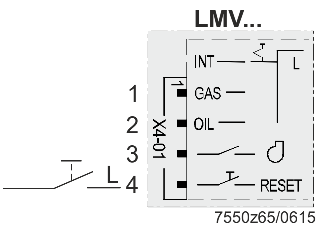
Reset

There are 2 ways to reset the system.

1. Reset on the AZL5
If the LMV5 is in lockout position, it can be reset by pressing **Esc**, followed by **Enter**.

2. Reset via the button on the connection terminal X4-01 pin 4
If the LMV5 is in lockout position, a reset can be carried out by pressing the button for 1…3 seconds. Longer or shorter presses on the button are ignored and the system maintains the lockout position. If the device is **not** in lockout position, a manual lockout can be triggered by pressing the button for 1...6 seconds.

With manual lockout



Without manual lockout

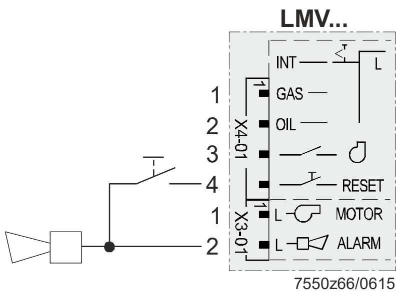


Figure 28: Reset / manual lockout (X4-01 pin 4)

4.1.5.3 **Fuel selector** (X4-01 pin 1 / X4-01 pin 2)

The fuel selector is given priority. It has the positions *INT, GAS* and *OIL* and is to be connected directly to the LMV5.
It is possible to switch between oil-fired and gas-fired operation.
When the fuel selector is set to *INT*, 1 of the other 2 sources can be selected (BACS **or** AZL5).

4.1.5.4 **Fan contactor contact / flue gas recirculation pressure switch** (X4-01 pin 3)

This input is used for connecting a fan contactor contact (FCC) or a flue gas recirculation pressure switch (FGR-PS).

The input serves for checking the position of the fan contactor.
The input is active both with oil-fired **and** gas-fired operation.
A signal is expected at this input after control of the fan

Parameter	*FGR-PS/FCC*

The input is used for connecting an air pressure switch required for flue gas recirculation (FGR)

Parameter	*FGR-PS/FCC (FGR-PS)*

The input can be deactivated

Parameter	*FGR-PS/FCC (deactivated)*

The input is used for the connection of an air pressure switch required for flue gas recirculation (FGR) or of an external process air fan, but the signal delivered by the air pressure switch is not valued during home run and in standby.

Parameter	*FGR-PS/FCC (deactInStby)*

Not LMV51.0 / LMV51.1

Additional speed-dependent air pressure switch

In this setting, an additional speed-dependent air pressure switch can be connected at the input.
The input is evaluated depending on the actual speed of the VSD.

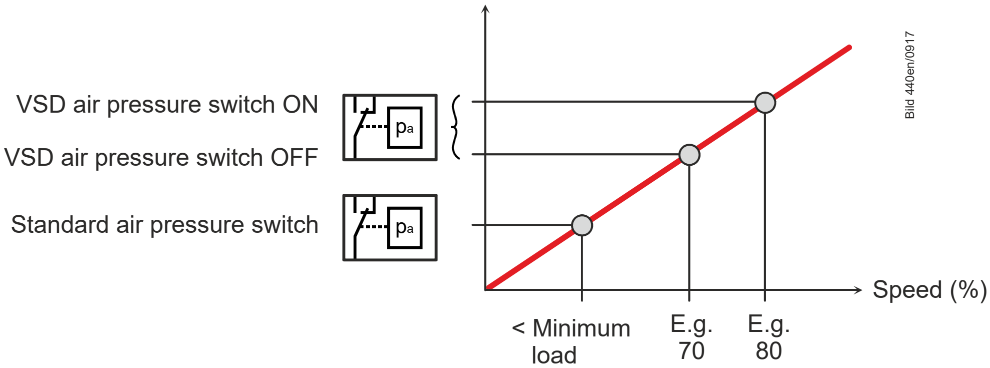


Figure 29: Additional speed-dependent air pressure switch

Parameter	*FGR-PS/FCC (PS VSD)*

This setting is linked to the following parameters:

Parameter	*RotSpeed PS on*
	RotSpeed PS off

Parameters *RotSpeed PS on* and *RotSpeed PS off* define the speed limit of the VSD above which the connected extra air pressure switch is monitored.

When the current speed exceeds *RotSpeed PS on*, the air pressure switch must deliver an ON signal.
When the current speed is below *RotSpeed PS off*, the air pressure switch must deliver an OFF signal.
When the current speed lies between the 2 speed limits, the air pressure switch is not valued.

The input is monitored during the phases from prepurging to postpurging and during the valve proving phases.

An erroneous signal leads to shutdown.

☞ Note!
If the input is set to *PS VSD* and the VSD is deactivated, the signal delivered by the air pressure switch is not valued.

4.1.5.5 **External boiler controller ON/OFF = heat request** (X5-03 pin 1)

Input for external controller (ON/OFF) X5-03 pin 1

When the external control loop is closed, the signal from the integrated controller (if present) is used to deliver the internal *Heat request* information to the input.

There is heat request when this external controller signal is pending and – if present and configured – there is a request for heat from the internal load controller or from BACS

When there is no more request for heat, the burner is shut down. Depending on the parameterization, the fuel valves are either shut the moment the period of time is completed by the timer, or after the MIN load is reached → Low-fire shutdown. In operation with the internal load controller or with load control, the input can be deactivated via BACS. This means that a wire link at this controller input is not required. In operating mode 1 (*ExtLC X5-03*), the input is always active, deactivation is not active → operating modes with load controller.

Parameter	*InputController (activated / deactivated)* [1)]

[1)] *(Parameter text)* in *Italics* = text displayed on the AZL5

☞ Note!
The input is also evaluated in manual mode!

4.1.5.6 External boiler controller OPEN/CLOSED or STAGE2 / STAGE3 (X5-03 pin 2 / X5-03 pin 3)

2 inputs (ON/OFF or STAGE2 / STAGE3)

(▲ ▼ ⌋2 ⌋3)

This input serves for the connection of an external controller with contact outputs. The input is only active when configured as *External load controller*.

X5-03 pin 3 / X5-03 pin 2

Parameter	*LC_OptgMode (ExtLC X5-03)*

2 operating modes are possible. The operating mode that is active depends on the parameterization of the fuel-air ratio control system.

Multistage operation can be implemented by using additional thermostats / pressure switches.

Parameter	*Operation Mode (2-stage / 3-stage)*

LMV5x std

X5-03 pin 3 (OPEN)	**X5-03 pin 2 (CLOSED)**	**3-stage**	**2-stage**
0	0	Stage 1	Stage 1
0	1	Stage 1	Stage 1
1	0	Stage 2	Stage 2
1	1	Stage 3	Stage 2

LMV2x3x std

X5-03 pin 3 (OPEN)	**X5-03 pin 2 (CLOSED)**	**3-stage**	**2-stage**
0	0	Stage 1	Stage 1
0	1	Stage 3	Stage 2
1	0	Stage 2	Stage 2
1	1	Stage 3	Stage 2

LMV2x3x inv

X5-03 pin 3 (OPEN)	**X5-03 pin 2 (CLOSED)**	**3-stage**	**2-stage**
0	0	Stage 1	Stage 1
0	1	Stage 2	Stage 1
1	0	Stage 3	Stage 2
1	1	Stage 3	Stage 2

Parameter	*Config X5-03 (LMV5x std / LMV2/3 std / LMV2/3 inv)*

The burner's output can be increased or decreased by means of a 3-position step controller output with 2 relays.
«▲» increases the output
«▼» decreases the output
If none of the 2 inputs is active, the burner's output is maintained at a constant level.
The shortest permissible positioning step is about 100 ms.

Parameter	*Operation Mode (modulating)*

4.1.5.7 **Air pressure switch** (X3-02 pin 1)

An air pressure switch can be connected to these terminals.

a) The input can be activated / deactivated.
When the input is activated, air pressure is anticipated after the fan has been switched on.
If there is no pressure signal, safety shutdown is initiated in any case.

Parameter	*AirPressureTest (activated / deactivated)*

b) In this setting, the signal of a connected air pressure switch is not evaluated in the *home run* and *standby* phases but leads to start prevention if the signal is not present.
In all other phases, a missing signal leads to safety shutdown in any case.

Parameter	*AirPressureTest (deactInStby)*

4.1.5.8 **Gas pressure switch - valve proving or valve closure contacts** (**X9-03** pin 2)

The input can be configured either as a pressure switch-valve proving input (PS-VP) **or** as a closed position indicator input (CPI).

PD-VP
The input is only active when firing on gas and when valve proving is activated.
→ valve proving of gas valves

Parameter	*PS-VP/CPI (PS-VP)*

CPI Gas
CPI:
It is used for checking the gas valves‘ fully closed position.
For that purpose, the gas valves‘ closure contacts for the fully closed position are to be connected in series using this input
The input is active in both gas- and oil-fired operation.

Gas-fired operation:
In phases 12 to 38 and phases 72 to 78, a check is made to ensure that the input is set to *On* (valve closed) und in phases 54 and 60 to *Off* (valve open).
In standby, *Off* (valve open) leads to a start prevention with a display message.
The display message can be output with a time delay (can be set with parameter *DelayStartPrev*).

Oil-fired operation:
In phases 12 to 38, 54, 60 and phases 72 to 78, a check is made to ensure that the input is set to *On* (valve closed).
In standby *Off* (valve open) leads to a start prevention with a display message.
The display message can be output with a time delay (can be set with parameter *DelayStartPrev*).

Parameter	*PS-VP/CPI (CPI or CPI Gas)*

CPI Gas+Oil
This input has been extended by the function of a CPI contact for oil valves.
The valve closure contacts of the gas and oil valves must be connected in series and then to this input.

Gas and oil-fired operation:
In phases 12 to 38 and phases 72 to 78, a check is made to ensure that the input is set to *On* (valve closed) and in phases 54 and 60 to *Off* (valve open).
In standby *Off* (valve open) leads to a start prevention with a display message.
The display message can be output with a time delay (can be set with parameter *DelayStartPrev*).

Parameter	*PS-VP/CPI (CPI Gas+Oil)*

CPI Oil
Is used for checking the oil valves' fully closed position.
To do this, the valve closure contacts of the oil valves must be connected in series and then
to this input.
The input is active in gas and oil-fired operation.

Oil-fired operation:
In phases 12 to 38 and phases 72 to 78, a check is made to ensure that the input is set to *On* (valve closed) and in phases 54 and 60 to *Off* (valve open).
In standby, *Off* (valve open) leads to a start prevention with a display message.
The display message can be output with a time delay (can be set with parameter *DelayStartPrev*).

Gas-fired operation:
In phases 12 to 38, 54, 60 and phases 72 to 78, a check is made to ensure that the input is set to *On* (valve closed).
In standby, *Off* (valve open) leads to a start prevention with a display message.
The display message can be output with a time delay (can be set with parameter *DelayStartPrev*).

Parameter	*PS-VP/CPI (CPI Oil)*

4.1.5.9 **Gas pressure switch-min** (X9-03 pin 4)

The input is used for connecting the gas pressure switch-min.
The input is only active when firing on gas and in the *LOgp* and *HOgp* programs until the end of second safety time. It can be deactivated for oil programs *LOgp* and *HOgp*.
The signal is anticipated in phase 21.
If there is no gas pressure, the → *gas shortage program* is activated.
Loss of gas pressure / start signal causes the burner to shut down.

Note!
If input X7-03 pin 2 (start release gas) is used as a valve closure contact, the start release gas (e.g. from the contact of an external outside air damper) can be connected in series to the gas pressure switch-min at this input (X9-03 pin 4).

Input X9-03 pin 4 can be parameterized as follows:

- Activate gas pressure-min
- Deactivate gas pressure-min for the oil fuel trains with gas pilot *LOgp* and *HOgp* (xOgp)
- Activate gas pressure-min

Parameter	*GasPressureMin (activated / deact x OGP / deactivated)* 2)

2) *(activated / deactivated)* Active inputs are checked for signal input.

There is a delayed reaction to loss of gas pressure during safety time to prevent shutdown caused by pressure shocks when the valves open.

Parameter	*PressReacTme (0.2s..MaxSafetyTGas)*

4.1.5.10 **Start release - gas / CPI** (X7-03 pin 2)

The input X7-03 pin 2 (*StartReleaseGas*) is used for connecting the start signal, e.g. from the release contact of an external outside air damper. The input is only active when firing on gas and in programs *LOgp* and *HOgp* until the end of second safety time. The signal is anticipated in phase 21. Loss of the start signal causes the burner to shut down. The input can be deactivated.

The input X7-03 pin 2 can alternatively be used as a valve closure contact POC / CPI input. In that case, it offers the same functionality as the original CPI input. This is needed on applications that demand valve proving and CPI. If a *Start release gas* signal is required, it must be delivered via input X9-03 pin 4 (*Pressure switch-min-gas*).

Configuration of the inputs (X7-03 pin 2):
- Deactivated
- Gas - start release
- Valve closure contact for gas (CPI gas)
- Valve closure contact for gas and oil (CPI gas+oil)
- Valve closure contact for oil (CPI oil)

Parameter	*StartReleaseGas (deactivated / StartRelGas / CPI Gas / CPI Gas+Oil / CPI Oil)*

CPI Gas:
CPI (Closed Position Indicator)
Used for checking the gas valves fully closed position. For that purpose, the valve closure contacts of the gas valves are to be connected in series and then to this input. The input is active both with gas-fired and oil-fired operation.

Firing on gas:
In the phases 12 to 38 and in the phases 72 to 78, the input is checked for *ON* (valve closed) and in phases 54 and 60, the input is checked for *OFF* (valve open).
In Standby, *OFF* (valve open) results in start prevention with display message.
The display message can be output with a time delay (can be set with parameter *DelayStartPrev*).

Firing on oil:
In the phases 12 to 38, 54, 60 and in the phases 72 to 78, the input is checked for *ON* (valve closed). In Standby, *OFF* (valve open) results in start prevention with display message. The display message can be output with a time delay (can be set with parameter *DelayStartPrev*).

Parameter	*PS-VP/CPI (CPI Gas)*

CPI Gas+Oil:
Here, this input has been extended by the function of a CPI contact for oil valves. The valve closure contacts of the gas and oil valves must be connected in series and then to this input.

Firing on gas and oil:
In the phases 12 to 38 and in the phases 72 to 78, the input is checked for *ON* (valve closed) and in phases 54 and 60, the input is checked for *OFF* (valve open).
In Standby, *OFF* (valve open) results in start prevention with display message.
The display message can be output with a time delay (can be set with parameter *DelayStartPrev*).

Parameter	*PS-VP/CPI (CPI Gas+Oil)*

CPI Oil:
This is used for checking the oil valves fully closed position.
For that purpose, the valve closure contacts of the oil valves are to be connected in series and then to this input.
The input is active both with gas-fired and oil-fired operation.

Firing on oil:
In the phases 12 to 38 and in the phases 72 to 78, the input is checked for *ON* (valve closed) and in phases 54 and 60, the input is checked for *OFF* (valve open).
In Standby, *OFF* (valve open) results in start prevention with display message.
The display message can be output with a time delay (can be set with parameter *DelayStartPrev*).

Firing on gas:
In the phases 12 to 38, 54, 60 and in the phases 72 to 78, the input is checked for *ON* (valve closed).
In Standby, *OFF* (valve open) results in start prevention with display message.
The display message can be output with a time delay (can be set with parameter *DelayStartPrev*).

Parameter	*PS-VP/CPI (CPI Oil)*

4.1.5.11 **Gas pressure switch-max** (X9-03 pin 3)

The input is used for connecting the gas pressure switch-max. It is only active when firing on gas.
The signal is anticipated when first safety time starts.
If the gas pressure is exceeded, safety shutdown is initiated in any case.
The input can be deactivated.

Parameter	*GasPressureMax (activated / deactivated)*

There is a delayed reaction to loss of gas pressure during safety time to prevent shutdown caused by pressure shocks when the valves open.

Parameter	*PressReacTme (0.2s..MaxSafetyTGas)*

4.1.5.12 **Oil pressure switch-min** (X5-01 pin 2)

The input is used for connecting an oil pressure switch-min. It is only active when firing on oil.

It is anticipated that the pressure signal appears during preignition to be critically valued (with HOgp in phase 44). If there is no oil pressure, or if the oil pressure drops, safety shutdown is initiated in any case. The signal is valued from safety time. If there is no oil pressure, safety shutdown is initiated in any case.

Parameter	*OilPressureMin (activated)*
	OilPressureMin (act from ts)

Note!
During preignition, there is no waiting for the oil pressure. The signal is valued from the first safety time.
The signal is valued from first safety time. If there is no oil pressure, safety shutdown is initiated in any case.

Caution!
This kind of parameterization is only permitted in case of individual system approvals.

The input can be deactivated
There is a delayed reaction to loss of oil pressure during safety time to prevent shutdown caused by pressure shocks when the valves open.

Parameter	*PressReacTme (0.2s..MaxSafetyTGas)*
	OilPressureMin (deactivated)

4.1.5.13 Oil pressure switch-max (X5- 02 pin 2)

The input is used for connecting an oil pressure switch-max. It is active only when firing on oil.
The maximum oil pressure must not be exceeded. If exceeded, at least 1 safety shutdown is initiated.
The input can be deactivated.

Parameter	*OilPressureMax (activated / deactivated)*

There is a delayed reaction to loss of oil pressure during safety time to prevent shutdown caused by pressure shocks when the valves open.

Parameter	*PressReacTme (0.2s..MaxSafetyTGas)*

4.1.5.14 Start release - oil (X6-01 pin 1)

The input is used for connecting a start signal, e.g. from the release contact of an external outside air damper. It is only active when firing on oil.
The signal is anticipated in phase 21. If the signal is not delivered, or lost, shutdown is initiated.
The input can be deactivated.

With the *HT/FW-RedKo* setting, the input can also be used for a second switching contact (redundancy contact) for external flame supervision or external high temperature supervision.

The redundancy contact must always be inverse to the first switching contact (at input X6-01 pin 3, heavy oil direct start):
- Mains voltage present — no flame
- Mains voltage not present — flame

Parameter	*StartReleaseOil (activated / deactivated / HT/FG-RedCo)*

4.1.5.15 Heavy oil - direct start (X6-01 pin 3)

The input is used for connecting a heavy oil direct start signal with which circulation phase 38 with HO, or phase 44 with *HOgp*, can be shortened.
In the circulation phase, the waiting time for the signal is a maximum of 45 seconds. If the signal is not delivered, home run is triggered, followed by → repetition. The input is only active when firing on heavy oil (HO or HOgp).
The input can be deactivated.

Input X6-01 pin 3 can be configured as follows:

deactivated	Deactivate input
activated 38/44	Heavy oil direct start active in phase 38 for *HO* or in phase 44 for *HOgp*. The input is only supervised in phases 38 or 44. A signal in these phases leads to the heavy oil direct start, i.e. switch to phase 40 or 50. A missing signal leads to lockout within 45 seconds.
38/44...62	Heavy oil direct start active in phase 38 for *HO* or phase 44 for *HOgp* and in phase 62. The input is also supervised in operating phases 50...62; a failure leads to a safety shutdown.
act 21...62	Heavy oil direct start active in phase 21 to 62. In phase 21 (start release), this enables the system to wait for the *HeavyOilDirStart* signal prior to starting up. The maximum waiting time is set via *MaxTmeStartRel*. The input is also supervised in operating phases 50...62; a failure leads to a safety shutdown.
HTempGuard	External safety limit thermostat for high-temperature supervision (>750 °C), refer to chapter *High-temperature supervision*.
ext.FlameGd	External flame safeguard, refer to chapter *External flame supervision*

Parameter	*HeavyOilDirStart (deactivated / activated 38/44 / 38/44...62 / act 21...62 / HTempGuard / ext.FlameGd)*

4.1.6 Digital outputs

Safety-related outputs, type SI
These contacts are read back by the microcomputers via a contact feedback network (CFN) and then monitored for correct positions.

Non-safety-related outputs, type No-SI
These outputs are not monitored by contact feedback network and, for this reason, can only be used for non-safety-related actuating devices are actuating devices that are secured in some other form (e.g. fans, oil pump / magnetic clutch, alarm).

4.1.6.1 Alarm, type No-SI (X3-01 pin 2)

A signal lamp or horn can be connected to this output.
The output is activated when the unit is in the lockout position (phase 00).
This output can also be used to signal start prevention
→ signaling start preventions
An active alarm output can be manually deactivated. Deactivation remains active until a lockout reset or a system reset is made, or up to the next startup. Then, the alarm is activated again. Deactivation only applies to the alarm output, lockout or start prevention continue to be active.

Parameter	*Alarm act/deact (activated / deactivated)*

4.1.6.2 Fan, type No-SI (X3- 01 pin 1)

This output is used for controlling a fan power contactor (200 VA). When changing to the lockout position, the fan continues to run for an adjustable period of time.

When → continuous purging is activated, the fan runs in all phases. This mode functions only when using an air pressure switch relieve valve which, in phase 21, ensures that the fan pressure switch does not sense any pressure, thus facilitating checking.

Parameter	*PostpurgeLockout*
	ContinuousPurge (activated / deactivated)

4.1.6.3 Ignition, type SI (X4-02)

This output is used for connecting ignition transformers or electronic igniters.
When firing on gas, ignition is switched on just prior to first safety time in phase 38.

When firing on oil, there is choice of short preignition as with gas operation and long preignition. In the case of long preignition, ignition is switched on when the fan starts to run in phase 22.

Parameter	*PreIgnitionTGas*
	PreIgnitionTOil
	IgnOilPumpStart (on in Ph38 / on in Ph22)

4.1.6.4 Oil valves, type SI (X8-02, X8-03, X7-01, X7-02, X6-03)

These outputs are used for connecting the oil valves in accordance with the selected fuel train. → Fuel trains, → Sequence diagrams.

Parameter	*FuelTrainOil (LightOilLO / HeavyOilHO / LO w Gasp / HO w Gasp)*

(Light oil with gas pilot and heavy oil with gas pilot may only be used in connection with **Gp2**)

4.1.6.5 Gas valves, type SI (X9-01)

These outputs are used for connecting the gas valves in accordance with the selected fuel train. → Fuel trains, → Sequence diagrams.

Parameter	*FuelTrainGas (DirectIgniG / Pilot Gp1 / Pilot Gp2)*

4.1.6.6 Operation indication gas / oil, type SI (X8-01)

This output shows the operating position of the LMV5.
The outputs are connected directly to valve output *V1Oil* or *V1Gas*. The operating position outputs for oil and gas must not be directly connected, since a wrong contact position of valve output 1 (unused fuel) would be detected, which would lead to lockout.

☞ Note!
During the valve proving sequence *Filling,* gas valve (V1) is controlled, so that *Gas* is displayed for a moment!

4.1.6.7 Oil pump / magnetic clutch, type No-SI (X6-02)

Applications with a separate oil pump or magnetic clutch

This output can be used for connecting an oil pump or a magnetic clutch for an oil pump. The switch-on time can be parameterized together with preignition. In the case of dual-fuel burners, short preignition must be used (phase 38). In the case of long preignition, the oil pump is switched on in phase 22 together with ignition, in the case of short preignition, in phase 38. With the heavy oil programs (heavy oil HO, heavy oil with gas pilot), the oil pump with short preignition is already activated in phase 36 to ensure oil pressure is available when circulation starts.

Parameter	*OilPumpCoupling (Magneticcoupl)*
	IgnOilPumpStart (on in Ph38)

Single-fuel applications with direct-coupled oil pump

On applications where the oil pump is coupled directly to the fan motor, the oil shutoff valve (SV-oil) can be connected to that output. The output is always activated when the fan operates, plus another 15 seconds after the fan has been switched off. If *Directcoupl* is selected, long preignition becomes automatically active. Direct coupling is only permitted in the case of oil-firing alone.

☞ Note!
With both variants, parameter *OnTmeOilIgnition* can be left set to *on in Ph38*. In that case, short or long preignition will automatically be correct, depending on the selection of *OilPumpCoupling.*

Parameter	*OilPumpCoupling (Directcoupl)*

4.1.6.8 Start signal or pressure switch relief valve, type No-SI (X4-03)

Depending on the parameterization, the output can be used for a start signal or for an pressure switch relief valve.

The start signal is used for controlling an outside air damper. When actuating the fresh outside air damper's end switch, which is fed back to the start release inputs of the LMV5, the startup sequence is continued

Parameter	*Start/PS-Valve (StartSignal)*

In this configuration, a 3-port valve for testing (no pressure) the air pressure switch (APS) can be connected. During the test, the valve is controlled

Parameter	*Start/PS-Valve (PS Relief)*

When using this configuration, a valve for testing (no pressure) the air pressure switch (APS) can be connected. The valve is controlled while the fan is running. During the test, the valve is deenergized.
This valve is required when parameterizing *NormDirectStart (NormalStart / DirectStart)* → direct start for testing the air pressure switch if *ContinuousPurge* is parameterized *(activated)* → Continuous purging

Parameter	*Start/PS-Valvel (PS Relief_Inv)*

4.2 Control sequence

The sequence diagrams show the control sequence in detail (refer to chapter *Sequence diagrams*).

4.2.1 Parameters

4.2.1.1 Time parameter

The most important time parameters for the control sequence are the following (for values, refer to Setting Lists, I7550):

- Prepurge time
- Preignition time / circulation time heavy oil
- First safety time
- Second safety time
- Interval 1
- Interval 2
- Postpurge time 1 (t8-1) with flue gas recirculation (FGR) damper shut (this part of the postpurge time is always executed)
- Postpurge time 3 (t8-3) with flue gas recirculation (FGR) damper open (this part of the postpurge time is interrupted when there is a heat request)
- Postpurging in the lockout phase (if fan motor (G) = ON before lockout occurred)

All the times mentioned above – with the exception of *Postpurge in the lockout phase* – depend on the type of fuel, which means that different times can be set for oil and gas. The prepurge time and the safety times are safety-related. This means that, using the AZL5, the heating engineer can only readjust them in the «safe» direction (against internal maximum or minimum values).
In other words, safety times can only be shortened and «tv» times can only be extended.

Attention!
On the OEM access level, it is possible to make parameter settings that differ from application standards for the maximum safety time (*MaxSafetyTGas* or *MaxSafetyTOil*). For this reason, check whether the parameter settings made are in compliance with the application standards (e.g. EN 676, EN 267, etc.), or whether the respective plant requires special approval!

4.2.1.2 Reaction time for loss of flame / safety time in operation

The reaction time to a loss of flame during operation (phases 44, 52, 54, 60, and 62) can be set via parameter *ReacTmeLossFlame*.

The safety time in operation results:

- With internal flame supervision (flame detector at input X10) by adding *ReacTmeLossFlame* + 0.8 second
- With external flame supervision (flame detector at input X6-01 pin 3 / pin 1) by adding *ReacTmeLossFlame* + 1 second + reaction time of the external flame safeguard (see also section *External flame supervision (LMV50 / LMV52)*

Examples of internal flame supervision:

- With the basic setting for *ReacTmeLossFlame* of 0.2 second, safety time during operation is less than 1 second (0.2 second + 0.8 second)
- At the maximum setting for *ReacTmeLossFlame* of 3.2 seconds, safety time during operation is less than 4 seconds (3.2 seconds + 0.8 second)

Examples of external flame supervision with a reaction time of the external flame safeguard of 1.4 second:

- At the basic setting for *ReacTmeLossFlame* of 0.2 second, safety time during operation is less than 2.6 seconds (0.2 second + 1 second + 1.4 second)
- At the maximum setting for *ReacTmeLossFlame* of 3.2 seconds, safety time during operation is less than 5.6 seconds (3.2 seconds + 1 second + 1.4 second)

Parameter	*ReacTmeLossFlame (0,2…3,2s)*

Attention!

- **The safety time in operation may only be extended if the applicable standards for the application allow this**
- **For applications to EN 676 or EN 267, the basic setting for *ReacTmeLossFlame* of 0.2 second must be retained so that safety time during operation for internal flame supervision is kept below 1 second.**
- **The parameter is also effective when using an external flame safeguard. However, as the internal reaction time of the LMV5 is already 1.2 seconds and the reaction time of the external flame safeguard still has to be added to this, a safety time during operation of less than 1 second is not possible with external flame supervision**

4.2.2 Gas valve proving

Gas valve proving is only active when firing on gas.
When a leak is detected, the gas valve proving function ensures that the gas valves are not opened, and that ignition is not switched on. Safety shutdown is initiated.

Example

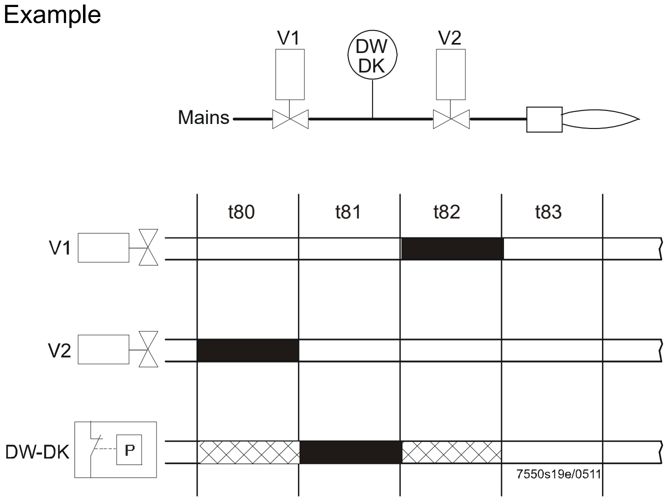


Figure 30: Gas valve proving

Step 1: t80 Evacuate the test space
With gas valve proving, first the gas valve on the burner side is opened to bring the test space to atmospheric pressure.

Step 2: t81 Atmospheric pressure test
After closing the gas valve, the pressure in the test space is not allowed to rise above the switching point of pressure switch-valve proving (e.g. gas pressure in operation x 0.5).

Step 3: t82 Fill test space
Then, the gas train is filled by opening the gas valve on the gas network side.

Step 4: t83 Gas pressure test
After closing the gas valve, the gas pressure is not allowed to fall below the switching point of pressure switch-valve proving (e.g. gas pressure in operation x 0.5).

Input / output signal 1 (ON)
Input / output signal 0 (OFF)
Input, permissible signal 1 (ON) or 0 (OFF)

DW-DK Pressure switch-valve proving
V... Fuel valve

The valve proving function can be parameterized and the time selected:

- During startup (between phases 30 and 32)
- During shutdown (between phases 62 and 70)
- During startup **and** during shutdown

Recommendation

Perform gas valve proving during shutdown.

Caution!
The evacuation and filling times as well as the test times at atmospheric pressure or mains pressure must be set by the OEM, for each individual plant and in accordance with the requirements of EN 1643.

In particular, it must be ensured that the 2 test times are set correctly. It must also be checked whether – on the specific application – it is permitted to introduce into the combustion chamber the gas required for testing.
The test times are safety-related.
After a reset, or in the event gas valve proving has been aborted or prevented, the burner control effects gas valve proving during the next startup sequence (only if gas valve proving is activated).

Example of aborted gas valve proving:
When the safety loop or the start prevention input for gas (containing pressure switch-min) opens during the time gas valve proving is performed.
The input for the valve proving function can also be used for the CPI (valve closure contact).

Note!
If gas valve proving is parameterized to take place with *startup **and** shutdown*, the gas valves must perform additional switching cycles. This means that wear and tear of the gas valves will increase.

Parameter	*ValveProvingType (No VP / VP startup / VP shutdown / VP stup/shd)*
	Config_PS-VP/CPI (PS-VP / CPI Gas / CPI Gas+Oil / CPI Oil)
	VP_EvacTme
	VP_TmeAtmPress
	VP_FillTme
	VP_Tme_GasPress

Determination of valve proving leakage rate

$$Q_{Leakage} = \frac{(P_G - P_W) \cdot V \cdot 3600}{P_{atm} \cdot t_{Test}}$$

Legend

$Q_{Leakage}$	in l/h	Leakage rate in liters per hour
P_G	in mbar	**Overpressure** in the piping section between the valves to be tested, at the beginning of the test phase
P_W	in mbar	Overpressure adjusted on the pressure switch (normally set to 50% of the gas inlet pressure)
P_{atm}	in mbar	**Absolute air pressure** (1,013 mbar normal pressure)
V	in l	Volume in the piping section between the valves to be tested, including the volume in the valves themselves, plus any pilot section (Gp1)
t_{Test}	in s	Test time

Examples

Refer to chapter *Commissioning instructions for LMV5 / gas valve proving / valve proving.*

4.2.3 Special functions during the control sequence

4.2.3.1 **Lockout phase** (phase 00) / **safety phase** (phase 01)

The safety loop relays are deenergized, the alarm relay is activated, and lockout is initiated, which means that phase 00 can only be quit via manual reset. In terms of time, phase 00 is unlimited. During the lockout phase, the fan motor remains off, provided it was already deactivated in the safety phase. During the lockout phase, the fan contact is controlled for a selectable period of time.

Parameter	*PostpurgeLockout*

Note!
When using a VSD, give consideration to its shutdown behavior.
Refer to chapter *Special features,* parameter *ShutdownBehav (Unchanged / PostpurgeP / HomePos).*

Safety phase (phase 01)

The safety phase is an intermediate phase that is ended before lockout occurs. The safety loop relays are deenergized, but lockout will not yet initiated. The alarm relay is not yet energized.
In the safety phase, the fan motor maintains the state of the previous phase, that is, it remains on if it was on before, and it remains off if it was off before.
If possible or permitted, safety checks or repetition counter checks are made. Their results decide on the transition to either *Lockout phase* or *Standby*.
The duration of the safety phase varies (depending on the scope of testing) but lasts a maximum of 30 seconds.
This procedure serves primarily for suppressing undesired lockouts, caused by EMC effects, for instance.

4.2.3.2 Repetition counter

With heavy oil	Repetition counter value: Heavy oil direct start Note: Changes only become active after a reset (power on / reset)
With start release	Repetition limit value: Start prevention Note: Changes only become active after a reset (power on / reset)
With safety loop	Repetition limit value: Safety loop Note: Changes only become active after a reset (power on / reset)
Only LMV50: With no flame at the end of safety time	Repetition limited value: No flame at the end of first safety time Setting choices for gas and oil together: 1…3 → none…2 repetitions Note! Changes only become active after a reset (power on / reset) **Caution!** **Setting only in accordance with the relevant application standard.**
With loss of flame	Repetition limit value: Loss of flame Note! Changes only become active after a reset (power on / reset). **Caution!** **Setting only in accordance with the relevant application standard.**

Number of repetitions = setting value - 1.
That is:

- Value = 1: No repetition
- Value = 2: Equals **1** repetition

Caution!
Value 16 represents an unlimited number of repetitions!

4.2.3.3 Signaling of start preventions

If startup is prevented, it is always displayed on the AZL5.
Startup is prevented only when there is a heat request **and** if 1 of the start criteria is not satisfied. The time from the moment start prevention occurs to the display on the AZL5 can be set via parameter *DelayStartPrev*.

It is also possible to signal start preventions via the alarm output. This function can be activated and deactivated via parameter *AlarmStartPrev*.

If *Signaling start preventions* is activated via the alarm relay, it is advisable to pick up power for the reset from the alarm output to prevent inadvertent manual lockouts.
The time from start prevention to signaling at the alarm contact can be set:

Parameter	*DelayStartPrev*
	AlarmStartPrev (activated / deactivated)
	AlarmDelay

4.2.3.4 Safety shutdown in standby mode

This parameter is used to determine the shutdown behavior should errors in standby mode occur, so that events (e.g. opening of safety loop) in standby mode which, in case of a heat request, would lead to start prevention, trigger safety shutdown and – when the respective repetition counter has elapsed – lockout.

Parameter	*Standby Error (activated / deactivated)*

4.2.3.5 Forced intermittent operation

No matter if the LMV5 is used for continuous operation or intermittent operation (e.g. when using a flame detector type QRB), forced intermittent operation can be activated, meaning short automatic shutdown after 23 hours and 50 minutes of uninterrupted operation.
As a general rule, it is recommended to activate forced intermittent operation or to leave it activated.
Forced intermittent operation should only be deactivated in plants where this function is not desired or is unacceptable.

Parameter	*ForcedIntermit (activated / deactivated)*

4.2.3.6 Prepurging

The prepurge position is approached in phase *Traveling to prepurging* (24).
The prepurge time is determined via the following parameters:

Parameter	*PrepurgeTmeGas*
	PrepurgeTmeOil

These 2 parameters determine the minimum prepurge time, provided the following parameters do not become effective.
This means that the prepurge time is allocated to phases 30 through 34:
In phase 30, the time defined in *PrepurgePt1...* is observed, followed by phase 32 or valve proving. Then, the time of *PrepurgeTmeGas* possibly remaining, or *PrepurgeTmeOil* in phase 34, is observed, but always *PrepurgePt3...* as a minimum.

Prepurge time after safety shutdown

These parameters determine the prepurge time after the following events:
• Alterable lockout position
• Off time >24 hours (standby)
• Power failure (Power-on)
• Shutdown due to interruption of gas supply (safety shutdown)

Parameter	*PrepurgeSafeGas*
	PrepurgeSafeOil

If these times are used, they are equally assigned to phases 30 and 34.

Prepurge times 1 and 3

These are minimum times that are always observed in phases 30 (prepurge time 1) and 34 (prepurge time 3)!
These parameters determine the minimum times for prepurging part 1 and part 3.

Parameter	*PrepurgePt1Gas*
	PrepurgePt1Oil
	PrepurgePt3Gas
	PrepurgePt3Oil

Example:
If the sum of prepurge time part 1 and part 3 exceeds *PrepurgeTmeXX* or *PrepurgeSafeXX*, this longer prepurge time applies!

Start without prepurging

When using valve proving and 2 class «A» fuel valves, prepurging will not be required (as per EN 676).
Skipping prepurging can be activated through parameterization.

In spite of an activated parameter, prepurging is performed under the following conditions:
• Alterable lockout position
• Off time >24 h (standby)
• Power failure (Power-on)
• Shutdown due to interruption of gas supply (safety shutdown)
• Direct start

Parameter	*SkipPrepurgeGas (deactivated / activated)*
	SkipPrepurgeOil (deactivated / activated)

Caution!
Deactivating valve proving does not automatically deactivate skipping prepurging. Hence, the person making the settings must ensure that *SkipPrepurgeGas* is activated only if permitted for the relevant type of plant.

4.2.3.7 Program stop function

To simplify burner adjustments during commissioning or in connection with maintenance work, the control sequence of the LMV5 can be stopped at the following points:

	Phase
a) Air damper in the prepurge position	24
b) Traveling to the flue gas recirculation (FGR) position	32
c) Ignition position	36
d) Interval 1	44
e) Interval 2	52
f) Air damper in the postpurge position	72
g) Traveling to the flue gas recirculation (FGR) position	76

Activation takes place via the relevant menu items on the AZL5.

The program stop function is maintained until manual deactivation takes place. If the system stops at a program stop, a message appears on the AZL5.

Parameter	*ProgramStop (deactivated / 24 PrePurgP / 32 PreP FGR / 36 IgnitPos / 44 Interv 1 / 52 Interv 2 / 72 PostPPos / 76 PostPFGR)*

4.2.3.8 Gas shortage program

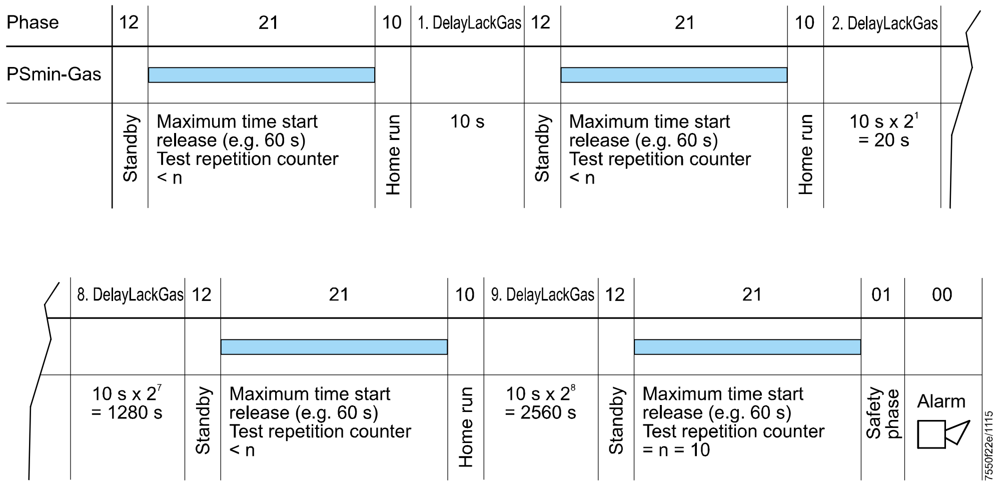
When gas pressure is insufficient (input gas pressure switch-min), the LMV5 ensures that a selectable number of start attempts (*StartRelease-1)* are made while observing a selectable waiting time.
The waiting time between the start attempts is automatically doubled, based on the value parameterized for the first waiting time = basic waiting time *(DelayLackGas*).

If, upon the last of the parameterized start attempts, there is still a shortage of gas, the burner control initiates lockout.

Parameter	*StartRelease*
	DelayLackGas

Sequence diagram

Start conditions must be satisfied.
n = number of start attempts (StartRelease-1). Example: 10
DelayLackGas = delay time gas shortage program.
Example: 10 s



- Repetition counter will be reset after controlled shutdown
- When phase 22 is reached for the first time, delay time will be reset to the selected parameter value *DelayLackGas*

4.2.3.9 Low-fire shutdown

To prevent the boiler from shutting down when operating at high-fire, the fuel-air ratio control system first changes to low-fire when there is no more request for heat from the controller. Only then do the valves close. The maximum time *MaxTmeLowFire* for changing to low-fire operation can be parameterized. If the time is set to 0.2 seconds, low-fire shutdown is deactivated.

Parameter	*MaxTmeLowFire*

4.2.3.10 Normal / direct start

Normal start

With a normal start, the fan is also deactivated when there is a new request for heat in phase 78 or when changing the type of fuel.

Direct start
there is a request for heat in phase 78, a direct change to startup is made via phase 79 to phase 24 without switching the fan off, so that the startup sequence will be accelerated. But this would suppress checking the OFF position of the air pressure switch in standby.

For this reason, the pressure switch relieve valve is controlled in phase 79. This valve ensures that the air pressure switch is relieved of the pressure produced by the fan so that it can signal *Air pressure OFF* although the fan motor is running, thus making possible a function check of the air pressure switch.

For both variants, following applies:
If, during postpurging, there is another request for heat, or if the request for heat is still present like in the case of type-of-fuel change, for example, that part of postpurging is stopped in phase 78 to accelerate the directly following startup sequence.

Parameter	*NormDirectStart (NormalStart / DirectStart)*

4.2.3.11 Continuous fan operation

In the case of burners that could be damaged by return heat (e.g. several burners operating on 1 combustion chamber), continuous purging can be activated. In that case, the fan runs in all phases.
A pressure switch relief valve must be connected on the output (X4-03) so that the air pressure switch can be tested.
This valve is controlled in phase 21 on burner startup, causing the air pressure to fall, allowing the *Air pressure OFF signal* can be delivered.
The function can be activated and deactivated.

The following settings are also available:

off Sloop	The continuous purging function is activated. If the safety loop / burner flange is open, the fan is switched off and the speed for the variable speed drive is set to 0 (if the no-load speed is not parameterized to 0).
deac/VSD-SL	The continuous purging function is deactivated. If the safety loop / burner flange is open, the speed for the variable speed drive is set to 0 (if the no-load speed is not parameterized to 0).

Attention!
The *off Sloop* setting causes that the fan and the variable speed drive to not be controlled if the safety loop / burner flange is open.
→ This must be taken into account with respect to return heat!

Parameter	*ContinuousPurge (deactivated / activated / off Sloop / deac/VSD-SL)*

4.2.3.12 Continuous pilot (only LMV50 / LMV52)

For fuel trains using a pilot (Gp1, Gp2, LOgp, HOgp), control of the pilot valve / ignition burner valve can be activated in phases 52 through 62.

Parameter	*ContinuousPilotGas (deactivated / activated)*
	ContinuousPilotOil (deactivated / activated)

Attention!
The following applies for applications conforming to EN 676:
For systems in which the pilot burner is in operation during the running time of the main burner, separate flame detectors must be provided to supervise the pilot and main flame.
The flame detector for the main flame must be installed in such a way that it does not detect the pilot flame under any circumstances.

4.2.3.13 Reaction of extraneous light in standby

As a response to extraneous light in the standby phase, it is possible to select start prevention or lockout.

Parameter	*ReacExtranLight (Lockout / Startblock)*

4.2.3.14 Startup sequence stop in phase 36

The burner's startup sequence can be stopped in phase 36 via input X5-03 pin 3 if parameter *Config X5-03* has been set to *DeaO2/Stp36*.
The stop takes place if **no** mains voltage is present.

Attention!
This function may only be used for *non-safety-related* multiple burner applications.

Note!
At the same time as this parameter setting, input X5-03 pin 2 is set *to deactivation of O2 trim control* (*DeaO2/Stp36)*.
This function cannot be used if the inputs (X5-03 pin 2 / pin 3) are being used to connect an external load controller
(LC_OptgMode = ExtLC X5-03) → invalid parameter setting.

Parameter	*Config X5-03 (DeaO2/Stp36)*

4.2.3.15 Cooling function in standby mode (only LMV50)

In order to cool the burner in standby mode, a cooling function can be activated using parameters.

The cooling function is started with a mains voltage signal at input X5-03 pin 3:
- The fan is switched on and supervised in the same way as for *continuous purging*
- The actuators used for determining the amount of air are driven to their postpurge positions
- If no mains voltage signal is present, the device behaves as for *without continuous purging* in standby mode

Parameter	*Config X5-03 (CoolFctStby)*

Attention!
This function may only be used for *non-safety-related*
multiple burner applications.
This means, for example, that the function may not be used for safety-related purging in plants with several burners in one combustion chamber.

Note!
- This function cannot be used if the inputs (X5-03 pin 2 / pin 3) are being used to connect an external load controller (LC_OptgMode = ExtLC X5-03) → invalid parameter setting
- When using the cooling function, the *ContinuousPurge* parameter must not be set to *off Sloop* or *deac/VSD-SL* as these settings cancel each other out, potentially resulting in error messages

4.2.3.16 Long postpurge time (only LMV50 / LMV52.4)

If a long postpurge time is required, an additional time can be set in one-minute intervals via an additional, *non* fuel-specific parameter *PostpurgeT3long.*
This time is added to the two fuel-specific times *PostpurgeT3Gas / Oil*.

Parameter	*PostpurgeT3long*

4.2.4 Selection of fuel

Selection of fuel on the AZL5

The type of fuel is selected via the menu on the AZL5.
The selection is only possible when the fuel selector is set to *INT* (or when no selector is connected).
Fuel selection is continuously stored via voltage-OFF, so that a valid fuel selection is present when power returns.

Selection of fuel via BACS (Modbus)

It is only possible to select a fuel via the building automation and control system if the fuel selector on the LMV5 is set to *INT* (or when no selector is connected).

Note!
Fuel selection via BACS should be cyclically repeated.
There is no definition of priorities between fuel selection via BACS and fuel selection via the AZL5, which means that the selection used is the selection made last.

Fuel changeover

After fuel changeover, the burner control maintains or changes to standby (→ Normal start). Now, a new start is made (provided there is a request for heat), firing on the selected type of fuel.
If → Direct start has been parameterized, fuel changeover can also take place upon shutdown in phase 76. The fan is not switched off.

4.2.5 Auxiliary functions

4.2.5.1 Hours run counter

The LMV5 has an hour's run counter for gas-fired and oil-fired operation.
The counters start from safety time 1 (phase 40) and are stopped at the end of operation (when leaving the 6X phases).

The following counters are available and can be displayed using the AZL52 in the *Operation / HoursRun* menu; some of the settings can also be adjusted:

Parameter	*GasFiring*	Operating hours for gas (adjustable)
	OilStage1/Mod	Operating hours for oil stage 1 or modulating (adjustable)
	OilStage2	Operating hours for oil stage 2 (adjustable)
	OilStage3	Operating hours for oil stage 3 (adjustable)
	TotalHoursReset	Total operating hours (resettable)
	TotalHours	Total operating hours (read only)
	SystemOnPower	Operating hours when system is connected to power (read only)

4.2.5.2 Start counter / startup counter

The LMV5 records the number of starts / startups and saves these permanently (via mains voltage OFF).
The relevant start counters count up with each burner startup cycle (phase 20). This also occurs if startup is subsequently aborted.

The following counters are available and can be displayed using the AZL52 in the *Operation / StartCounter* menu; some of the settings can also be adjusted:

Parameter	*GasStartCount*	Number of startups for gas, start counter (adjustable)
	OilStartCount	Number of startups for oil, start counter (adjustable)
	TotalStartCountR	Total no. of startups, start counter (resettable)
	TotalStartCount	Total no. of startups, start counter (read only)

4.2.5.3 End of life cycle function

The end of the life cycle of the LMV5 (switching cycles of the relays) is detected and displayed on the AZL52.
The end of the life cycle is reached when the total startup counter *TotalStartCount* has reached 250,000 starts.

This leads to the following message on the AZL52:
Startups > 250,000 maintenance

This means that the LMV5 has to be replaced, refer to chapter *Life cycle*.

This message can be hidden manually by pressing ESC.
If the message has been hidden, it will automatically appear again after an additional 10,000 starts.
Error and start prevention messages have priority over the end of lifecycle message.

4.2.5.4 Fuel meter

Refer to chapter *VSD module*.

5 Sequence diagrams

Gas direct ignition (G)

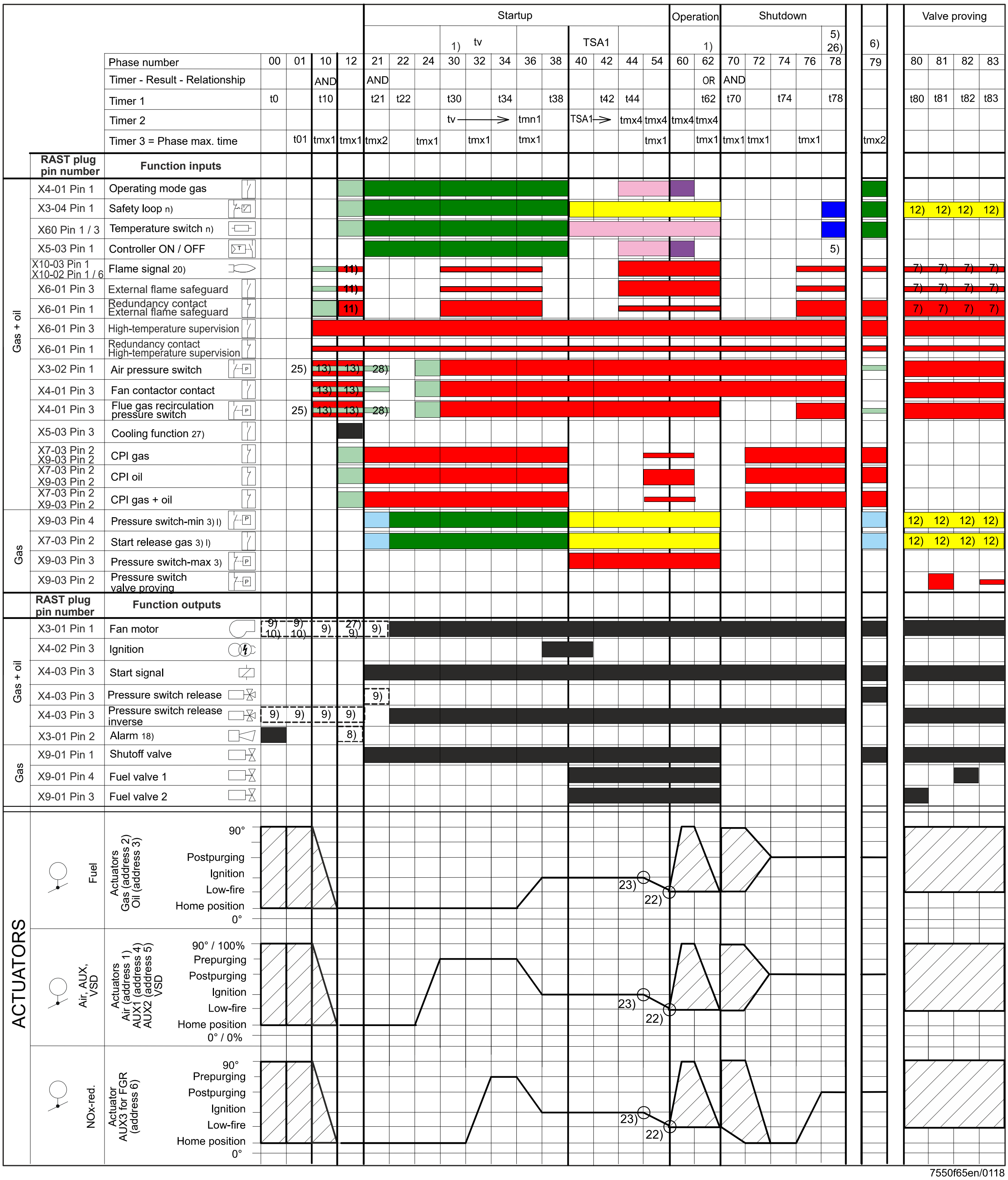


Figure 31: Fuel train application – program gas direct ignition (G)

Gas pilot ignition 1 (Gp1)

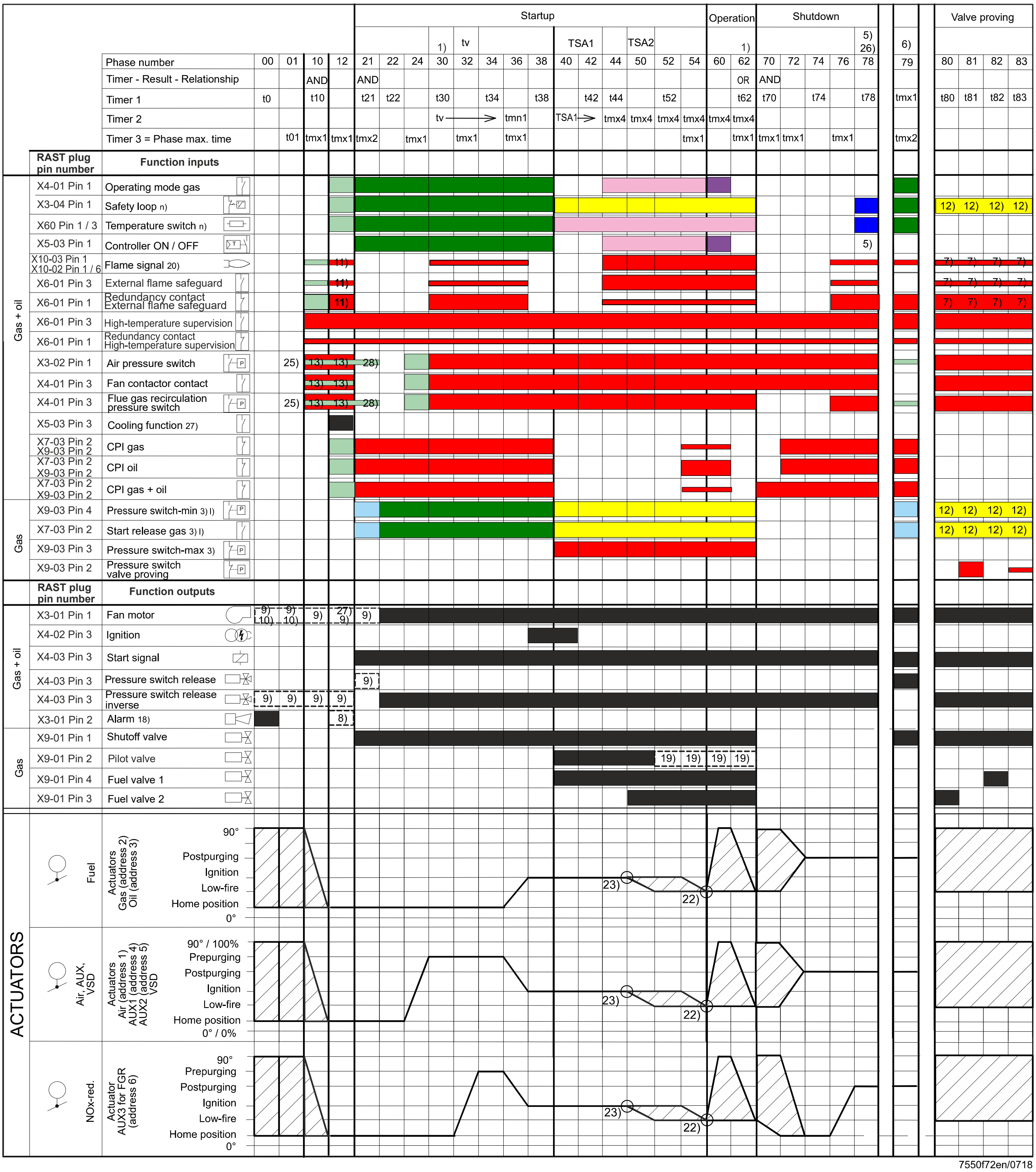


Figure 32: Fuel train application – program gas direct ignition (Gp1)

Gas pilot ignition 2 (Gp2)

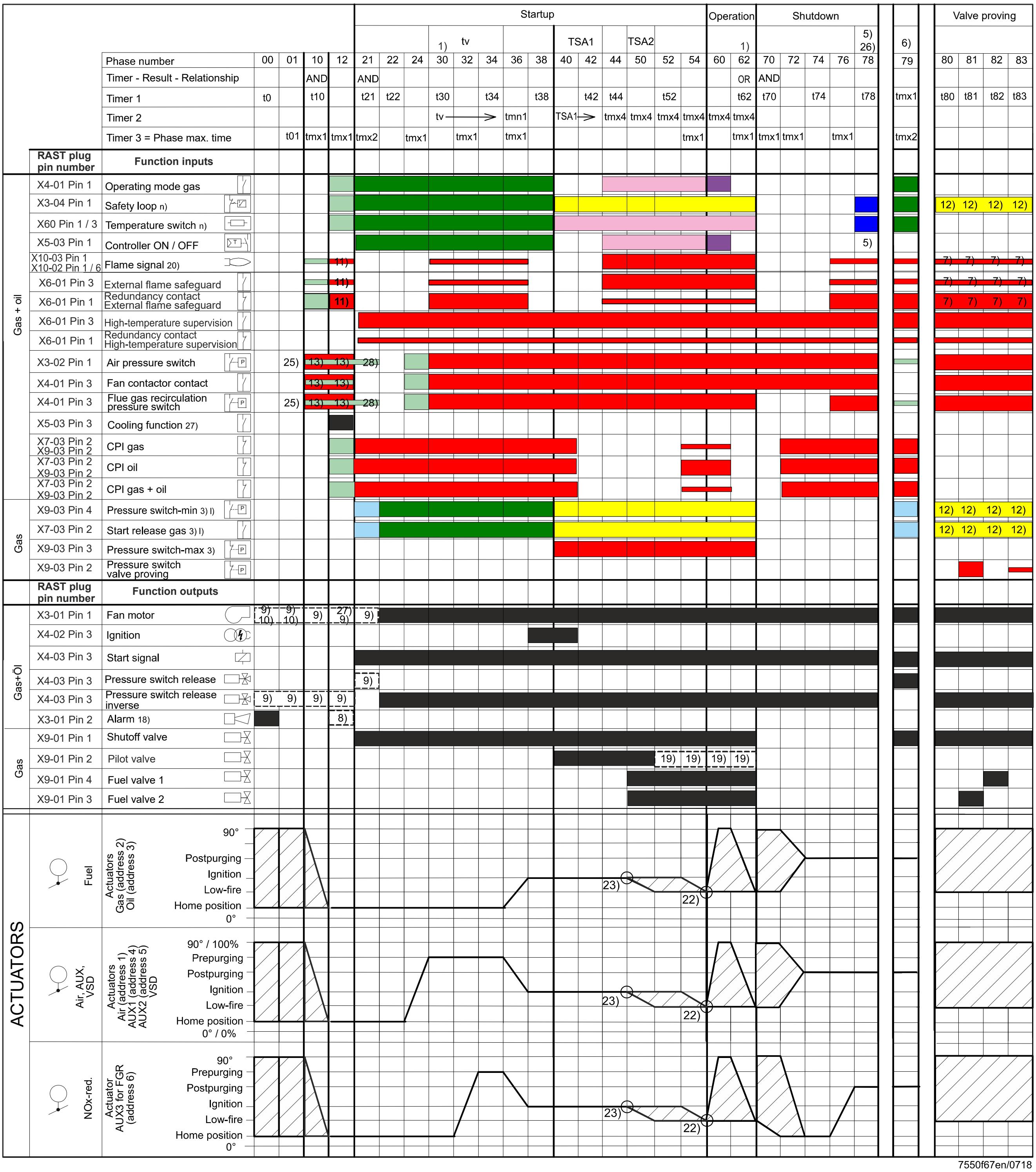


Figure 33: Fuel train application – program gas pilot ignition (Gp2)

Light oil direct ignition (LO)

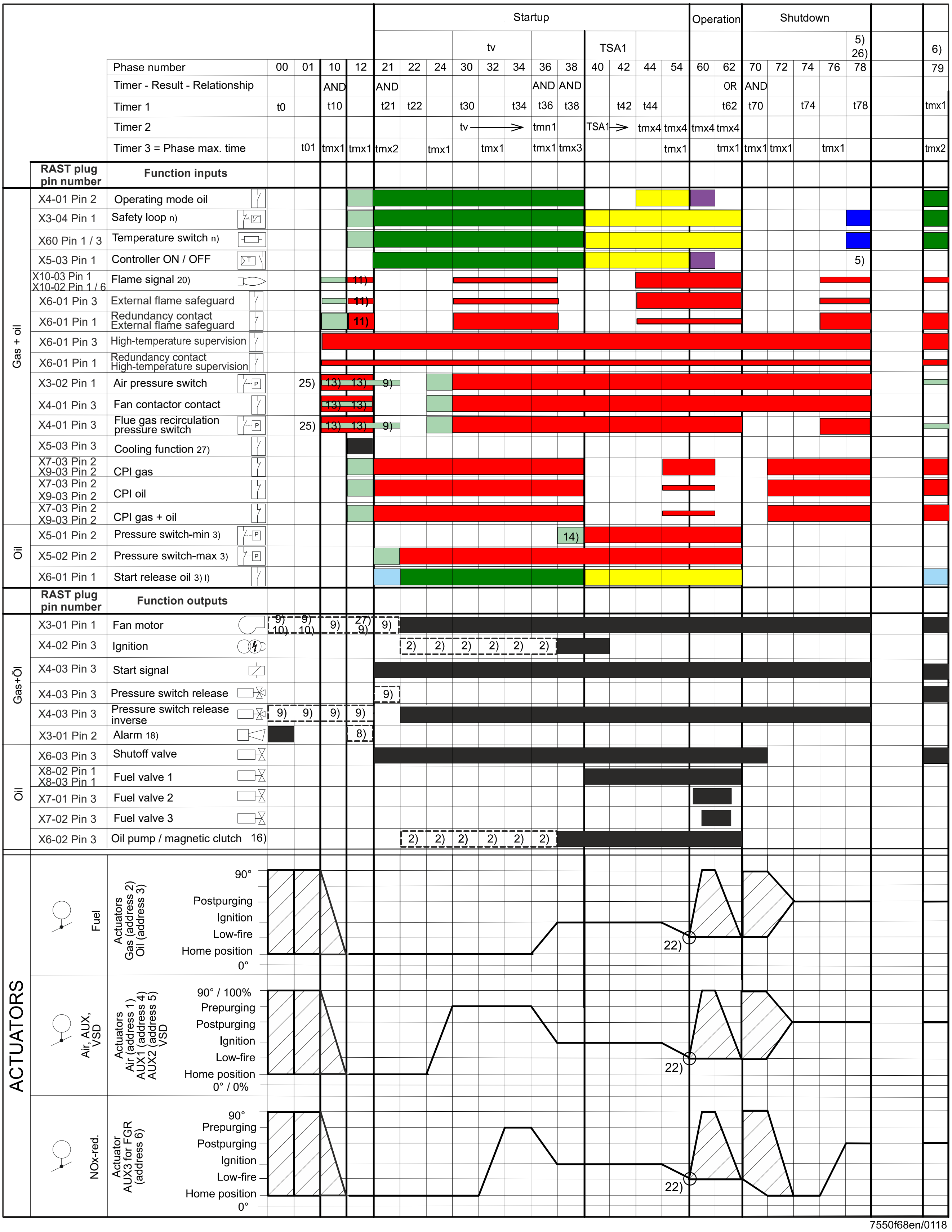


Figure 34: Fuel train application – program light oil direct ignition (LO)

Heavy oil direct ignition (HO)

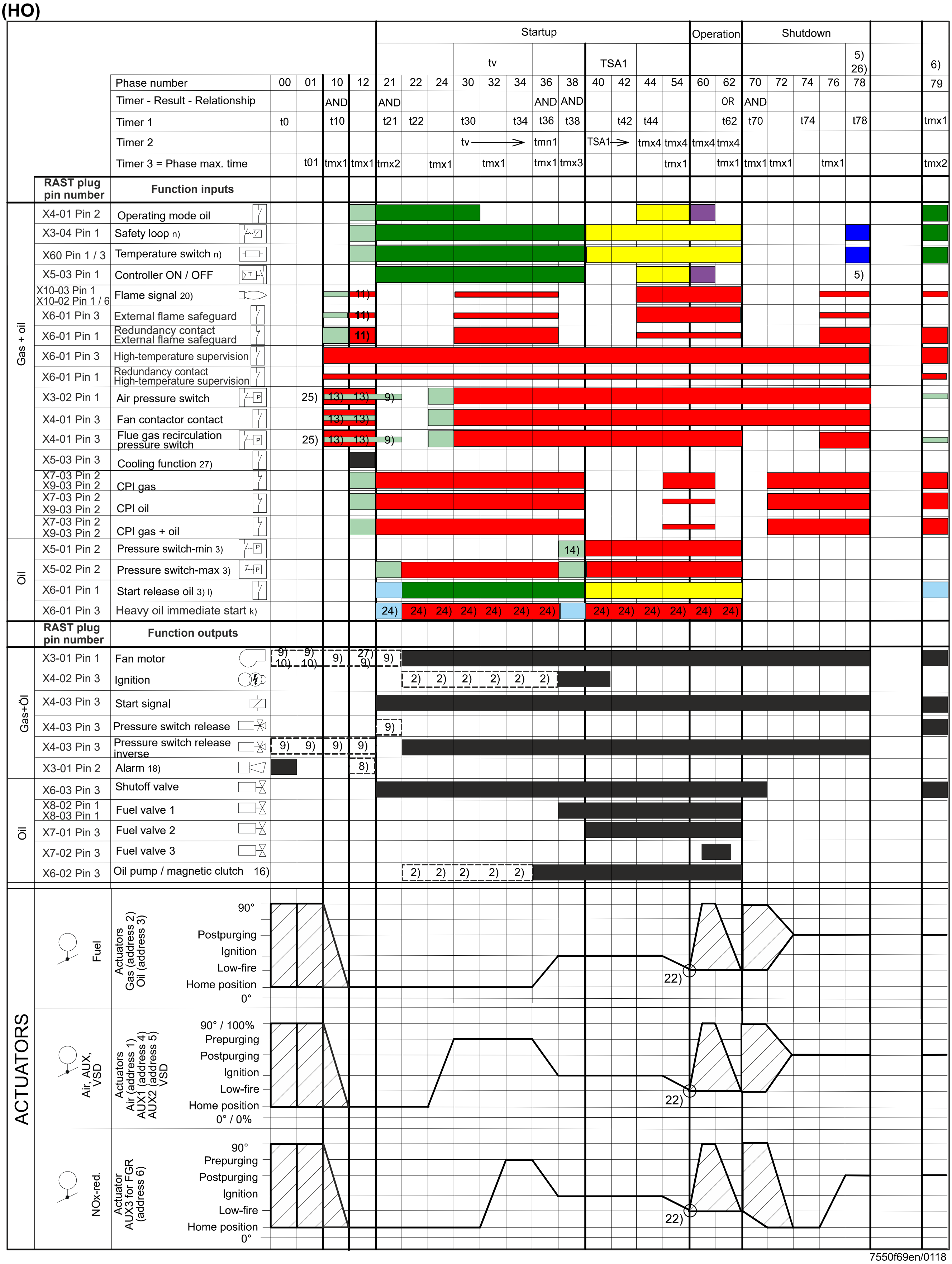


Figure 35: Fuel train application – program heavy oil direct ignition (HO)

Light oil with gas pilot ignition (LOgp)

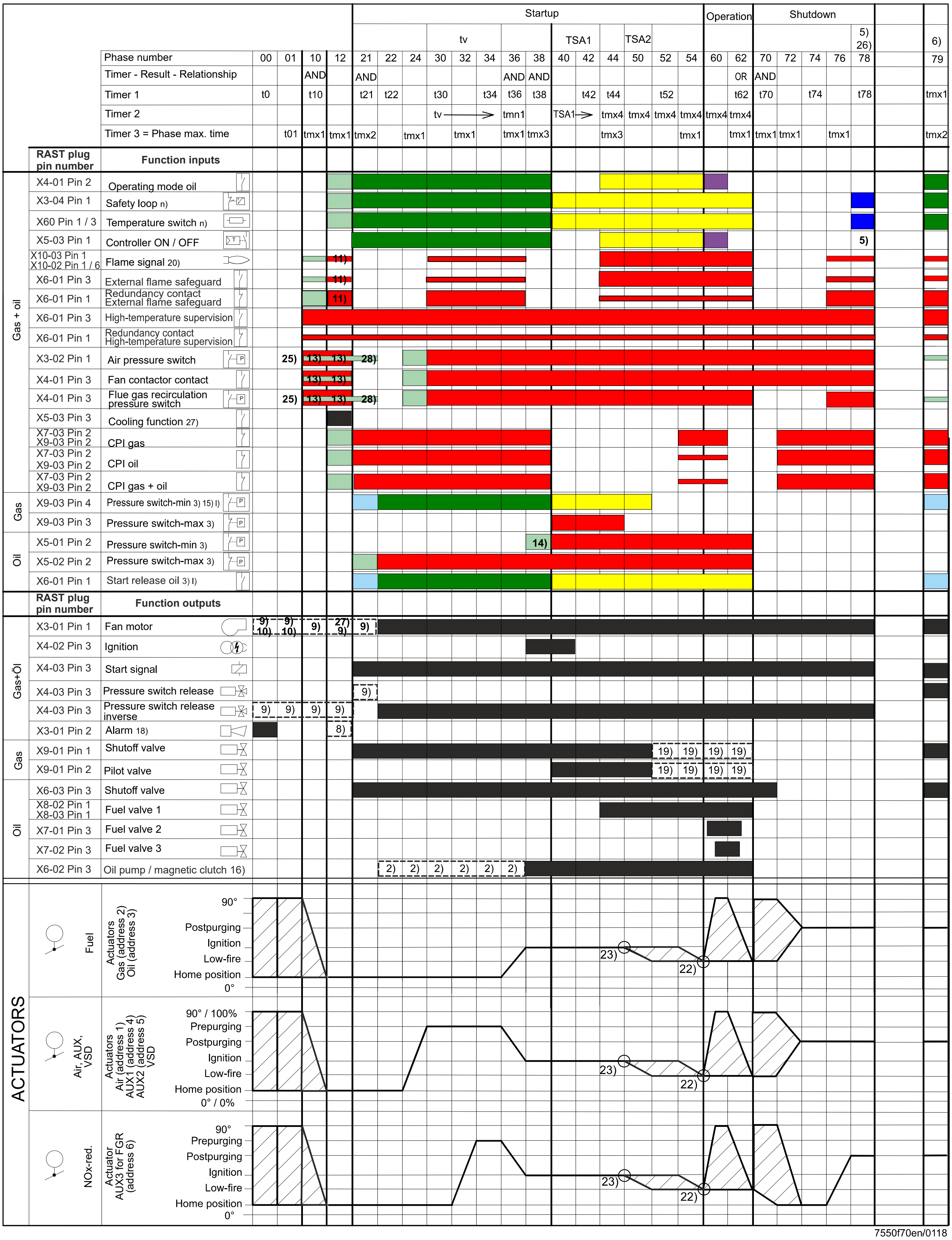


Figure 36: Fuel train application – program light oil gas pilot ignition (LOgp)

Heavy oil with gas pilot ignition (HOgp)

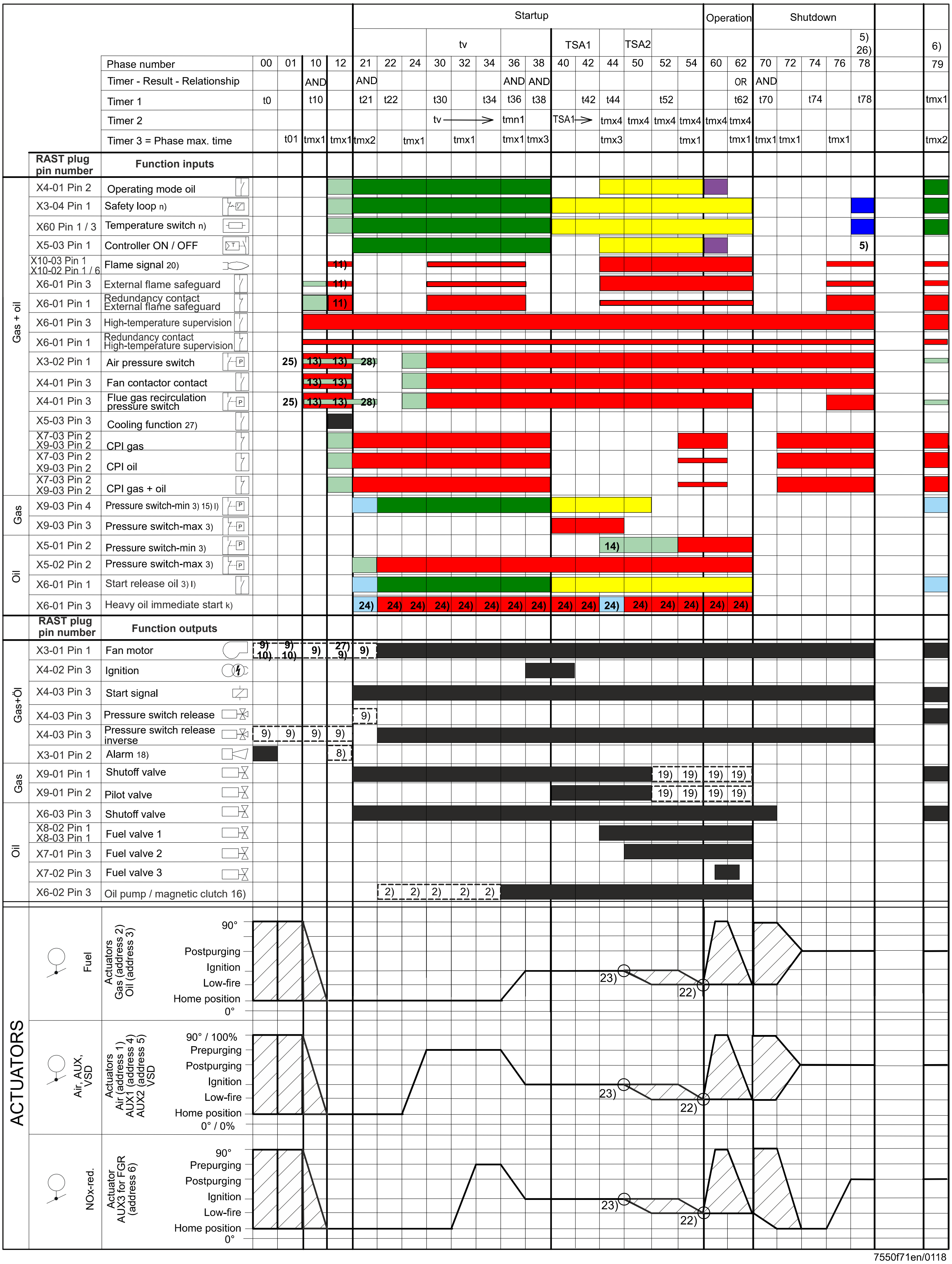


Figure 37: Fuel train application – program heavy oil gas pilot ignition (HOgp)

Legend to the sequence diagrams

Phases

00	Lockout phase
01	Safety phase
10	Homerun
12	Standby (stationary)
21	Shutoff valve ON (start release)
22	Fan motor ON
24	Prepurge position
30	Prepurge time (tv1)
32	Prepurge time (tv)
34	Prepurge time (tv2) (flue gas recirculation FGR)
36	Ignition position
38	Preignition (Z) ON
40	Burner valve ON
42	Ignition OFF
44	Interval 1 (ti1)
50	2^{nd} safety time
52	Interval 2 (ti2)
54	Low-fire position
60	Operation 1 (stationary)
62	Operation 2 Low-fire position
70	Postburne time
72	Postpurge position
74	Postpurge time (tn1)
76	Flue gas recirculation postpurge position
78	Postpurge time (tn3)
79	Direct start
80	Valve proving evacuating time
81	Valve proving time atmospheric pressure
82	Valve proving filling time
83	Valve proving time gas pressure

Legend to the sequence diagrams (cont'd)

Assignment of times:

t0	Postpurge lockout position
t01	Max. time safety phase
t10	Min. time home run
t21	Min. time start release
t22	Fan runup time
t30	Prepurge time part 1
t34	Prepurge time part 3
t36	Min. ON time oil pump
t38	Preignition time gas/oil
t42	Preignition time OFF
t44	Interval 1 gas/oil
t62	Max. time low-fire
t70	Afterburn time
t74	Postpurge time 1 gas/oil (tn1)
t78	Postpurge time 3 gas/oil (tn3)
t80	Valve proving evacuate time
t81	Valve proving time atmospheric pressure
t82	Valve proving filling time
t83	Valve proving time gas pressure
tmn1	Min. time extraneous light test (5 s) after skipping prepurge
tmx1	Max. damper running time
tmx2	Max. time startup release
tmx3	Max. time circulation heavy oil
tn	Postpurge time
TSA1	First safety time gas / oil
TSA2	Second safety time gas / oil
tv	Prepurge time gas / oil
tmx4	Time until reaction to flame OFF (parameter *ReacTmeLossFlame*)

Legend to the sequence diagrams (cont'd)

Signal ON	Signal OFF	Next phase
		01 → 00, repetition = 0 01 → 12, repetition > 0
		Parameter *NormalDirectstart* Checking with controller ON Deviation → 10 No repetition decrement
		10
		70
		Without valve proving → 70 With valve proving → 80
		62
		Stop, upto phase maximum time → 01
0...3 s		Stop, upto phase maximum time → 10

	Output OFF / input Don't care
	Output ON / input ON

	Permissible positioning range
	In Standby: actuator can travel within the permissible positioning range but is always driven to the home position. Must be in the home position before changing the phase

0°	Position as supplied (0°)
90°	Actuator fully open (90°)

Legend to the sequence diagrams (cont'd)

Indices:

1)	Parameter:	*ValveProvingType* → Valve proving takes place between phases 30 / 32 and/or phases 60 / 70
2)	Parameter:	Short / long preignition time for oil only
		Short / long oil pump – ON – time
3)		Delayed shutdown within safety time
5)	Parameter:	Normal / direct startup Normal startup → sequential phase = 10 Direct startup → sequential phase = 79 (when R = ON)
6)		Sequential phase = 24
7)		Only with valve proving during startup
8)	Parameter:	With / without alarm on prevention of startup
9)	Parameter:	With continuous purging the shown output signals are inverted
10)		Fan controlled as before Postpurging in lockout position = *PostpurgeLockout*
11)	Parameter:	With / without extraneous light test in STANDBY
12)		With valve proving during startup phase 10
13)	Parameter:	Normal / continuous purging Normal purging: Checking for off in 10 and 12, stop to phase-max time → 01 Continuous purging: Checking for on in 10 and 12, stop up to phase-max time → 01
14)	Parameter:	*OilPressureMin*, *act from ts* → no check before fist safety time (LO, HO) or second safety time (LOgp, HOgp)
15)	Parameter:	*GasPressureMin*, *deact xOGP* → pressure switch-min (Pmin) can be deactivated for oil programs with gas pilot
16)	Parameter:	*OilPumpCoupling:* *direct_coupl* → shutoff valve - oil to be connected to output *Oil pump / magnetic clutch*. Output is active when fan is on and for another 15 s after fan is switched off
18)	Parameter:	*Alarm act / deact*, *deactivated*→ alarm output can temporarily be deactivated (for current error only)
19)	Parameter:	Only LMV50 and LMV52: Continuous pilot gas/oil: Activated → pilot valve is also activated in operation
20)	Parameter:	Only LMV50 and LMV52: Extraneous light, pilot phase, operating phase gas/oil → Separate flame supervision possible
22)	Parameter:	Depending on parameter *StartPoint Op*
23)	Parameter:	Depending on parameter *DriveLowfire Gas* or *DriveLowfire Oil*
24)	Parameter:	Depending on parameter *HeavyOilDirStart*
25)	Parameter:	Air pressure test = deactivated in standby → don't care in phase 10 and 12
26)	Parameter:	Long postpurge time tn3 (*PostpurgeT3long*)
27)	Parameter:	Only LMV50 → cooling function in standby
28)	Parameter:	Continuous purging

Repetition counter:

k)	Heavy oil direct start
l)	Restricted startup behavior
n)	Restricted safety loop

6 Fuel-air ratio control (FARC)

6.1 Actuator addresses

The functions of the dampers are ready assigned to the addresses and are defined as follows:

Addresses	LMV51.0 / LMV51.1	Parameter
1	Air damper	*AirActuator*
2	Fuel 1 (gas)	*GasActuator*
3	Fuel 2 (oil)	*OilActuator*
4	Auxiliary actuator 1 (e.g. mixing equipment)	*AuxActuator*

☞ Note!
Up to 4 actuators can be connected to the LMV51.0 / LMV51.1.
Of these, up to 3 actuators can be controlled simultaneously.
The fuel actuators cannot be controlled simultaneously.

Addresses	LMV50 / LMV51.3	Parameter
1	Air damper	*AirActuator*
2	Fuel 1 (gas)	*GasActuator*
3	Fuel 2 (oil)	*OilActuator*
4	Auxiliary actuator 1 (mixing equipment) [1])	*AuxActuator*
6	Auxiliary actuator 3 (flue gas recirculation) [1])	*AuxActuator*
	VSD [1])	*AuxActuator*

[1]) Possible combinations: Auxiliary actuator 1 or VSD or auxiliary actuator 3 or VSD + auxiliary actuator 3

☞ Note!
Up to 4 actuators and 1 variable speed drive can be connected to the LMV50 / LMV51.3. Of these, up to 3 actuators can be controlled simultaneously.
The fuel actuators cannot be controlled simultaneously.

Addresses	LMV52	Parameter
1	Air damper [2])	*AirActuator*
2	Fuel 1 (gas)	*GasActuator*
3	Fuel 2 (oil)	*OilActuator*
4	Auxiliary actuator 1 (e.g. mixing equipment) [2])	*AuxActuator1*
5	Auxiliary actuator 2 [2])	*AuxActuator2*
6	Auxiliary actuator 3 (flue gas recirculation) [2])	*AuxActuator3*
	VSD [2])	*VSD*

[2]) Air-regulating actuators (can be parameterized)

☞ Note!
Up to 6 actuators and 1 variable speed drive can be connected to the LMV52. Of these, up to 5 actuators can be controlled simultaneously.
The fuel actuators cannot be controlled simultaneously.

Actuators 1...6 are controlled with a resolution of 0.1°. They can be adjusted between 0° and 90°. The VSD is controlled with a resolution of 0.1%. It can be adjusted between 0% (off, prepurge / postpurge fan speed) or 10% (ignition and operating speeds) and 100%.

6.2 Activating / deactivating the actuators

If the auxiliary actuator is not needed, it must be deactivated.
This can be carried out separately for both fuels.

For LMV50 and LMV51.3, the variable speed drive / auxiliary actuator 3 (for flue gas recirculation) can be activated.

The required actuators must be activated.
If O2 trim control or a variable speed drive is used, the actuators that have an impact on the air volume must be parameterized to *air influen*.

Parameter:	**LMV51.0 LMV51.1**	**LMV50 LMV51.3**	**LMV52**
AuxActuator (deactivated / Damper act)	●		
AuxActuator (deactivated / Damper act / activated VSD / AUX3 / VSD + AUX3)		●	
AirActuator (deactivated / activated)	●		
AirActuator (deactivated / activated / air influen)		●	●
GasActuator or *OilActuator (deactivated / activated)*	●	●	●
AuxActuator 1 (deactivated / activated / air influen)			●
AuxActuator 2 (deactivated / activated / air influen)			●
AuxActuator 3 (deactivated / activated / air influen)			●
VSD (deactivated / activated / air influen)			●

Meaning:

deactivated	Deactivated
Damper act	AUX actuator 1 - damper (mixing device) active
activated VSD	VSD activated
AUX3	AUX actuator 3 - damper (flue gas recirculation damper) active
VSD + AUX3	VSD and AUX actuator 3 - (flue gas recirculation -) damper active
air influen	Damper / VSD activated that have an impact on the combustion air. These are also driven to the prepurge positions during standardization, refer to chapter *Configuring speed acquisition*.

Number of fuel actuators

- The LMV5 system uses one burner actuator for gas and one for oil as standard *(NumFuelActuators = 2)*
- It is possible to use one common actuator for the fuel damper and the oil pressure controller *(NumFuelActuators = 1)*.
  It is then still possible to parameterize independent curves for both types of fuel.

Parameter	*NumFuelActuators (1 / 2)*

☞ Note!
If the *NumFuelActuators* parameter was set to «1»,
the common fuel actuator must be addressed as a *GasActuator*.

6.3 Direction of rotation of the actuators

The actuators' direction of rotation can be set in the ***Params & Display → Actuators → DirectionRot*** menu. This enables the direction of rotation to be matched to the mounting method.
The direction of rotation must be selected before defining the ignition position and curvepoints. If this is not observed, these points must be deleted before the direction of rotation is reversed. For that purpose, the *DeleteCurves* function is offered in the menu for selecting the direction of rotation.

Select the direction of rotation as *standard* or *reversed.*
The standard direction of rotation is anticlockwise when facing the end of the drive shaft.

Parameter:	**LMV51**	**LMV50 LMV51.3**	**LMV52**
1 AirActuator (standard / reversed)	●	●	●
2 *GasActuator (standard / reversed)* (and *OilActuator,* if *NumFuelActuators = 1)*	●	●	●
3 *OilActuator (standard / reversed)*	●	●	●
4 *AuxActuator (standard / reversed)*	●	●	●
5 AuxActuator2 (standard / reversed)			●
6 AuxActuator3 (standard / reversed)		●	●

6.4 Control sequence

The program phases are controlled by the burner control. They advance in tune with the fuel-air ratio control system.

6.4.1 Idle position

In standby, the actuators are driven to their home positions. A deviation from the required position does not lead to lockout, but only to start prevention. The home position is defined for all actuators and can be adjusted differently for oil and gas.

Parameter:	**LMV51**	**LMV50** **LMV51.3**	**LMV52**	
HomePosAir	●	●	●	
HomePosGas	●	●	●	
HomePosOil	●	●	●	
HomePosAux	●	●	●	
HomePosAux2			●	
HomePosAux3		●	●	
HomePosVSD		●	●	

6.4.2 Prepurge positions

In phase 24, the actuators used for the control of air (air actuator and auxiliary actuator) are driven to their prepurge positions. If the actuator does not reach the required position within the maximum time, safety shutdown is initiated → position check. The prepurge time starts only when the actuators have reached their prepurge positions. The prepurge position is only defined for the actuators used for the control of air and can be parameterized depending on the type of fuel. The fuel actuators maintain their home positions.

Parameter:	**LMV51**	**LMV50** **LMV51.3**	**LMV52**	
PrepurgePosAir	●	●	●	
PrepurgePosAux1	●	●	●	
PrepurgePosAux2			●	
PrepurgePosAux3		●	●	
PrepurgePosVSD		●	●	

6.4.3 Ignition positions

In phase 36, all actuators are driven to their ignition positions. For that purpose – like in prepurging – a maximum time is available within which the ignition position must be reached → position check.
Ignition takes place only when the required position is reached. The ignition position can be adjusted for all actuators, depending on the type of fuel.

Parameter:	**LMV51**	**LMV50** **LMV51.3**	**LMV52**	
IgnitionPosAir	●	●	●	
IgnitionPosGas	●	●	●	
IgnitionPosOil	●	●	●	
IgnitionPosAux1	●	●	●	
IgnitionPosAux2			●	
IgnitionPosAux3		●	●	
IgnitionPosVSD		●	●	

6.4.4 Startpoint operation

When ignition has taken place and the flame has stabilized, the actuators must be brought to their ratio control positions. To do this, the LMV5 approaches the positions of the curvepoint, which was set using the *StartPoint Op* parameter.
This enables a burner with a high modulation range during operation, which would not burn when started cold from the lowest modulation output, to be started with a higher initial output (determined by the *StartPoint Op)* parameter.

Parameter	*StartPoint Op*

If the *MinLoadGas* / *MinLoadOil* parameter was set to a value above the *StartPoint Op,* as soon as the *StartPoint Op* has been reached, the actuators move on further to the *MinLoadGas* / *MinLoadOil* positions.

6.4.5 Approaching low fire in phase 50 / 54

For fuel trains with pilot ignition (Gp1, Gp2, LOgp, HOgp), the following parameter can be used to specify whether the actuators approach their ratio control positions in phase 54 or beforehand in phase 50.

Parameter	*DriveLowfire Gas (LowfireP50 / LowfireP54)*
	DriveLowfire Oil (LowfireP50 / LowfireP54)

The actuators which, for ignition, have assumed a special position, travel at individually calculated speeds to ensure that all will reach their low-fire positions at the same time.

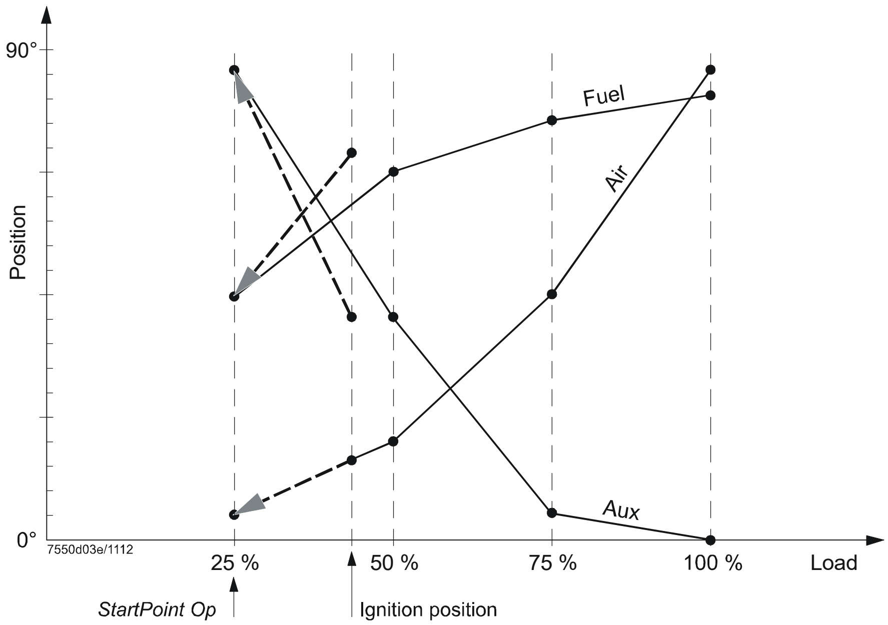


Figure 38: Traveling to the low-fire position after ignition

> Note!
> The system also allows ignition positions outside the defined range of fuel-air ratio control, that is, not between nominal load and low-fire.

Operation

In the operating position, the dampers are adjusted according to demand. The ratio control curves are defined for gas and oil.
For modulating operation, the output can be adjusted in increments of 0.1°.
The actuators are driven to the defined ratio control curves.
In multistage operation, 2 or 3 load points can be approached.
For more detailed information, refer to chapter *Operating position.*

End of operating position

After there is no more request for heat from the controller, the fuel-air ratio control system first changes to low-fire (phase 62) before the fuel valves close. For that purpose, a maximum time is available which can be parameterized → low-fire shutdown.

6.4.6 Postpurge positions

When the burner is shut down, the actuators are driven to their postpurge positions in phase 72.
For that purpose, a maximum time is available → position check.
The postpurge position is defined for all actuators and can be adjusted depending on the type of fuel.

Parameter:	**LMV51**	**LMV50** **LMV51.3**	**LMV52**
PostpurgePosAir	●	●	●
PostpurgePosGas	●	●	●
PostpurgePosOil	●	●	●
PostpurgePosAux1	●	●	●
PostpurgePosAux2			●
PostpurgePosAux3		●	●
PostpurgePosVSD		●	●

6.4.7 Actuator speed outside normal operation = TmNoFlame

The actuators‘ speed when traveling to the home, prepurge, ignition and postpurge positions can be parameterized.
Outside normal operation, all actuators travel at that speed.

☞ Note!
When parameterizing the operating ramp, the speed of the **slowest** actuator must be taken into consideration!

Parameter	*TmeNoFlame*

6.4.8 Actuator speed in normal operation = OperatRampMod

Modulating

Modulating operation is possible for both types of fuel, gas and oil.

In the operating position, the dampers are driven to the defined ratio control curves in accordance with the required output. Up to 15 curvepoints can be defined. The spacing of the points (difference in output) can be freely selected.
The positions of the curvepoints are calculated by making linear interpolations.
To ensure correct fuel-air ratio control at any time, the actuators travel in steps of maximum 1.2 seconds. This traveling time corresponds to a positioning angle of 3.6° at an operating ramp of 30 seconds / 90 °.
For each of these steps, an individual speed is calculated for each actuator, so that all actuators reach the required positions at the same time.
The position check is always made between the individual steps when the actuators do not move.
The speed of the fastest actuator can be parameterized.
If there is a curvepoint on the way to the next target on the curve, it will always be approached.

☞ Note!
When parameterizing the operating ramp, the speed of the **slowest** actuator must be taken into consideration!

Parameter	*OperatRampMod*

6.4.9 Multistage operation

Multistage

Multistage operation is only possible when firing on oil. It is possible to parameterize if multistage or modulating operation is used.
Electronic fuel-air ratio control can be configured for both 2-stage and 3-stage burners. In this operating mode, the oil actuator is not controlled.

Multistage fuel-air ratio control is defined via different load points. These are the stationary operating points and separately adjustable switch-on/off points.

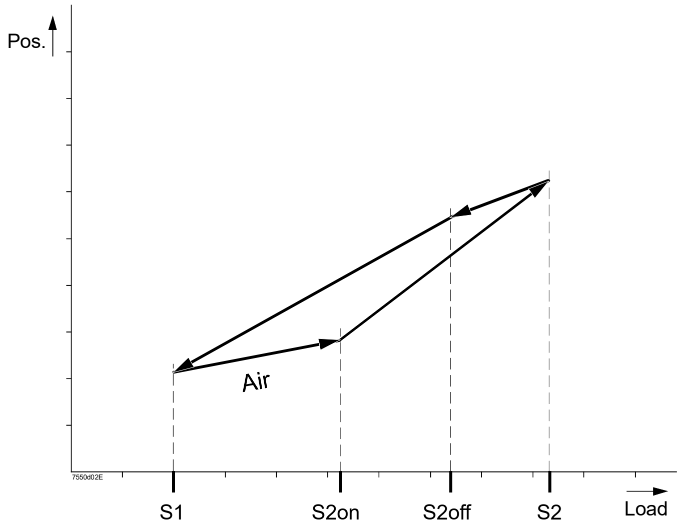


Figure 39: Multistage operation (here: 2-stage)

Between these points, the actuators are adjusted during their continuous travel. The speeds of the individual actuators are calculated such that they reach their targets at the same time.

☞ Note!
When parameterizing the multistage operating ramp, the speed of the **slowest** actuator must be taken into consideration!
When changing from stage 1 to stage 2, *switch-on point S2* is approached first, starting from *operating point S1*. Now, the second fuel valve is opened.
Then, the system is driven to *operating point S2*.
If the output shall be cut back to stage 1, *switch-off point S2* is approached first.
If *switch-off point S2* has not yet been set, *switch-on point S2* is approached and the fuel valve closed.
Then, the fuel-air ratio position of *operating point S1* is approached again.
The procedure is analogous when switching from stage 2 to stage 3, and back again.

Parameter	*Operation Mode (2-stage / 3-stage / modulating)*
	Curve Settings (curve position stage: Stage 1...3 and on and off switching points)
	Betr_Rampe_Stuf

6.5 Position check, dynamic safety time

Definition of *Safety time fuel-air ratio control*:

- *Safety time fuel-air ratio control* is the period of time during which deviations from the required position of 1 or several actuating devices are tolerated before the valves are shut down
- In contrast to the burner control's safety time, this safety time need not be fixed since the risk potential of a fuel-air ratio control system increases in proportion to its deviation from the required state

All safety-related supervision functions of the fuel-air ratio control system, especially checking of the actuator positions with regard to the required positions, are based on *Safety time fuel-air ratio control*.
The *Safety time fuel-air ratio control* of 3 seconds takes the worst case into consideration. This describes the situation where the deviations from the actuators' required positions are such that loss of flame does just not yet occur, that is, the combustion process is as poor as it can possibly be.
In such a case, it is assumed that the amount of unburnt or partly burnt gases produced within 3 seconds is not sufficient to cause deflagrations or explosions within the *Safety time fuel-air ratio control* or just after it (that is, after the valves are shut down).
As mentioned above, it should also be considered that the smaller the deviation from the required state, the smaller the proportion of unburnt gases. This means that the closer the required positions, the smaller the risk of dangerous conditions.
For this reason and for reasons of availability, the LMV5 uses a *Dynamic safety time fuel-air ratio control*.

This safety time is implemented as follows:

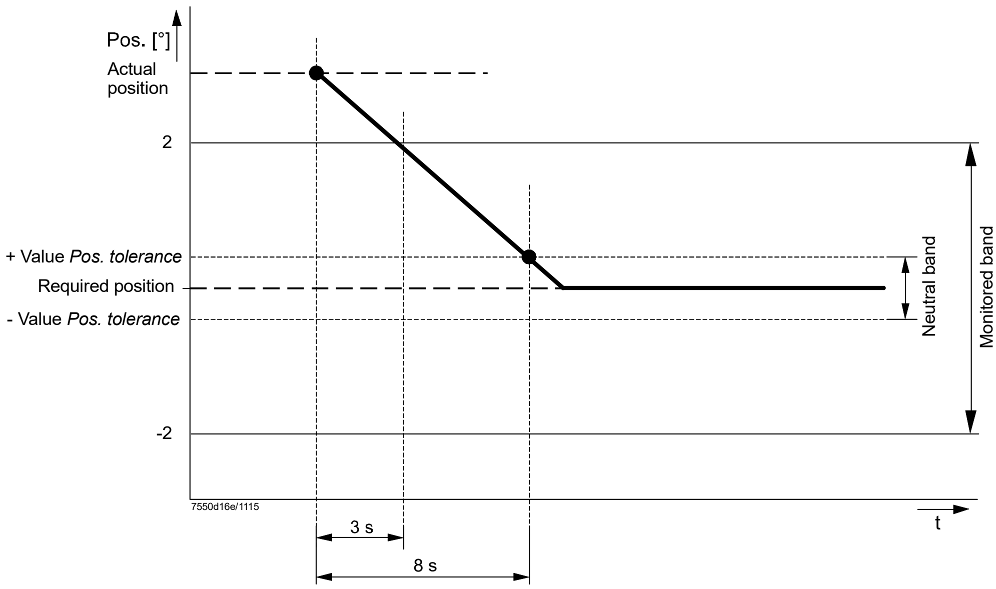


Figure 40: Successful change of position

In case of a change of position, the actuator must leave its current position to reach the required position within 2° in no more than 3 seconds.
Otherwise, safety shutdown is triggered.
Also, the neutral band must be reached within 8 seconds after starting the change in position.

If, due to external effects, an actuator moves from its required position by more than ± value *Pos. tolerance* (neutral band) for more than 8 seconds, the supply of fuel will be shut down.

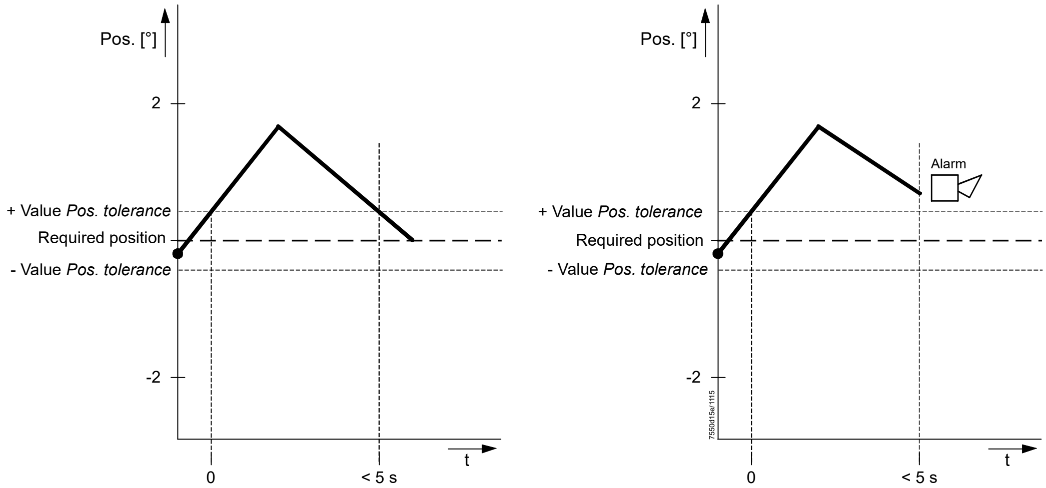


Figure 41: Successful correction <2°

Fault < 2° (Stall point at constant output)

The required position is considered to be reached when it is within ± value *Tolerancia pos.* (neutral band).
When reaching a new position within ± value *Tolerancia pos.* (neutral band), the electronic ratio control makes a fine adjustment on the actuators.
Corrections are only made to the position if the current position deviates from the required position by more than the value *Tolerancia pos.* (neutral band). These corrections are then followed by another fine adjustment.
If, during the load change, an actuator is mechanically blocked, the supply of fuel is shut down within 3 or 8 seconds.

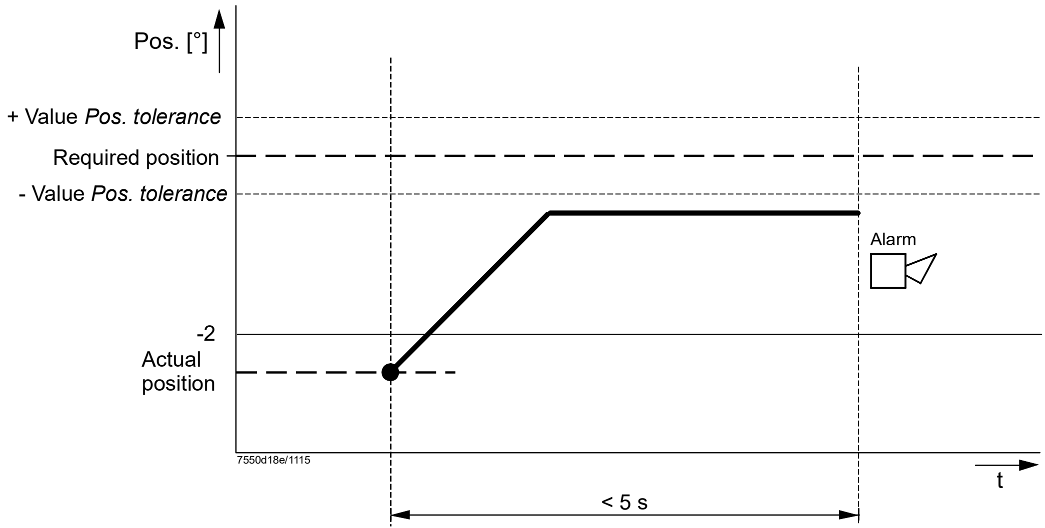


Figure 42: Locking on change of load (approaching <2° / > value position tolerance)

Parameter	*Pos. tolerance*

It may be necessary to adjust the parameter *Pos. tolerance* in the event of changing loads (e.g. fluttering damper).

This parameter can be used to set the tolerated deviation between the actual position and the target position / target speed specified by the electronic fuel / air ratio control system.
This means that the previous neutral zone of 0.3° (factory setting) can be increased to 1.2°.
The tolerated deviation of the variable speed drive speed is only increased along with it from 0.6%. This means that the smallest tolerance value is 0.5% and can be increased to 1.2% (see following table).

	Tolerance
	Actuator / variable speed drive
Display on the AZL52	0.3°/0.5%
	0.4°/0.5%
	0.5°/0.5%
	0.6°/0.6%
	• • •
	1.2°/1.2%

Figure 43: Display on AZL52

Note!
The parameter influences the tolerance of the position assessment for **all** actuators (actuators and variable speed drive) at the same time.

Attention!
This parameter may only be set in a way that does not affect the combustion.
It may be necessary to set a higher residual oxygen content on the system or to install an O2 supervision if this value is increased above the value set in the delivery state.

Outside the operating position

In the phases where the actuators are driven to 1 of the special positions (*home*, *prepurge*, *ignition* or *postpurge* position), there is no continuous position check. To make possible the change to the next phase, the required position must be reached. To travel to the required position, the maximum time available is 35 seconds or 20% longer than the time parameterized for *TmeNoFlame*. If the required position is not reached within this maximum period of time, safety shutdown is initiated → actuator overload protection. In phases during which the damper does not move, the position is continuously checked. If there are deviations from the required position, adjustment attempts are made for which the → *dynamic safety time of fuel-air ratio control* is used.

Operating position modulating

The position checkback signal delivered by the actuators is evaluated only when the actuators do not travel, thus making possible precise position measurements.
To ensure that the actuators are not out of control of the LMV5 for longer periods of time, longer movements are subdivided into traveling steps of 1.2 seconds. After each step, the required position must be reached.
The target position is considered to be reached when the actuator has traveled to a band width of ± *Pos. tolerance* value (neutral band).
If the actual position does not agree with the required position, readjustments are made, whereby the → *dynamic safety time of fuel-air ratio control* is applied.

Operating position multistage

In multistage operation, the actuators are monitored at stationary points. The actuators must reach these points within the calculated period of time, whereby the → *dynamic safety time of fuel-air ratio control* is applied.
Additional position checks are made during the actuators‘ travel to find out if the actuators do not move, or if they travel in the wrong direction.

6.6 Special features

6.6.1 Program stop

To facilitate burner startup, startup and shutdown can be stopped in several phases.
If a program stop is active, the special positions (prepurge, ignition and postpurge position) can be set in the respective phase.
If a program stop has been activated, it remains active until manual deactivation takes place (even after Power-off).

Parameter	*ProgramStop (deactivated / 24 PrePurgP / 32 PreP FGR / 36 IgnitPos / 44 Interv 1 / 52 Interv 2 / 72 PostPPos / 76 PostPFGR)*

6.6.2 Limitation of load range

The curves are defined by the 2 limits: Low-fire and nominal load (maximum load). In certain cases, it has proven practical to limit the burner's output, either temporarily or permanently.
This limitation of the burner's working range can make sense in both directions. The burner's working range then looks as follows:

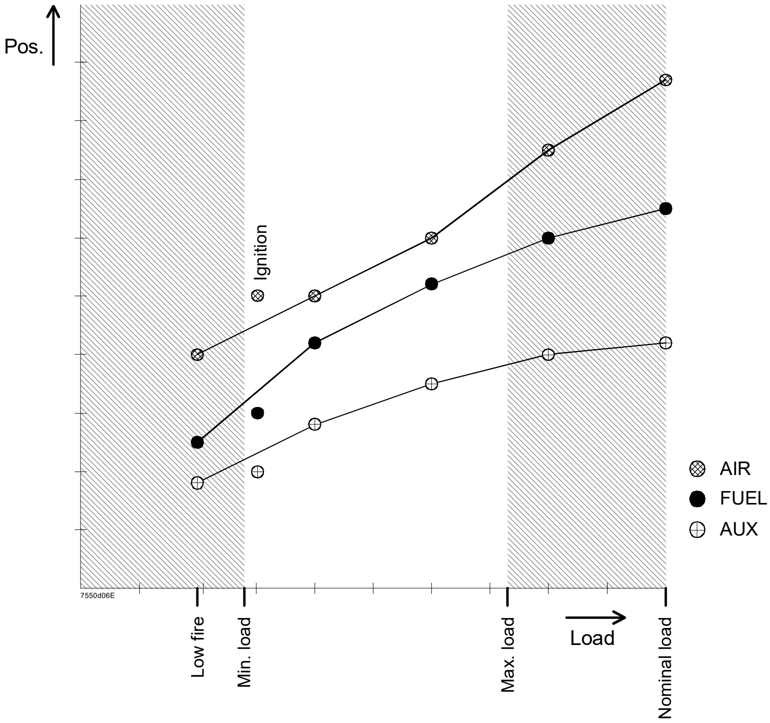


Figure 44: Limited working range

The usable load range always lies within the defined curves. This means: If the minimum load is smaller than the low-fire load, any load below low-fire is ignored. And if the maximum load is greater than the nominal load, it is ignored as well. If the minimum load is greater than or equal to low-fire, it assumes the role of the low-fire load, which means that – after ignition – the minimum load is considered. The 2 parameters *MinLoad...* and *MaxLoad...* can be set depending on the type of fuel,

whereby:

Low-fire load ≤ minimum load ≤ maximum load ≤ nominal load

Parameter	*MinLoadGas*
	MaxLoadGas
	MinLoadOil
	MaxLoadOil

The plant operator can confine the load range further:

Parameter	*UserMaxLoadMod*
	UserMaxLoadStg (S1 / S2 / S3)

Here, the plant operator can further confine the maximum output to be delivered. There is a limit parameter for modulating operation and a limit parameter for multistage operation.

6.6.3 Masking out a load range

Here, it is possible to set a load range that is not constantly approached.

Example: *LoadMaskLowLImit* 45%
LoadMaskHighLimit 53%

The system travels to a load of 45% from below and waits there until the preset load of 53% is reached or exceeded. Then, using the operating ramp, it travels to 53% and beyond. In case the load changes from a higher to a lower level, the system waits at 53%. When the preset load reaches 45% or drops below that level, the hidden range is overridden.

Parameter	*LoadMaskLowLImit*
	LoadMaskHighLimit

6.6.4 Traveling times

The traveling speeds of the actuators for the different burner states can be adjusted. The time to be parameterized is the period of time the actuator requires to cover an angular rotation of 90°.
Traveling speed in the phases with no flame (e.g. driving to prepurge):

Parameter	*TmeNoFlame*

Traveling speed in the operating position in modulating operation:

Parameter	*OperatRampMod*

Traveling speed in the operating position in multistage operation:

Parameter	*OperatRampStage*

☞ Note!
When parameterizing the speeds, the running times of the connected actuators must be taken into consideration.

6.6.5 Shutdown behavior

The positions the actuators assume in the event of lockout can be adjusted. To facilitate fault diagnostics, the actuators can be stopped at their last position or can be driven to their *home* or *postpurge* position.

Parameter	*ShutdownBehav (Unchanged / PostpurgeP / HomePos)*

6.6.6 Overload protection

If the actuators block, lockout is enforced.
However, if the actuators cannot reach the positions required by lockout, they would be damaged due to overtemperatures.
To prevent this, the actuators are deactivated after a maximum time of 35 seconds, or at 20% above the value parameterized for *TmeNoFlame*.

Curve adjustment

Refer to chapter *Displays and settings / special function curve adjustment fuel-air ratio control.*

7 Boiler controller / load controller

7.1 General

The boiler controller integrated in the LMV5 is a digital PID boiler temperature controller / a boiler pressure controller, which depends on the connected boiler sensor.

The controller can be operated using self-setting = adaption or by manually setting the controller parameters (P, I, and D parts).

On fuel changeover, the control characteristics for modulating or multistage burners are automatically adapted if required.

The internal controller is available as an option for use with the LMV51:
- LMV51.0 = with no load controller
- LMV51.1 = with load controller

For LMV50, LMV51.3, and LMV52, the load controller is integrated as standard.

Note!
For operation and parameterization, refer to chapter *Display and operating unit AZL5.*

7.2 Connection diagram

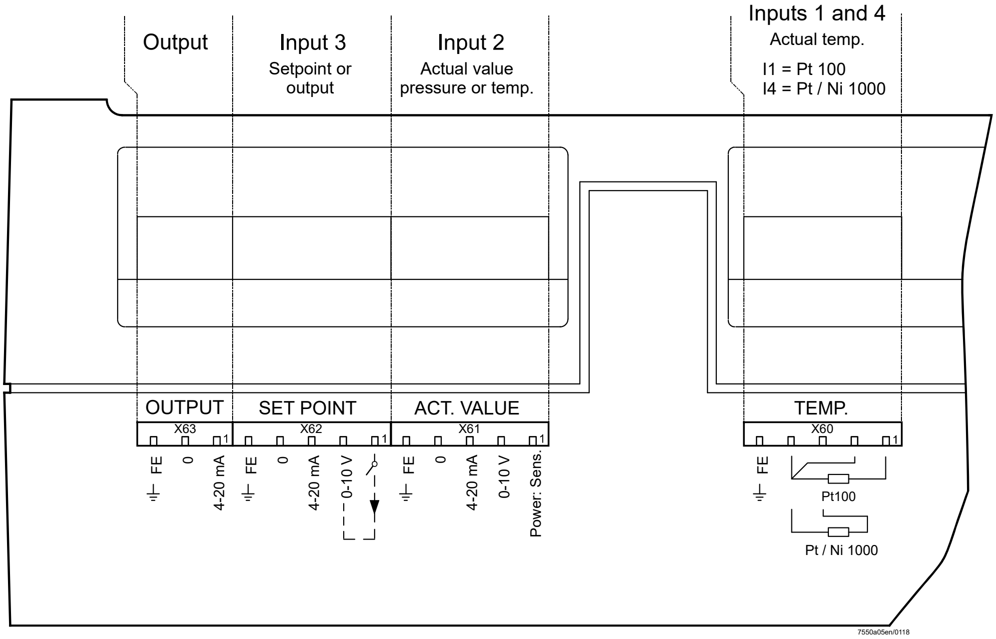


Figure 45: Connection diagram – temperature or pressure controller (internal load controller (LC)

7.3 Operating modes load controller

For the connection of a load controller, the LMV5 can be operated in different configurations. In that case, the internal load controller, different external load controllers, or a load controller via BACS can be used.
To ensure all involved bus users (LMV5, load controller, AZL5) are correctly configured, global parameter *LC_OptgMode* is defined.
This parameter is set on the AZL5 when selecting the operating mode and is delivered to all bus users involved. Then, each bus user makes the configurations required for the relevant operating modes.

Parameter	*LC_OptgMode (ExtLC X5-03/Int LC/Int LC Bus/Int LC X62/Ext LC X62/Ext LC Bus)*

Operating mode 1 (ExtLC X5-03)

External load controller.

In this operating mode, an external load controller (e.g. RWF5) is used. The internal control algorithm is not active.
The internal temperature limiter function can be activated.
The external load controller must have 3 contact outputs which – as shown below – must be connected to the LMV5.

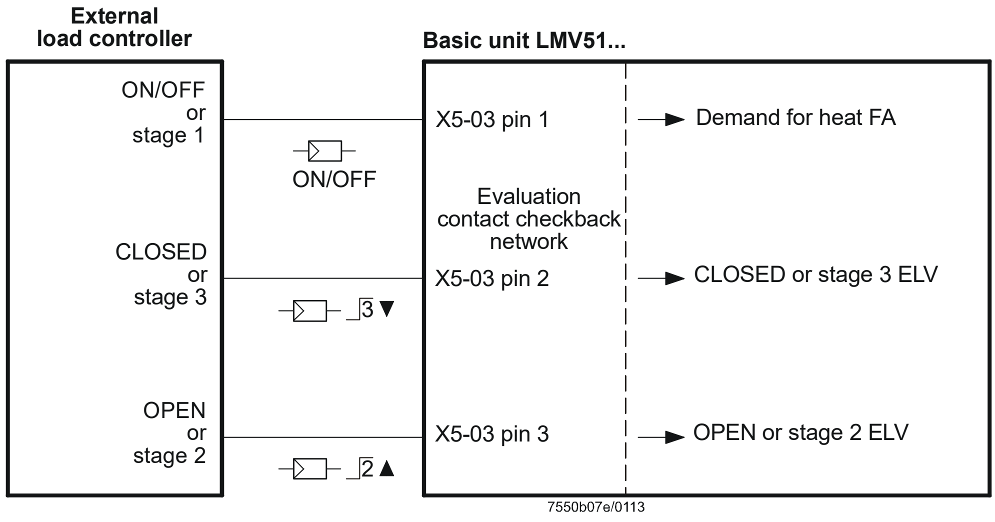


Figure 46: Operating mode 1 with load controller

Special case: **BACS** for control via a contact.

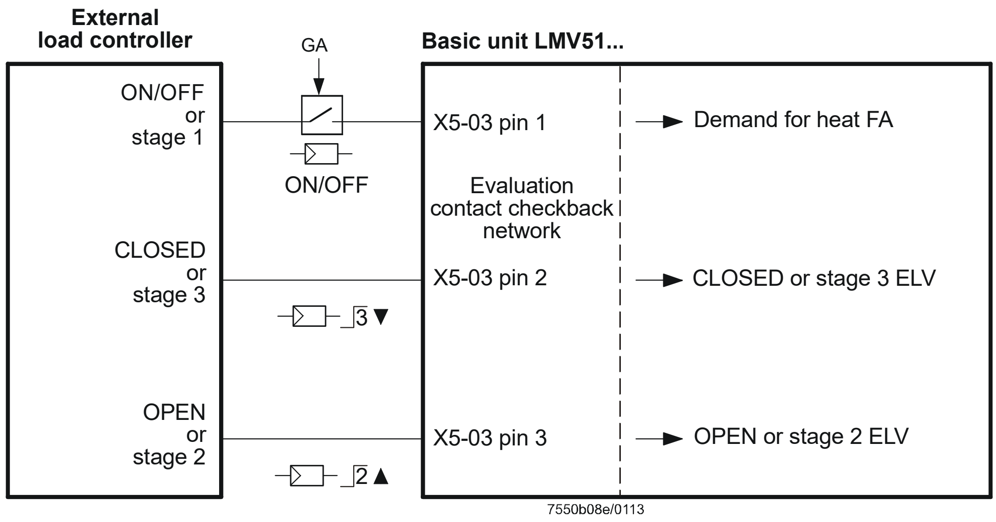


Figure 47: Operating mode 1 with load controller – special case

Operating mode 2 (intLC)

Internal load controller

In this operating mode, the load controller inside the LMV5 is used (standard application). The manipulated variable and the request for heat are internally generated and handled.
Terminals X62 pin 1 and X62 pin 2 can be used to make an external changeover between the internal setpoints W1 and W2.

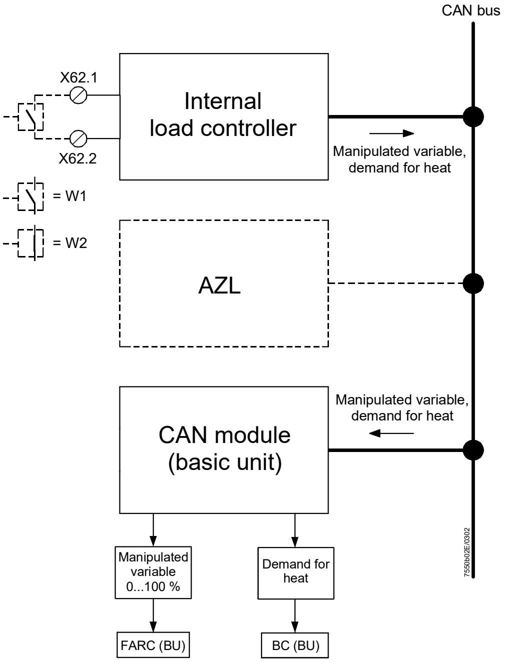


Figure 48: Operating mode 2 with load controller

Operating mode 3 (int LC bus)

BACS for control via bus with the internal load controller.
The internal load controller is connected via the AZL5 and an external bus interface (Modbus) with a BACS. The BACS transmits «only» predefined setpoints to the internal controller. This means that the actual control is provided by the internal load controller.
Terminals X62 pin 1 and X62 pin 2 can be used for changeover from the external predefined setpoint to the internal setpoint W1 (e.g. in the event the BACS fails), triggered via a potential-free contact (load controller software version V01.50 or higher).

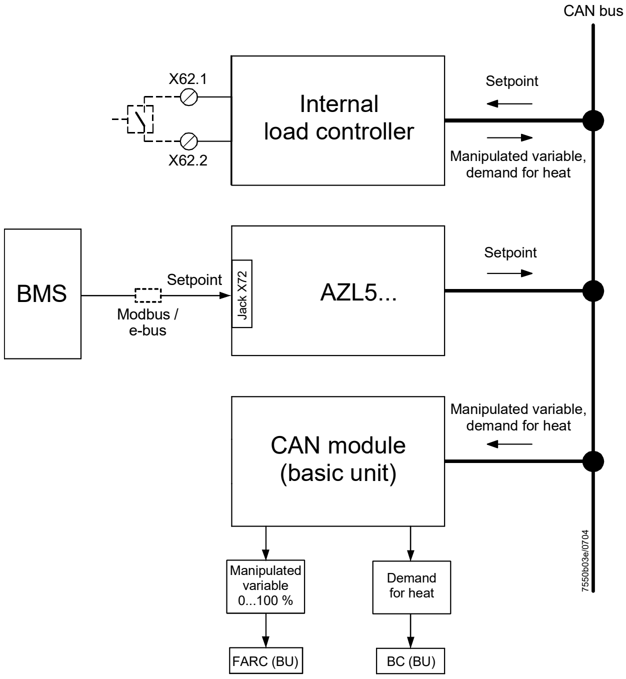


Figure 49: Operating mode 3 with load controller

Operating mode 4 (int LC X62)

BACS for control via analog input with the internal load controller. In principle, identical to operating mode 3, except that the BACS delivers the predefined setpoint via analog input 3 (SETPOINT INPUT). Terminals X62 pin 1 and X62 pin 2 can be used to make a changeover from externally (e.g. in the event the BACS fails) from the external predefined setpoints to the internal setpoint W1, using a potential-free contact (load controller software version V01.50 or higher).
With a predefined setpoint via DC 0...10 V signal, voltage – in the case of changeover to the internal setpoint W1 – must be separated from input X62 pin 2.

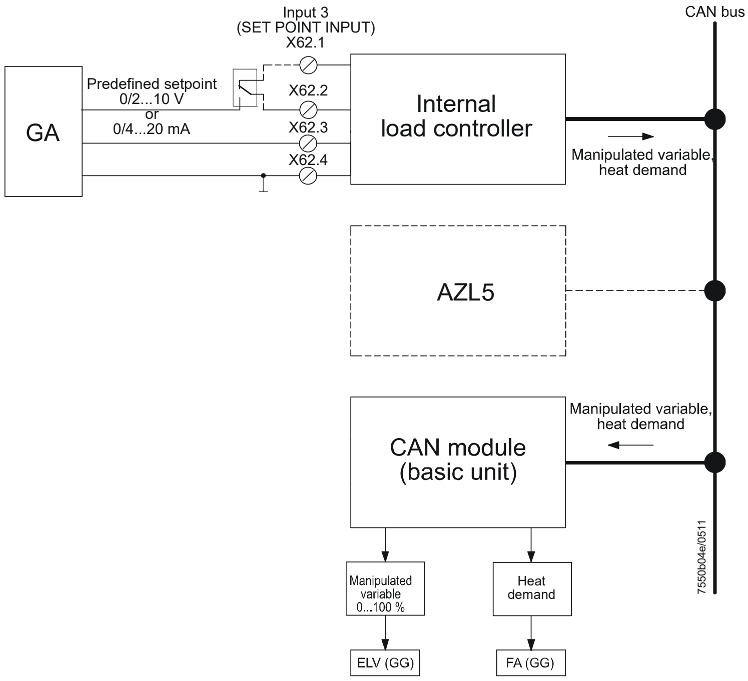


Figure 50: Operating mode 4 with load controller

Operating mode 5 (Ext LC X62)

The internal load controller is used for translating the analog load signal to the CAN bus protocol. The internal control algorithm is not active. BACS for control (or external controller) with analog predefined manipulated variable (load signal) to the controller inside the LMV5.
Terminals X62 pin 1 and X62 pin 2 can be used to make a changeover externally (e.g. in the event of a failure in the building automation) from the external predefined setpoint to the internal setpoint W1 using a potential-free contact (software version V01.50 or higher).
With a predefined setpoint via 0...10 V signal, the voltage – in the case of changeover to the internal setpoint 1 (W1) – must be separated from input X62 pin 2.

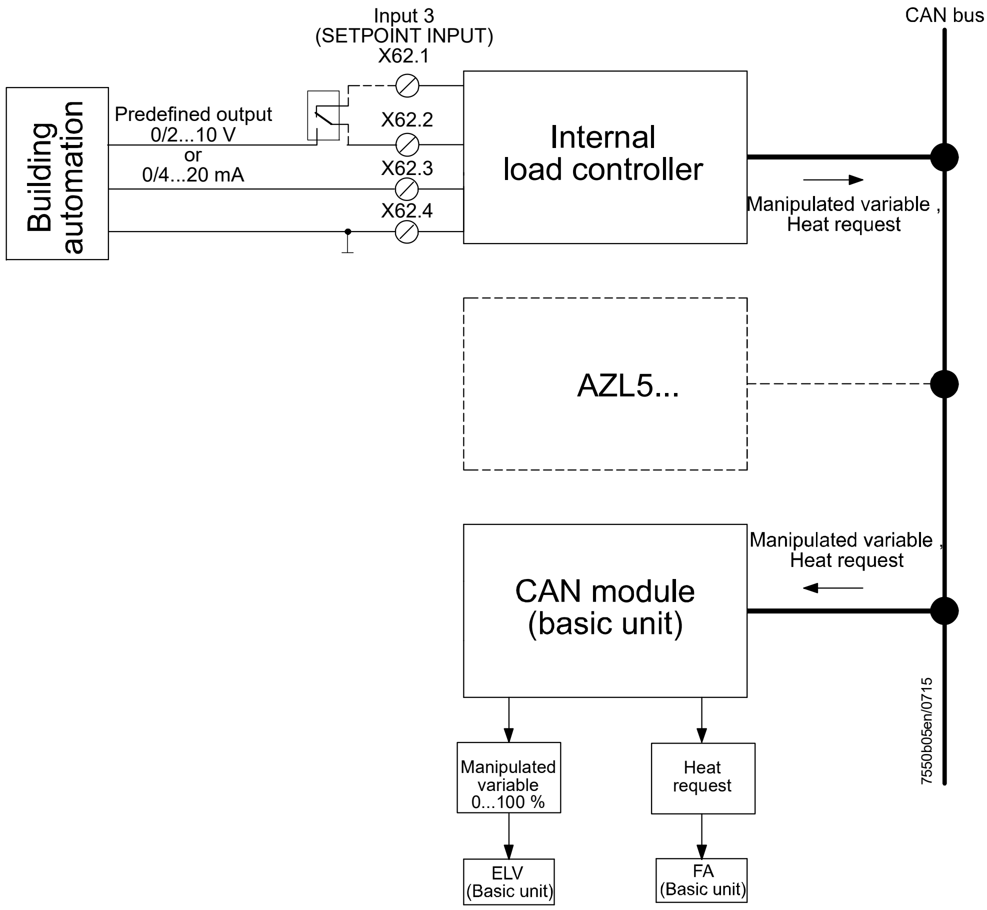


Figure 51: Operating mode 5 with load controller

Operating mode 6 (Ext LC bus)

BACS for control with digital predefined load via bus.
The LMV5 is connected to a BACS via the AZL5 and an external bus interface (e.g. Modbus).
The BACS contains the controller and transmits the load (manipulated variable) and the heat request to the LMV5.
In this operating mode, the load controller inside the LMV5 is not required.

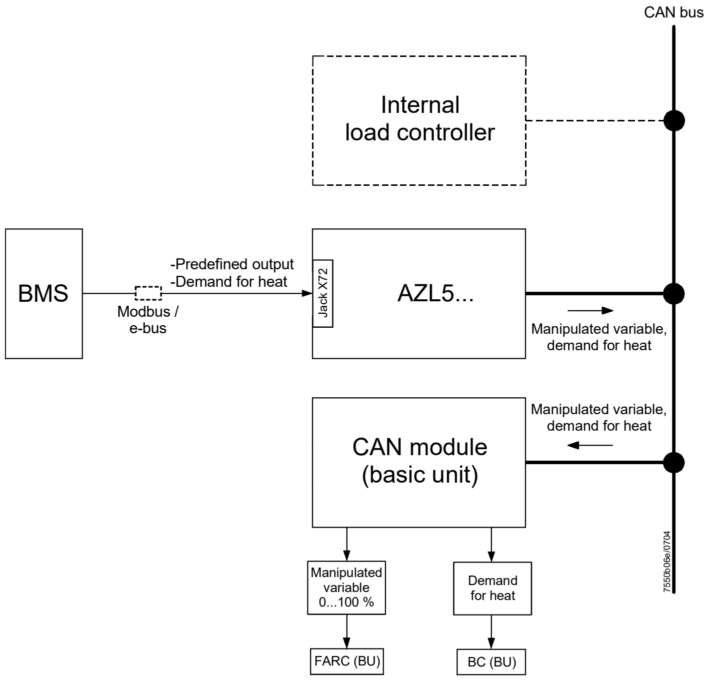


Figure 52: Operating mode 6 with load controller

7.3.1 Manual / automatic burner startup

Parameter	Autom/Manual/Off (Automatic/ Manual / Burner off)

Parameter	SetLoad (0…100% / S1 / S2 / S3)

Parameter *Autom / Manual / Off* is used to define whether the burner is operated manually or automatically (controller mode).

Burner off	The LMV5 remains in or goes into standby mode, irrespective of whether the boiler controller demands heat or not. An error message is not displayed.
Manual	The burner is switched on provided that the controller release is present at terminal X5-03 pin 1 and the start release for the respective fuel occurs in phase 21 at the terminal (X6-01 / X7-03). The burner output can then be set using the *SetLoad* parameter and must lie within the burner's working range.
Automatic	The burner start for the respective fuel (which is present at terminal (X6-01 / X7-03)) depends on heat demand of controller (X5-03 pin 1) and of start release (phase 21).

With remote control, parameter *Autom / Manual / Off* can only be accessed by reading. Parameter *SetLoad* – by contrast – can be read and written.

7.3.2 Operating mode changeover to internal load controller

To improve availability, a potential-free contact at inputs X62 pin 1 / X62 pin 2 can be used to switch from any of the other operating modes to the internal load controller. In that case, setpoint W1 applies. For the selected external operating mode, the switch connected to X62 pin 1 / X62 pin 2 is open. To switch over to the internal load controller, the switch closes.

7.4 Control (characteristics)

Operating mode

The load controller can operate in 2 different operating modes:
- Modulating, or
- Multistage

With electronic fuel-air ratio control, modulating or multistage mode must be selected, depending on the type of burner.

Parameter	*Operation Mode (Two-stage / Three-stage / Modulating)*

7.4.1 Integrated 2-position controller (R = ON/OFF)

General

The integrated 2-position controller transmits to the burner control section the internal information *Heat request controller* (R = ON/OFF).

Switching differentials

Modulating mode:

R = ON when: Actual value ≤ (setpoint ± SD_ModOn)
R = OFF when: Actual value > (setpoint + SD_ModOff)

Multistage mode:

R = ON when: Actual value ≤ (setpoint ± SD_Stage1On)
R = OFF when: Actual value > (setpoint + SD_Stage1Off) or
R = OFF when: Actual value > (setpoint + SD_Stage3Off) = low-fire operation; always applies if none of the 2 thresholds *Q2* and *Q3* has been exceeded

Note!
The following standards also have to be observed for multistage operating mode:
- *SD_Stage3Off > SD_Stage1On*
- *SD_Stage3Off < SD_Stage2Off < SD_Stage1Off*

Note!
When *SD_*_On* is positive, the switching differential lies above the setpoint. When *SD_*_On* is negative, it lies below the setpoint (load controller software version V01.40 or higher).

Parameter	*SD_ModOn*
	SD_ModOff
	SD_Stage1On
	SD_Stage1Off
	SD_Stage2Off
	SD_Stage3Off

7.4.2 Modulating control

General

When selecting *Gas*, the LMV5 will automatically operate in modulating mode. For this reason, parameterization is not required when firing on gas.
When selecting *Oil*, the operating mode is to be set to *modulating,* if required, using parameter *Operation Mode* of the electronic fuel-air ratio control system.
In this operation mode, the load controller calculates the manipulated variable by means of a PID algorithm, depending on the control deviation.

Function diagrams

Example 1: The load is very small so that the controller must switch to ON/OFF mode.

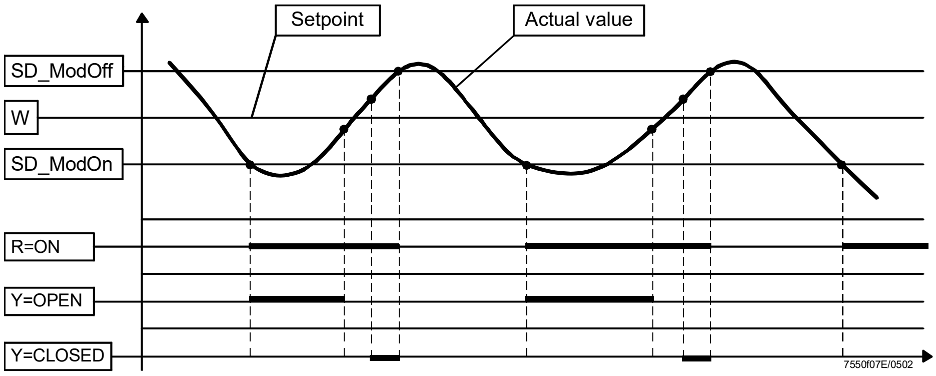


Figure 53: Modulating control – function diagram example 1

Example 2: The load is greater than the amount of heat produced by the burner under low-fire conditions, thus enabling correct modulating operation.

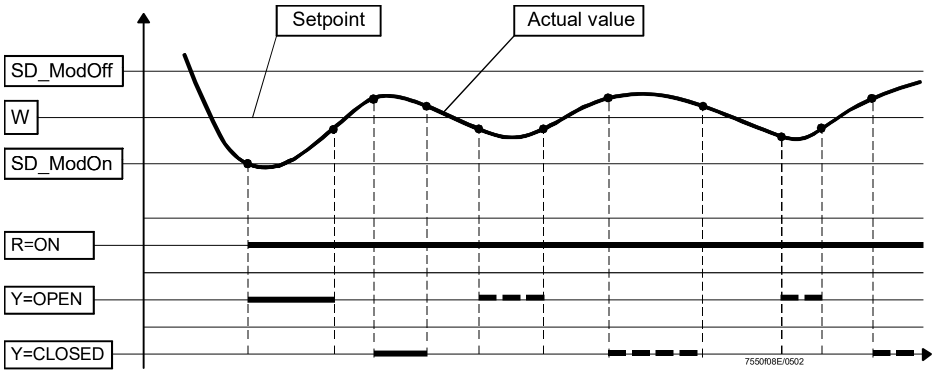


Figure 54: Modulating control – function diagram example 2

7.4.2.1 Manual setting of the PID control parameters

It is possible to manually set the PID parameters to any value in the setting range shown below, to activate a triple value from the predefined standard values described below (and edit it further if required), or to use the adaption function (self-setting function) instead of making the settings manually. The LMV5 then acquires the PID parameters itself.

Parameter:	
Proportional band	*P-part (Xp) (2...500%)* from 100 °C / 1 bar or 212 °F / 14.5 psi Reaction: Xp = 2% → strong / fast Xp = 500% → weak / slow
Integral action time	*I-part (Tn) (0...2,000 s)* 0 = no I-part Reaction: Tn = 1 → strong / fast Tn = 2.000 → weak / slow
Derivative action time	*D-part (Tv) (0...1,000 s)* 0 = no D-part Reaction: Tv = 1 → weak / slow Tv = 1,000 → strong / fast

Standard values of control parameters

The controller's memory contains 5 standard parameter sets.
If required, 1 of these 5 PID triple values can be copied to the storage locations for the actual values so that it becomes active.

PID standard values for the following applications:

Parameter	*Standardparam (Adaption / very fast / fast / normal / slow / very slow)*

Adaption	The values acquired by the LMV5 adaption function are used		
	Xp in %	**Tn** in s	**Tv** in s
very fast (e.g. for small boiler)	42.5	68	12
fast	14.5	77	14
normal	6.4	136	24
slow	4.7	250	44
very slow (e.g. for large boiler)	3.4	273	48

7.4.2.2 Adaption / self-setting of PID controller parameters

The load controller integrated in the LMV5 is capable of identifying the controlled system, of calculating its PID parameters based on the acquired characteristic data, and of resetting the parameters. In modulating mode, the adaption function is available for both temperature and pressure control. In multistage mode, the PID controller is active, which means that no adaption can be made there.

Preconditions for adaption to be started:

- Boiler / combustion plant has fully reached the operating temperature
- Actual value lies 10…20% below the setpoint

Adaption can be activated in different ways:

1. Adaption from manual operation:
   a) Adaption from shutdown or standby *Manual*
   b) Adaption from startup or operation *Manual*
2. Adaption from automatic operation:
   a) Start of adaption from shutdown or standby
   b) Start of adaption from startup or operation

If adaption is not successful due to high burner output, the adaption load can be reduced.

Parameter	*StartAdaption*
	AdaptionLoad

Adaption sequence

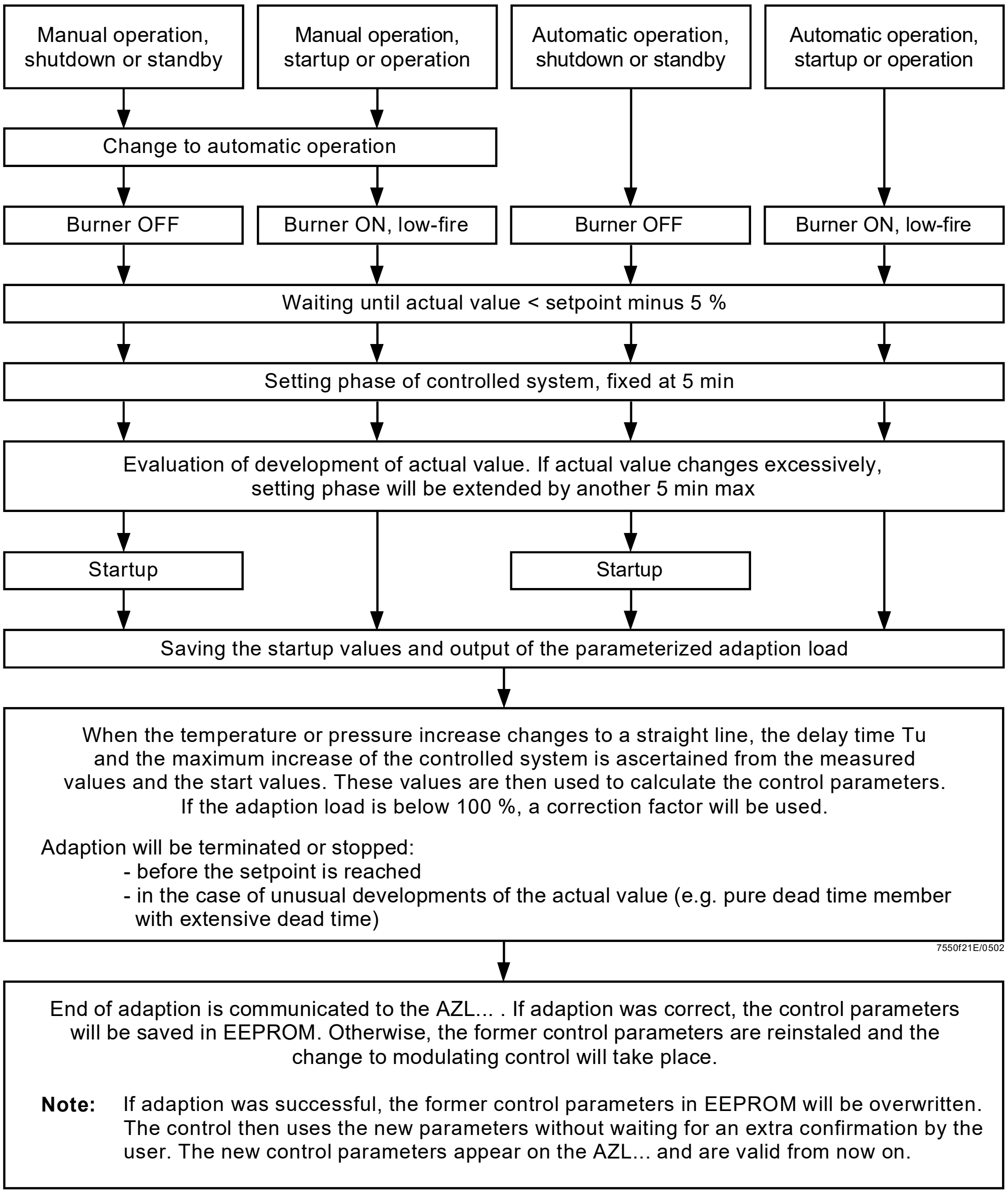


Figure 55: Modulating control – adaption sequence

Note!
Refer to chapter *Displays and settings / special function adaption load controller*

Checking the control parameters

Optimum adaption of the controllers to the controlled system can be checked by recording the actual value during startup while the controlled system is working. The diagrams below reveal incorrect settings and give hints on remedy.

Example

Here, the behavior of a controlled system of 3rd order for a PID controller is shown. The procedure for setting the control parameters can also be applied to other types of controlled systems.
Practical value of Tn : Tv = 4...6.

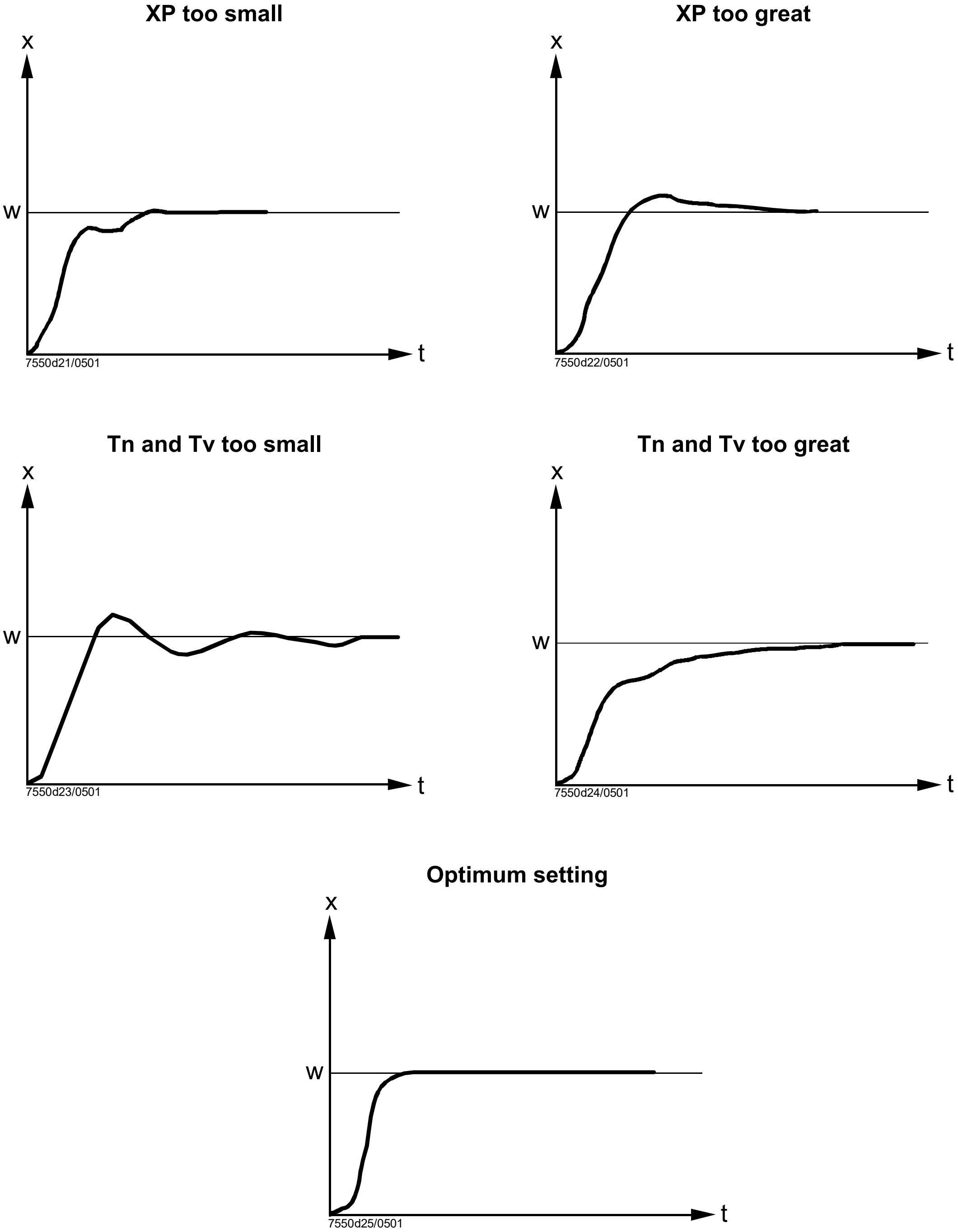


Figure 56: Modulating control – checking the control parameters

Settling of the manipulated variable

Settling of the manipulated variable is used in modulating mode to avoid unnecessary drive pulses, thus extending the life of the controlling elements.
Settling of the manipulated variable is active across the entire working range so that a neutral zone is no longer required.

Principle

For setting the settling of the manipulated variable, a parameter is used that can be set by you; it is called *Minimum possible step of the controlling element*.

With an external load controller, this parameter acts as a hysteresis on the current load. This means that, as long as the new load is not outside the current load ± *MinActuatorStep*, the controller does not react.

Example:
Current load = 40%
MinActuatorStep = 5%

If the setpoint is within 40% ±5%, there is no reaction from the control.
The system only reacts if the setpoint is above or below 40% ±5%.

With an internal load controller, the impact on the system is optimized in a similar way.

☞ Note!
When setting the parameter *MinActuatorStep*, ensure that the setpoint is stable.

Parameter	*MinActuatorStep*

7.4.3 Multistage control

General

When selecting *Oil*, the LMV5 must be set to *2-stage* or *3-stage*, depending on the type of burner, using parameter *Operation Mode (*refer to chapter *Control characteristics)*.
In these 2 operation modes, the PID algorithm is not required and is not calculated.
Maximum 3 fuel stages are activated and deactivated depending on the actual values, the parameterized switching differentials_Stage1...3 *(*refer to chapter *Integrated 2-position controller (R = ON/OFF)*), and the parameterized reaction thresholds *Q2* and *Q3*.

Load-dependent activation of the higher burner stages

This approach is used to reduce the switching frequency of the higher stages.

- The integral of the control deviation over time is generated
- Switching on of stage 2 is locked until the temperature has dropped below the adjustable reaction threshold *Q2*
- Switching on of stage 3 is locked until the temperature has dropped below the adjustable reaction threshold *Q3*

If the temperature frequently drops below the switch-on thresholds, the integrals are added up and the higher stage switched on when the associated Q-value is reached.
If, before that, the setpoint is reached with the lower stage, the counter is reset.

Parameter	*ThreshStage2On (Q2)*
	ThreshStage3On (Q3)

Reaction thresholds *Q2* and *Q3* (integral of control deviation (K) x time (s))

Function diagrams

Example 1: Reaction thresholds *Q2* and *Q3* for switching stages 2 and 3 on are not reached. In this case, stage 1 is already switched off when threshold *W+SD_Stage3Off* is reached (low-fire operation).

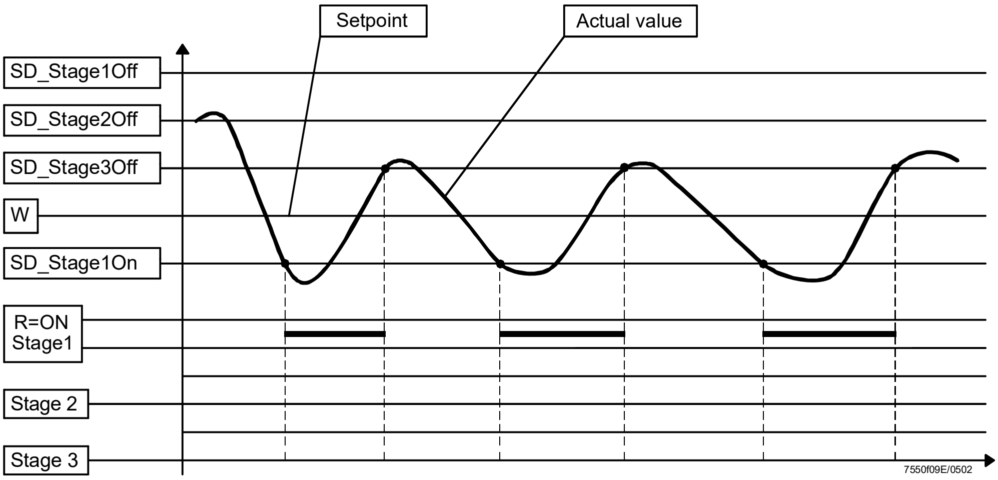


Figure 57: Multistage control – function diagram 1

Example 2: Reaction thresholds *Q2* and *Q3* for switching on stages 2 and 3 are exceeded and the stages are switched on.
In this case, stage 1 is switched off when threshold *W+ SD_Stage1Off* is reached.

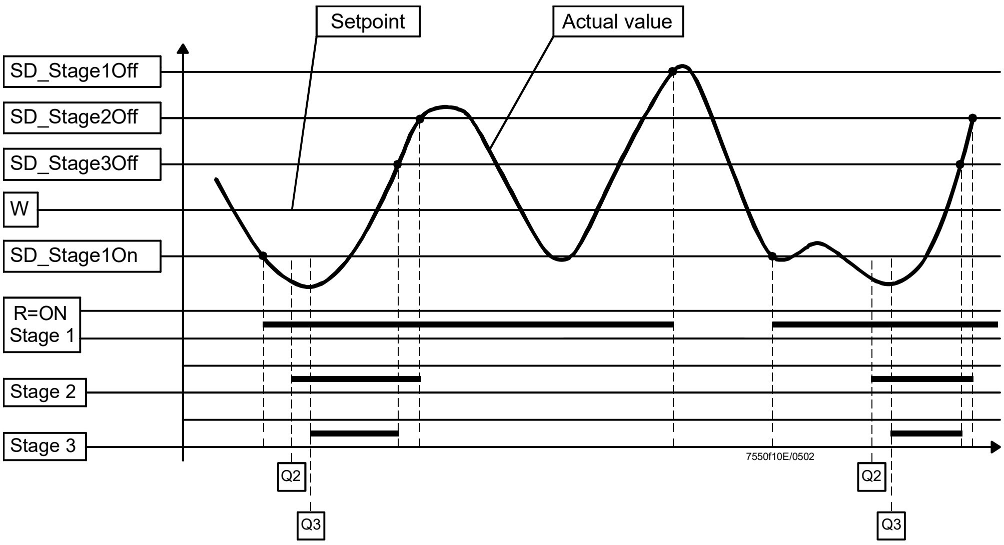


Figure 58: Multistage control – function diagram 2

7.5 Actual values (X)

Measuring accuracy: Min. ±1% of the measuring range (excluding the sensor error).

Definition of sensors (incl. activation / deactivation of the temperature limiter function):

Pt100	Temperature sensor Pt100 at the input X60, internal temperature limiter function = *activated*.
Pt1000	Temperature sensor Pt1000 at the input X60, internal temperature limiter function = *activated*.
Ni1000	Temperature sensor LG-Ni1000 at the input X60, internal temperature limiter function = *activated*.
TempSensor	Temperature sensor at the input X61, internal temperature switch function = *deactivated*.
PressSensor	Pressure sensor at the input X61, internal temperature switch function = *deactivated*.
Pt100Pt1000	Temperature sensor Pt100 at input X60 for temperature controller and temperature limiter function **and** temperature sensor Pt1000 at input X60 additionally for temperature limiter function.
Pt100Ni1000	Temperature sensor Pt100 at input X60 for temperature controller and temperature limiter function **and** temperature sensor LG-Ni at input X60 additionally for temperature limiter function.
No Sensor	No actual value sensor (e.g. in the case of external predefined loads and **without** internal temperature limiter).

Parameter	*PhysicalUnits (°C / bar / °F / psi)*
	SensorSelect (Pt100 / Pt1000 / Ni1000 / TempSensor / PressSensor / Pt100Pt1000 / Pt100Ni1000 / No Sensor)

Input 1, TEMP, Pt100 sensor (DIN) X60

3-wire circuit (copper wires); line balancing is not required when the resistances of the measuring leads are identical.
The temperature limiter function is active.

The end of the measuring range of 150 °C, 400 °C or 850 °C depends on the parameterization. With parameter *var.Range.PtNi*, the variable end of the measuring range at 850 °C can be set to 100 °C. This way, wrong adjustments of the setpoint are prevented since the setpoint's setting range will automatically be limited to the end of the measuring range.

☞ Note!
Set the end of the measuring range to 850 °C and reduce the variable end to 100 °C.
Scaling is not affected by this change since the Pt curves are fixed.

Start of measuring range: 0 °C or equivalent to 32 °F
End of measuring range: 150 °C or equivalent to 302 °F
(depending on the setting) 400 °C or equivalent to 752 °F
850 °C (1562 °F)

Parameter: Measuring range PtNi	Open-circuit detection	Short-circuit detection
150 °C	Approx. 165 °C	-15 °C
400 °C	Approx. 440 °C	-40 °C
850 °C	Approx. 1000 °C	-85 °C

Reducing the variable measuring range (parameter *var. RangePtNi*) does **not** change the short-circuit detection or open-circuit detection.

Parameter	*MeasureRangePtNi (150°C/302°F / 400°C/752°F / 850°C/1562F)*
	var.RangePtNi

Input 2: TEMP. / PRESS INPUT, DC 0...10 V / DC 2...10 V / 4...20 mA / 0…20 mA X61

This input can be parameterized as a pressure or temperature input.

The temperature limiter function is **not** active.
Active power supply by the LMV5; typically, a pressure or temperature sensor / transmitter is connected here (e.g. QBE2003-P).
Power supply to the pressure sensor: DC 20 V / 25 mA (rated).

Parameter	*MeasureRangePtNi (150°C/302°F / 400°C/752°F / 850°C/1562F)*
	Ext Inp X61 U/I: (4...20 mA / 2...10 V / 0...10 V / 0…20 mA)

Measuring range temperature (can be parameterized)

Start of measuring range: 0 °C or equivalent to 32 °F

End of measuring range: Continuously up to 2,000 °C or equivalent to 3,632 °F

Parameter	*MRange TempSens*

Measuring range pressure (can be parameterized)

Start of measuring range: 0 bar (0 psi)

End of measuring range: Continuously up to 100 bar (1,450 psi)

Detection of sensor short-circuit and line interruption is provided (distance from ends of the measuring range about 10% of the measuring range).

In the case of DC 0...10 V / 0…20 mA signals, the detection of short-circuits and line interruptions is not possible.

If a fault is detected, the burner is shut down (changing to the safety phase). If the short-circuit or line interruption disappears within the safety phase, a change to standby is made. Otherwise, lockout is triggered.

Parameter	*MeasureRange PressSensor*

Input 4: TEMP, Pt1000 / LG-Ni1000 X60

2-wire circuit: Line balancing is not required if the resistances of the measuring leads are small compared to the sensor's resistance.
The temperature limiter function is active.
Suitable sensors are QAE22.5A, QAE21.1 and QAE2112.0151.

Start of measuring range: 0 °C (32 °F)
End of measuring range: 150 °C (302 °F) or
400 °C (752 °F)
850 °C (1562 °F)

For the end of the measuring range of 850 °C (1562 °F), another parameter called *var.RangePtNi* is used.

Setting range: Continuously up to 850 °C (1562 °F).

Parameter	*MeasureRange PtNi (150°C/302°F / 400°C/752°F / 850°C/1562F)*
	var.RangePtNi

7.6 Setpoints (W)

Internal setpoint

Using the AZL5, 2 setpoints (W1 and W2) can be adjusted. It is not possible to adjust a temperature controller setpoint to a level above the actual limit value of the integrated temperature limiter function. The setting range automatically corresponds to the parameterized measuring range of the actual value. Changeover between W1 and W2 can be accomplished by means of an external (potential-free) contact connected to input 3 (X62), *External predefinition of setpoint / load*. W1 is active as standard (contact open).

Parameter	*SetpointW1 (0..2000 °C / 0..100bar)*
	SetpointW2 (0..2000 °C / 0..100bar)

Input 3: SET POINT INPUT X62

Input for an external predefined setpoint, suited for a predefined load or setpoint changeover. The input is passive (not powered by the LMV5). Typically, an active PC output is connected here (PC output requires galvanic separation for PELV).

With DC 0…10 V / 0…20 mA signals, the detection of short-circuits and line interruptions is not possible.

Parameter	*Ext Inp X62 U/I: (4...20 mA / 2…10 V / 0…10 V / 0...20 mA)*

External predefined setpoint

If parameterized for *Int LC X62*, the input signal is converted to pressure or temperature according to the parameterization of the measuring range and interpreted as the boiler's setpoint. The setting range automatically corresponds to the parameterized measuring range of the actual value and can also be limited.

	Setpoint min. measuring range	Setpoint max. measuring range
I (mA)	0 / 4	20
U (V)	0 / 2	10

The detection of short-circuits and line interruptions is ensured – similar to the sensor inputs (but not when configured for DC 0...10 V / 0…20 mA). The request for heat results from the difference of actual value and setpoint.

Parameter	*Ext MinSetpoint*
	Ext MaxSetpoint

Example: DC 0...10 V or 4...20 mA with *MRange TempSens* = 150 °C
Setting parameter *Ext MinSetpoint* = 33%
Setting parameter *Ext MaxSetpoint* = 80%

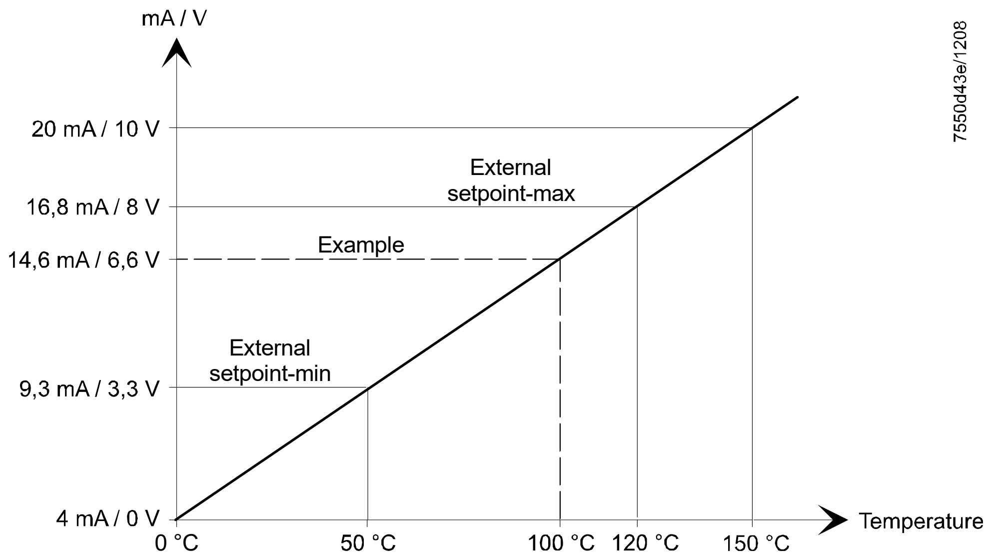


Figure 59: Setpoints

External predefined load

If parameterized for *Ext LC X62*, the input signal is interpreted as the predefined load. This is internally transmitted to the fuel-air ratio control system where it is translated into the respective actuator driving signals. Since the internal controller is inactive in this operating mode, control must be performed externally. If, in addition, a temperature sensor Pt100 (and/or Pt1000, LG-Ni1000 sensor) is connected, it is also possible to use the internal temperature limiter function with the external predefined load.

External predefined load, modulating

	Low-fire	Nominal load
I (mA)	0 / 4	20
U (V)	0 / 2	10

External predefined load, multistage

	Stage 1	Stage 2	Stage 3
I (mA)	5	10	15
U (V)	2.5	5	7.5

The detection of short-circuits and line interruptions is ensured – similar to the sensor inputs.

External setpoint changeover

In operating mode 2 (intLC), changeover between the 2 internally defined setpoints W1 and W2 can be implemented by means of an external (potential-free) contact.

External setpoints or predefined load via digital interface

The settings described under *Input 3* can also be made from a BACS connected to the AZL5 via RS-232 and bus interface.

An external predefined setpoint exists with *Int LC bus*.
An external predefined load exists with *Ext LC bus*.

Parameter	*LC_OptgMode (intLC o.DDC / extLC o.DDC)*

7.7 Integrated temperature limiter function

The temperature limiter function is implemented as a «safety-related» function. This means that the function is single-error-proof, which means that a single error cannot negate the protective function of the controller and the temperature limiter. The temperature limiter works similar to the 2-position controller but with a separate limit value that can only be changed after entry of a password.

The temperature limiter function also ensures that controller setpoints > *TL_Threshold_Off* cannot become active.
The temperature limiter function is only active in connection with the Pt100, Pt1000 and LG-Ni1000 sensors. These sensors are monitored for short-circuits and line interruptions. Activation / deactivation of the temperature limiter function depends on the parameterization of the actual value input (parameter *SensorSelect*) (refer to chapter *Actual value (X)*).

Short-circuits or line interruptions of the temperature limiter's sensors lead to *R = OFF*, *temperature limiter = OFF* and to the relevant error message.

Parameter	*TL_ThreshOff*
	TL_SD_On

Attention!
In order to be able to do without an external temperature limiter, the internal temperature limiter function must be used with 2 temperature sensors.
This can only be achieved by making the following *Sensor Select* parameter settings:

Parameter	*Sensor Select (Pt100Pt1000)*
	Sensor Select (Pt100Ni1000)

Temperature limiter

Temperature limiter with external predefined load

The internal temperature limiter function can be used in all operating modes, provided the appropriate actual value input is parameterized and the associated temperature sensor is connected.

Requirements placed on sensor and protection pocket

If the internal temperature limiter function is used, the time constant «T» of the temperature sensor with protection pocket must not exceed 45 seconds.

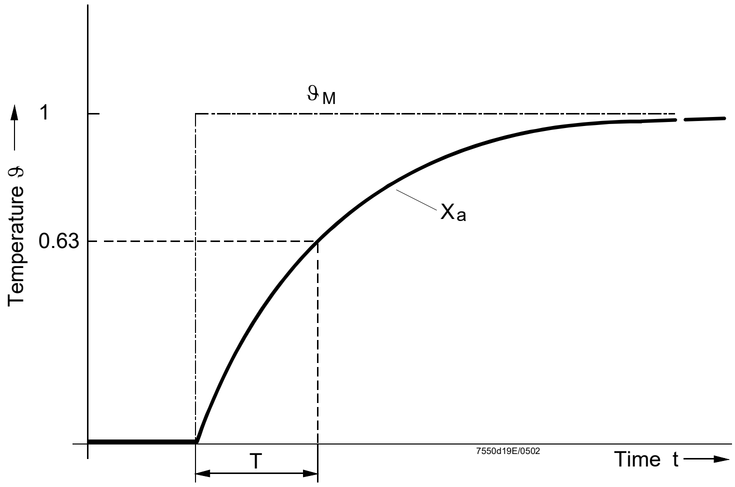


Figure 60: Instant temperature change of test medium to determine the time constant

Legend

ϑ_M	Temperature of test medium
X_a	Output signal of temperature sensor
T	Time constant

7.8 Cold start thermal shock protection (CSTP)

Thermal shock protection can be activated and deactivated.
A differentiation is made between modulating and multistage control.
The cold start sequence is activated when, upon startup, the actual value lies below the ON threshold).
If thermal shock protection is activated, the manipulated variable on cold start is increased in a stepwise fashion using the set load step (or the next stage is activated).
The output is increased as soon as the actual value exceeds the start value of the load stage by the setpoint step.
If this switching threshold is not reached within the adjustable maximum time, heating is automatically ensured by the next output stage. When the OFF threshold is reached, the cold start sequence is ended to switch to normal control operation.
An active cold start thermal shock protection function is signaled via the AZL5; to check the actual values, the normal display flashes up alternately.

Parameters:	Thermal shock protection on/off	*ColdStartOn*
	Activation value for thermal shock protection	*ThresholdOn*
	Deactivation value for thermal shock protection	*ThresholdOff*
	Load step (for modulating control only)	*StageLoad*
	Setpoint step, modulating	*StageStep_Mod*
	Setpoint step, multistage	*StageStep_Stage*
	Max. time, modulating per step	*MaxTmeMod*
	Max. time, multistage per step	*MaxTmeStage*

7.8.1 Cold start thermal shock protection – modulating operation

For the output step, any output value in % can be predefined.
100% divided by the output step gives the number of possible stages.

Example:

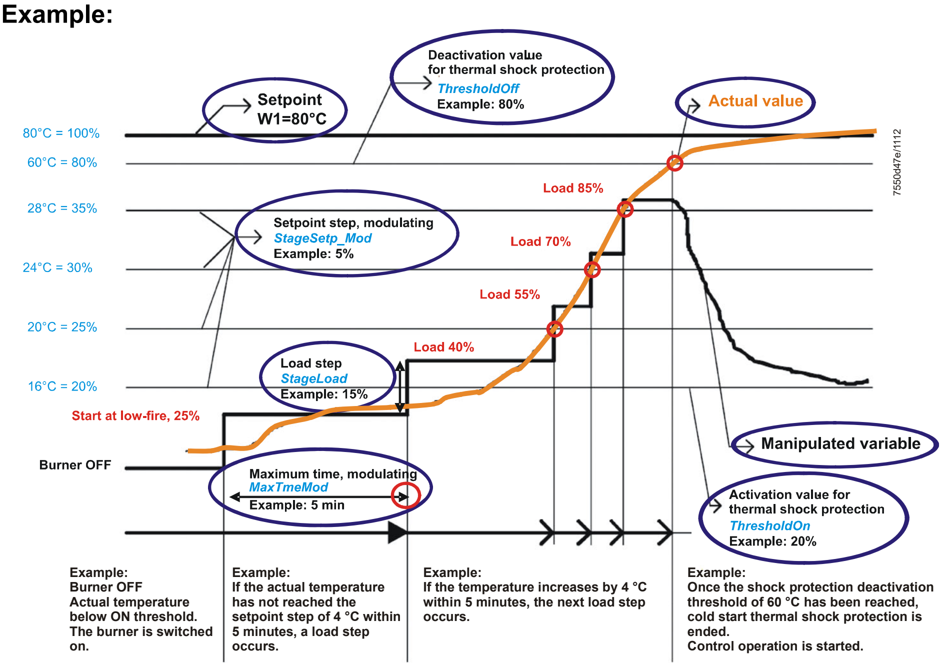


Figure 61: Cold start thermal shock protection – modulating operation

7.8.2 Cold start thermal shock protection – multistage operation

The difference between multistage and modulating control is that with multistage control, the output steps are defined by the number of burner stages. With modulating control, any output value in % can be entered.

With multistage control, a maximum of 3 output stages are available:
1. Stage 1
2. Stage 1 and stage 2
3. Stage 1, stage 2, and stage 3

Use of the output stages 2 and 3 can be locked. In that case, the boiler is heated with stage 1 only.

Parameter	Release Stages (release / no release)

When stages 2 and 3 are locked, the system may maintain low-fire operation until the cold start function is ended, if the output delivered by stage 1 is not sufficient to reach the switch-off threshold for thermal shock protection.

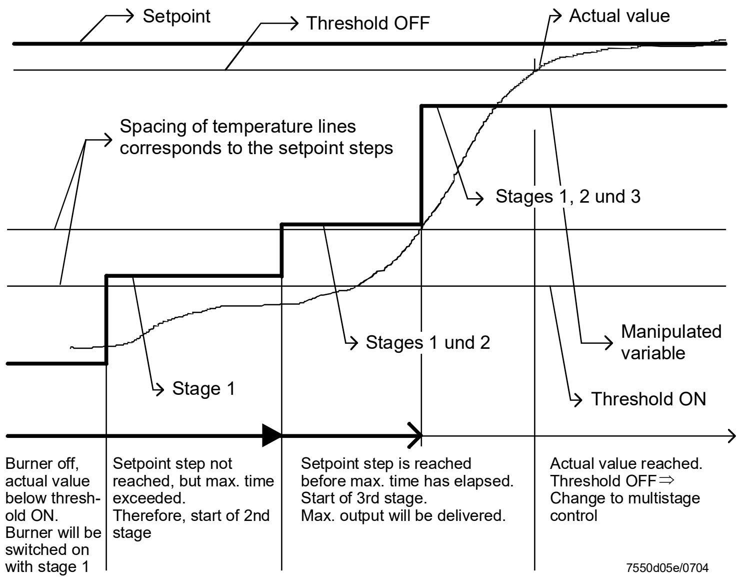


Figure 62: Cold start thermal shock protection – multistage operation

7.8.3 Cold start thermal shock protection with temperature sensor in pressure plants

In pressure plants, thermal shock protection can also be implemented with a temperature sensor (additional sensor), as an alternative to the pressure sensor.
If an additional temperature sensor is installed and activated (*Additional Sensor* set to *Pt100* or *Pt1000* or *Ni1000),* for the CSTP function the temperature signal from this additional sensor is used instead of the pressure signal from the boiler controller and also the temperature setpoint for the additional sensor (*Setpoint AddSens)* is used.
The parameters *ThresholdOn* and *ThresholdOff* are then percentage values from this temperature setpoint (*Setpoint AddSens)* of the additional sensor.

Parameter	*Additional Sensor (deactivated / Pt100 / Pt1000 / Ni1000)*
	Setpoint AddSens
	Temp. ColdStart

Caution!
When using a pressure sensor, the temperature limiter is not active.

7.9 Analog output X63 (0(4)...20 mA)

The active analog output X63 (0(4)...20 mA) is used to deliver the current output or another system value.
The output value can be determined using the *OutValuSelection* parameter.
If a voltage signal is required, it can be made available by connecting a resistor (max. 500 Ω). The settings are to be made on the load controller / configuration / analog output.

Restrictions

The load controller only outputs the sensor data actually used (temperature limiter or control). Only *Pt1000 / Ni1000* can be output, independent of usage.

Parameter	*OutValuSelection (Load / Load 0 / O2 / Pos Air / Pos Fuel / Pos Aux1 / Pos Aux2 / Pos Aux3 / Speed VSD / Flame / Temp Pt1000 / Temp Ni1000 / Temp Pt100 / Temp X61 / Press X61)*

Output, modulating

Load output *Load* appears after the internal fixed setting (see table below). If other alternative settings of load output occur, the scalable parameter *Load 0* can be used.

	Burner OFF	0%	100%
I (mA)	4	4	20

Output, multistage

	Burner OFF	Stage 1	Stage 2	Stage 3
I (mA)	4	5	10	15

☞ Note!
When resetting the LMV5, the output is set to 0 mA for approx. 30 seconds!

Output of other values

When selecting the other setting values (all with the exception of *Load*), the output mode can be changed.

The output values can be scaled.

Parameter	*CurrMode 0/4mA (0…20 mA / 4…20 mA)*

Upper scaling parameter

Parameter	*Scale20mA perc*

Concerns: *Load 0 / O2 / Speed VSD / Flame*

Parameter	*Scale20mA temp*

Concerns: *Temp Pt1000 / Temp Ni1000 / Temp Pt100 / Temp X61*

Parameter	*Scale20mA press*

Concerns: *Press X61*

Parameter	*Scale20mA angle*

Concerns: *Pos Air / Pos Fuel / Pos Aux1 / Pos Aux2 / Pos Aux3*

Lower scaling parameter:

This relative value always refers to the respective upper scaling value.

Parameter	*Scale 0/4mA*

7.10 Multiboiler plants

Boiler sequence control is accomplished with the help of external devices or control systems (e.g. BACS or PCs).
In principle, 2 choices are available:

7.10.1 Multiboiler plants by means of analog input

For that purpose, the load controller of the LMV5 has an analog input (X62).

This means that the individual boilers can be…
a) released / locked, and
b) operated at the required output (or set to the required setpoint).

7.10.2 Multiboiler plants by means of digital interface

For that purpose, BACS terminal X72 on the AZL5 can be used via the bus interface.

Inputs:

- Controller release / lock
- Predefined setpoint or predefined load

Outputs:

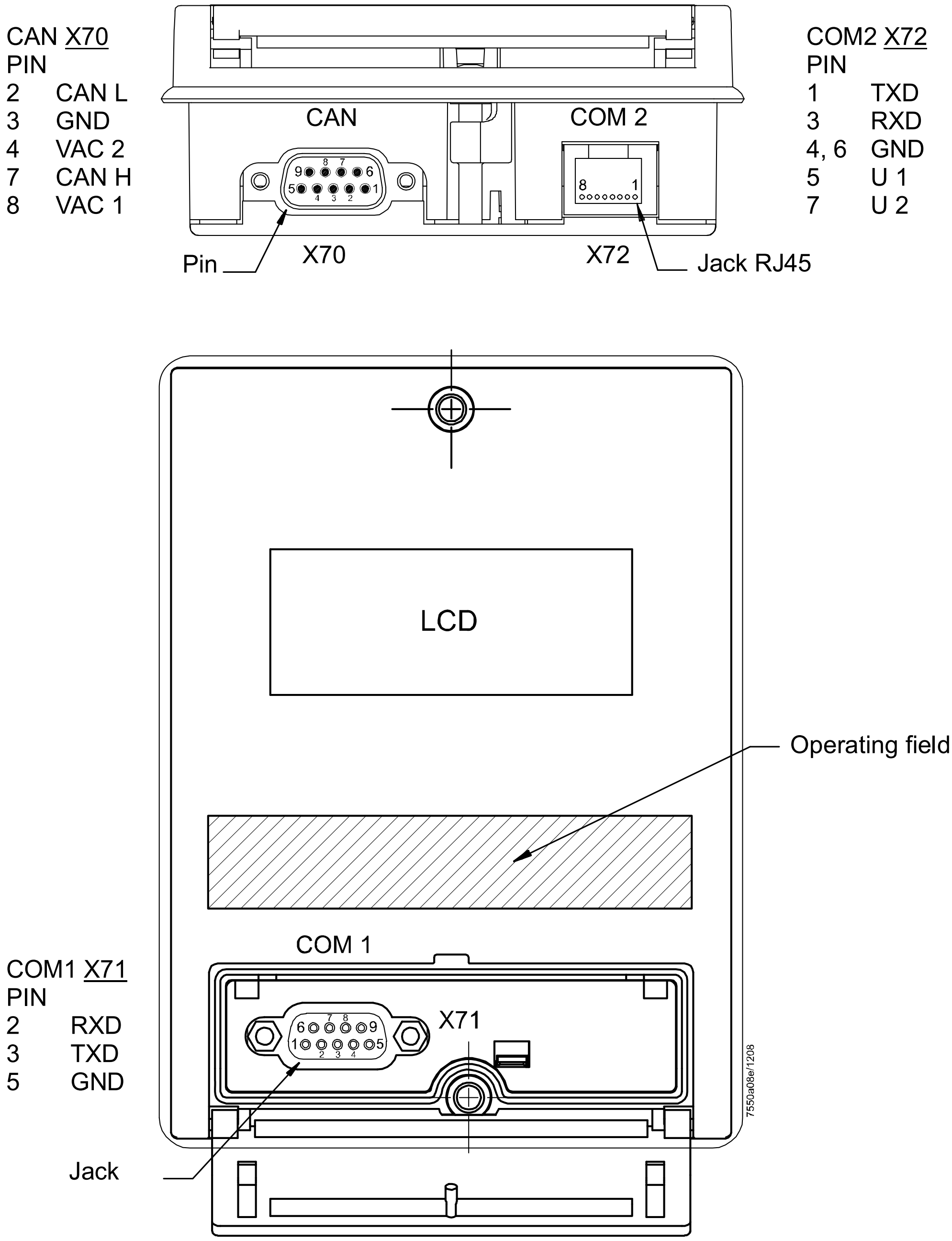
- Actual value
- Controller ON/OFF
- Manipulated variable multistage / modulating
- Error messages

For more detailed information, refer to chapter *Cold start thermal shock protection.*

8 Display and operating unit AZL5

Figure 63: Display and operating unit AZL5

8.1 Assignment of AZL5 terminals



Pins without designation = not connected

Figure 64: Assignment of AZL5 terminals

The AZL5 has three different interfaces (connections):

COM1 X71	Port for PC (RS-232); for parameterization and visualization with the help of the PC software, SUB-D 9 pins
COM2 X72	Port for BACS (RJ45-jack) via external bus interface (RS-232 or RS-485)
CAN X70	CAN bus connection to LMV5, RJ45 (Sub-D connector, jack)

Note!
COM1 and COM2 **cannot** be simultaneously active!

Connecting cable to the PC (null modem cable)

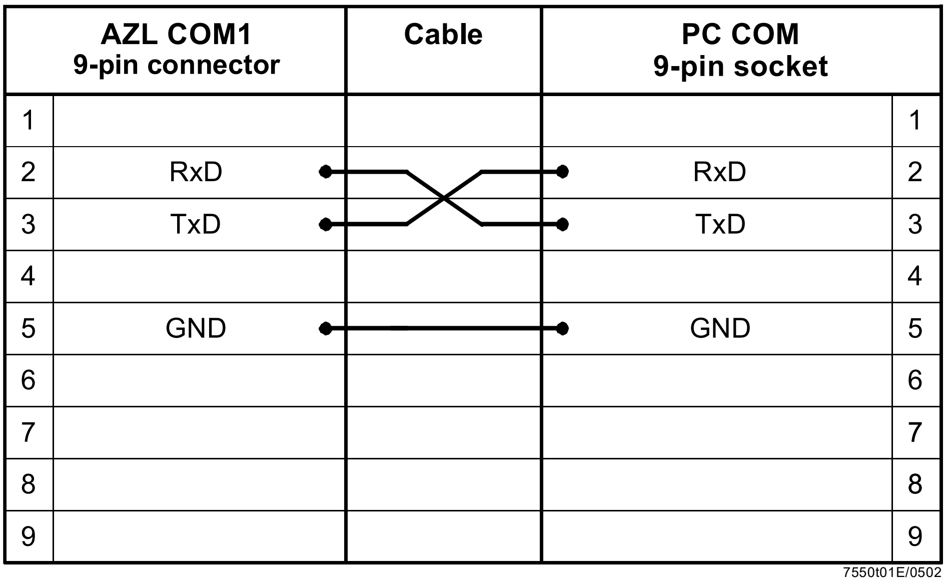


Figure 65: Connecting cable to the PC

Pin assignment cable connection Siemens AZL5 - Trebing & Himstedt SPI3

Trebing & Himstedt SUB-D		AZL5 RJ45
Pin	RS-232	Pin
2	RxD	3
3	TxD	1
5	GND	4 6

Trebing & Himstedt SUB-D		Converter RS-232 / RS-485	AZL5 RJ45
Pin	RS-485	Depending on	Pin
3	Bus-P	manufacturer	1
8	Bus-N		3
			4 6

8.2 Ports of the AZL5

The AZL5 has 3 ports (connections):

- Port for the LMV5: CAN bus including power supply for the AZL5 (Sub-D connector on the underside of the AZL5)
- Port for the PC / laptop: RS-232 (Sub-D jack under the cover of the AZL5 front)
- Port for BACS including power supply for the external e-bus interface (RJ45 jack on the underside of the AZL5).
  This interface can also be used as the output for delivering trending data. The interface configuration of the Modbus is also used here

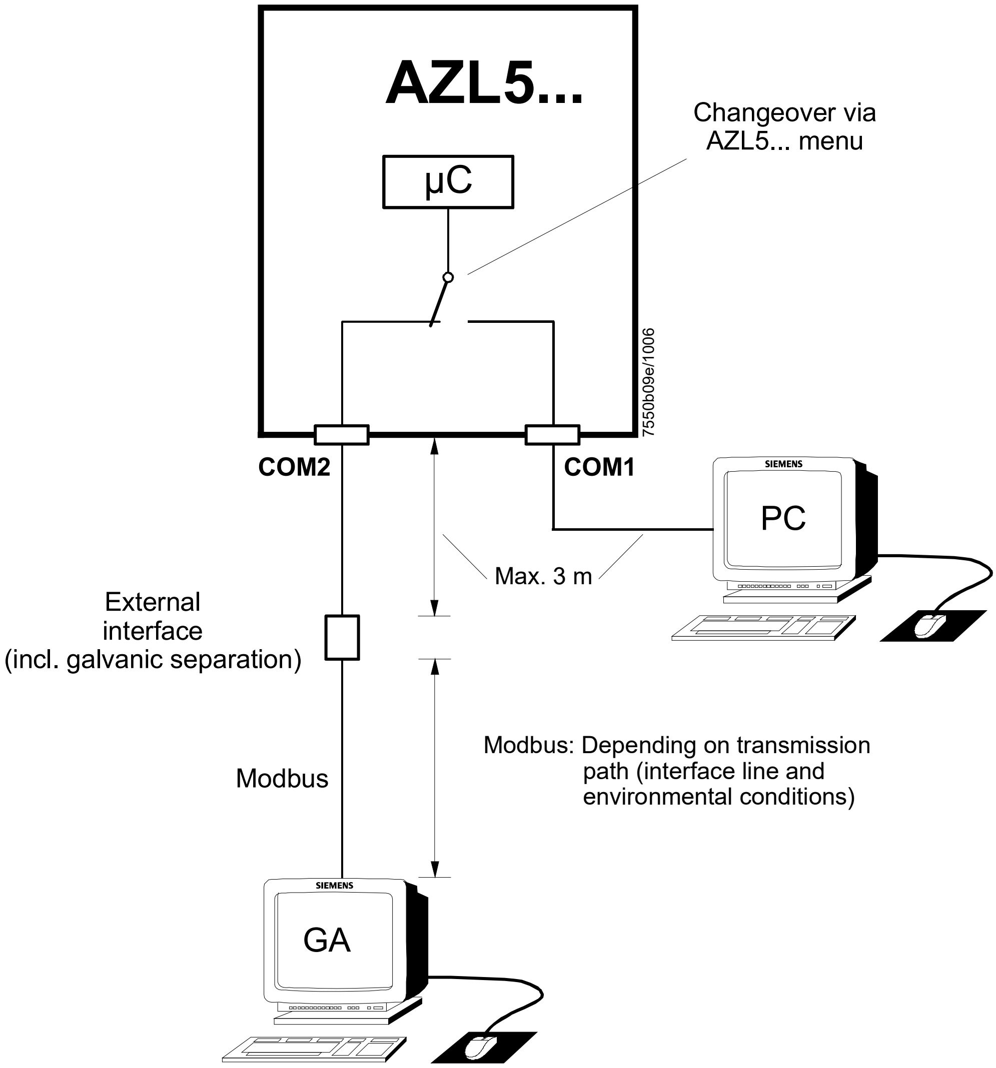


Figure 66: Ports of the AZL5

The AZL5 menu (*Operation → Select operating mode*) offers the following choices:

- Interface PC
- Gateway BACS on
- Gateway BACS off

☞ Note!
The CAN bus connection to the LMV5 can simultaneously be combined with only **1** of the 2 ports, either *Interface PC* or *Gateway BACS*.

8.2.1 Port for the PC

Communication with the PC takes place via the COM1 port of the AZL5 (RS-232).

The PC software ACS450 offers the following operating functions:
- Readout of settings, operating states, types of error, and points in time the errors occur (LMV5)
- Graphic support for setting the electronic fuel-air ratio control system
- Parameterization of the LMV5
- Trend recording (write function)
- Printout functions for documenting the plant settings
- Program update of the AZL5

For the standard operating functions, the following transmission parameters have been set:
- 19,200 bit / s
- 8 data bits
- No parity
- 1 stop bit

During the program update of the AZL5, the transmission rate between PC software and AZL5 is automatically increased to 38,400 bit/s.

Order data for a RS-232-USB adapters for connection AZL52 to PCs that have only a USB interface, refer to chapter *RS-232-USB adapter (connection AZL52 to PC for using the ACS450 PC tool*.

8.2.2 Interface to BACS

8.2.2.1 General information and BACS functions

Communication with a BACS is accomplished via a data link and an external bus interface with galvanic separation. This interface is to be connected to the COM2 port of the AZL5 It facilitates Modbus operation, depending on the configuration of the AZL5.

8.2.2.2 Modbus

With this bus protocol, the AZL5 operates as a slave. The transmission mode used is Remote Terminal Unit. For detailed information, refer to the document *Modbus AZL5 A7550.*
Standardized interfacing software is available on request.

Example: Interconnection of Siemens Simatic S7 and LMV5

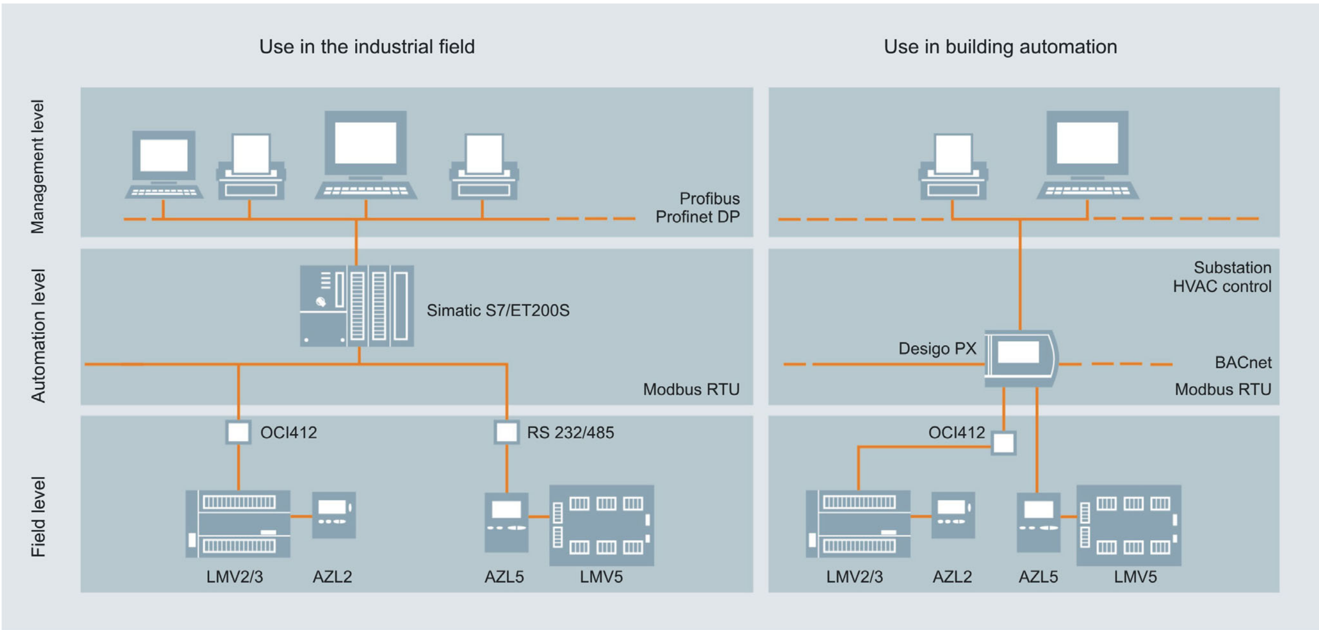


Figure 67: Connection to superposed systems

Writing parameters

- Boiler sequence control (max. 8 boilers)
  Boiler sequence control with predefined setpoints:
  On the AZL5 menu *Params & Display* → *SystemConfig*, set parameter *LC_OptgMode* to *Int LC bus*,
  or
  Boiler sequence control with predefined load:
  In this case, set the parameter to *Ext LC bus*.
- Select the type of fuel
- Set the date and the time of day

Only **non**-safety-related data may be changed via BACS.
A reset via BACS is **not** possible.

Examples: Connection Siemens Simatic S7-1200 and LMV5

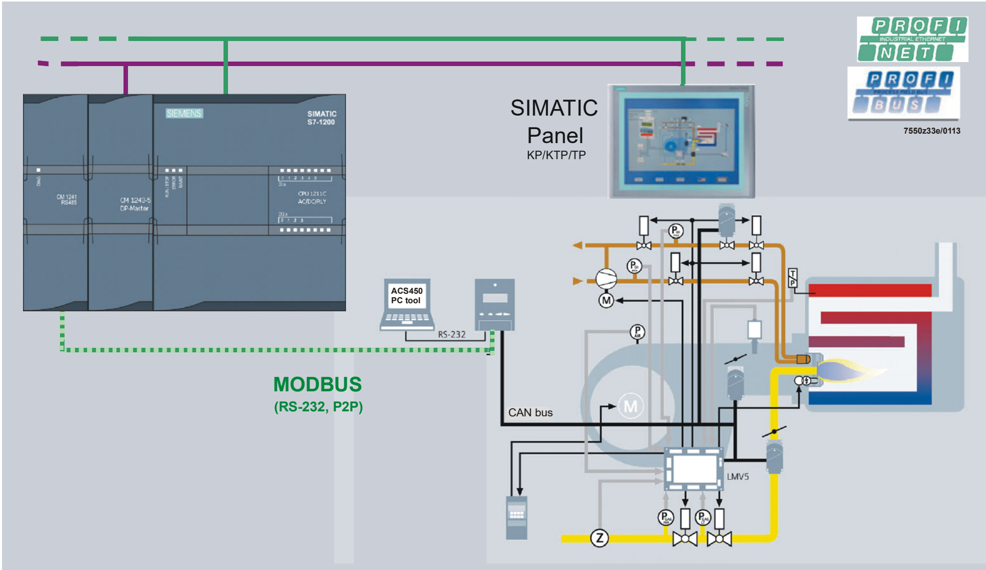


Figure 68: Connection for LMV5 to SIMATIC S7-1200 via Modbus

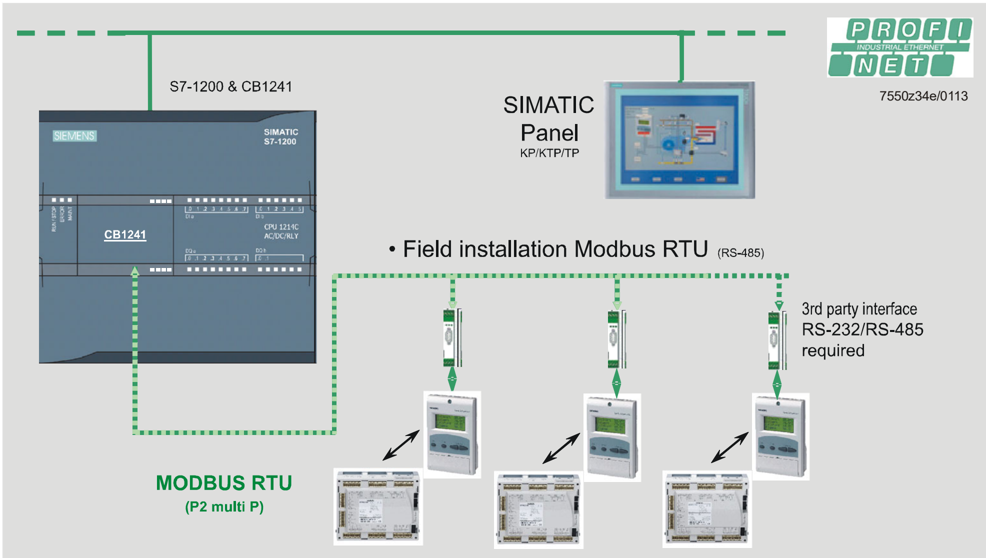


Figure 69: Connection for several LMV5s to SIMATIC S7-1200 via common Modbus

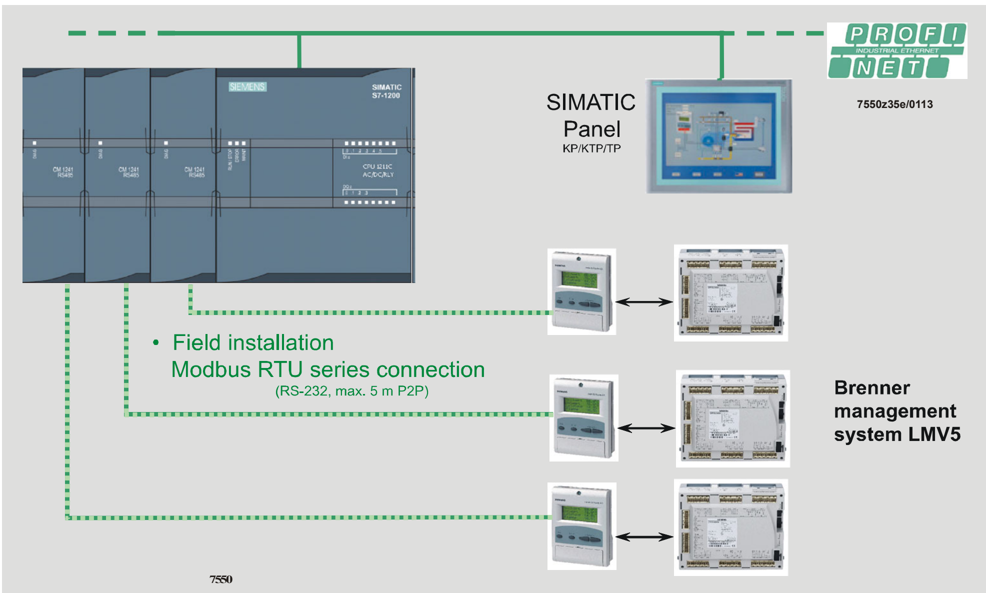


Figure 70: Connection for several LMV5s to SIMATIC S7-1200 via separate Modbus connections

Examples: Connection Siemens ET 200S and LMV5

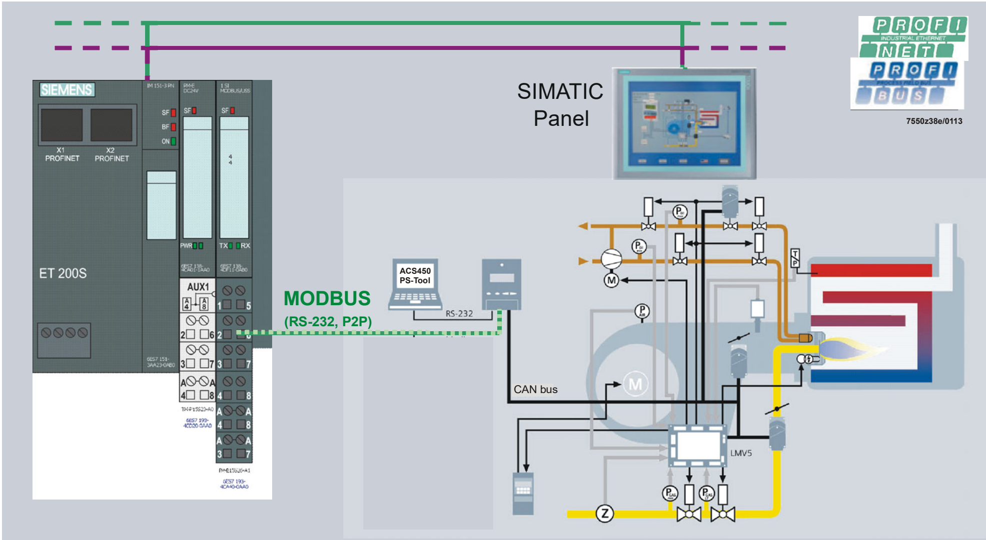


Figure 71: Connection for LMV5 to ET 200S via Modbus

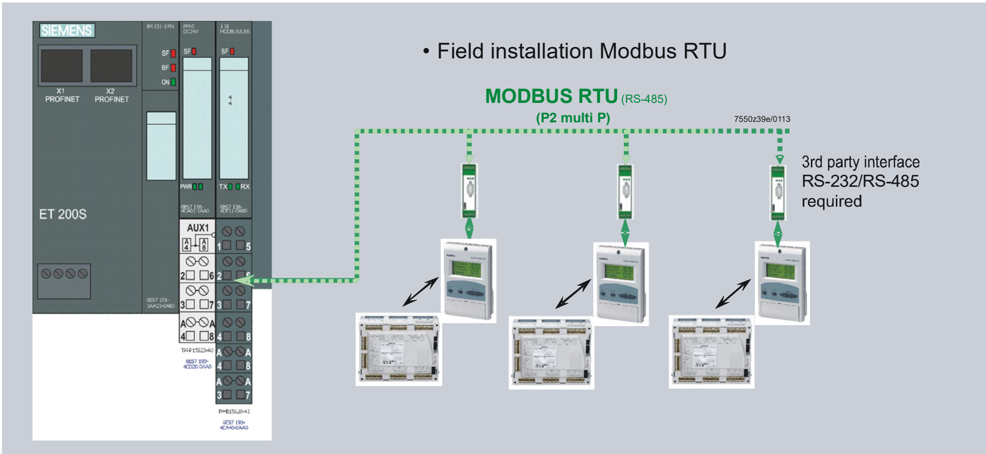


Figure 72: Connection for several LMV5s to ET 200S via common Modbus

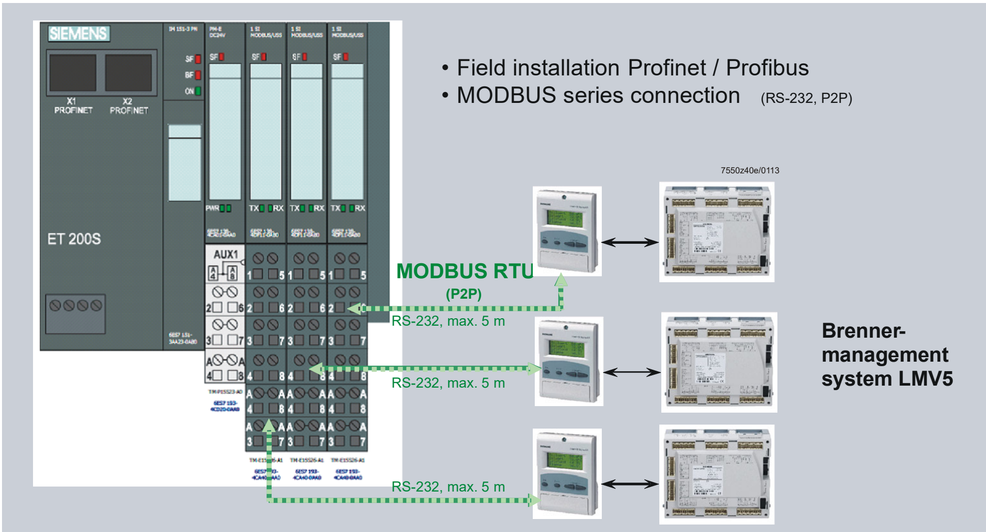


Figure 73: Connection for several LMV5s to ET 200S via separate Modbus connections

8.2.3 Interface for the output of trending data

The COM2 X72 interface (RJ45-jack on the underside of the AZL5) can also be used as an output for delivering trending data by setting the *Type of Gateway* parameter to *Data output*.
The interface configuration for Modbus is also active for this.

Data protocol content (data output AZL52):

1. Phase (Byte)
2. Fuel train(byte):
   0x00 → Gas direct injection
   0x01 → Gas pilot ignition 1
   0x02 → Gas pilot ignition 2 (combined with LOgp, HOgp)
   0x13 → Light oil
   0x14 → Heavy oil
   0x15 → Light oil with gas pilot
   0x16 → Heavy oil with gas pilot
3. Position of air actuator (word with offset 100; e.g. value 200 means 10.0°)
4. Position of fuel actuator (word with offset 100)
5. Position of auxiliary actuator1 (word with offset 100)
6. Position of auxiliary actuator2 (word with offset 100)
7. Position of auxiliary actuator3 (word with offset 100)
8. VSD speed (word with offset 100; e.g. value 600 means 50.0%)
9. O2 actual value (word, e.g. value means 20.0%)
10. Actual value (word, e.g. value 1000 means 100.0%)
11. Actual temperature / pressure (word, e.g. value 120 means 120 °C or 12.0 bar)
12. Set temperature / pressure (word, e.g. value 85 means 85 °C or 8.5 bar)
13. O2 trim controller manipulated variable (word with offset 500, e.g. 400 means 10.0% air reduction in relation to ratio control curve)
14. O2 trim controller status (byte)
15. O2 setpoint (byte, e.g. 85 means 8.5%)
16. Flue gas recirculation temperature (word, e.g. value 320 means 320 °C)
17. Flame signal (byte, e.g. value 95 means 95%)

Parameter	*Type of Gateway (eBus / Modbus / Data output.)*

8.3 Displays and settings

8.3.1 Menu structure

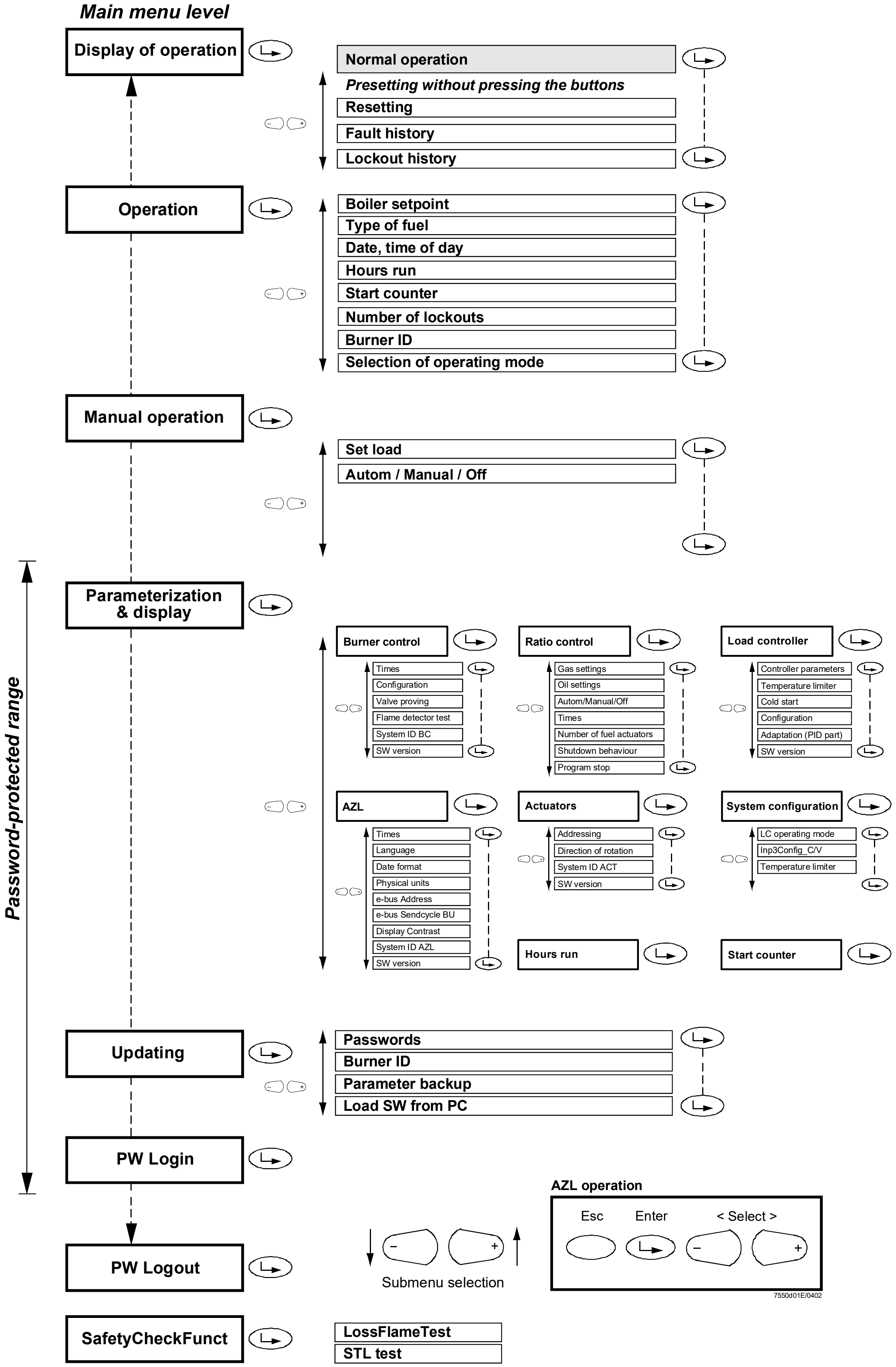


Figure 74: Display and settings

8.3.2 Display of normal operation

Below, the most important displays of normal operation and examples of *Lockout and start prevention messages* and *Parameterization* are defined. In normal operation, the display shown is the default display which automatically appears and which is maintained as long as no settings are made and no unusual events like faults or start preventions occur. The change from other displays to the normal display can be made by pressing the **Info** button. If the startup procedure shall be watched, the display can be switched to *Normal operation* by simultaneously pressing the select buttons «**<**» and «**>**» or the **Info** button.

Normal operation (undisturbed, no manual entries)

HOME RUN (Phase 10)

```
LMV 5x
Home Run      10
Start No  123456
F05.1 A02.4 04.3
```

STANDBY (Phase 12)

```
Setpoint  125°C
Act Value 124°C
Fuel        Oil
Standby       12
```

STARTUP I (Phases 20, 21)

```
Waiting for
Start Realase 21

F05.1 A02.4 04.3
```

STARTUP II (Phase 22)

```
Start
Fan on        22

F05.1 A02.4 04.3
```

STARTUP III (Phase 24)

```
Driving to
Prepurging    24

F05.1 L44.6 30.3
```

STARTUP IV (Phases 30...34)

```

Prepurging    32

F05.1 L94.6 98.3
```

STARTUP V (Phase 36)

```
Driving to
Ignition Pos  36

F65.1 L44.6 10.3
```

Display normal operation (cont'd)

STARTUP VI (Phase 38)

```
Ignition Pos     38
F32.1 L42.3 22.3
```

STARTUP VII (Phases 40, 42, 44)

```
Fuel
Release 1       40
Flame          80%
F32.1 L42.3 22.3
```

STARTUP VIII (Phases 50, 52)

```
Fuel
Release 2       50
Flame          80%
F32.1 L42.3 22.3
```

STARTUP IX (Phase 54)

```
Driving to
Low-fire        54

F28.5 L38.3 18.5
```

OPERATION I (Phase 60)

```
Setpoint  125°C
Act Value 124°C
Load     57.5%
Flame     100%
```

OPERATION II (Phase 62)

```
Shutdown
Low-fire        62

F28.5 L17.6 12.5
```

SHUTDOWN (Phase 70)

```
Shutdown
                70

F28.5 L17.6 12.5
```

SHUTDOWN (Phase 72)

```
Driving to
Postpurge       72

F05.1 L44.6 30.3
```

Display normal operation (cont'd)

SHUTDOWN (Phases 74...78)

```
Postpurging      74
F28.5 L17.6 12.5
```

SHUTDOWN (Phase 79)

```
Test Air Press
Switch           79
F28.5 L17.6 12.5
```

VALVE PROVING (Phases 80...83)

```
Valve Proving
                 80
Evacuating
```

```
Valve Proving
                 81
Test atmos Press
```

```
Valve Proving
                 82
Filling
```

```
Valve Proving
                 83
Test Gas Press
```

8.3.3 Lockout and error messages

SAFETY PHASE (Phase 01)

```
Safety Phase
              01


```

LOCKOUT (Phase 00)

```
Lockout
Reset via
Operational Stat
 Status/Reset
```

8.3.3.1 Example: Display of lockouts in the lockout history

In the event lockout occurs, the display alternates at 5-second intervals.
Press **Enter** to select 1 of the 2 display texts. In that case, the alternating cycle is interrupted.
Example: Lockout due to a gas pressure signal in connection with gas valve proving.

```
1 18.06.99 10:35
C:31 D:00 P:81
Start No :123456
Load:  25.0  Gas
```

```
Gas Pressure
Valve Proving:
Valve on Gas
Side leaking
```

C = error code   D = diagnostics
P = phase   DK = gas valve proving

Example: Display of errors in the error history

In contrast to the lockout history, the error history contains the errors of all error classes and not only the lockouts.
If an error occurs, the display alternates at 5-second intervals.

```
12 Class: 03 GAS
Code:21 Phase:24
Diag:00 Lod: 0.0
Start No:123456
```

Example: Safety loop open

```
Safety Loop
open


```

Lockout and error messages (cont'd)

Example: Immediate display of lockouts

In the event lockout occurs, the display alternates at 5-second intervals.

```
Lockout
```

```
Gas Pressure w
Valve Proving:
Valve on Gas
Side leaking
```

Example: Immediate display of safety shutdowns

In the event of safety shutdown, the display alternates at 5-second intervals.

```
Safety Shutdown
```

```
Gas Pressure has
dropped below
minimum Limit
```

Example: Immediate display of warnings

In the event of warnings, the display alternates at 5-second intervals.

```
Warning
```

```
Slope too steep
```

Example: Immediate display of start preventions

In the event of start preventions, the display alternates at 5-second intervals.

```
Start Prevention
```

```
Air Pressure
on
```

8.3.4 **Standard parameterizations** (inclusive entry of password)

For the complete parameter list, refer to *Setting List I7550*.

Menu selection

A main menu item is selected as follows:

```
OperationalStat
Operation
ManualOperation
Params & Display
```

Calling up and selection

To indicate a selection, the first letter of the menu item is shown with a flashing pointer.
As long as the selection is made by pressing the **Select** buttons within the 4 menu items shown on the display, the selection scrolls.
If some other (presently not shown) menu item shall be selected, the menu display scrolls.
Press **Enter** to make the final selection.
This calling up and selection procedure is similar on all other menu levels.

Example:

```
Operation
ManualOperation
Params & Display
Updating
```

Changing the standard parameters

This action is shown using the example of setting the prepurge time of the burner control section.

Selection of the associated main menu item:

Main menu item *Params & Display* is called up and selected as described above:

```
OperationalStat
Operation
ManualOperation
Params & Display
```

P = flashing pointer

Entry of password (PW)

It is very important to observe chapter *Safety notes on settings and parameterization*!
Before changing to parameter settings, a password must be entered. For that purpose, the display shown below appears.

First, the pointer points to the first character of the line *Access without PW*. Access without password is always possible for the Enduser level.

- If a valid password has been entered, there will be no more password prompt when accessing this parameter setting level until the end of the legitimation period is reached, or until legitimation is manually deactivated
- If required, access to the parameters can be deactivated on the bottom line of the main menu before the legitimation period expires

If a password shall be entered, line *Enter password* is selected by means of decrementing (pointer points to the first character of that line) and then finally selected by pressing **Enter**.
Then, the pointer jumps to the first position of the password entry line. Now, through incrementing or decrementing, a character (digit or letter) can be selected. A character is confirmed by pressing **Enter**. If a wrong entry has been made, the last character can be edited again by pressing **Esc**.
The other password positions can be selected, edited and entered in a similar way. Hence, when making an entry, only 1 character is visible.
When the last character of the password is reached, the entry is to be confirmed by pressing **Enter**.

Service
OEM = burner manufacturer
SBT = Siemens

- The passwords are linked to the access levels (Service, OEM, SBT). This means that the parameters available for editing are only those associated with the access level
- When leaving the parameter setting level, a backup is offered

Start display

```
Access w-out  PW
Access Serv
Access OEM
Access SBT
```

Display before the first password character is entered:

```
Enter Password
:********
```

Display when entering the third password character:

```
Enter Password
:**S*****
```

If the check of the password entered is positive, the change to the next menu level takes place. Otherwise, the display returns to the main menu level.

First submenu level

Example: Calling up and selecting submenu *BurnerControl*

```
BurnerControl
RatioControl
LoadController
AZL
```

Second submenu level

Example: Calling up and selecting submenu *Times*

```
Times
Configuration
ValveProving
LossFlameTest
```

Third submenu level

Example: Calling up and selecting submenu *TimesStartupx*

```
TimeStartup1
TimeStartup2
TimesShutdown
TimesGeneral
```

Fourth submenu level

Example: Calling up and selecting parameter *PrepurgeTmeGas*

```
MinTmeStartRel
FanRunupTme
PrepurgeTmeGas
PrepurgeTmeOil
```

Setting the parameter:
After the required parameter has been called up and selected, the display shown below appears. Lines *Curr* and *New* show identical values at first, namely the actual parameter value

The pointer automatically points to the colon on line *New*. Here, the required new value can be entered, whereby the AZL5 automatically displays the 4 possible line setting ranges with the associated resolutions:

- 0...12.6 s resolution 0.2 s
- 13...63 s resolution 1 s
- 70...630 s resolution 10 s
- 11...63 min resolution 1 min

```
PrepurgeTmeGas
Curr:12.6s
New :12.6s
```

Setting the new value.

```
PrepurgeTmeGas
Curr:12.6s
New :  30s
```

a) As soon as the LMV5 has handled the parameter settings, the new value appears on line *Curr*. You need to make certain that the 2 values are identical (safety test of display)

```
PrepurgeTmeGas
Curr:  30s
New :  30s
```

You can return to the next higher menu level by pressing **Esc.**

8.3.5 Addressing / function assignment of actuators

To make the addressing, the actuator must be opened. A button and an LED are located behind the actuator's removable plastic cover.
In connection with addressing with the help of the AZL5, the button is used to define the address of an actuator.
When commissioning the plant, the actuators are in their addressing mode as supplied. To indicate this, the LED is steady on. If the LED is **not** steady on, refer to *Reset* below.

To make the addressing, select the following menu on the AZL5:
Params & Display → Actuators → Addressing

This menu contains the choice of actuators to be addressed (e.g. the air actuator). By appropriately positioning the pointer and then pressing **Enter**, you can select the required actuator function.
Address assignment is started by pressing **Enter**. After a short period of time, you will be prompted to press the button on the actuator to be addressed.
The AZL5 confirms successful address assignment. To be sure, the address of the actuator can be checked against the blink code which now appears.
This procedure can be repeated for other actuators used by the system, but the AZL5 does not allow double assignments. In that case, a display tells you that an appropriate actuator is already used by the system.

Direction of rotation

To select the direction of rotation, use the following menu on the AZL5:
Params & Display → Actuators → DirectionRot

You are given the choice of *standard* and *reversed*:

Standard (counterclockwise) **Reversed** (clockwise)

Facing the end of the drive shaft (**not** mounted)

Figure 75: Addressing the actuators

To check the direction of rotation, every actuator can be moved in the home position in fault-free standby mode.
The parameter is filed in the LMV5 so that the direction of rotation need not be reentered when replacing the actuator.

Note!
After setting the ignition positions or curves, the direction of rotation can only be changed after deleting the curves and ignition positions on setting menu *Delete Curves*.

Operational status indication by LED on the actuator:

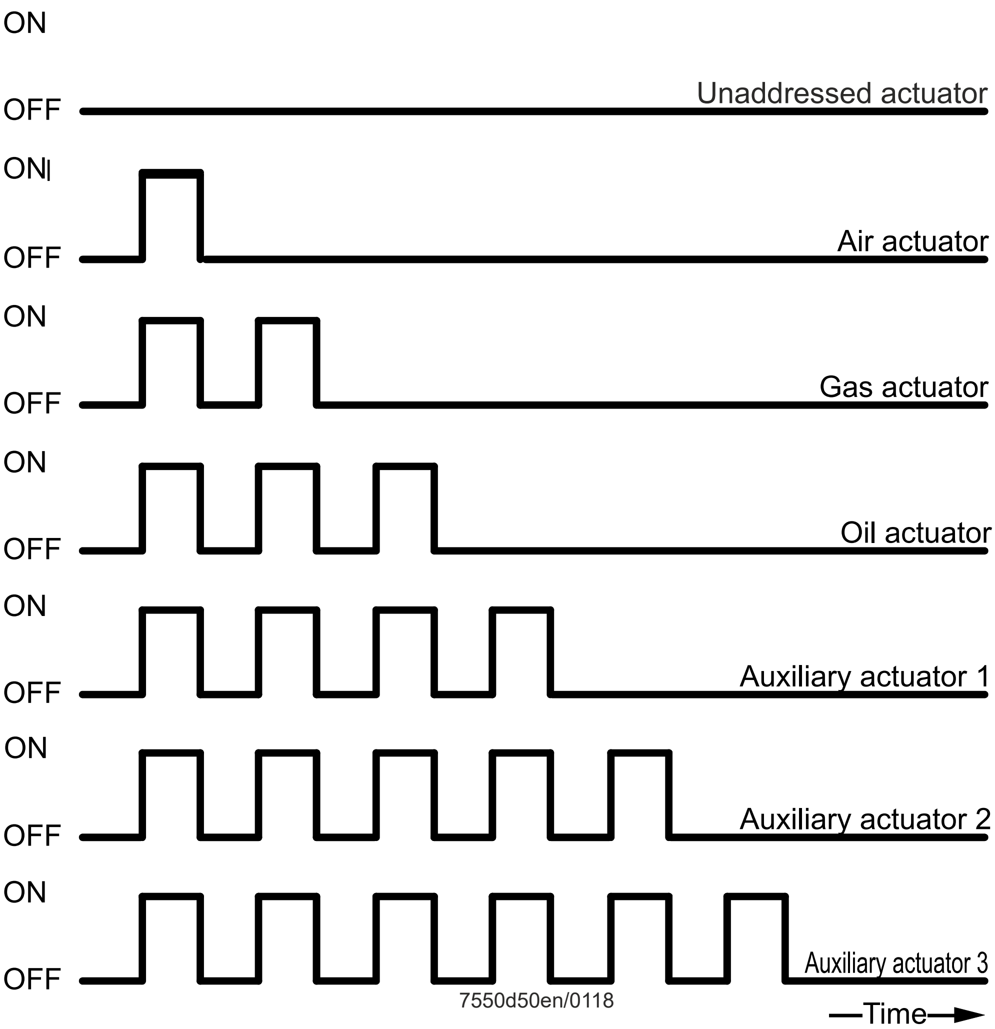


Figure 76: LED function code

The actuator gives the addressing address via the blinking signal of the LED.
The blink interval is 200 ms.
After each blink cycle, there is a pause of 1.2 seconds.

Example of an actuator for gas

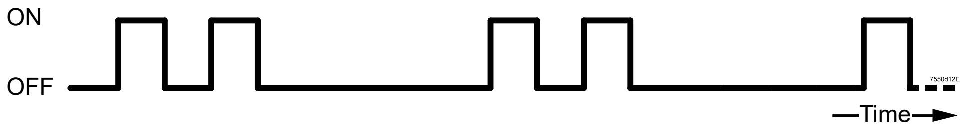


Figure 77: Addressing completed

Reset

This facility makes it possible to reset an addressed actuator in the case of a replacement, repair, or if addressing is wrong (wrong address assignment by the user). For that purpose, you need to press the actuator's addressing button for at least 10 seconds when the actuator is in normal operation. The actuator will then reset its address which is indicated by the LED, which is steady on.

8.3.6 Setting the fuel-air ratio control curves

The following chapter deals with the parameterization of the *Fuel-air ratio control*.

Selection menu *Ratio control*

The selection menu looks as follows:

GasSettings	1)
OilSettings	2)
Autom/Manual/Off	3)
Times	4)
NumFuelActuators	5)
ShutdownBehav	6)
ProgramStop	7)

The selection of 3) through 7) leads to standard parameterizations of the specified parameters.

The selection of 1) leads to:
Selection menu *Settings Gas*

Only the data associated with the currently active type of fuel can be parameterized.

SpecialPositions	1)
CurveParams	2)
LoadLimits	3)
Load mask out	4)
AuxActuator	5)

Calling up 1) (*HomePos..., PrepurgePositions*...), 3) through 5) leads to standard parameterizations of the specified parameters.

Selection of 2) leads to:
Selection menu *Curve Param* (modulating)

Point	Load : 23.2	
: 1	Fuel : 23.2	
Man	Air : 41.6	
	Aux : 33.3	
	Aux2 : 29.2	only LMV52
	Aux3 : 13.8	LMV50/LMV51.3/ LMV52
	VSD : 45.0	LMV50/LMV51.3/ LMV52

In this example, the ignition positions are copied to the first point of the curve. This is always made automatically when the ignition positions are defined but no point on the curve has as yet been entered. The preliminary load value entered is the position value of the fuel actuator. This point is also automatically approached as the low-fire point. If the installer attempts to reach submenu *CurveParams* before the ignition positions are defined, point number «1» appears.
But the position fields display «XXXX», indicating that the data are **invalid**. When making the parameter settings, the installer is guided, starting with entry of the ignition positions and coarse adjustment of the low- and high-fire positions to fine adjustment of the curve settings with up to 15 curvepoints.

This setting of the curve can be made in 2 different ways:

1. Individual points are specifically entered.
2. Ratio control is operated in manual operation until the value reached is to be stored as a new point.

A more detailed description of both approaches is given below:

8.3.6.1 Adjusting the curves by introducing or editing an individual point

In this setting mode, an individual curvepoint is edited by acknowledging the pointer on *Point* by pressing **Enter**, causing the pointer to jump to the curvepoint number.
By scrolling the (available) curvepoints, the point to be edited or a new point can be selected. After acknowledgement, the pointer jumps to the right field of the display, thus releasing the individual actuator positions and the associated load value for change or adjustment. Below, the procedure is shown in graphic form:
When accessing this menu, the pointer is positioned on *Point*. To edit the curvepoint, the pointer must be positioned on *Point*.

- Pointer positioned on *Point*:

```
Point |Load  :23.5
      |Fuel  :23.2
Man   |Air   :41.6
      |Aux   :33.3
```

- Continue by pressing **Enter**

⇓

```
Point |Load  :23.5
  :  3|Fuel  :23.2
 O2   |Air   :41.6
  4.5 |Aux   :33.3
```

After selecting the curvepoint number, the associated point data are always displayed in the right column (see above). Below that, the currently acquired O2 value is now shown if a PLL52 and a QGO20 are connected to the system.
The first unused point always has the highest number. If, for instance, 3 points are used, a new point is given number 4 prior to sorting. The new point is also characterized by the display of «XXXX» for the point‘s data.

Note!
When introducing a new point, the following display is skipped!
- For changing the parameter data:
  Select the required curvepoint, then continue by pressing **Enter**.

⇓

```
Point |Point
  :  3|change?
Man   |delete?
      |
```

Here, the pointer position can vary between *change?* and *delete?*.
To edit the point, select *change?*.

- Continue by pressing **Enter**

⇓

```
Actuator       §
Positions
 Followed
 Not followed
```

This selection can be used to determine whether the load and the positions of the selected curvepoint shall be approached. Hence, curvepoints can be changed without having to drive to them.

The following description also applies to *without driving*, but the load and the positions will not be approached:

Caution!
Curvepoints that have been changed via the *without driving* function must be checked to ensure that their combustion values are correct!

If curvepoints have been set *without driving,* the degree of readjustment is based on estimation. This means that there is no proof yet that all curvepoints are correctly set from the combustion point of view. This must be ensured using adequate measuring equipment.

- Continue by pressing **Enter**

⇓

```
Point|Load  :23.5
  :  3|Fuel  :23.2
 O2   |Air   :41.6
  4.5|Aux   :33.3
```

It is to be noted that with these settings, which can be made in standby and normal operation, the actuators are driven to the displayed or changed positions.
Traveling to the load that is assigned to the curvepoint can be stopped by pressing **Esc**.
During the time the actuators approach the positions, the display shows «**>**» in place of «**:**».

Note!
If a new point is created, the current actual values are adopted as point data and can be changed.

The parameter that shall be changed (e.g. *Fuel position*) can be selected by changing the pointer position.

```
Point|Load  :23.5
  :  3|Fuel  :23.2
 O2   |Air   :41.6
  4.5|Aux   :33.3
```

After the selected curvepoint has been reached by the system:
- Continue by pressing **Enter**

⇓

```
Point|Load :23.5
  : 3|Fuel :23.2
 O2  |Air  :41.6
  4.5|Aux  :33.3
```

Now, the selected parameter can be changed online. This means that the system follows the changes at the rate of the selected ramp speed. Press **Enter** to save the changed values.
Now, other parameters for change can be selected.
If **Esc** is pressed before **Enter**, changes made to the selected parameter (e.g. *Fuel position*) are rejected and the value saved last is restored.

When leaving this level by pressing **Esc**, the following query appears:

```
Point
Store ->ENTER
Cancel->ESC
```

Enter saves the changes or the new point and adds them to the existing points in the correct order (during the storage process, no buttons are evaluated; to indicate this, a symbol appears on the display).
The changes can be rejected by pressing **Esc**.

Canceling a curvepoint

When accessing this menu, the pointer is positioned on *Point*. To cancel a curvepoint, the pointer must be positioned on *Point*.

- Pointer positioned on *Point*:

```
Point |Load   :23.5
      |Fuel   :23.2
Man   |Air    :41.6
      |Aux    :33.3
```

- Continue by pressing **Enter**

⇓

Point of curve number

```
Point |Load   :23.5
  :  3|Fuel   :23.2
 O2   |Air    :41.6
  4.5 |Aux    :33.3
```

The respective point (SP) is selected by calling up the curvepoint number.
The data associated with the point number are always displayed in the column on the right (see above).

- For canceling the parameter data:
  Select the required curvepoint, then continue by pressing **Enter**

⇓

```
Point |Point
  :  3|change?
Man   |delete?
      |
```

Here, the pointer position can vary between *change?* and *delete?*.
To cancel the curvepoint, select *delete?*
Confirm by pressing **Enter**.
The selected point has been canceled and the actuators travel to the positions determined by the remaining curvepoints, in other words, the system's output is maintained.

8.3.6.2 Curve setting via manual operation

In addition to curve settings by means of individual point entry, it is also possible to adjust the burner in manual operation with optional point storage.

The procedure is the following:
After leaving menu item *CurveParams*, position the pointer on *Man* when reaching the menu.

- Pointer positioned on *Man*:

Point	Load : 23.5
	Fuel : 23.2
Man	Air : 41.6
	Aux : 33.3

When pressing **Enter**, the following display appears:

O2	Load : 23.5
4.5	Fuel : 23.2
Man	Air : 41 6
:23.5	Aux : 33.3

This menu enables the installer to manually change the output by using incrementing or decrementing commands, letting the actuators operate on interpolated straight lines (outside the parameterized curvepoints: Extrapolation). Above that, the currently acquired O2 value is now shown if a PLL52.110A200 and a QGO20 are connected to the system.
Traveling to the output preset here can be stopped by pressing **Esc**.
The actual curve settings are made by adjusting the entire fuel-air ratio control system based on the roughly predefined curvepoints and outside the defined points. After pressing **Enter** again, new points can be introduced at the required positions.

Then, the values can be changed:

Point	Load : 28.5
:3	Fuel : 28.4
O2	Air : 45.2
4.5	Aux : 31.3

The further setting procedure is the same as that used with *Edit individual point*.

Example: Adjustment of the fuel-air ratio control system via manual control

Prerequisite: No curvepoints parameterized.

1. Activating program stop
Via menu: *Params & Display* → *RatioControl* → *Program Stop*
→ parameterize from *deactivated* set *24 PrePurgP*

2. Starting the system
Via menu: *Params & Display* → *RatioControl* → *Autom/Manual/Off*
or via: *Manual Operation* → *Autom/Manual/Off* → *Manual*
and confirm.

3. Setting the prepurge positions
The system commences the startup sequence and stops in phase *24 PrePurgP*. Now, the prepurge positions can be set on menu *SpecialPositions*. Then, on *ProgramStop*, change to *36 IgnitPos*.

4. Setting the ignition positions

The system continues the startup sequence and stops in phase *36 IgnitPos*. Now, the ignition positions can be set on menu *SpecialPositions*.
Then, set *ProgramStop* to *72 PostPPos*, if operation shall immediately follow.
To readjust the ignition positions after the burner has ignited: Set *ProgramStop* to *44 Interv 1* or *52 Interv 2* for pilot ignition after the pilot flame has been shut down. Then, set *ProgramStop* to *72 PostPPos*.

5. Curve settings via manual control

The system continues the startup sequence and assumes normal operation. The first curvepoint entered are the ignition positions and the load entered is the number of degrees (angular rotation) of the fuel actuator.

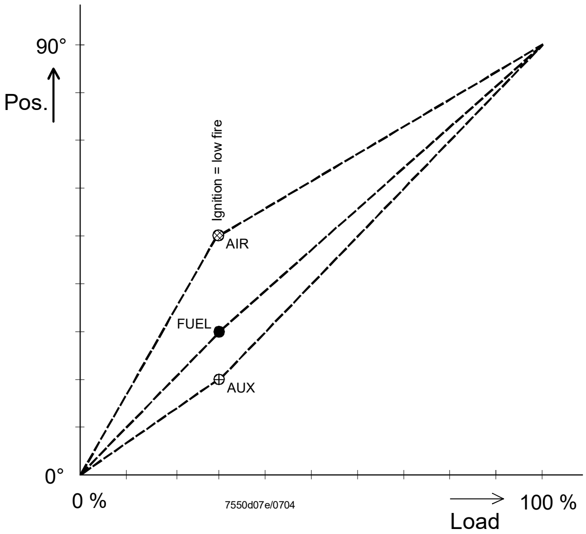


Figure 78: Adjustment of the actuator positions via the load with automatically entered point

Select *Man* from menu *Params & Display* → *RatioControl* → *Settings Gas* or *Oil* → *Curve Param*. It is now possible to follow the above curves by changing the load. A point can be saved at every intermediate point. Then the figure of the adjustment of the actuator positions via the load will change as follows:

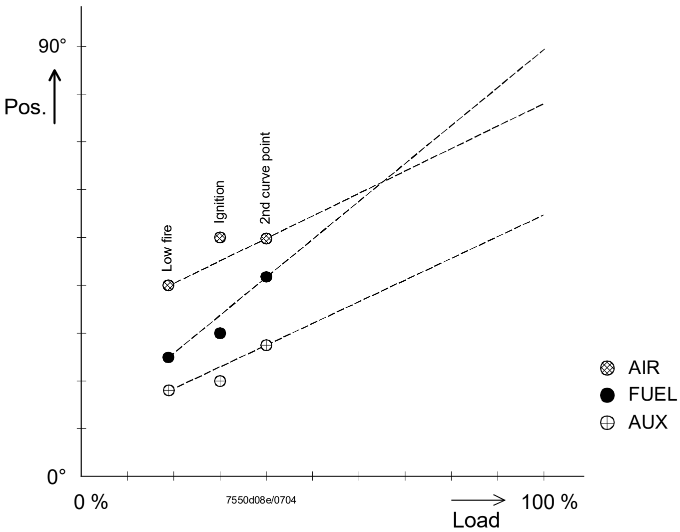


Figure 79: Adjustment of the actuator positions via the load with 2 points

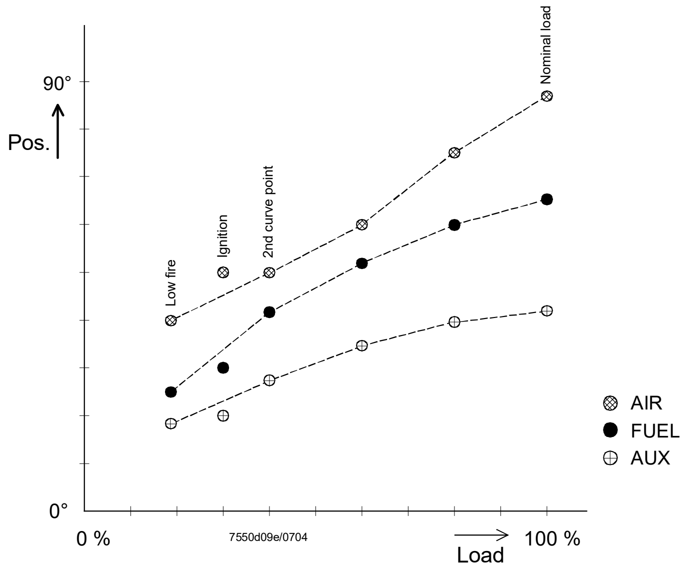


Figure 80: Adjustment of the actuator positions via the load with multiple points

Using this method, up to 15 points can be defined.

6. Shutdown

Via menu: *Params & Display* → *Ratio Control* → *Autom/Manual/Off*
or via: *Manual Operation* → *Autom/Manual/Off* to *Burner off* and confirm

7. Setting the postpurge positions

The system shuts down and stops in phase *Driving to postpurge 72*.
Now, the postpurge positions can be set via menu *Special positions*.
Then, set *Program Stop* to *deactivated*.
The system continues the shutdown sequence and stops in phase *Standby 12*.

Selection menu setting oil

Only the data associated with the currently active type of fuel can be parameterized.

SpecialPositions	1)
CurveParams	2)
LoadLimits	3)
AuxActuator	4)

Selection of 1) (*HomePos, PrepurgePositions*), 3) and 4) leads to standard parameterizations of the specified parameters.

Selection of 2) leads to:

Curve Settings	1)
Operation Mode	2)

Selection of 2) leads to the standard parameterization of the operation mode (modulating or multistage).
Selection of 1) leads to curve settings – modulating (refer to *Gas*) or to curve settings – multistage, depending on the parameterized operation mode.

8.3.6.3 Setting modulating ratio control

Refer to selection menu *Settings Gas*

8.3.6.4 Setting multistage ratio control

With multistage fuel-air ratio control, the position values can be changed in 2 different ways:

1. Presetting the positions with no response by the actuators to fine-adjust the points later using *followed*.
2. Setting the switching and operating positions from «below» using *followed*. This means that stage 1 must be adjusted first, followed by the next switching on point, etc.

```
Actuator          §
Positions
 Followed
 Not followed
```

When the switch on/off and operating positions have been parameterized with *not followed*, the values can be changed. The system maintains its current load stage.
The menu offers the choice of *followed* or *not followed*.
The display is maintained while the settings are made.
When accessing the menu, the operating positions *Stage 1* appear.
By pressing the **Selection** buttons, the entered positions of all switching and operating points can be viewed.
This has no impact on the system, even if *followed* was selected:

If *followed* is selected, parameterization is made as follows:

```
Point I Air   : 28.5
:BS1  I Aux1  : 28.4
 O2   I       :
  4.3 I       :
```

Setting multistage fuel-air ratio control *followed*

The startup is made similar to modulating operation, including automatic entry of the ignition positions in the operating positions *Stage 1*, if these still display invalid values (showing via XXX.X as a value).

```
Point I Air   : 28.5
:BS1  I Aux1  : 28.4
 O2   I       :
  4.3 I       :
```

For fine adjustment of that point, confirm by pressing **Enter**.

```
Point I Air   : 28.5
:BS1  I Aux1  : 28.4
 O2   I       :
  4.3 I       :
```

This causes output stage 1 to be approached. Here, the actuator to be adjusted can be selected. Again, confirm by pressing **Enter**.

```
Point I Air   : 28.5
:BS1  I Aux1  : 28.4
 O2   I       :
  4.3 I       :
```

Now, the value can be changed and the respective actuator follows at the rate of the set ramp speed.
Enter saves the value, **Esc** discards it.

This way, all stages can be set, one by one.
The following table shows the response of the system when a point is selected.
However, the relevant valve is switched on only when at least the switch-on point is definitely used (≠ XXXX).

Selected point	Response	Remark
Operating point stage 1	Approach of stage 1	Fine adjustment of stage 1
Switch-on point stage 2	Approach of stage 1	Adjustment of stage 1 off
Switch-off point stage 2	--	Adjustment of stages 1 and 2 off
Operating point stage 2	Approach of stage 2	Fine adjustment of stage 2
Switch-on point stage 3	Approach of stage 2	Adjustment of stage 2 off
Switch-off point stage 3	--	Adjustment of stages 2 and 3 off
Operating point stage 3	Approach of stage 3	Fine adjustment of stage 3

System response when a point is selected

8.3.7 Adaption of the load controller's PID parameters

Sequence steps of adaption (self-setting):

1) Starting the adaption
Using the AZL5 menu, the heating engineer manually activates the adaption function of the load controller.

After selecting menu item *Adaption* (within the parameterization of the load controller), the following display appears:
– The pointer is positioned on *Start Adaption*. Adaption is activated by pressing **Enter**

```
Start Adaption
with ENTER    60
Setpoint:70.0°C
Act Val :60.0°C
```

Adaption starts after pressing **Enter** whereupon the following text appears:

```
Adaption active
Load    :52.0%
Act Val :60.0°C
Cancel with ESC
```

Depending on the adaption step, the following displays appear, alternating with the display shown above:

```
Adaption active
Settling Phase
max 10 min
Cancel with ESC
```

```
Adaption active
Temp Setback
Act Val :60.0°C
Cancel with ESC
```

```
Adaption active
Heating
max 10 min
Cancel with ESC
```

2) End of a successful adaption

After adaption, the relevant characteristics are displayed.
By pressing the **Selection** buttons, the P-, I- and D-parts as well as the acquired loop delay time «Tu» are displayed:

```
Adaption ok
P-Part (Xp)
          X25.0%
Continue with <>
```

```
Adaption ok
I-Part (Tn)
            400s
Continue with <>
```

```
Adaption ok
D-Part (Tv)
             35s
Continue with <>
```

```
Adaption ok
Delay Time (Tu)
             10s
Continue with <>
```

3) Canceling the adaption

If the load controller was not able to select a suitable loop, it stops the adaption and displays the following text.

If an adaption in progress is manually canceled by pressing **Esc**, the following text also appears:

```
Adaption
cancelled

Continue w ESC
```

The system changes to normal operation. In that case, the previous PID parameters are maintained.

8.3.8 Burner identification / backup - restore

The burner ID offers the OEM the opportunity – which may also be the OEM's duty – to store an **individual** burner ID in each LMV5 by means of the OEM password, prior to delivery. The burner ID can be entered here, for example, please also refer to chapter *Settings and parameterization notes.*

☞ Note!
The burner ID is then used to enable or disable the transfer of data between the LMV5 and the AZL5 backup storage. Parameters can be loaded to the AZL5 at any time, if the burner ID in the LMV5 is not in the state as supplied.

Saving the parameter backup data of the AZL5 in the LMV5 is possible only if the burner ID is the same as that in the AZL5 and in the LMV5, or the burner ID of the LMV5 is still in the state as supplied.
The burner ID itself is part of the data transfer in both directions (if possible).
In addition, for the burner, the burner ID represents 1 of a number of start prerequisites. In other words, the burner cannot be started up as long as the burner ID is in the state as supplied.
So, it is possible to have data transmission between the LMV5 and the AZL5 of **1** plant (burner IDs are identical) and between an AZL5 and a **new** LMV5 (burner ID as supplied by Siemens).
Data transmission between the AZL5 and LMV5 of different plants (burner IDs not identical) is not possible (no «cloning»!).

Backup - restore

From software version V05.00 of the AZL52, the restoring of backup data from LMV5 devices with a larger scope of functions and with more parameters into LMV5 devices with a smaller scope of functions and fewer parameters is prevented.

Backup files from a LMV50 can only be restored again into a LMV50.

Example:
- Backup file from LMV52 cannot be restored into a LMV51.
- Backup file from a LMV51 can be restored into a LMV52.

Makeup of burner ID

Invalid characters for the burner ID are all vowels (ä, ö, ü, and ß).
Minimum length of burner ID = 4 characters.
Maximum length of burner ID = 15 characters.

8.3.9 Languages

The AZL5 can output the display texts in different languages.
Changeover to another language takes place via menu *Params & Display* → *AZL5* → *Language*.
In addition to English as the basic language, the AZL5 provides another 5 languages. This means that a language group can comprise a maximum of 6 languages.
Using the program update function of the PC software, additional language groups can be loaded to the AZL5 together with the relevant program version.
Hence, direct exchange of the language without loading a new program version is not possible.

8.3.10 Real time clock / calendar, automatic summer / wintertime changeover

The LMV5 is equipped with a real time clock including calendar and backup, which are accommodated in the AZL5.
The clock features automatic **s**ummer- / **w**intertime changeover.

S/W changeover

The following parameter setting choices are available:

Parameter	*Sum/WinterTime (Manual / Automatic)*
	Time EU/US (S/W time EU / S/W time US)

S/W time EU: start: Last Sunday in March
end: Last Sunday in October
S/W time US: start: First Sunday in April
end: Last Sunday in October

Changeover takes place on the dates given above in the night between 02:00 and 03:00 hrs. The time shift is always 1 hour.
Changeover takes place only if the AZL5 receives power at that moment in time.

Backup

Backup is about 10 years.
The backup battery is a replaceable lithium battery.

Type of battery

Refer to chapter *Technical data*.
When changing batteries, ensure ESD protection!
If the AZL5 uses the associated interface to communicate with a BACS, the latter can act as the clock master by cyclically transmitting a preset time of day and date to the AZL5. This information is given priority over all other time of day / date sources.

8.3.11 Adjustment of contrast, shut-off, quick access

Adjustment of contrast (display)

In normal operation of the AZL5, the contrast of the display can be adjusted.
To do this, keep the **Enter** button depressed and, **at the same time,** press the **Selection** buttons (+ or -).
The display contrast changes correspondingly.
The adjustment does not change until power supply is turned off.
For permanent adjustment, use the menu at the parameter setting level.

Shutdown function

Lockout of the LMV5 can be triggered by **simultaneously** pressing **Enter** and **Esc**.
Lockout is stored in the LMV5.

Quick access
Normal operation

To be able to check burner operation any time, press the 2 **Select** buttons simultaneously to switch from any menu item to the *Normal operation* view, either during operation when making parameter settings, or when programming. To return to the menu item previously used, press **Esc.**

8.4 TÜV test

Caution!
The TÜV test function must be performed by authorized personnel.

It is possible to activate…
- **the loss-of-flame test, and**
- **the safety limit thermostat test**

Loss-of-flame test

The loss-of-flame test is activated manually with the AZL5 via the ***SafetyCheckFunct → LossFlameTest*** menu and generates an electronic interruption of the flame signal. Using safety shutdown *Loss of flame*, the LMV5 must shut the burner down.

Safety limit thermostat test

The safety limit thermostat test is activated manually with the AZL5 via ***SafetyCheckFunct → SLT Test***.
The burner is switched on and the load automatically set to the following adjustable level.
Here, it is possible to set the load level that shall be approached in modulating operation:

Parameter	*SLT-TestloadMod*

Here, it is possible to set the load stage that shall be approached in multistage operation:

Parameter	*SLT-TestloadStg (S1 / S2 / S3)*

After safety shutdown triggered by the safety limit thermostat or manual selection, the safety limit thermostat test can be deactivated again.

Caution!
When activating the safety limit thermostat test, the internal controller and temperature limiter functions are deactivated!
Both the setpoint and the temperature limiter switch-off threshold are ignored.

9 Commissioning instructions for the LMV5

Practice-oriented setting instructions for the system configuration, the burner control, and the electronic fuel-air ratio control system

These setting instructions serve for commissioning the LMV5.
To access the parameter setting levels, a password must be entered.
After having entered the correct password, the data appear on the AZL5 (backup for emergencies). Then, the unit can be parameterized.
After leaving the parameter setting level, we recommend to make a backup.

9.1 Basic configuration

1. Parameterizing the burner identification (burner ID)

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Updating					
	BurnerID				

Burner identification: E.g. OEM13-10-02-003 (name of OEM = burner manufacturer; date 13-10-2002, production number 003); minimum 4 characters

2. Selecting the fuel trains

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	BurnerControl				
		Configuration			
			ConfigGeneral		
				FuelTrainGas	
				FuelTrainOil	

FuelTrainGas from *DirectIgniG* to *Pilot Gp2*
FuelTrainOil from *LightOilLO* to *HO w Gasp*

3. Checking the inputs / outputs while taking into account the burner and plant conditions. For details, refer to chapter *Digital inputs.*

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Parameter & Display					
	BurnerControl				
		Configuration			
			ConfigIn/Output		

4. Setting gas valve proving

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	BurnerControl				
		ValveProving			
			ValveProvingType		

Selection of gas valve proving: No VP, VP startup, VP shutdown or VP stup/shd
(→ Gas valve proving system)

5. Addressing the actuators

Prior to programming the actuators, the connector for the bus connection at the last CAN bus element must be plugged in.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	Actuators				
		Addressing			
			1 AirActuator *2 GasActuat(Oil)* *3 OilActuator* *4 AuxActuator* *5 AuxActuator2* *6 AuxActuator3*		

For addressing an actuator, select the respective type of actuator:
1. Air actuator
2. Gas actuator [for dual-fuel burners with only 1 fuel actuator]
3. Oil actuator
4. Auxiliary actuator
5. Auxiliary actuator 2
6. Auxiliary actuator 3
Confirm by pressing **Enter** (→ AZL5).

The AZL5 prompts you to operate the addressing switch on the actuator.

6. Selecting the actuator's direction of rotation

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	Actuators				
		DirectionRot			
			DeleteCurves *1 AirActuator* *2 GasActuat(Oil)* *3 OilActuator* *4 AuxActuator* *5 AuxActuator2* *6 AuxActuator3*		

Select the direction of rotation with *standard* or *Reversed*.
The standard direction of rotation is counterclockwise when facing the end of the drive shaft (→ AZL5).

Note:
To check the direction of rotation, every actuator can be rotated when in the home position (see item 11).
After setting the curves for the ignition position, the direction of rotation can only be changed after deleting the curves and the ignition positions in the setting menu *DeleteCurves*.

7. LMV50/LMV51. activating and deactivating the actuators

In accordance with the application (with or without auxiliary actuator) and the type of fuel, the auxiliary actuator can be activated, deactivated or – in connection with the LMV50 / LMV51.3 – be used as a VSD and/or auxiliary actuator 3 for the flue gas recirculation function (refer to chapter *Actuator addresses*).

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	RatioControl				
		GasSettings			
			AirActuator		
			AuxActuator		
			GasActuator		
		OilSettings			
			AirActuator		
			AuxActuator		
			OilActuator		

LMV52

The actuators can be activated and deactivated in accordance with the application and the type of fuel. Here, it is also defined whether the relevant actuator is used for regulating the air volume. The definition of air-regulating actuators is required for applications employing VSD and O2 trim control.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	RatioControl				
		GasSettings			
			AirActuator		
			AuxActuator 1		
			AuxActuator 2		
			AuxActuator 3		
			VSD		
			GasActuator		
		OilSettings			
			AirActuator		
			AuxActuator 1		
			AuxActuator 2		
			AuxActuator 3		
			VSD		
			OilActuator		

LMV50 / LMV51.3 and LMV52.2

For the configuration of VSDs, refer to chapter *Configuring the VSD*.

8. Setting the load controller (option)

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	LoadController				
		Configuration			
			LC_OptgMode		

Select a load controller operating mode in accordance with the examples given in chapter *Operating modes with load controller ON*.

This configures the output signal for the VSD (refer to chapter *Configuring the current interface*).

9. Selecting a temperature or pressure sensor

If the internal load controller of the LMV5 is used, a temperature or pressure sensor must be connected to input 1, 2 or 4.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	LoadController				
		Configuration			
			SensorSelect *MeasureRange PtNi* *Ext Input X61 U/I* *MRange TempSens* *MeasureRange PressSens* *Ext MinSetpoint* *Ext MaxSetpoint*		

On the configuration level of the load controller, select the required type of sensor. Then, define the sensor's measuring range.

9.2 Settings for gas-fired operation

The next steps explain how the fuel-air ratio control system is to be set.
Specific curves are required for each type of fuel.

10. Activating program stops in different program phases

Activate a program stop when startup shall be stopped to set the special positions.

Prepurging	Phases 24…34
Ignition position	Phase 36
Interval 1	Phase 44
Interval 2	Phase 52
Postpurging	Phases 72…78

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	RatioControl				
		ProgramStop			
			deactivated *24PrePurgP* *32PreP FGR* *36IgnitPos* *44Interv1* *52Interv2* *72PostPPos* *76PostPFGR*		

Activate a program stop in phase 24.

11. Checking and presetting the actuator positions for gas ignition

The unit is supplied with presettings of the parameters *HomePos, PrepurgePos* and *PostpurgePos*. These positions should be checked and adapted if required, either now or during the following program stops.
The ignition positions are **not** predefined. In this section, a valid setting must be made or, otherwise, burner startup is **not** possible.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6	
Params & Display						
	RatioControl					
		GasSettings				
			SpecialPositions			
				IgnitionPos		
					IgnitionPosGas *IgnitionPosAir* *IgnitionPosAux1*	
					IgnitionPosAux2	Only LMV52
					IgnitionPosAux3 *IgnitionPosVSD*	LMV50/LMV51.3/ LMV52

Example: Gas actuator: 32.5° Air actuator: 25.6°

12. Manual startup

To start the burner, select *Autom/Manual/Off* and then *Manual*.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
ManualOperation					
	Autom/Manual/Off				

If startup shall be watched, press simultaneously selection buttons «**<**» and «**>**» to switch the display to *Normal operation*.

13. Actuator positions during the prepurge time

The burner control stops startup during the prepurge phase (phase 24).
The positions of the actuators for prepurging can thus be set very straightforwardly.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6	
Params & Display						
	RatioControl					
		GasSettings				
			SpecialPositions			
				PrepurgePos		
					PrepurgePosAir *PrepurgePosAux 1*	
					PrepurgePosAux 2	Only LMV52
					PrepurgePosAux 3 *PrepurgePosVSD*	LMV50/LMV51.3/ LMV52

Note!
The prepurge position of auxiliary actuator 3 is approached in phase 32 (flue gas recirculation (FGR)).

After the settings have been made, the program stop in the prepurge position should be replaced by the program stop of the ignition position in phase 36.

14. Ignition positions

The burner control continues the startup sequence until the ignition position (phase 36) is reached. Then, it stops again, enabling the actuator's ignition positions to be set.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6	
Params & Display						
	RatioControl					
		GasSettings				
			SpecialPositions			
				IgnitionPos		
					IgnitionPosGas *IgnitionPosAir* *IgnitionPosAux1*	
					IgnitionPosAux2	Only LMV52
					IgnitionPosAux3 *IgnitionPosVSD*	LMV50/LMV51.3/ LMV52

To verify the ignition positions again, the control sequence can be stopped in interval phase 44 or 52 (interval with ignited flame on completion of the relevant safety time). Upon deactivation of the program stop, the burner continues its program until the operating phase (phase 60) is reached.
If no point for the fuel-air ratio control system has as yet been predefined, the first curvepoint «P1» to be adopted on a preliminary basis are the ignition positions of the actuators.

15. Setting the curve

First setting

The burner travels to the ignition load. The burner's output should now be increased manually and in steps of the curve settings until the rated capacity (100%) is reached. During the manual action, the actuators travel on the interpolated straight line to the maximum position of 90° for 100% output. The flue gas values and the stability of the flame must be constantly checked. It may be necessary to define provisional curvepoints, which can be canceled again later. As soon as the rated capacity is reached, the burner should be optimized with regard to flue gas values.

☞ Note!
So that the precontrol of the O2 trim control can work correctly, the loads (%) must be parameterized on the curve points in accordance with the actual burner output (kW).

Example: 2,000 kW burner:

- 100% curve point: 2,000 kW ≈ 200 m³/h natural gas
- - 75% curve point: 1,500 kW ≈ 150 m³/h natural gas
- - 50% curve point: 1,000 kW ≈ 100 m³/h natural gas

This can be achieved by measuring the amount of fuel with a fuel meter when setting, for example.

- Press **Esc** to leave the curvepoint setting
- Store the curvepoint by pressing **Enter**
- Now, select the second curvepoint. The settings of the previous curvepoint are adopted on a preliminary basis
- Store the second curvepoint like the first one

During storage, the LMV5 sorts the curvepoints based on rising output. This means that you can enter the curvepoints in any order you like as long as the output was correctly set. Proceed this way point by point until the minimum output is reached. After storage of the minimum output point, leave the curve settings.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	RatioControl				
		GasSettings			
			CurveParams		
				*) Point	
				*) Manual	

*) Not a parameter name, but a term of curve parameterization

Example:

Point	1	2	3	4	5
Order of setting	5	4	3	2	1
Output	15%	28%	50%	71%	100%
Gas	8.6°	28.0°	43.0°	62.5°	81.5°
Air	10.5°	28.8°	46.0°	55.7°	70.8°
AUX	20.3°	30.0°	45.0°	52.0°	60.0°

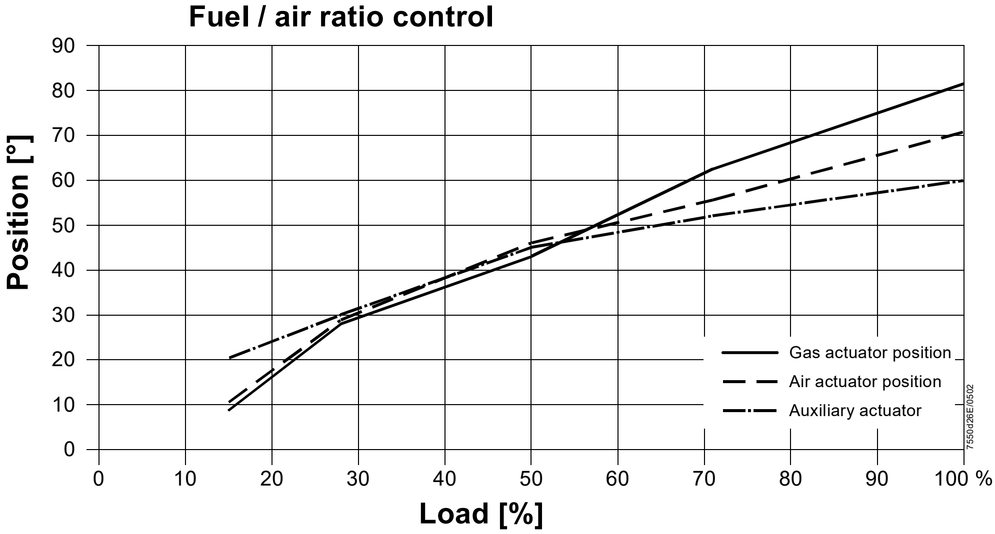


Figure 81: Fuel-air ratio control

Changing an existing curve

The curvepoints can be changed either during burner off periods (phase 12) or during burner operation (phase 60).
To change an existing curve, select the curvepoint in *Point* mode. You are now able to change the point, or to cancel it.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	RatioControl				
		GasSettings			
			CurveParams		
				*) Point	
				*) Manual	

*) Not a parameter name, but a term of curve parameterization

Creating a new curvepoint

To create a new curvepoint, select *Manual*. Set the output of the new point and acknowledge by pressing **Enter**.
During the manual action, the actuators travel on the interpolated straight lines between the curvepoints.
After pressing **Enter**, each individual actuating device can be selected to optimize the position.
To leave the curvepoint setting, press the **Esc** button or store the point by pressing **Enter**.

16. Load limits

Finally, you can limit the burner output to a minimum and maximum in accordance with the boiler's requirements.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	RatioControl				
		GasSettings			
			LoadLimits		
				MinLoadGas *MaxLoadGas*	

17. Shutdown

Select *Autom/Manual/Off* and then *Burner off*.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
ManualOperation					
	Autom/Manual/Off				

9.3 Settings for multistage oil-fired operation

18. Fuel changeover for oil-fired operation

Fuel changeover on the AZL5 is possible only if input *FuelSelect* is set to *internal*.
Set fuel selection to *Oil* or set the external fuel selector to *Oil*.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Operation					
	Fuel				
		FuelSelect			

19. Changing the burner operation mode from modulating to multistage (only when firing on oil)

Here, the burner operation mode can be set to *2-stage* or *3-stage*.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	RatioControl				
		OilSettings			
			CurveParams		
				Operation Mode	

20. Activating the program stops in the different program phases

Activate the program stop if startup shall be interrupted to continue setting the special positions.

Prepurge	Phases 24…34
Ignition position	Phase 36
Interval 1	Phase 44
Interval 2	Phase 52
Postpurge	Phases 72…78

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	RatioControl				
		ProgramStop			
			deactivated *24PrePurgP* *32PreP FGR* *36IgnitPos* *44Interv1* *52Interv2* *72PostPPos* *76PostPFGR*		

Activate a program stop in phase 24.

21. Checking and presetting the ignition positions for firing on oil

For the parameters *HomePos*, *Prepurge position* and *Postpurge position*, the parameter set supplied offers presettings. These should be checked and, if necessary, adapted, either now or during the following program stops.
There is **no** presetting for the ignition position. In this section, a valid setting must be made because otherwise, the burner cannot be started up.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6	
Params & Display						
	RatioControl					
		OilSettings				
			SpecialPositions			
				IgnitionPos		
					IgnitionPosOil *IgnitionPosAir* *IgnitionPosAux1*	
					IgnitionPosAux2	Only LMV52
					IgnitionPosAux3 *IgnitionPosVSD*	LMV50/LMV51.3/ LMV52

Example: Auxiliary actuator: 22.5° Air actuator: 37.6°
These values are also transferred to operating point S1 even if it has not yet been set.

22. Manual startup

To start the burner, select *Autom/Manual/Off,* and then *Manual*.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
ManualOperation					
	Autom/Manual/Off				

If startup shall be watched, the display can be changed to *Normal operation* by pressing simultaneously selection buttons «**<**» and «**>**».

23. Actuator positions during the prepurge time

The burner control stops startup in the prepurge phase (phase 24), enabling the positions of the actuators for prepurging to be straightforwardly set.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6	
Params & Display						
	RatioControl					
		OilSettings				
			SpecialPositions			
				PrepurgePos		
					PrepurgePosAir *PrepurgePosAux1*	
					PrepurgePosAux2	only LMV52
					PrepurgePosAux3 *PrepurgePosVSD*	LMV50/LMV51.3/ LMV52

Note!
The prepurge position of auxiliary actuator 3 is approached in phase 32 (flue gas recirculation (FGR)).

After the settings are made, the program stop in the prepurge position should be replaced by the program stop of the ignition position in phase 36.

24. Ignition positions

The burner control proceeds with the startup sequence until the ignition position (phase 36) is reached. There, the burner control stops again for setting the ignition positions of the actuators.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6	
Params & Display						
	RatioControl					
		OilSettings				
			SpecialPositions			
				IgnitionPos		
					IgnitionPosOil *IgnitionPosAir* *IgnitionPosAux1*	
					IgnitionPosAux2	Only LMV52
					IgnitionPosAux3 *IgnitionPosVSD*	LMV50/LMV51.3/ LMV52

To repeatedly verify the ignition positions, the control sequence can be stopped in interval phase 44 or 52 (interval with ignited flame on completion of the respective safety time).
When the program stop is deactivated, the burner proceeds with its program until normal operation is reached (phase 60).
If the switching points of the burner stages have not yet been defined, the ignition positions of the actuators are used as the first stage for the moment.

25. Setting the burner stages

The burner operates at ignition load or with the first burner stage. The positions of the actuators can now be changed.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	RatioControl				
		OilSettings			
			CurveParams		
				Curve Settings	
					*) Actuator Positions followed not followed

*) Not a parameter name, but a term of curve parameterization

It is recommended to use the function *Actuator positions followed* to set all switching points and operating points.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	RatioControl				
		OilSettings			
			CurveParams		
				Curve Settings	
					*) Actuator Positions followed not followed ———————— *Curve Settings* (curve setting stage: Stage 1...3 and on and off switching points)

*) Not a parameter name, but a term of curve parameterization

Example:

Stage	S1	S2 on	S2 off	S2	S3 on	S3 off	S3
Air	35.0°	43.0°	45.0°	53.0°	61.0°	62.0°	69.0°
AUX	13.0°	28.0°	20.0°	43.0°	50.0°	50.0°	54.0°

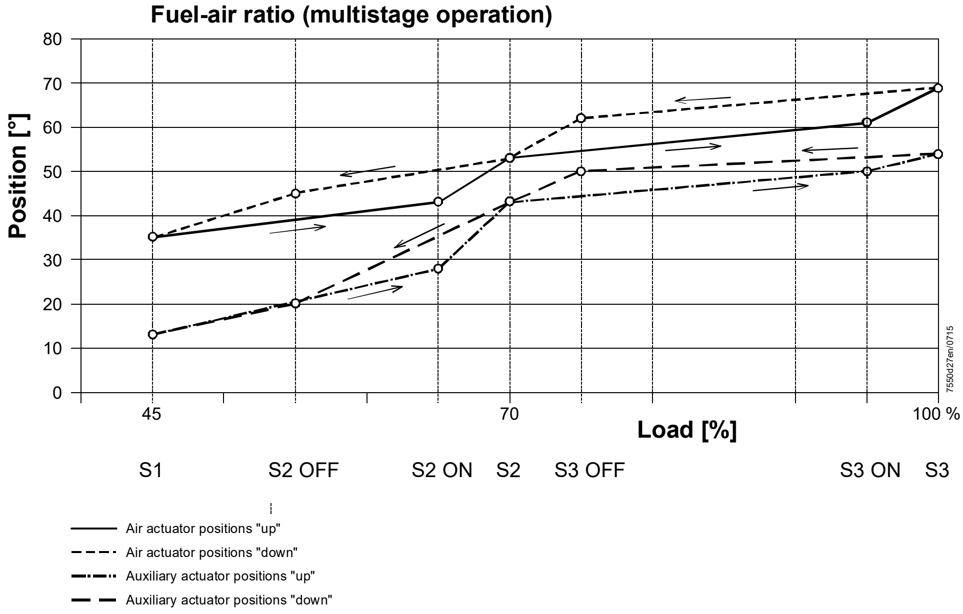


Figure 82: Fuel-air ratio control – multistage operation

26. Shutdown

Select *Autom/Manual/Off* and then *Burner off*.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
ManualOperation					
	Autom/Manual/Off				

9.4 Extra functions of the LMV5

27. Valve leak test (valve proving)

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	BurnerControl				
		ValveProving			
			ValveProvingType		
			Config_PS-VP/CPI		
			VP_EvacTme		
			VP_TmeAtmPress		
			VP_FillTme		
			VP_Tme_GasPress		

The gas volume contained in the piping between the valves (including the valve volume) must be calculated in accordance with the type of gas train.

Example of fuel train

Program **G** Direct ignition

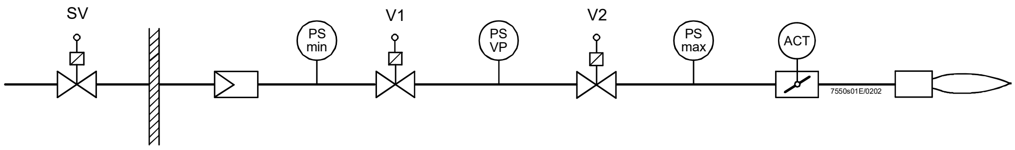


Figure 83: Extra functions of the LMV5

Determination of the test time with predefined leakage rate to be detected during valve proving:

$$t_{Test} = \frac{(P_G - P_W) \cdot V \cdot 3600}{P_{atm} \cdot Q_{Leck}}$$

Determination of the detected leakage rate during valve proving:

$$Q_{Leck} = \frac{(P_G - P_W) \cdot V \cdot 3600}{P_{atm} \cdot t_{Test}}$$

Legend

Q_{Leck}	in l/h	Leakage rate in liters per hour
P_G	in mbar	**Overpressure** between the valves at the beginning of the test phase
P_W	in mbar	Overpressure set on the pressure switch (normally 50% of the gas inlet pressure)
P_{atm}	in mbar	**Absolute air pressure** (1,013 mbar normal pressure)
V	in l	Volume between the valves (test volume) including valve volume and pilot path (Gp1) if present
t_{Test}	in s	Test time

Example 1 (calculation of test time)

P_G = 30 mbar
P_W = 15 mbar
P_{atm} = 1013 mbar
V = 3 l
Q_{Leck} = 50 l/h

$$t_{Test} = \frac{(30 - 15)\ \text{mbar} \cdot 3\ \text{l} \cdot 3600\ \text{s / h}}{1013\ \text{mbar} \cdot 50\ \text{l/h}} = \mathbf{3{,}2\ s}$$

Result: The test time to be set is 4 seconds

Example 2 (determination of detectable leakage rate)

P_G = 30 mbar
P_W = 15 mbar
P_{atm} = 1013 mbar
V = 3 l
t_{Test} = 4 s

$$Q_{Leck} = \frac{(30 - 15)\ \text{mbar} \cdot 3\ \text{l} \cdot 3600\ \text{s/h}}{1013\ \text{mbar} \cdot 4\ \text{s}} = \mathbf{40{,}0\ l/h}$$

Result: The detected leakage rate is 40 l/h

9.5 Configuring the load controller

Selection of operating mode

→ Operating modes with the load controller

Example: Internal load controller with Pt1000 sensor.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	SystemConfig				
		LC_OptgMode			
			ExtLC X5-03 *Int LC* *Int LC Bus* *Int LC X62* *Ext LC X62* *Ext LC Bus*		

Or, alternatively:

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	LoadController				
		Configuration			
			LC_OptgMode		
				ExtLC X5-03 *Int LC* *Int LC Bus* *Int LC X62* *Ext LC X62* *Ext LC Bus*	

After the internal load controller has been activated, the sensor input must be selected and configured.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	LoadController				
		Configuration			
			SensorSelect		
				Pt100 *Pt1000* *Ni1000* *TempSensor* *PressSensor* *Pt100Pt1000* *Pt100Ni1000* *NoSensor*	

Then, the temperature measuring range must be defined.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	LoadController				
		Configuration			
			MeasureRange PtNi		
				150°C/302°F *400°C/752°F* *850°C/1562°F*	

9.6 Control parameters of the load controller

The control parameters can be defined in 3 different ways.

1. Selection of standard parameter set

The memory of the load controller contains 5 standard parameter sets.
Depending on the characteristics of the controlled system, a PID triple value can be selected and activated.

The following standard parameter sets can be selected:

	Xp [%]	Tn [s]	Tv [s]
very fast (e.g. for small boilers)	42.5	68	12
fast	14.5	77	14
normal	6.4	136	24
slow	4.7	250	44
very slow (e.g. for large boilers)	3.4	273	48

2. Individual setting of PID parameters

Alternatively, the PID parameters can be directly selected and set within the predefined value range.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	LoadController				
		ControllerParam			
			ContrlParamList		
				StandardParam	
					Adaption *very fast* *fast* *normal* *slow* *very slow*
	Or				
				P-Part (Xp) *I_Part (Tn)* *D-Part (Tv)*	

3. Automatic adaption

With the method of adapting the control parameters, the characteristic data of the controlled system are acquired with an adaption procedure whereupon matching PID parameters are calculated.
If possible, the adaption load should be 100%.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	LoadController				
		Adaption			
			StartAdaption		
			AdaptionLoad		

Temperature limiter function

The integrated temperature limiter observes a separate temperature limit.
(for details, refer to *Integrated temperature limiter function*).
After the switch-off point in °C for the temperature limiter has been entered, the relative switch-on point in % is given.

Example:	*TW_Threshold_Off*:	80 °C
	TW_SwiDiff_On	-10% (= 8 K)
	Temperature limitation on at	72 °C

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	LoadController				
		TempLimiter			
			TL_Thresh_Off		
			TL_SD_On		

Or

	SystemConfig				
		TempLimiter			
			TL_Thresh_Off		
			TL_SD_On		

Boiler setpoints W1 and W2

2 boiler setpoints can be adjusted which, however, must not lie above the actual limit value of the temperature limiter function (→ Setpoints).
Changeover from setpoint W1 to setpoint W2 is implemented by means of an external, potential-free contact at input 3.

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	LoadController				
		ControllerParam			
			Setpoint W1		
			Setpoint W2		

Or

Operation					
	BoilerSetpoint				
		Setpoint W1			
		Setpoint W2			

2-position controller (C = ON/OFF)

Example: Modulating control

After the boiler setpoint in °C has been entered, the switch-on and switch-off point of the 2-position controller in % is given.
The switching points are calculated in relation to the current setpoint.

Example:	Setpoint:	70 °C
	SD_ModOn	+5% (= 3.5 K)
	SD_ModOff	+10% (= 7 K)
	Controller loop open (Off)	70 + 3.5 = 73.5 °C
	Controller loop closed (On)	70 - 7 = 63 °C

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	LoadController				
		ControllerParam			
			SD_ModOn		
			SD_ModOff		

Diagram

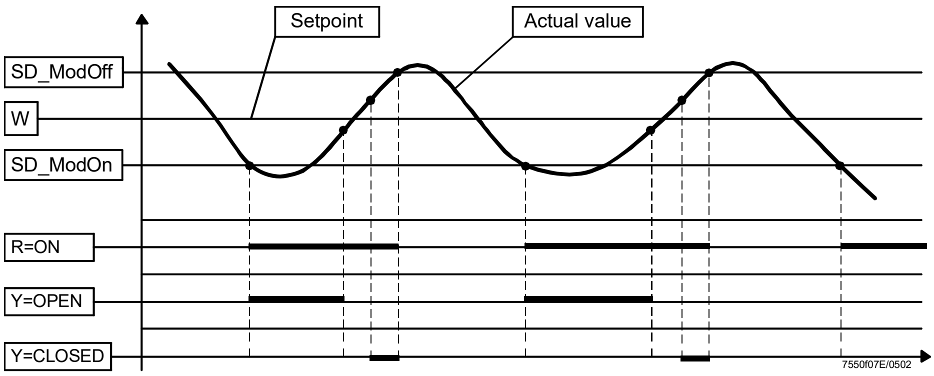


Figure 84: 2-position controller

Cold start thermal shock protection (CSTP)

When the cold start thermal protection function is activated, a boiler – after having dropped below a predefined switch-on threshold – is heated up in multistage operation. This approach ensures that when cold, the boiler does not have to satisfy the maximum request for heat within a very short period of time. Thermal strain on the boiler will thus be prevented.

Description

The cold start sequence is activated when, upon startup, the actual value lies below the switch-on threshold. When cold start thermal shock protection is activated, the manipulated variable – upon cold start – is increased in a stepwise fashion using the adjusted output step (or the next stage is switched on).

The load is increased by one load step (15% in the example below):

1. as soon as the actual temperature has increased by the set setpoint step (in the example below, by 5% = 4°)
2. or if this temperature increase was not reached by the end of the set maximum time.

When the switch-off threshold is reached, the cold start sequence is ended and normal control operation started.

Example

Modulating burner with pressure control

For the output step, any output value in % can be predefined. 100% divided by the output step gives the number of possible steps.

Parameters:	Shock protection on/off	*ColdStartOn*	Activated
	Shock protection activation level	*ThresholdOn*	40% of setpoint
	Output step (only for modulating operation)	*StageLoad*	15% of burner output
	Setpoint step modulating	*StageStep_Mod*	10% of setpoint
	Max. time modulating per step	*MaxTmeMod*	5 minutes
	Shock protection deactivation level	*ThresholdOff*	80% of setpoint

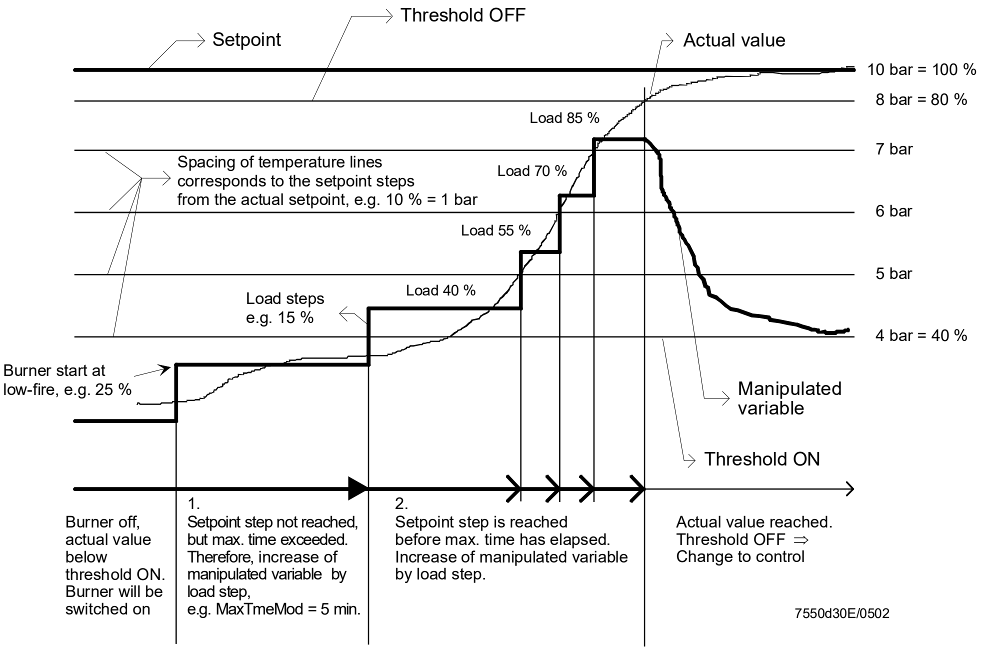


Figure 85: Cold start thermal shock protection

Menu level 1	Menu level 2	Menu level 3	Menu level 4	Menu level 5	Menu level 6
Params & Display					
	LoadController				
		ColdStart			
			ColdStartOn *ThresholdOn* *StageLoad* *StageStep_Mod* *StageStep_Stage* *MaxTmeMod* *MaxTmeStage* *ThresholdOff*		

10 Connection terminals / coding of connectors

10.1 Connection terminals LMV51.040x1

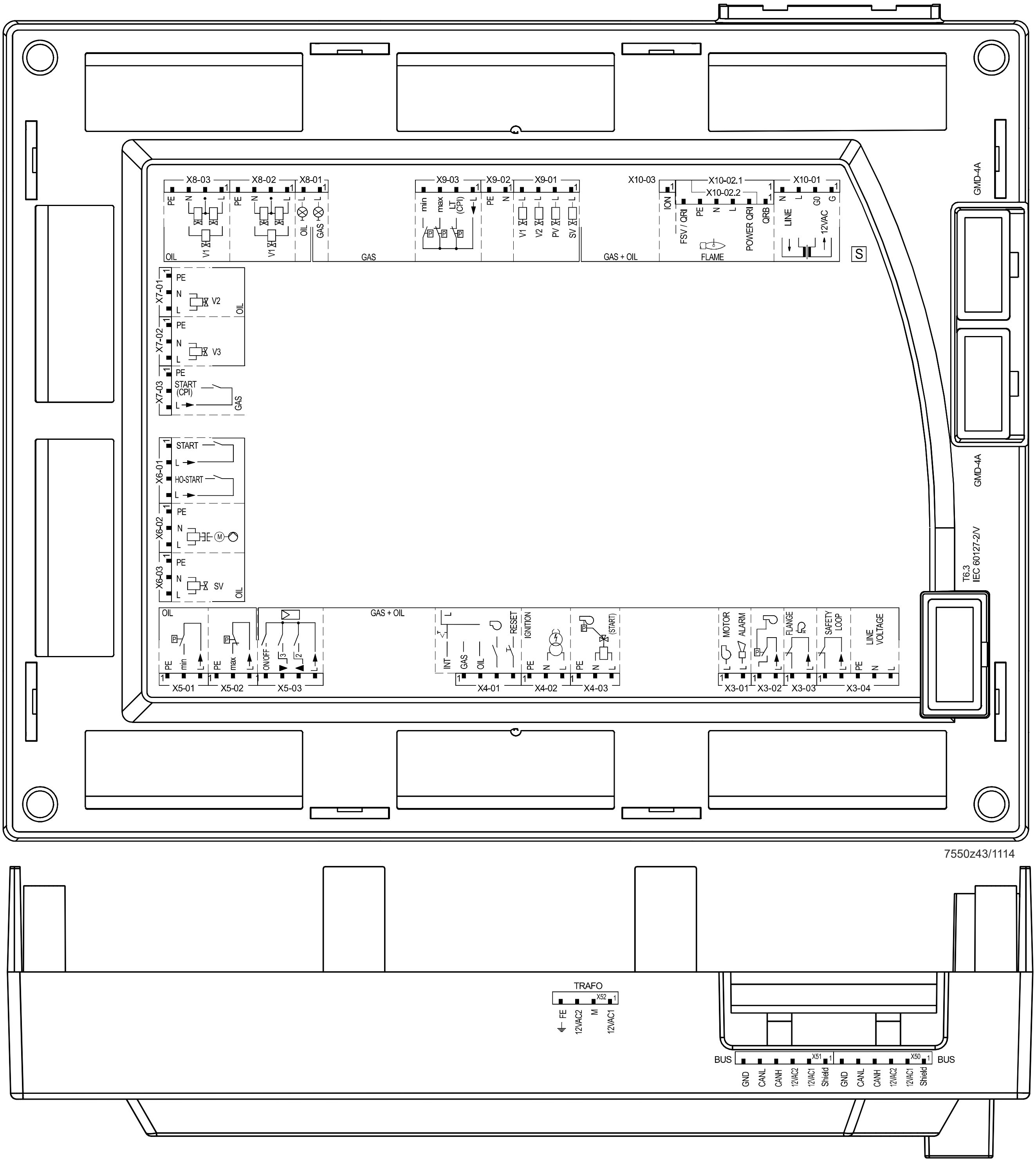


Figure 86: Connection terminals LMV51.040x1

10.2 Connection terminals LMV51.000x1 / LMV51.000x2 / LMV51.040x2

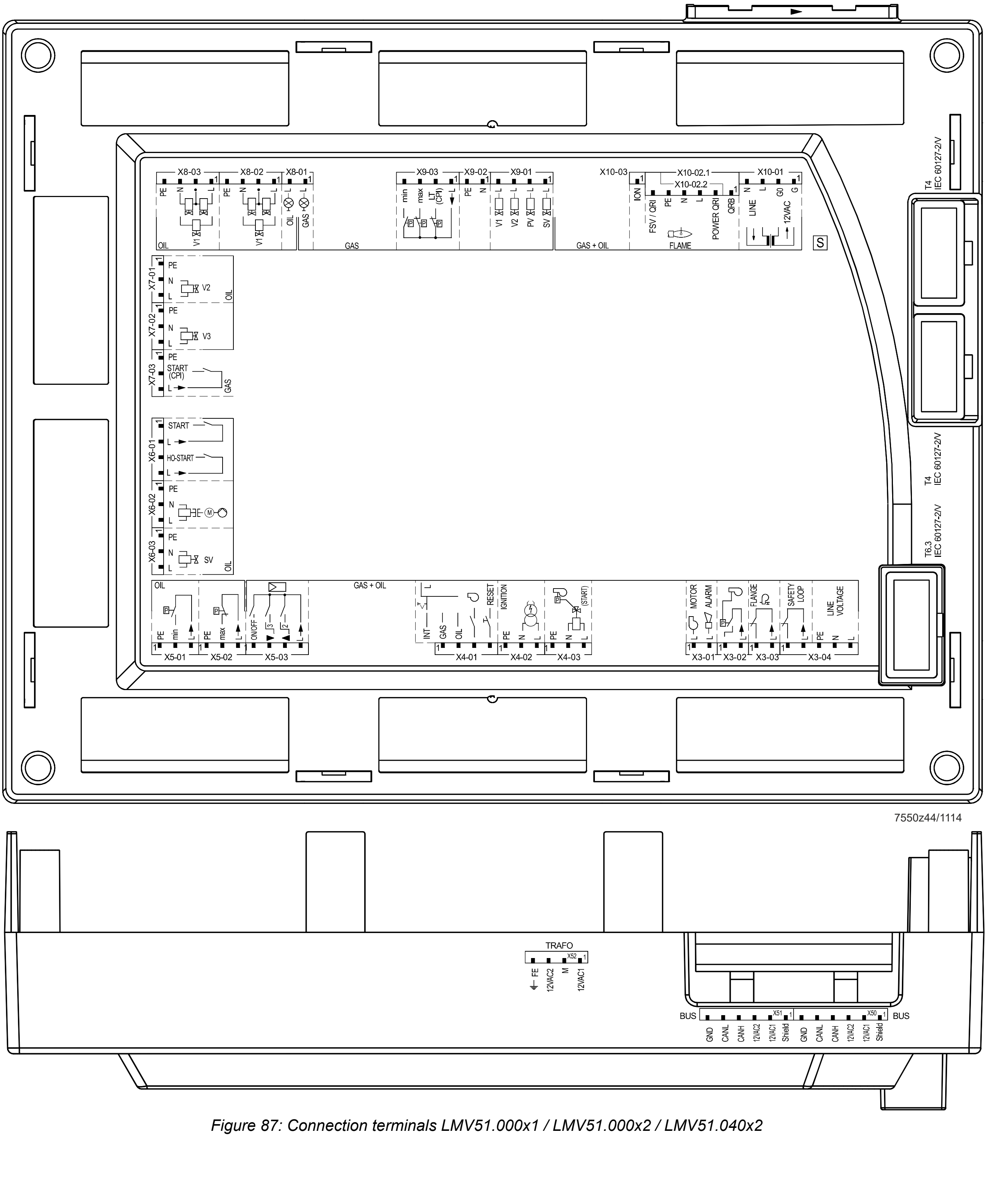


Figure 87: Connection terminals LMV51.000x1 / LMV51.000x2 / LMV51.040x2

10.3 Connection terminals LMV51.140x1

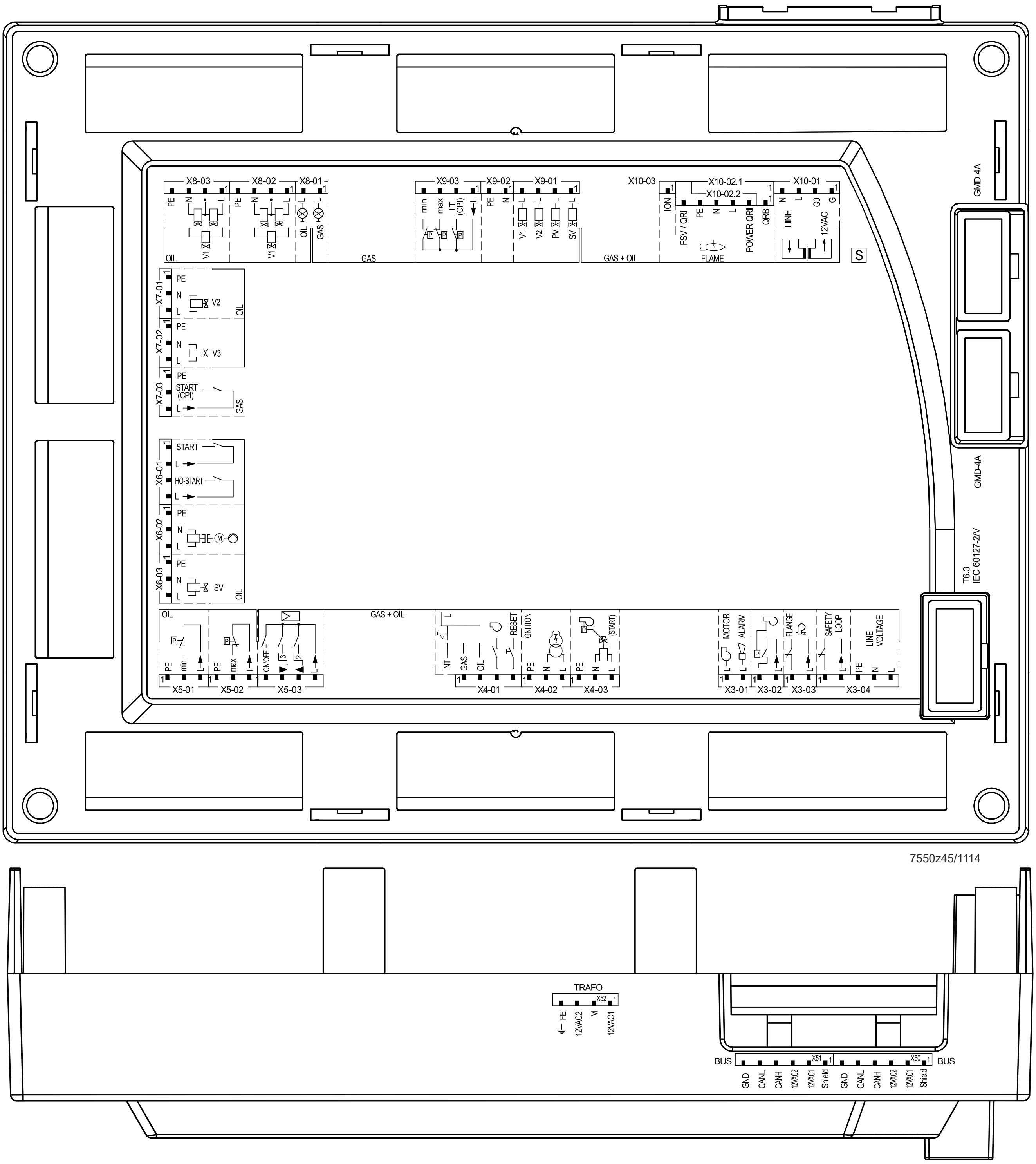


Figure 88: Connection terminals LMV51.140x1

10.4 Connection terminals LMV51.100x1 / LMV51.100x2 / LMV51.140x2

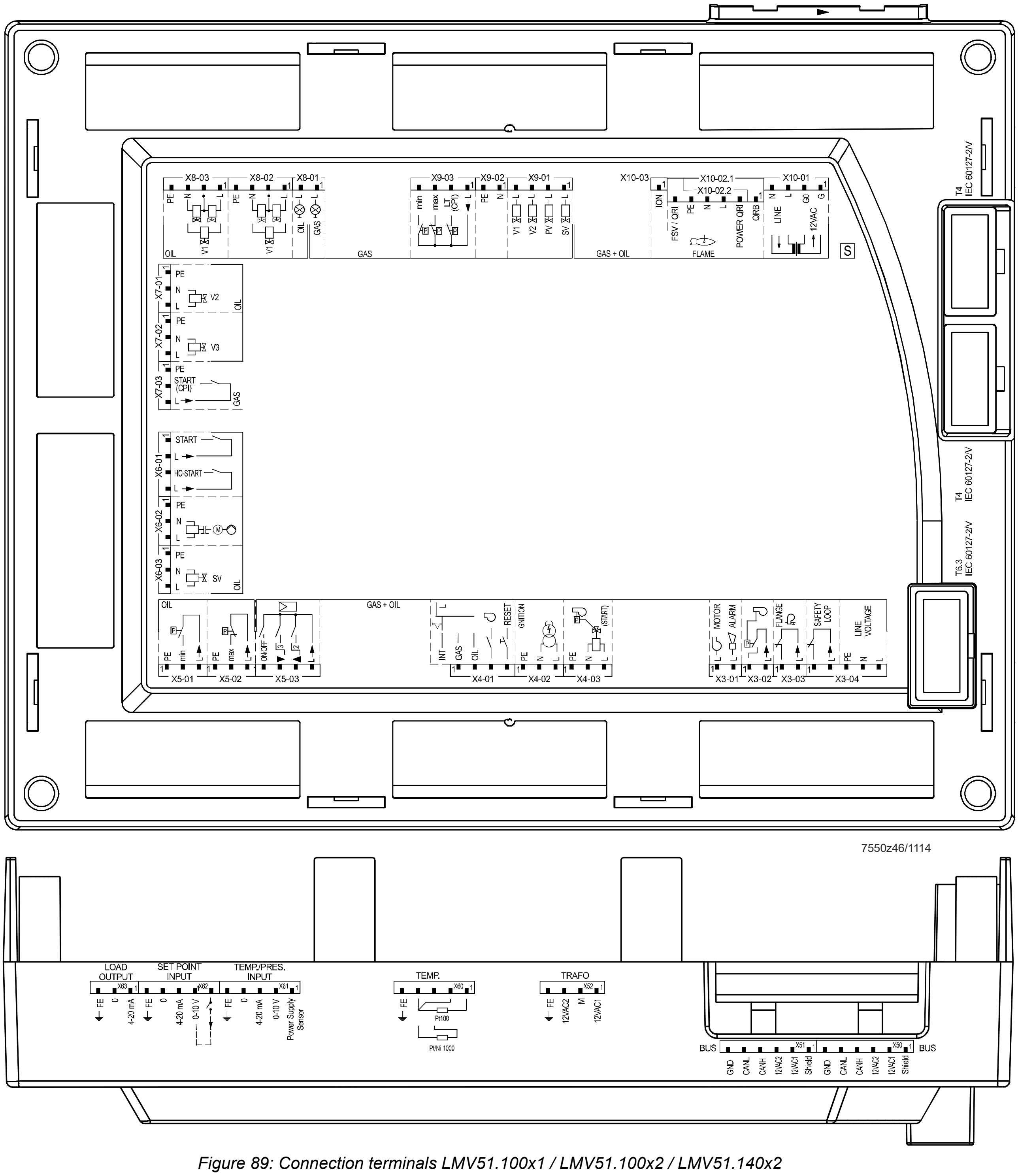


Figure 89: Connection terminals LMV51.100x1 / LMV51.100x2 / LMV51.140x2

10.5 Connection terminals LMV51.300x1 / LMV51.300x2 / LMV52.200x1 / LMV52.200x2 / LMV52.240x2 / LMV52.400x1 / LMV52.400x2

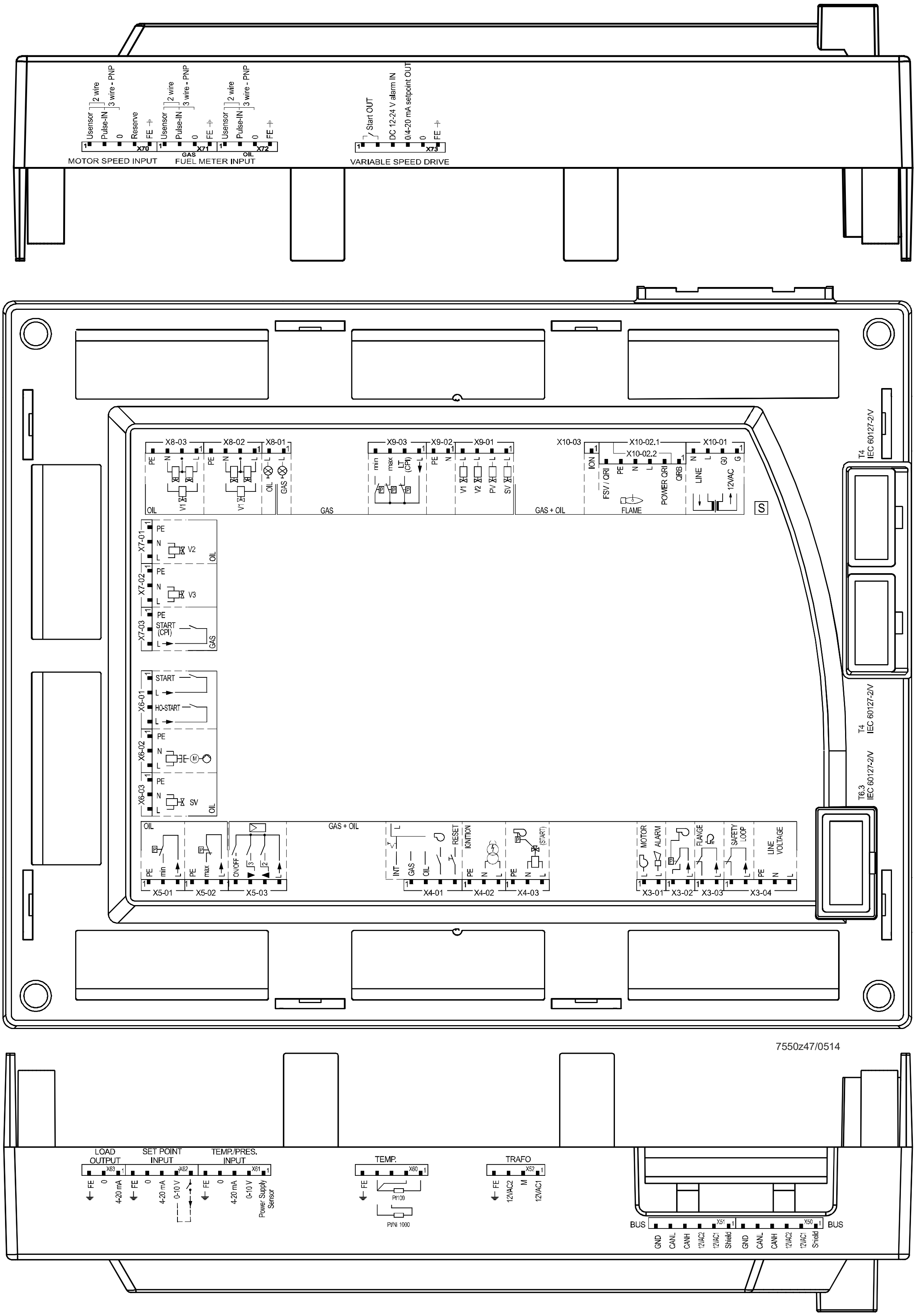


Figure 90: Connection terminals LMV51.300x1 / LMV51.300x2 / LMV52.200x1 / LMV52.200x2 / LMV52.240x2 / LMV52.400x1 / LMV52.400X2

10.6 Connection terminals LMV51.340x1 / LMV52.240x1 / LMV52.440x1 / LMV52.440x2

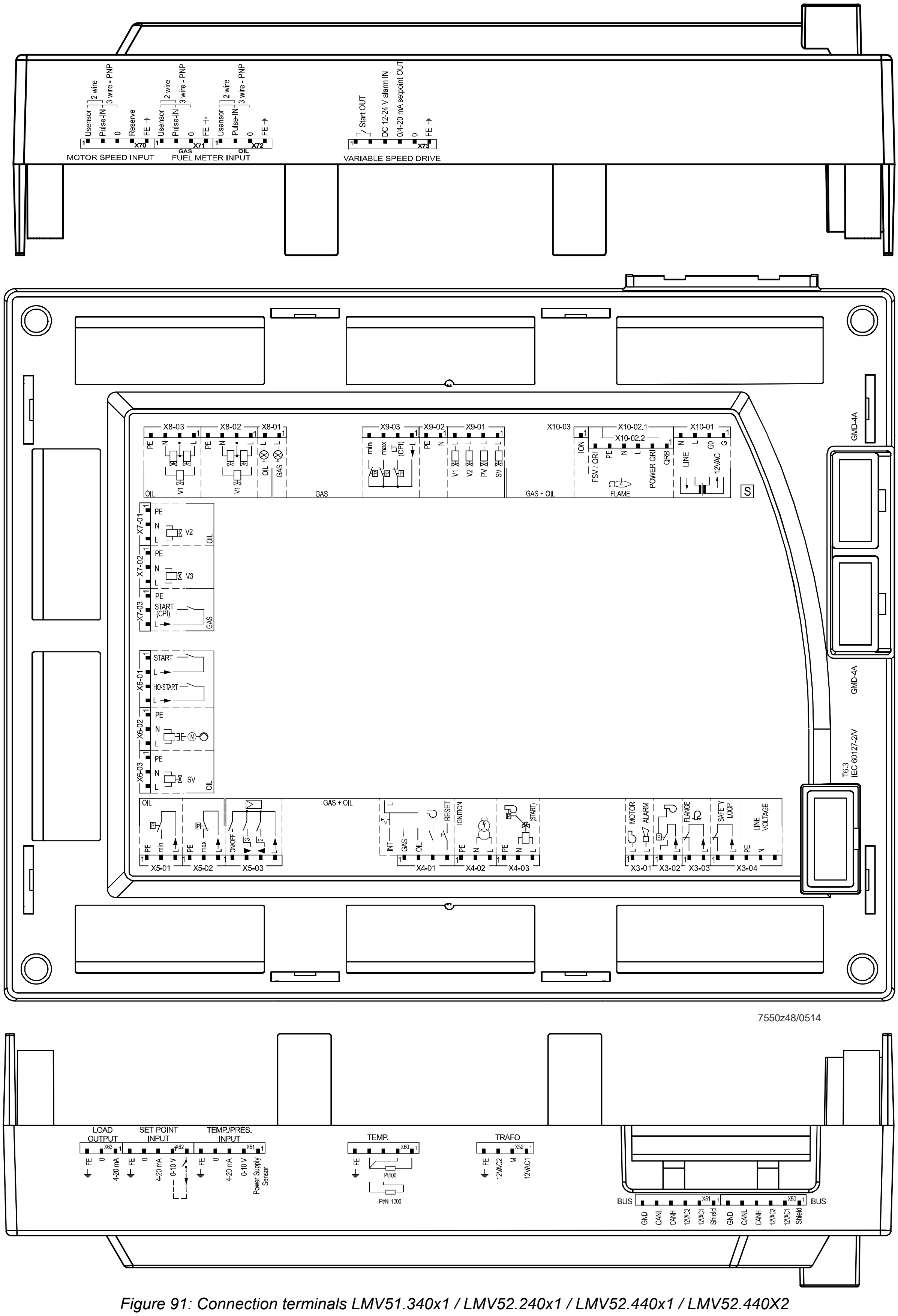


Figure 91: Connection terminals LMV51.340x1 / LMV52.240x1 / LMV52.440x1 / LMV52.440X2

10.7 Coding of connectors

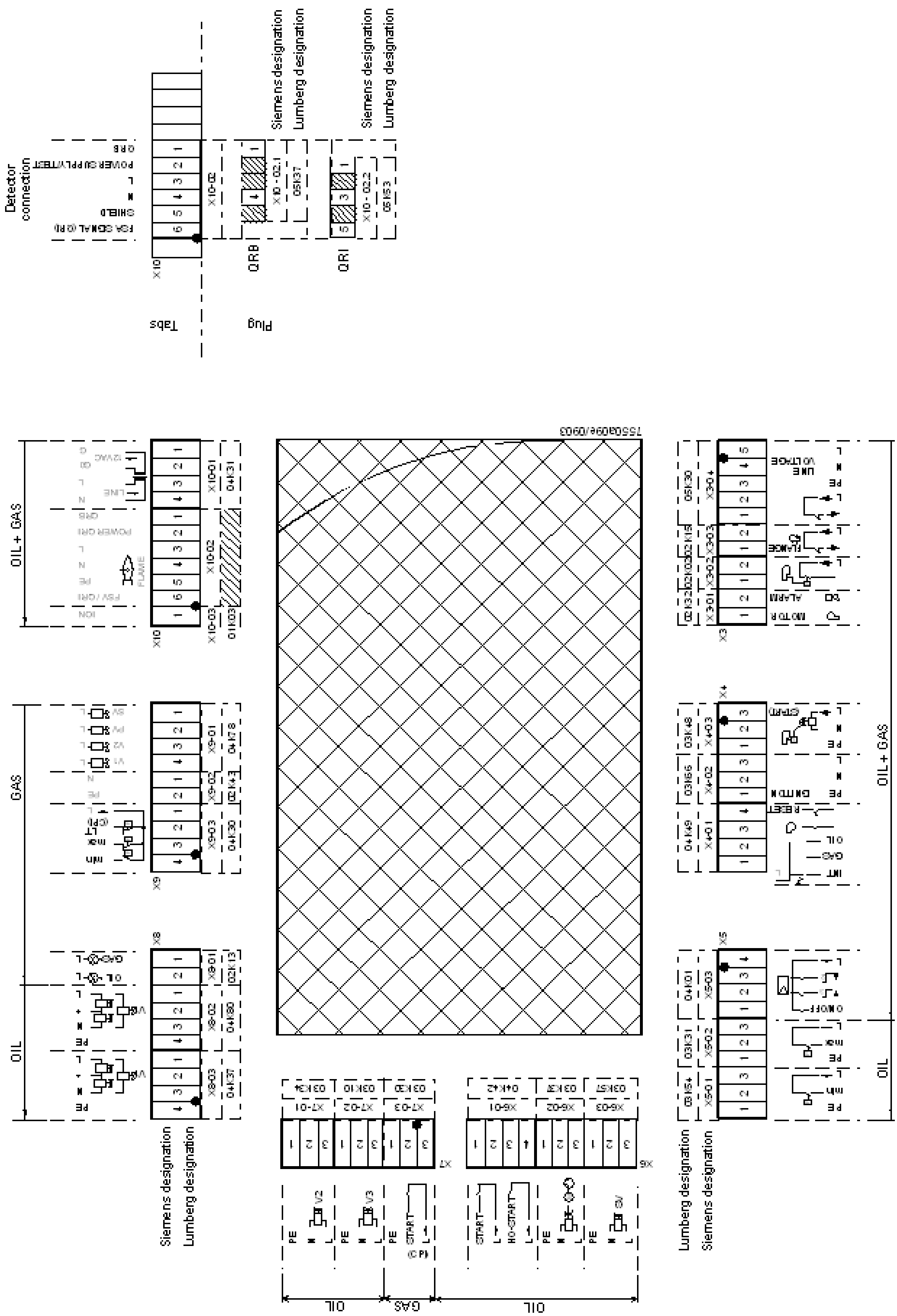


Figure 92: Coding of connectors

AGG5.720

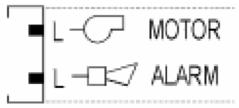
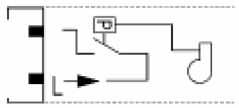
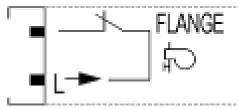
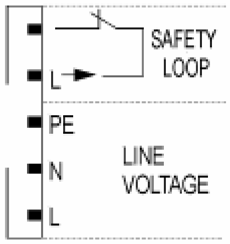
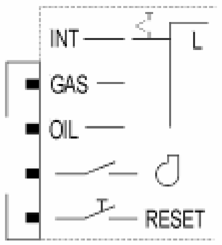
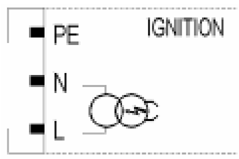
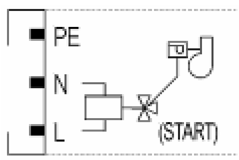
Standard connector set LMV50/LMV51 for gas / oil applications with up to 3 actuators.
Standard connector set LMV52 for gas / oil applications with up to 3 actuators.

LMV5	Terminal designation	Description
		RAST5
1	X3-01	Alarm, fan
1	X3-02	Air pressure switch (APS)
1	X3-03	Burner flange
1	X3-04	Power supply safety loop
1	X4-01	Fuel selection, lockout reset, fan contactor contact or pressure switch for flue gas recirculation (FGR)
1	X4-02	Ignition
1	X4-03	Start signal / pressure switch relieve valve
1	X5-01	Oil pressure switch min.
1	X5-02	Oil pressure switch-max.
1	X5-03	Load controller external
1	X6-01	Heavy oil direct start
1	X6-02	Magnetic clutch / oil pump
1	X6-03	Fuel valve (oil shutoff valve)
1	X7-01	Fuel valve 2-oil
1	X7-02	Fuel valve 3-oil
1	X7-03	Not used
1	X8-01	Firing on gas/oil
1	X8-02	Fuel valve 1-oil
1	X8-03	Fuel valve 1-oil
1	X9-01	Gas valves
1	X9-02	Protective earth, neutral conductor
1	X9-03	Gas pressure switch min., max., valve proving or valve closure contacts
1	X10-01	Power transformer (prim I, sec I)
1	X10-02 pin 2	Infrared flame detector QRI / flame detector QRA7
1	X10-03	Ionization probe ION
		Transformer
1	prim I	Power supply AC 120 V / AC 230 V
1	sec I	AC 12 V
1	sec II / sec III	AC12 V / AC2 12 V
		RAST3.5
2	X50, X51	CAN bus (6-pole)
1	X52	Transformer, secondary side (4-pole, low-voltage)
1	X60	Inputs 1 and 4 – temperature sensor (5 pins), TEMP.
1	X61	Input 2 – pressure input – temperature sensor (5 pins) TEMP. / PRESS. INPUT
1	X62	Input 3, analog input (5 pins), SETPOINT INPUT
1	X63	Load output (3 pins), LOAD OUTPUT
6	[/]	CAN bus actuator (5 pins)

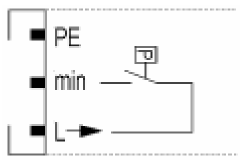
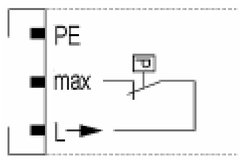
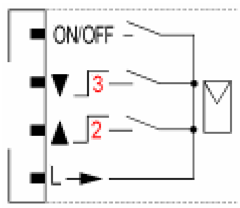
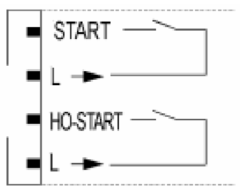
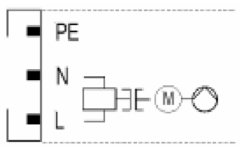
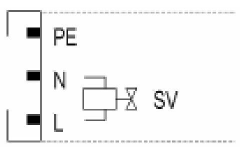
AGG5.721 Extension connector set LMV5

LMV5	Terminal marking	Description
		RAST3.5
2	[/]	Actuator (5 pins)
		VSD
2	[/]	4-pin connector 2 x
1	[/]	5-pin connector 1 x
1	[/]	6-pin connector 1 x
		RAST5
		Transformer
1	prim I	Power supply
1	sec II	AC12 V 1 / AC 12 V 2
1	X10-02 pin 1	Photoresistive flame detector QRB

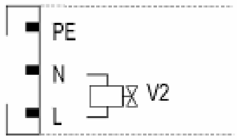
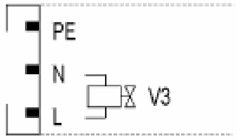
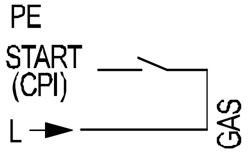
11 Description of connection terminals (AC 120 V)

Terminal marking	Connection symbol		Safety class	Input	Output	Description of connections	Electrical rating
X3-01	PIN 1		I		●	Fan motor contactor	AC 120 V +10 % / -15 %, 50...60 Hz, 1 A, (pilot duty), cosφ 0.4
	PIN 2				●	Alarm	AC 120 V +10 % / -15 %, 50...60 Hz, 1 A, (pilot duty), cosφ 0.4
X3-02	PIN 1		I	●		Air pressure switch (APS)	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 2				●	Power signal for air pressure switch (APS)	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
X3-03	PIN 1		I	●		End switch burner flange	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 5 A
	PIN 2				●	Power signal for end switch burner flange	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 5 A
X3-04	PIN 1		I	●		Safety loop	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 5 A
	PIN 2				●	Power signal for safety loop	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 5 A
	PIN 3			●		Protective earth (PE)	
	PIN 4			●		Power supply neutral conductor (N)	
	PIN 5			●		Power supply live conductor (L)	AC 120 V +10% / -15%, 50...60 Hz, fuse 6.3 AT (DIN EN 60127 2 / 5)
X4-01			I			Fuel selection „internal“ if pin 1-2 is not used	
	PIN 1			●		Fuel selection gas	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 2			●		Fuel selection oil	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 3			●		Fan contactor contact (FCC) or flue gas recirculation power switch (FGR-PS)	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 4			●		Reset / manual lockout	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
X4-02	PIN 1		I		●	Protective earth (PE)	
	PIN 2				●	Neutral conductor (N)	
	PIN 3				●	Ignition	AC 120 V +10 % / -15 %, 50...60 Hz, 1.6 A, (pilot duty), cosφ 0.2
X4-03	PIN 1		I		●	Protective earth (PE)	
	PIN 2				●	Neutral conductor (N)	
	PIN 3				●	Start signal or pressure switch-relief valve	AC 120 V +10 % / -15 %, 50...60 Hz, 75 VA, (pilot duty), cosφ 0.4

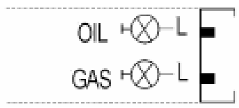
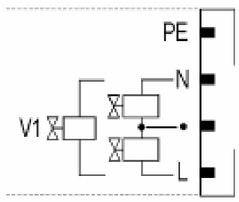
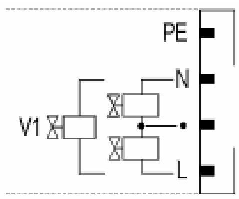
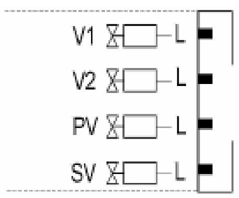
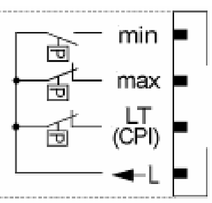
Description of connection terminals (cont'd)

Terminal marking		Connection symbol	Safety class	Input	Output	Description of connections	Electrical rating
X5-01	PIN 1		I		●	Protective earth (PE)	
	PIN 2			●		Pressure switch min-oil (Pmin-oil)	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 3				●	Power signal for pressure switch-min-oil (Pmin-oil)	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
X5-02	PIN 1		I		●	Protective earth (PE)	
	PIN 2			●		Pressure switch-max-oil (Pmax-oil)	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 3				●	Power signal for pressure switch-max-oil (Pmax-oil)	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
X5-03	PIN 1		I	●		Controller (ON / OFF)	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 2			●		Controller closes / stage 3	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 3			●		Controller opens / stage 2	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 4				●	Power signal for control of controller	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
X6-01	PIN 1		I	●		Start release oil	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 2				●	Power signal start release oil	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
	PIN 3			●		Direct heavy oil start	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 4				●	Power signal direct heavy oil start	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
X6-02	PIN 1		I		●	Protective earth (PE)	
	PIN 2				●	Neutral conductor (N)	
	PIN 3				●	Oil pump / magnetic coupling	AC 120 V +10 % / -15 %, 50...60 Hz, 1.6 A, (pilot duty), cosφ 0.4
X6-03	PIN 1		I		●	Protective earth (PE)	
	PIN 2				●	Neutral conductor (N)	
	PIN 3					Fuel valve (shut-off valve-oil)	AC 120 V +10 % / -15 %, 50...60 Hz, 1.6 A, (pilot duty), cosφ 0.4

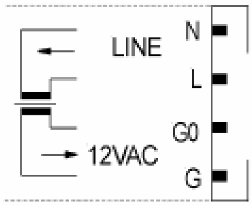
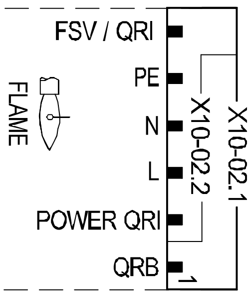
Description of connection terminals (cont'd)

Terminal marking	Connection symbol		Safety class	Input	Output	Description of connections	Electrical rating
X7-01	PIN 1		I		●	Protective earth (PE)	
	PIN 2				●	Neutral conductor (N)	
	PIN 3					Fuel valve 2 (oil)	AC 120 V +10 % / -15 %, 50...60 Hz, 1.6 A, (pilot duty), cosφ 0.4
X7-02	PIN 1		I		●	Protective earth (PE)	
	PIN 2				●	Neutral conductor (N)	
	PIN 3					Fuel valve 3 (oil)	AC 120 V +10 % / -15 %, 50...60 Hz, 1.6 A, (pilot duty), cosφ 0.4
X7-03	PIN 1		I		●	Protective earth (PE)	
	PIN 2			●		Start release gas / oil CPI	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 3				●	Power signal (reserve)	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 500 mA

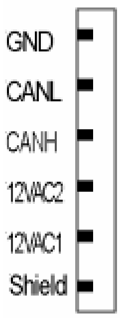
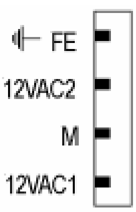
Description of connection terminals (cont'd)

Terminal marking	Connection symbol		Safety class	Input	Output	Description of connections	Electrical rating
X8-01		PIN 2	I		●	Firing on oil	AC 120 V +10 % / -15 %, 50...60 Hz, 1 A, cosφ 0.4
		PIN 1			●	Firing on gas	AC 120 V +10 % / -15 %, 50...60 Hz, 1 A, cosφ 0.4
X8-02		PIN 4	I		●	Protective earth (PE)	
		PIN 3			●	Neutral conductor (N)	
		PIN 2			●	Wiring point for in series switched valves	
		PIN 1			●	Fuel valve 1 (oil)	AC 120 V +10 % / -15 %, 50...60 Hz, 1.6 A, (pilot duty), cosφ 0.4
X8-03		PIN 4	I		●	Protective earth (PE)	
		PIN 3			●	Neutral conductor (N)	
		PIN 2			●	Wiring point for in series switched valves	
		PIN 1			●	Fuel valve 1 (oil)	AC 120 V +10 % / -15 %, 50...60 Hz, 1.6 A, (pilot duty), cosφ 0.4
X9-01		PIN 4	I		●	Fuel valve 1 (gas)	AC 120 V +10 % / -15 %, 50...60 Hz, 1.6 A, (pilot duty), cosφ 0.4
		PIN 3			●	Fuel valve 2 (gas)	AC 120 V +10 % / -15 %, 50...60 Hz, 1.6 A, (pilot duty), cosφ 0.4
		PIN 2			●	Pilot valve (gas)	AC 120 V +10 % / -15 %, 50...60 Hz, 1.6 A, (pilot duty), cosφ 0.4
		PIN 1			●	Fuel valve (shut-off valve-gas)	AC 120 V +10 % / -15 %, 50...60 Hz, 1.6 A, (pilot duty), cosφ 0.4
X9-02		PIN 2	I		●	Protective earth (PE)	
		PIN 1			●	Neutral conductor (N)	
X9-03		PIN 4	I	●		Pressure switch-min-gas (Pmin-gas, start release gas)	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
		PIN 3		●		Pressure switch-max-gas (Pmax-gas)	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
		PIN 2		●		Gas pressure switch valve proving / valve proving or valve closure contacts (CPI)	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
		PIN 1			●	Power signal for pressure switch	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 500 mA

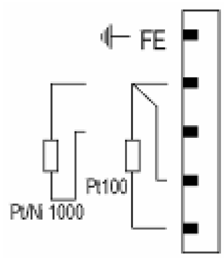
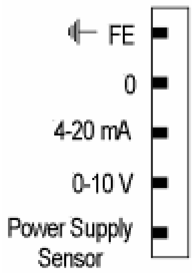
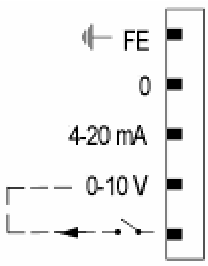
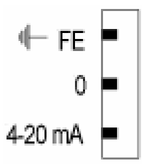
Description of connection terminals (cont'd)

Terminal marking	Connection symbol		Safety class	Input	Output	Description of connections	Electrical rating
X10-01		PIN 4	I		●	Neutral conductor (N)	AC 120 V +10 % / -15 %, 50...60 Hz, Max. 1 mA
		PIN 3			●	Power signal transformer	
		PIN 2		●		AC power signal G0	AC 12 V +10 % / -15 %, 50...60 Hz, Max. 1.2 mA
		PIN 1		●		AC power signal fan (G)	
X10-02		PIN 6	I	●		QRI (IR detector) / QRA7 signal voltage	Umax DC 5 V
		PIN 5			●	Protective earth (PE)	
		PIN 4			●	Neutral conductor (N)	
		PIN 3			●	Power signal	AC 120 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
		PIN 2			●	QRI (IR detector) / QRA7 power supply	DC 14 / 21 VC Imax 100 mA
		PIN 1		●		QRB signal voltage	Max. DC 8 V
X10-03		PIN 1	I		●	Ionization probe (ION) (alternatively QRA2/ QRA4 / QRA10, refer to chapter *Description of inputs and outputs)*	Umax (X3-04-PINS) Imax. 0.5 mA

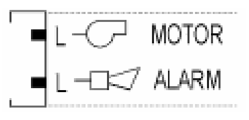
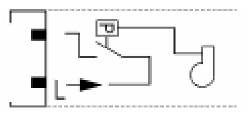
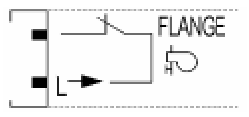
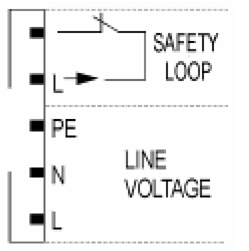
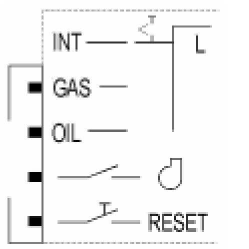
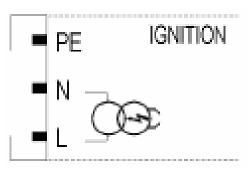
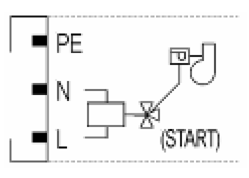
Description of connection terminals (cont'd)

Terminal marking	Connection symbol		Safety class	Input	Output	Description of connections	Electrical rating
X50		PIN 6	III		●	Reference ground (PELV)	
		PIN 5			●	Communication signal (CANL)	DC U ← 5 V, Rw = 120 Ω, level to ISO-DIS 11898
		PIN 4			●	Communication signal (CANH)	
		PIN 3			●	AC power supply for actuators / display and operating unit AZL5	AC 12 V +10 % / -15 %, 50...60 Hz, Fuse max. 4 A
		PIN 2			●		
		PIN 1			●	Shield connection (functional earth)	
X51		PIN 6	III		●	Reference ground (PELV)	
		PIN 5			●	Communication signal (CANL)	DC U ← 5 V, Rw = 120 Ω, level to ISO-DIS 11898
		PIN 4			●	Communication signal (CANH)	
		PIN 3			●	AC power supply for actuators / display and operating unit AZL5	AC 12 V +10 % / -15 %, 50...60 Hz, Fuse max. 4 A
		PIN 2			●		
		PIN 1			●	Shield connection (functional earth)	
X52		PIN 4	III	●		Functional earth	
		PIN 3		●		AC power supply from transformer to LMV5 system	AC 12 V +10 % / -15 %, 50...60 Hz
		PIN 2		●		Reference ground (PELV)	
		PIN 1		●		AC power supply from transformer to LMV5 system	AC 12 V +10 % / -15 %, 50...60 Hz

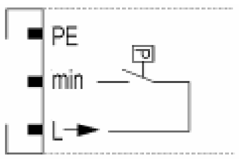
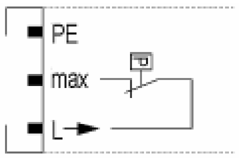
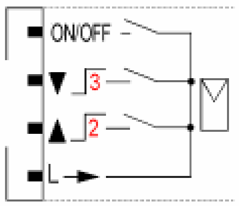
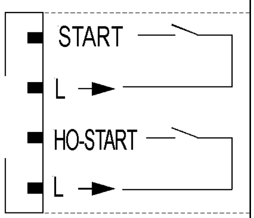
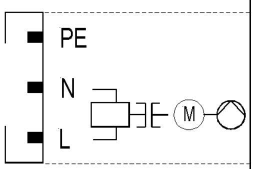
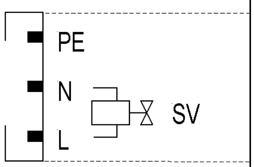
Description of connection terminals (cont'd)

Terminal markings	Connection symbol		Safety class	Input	Output	Description of connections	Electrical rating
Temperature / pressure controller							
X60		PIN 5	III	●		Functional earth for shield connection	
		PIN 4		●		Reference ground	
		PIN 3		●		Temperature sensor input Pt / LG-Ni 1000 (Input 4, TEMP.)	
		PIN 2		●		Line compensation temperature sensor Pt100	
		PIN 1		●		Temperature sensor input Pt100 (input 1, TEMP.)	
X61		PIN 5	III	●		Functional earth for shield connection	
		PIN 4		●		Reference ground	
		PIN 3		●		Current input for temperature / pressure signal (input 2, TEMP / PRESS INPUT 4...20 mA)	DC 0...20 mA
		PIN 2		●		Voltage input for temperature / pressure signal (input 2, TEMP / PRESS INPUT DC 0...10 V)	DC 0...10 V
		PIN 1			●	Power supply for temperature / pressure transmitter	Approx. DC 20 V, Max. 25 mA
X62		PIN 5	III	●		Functional earth for shield connection	
		PIN 4		●		Reference ground	
		PIN 3		●		Current input for setpoint or load (input 3, SETPOINT INPUT)	DC 0...20 mA
		PIN 2		●		Voltage input for setpoint or load (input 3, SETPOINT INPUT)	DC 0...10 V (up to DC 24 V on setpoint change of X62 / pin 1)
		PIN 1			●	Power supply for setpoint changeover	Approx. DC 24 V, Max. 2 mA
X63		PIN 3	III	●		Functional earth for shield connection	
		PIN 2			●	Reference ground	
		PIN 1			●	Current output for burner load (LOAD OUTPUT)	DC 4...20 mA, RLmax = 500 Ω

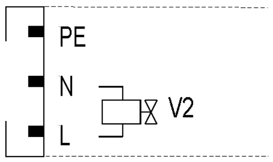
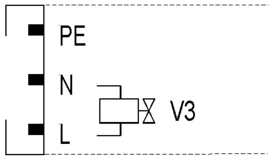
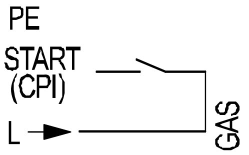
12 Description of connection terminals (AC 230 V)

Terminal markings	Connection symbol		Safety class	Input	Output	Description of connections	Electrical rating
X3-01	PIN 1		I		●	Fan motor contactor	AC 230 V +10 % / -15 %, 50...60 Hz, 1 A, cosφ 0.4
	PIN 2				●	Alarm	AC 230 V +10 % / -15 %, 50...60 Hz, 1 A, cosφ 0.4
X3-02	PIN 1		I	●		Air pressure switch (APS)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 2				●	Power signal for air pressure switch (APS)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
X3-03	PIN 1		I	●		End switch burner flange	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 5 A
	PIN 2				●	Power signal for end switch burner flange	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 5 A
X3-04	PIN 1		I	●		Safety loop	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 5 A
	PIN 2				●	Power signal for safety loop	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 5 A
	PIN 3			●		Protective earth (PE)	
	PIN 4			●		Power supply neutral conductor (N)	
	PIN 5			●		Power supply live conductor (L)	AC 230 V +10% / -15%, 50...60 Hz, fuse 6.3 AT (DIN EN 60127 2 / 5)
X4-01			I			Fuel selection “internal” if pin 1-2 is not used	
	PIN 1			●		Fuel selection gas	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 2			●		Fuel selection oil	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 3			●		Fan contactor contact (FCC) or flue gas recirculation (FGR-PS)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 4			●		Reset / manual lockout	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
X4-02	PIN 1		I		●	Protective earth (PE)	
	PIN 2				●	Neutral conductor (N)	
	PIN 3				●	Ignition	AC 230 V +10 % / -15 %, 50...60 Hz, 2 A, cosφ 0.2
X4-03	PIN 1		I		●	Protective earth (PE)	
	PIN 2				●	Neutral conductor (N)	
	PIN 3				●	Start signal or pressure switch relief valve	AC 230 V +10 % / -15 %, 50...60 Hz, 0.5 A, cosφ 0.4

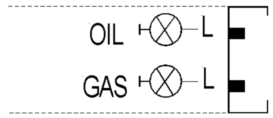
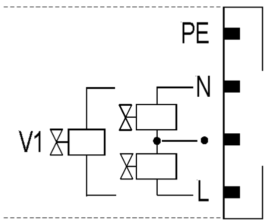
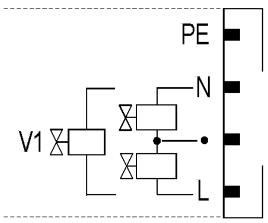
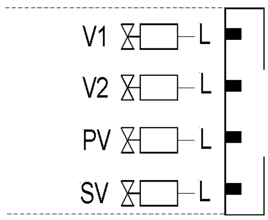
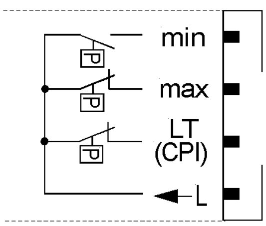
Description of connection terminals (cont'd)

Terminal markings	Connection symbol		Safety class	Input	Output	Description of connections	Electrical rating
X5-01	PIN 1		I		●	Protective earth (PE)	
	PIN 2			●		Pressure switch min-oil (Pmin-oil)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 3				●	Power signal for pressure switch-min-oil (Pmin-oil)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
X5-02	PIN 1		I		●	Protective earth (PE)	
	PIN 2			●		Pressure switch-max-oil (Pmax-oil)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 3				●	Power signal for pressure switch-max-oil (Pmax-oil)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
X5-03	PIN 1		I	●		Controller (ON / OFF)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 2			●		Controller closes / stage 3	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 3			●		Controller opens / stage 2	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 4				●	Power signal for control of controller	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
X6-01	PIN 1		I	●		Start release oil (START)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 2				●	Power signal start release oil (START)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
	PIN 3			●		Direct heavy oil start	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 4				●	Power signal direct heavy oil start	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
X6-02	PIN 1		I		●	Protective earth (PE)	
	PIN 2				●	Neutral conductor (N)	
	PIN 3				●	Oil pump / magnetic coupling	AC 230 V +10 % / -15 %, 50...60 Hz, 2 A, cosφ 0.4
X6-03	PIN 1		I		●	Protective earth (PE)	
	PIN 2				●	Neutral conductor (N)	
	PIN 3					Fuel valve (shut-off valve-oil)	AC 230 V +10 % / -15 %, 50...60 Hz, 1 A, cosφ 0.4

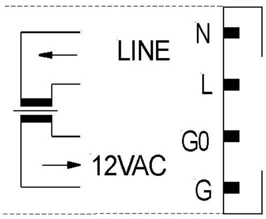
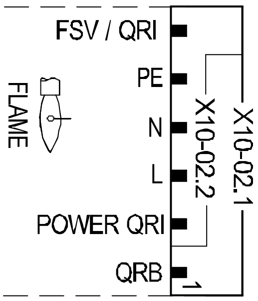
Description of connection terminals (cont'd)

Terminal markings	Connection symbol		Safety class	Input	Output	Description of connections	Electrical rating
X7-01	PIN 1		I		●	Protective earth (PE)	
	PIN 2				●	Neutral conductor (N)	
	PIN 3					Fuel valve 2 (oil)	AC 230 V +10 % / -15 %, 50...60 Hz, 1 A, cosφ 0.4
X7-02	PIN 1		I		●	Protective earth (PE)	
	PIN 2				●	Neutral conductor (N)	
	PIN 3					Fuel valve 3 (oil)	AC 230 V +10 % / -15 %, 50...60 Hz, 1 A, cosφ 0.4
X7-03	PIN 1		I		●	Protective earth (PE)	
	PIN 2			●		Start release gas / oil or valve closure contact (CPI)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
	PIN 3				●	Power signal (reserve)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 500 mA

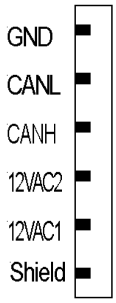
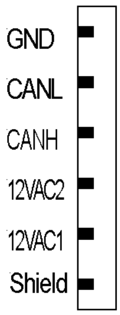
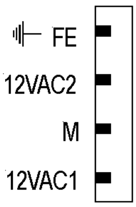
Description of connection terminals (cont'd)

Terminal markings	Connection symbol		Safety class	Input	Output	Description of connections	Electrical rating
X8-01		PIN 2	I		●	Firing on oil	AC 230 V +10 % / -15 %, 50...60 Hz, 1 A, cosφ 0.4
		PIN 1			●	Firing on gas	AC 230 V +10 % / -15 %, 50...60 Hz, 1 A, cosφ 0.4
X8-02		PIN 4	I		●	Protective earth (PE)	
		PIN 3			●	Neutral conductor (N)	
		PIN 2			●	Wiring point for in series switched valves	
		PIN 1			●	Fuel valve 1 (oil)	AC 230 V +10 % / -15 %, 50...60 Hz, 1 A, cosφ 0.4
X8-03		PIN 4	I		●	Protective earth (PE)	
		PIN 3			●	Neutral conductor (N)	
		PIN 2			●	Wiring point for in series switched valves	
		PIN 1			●	Fuel valve 1 (oil)	AC 230 V +10 % / -15 %, 50...60 Hz, 1 A, cosφ 0.4
X9-01		PIN 4	I		●	Fuel valve 1 (gas)	AC 230 V +10 % / -15 %, 50...60 Hz, 2 A, cosφ 0.4
		PIN 3			●	Fuel valve 2 (gas)	AC 230 V +10 % / -15 %, 50...60 Hz, 2 A, cosφ 0.4
		PIN 2			●	Pilot valve (gas)	AC 230 V +10 % / -15 %, 50...60 Hz, 2 A, cosφ 0.4
		PIN 1			●	Fuel valve (shut-off valve-gas)	AC 230 V +10 % / -15 %, 50...60 Hz, 2 A, cosφ 0.4
X9-02		PIN 2	I		●	Protective earth (PE)	
		PIN 1			●	Neutral conductor (N)	
X9-03		PIN 4	I	●		Pressure switch-min-gas (Pmin-gas, start release gas)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
		PIN 3		●		Pressure switch-max-gas (Pmax-gas)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
		PIN 2		●		Pressure switch valve proofed-gas / leakage test or valve closure contacts (CPI)	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 1.5 mA
		PIN 1			●	Power signal for pressure switch	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 500 mA

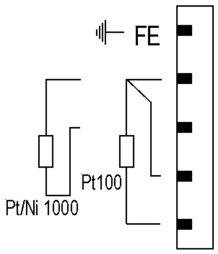
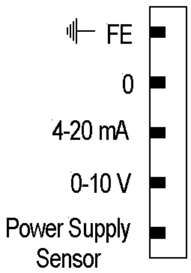
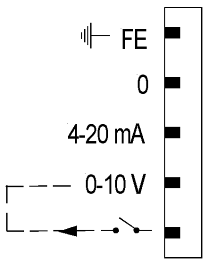
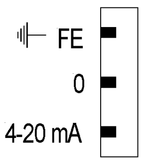
Description of connection terminals (cont'd)

Terminal markings	Connection symbol		Safety class	Input	Output	Description of connections	Electrical rating
X10-01		PIN 4	I		●	Neutral conductor (N)	AC 230 V +10 % / -15 %, 50...60 Hz, Max. 1 mA
		PIN 3			●	Power signal transformer	
		PIN 2		●		AC power signal G0	AC 12 V +10 % / -15 %, 50...60 Hz, Max. 1.2 mA
		PIN 1		●		AC power signal fan (G)	
X10-02		PIN 6	I	●		QRI (IR detector) / QRA7 signal voltage	Umax DC 5 V
		PIN 5			●	Protective earth (PE)	
		PIN 4			●	Neutral conductor (N)	
		PIN 3			●	Power signal	AC 230 V +10 % / -15 %, 50...60 Hz, Imax 500 mA
		PIN 2			●	QRI (IR detector) / QRA7 power supply	DC 14 / 21 VC Imax 100 mA
		PIN 1		●		QRB signal voltage	Max. DC 8 V
X10-03		PIN 1	I		●	Ionization probe (ION) (alternatively QRA2/ QRA4 / QRA10, refer to chapter *Description of inputs and outputs*)	Umax (X3-04-PINS), Imax. 0.5 mA

Description of connection terminals (cont'd)

Terminal markings	Connection symbol		Safety class	Input	Output	Description of connections	Electrical rating
X50		PIN 6	III		●	Reference ground (PELV)	
		PIN 5			●	Communication signal (CANL)	DC U ← 5 V, Rw = 120 Ω, level to ISO-DIS 11898
		PIN 4			●	Communication signal (CANH)	
		PIN 3			●	AC power supply for actuators / display and operating unit AZL5	AC 12 V +10 % / -15 %, 50...60 Hz, Fuse max. 4 A
		PIN 2			●		
		PIN 1			●	Shield connection (functional earth)	
X51		PIN 6	III		●	Reference ground (PELV)	
		PIN 5			●	Communication signal (CANL)	DC U ← 5 V, Rw = 120 Ω, level to ISO-DIS 11898
		PIN 4			●	Communication signal (CANH)	
		PIN 3			●	AC power supply for actuators / display and operating unit AZL5	AC 12 V +10 % / -15 %, 50...60 Hz, Fuse max. 4 A
		PIN 2			●		
		PIN 1			●	Shield connection (functional earth)	
X52		PIN 4	III	●		Functional earth	
		PIN 3		●		AC power supply from transformer to LMV5 system	AC 12 V +10 % / -15 %, 50...60 Hz
		PIN 2		●		Reference ground (PELV)	
		PIN 1		●		AC power supply from transformer to LMV5 system	AC 12 V +10 % / -15 %, 50...60 Hz

Description of connection terminals (cont'd)

Terminal marking	Connection symbol		Safety class	Input	Output	Description of connections	Electrical rating
Temperature / pressure controller							
X60		PIN 5	III	●		Functional earth for shield connection	
		PIN 4		●		Reference ground	
		PIN 3		●		Temperature sensor input Pt / LG-Ni 1000 (Input 4, TEMP)	
		PIN 2		●		Line compensation temperature sensor Pt100	
		PIN 1		●		Temperature sensor input Pt100 (input 1, TEMP)	
X61		PIN 5	III	●		Functional earth for shield connection	
		PIN 4		●		Reference ground	
		PIN 3		●		Current input for temperature / pressure signal (input 2, TEMP / PRESS INPUT 4...20 mA)	DC 0...20 mA
		PIN 2		●		Voltage input for temperature / pressure signal (input 2, TEMP / PRESS INPUT DC 0...10 V	DC 0...10 V
		PIN 1			●	Power supply for temperature / pressure transmitter	Approx. DC 20 V, Max. 25 mA
X62		PIN 5	III	●		Functional earth for shield connection	
		PIN 4		●		Reference ground	
		PIN 3		●		Current input for setpoint or load (input 3, SETPOINT INPUT)	DC 0...20 mA
		PIN 2		●		Voltage input for setpoint or load (input 3, SETPOINT INPUT)	DC 0...10 V
		PIN 1			●	Power supply for setpoint changeover	Approx. DC 24 V, Max. 2 mA
X63		PIN 3	III	●		Functional earth for shield connection	
		PIN 2			●	Reference ground	
		PIN 1			●	Current output for burner load (LOAD OUTPUT)	DC 4...20 mA, RLmax = 500 Ω

13 Mounting , electrical installation and service

Installation

- **The burner / boiler manufacturer must ensure degree of protection IP40 through appropriate mounting**
- **Depending on the field of use, external requirements may impose more stringent degrees of protection, which must then be observed**
- **When fitted, the maximum permissible ambient temperature must not be exceeded!**
- **The unit is designed for mounting inside the burner casing or in a control panel**
- **The AZL5 has its own housing and can be mounted in a suitable location (detached from the LMV5), e.g. away from the burner or in the control panel door**
- **Condensation water must not drip on the unit, neither in operation nor while service work is performed!**
- **The power transformer is not integrated in the LMV5 and must be fitted by the burner / boiler manufacturer in a suitable location**
  (Only the AGG5.2XX transformers specified by Siemens may be used!)

Electrical connections and wiring

The entire RAST5 connection area **does not** feature functional low-voltage.
The RAST3.5 connection area on the unit's small side offers functional low-voltage.

- **When making the wiring, the functional low-voltage section must be strictly separated from the other sections to ensure protection against electric shock!**
- **Adequate protection against electrical shock on unused AC 230 V terminals (RAST5) must be provided by fitting dummy plugs!**
- **To isolate the unit from mains supply, a multipolar switch must be used**
- **For wiring the bus users, only the cables specified by Siemens may be used!**
- **The electrical contacts used by the external signal sources (pressure switch-min, pressure switch-max, load controller, etc.) must be gold-plated silver contacts!**
- **The ignition cable must be run to the ignition electrode as directly as possible, with no loops**
  It must never be laid parallel with or very close to other electrical cables.

Connection of LMV5 CAN bus

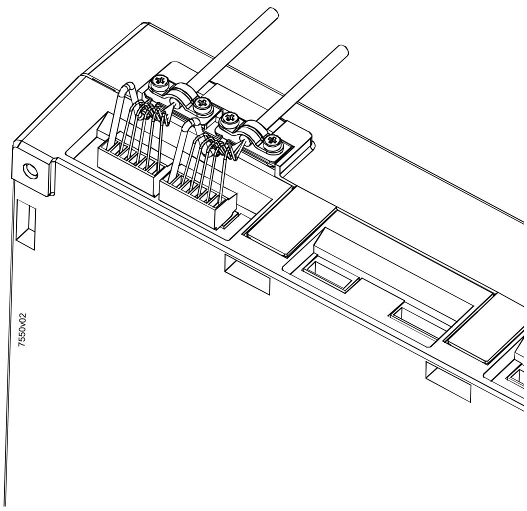


Figure 93: Connection of LMV5 CAN bus

13.1 Power supply to the LMV5

General

The LMV5 is powered via external transformer AGG5.2. This transformer supplies power to certain electronics sections via terminal X10-01, and to internal modules, actuators and AZL5 via terminal X52.
Run the power lines to the bus users together with the communication lines in a common cable.
Since the transformer's power line is restricted, a second power transformer is required if the system uses more than 4 SQM45 actuator (or in the case of longer distances).
The second power transformer is operated as shown in example 2.
In principle, the bus topology must always have a line structure and, therefore, must have a start and an end node.
The individual bus users must be connected in series, whereby the respective end nodes are to be terminated by bus terminating resistors.
The LMV5 is a component of the communication line and to be looped in between the AZL5 and the actuators.
Within the system, the AZL5 always assumes the function of a bus end node. The required bus terminating resistor is already integrated in that case.
With the actuators, the last user becomes the bus end node (here, the internal bus termination must be activated via a connecting plug).
The other node users within the line structure are to be configured without using a terminating resistor.

13.1.1 Examples of various installation situations

Example 1

Installation of all components in the burner; CAN bus cable LMV5 ↔ last actuator <20 m

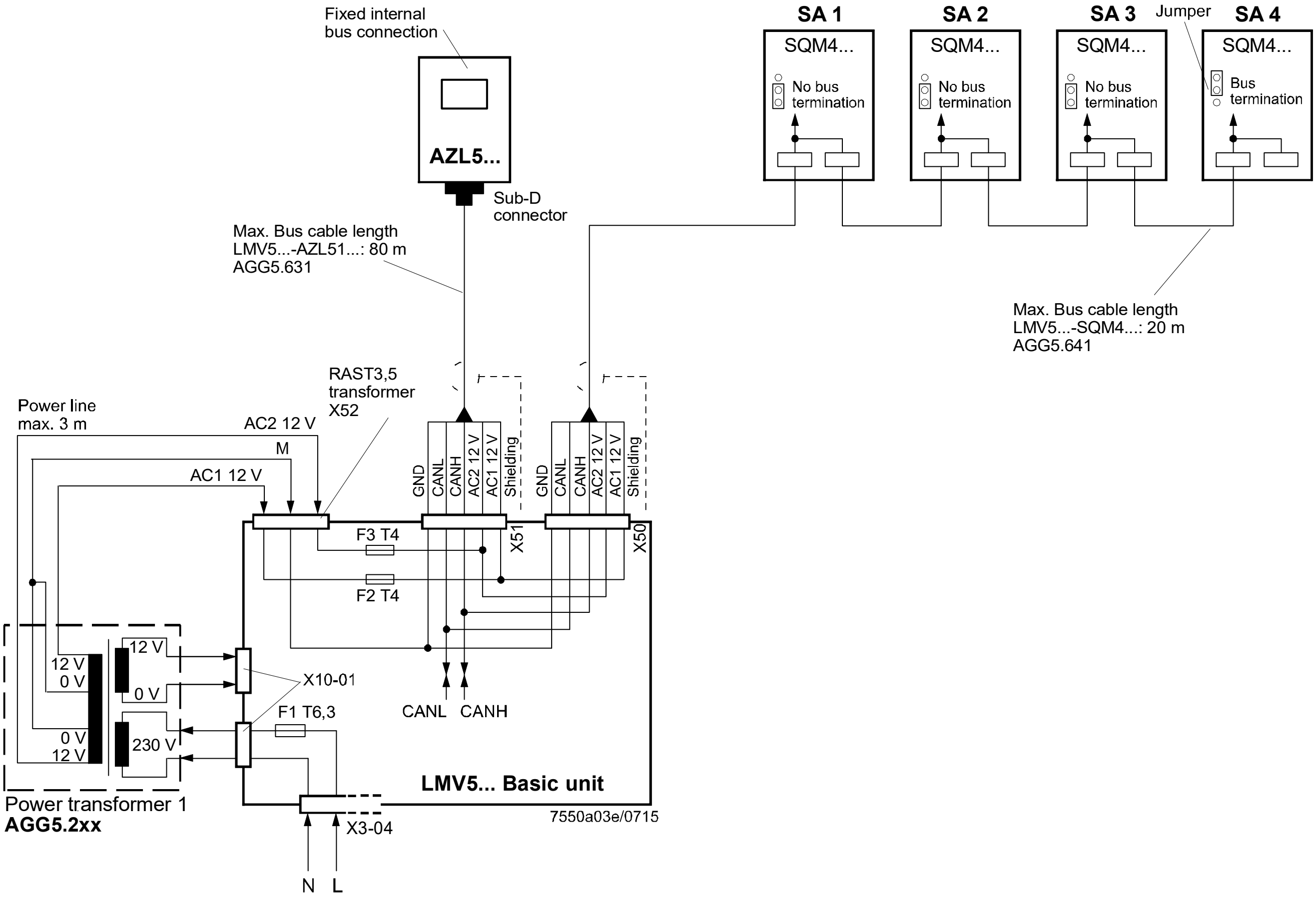


Figure 94: Installation of all components in the burner; CAN bus cable LMV5 ↔ last actuator <20 m

Note on example 1!
Total length of CAN bus cable ≤100 m.

Example 2

LMV5 in the control panel, actuator on the burner; CAN bus cable LMV5 → last actuator >20 m

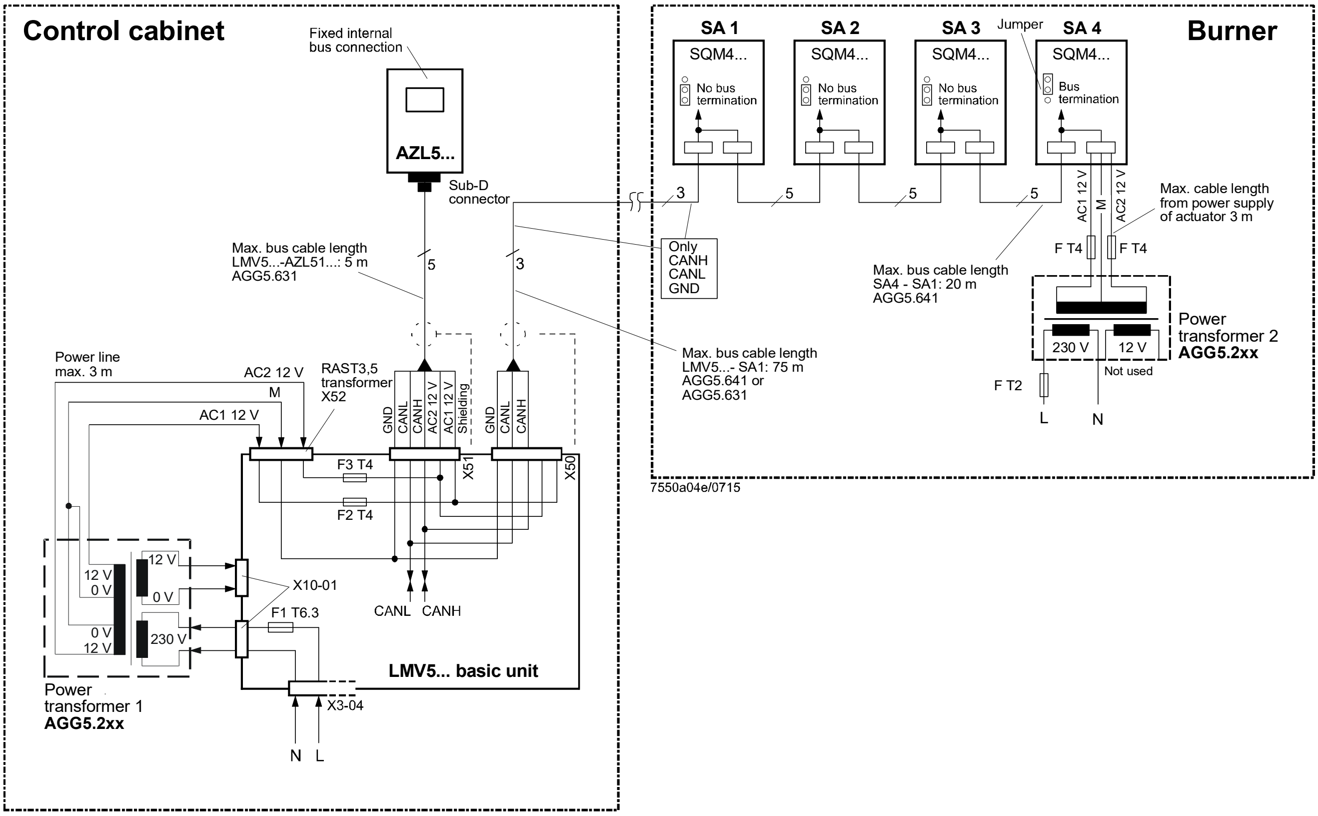


Figure 95: LMV5 in the control panels, actuator on the burner; CAN bus cable LMV5 → last actuator >20 m

Notes on example 2!
Total length of CAN bus cable ≤100 m

Whenever the distance between the LMV5 and the last actuator exceeds 20 m, or if more than 4 SQM45 are used on the burner (see chapter *Determination of maximum CAN cable length AGG5.6*), a second transformer is required for powering the actuators.

In that case, transformer 1 powers the LMV5 and the AZL5 (control panel). Transformer 2 powers the actuators (burner).

Note!
With the CAN bus cable connections from the LMV5 (control panel) to the first actuator (burner), the 2 voltages AC1 and AC2 on the LMV5 side must **not** be connected and only cables CANH, CANL and GND (+shielding) are to be connected to the first actuator (burner).
In that case, the actuators must be powered by a second transformer which is to be located near the actuators.

The power from that transformer (lines AC1, AC2, GND) must be fed to the actuator (ACT4 in the example above) and then connected through via bus cable AGG5.641 to all the other actuators.
The fuses required for transformer 1 are accommodated in the LMV5.

Caution!
For transformer 2, the 3 fuses (F T2 and 2*F T4) must be located close to the transformer.

Example 3a

Installation of all components in the burner; CAN bus cable LMV52 ↔ last actuator >20 m with 6 actuators and PLL52

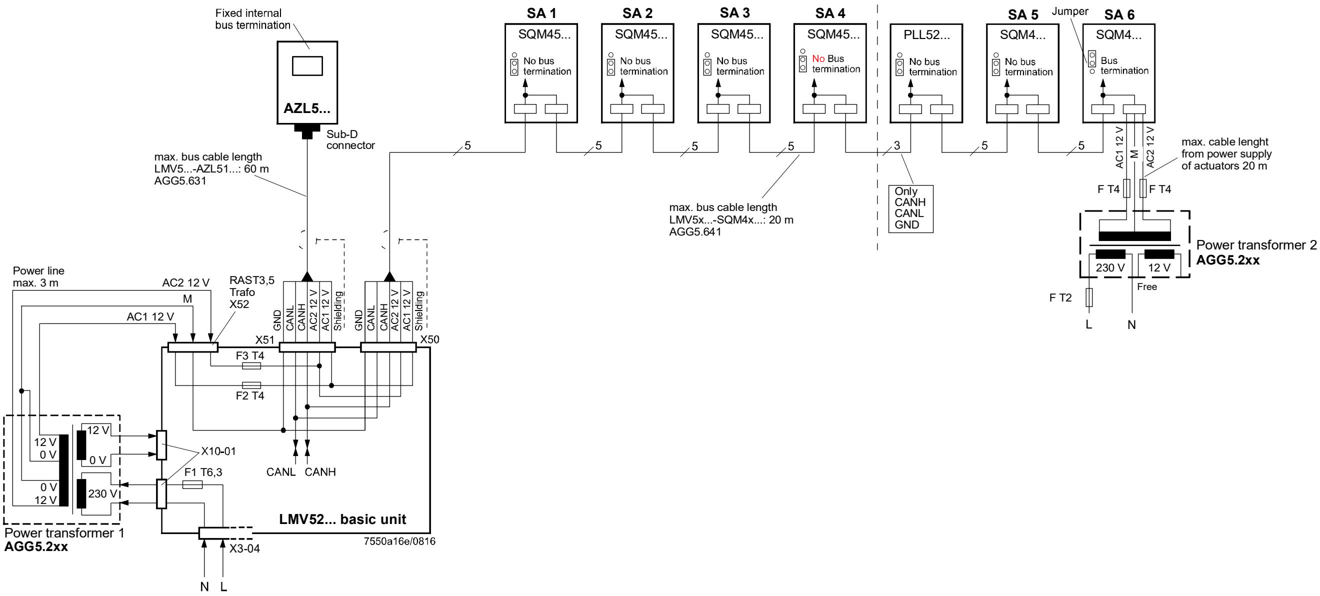


Figure 96: Installation of all components in the burner; CAN bus cable LMV52 ↔ last actuator >20 m with 6 actuators and PLL52

Example 3b

Installation in the control panel, actuator on the burner and on the boiler; CAN bus cable LMV52 ↔ last actuator >25 m with 4 actuators and PLL52

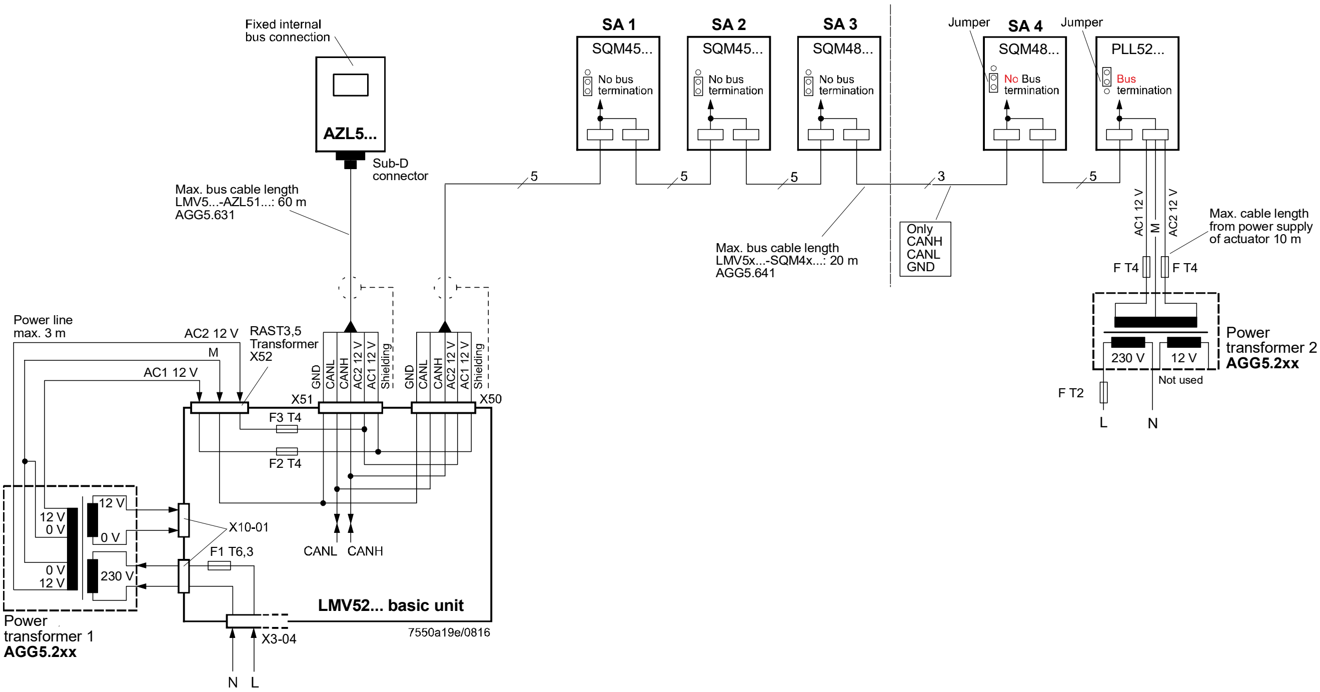


Figure 97: Installation in the control panel, actuator on the burner and the boiler; CAN bus cable LMV52 ↔ last actuator >25 m with 4 actuators and PLL52

Note on example 3a/3b!
CAN bus cable with LMV52 and more than 4 actuators and PLL52.

On LMV52 applications with more than 4 actuators (SQM45), a second transformer is required to power the extra actuators.
In that case, transformer 1 powers the LMV52, the AZL5, and the first 4 actuators.

Note!
Cut the connection between the components at a suitable location. On the actuator side, the 2 voltages AC1 and AC2 must **not** be connected but only lines CANH, CANL and GND (+ shield) to the PLL52 and the other actuator.

The actuators (SA5, SA6) and the PLL52 must be powered by a second transformer to be located near the actuators and the PLL52.

The supply voltage of this transformer is connected in Example 3a on the actuator 6 (SA6) and in Example 3b on PLL52 (lines AC1, AC2, M) and connected from there via the bus cable AGG5.641 to the next component.
The fuses for transformer 1 are accommodated in the LMV52.

Optionally, the supply voltage can also be delivered via a conduit box and fed into the connecting line between SA4 and PLL52.

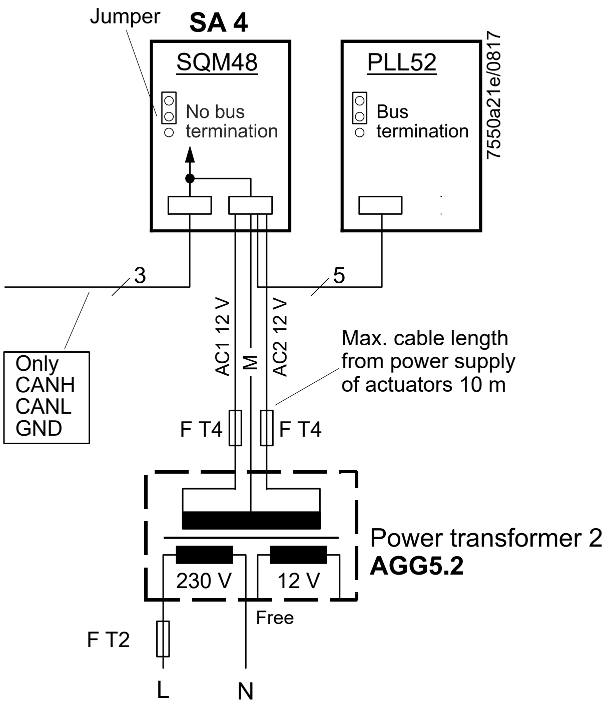


Figure 98: Installation in the control panel, the burner and on the boiler; CAN bus cable LMV52 ↔ last actuator >25 m with 4 actuators and PLL52

Caution!
For transformer 2, the OEM must fit the 3 fuses (F T2 and 2*F T4) close to the transformer.

Example 3c

Installation of all components in the burner; CAN bus cable LMV52 ↔ last actuator <20 m with 4 actuators and PLL52

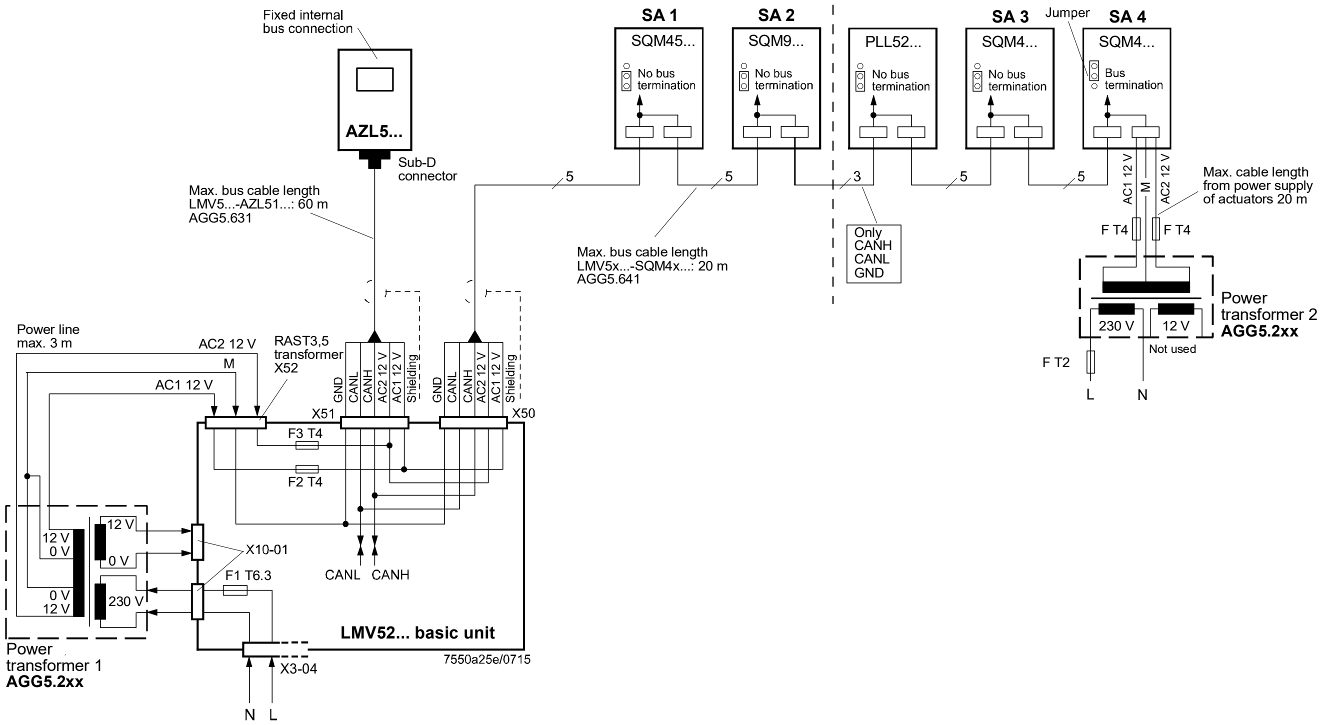


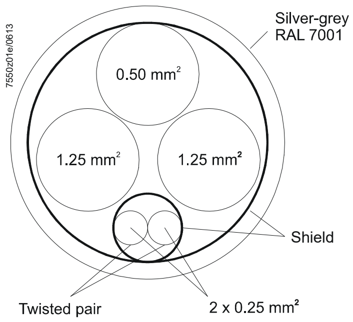
Figure 99: Installation of all components in the burner; CAN bus cable LMV52 ↔ last actuator <20 m with 4 actuators and PLL52

13.1.2 Determination of the maximum cable length AGG5.6

The maximum cable length between transformer and CAN bus users depends on the type of cable (cross-sectional area), the number of actuators, and the type of actuator (current).
The following graphs can be used to determine the maximum CAN bus cable lengths between the transformer and the group of actuators or the AZL5, depending on the relevant influencing factors.
The assumption was made that the actuators within the group are close to one another.
The **minimum** cross-sectional area for the system examples shown results from the start of the curve.
The **maximum** cable lengths for the defined system cables AGG5.641 and AGG5.631 result from the points of intersection in the graph.

Types of cable

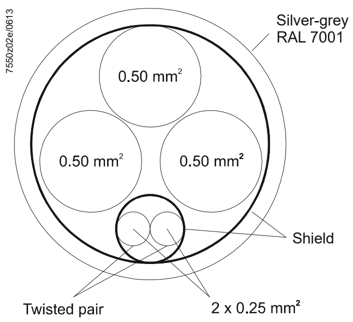
AGG5.641 (cable type 1) LMV5 ↔ actuator



Connection	**Color**	**Cross-sectional area** in mm^2
12 VAC 1	White	1.25
12 VAC 2	Brown	1.25
CANH	Yellow	0.25
CANL	Green	0.25
GND	Black	0.5

Figure 100: AGG5.641

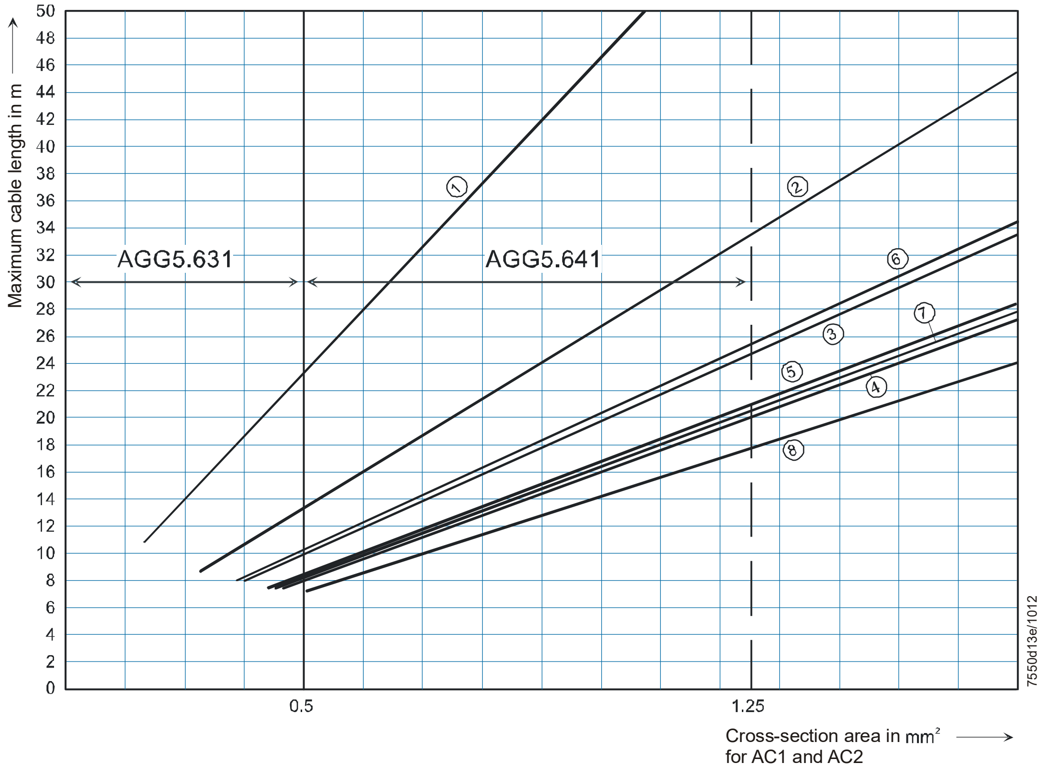
AGG5.631 (cable type 2) LMV5 ↔ AZL5



Connection	**Color**	**Cross-sectional area** in mm^2
12 VAC 1	White	0.5
12 VAC 2	Brown	0.5
CANH	Yellow	0.25
CANL	Green	0.25
GND	Black	0.5

Figure 101: AGG5.631

Diagram 1 for cable length SQM45 / SQM48



AGG5.631(cable type 2)
AGG5.641(cable typep 1)

①	1 x SQM45...	⑤	2 x SQM48...
②	2 x SQM45...	⑥	1 x SQM45... + 1 x SQM48...
③	3 x SQM45...	⑦	2 x SQM45... + 1 x SQM48...
④	4 x SQM45...	⑧	3 x SQM45... + 1 x SQM48...

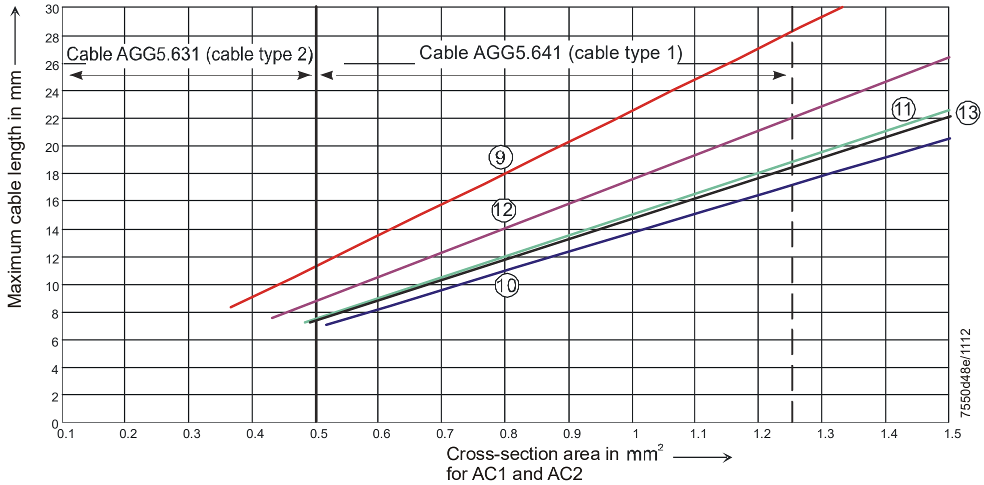
Figure 102: CAN bus connection between transformer and actuator group

Example: - System cable: AGG5.641 (1.25 mm² cross-sectional area)
- Actuators: 2 x SQM45

The point of intersection of the vertical line for the AGG5.641 (1.25 mm^2) and curve ② (2 x SQM45) gives a maximum cable length of 33.4 m between the transformer and the group of actuators.

Note!
For additional connection of a PLL52, the maximum permissible cable length is reduced by 2 m.

Diagram 2 for cable length SQM45 / SQM48 and SQM9



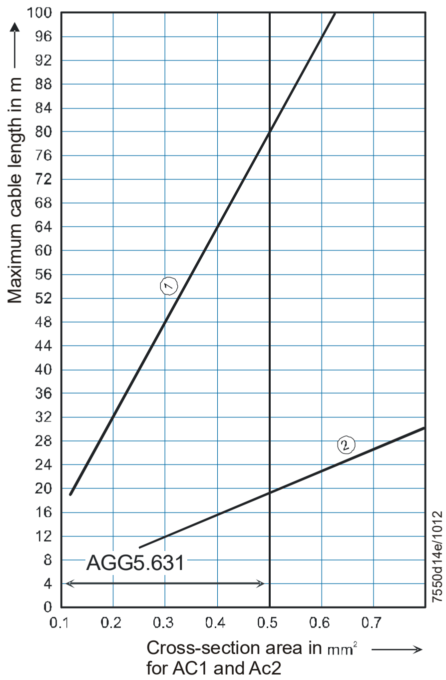
AGG5.631(cable type 2)
AGG5.641(cable type 1)

- (9) 1 x SQM91...
- (10) 2 x SQM91...
- (11) 1 x SQM48... + 1 x SQM91...
- (12) 1 x SQM45... + 1 x SQM91...
- (13) 2 x SQM45 + 1 x SQM91...

Figure 103: CAN bus connection between transformer and group of actuators

Note!
For additional connection of a PLL52, the maximum permissible cable length is reduced by 2 m.

Diagram 3 for cable lengths transformer to AZL52



AGG5.631(cable type 2)

- (1) 1 x AZL5...
- (2) 1 x AZL5... + 1 x SQM45...

Figure 104: CAN bus connection between transformer and AZL5

13.1.3 When is a second AGG5.2 power transformer required?

The table shows examples of components groups that can be operated with just one power transformer (including LMV5, AZL52, and PLL52):

Group	SQM45	SQM48	SQM9
④ Diagram 1	4	---	---
⑤ Diagram 1	---	2	---
⑧ Diagram 1	3	1	---
⑪ Diagram 2	---	1	1
⑬ Diagram 2	2	---	1

Example:
Group 8
Diagram 1 = 3 x SQM45 + 1 x SQM48 + 1 x LMV5 + 1 x AZL52 + 1 x PLL52
can be operated with just one AGG5.2 power transformer.

If additional components are connected to this group (or to one of the other groups listed in the table above), it will be necessary to divide the components into 2 groups and to incorporate a second power transformer (as well as the respective external fuses; refer to the corresponding note in the chapter *Power supply for the LMV5system*).
The same requirements apply for the second group as for the first group with regard to cable length and the maximum number of components.

Note:
2 SQM91 actuators can be operated on one second power transformer that is only used to supply these actuators.

13.2 Suppliers of other accessory items

13.2.1 Mounting clip for mounting rail

Mounting clip for mounting rail order no. 2309.000

Rittal GmbH & Co. KG
Auf dem Stützelberg
35745 Herborn
Germany
Tel: 0049 / 2772 / 505-0
Fax: 0049 / 2772 / 505-2319
www.rittal.de

Figure 105: Mounting clip

13.2.2 eBus PC adapter

eBus PC adapter part no. 230 437

Karl Dungs GmbH & Co.
Steuer- und Regeltechnik
Postfach 1229
D-73602 Schorndorf
Germany

13.2.3 RS232-USB adapter (connection AZL52 to PC for using the ACS450 PC software)

USB-RS-232 adapter special for using SPS
part no.: USB to RS232

Horter & Kalb Online Shop:
www.horter.de/shop/index.html

13.2.4 Mechanical coupling

The mechanical coupling enables a force-fit and positive-fit connection between our SQM actuator and the Fluidics oil controller xx-VK.
The flexible structure of the coupling means that an axial or radial offset can be compensated.

Fluidics Instruments specialist retailer list:
www.fluidics.nl

Type	Actuator	Shaft end
24-VK	SQM33 / SQM45	Ø 10 mm with shaft
32-VK	SQM48	Ø 14 mm with parallel key

14 Duties of the authorized inspector

Prior to approval, the manufacturer must state the assigned DIN registration number and product ID number, confirming that the LMV5 complies with the type-tested system.
Also, only the components specified for use with the LMV5 (AZL5, actuating devices, flame detectors, transformer, and CAN bus cable) may be used and, in addition with the LMV52, the PLL52 and the QGO20 In the case of VSD operation, we recommend to use the AGG5.310 accessory set for acquiring the fan speed.

	Flame detectors QRA	refer to Data Sheet N7712
	Flame detectors QRB	refer to Data Sheet N7714
	Flame detectors QRI	refer to Data Sheet N7719
	Actuators SQM4	refer to Data Sheet N7814
	Actuators SQM9	refer to Data Sheet N7818
	Operating and display unit AZL5	refer to User Documentation A7550
	Transformer AGG5	refer to Basic Documentation P7550
	CAN bus connecting cable AGG5.63	refer to Basic Documentation P7550
	Accessory set AGG5.310 for acquiring the fan speed (recommended, if required)	refer to Basic Documentation P7550
In addition, with LMV52	O2 module PLL52	refer to Basic Documentation P7550
	O2 sensor QGO20	refer to Data Sheet N7842
	Flue gas collector AGO20	refer to Data Sheet N7842
	Accessory set AGG5.310 for acquiring the fan speed (recommended)	refer to Basic Documentation P7550

The mechanical links between the actuators and the fuel and air actuating devices and any other actuating devices used must be rigid.

In addition, following must be checked:

Correct parameterization of the system

The parameterized values and setting values (e.g. curve characteristics) that define the fuel-air ratio control system and – if used – the O2 trim control must be **documented** by the individual responsible for plant / the heating engineer after the plant is installed and commissioned. These data can be printed out with the help of the ACS450 PC software, for example, or they must be put down in writing. These documents must be kept in a safe place and are to be checked by the inspector.

Caution!
On the OEM level of the LMV5, it is possible to make parameter settings that differ from application standards. For this reason, it is to be checked whether parameterization is in compliance with the relevant application standards (e.g. EN 298, EN 676, EN 267, etc.) or whether the respective plant must be approved on an individual basis.

The following parameters are of particular importance:

Fuel-air ratio control system

The setting values (curve parameters) for the actuating devices, the types of fuel, and the combustion air across the burner's load range must be stored in adequate numbers. While considering the combustion chamber pressure, fuel pressure as well as temperature and pressure of the combustion air, assignment of the selected setting values of fuel and combustion air must be made such that correct operation with sufficient amounts of excess air is ensured across the entire load range of the burner. Proof of this must be delivered by the burner / boiler manufacturer by measuring the combustion characteristics. When using a VSD, the fan is run to the steady-state condition. Hence, the burner's rated load refers to the fan speed acquired with speed standardization.

Burner control section

Fuel train parameterization (G, Gp1, Gp2, LO, HO, LOgp, HOgp, refer to chapter 3 Fuel train (examples) must be checked prior to commissioning to ensure it agrees with the fuel trains implemented on the burner and to make certain the valves are correctly assigned to the valve outputs on the LMV5.

The correct setting of the time parameters, especially the safety and prepurge times (separately for oil and gas), must be checked.
It must also be checked to ensure that – in the case of plants with continuous operation – flame detector QRI / QRA7 (or the ionization probe) is used, because only these are suited for continuous operation.
Further, the function of the flame detector in the event of loss of flame during operation and with extraneous light during the prepurge time, or in the case there is no establishment of flame at the end of the safety time, must be checked.
(With the QRI flame detector, generation of an extraneous light signal is achieved by simulating a flickering flame with an artificial light source). With the QRA7, extraneous light can be simulated by a lighter or a halogen emitter without UV filter.

The functions of all available or required input messages must be checked, for example:

- Air pressure
- Minimum gas pressure
- Maximum gas pressure
- Gas valve proving or CPI
- Minimum oil pressure
- Maximum oil pressure
- Safety loop (e.g. safety limit thermostat)
- Fan contactor contact in at least 2 phases (e.g. prepurge and operation)

It is to be checked whether gas valve proving is activated if required by the application. If it is, the correct leakage rate is to be checked. For details, refer to chapter *Gas valve proving*.
In the case of dual-fuel burners, short *PreIgnitionTOil* (from phase 38) must be parameterized when firing on oil, and the oil pump must be equipped with a magnetic clutch, for example, ensuring that the oil pressure is increased in phase 38 before ignition takes place. In addition, parameter *OilPumpCoupling* must be set to *Magnetcoupl*.
Burners for oil alone do not require a magnetic clutch, in which case long *PreIgnitionTOil* (from phase 22) is to be parameterized, or parameter *OilPumpCoupling* is to be set to *Directcoupl*.

O2 trim control (only with LMV52 system)

The O2 trim control system of the LMV52 offers a number of operating modes. In operating mode *conAutoDeac*, O2 trim control is automatically deactivated by the LMV52 if the O2 alarm responds, or if a fault in connection with actual value acquisition of O2 occurs (QGO20, PLL52, O2 sensor test, etc.). Also, O2 trim control can be deactivated manually by selecting *mandeact*. For this reason, the ratio control curves with the LMV52 must always be set such that there are sufficient amounts of excess air, irrespective of environmental conditions (e.g. combustion chamber and fuel pressure, and temperature and pressure of the combustion air) across the entire load range – same as with a system without O2 trim control (LMV50/LMV51). Also, the ratio control curves must be proven. The actual O2 value should not fall below the O2 setpoint of O2 trim control.

A sufficient number of curvepoints (for actuator positions, O2 setpoints, etc.) should be stored to ensure that there is a linear progression of the O2 value across the entire load range. The second curvepoint must correspond to the low-fire position (or be set to a lower value). The first curvepoint must lie sufficiently below curvepoint 2 (at about 50 % load) so that the curves are defined for reducing the air rate by O2 trim control below the low-fire position also.

The *O2 min.* value represents the switch-off threshold of the O2 alarm function and must be set and proven such that – across the entire load range and while taking into account the combustion chamber and fuel pressure as well as the temperature and pressure of the combustion air – there will be no dangerous increase of the CO and/or soot values.
On the other hand, the safety distance from the dangerous area should be selected as small as possible to prevent inadvertent or undesired shutdowns (guide values: CO <2000 ppm Vol % or soot number <3 according to Bacharach).

The O2 setpoint must have an adequate distance from the above mentioned O2 min. value (guide value: O2 setpoint = O2 min. value +1% O2).

General

It must be made certain that all safety notes and the notes on mounting, electrical installation and service according to the above mentioned chapter and Data Sheets are complied with.

15 Technical data

15.1 LMV5 and AZL5

LMV5

Mains voltage	**AC 120 V** -15% / +10%	**AC 230 V** -15% / +10%

☞ Note!
Only for use in earthed networks!

Transformer AGG5.210 / AGG5.220 - Primary side - Secondary side 1 - Secondary side 2	 AC 120 V AC 12 V 2 x AC 12 V	 AC 230 V AC 12 V 2 x AC 12 V
Mains frequency	50 / 60 Hz ±6%	50 / 60 Hz ±6%
Power consumption	<30 W (typically)	<30 W (typically)
Safety class	I with parts according to II and III as per DIN EN 60730-1	
Degree of protection of housing	IP00 in accordance with DIN EN 60529 IP40 in accordance with DIN EN 60529 must be ensured through adequate installation of the LMV5 by the burner or boiler manufacturer	
Mode of operation	Type 2B in accordance with DIN EN 60730-1	
Rated impulse voltage	Rated impulse voltage in accordance with DIN EN 60730-1; chapter 20 (overvoltage class III)	
Mains voltage and power supply for EMC emitted interference tests	The emitted interference measurement is tested with mains voltage and maximum power consumption	

15.2 Loads on terminals, cable lengths and cross-sectional areas

Loads on input terminals

General data		
Mains voltage	**AC 120 V** -15% / +10%	**AC 230 V** -15% / +10%
• Perm. mains primary fuse (external)	Max. 16 AT	Max. 16 AT
• Unit fuse F1 (internal)	6,3 AT to DIN EN 60127 2/5	6,3 AT to DIN EN 60127 2/5
• Mains supply: The mains input current depends on the status of the unit		
Under voltage		
• Safety shutdown from operating position at mains voltage	< AC 96 V	< AC 186 V
• Restart on increase of mains voltage	> AC 100 V	> AC 188 V
Oil pump / magnetic clutch (rated voltage)		
• Rated current	1.6 A	2 A
• Power factor	Cosφ >0.4	Cosφ >0.4
Pressure switch relief valve (rated voltage)		
• Rated current	0.5 A	0.5 A
• Power factor	Cosφ >0.4	Cosφ >0.4
Status inputs (CFN): Status inputs (with the exception of the safety loop) of the contact feedback network (CFN) are used for system supervision and require a mains-related input voltage		
• Input safety loop	Refer to *Loads on output terminals*	
• Input currents and input voltages		
- UeMax	UN +10%	UN +10%
- UeMin	UN -15%	UN -15%
- IeMax	1.5 mA peak	1.5 mA peak
- IeMin	0.7 mA peak	0.7 mA peak
• Recommended contact material for external signal sources (air pressure switch, pressure switch-min, pressure switch max, etc.)	Gold-plated silver contacts	
• Transition / transient behavior / bouncing		
- Perm. bounce time of contacts when switching on/off	Max. 50 ms (after the bounce time, the contact must be permanently closed or open)	
• UN	AC 120 V	AC 230 V
• Voltage detection		
- ON	AC 90...132 V	AC 180...253 V
- OFF	< AC 40 V	< AC 80 V

Loads on output terminals

Total load on contacts

Mains voltage	**AC 120 V** -15% / +10%	**AC 230 V** -15% / +10%
• Input current of unit (safety loop) total load on contacts resulting from: - Fan motor conductor - Ignition transformer - Valve - Oil pump / magnetic clutch	Max. 5 A	Max. 5 A

Single contact load

Fan motor contactor (rated voltage)		
• Rated current	1 A	1 A
• Power factor	Cos φ >0.4	Cos φ >0.4
Alarm output (rated voltage)		
• Rated current	1 A	1 A
• Power factor	Cos φ >0.4	Cos φ >0.4
Ignition transformer (rated voltage)		
• Rated current	1.6 A	2 A
• Power factor	Cos φ >0.2	Cos φ >0.2
Gas valves (rated voltage)		
• Rated current	1.6 A	2 A
• Power factor	Cos φ >0.4	Cos φ >0.4
Oil valves (rated voltage)		
• Rated current	1.6 A	1 A
• Power factor	Cos φ >0.4	Cos φ >0.4
Cable lengths		
• Main cable	Max. 100 m (100 pF/m)	Max. 100 m (100 pF/m)
• CFN cable	Max. 100 m (100 pF/m) [1)]	Max. 100 m (100 pF/m) [1)]
• Analog cable	Max. 100 m (100 pF/m)	Max. 100 m (100 pF/m)
• Flame detector	Refer to chapter *Technical Data / Flame supervision*	
• CAN-bus	Total length max. 100 m	

Note!
[1)] If the cable length exceeds 50 m, no additional loads may be connected to the status inputs, refer to *Power supply for LMV5*!

If a certain cable length is exceeded, the actuators must be powered by a transformer located near the actuators.

15.3 Cross-sectional areas

The cross-sectional areas of the mains supply lines (L, N, PE) and – if applicable – the safety loop (safety limit thermostat, shortage of water, etc.) must be sized for rated currents in agreement with the selected external primary fuse.
The cross-sectional areas of the other cables must be sized in agreement with the internal unit fuse (max. 6.3 AT).

Min. cross-sectional area	0.75 mm² (single- or multi-core to VDE 0100)

Cable insulation must satisfy the requirements of the relevant temperature and environmental conditions. The CAN (bus) cables have been specified by Siemens and can be ordered as accessory items. **Other types of cables must not be used. Otherwise, the EMC characteristics of the LMV5 will become unpredictable!**

Main voltage	**AC 120 V** -15% / +10%	**AC 230 V** -15% / +10%
Fuses in the LMV5		
- F1	6.3 AT DIN EN 60127 2/5	6.3 AT DIN EN 60127 2/5
- F2	4 AT GMD-4A	4 AT DIN EN 60127 2/5
- F3	4 AT GMD-4A	4 AT DIN EN 60127 2/5

15.4 AZL5 display and operating unit

Operating voltage	AC 24 V -15% / +10%
Power consumption	<5 W (typically)
Degree of protection of housing - Rear - Front	 IP00 to IEC 529 IP54 to IEC 529 (when built in)
Safety class	I with parts according to II and III as per DIN EN 60730-1
Battery: **Manufacturer** VARTA DURACELL SANYO ELECTRIC, Osaka / Japan RENATA AG, Itingen / CH	 **Type** CR 2430 (LF-1/2 W) DL 2430 CR 2430 (LF-1/2 W) CR 2430
Pollution degree	2

15.5 CAN bus cable

Types of cable	
AGG5.641	8 mm dia. +0,5 / -0,2 mm Bending radius: ≥120 mm Ambient temperature: -30...+70 °C (cable not moving) Cable jacket resistant to almost all types of mineral oil
AGG5.631	7.5 mm dia. ±0.2 mm Bending radius: ≥113 mm Ambient temperature: -30...+70 °C (cable not moving) Cable jacket resistant to almost all types of mineral oil

15.6 Environmental conditions (for all LMV5 components)

Storage	DIN EN 60721-3-1
Climatic conditions	Class 1K3
Mechanical conditions	Class 1M2
Temperature range	-20...60 °C
Humidity	<95% r.h.
Transport	DIN EN 60721-3-2
Climatic conditions	Class 2K2
Mechanical conditions	Class 2M2
Temperature range	-20...60 °C
Humidity	<95% r.h.
Operation	DIN EN 60721-3-3
Climatic conditions	Class 3K3
Mechanical conditions	Class 3M3
Temperature range	-20...60 °C
Humidity	<95% r.h.

Caution!
Condensation, formation of ice and ingress of water are not permitted!

16 Dimensions

Dimensions in mm

LMV5

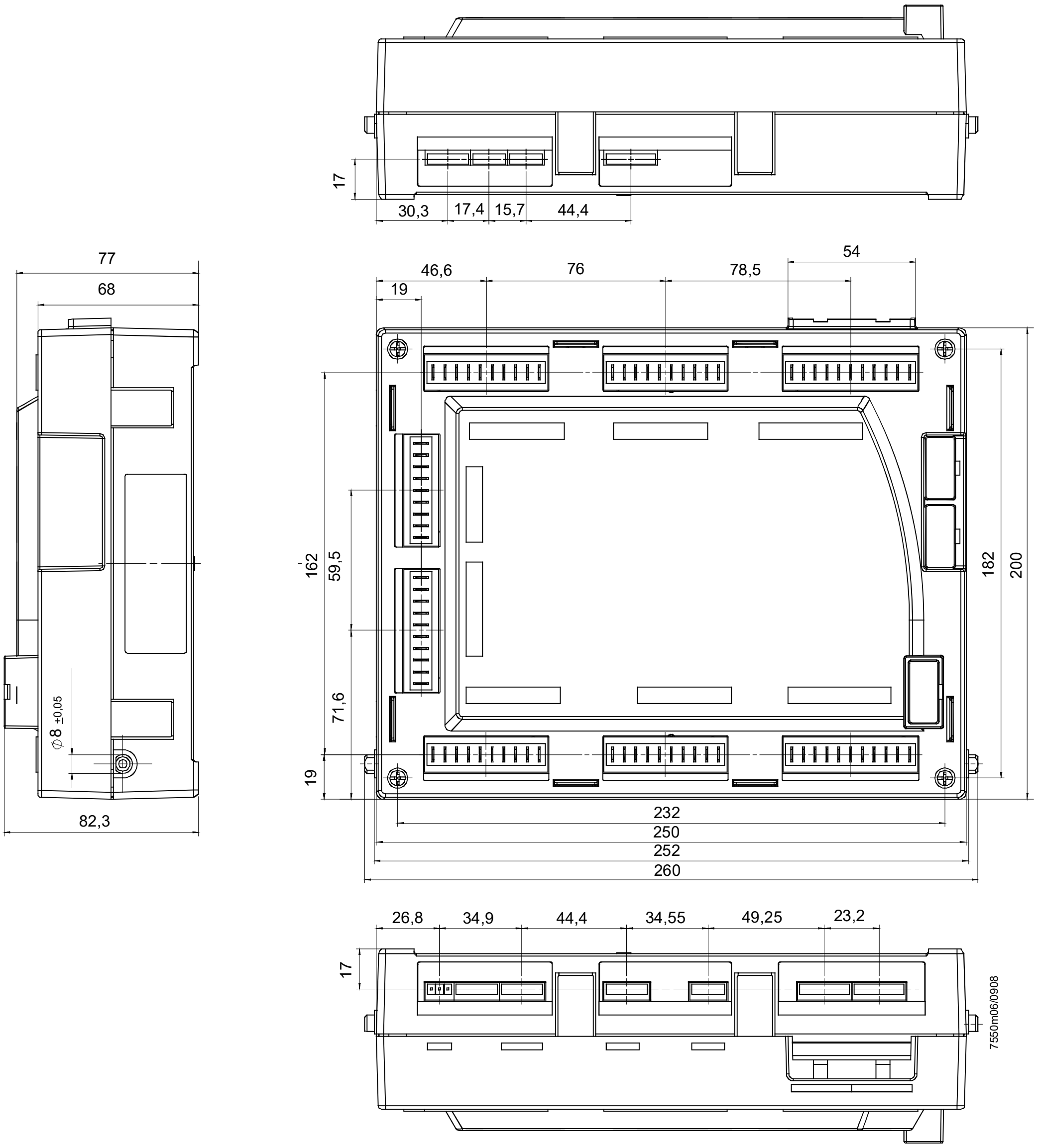


Figure 106: Dimensions of LMV5

Dimensions in mm

AZL5

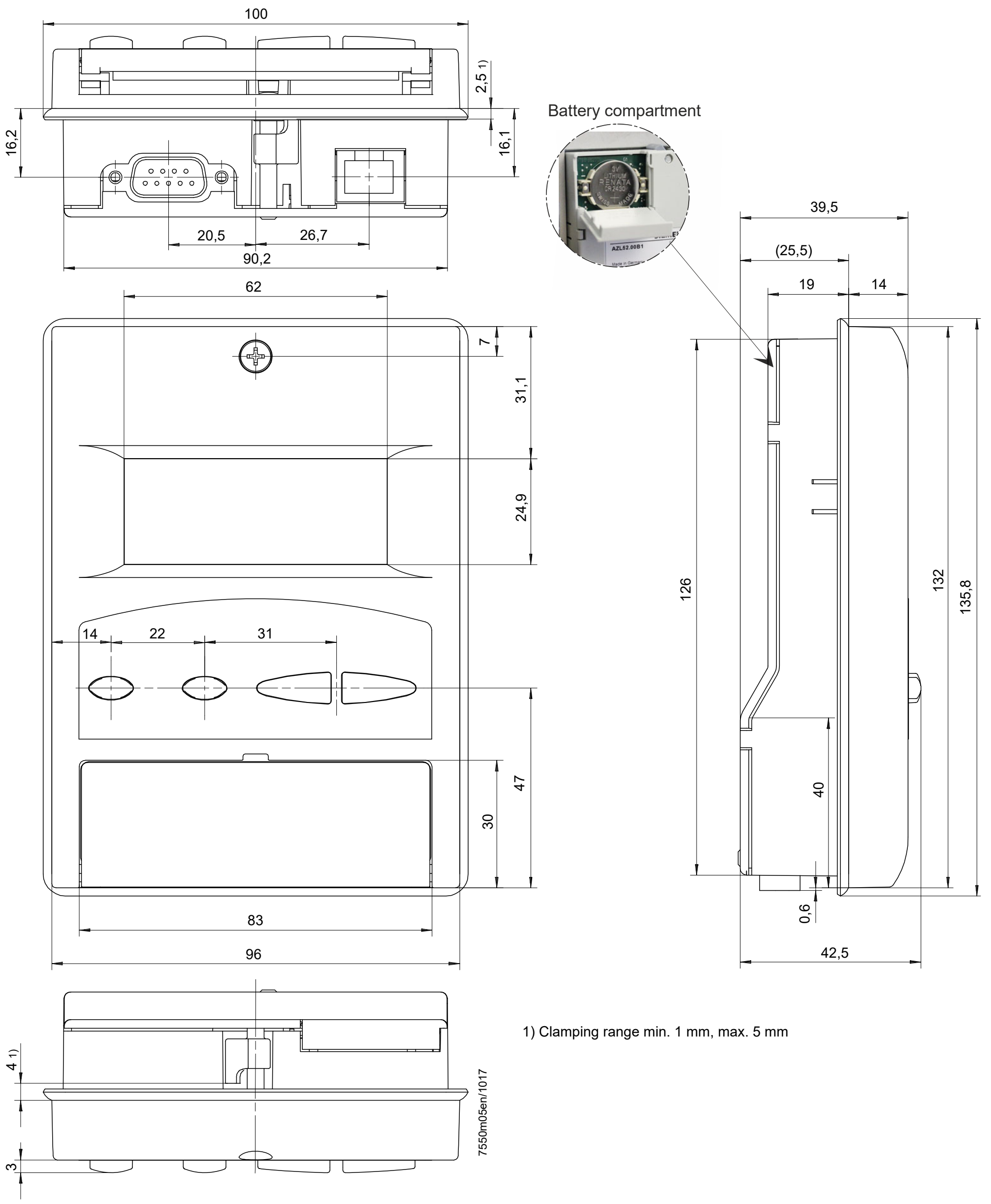


Figure 107: Dimensions of AZL5

Dimensions in mm

AGG5.210 / AGG5.220

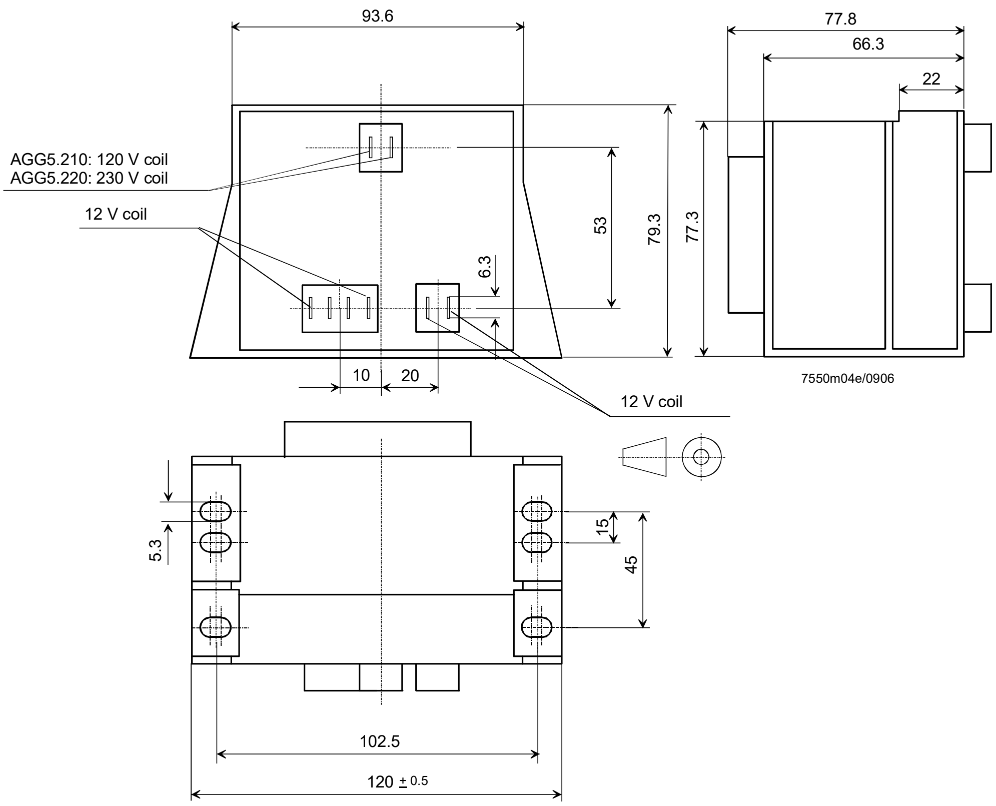
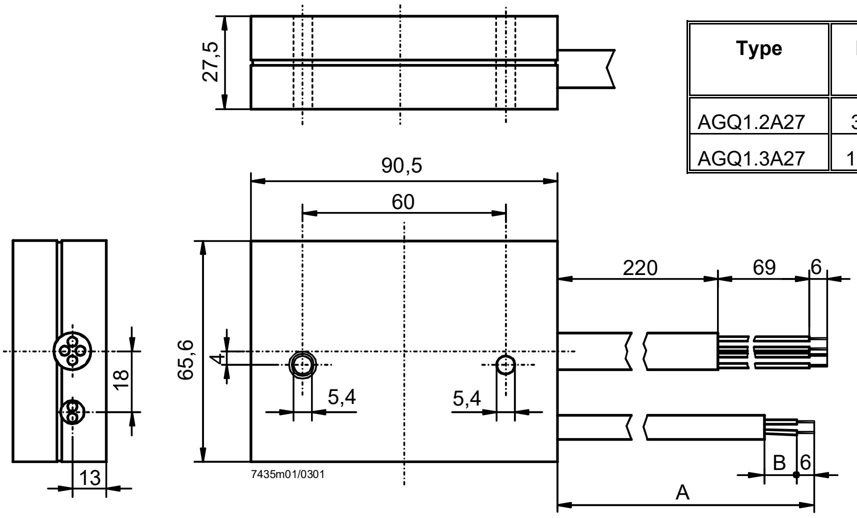


Figure 108: Dimensions of AGG5.210 / AGG5.220

AGQ1.xA27



Type	Measure A	Measure B
AGQ1.2A27	300	220
AGQ1.3A27	1200	350

Figure 109: Dimension AGQ1.xA27

17 Block diagram of contact links

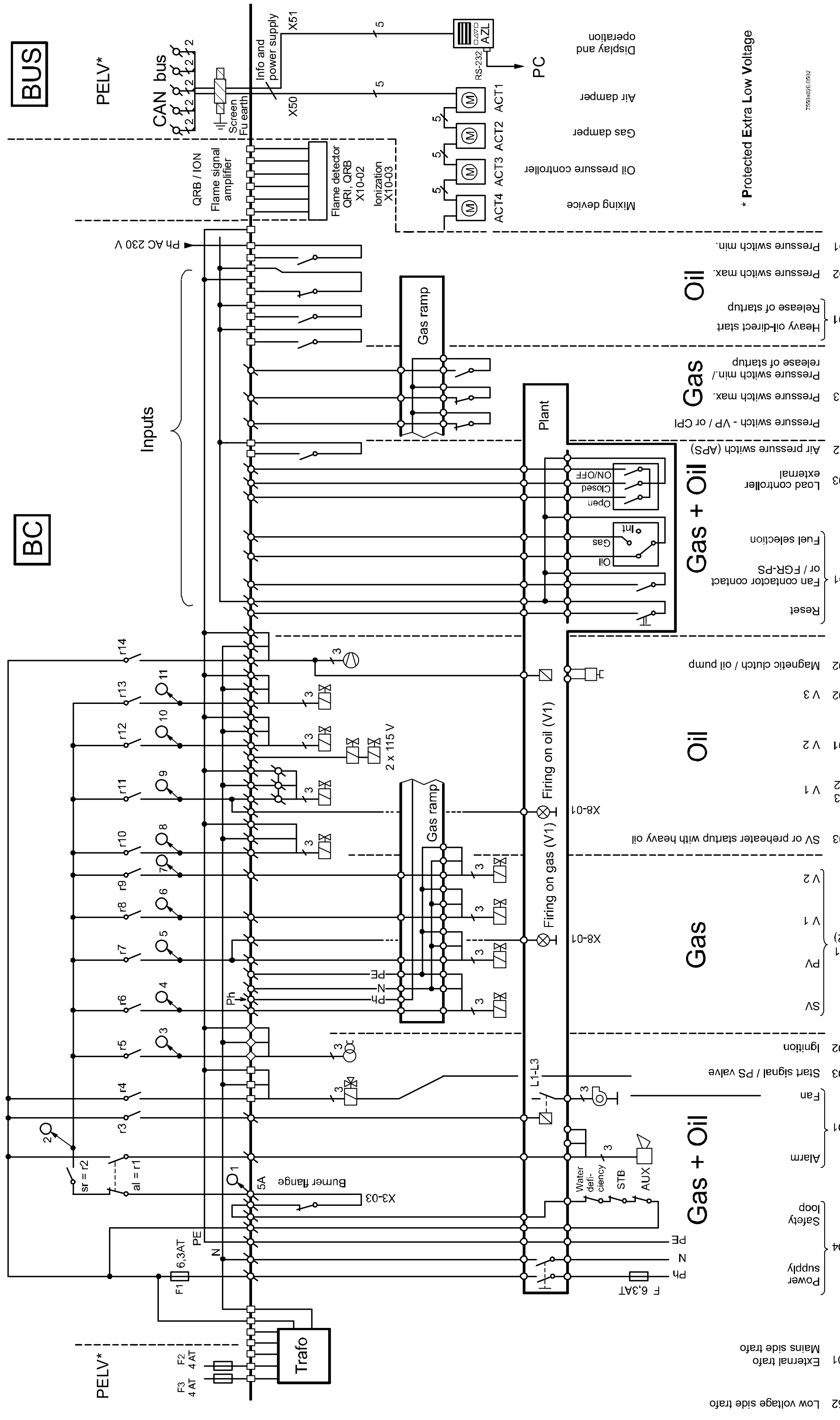


Figure 110: Block diagram of contact links for LMV5

18 VSD module

Only LMV50 / LMV51.3 / LMV52

General

The VSD module is an internal extension to the LMV5 (PBC) and is used for the control of VSD that ensure safety-related supervision of the fan speed.
2 fuel meters (oil and gas) can be connected as an option.

Basic diagram

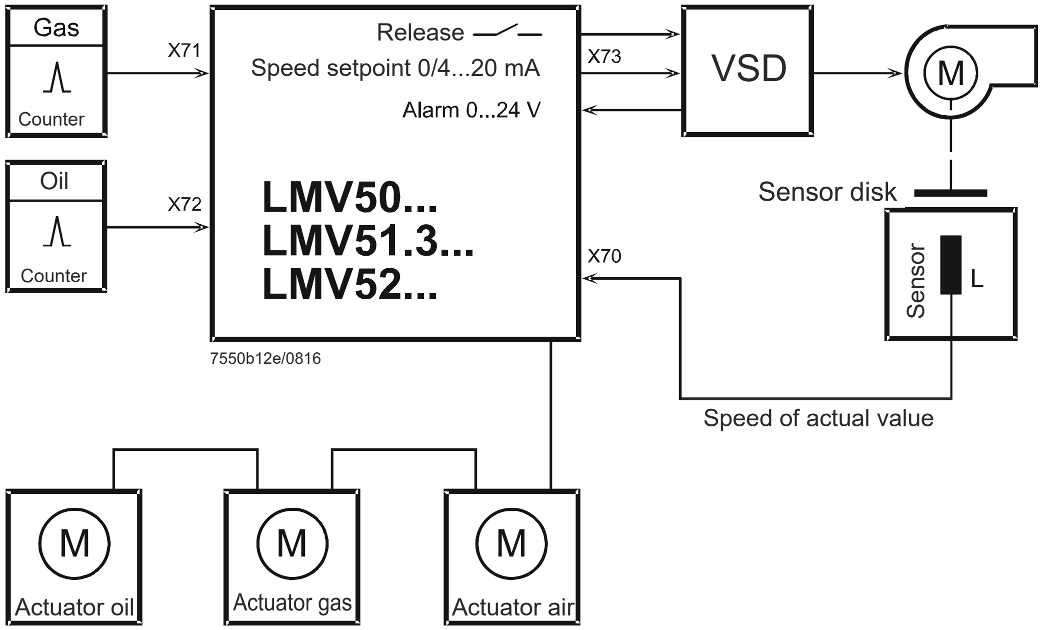


Figure 111: Connection of VSD module

LMV50/LMV51.3 Configuration of the LMV5 (BU)

The auxiliary actuator can be parameterized on the LMV5, depending on the type of fuel. The function offers 2 choices: *Air damper* or *VSD*.

The *Damper act* configuration corresponds to the previous function of the LMV51.0 and LMV51.1.

Parameter	*Aux Actuator (deactivated / activeDamper / active VSD / AuxActuator3 / VSD + AuxActuator3)*

LMV52 configuration of the LMV5 (BU)

On the LMV52, the VSD option can be selected in addition to the actuators.

Here, it is also selected whether the VSD shall be used in connection with O2 trim control.

Parameter	*VSD (deactivated / activated / air influen)*

18.1 VSD module

General

A VSD can be connected to the VSD module integrated in the LMV5.
The VSD is controlled via an analog current output and a potential-free release contact.
Evaluation of the alarm feedback signal from the VSD is accomplished with a 0...24 V output. When activated, the LMV5 enters the safety phase.
Both motor speed and direction of rotation are acquired by an inductive sensor. The asymmetric speed signal is checked for direction of rotation and plausibility.

The VSD module generates acceleration and deceleration ramps in accordance with the parameters settings made on the LMV5.
The motor speed is adjusted based on the same principle as that used with actuator adjustments. For this reason, the characteristic of the VSD must be linear. Filters, delay and damping members must be removed.
The VSD module controls the motor speed to the setpoint.
If control range limitation becomes active, an appropriate display appears on the AZL5.
If that is the case over a longer period of time (→ Safety time ratio control), the LMV5 is shut down and the message *Special position not reached* or *Speed not reached* appears.
Speed control is active for speeds ≥8%.

18.1.1 Inputs / outputs

Connection diagram

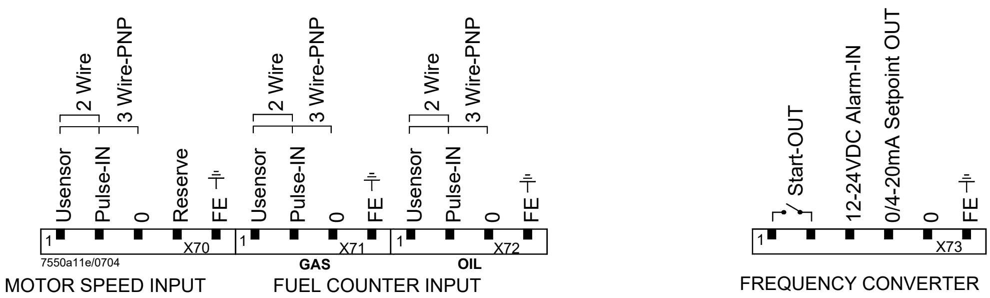


Figure 112: Inputs/outputs VSD module

Release contact
X73 pin 1 / X73 pin 2

The VSD module has a potential-free release contact for the VSD. This contact is activated when a motor speed other than zero is required.

The behavior of the release contact in the home run phase and a no-load position of 0% can be defined via the following parameter. *ReleasecontctVSD = open* allows the use of a DC break, for instance.

Voltage:	≤ AC / DC 24 V (protective extra low-voltage)
Current:	5 mA to 2 A

Parameter	*ReleasecontctVSD (closed / open)*

Alarm input
X73 pin 3

The alarm input of the VSD module is connected to the alarm output of the VSD. In the event of an alarm, safety shutdown is triggered as a minimum requirement.

Voltage active:	DC 12...24 V	(alarm ON)
Voltage inactive:	< DC 4 V	(alarm OFF)

Analog output to the VSD X73 pin 4

This output is used for delivering the preselected speed setpoint to the VSD.

Current:	0/4...20 mA ≈ 0...105% (→ Standardization of speed)
Output load:	max. 750 Ω (burden), short-circuit-proof
Resolution:	0.1%
Cross-sectional area of wire:	≥0.1 mm^2

Quick shutdown in the event of great speed deviations during operation

This function is used to trigger safety shutdown as quickly as possible (within about 1 second) if great speed deviations are detected, or if speed = 0 is detected in operation. This check is made in phase *Ignition On 38* through *Afterburn time* 70.

The degree of deviation where quick shutdown shall take place can be set via parameter *TolQuickShutdown*:

Checking is deactivated when 100% is entered as the tolerance value.

Parameter	*TolQuickShutdown*

Monitoring with flue gas recirculation pressure switch (FGR-PS)

For details, refer to the description in chapter *Digital inputs,* section *Fan contactor contact (FCC)* or *FGR pressure switch (FGR-PS) X4-01*.

Speed feedback signal

The motor's speed can be acquired with different types of sensors. To detect the motor's direction of rotation with a sensor, a sensor disk with angular steps of 60°, 120° and 180° is used. The sensor disk generates pulse intervals of different length.

Attention!
Speed acquisition is safety-related!

We recommend using accessory set AGG5.310.
To enable the acquired speed to be standardized to the range of 0...100%, the speed that corresponds to 100% must be parameterized (→ Standardization of speed).

Speed input X70

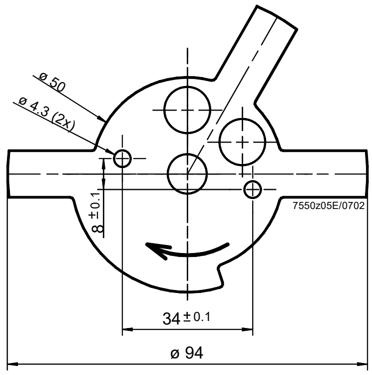
Motor speed:	300...6300 1/min
100% speed:	1350...6300 1/min
Sensor:	Inductive sensor to DIN 19234 or open collector (pnp) U_{CEsat} <4 V, U_{CEmin} > DC 15 V
Power supply:	DC 10 V, max. 15 mA
Switching current:	>10 mA
Cable length:	Max. 100 m (sensor line must be run **separately**!)

Safe separation between mains voltage and protective extra low-voltage

Caution!
All inputs and outputs of the VSD module comply with the requirements for protective extra low-voltage. Hence, the mains voltage section must be strictly separated!

Sensor disk

Sensor disk and speed sensor can be ordered as accessory set AGG5.310.



Number of tappets:	3
Angular steps:	60°, 120°, 180°
Accuracy:	±2°

Figure 113: Sensor disk

Speed sensor

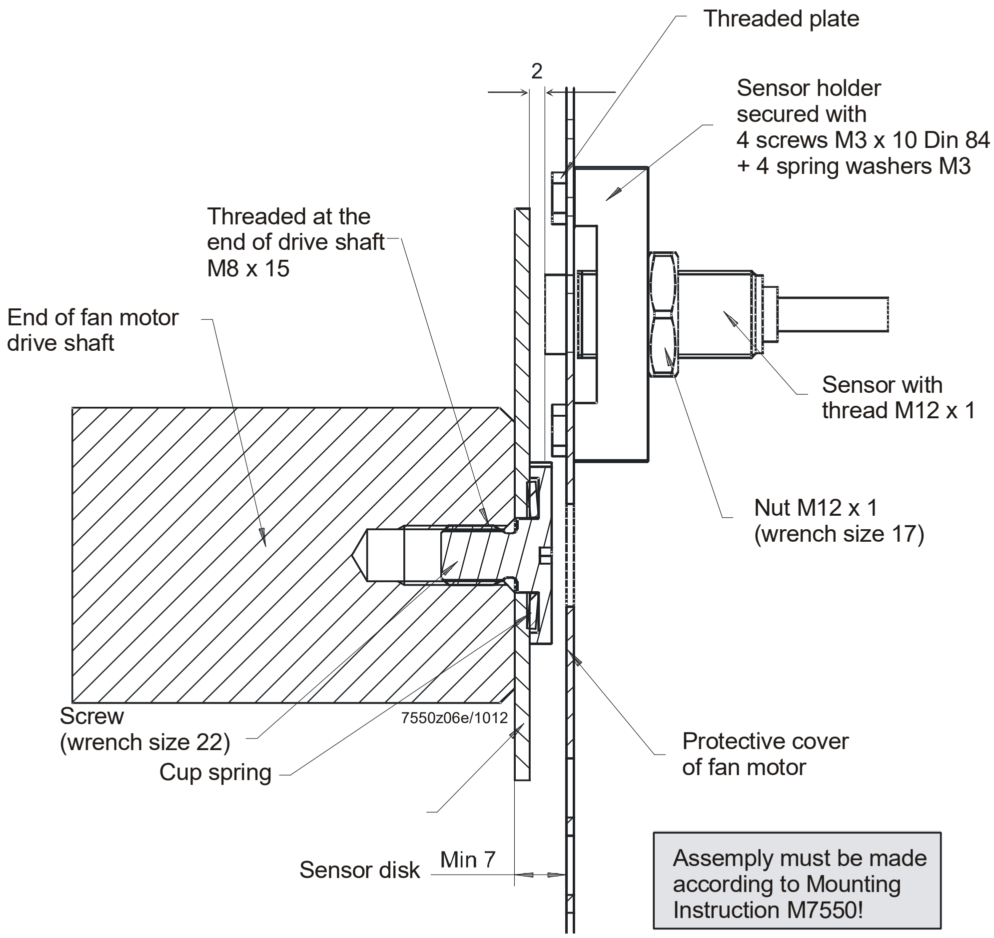


Figure 114: Speed sensor

Selection of fan motor

1. Motor supplier: Version **with** threaded hole M8x15.
2. Standard motor plus extra machining (drilling hole and cutting thread M8x15).

Fuel meter

To acquire the amount of fuel consumed, up to 2 fuel meters can be connected. Assignment to the type of fuel is fixed.
To adapt to different types of fuel meters, assignment of the number of pulses and the resulting fuel throughput must be parameterized.

Fuel meter input X71/X72

Type of sensor:	Inductive sensor to DIN 19234 (Namur) or open collector (pn) with U_{CEsat} <4 V, U_{CEmin} > DC 15 V or Reed contact
Frequency:	≤300 Hz
Pulses / l or gal, m^3:	≤9999.9999 (to be parameterized)
Pulses / ft^3:	≤999.99999 (to be parameterized)
Power supply:	DC 10 V, max. 15 mA
Switching current:	>10 mA

18.1.2 Configuring the VSD

The VSD must be configured in accordance with the type of motor connected.
The acceleration and deceleration ramps must be set about 30% shorter than the ramps parameterized in the electronic fuel-air ratio control system of the LMV5.

Example: Drive ramp of 10 seconds ⇒ VSD ramps to be set to 7 seconds
Drive ramp of 30 seconds ⇒ VSD ramps to be set to 20 seconds
Drive ramp of 60 seconds ⇒ VSD ramps to be set to 40 seconds

The motor must be able to follow the parameterized VSD ramp.
If this is not observed, the predefined speeds will not be reached within the respective periods of time.
The configuration of the current / voltage interfaces of the VSD must be in accordance with the configuration of the VSD module in the LMV5.

The minimum output frequency of the VSD must be set to 0 Hz. To ensure that the fan motor reaches the required speed under all operating conditions, the VSD during configuration is controlled with a maximum of only 95% of the positioning signal. If the burner's rated capacity calls for full fan speed, the maximum output frequency must be set to 105.2% of mains frequency.

It is recommended to internal control of the internal VSD plus slippage or load compensation since they might adversely affect speed control in the VSD module.

18.1.3 Configuring speed acquisition

The speed sensor to be used must be an inductive sensor (Namur or open collector (pnp) (refer to chapter *Inputs / Outputs*). The motor speed is acquired with an asymmetric sensor disk having 3 protrusions spaced at 60°, 120° and 180° respectively. The number of protrusions must be appropriately parameterized. The sensor disk is to be fitted such that the pulse intervals are generated in the direction of rotation as described.

Since the different types of motors have different maximum speeds, the VSD module must know the speed that corresponds to 100%.

Parameter	*Num Puls per R*

18.1.4 Speed standardization

Standardization

Since the standardized speed is difficult to adjust – but the correct adjustment has a great impact on the control performance of the VSD module – an automatic measurement function has been implemented.

☞ Note!

- The speed should be standardized in standby mode
- The speed is only standardized when parameter *VSD* is set to *activated* or to *air influen*
- For speed standardization to start, both safety loop and burner flange contact must be closed
- All actuators that have an impact on the amount of combustion air must be driven during the normalization process to the prepurge position. Therefore, parameterize the actuators to *air influen*

When activating this function, the air actuators (all actuators parameterized for determining the amount of air) are first driven to the prepurge position. The prepurge position of the air actuators / actuators determining the amount of air should be adjusted such that the damper is fully open.

This action can be watched via menu *RatioControl* → *Settings Gas* or *Oil* → *Curve Parameters.*

Then, the VSD is controlled at 95%. A reserve of 5% is left, enabling the VSD module to safely reach the 100% speed in situations where environmental conditions may change. Once the motor speed has stabilized, that speed will be standardized. In other words, that speed will represent 100%. It can be read using parameter *StandardizedSp*.

StandardizedSp should not be parameterized manually.

☞ Note!

If, based on the steps described above, the burner's rated output cannot be reached (the fan is controlled at 47.5 Hz), proceed as follows:

- Set the maximum frequency to 105.2% of the motor's rated speed.
  This means that at a motor frequency of 50 Hz:
  Parameterize the maximum frequency of the VSD to 50 Hz • 1.052 = 52.6 Hz (on the VSD)
- Then, standardize

This standardization cannot lead to motor overloads since only 95% of the maximum control signal is delivered during standardization and the actual speed is controlled later in operation and monitored via *Safety time ratio control*.

⚠ **Caution!**
If automatic speed standardization is activated, or if the standardized speed is changed, the burner must be readjusted! Any change to the standardized speed changes the assignment between the parameterized percentages on the curves and the speed.

Parameter	*standard (deactivated / activated)*
	StandardizedSp

Settling time

If oscillations occur during extensive running times, the settling time between acceleration ramp and speed measurement can be extended to overcome the problem.

Parameter	*Settling Time (in x • 25 ms) → value of 16 means 16 • 25 ms = 400 ms (0.4 s)*

18.1.5 Configuring the current interface

The VSD is controlled via a current interface which can be switched from 0...20 mA to 4...20 mA, or vice versa.

Note!
If the VSD requires an input signal of DC 0...10 V, a resistor of 500 Ω ±1% must be connected parallel to its input.

18.1.6 Configuring the fuel meter

The module can be used with fuel meters having a Namur or Reed output or open collector (pnp).
To be able to adapt the module to different types of meters, the number of pulses corresponding to a volume unit must be parameterized in the system.
The setting requires 4 or 5 decimal points. If **one** of these values shall be changed, the following setting procedure is required on the following menu:

Params & Display → *VSD Module* → *Configuration* → *Fuel Meter* → *Pulse Value Gas* or
Params & Display → *VSD Module* → *Configuration* → *Fuel Meter* → *Pulse Value Oil*

The pointer indicates the unit to be selected (1 m^3/1 ft^3).

Parameter	*Analog Output*

Pulse value gas

P	u	l	s	e	V	a	l	u	e	G	a	s	
C	u	r	r	:				3	.	0	0	0	0
1	m	3		=				3	.	0	0	0	0

The proposed unit can be changed by pressing **Select**.
When pressing **Enter**, the pointer jumps to the first position of the display section with the numbers.

P	u	l	s	e	V	a	l	u	e	G	a	s	
C	u	r	r	:				3	.	0	0	0	0
1	m	3		=				3	.	0	0	0	0

Select can be used to change the digit with the highest value of the numerical number or **Enter** can be pressed to switch to the next digit.
After selecting the last decimal place and pressing **Enter**, the value is adopted.
Press **Esc** to exit the menu.

Pulse value oil

The setting procedure for *Pulse Value Oil* is the same as that for *Pulse Value Gas*, the selectable units being 1 l or 1 gal.

18.1.7 Fuel meter readings

The VSD module ascertains the cumulated gas or oil throughout. For each type of fuel, there is 1 resettable and 1 nonresettable meter available.

When resetting the fuel meters, the reset date is stored.

The system continuously calculates the throughput of the selected type of fuel. The calculation time is dynamic and reaches from 1 to 10 seconds.
If the meter delivers no pulse for 10 seconds, the throughput displayed is «0». This means that with minimum throughput, the sensor's pulse frequency should be a minimum of 0.1 Hz.
The display is smoothed.
The maximum frequency is 300 Hz when fuel throughput is at its maximum.

Parameter	*Volume Gas*
	Volume Oil
	Volume Gas R
	Volume Oil R
	Reset DateGas
	Reset DateOil
	Curr Flow Rate

18.1.8 Process data

In its operating position, the VSD module records data that show how well the system components work together (LMV5, VSD module, VSD, motor, and LMV5).
These data can only be read.
The maximum static deviation indicates the greatest speed deviation that occurred during a drive command in modulating operation. This means that the deviation indicated is the maximum difference that has been measured during an individual run.

The maximum dynamic deviation indicates the greatest speed deviation between the ramp predefined by the VSD module and the measured speed. This gives the existing maximum deviation between the expected speed and the speed currently measured. Hence, control of the fan motor by the VSD lags behind the presetting in terms of time or amount; in other words, the VSD is not capable of exactly following the presetting. This does not necessarily represent a problem if *Num Dev >0.5%* contains only a few entries, or no entries at all.

In addition, the number of static deviations >0.3% or >0.5% respectively are counted. This gives the number of speed deviations above 0.3% or 0.5% that occurred during a drive command.
The number of deviations >0.5% also corresponds to the number of correcting cycles.

The process data are only stored in RAM, which means that they are reset via reset or lockout reset.

☞ Note!
Procedure in case the values are too high!

Great dynamic deviation:

- If no entries or only a few entries were made at *Num Dev >0.5%,* the value is of no importance. It only shows that at the beginning of speed readjustment, the fan motor will probably follow the readjustment with a certain delay
- For *Num Dev >0.5%,* refer to *Max Stat Dev*

Great static deviation and, usually, a large number of entries at *Num Dev >0.5%*:

- The VSD is not able to readjust the fan motor's speed in accordance with the VSD module's presetting

This problem can be solved by increasing the ramp time on the LMV5, or by decreasing the ramp time on the VSD (provided the VSD is powerful enough, also refer to chapter *Configuring the VSD*).

If the display of the actual speed (AZL52, ACS450, or on the VSD itself) gives the impression that the speed oscillates or lags behind, an internal control algorithm in the VSD is probably active (slippage compensation or load compensation), counteracting speed control in the VSD module. Deactivation of these functions can solve the problem.

Parameter	*Max Stat Dev*
	Max Dyn Dev
	Num Dev >0.3%
	Num Dev >0.5%

18.2 EMC: LMV5 – VSD

The function and EMC tests of the LMV5 were conducted and successfully completed with the following types of VSD:

Siemens: - Micromaster 440
Danfoss: - VT2807

In operation, VSDs produce electromagnetic interference. For this reason – to ensure EMC of the entire system – the instructions provided by the manufacturers must be observed:

Siemens: - Operating Instructions
→ EMC-compatible installation

Danfoss: - Technical Brochure → Radio Interference Suppression Filters
- Data Sheet of Danfoss EMC filter for long motor cables

☞ Note!
When using other types of VSD, compliance with EMC regulations and correct functioning are not ensured!

18.3 Connection terminals

Also refer to chapter *Connection terminals / coding of connectors*.

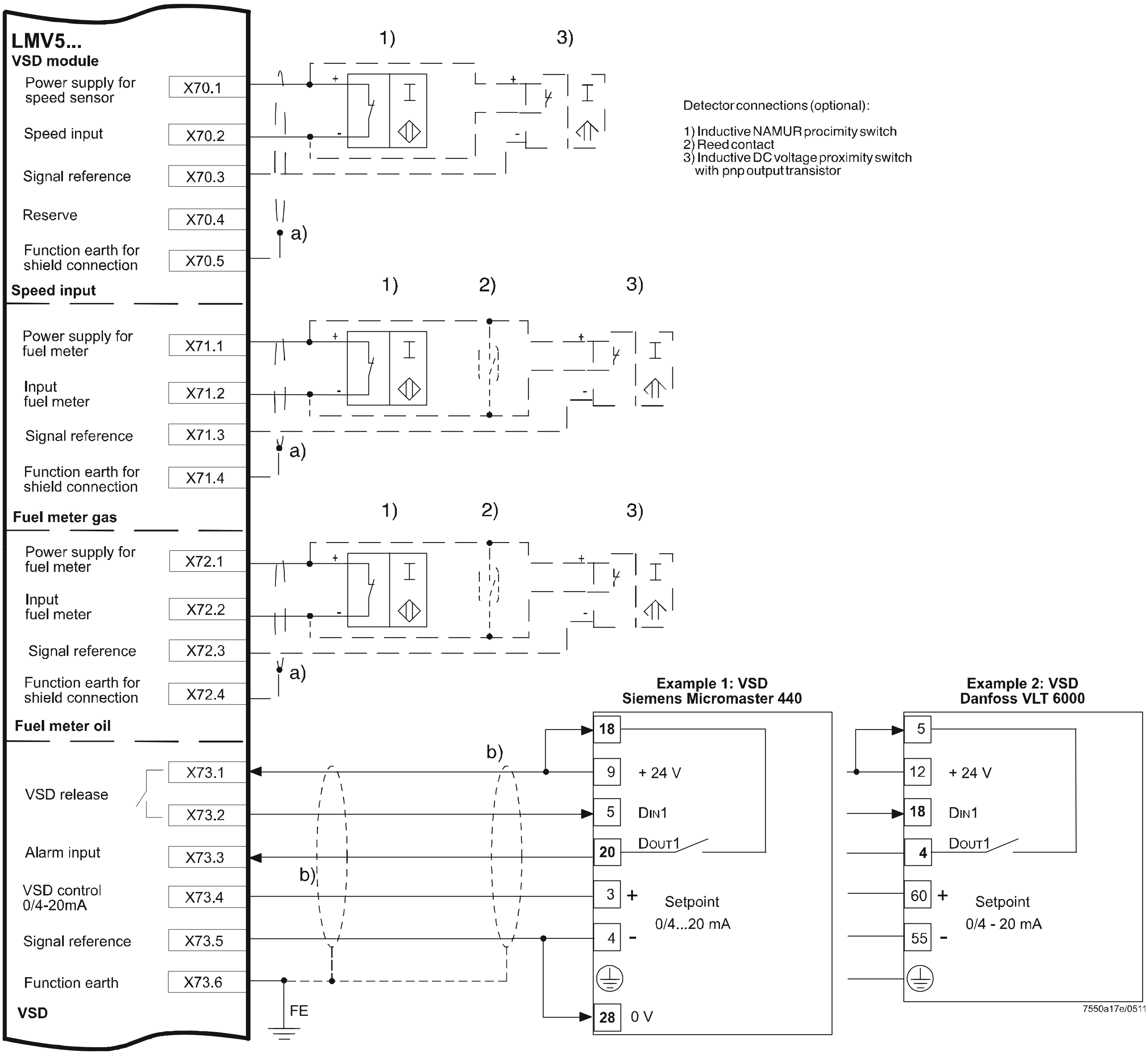


Figure 115: Connection terminals of LMV5

Shielding:

a)	Optional shield connection for arduous environmental conditions
b)	Alternative connection of VSD, refer to documentation of used VSD

18.4 Description of connection terminals for the VSD module

Terminal marking	Connection symbol		Safety class	Input	Output	Description of connection	Electrical rating
VSD module							
X70	2 Wire / 3 Wire - PNP: Usensor, Pulse-IN, 0, Reserve, FE	PIN 1	III		●	Power supply for speed sensor	Approx. 10 V Max. 45 mA
		PIN 2		●		Speed input	Uin max = DC 10 V Uin min High level = DC 3 V Uin max Low level = DC 1.5 V
		PIN 3			●	Reference ground	
		PIN 4				Reserve	
		PIN 5		●		Functional earth for shield connection	
X71	2 Wire / 3 Wire - PNP: Usensor, Pulse-IN, 0, FE	PIN 1	III		●	Power supply for fuel meter	Approx. 10 V Max. 45 mA
		PIN 2		●		Fuel meter input gas	Uin max = DC 10 V Uin min High level = DC 3 V Uin max Low level = DC 1.5 V
		PIN 3			●	Reference ground	
		PIN 4		●		Functional earth for shield connection	
X72	2 Wire / 3 Wire - PNP: Usensor, Pulse-IN, 0, FE	PIN 1	III		●	Power supply for fuel meter	Approx. 10 V Max. 45 mA
		PIN 2		●		Fuel meter input oil	Uin max = DC 10 V Uin min High level = DC 3 V Uin max Low level = DC 1.5 V
		PIN 3			●	Reference ground	
		PIN 4		●		Functional earth for shield connection	
X73	Start - OUT	PIN 1	III		●	Reference contact	Max. AC / DC 24 V, Max. 2 A
		PIN 2			●	Release contact	
	12-24VDC Alarm-IN	PIN 3		●		Alarm input	DC 0...24 V
	0/4-20mA Setpoint OUT	PIN 4			●	0 / 4...20 mA control of VSD	0...20 mA RLmax = 750 Ω
	0	PIN 5			●	Reference ground	
	FE	PIN 6		●		Functional earth	

19 O2 trim control with LMV52 and PLL52

19.1 General

The LMV52 is an extended LMV51. A special feature of the LMV52 is control of the residual O2 content to increase the boiler's efficiency.

In addition to the features of the LMV51, the LMV52 provides O2 trim control, control of a maximum of 6 actuators, control of a VSD, and acquisition of cumulated fuel consumption and current fuel throughput. The LMV52 uses a QGO20, an external PLL52, and the standard components of the LMV51.

The PLL52 is a detached measuring module for the O2 sensor and for 2 temperature sensors (Pt1000 / LG-Ni1000). The module communicates with the LMV52 via CAN bus.

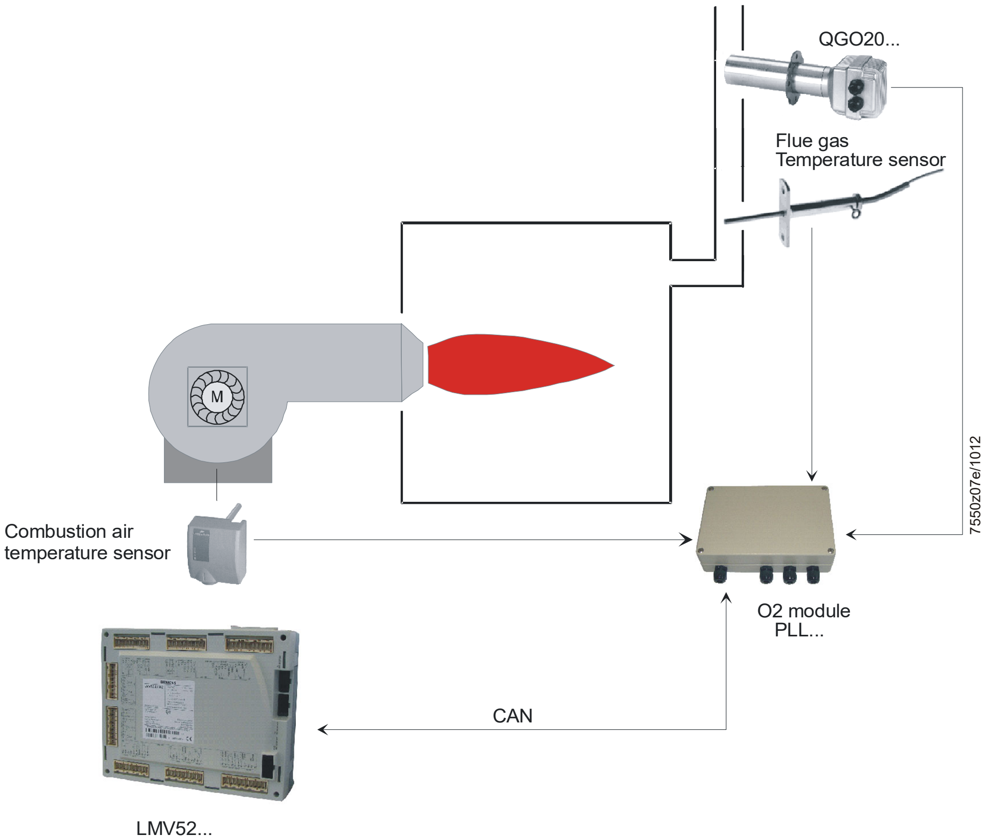


Figure 116: LMV52with O2 trim control and PLL52

19.2 Functioning principle of O2 trim control

The residual O2 control system reduces the amount of combustion air depending on the control deviation (O2 setpoint minus actual of O2). The amount of combustion air is normally influenced by several actuators and, if used, by a VSD. **Reduction of the amount of air is reached by reducing the «air rate» of the air-regulating actuators.** For that purpose, the damper positions of these actuators are calculated from some other load point on the ratio control curves. Hence, due to the parameterized ratio control curves, the air-regulating actuators are in a fixed relation to one another.

O2 trim control is supported by **precontrol. Precontrol calculates the air rate reduction such that changes in burner load do not require the O2 trim controller to interfere**. Consideration is given to a number of measured values that are ascertained when the burner is set. This means that the controller only becomes active when environmental conditions (temperature, pressure) change, and not when the burner load changes.

19.2.1 Air rate change

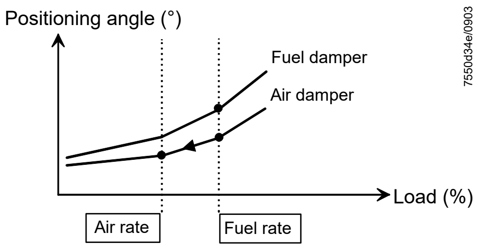


Figure 117: Air rate reduction

Due to the air rate reduction, the O2 trim controller reduces the amount of air. For that purpose, the air-regulating actuators are driven to a smaller load (air rate) on the ratio control curve. Fuel rate and air rate on the ratio control curve are the same.

Example: If the air rate is 50% of the fuel rate, half the amount of air is delivered to the burner compared to the ratio control curve (if λ is the same for all curvepoints).

If *Startmode* is parameterized to *Ign Load TC, IgnPtWithTC* or *IgnPtWoutTC*, the air rate can also be increased in relation to the fuel rate (refer to chapter *Burner start mode for O2 trim control*).
Additionally, the fuel rate is altered if the required difference between the fuel and air rate cannot be achieved by altering the air rate (e.g. at the highest curvepoint when air rate > fuel rate).

19.2.2 Definition of O2 setpoint

Using the ratio control curve as a basis, the O2 setpoint is adjusted by manually lowering the air rate.

⇒ The system stores the O2 ratio value, the O2 setpoint, and the relative air rate reduction (standardized value required to attain the O2 setpoint).

Example:
With a relative air rate reduction of 10%, the air rate must be lowered by 6 percentage points from 60% to 54%.

By measuring both O2 values and by having the relative air rate reduction required for the readjustment, the system identifies the burner's behavior. Effects, such as the fan pressure's impact on the amount of gas, are taken into consideration.

19.2.3 Lambda factor

The system calculates the lambda factor from the O2 ratio value, the O2 setpoint, and the required air rate reduction (standardized value to attain the O2 setpoint). The lambda factor reflects the ratio of the actual lambda change and the theoretical lambda change, in relation to a change of air rate.

With an ideal burner, a relative air rate reduction of 10% produces a lambda change of

$$\lambda\text{Theory} = \frac{\lambda\text{new}}{\lambda\text{old}} = 0.9$$

corresponding to a lambda factor of 1.

Example:
If the amount of gas is influenced by the fan pressure, a reduction of the air volume can simultaneously lead to an increase in the amount of gas. In practice, this results in a more pronounced change of the lambda value. If the change of lambda value is twice the theoretical value, an air rate change of 10% produces

a value of

$$\lambda\text{Practice} = \frac{\lambda\text{new}}{\lambda\text{old}} = 0.8$$

Corresponding to a lambda factor of 2.

From the lambda values of the ratio control curve, the setpoint curve, and the standardized value (required air ratio reduction), the lambda factor is calculated as follows:

$$\text{Lambda factor} = \frac{\lambda\text{setpoint} - \lambda\text{ratio}}{\lambda\text{ratio} \bullet (-\text{ standardized value})} \bullet 100$$

The system should be adjusted such that the lambda factor across the load range will be as flat as possible. This can be checked with the ACS450 PC software. When no tool via available, the lambda factors can be calculated according to the above formula to be entered in a graph.

19.3 Precontrol

As a result of the **measurements** made when **setting the O2 setpoint,** the properties and the **behavior of the burner are learned**.
Based on the type of fuel, the O2 ratio value, the O2 setpoint, and the standardized value, precontrol calculates the air rate reduction such that changes in burner load do not require the O2 trim controller to interfere.

Calculation of the air rate from the manipulated variable is made such that a manipulated variable of +10% will offset an air density change of -10%.

To enable precontrol to function correctly, the outputs for the curvepoints must be parameterized so that they concord with the actual burner output.

Example: 2'000 kW burner:

- 100% point: 2'000 kW ≈ 200 m³/h natural gas
- 75% point: 1'500 kW ≈ 150 m³/h natural gas
- 50% point: 1'000 kW ≈ 100 m³/h natural gas

This can be achieved, for example, by measuring the amount of fuel with a fuel meter when making the setting.

19.3.1 Calculation of precontrol

Based on the settings for O2 trim control, the system becomes familiar with the characteristics and behavior of the burner. The lambda factor, which is taken into consideration when calculating the air rate reduction, reflects these learned behavior.

Precontrol can be calculated in 3 different ways:

like P air	The learned lambda factor is also considered when air density (temperature / pressure) changes. Air pressure and air density have an impact on the fuel throughput
like theory	The learned lambda factor is not considered when air density (temperature / pressure) changes. Air pressure and air density have no impact on the fuel throughput.
LambdaFact1	The system anticipates a lambda factor of 1. The learned value is irrelevant. This parameter setting is only intended for use with burners that have a lambda factor of 1.

Recommendation:

When firing on gas: *like P air*

When firing on oil: *like theory*

For burners where the air pressure does not have any impact on the gas pressure (e.g. burner head with metal mesh for Super-Low-NOx applications) : *LambdaFact1*

Parameter	*Type Air Change (like P air, like theory LambdaFact1)*

19.4 O2 trim control

19.4.1 Operating modes of O2 trim controller / O2 alarm

The O2 trim controller or O2 alarm can be deactivated or activated in various operating modes by setting a parameter.

Caution!
The ratio control curves must always be adjusted such that there are sufficient amounts of excess O2 available, irrespective of environmental conditions!

man deact	Both the O2 trim controller and O2 alarm are deactivated. The system operates along the parameterized ratio control curves.
O2 Alarm	Only the O2 alarm is active. Prior to startup, the QGO20 must have reached its operating temperature. If not, startup is prevented. If the O2 alarm responds, or if an error occurs in connection with O2 measurement, the PLL52 or the QGO20, safety shutdown is initiated, depending on the reading of the repetition counter, followed by lockout, if necessary
O2 Control	Both the O2 trim controller and the O2 alarm are active. Prior to startup, the QGO20 must have reached its operating temperature. If not, startup is prevented. If the O2 alarm responds, or if an error occurs in connection with O2 measurement, the PLL52 or the QGO20, safety shutdown is initiated, depending on the reading of the repetition counter, followed by lockout, if necessary
conAutoDeac	Both the O2 trim controller and the O2 alarm are active (option *automatic deactivation*). Startup takes place before the QGO20 has reached its operating temperature.

Caution!
Accumulation of condensate inside the QGO20!
If the mains voltage is switched off in advance, then starting up before the QGO20 has reached its operating temperature may lead to an accumulation of condensate inside the QGO20, which could damage it. The QGO20 must be heated to at least 300°C to ensure no condensate can accumulate.

Display on the AZL52:

```
QGO SensotTemp
Curr:300°C
```

	O2 trim control in operation is activated only when the operating temperature is reached and the O2 sensor test has been successfully completed. If the O2 maximum value alarm responds, or if an error occurs in connection with O2 measurement, the O2 module, the O2 sensor, or the sensor test, *OptgMode* is automatically switched to *auto deact*. If the O2 minimum value alarm responds, the system returns to the ratio control curves. After a period of 3 x *Tau* time constants, a check is carried out to see whether the O2 value is above the O2 minimum value: • If the O2 value exceeds the O2 minimum value, the controller is released again. • If the O2 value is still below the O2 minimum value, safety shutdown is initiated, followed by repetition. The O2 value may fall below the minimum value the number of times entered in parameter *NumMinUntilDeact* until the O2 trim controller is deactivated automatically. The O2 minimum value alarm remains active. The system operates along the parameterized ratio control curves, and this parameter is set to *auto deact*. The AZL5 indicates automatic deactivation. The error code is maintained until O2 trim control is manually deactivated or activated
auto deact	O2 trim control was deactivated automatically by the LMV5. The system operates along the parameterized ratio control curves. Do not select this system parameter! To deactivate the O2 trim controller / O2 alarm, the *man deact* parameter setting must be used. If an error occurs in connection with O2 measurement, the O2 module, the O2 sensor, the sensor test, or the O2 maximum value alarm, there is no response. If the O2 minimum value alarm responds and a valid O2 measured value is present, safety shutdown is initiated once the time has elapsed (3 x *Tau* time constants + Time O2 Alarm).

Also refer to the chapter *Heating up the QGO20 sensor after «Power On».*

Parameter	*OptgMode (man deact / O2 Alarm / O2 Control / conAutoDeac / auto deact)*

19.4.2 Load limitation with O2 trim control

O2 trim control becomes inactive below the low-fire adaption point *LowfireAdaptPtNo*.

Parameter	Gas: *LowfireAdaptPtNo*
	Oil: *LowfireAdaptPtNo*

If O2 trim control and O2 alarm are to be inactive below a higher output, the *O2 CtrlThreshold* parameter is also available.

Parameter	Gas: *O2 CtrlThreshold*
	Oil: *O2 CtrlThreshold*

Attention!
If the load falls below one of the two thresholds named above, O2 control and O2 alarm become inactive and the system operates along the parameterized ratio control curves.
If the load increases and exceeds one of the two thresholds named above by 5% (absolute value), the O2 trim controller is reinitialized and activated together with the alarm.

19.4.3 Startup

When setting parameter *OptgMode* to *O2 Alarm* or *O2 Control*, startup is prevented until the sensor reaches its operating temperature.
When setting the parameter to *conAutoDeac,* the burner is started immediately and O2 trim control is activated only when the sensor reaches its operating temperature and the O2 sensor test has been successfully completed.

Also refer to the chapter *Heating up the QGO20 sensor after power On.*

19.4.4 Heating up the QGO20 sensor after *power ON*

When the system or the PLL52 is switched on for the first time, the cold QGO20 is slowly heated up until its operating temperature is reached. **When temperature of 700 °C is reached,** the sensor needs **another 10 minutes** t to be complete heated through. This waiting time does not apply following interruptions to the power supply if the temperature on startup is >690 °C.
A longer time applies when the plant is commissioned (refer to QGO20 Basic Documentation P7842).
When setting parameter *OptgMode* to *O2 Alarm* or *O2 Control,* startup is prevented until the sensor reaches its operating temperature, followed by burner startup. O2 trim control in the operating position is activated the moment the controller locking time has elapsed.
When the parameter is set to *conAutoDeac,* the burner is started immediately. O2 trim control in the operating position is performed only when the sensor reaches its operating temperature and the O2 sensor test has been successfully completed.

19.4.5 Burner start mode for O2 trim control (only LMV52.4, only in operating modes *O2 Control* and *conAutoDeac*)

This startup behavior startup behavior was implemented specially for use with super-low NOx burners (burner head with metal mesh), as these types of burners require the burner to be started at the O2 setpoint.
The burner head with metal mesh can only be operated in a narrow O2 band.
The new start modes are used so that the O2 band can be reached on burner startup, particularly in the event that the environmental conditions have changed significantly compared to those of the burner setting.
As active O2 trim control is required in order to comply with the narrow O2 band, these start modes are only active in the *O2 Control* and *conAutoDeac* operating modes for the O2 trim controller.
If the start mode is parameterized to *Ign Load TC, IgnPtWithTC* or *IgnPtWoutTC*, the air rate can also be increased in relation to the fuel rate; this means that the actuators used for determining the amount of air can be driven to positions above the ratio control curve.
Additionally, the fuel rate is altered if the required difference between the fuel and air rate cannot be achieved by altering the air rate (e.g. at the highest curvepoint when air rate > fuel rate).

standard	The system is started using the parameterized ignition positions and drives to the ratio control curves positions **with the O2 trim controller locked** in phase 54 (or phase 50). This corresponds to the factory setting and the behavior of previous LMV5 software versions without this parameter.
Ign Load TC	The system is **not** started using the parameterized ignition positions, and instead goes directly to the O2 setpoint (with the O2 trim controller initialized via temperature compensation). The ignition load can be set using the *Load of Ignition* parameter. The O2 trim controller is initialized using temperature compensation; a supply air temperature sensor is required for this.
IgnPtWithTC	The system is started using the parameterized ignition positions and travels directly to the O2 setpoint in phase 54 or phase 50 (with the O2 trim controller initialized via temperature compensation). The O2 trim controller is initialized using temperature compensation; a supply air temperature sensor is required for this.
IgnPtWoutTC	The system is started using the parameterized ignition positions and, **with O2 trim controller initialized to 0,** travels directly to the non-temperature-compensated O2 setpoint in phase 54 (or phase 50). The O2 trim controller initialization is made without temperature compensation; a supply air temperature sensor is <u>not</u> required for this.

Parameter	*Startmode (standard, Ign Load TC, IgnPtWithTC, IgnPtWoutTC)*

Note!
In order to be able to use *Ign Load TC, IgnPtWithTC* or *IgnPtWoutTC,* the burner must initially be started using the *standard* start mode. Once the fuel-air ratio control and O2 trim control have been set, you can switch to the *Ign Load TC, IgnPtWithTC* or *IgnPtWoutTC* option.

Attention!
Burner head with metal mesh can only be operated in the O2 controller operating mode *O2 controller*, as, when the O2 controller is deactivated automatically, the actuators operate along the ratio control curve, which can result in the flame lifting.

Load at which a system is ignited with O2 trim control and *Startmode* parameter set to *Ign Load TC.*

Parameter	Gas: *Load of Ignition*
	Oil: *Load of Ignition*

19.4.6 Initializing and release of the O2 trim controller

Parameter setting *standard*

With this setting, the LMV52 behaves as it did before this parameter was introduced.
The burner is started with the O2 trim controller locked and is put into operation along the safe ratio control curves.
The locking time for startup commences when operating phase 60 is entered.
It is defined as a multiple of the *Tau Low-Fire* value using the *NumberTauSuspend* parameter (*NumberTauSuspend* x *Tau Low-Fire)*.
Once this locking time has passed, the O2 trim controller is initialized and after a further 4 x *Tau Low-Fire* released.
The *dynamic release criterion* then becomes active (refer to chapter *Behavior in the event of load changes*).
For initialization, the start value of the manipulated variable is calculated.
An offset is added to this, which is defined using the *O2ModOffset* parameter.

Parameter	*NumberTauSuspend*
	Gas: *O2ModOffset*
	Oil: *O2ModOffset*

Note!
Parameter *O2Offset* has been renamed to*O2ModOffset.*

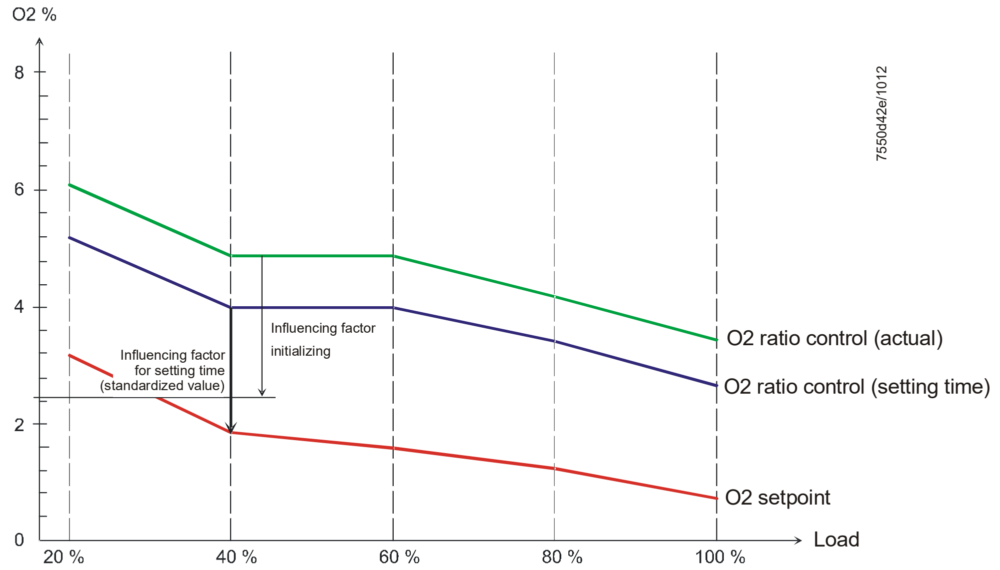


Figure 118: Initializing the O2 trim controller

Parameter setting *Ign Load TC*

The burner is ignited at the temperature-compensated ignition **load** and is put into operation with the O2 trim controller initialized.
The trim controller is initialized when driving to ignition load.
The system is therefore **not** started with excess O2 from the ratio control curves but using the O2 setpoint instead.
The initialization value of the manipulated variable is calculated based on the change to the current supply air temperature in relation to the supply air temperature at the time the settings were made (*Adjust. Temp O2))*.
The temperature at which the burner was adjusted is saved automatically for low-fire point adaption and can be displayed.
A supply air temperature sensor is required for this.
The O2 trim controller is locked initially but is released once the set locking time *NumberTauSuspend* has passed or if the actual O2 value falls below the setpoint.
The *dynamic release criterion* then becomes active (refer to chapter *Behavior in the event of load changes*).

Parameter setting ***IgnPtWithTC***

The burner is ignited at the set ignition **positions** and is then put into operation with the temperature-compensated O2 trim controller initialized.
The system is therefore **not** started with excess O2 from the ratio control curves but using the O2 setpoint instead.
The initialization value of the manipulated variable is calculated based on the change to the current supply air temperature in relation to the supply air temperature at the time the settings were made (*Adjust. Temp O2*).
The temperature at which the burner was adjusted is saved automatically for low-fire point adaption and can be displayed.
A supply air temperature sensor is required for this.
The O2 trim controller is locked initially but is released once the set locking time *NumberTauSuspend* has passed or if the actual O2 value falls below the setpoint.
The *dynamic release criterion* then becomes active (refer to chapter *Behavior in the event of load changes*).

Parameter setting *IgnPtWoutTC*

The burner is ignited at the set ignition **positions** and is then put into operation with the O2 trim controller initialized but **without temperature compensation**.
The system is therefore **not** started with excess O2 from the ratio control curves but using the O2 setpoint instead.
The O2 trim controller is locked initially but is released once the set locking time *NumberTauSuspend* has passed or if the actual O2 value falls below the setpoint.
The *dynamic release criterion* then becomes active (refer to chapter *Behavior in the event of load changes*).

Display value	Gas*: Adjust. Temp O2*
	Oil: *Adjust. Temp O2*
Parameter	Gas: *NumberTauSuspend*
	Oil: *NumberTauSuspend*

O2 offset during O2 trim controller initialization

For start mode *Ign Load TC*, *IgnPtWithTC* and *IgnPtWoutTC* the offset *O2InitOffset* is added to the manipulated variable that was calculated during controller initialization.
This O2 value can be adjusted using parameters.

Parameter	Gas*: O2InitOffset*
	Oil: *O2InitOffset*

19.4.7 Modulation release on startup

Parameter setting *standard*
Modulation by the load controller is always enabled when the system is put into operation.

Parameter settings *Ign Load TC, IgnPtWithTC* or *IgnPtWoutTC*
With these options, the burner is put into operation straight away with the O2 trim controller initialized.
As various factors mean that initialization is not infinitely accurate, modulation of the load controller is locked until the O2 trim controller has corrected the deviation, in other words until the O2 setpoint has reached a band of ±0.2%.
Following this, modulation of the load controller is enabled.

19.4.8 Behavior in the event of load changes (dynamic release criterion)

Slow load changes
→ O2 trim control remains active

Fast load changes
→ O2 trim control becomes temporarily inactive
→ Precontrol remains active
→ *O2ModOffset* value becomes active for O2 precontrol (also refer to chapter *Increasing the manipulated variable in the case of **fast** load changes*)

A load change is considered to be *fast* if an internally calculated value exceeds the *LoadCtrlSuspend* threshold that can be parameterized.

Example:
- 0%
→ Each load change is considered to be *fast,* resulting in the temporary inactivation of O2 trim control

- 25%
→ Only large and fast load changes are considered to be *fast,* resulting in the temporary inactivation of O2 control

O2 trim control is reactivated when the internally calculated value exceeds the *LoadCtrlSuspend* threshold and a subsequent waiting time of *2 x Tau current load* has elapsed.

Parameter	Gas: *LoadCtrlSuspend*
	Oil: *LoadCtrlSuspend*

19.4.9 Increasing the manipulated variable in case of *fast* load changes (*O2ModOffset*, formerly *O2Offset*)

When changing the load under unfavorable setting conditions, it could happen that the actual O2 value drops below the O2-min-limit.

In order to prevent this, the user can use parameters to set an offset for the O2 value in the event that a *fast* load change occurs.
One increase is made depending on how *fast* the load change is (for definition of *fast* refer to chapter *Behavior in the event of load changes*).
The next increase can only be made once the locking time for the load change has elapsed (waiting time of 2 x *Tau current load*).

There will be no increase of the O2 value when O2 trim control is deactivated.

The parameter defines the increase of the O2 value in %.

Example:
O2ModOffset = 0.5%, O2 actual value 1.4% ⇨ In the event of fast load change, the O2 value reached will be 1.9%.

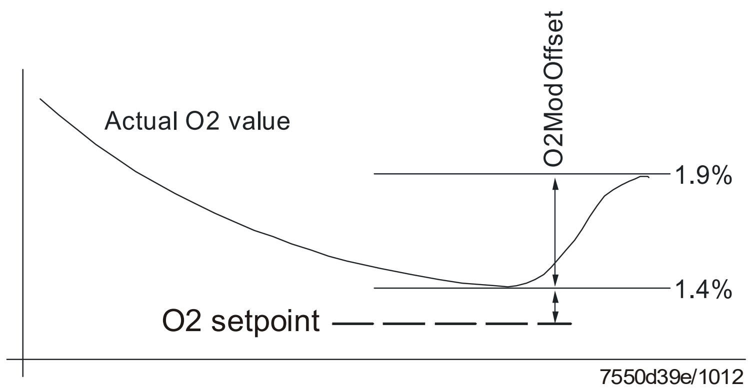


Figure 119: Increasing the manipulated variable in the case of a load change

Parameter	Gas: *O2ModOffset*
	Oil*: O2ModOffset*

19.4.10 Control interventions (switching functions) by the O2 trim controller

In order to prevent the burner from receiving insufficient amounts of air when the load changes, the O2 trim controller contains additional functions which can be used when the *startmode* parameter is set to *standard*.
These become active if the O2 trim controller or precontrol is not optimally adjusted, or if the burner's behavior cannot be adequately mapped by the measured values.
The control interventions are also active during the controller locking time (waiting for 2 x *Tau current load*).

If the O2 value drops below the setpoint in the direction of the O2 minimum value, the manipulated variable will be increased ⇒ more air supplied.

19.4.11 O2 trim control behavior

O2 trim control behavior can be altered using the *O2TrimBehavior* parameter:

ForcdAirAdd	Air is added faster than it is reduced. This setting is recommended for burners where the O2 setpoint is close to the O2 minimum value. Corresponds to the factory setting and the behavior of previous LMV5 software versions without this parameter.
ForcdAirRed	Air is reduced faster than it is added. This setting is recommended for burners where the O2 setpoint is close to the O2 maximum value.
symmetric	The time taken to add or reduce air is the same for both processes. This setting is recommended if the user does not require trim control behavior to be faster for one process over the other, if the difference between the O2 minimum and O2 maximum values is very small, or if the O2 setpoint is approximately in the middle of these two values (burner head with metal mesh).

Parameter	Gas: *O2TrimBehavior (ForcdAirAdd, ForcdAirRed, symmetric)*
	Oil: *O2TrimBehavior (ForcdAirAdd, ForcdAirRed, symmetric)*

19.4.12 Limiting the O2 trim controller manipulated variable with shutdown

A minimum and a maximum value can be set for the O2 trim controller manipulated variable using the *O2MinManVariable* and *O2MaxManVariable* parameters.

The behavior if the value falls below or exceeds the related threshold of the O2 trim control manipulated variable limitation depends on the O2 parameter *OptgMode:*

Parameterization	*conAutoDeac* A low fire safety shutdown is initiated followed by repetition and with automatic deactivated O2 trim controller. That means the system works in operation along the ratio control curves.
	O2 Control A low fire safety shutdown is initiated followed by a lockout

The addition or removal of combustion air by the O2 trim controller can be limited in the following situations:

- Insufficient flow through QGO20
- Blockage of reference air inlets for QGO20
- False air (ambient air) in the flue gas channel for QGO20
- Blockage in the combustion air inlet

Parameter	Gas: *O2MaxManVariable*
	Oil: *O2MaxManVariable*
	Gas: *O2MinManVariable*
	Oil: *O2MinManVariable*

The thresholds for the manipulated variable are determined based on the anticipated changes to the supply air temperature and air pressure.
The manipulated variables resulting from changes to air pressure and air temperature can be determined graphically.
Temperature and air pressure are to be regarded as deltas for the setting conditions.

Attention!
On the one hand, the values for limiting the manipulated variables must be set in such a way that climatic fluctuations (and similar variations) that occur during regular operation do not allow the limit values to be reached.
On the other hand, the manipulated variable limit values must be as small as possible to ensure that any violations of these limit values are detected as early as possible and the burner is shut down as soon as possible in the situations described above.

Refer to the diagram and example below for how to determine to values.

The preset manipulated variable limit values must be individually adjusted for each plant.

Example for calculating manipulated variables

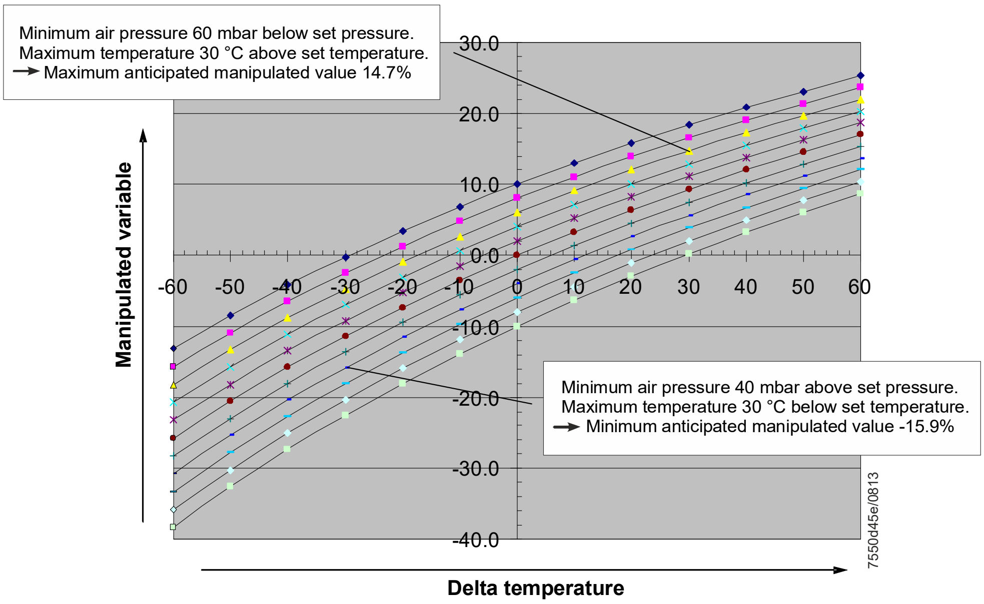


Figure 120: Calculating manipulate variables

Legend

- -100 mbar
- -80 mbar
- -60 mbar
- -40 mbar
- -20 mbar
- 0 mbar
- 20 mbar
- 40 mbar
- 60 mbar
- 80 mbar
- 100 mbar

19.4.13 Deactivating O2 trim control via a contact

There are two different ways of deactivating the O2 trim control via a mains voltage signal at input X5-03 pin 2:

1. Parameterization to *DeaO2/Stp36*
O2 trim control can be deactivated via a mains signal at terminal X5-03 pin 2.
The system then operates along the ratio control curves. The O2 alarm function remains active. If the mains signal is switched off, O2 trim control is reinitialized and activated.
This function is activated by setting parameter *Config X5-03* to *DeaO2/Stp36*.

Parameter	*Config X5-03 (DeaO2/Stp36)*

☞ Note!

- This function can only be used if inputs X5-03 pin 2 and X5-03 pin 3 are not already being used to connect an external load controller (*LC_OptgMode = ExtLC X5-03*) → invalid parameter setting
- This parameter setting activates also to stop a startup in phase 36 by switching off the mains voltage at X5-03 pin 3 (only for **non**-safety-related applications).
  If this function is not used simultaneously with the O2 deactivation function, input X5-03 pin 3 has to be linked with X5-03 pin 4 (L)

2. Parameterization to *AutoDeactO2*
Alternatively, the operating mode of the O2 trim controller can be changed via a mains signal at input X5-03 pin 2 from *conAutodeact* to *auto deact* by parameterizing *Config X5-03* to *AutoDeactO2*.
The system then operates along the ratio control curves.
The O2 alarm function remains active while a valid O2 signal is present, see also chapter *Operating modes O2 trim controller*.
The display message *O2 trim control automatically deactivated* which is otherwise displayed is **not** shown when switching via a mains signal at input X5-03.
If the mains signal is switched off, the O2 trim control is initialized and activated again.
The O2 control operating mode is reset to *RegAutoDeact*.

If the system is already in the O2 operating mode *auto deact*, the display message *O2 trim control automatically deactivated* is no longer displayed when this contact is closed.

Parameter	*Config X5-03 (AutoDeactO2)*

☞ Notes!
This function can only be used if the inputs X5-03 pin 2 and X5-03 pin 3 are not already being used for an external load controller (*LC_OptgMode = ExtLC X5-03*)
→ invalid parameterization.

19.4.14 Displaying the O2 trim controller status

The status of the O2 trim controller can be read out with the AZL52 via data point *State O2 Ctrl*.

deactivated	The O2 trim controller is not active. The system operates along the ratio control curves.
locked	The manipulated variable of the O2 trim controller is held at the last value.
LockTStart	Locking time following startup until the O2 trim controller is initialized or released. The locking time is necessary in order to ensure that the actual O2 value is measured. The O2 trim controller is still deactivated or locked
InitContr	The O2 trim controller is initialized. The O2 trim controller is locked.
LockTLoad	The O2 trim controller is locked due to a load change.
active	The O2 trim controller is active and operates to the O2 setpoint.
LockTCAct	If switching functions (control interventions by the O2 trim controller) are active, the O2 trim controller is locked for 2 x Tau.

Process data display values	*State O2 Ctrl (deactivated / locked / LockTStart / InitContr / LockTLoad / active / LockTCAct)*

19.5 O2 alarm

The O2 alarm can be used with or without O2 trim control. When O2 trim control is activated, the O2 alarm becomes automatically active.

There is one alarm for the O2 minimum value and one for the O2 maximum value.

For the O2 minimum value alarm, the thresholds are defined by the O2 minimum value curve (refer to chapter *Setting the O2 alarm*, *Direct entry of O2 min. values* and *Measuring the O2 min. values by lowering the air rate*).

For the O2 maximum value alarm, the user can select the *O2 MaxValue* parameter (all LMV52) or the O2 ratio control curve values (only LMV52.4).

This is defined using the *Type O2 MaxValue* parameter:

- *O2 MaxValue*
  The *O2 MaxValue* parameter is used
- *O2MaxCurve*
  The O2 values at the ratio control curve that were measured when setting the O2 trim controller are used as O2 maximum alarm values.

Parameter	*Gas: Type O2 MaxValue (O2 MaxValue, O2MaxCurve)*
	Oil: Type O2 MaxValue (O2 MaxValue, O2MaxCurve)
	Gas: O2 MaxValue
	Oil: O2 MaxValue

19.5.1 Delayed O2 limit value

Due to the long time it takes for the flue gases to pass through the boiler's flueways, the O2 value currently acquired is delayed compared to the residual O2 content occurring the same moment in the combustion chamber.
To prevent O2 minimum and maximum values from being compared with O2 values from an old load, these limit values are delayed accordingly. The delay is derived from the acquired Tau value and simulates the boiler delay.

19.5.2 Switch-off criteria of the O2 alarm

19.5.2.1 O2 minimum value alarm

If …

a) the O2 actual value falls below the O2 minimum value delayed via the PT1 element for the period *Time O2 Alarm* or

b) the actual O2 value falls below the smallest parameterized O2 minimum value for the period *Time O2 Alarm*, one of the following reactions takes place, depending on the operating mode:

- In all O2 trim controller operating modes **except** *conAutoDeac*:
  Safety shutdown is initiated, followed by repetitions if possible, otherwise lockout.
- In the *conAutoDeac*: O2 trim controller operating mode:
  If an error occurs in connection with O2 measurement, the PLL52, the QGO20, or the sensor test, the LMV5 automatically switches the *O2 Control* operating mode to *auto deact*.

  If the O2 minimum value alarm responds, the system returns to the ratio control curves.

  After a period of 3 x *Tau* time constants, a check is carried out to see whether the O2 value is above the O2 minimum value:
  - If the O2 value exceeds the O2 minimum value, the controller is released again.
  - If the O2 value is still below the O2 minimum value, safety shutdown is initiated, followed by repetition. The O2 value may fall below the minimum value the number of times entered in parameter *NumMinUntilDeact* until the O2 trim controller is deactivated automatically.

Parameter	Gas: *Time O2 Alarm*
	Oil: *Time O2 Alarm*

The following parameter is only active in the *conAutoDeac* O2 trim controller operating mode.

Parameter	Gas: *NumMinUntilDeact*
	Oil: *NumMinUntilDeact*

19.5.2.2 O2 maximum value alarm

If the actual O2 value exceeds the O2 maximum value by > *Time O2 Alarm,* one of the following reactions takes place, depending on the operating mode:

- In all O2 trim controller operating modes **except** *conAutoDeac*
  Safety shutdown is initiated, followed by repetitions if possible, otherwise lockout.
- In the O2 trim controller operating modes *conAutoDeac*
  If an error occurs, the LMV5 automatically switches the *O2 Control* operating mode to *auto deact*

Parameter	Gas: *Time O2 Alarm*
	Oil: *Time O2 Alarm*

For the O2 maximum value alarm, the user can select the *O2 MaxValue* parameter or the *O2MaxCurve* (only LMV52.4).

This is defined using the *Type O2 MaxValue* parameter:

- *O2 MaxValue*
  The *O2 MaxValue* parameter is used
- *O2MaxCurve*
  The O2 values at the ratio control curve that were measured when setting the O2 trim controller are used as O2 maximum alarm values.

Parameter	Gas: *Type O2 MaxValue (O2 MaxValue, O2MaxCurve)*
	Oil: *Type O2 MaxValue (O2 MaxValue, O2MaxCurve)*
	Gas: O2 MaxValue
	Oil: O2 MaxValue

19.5.3 Inactivation / deactivation of the O2 alarm

Attention!
The O2 minimum value and O2 maximum value alarms are inactivated / deactivated in the following cases:

1. **Inactivation of O2 minimum value alarm**
   (automatic reactivation by the LMV5 if required)**:**
   In *auto deact* O2 operating mode if the measuring signal is invalid (error in measuring signal, no response from PLL52)
2. **Deactivation of O2 maximum value alarm**
   (manual activation by the user required):
   In *man deact* **and** *auto deact* **O2 operating modes**
3. **Deactivation of O2 minimum value alarm**
   (manual activation by the user required):
   In *man deact* O2 operating mode

19.6 Self-test

During the startup phase and during operation, the system performs a number of self-tests to ensure that the QGO20 is working correctly.

19.6.1 O2 Sensor test

To detect aging QGO20, an O2 sensor test is made. An aged measuring cell can be identified by its increased internal resistance. The cell is considered too old when the internal resistance measured is Ri <5 Ω or Ri >150 Ω.

The display Ri = XXXX in the AZL52 signals that a sensor test has still not been performed (e.g. after switching the mains voltage off and then on again up to the end of prepurging).

The test is made at 23-hour intervals. To perform the test, a constant O2 value is essential. This requirement is satisfied after prepurging or when a stationary load point is reached. The system performs the test after 23 hours as soon as such stationary values are available. If this is not the case after 24 hours, the load is «frozen» in operation so that the test can be made. If the system is in standby mode, the test is performed during the next startup phase (maximum 3 repetitions).

If the test is negative, the system's response will be one of the following, depending on the parameterization of *O2Contr/Alarm*:

man deact (auto deact):	O2 trim controller and O2 alarm are deactivated. No O2 sensor test is made
O2 Alarm / O2 Control:	O2 trim controller / O2 alarm is / are activated. If the test is negative, safety shutdown is initiated, followed by a repetition, if possible, otherwise lockout
conAutoDeac:	Both the O2 trim controller and the O2 alarm are activated. If the test is negative, O2 trim control is deactivated and the burner started up without O2 trim control

Parameter	Gas: *OptgMode (auto deact / man deact / O2 Alarm / O2 Control / conAutoDeac)*
	Oil: *OptgMode (auto deact / man deact / O2 Alarm / O2 Control / conAutoDeac)*

19.6.2 Checking the O2 content (20.9%)

Every time the burner is started up, the measured residual O2 content is compared with the O2 content of the ambient air at the end of prepurging.
This test detects offset errors of the measuring cell.
Normally, this value reads 20.9%, but it can be parameterized in the case of plants that operate with enriched air.

Parameter	Gas: *O2 Content Air*
	Oil: *O2 Content Air*

For the QGO20, the tolerance band for checking the O2 content is = ±2%.

If the O2 content lies outside the tolerance band of ±2%, one of the following reactions takes place, depending on the parameterization of *O2Contr/Alarm.*

man deact (auto deact):	O2 trim controller and O2 alarm are deactivated. No O2 test is made
O2 Alarm / O2 Control:	O2 trim controller / O2 alarm is / are activated. If the test is negative, safety shutdown is initiated, followed by a repetition if possible, otherwise lockout
conAutoDeac:	O2 trim controller and O2 alarm are activated. If the test is negative, both the O2 trim controller and the O2 alarm are deactivated.

Caution!
For that purpose, the prepurging time of the LMV52 must be parameterized such that the combustion chamber and the flueways will be completely purged.

The correct setting of the air's O2 content is safety-related.

19.7 Auxiliary functions

19.7.1 Warning when flue gas temperature is too high

If a flue gas temperature sensor is connected and activated, a warning is delivered in case the adjusted flue gas temperature is exceeded. Excessive flue gas temperatures are an indicator of increased boiler losses ⇒ boiler should be cleaned. The warning threshold for gas- and oil-firing can be set separately.

Parameter	*MaxTempFlueGas Gas*
	MaxTempFlueGas Oil

19.7.2 Combustion efficiency

If a QGO20, a combustion air and flue gas temperature sensor are connected and activated, the combustion efficiency is calculated and displayed.

To ensure that the calculation is made correctly, the fuel parameters must be selected and set in accordance with the type of fuel.
Also refer to chapter *Parameterization of type of fuel.*

The calculation is made according to the following formula (1. BimSchV = 1. Bundes-Imissionsschutzverordnung = First Federal Imission Protection Decree):

Flue gas volume ratio:	$AVft = \frac{V\_afNmin}{V\_atrNmin}$
O2 value dry:	$O2\_tr = \frac{AVft \bullet O2ContentAir}{\frac{O2ContentAir}{O2Value\_Wet} + AVft - 1}$
Flue gas losses:	$qa = \left(\frac{A2}{O2ContentAir - O2\_tr} + B \right) \bullet \left(\vartheta_{flue\,gas} - \vartheta_{supply\,air} \right)$
Efficiency:	$\eta_F = 100\% - qa$

Parameter	*Combustion air temperature sensor (NoSensor, Pt1000, LG-Ni1000)*
	Flue gas temperature sensor (NoSensor, Pt1000, LG-Ni1000)

As an alternative to connecting the supply air temperature sensor at input X87 of the PLL52, it can also be connected at input X60 of the LMV52. To do this *AirTempX60PT1000* must be activated.

Parameter	*AirTempX60PT1000 (deactivated, activated)*

19.7.3 Service timer for QGO20

A service timer has been implemented for the QGO20.
The time on the service timer is compared against the time that the system has been in operation (*TotalHours* hours run counter).

The following occurs if the set time has elapsed:

- In the *conAutoDeac* operating mode, O2 trim control is deactivated automatically; however, the O2 alarm remains active
- In the *O2 Alarm* and *O2 Control* operating modes, lockout is initiated
- The following displays appear in the display of the AZL52:

```
O2 Sensor
Service interval
expired
```

The service work to be performed is described in the QGO20 Basic Documentation (P7842), refer to chapter *Service note*.

Using the *O2SensServTimRes* parameter, the timer can be reset once the service work has been completed:
If the O2 trim control is set to *auto deact*, it is reactivated by setting it to *conAutoDeac*.

The service interval can be set via the *O2SensServTim* parameter.
If the service interval is set to **0**, the function is deactivated!

Parameter	*O2SensServTim*
	O2SensServTimRes

19.8 PLL52 O2 module

The PLL52 and QGO20 must be connected to enable the residual oxygen control system to be activated on the LMV52.
A combustion air and flue gas temperature sensor can also be connected as an option, enabling, for example, the combustion efficiency to also be calculated and displayed.
The PLL52 is to be connected to the LMV5 via CAN bus. The PLL52 must be located in the vicinity of the QGO20 (<10 m), aimed at keeping interference on the sensitive detector lines as low as possible. For sensor heating, the PLL52 requires a separate mains connection facility.

19.8.1 Inputs and outputs

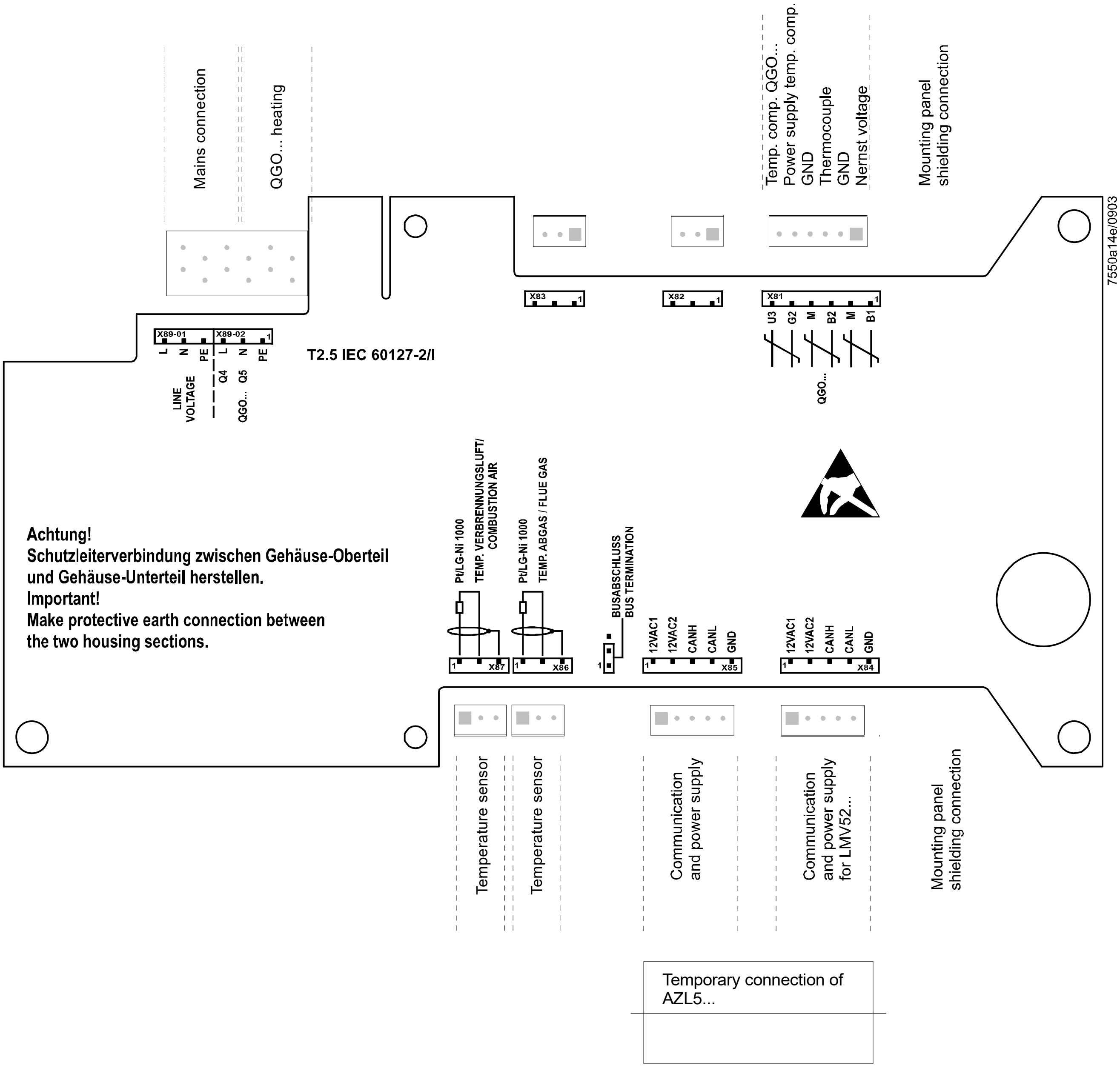
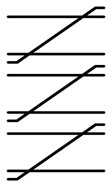
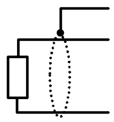
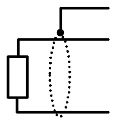


Figure 121: Inputs/outputs PLL52

Terminal marking	Connection symbol		Safety class	Input	Output	Description of connection	Electrical rating
O2 module							
X81	PIN 6		III	●		Temperature compensation QGO20 (U3)	DC [0...2 V], Ri > 100 kΩ
	PIN 5				●	Power supply temperature compensation (G2)	DC [12...18 V], Ra = 20 Ω
	PIN 4			●	●	GND (M)	
	PIN 3			●		Thermocouple (B2)	DC [0...33 mV], Ri > 100 kΩ
	PIN 2			●	●	GND (M)	
	PIN 1			●		Nernst voltage (B1)	DC [-25...1 mV], Ri > 100 kΩ
X84	PIN 5	GND	III	●		Signal reference	
	PIN 4	CANL		●		Communication signal	DC U <= 5 V, Rw = 120 Ω,
	PIN 3	CANH		●		Communication signal	level to ISO-DIS 11898
	PIN 2	12VAC2		●		AC supply for O2 module	AC 12 V +10% / -15%, 0...60 Hz,
	PIN 1	12VAC1		●		AC supply for O2 module	fuse max. 4 A
X85	PIN 5	GND	III	●		Signal reference	
	PIN 4	CANL		●		Communication signal	DC U <= 5 V, Rw = 120 Ω,
	PIN 3	CANH		●		Communication signal	level to ISO-DIS 11898
	PIN 2	12VAC2		●		AC supply for O2 module	AC 12 V +10% / -15%, 0...60 Hz,
	PIN 1	12VAC1		●*		AC supply for O2 module	fuse max. 4 A

Combustion air / flue gas temperature sensor

X86	PIN 3		III	●		Shield connection	
	PIN 2			●		Signal reference	
	PIN 1			●		Flue gas temperature sensor input Pt1000 / LG-Ni 1000	
X87	PIN 3		III	●		Shield connection	
	PIN 2			●		Signal reference	
	PIN 1			●		Combustion air temperature input Pt1000 / LG-Ni 1000	
X89-02	PIN 1	PE	I		●	Protective earth (PE)	
	PIN 2	Q5 N			●	QGO20 heating	
	PIN 3	Q4 L			●	QGO20 heating	At AC 120 V +10 % / -15%, 50...60 Hz, Imax. 2.5 A At AC 230 V +10 % / -15%, 50...60 Hz, Imax. 2.5 A
X89-01	PIN 1	PE	I	●		Protective earth (PE)	
	PIN 2	N		●		Power supply neutral conductors (N)	
	PIN 3	L		●		Power supply live conductor (L)	AC 230 V +10 %/ -15%, 50...60 Hz, Imax. 2.5 A

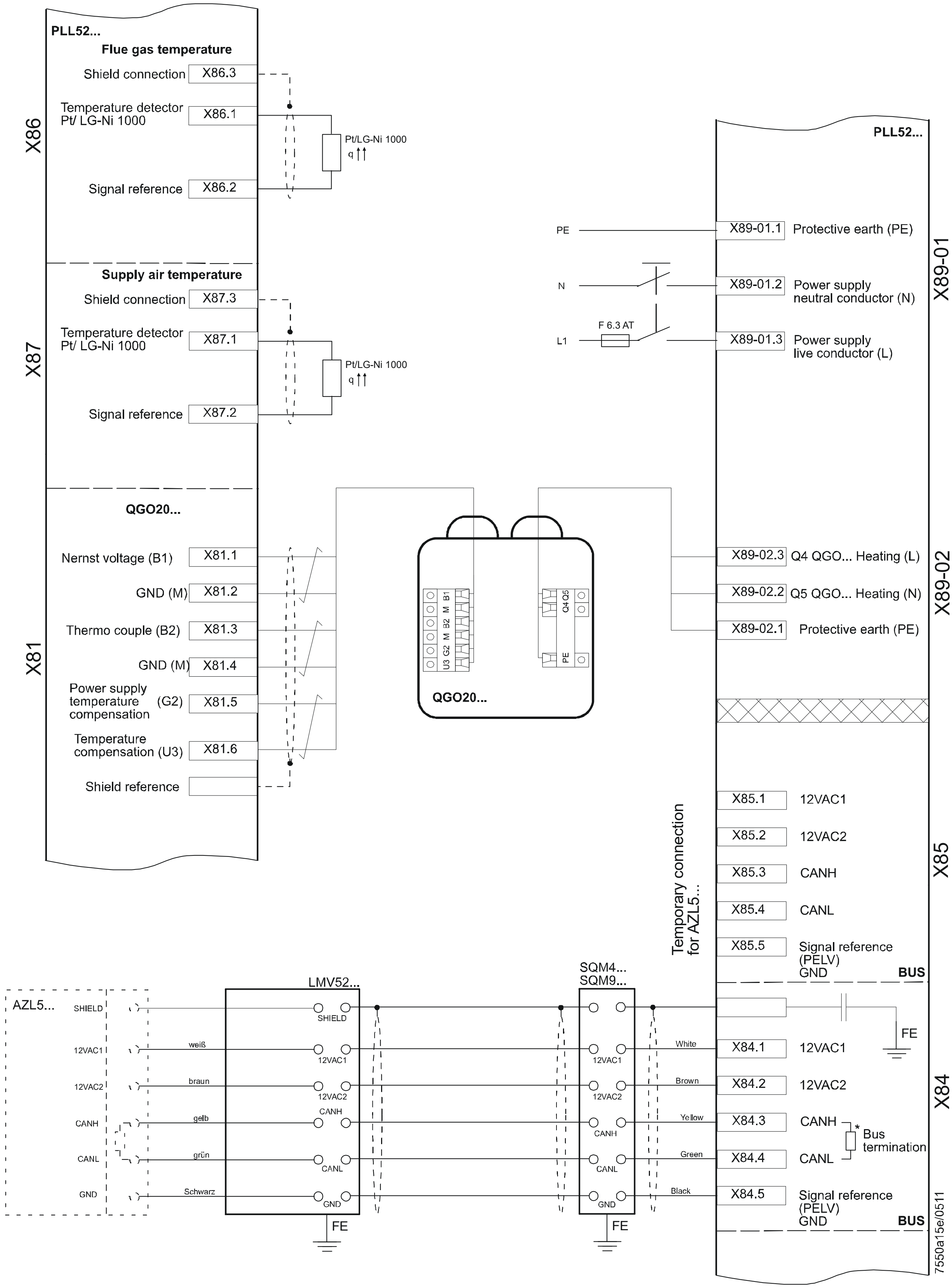


Figure 122: Connection diagram PLL52

19.8.2 CAN bus X84, X85

The PLL52 is to be connected to the LMV5 via CAN bus. There are 2 terminals for the CAN bus, X84 for the supply, and X85 for the connection of the AZL5. If the PLL52 is located at the end of the bus line, the CAN bus termination must be activated.

19.9 Configuring the PLL52

The connected sensors are to be configured via the AZL5.

The QGO20 connected to terminals X81 / X89-02 must be parameterized.

Parameter	*O2 Sensor (NoSensor, QGO20)*

The combustion air temperature sensor connected to terminal X87 must be parameterized.

Parameter	*Combustion air temperature sensor (NoSensor, Pt1000, LG-Ni1000)*

The flue gas temperature sensor connected to terminal X86 must be parameterized.

Parameter	*Flue gas temperature sensor (NoSensor, Pt1000, LG-Ni1000)*

19.10 Configuring the system

(Description of the plant-dependent basic configuration)

First, make all configurations as described in detail with the LMV51.

19.10.1 Actuators / VSDs

When activating the actuators / VSDs via menu section *RatioControl*, parameterization comprises *activated* and *deactivated* and, in addition, *air influen*. Air-influencing (or air-regulating) actuators have an impact on the amount of air. The actuators defined as *air influen* actuators are used for O2 trim control. Basically, all actuators having an impact on the air volume are to be parameterized as *air influen*. In exceptional cases, a truly air-regulating actuator can be excluded from O2 trim control by setting it to *activated*.

☞ Note!
If the parameterization is changed, O2 trim control must be readjusted.

deactivated:	Actuator is not active
activated:	Actuator is active but has no impact on the air volume. Actuator is not used for O2 trim control
air influen:	Actuator is active and has an impact on the air volume. Actuator is used for O2 trim control

Parameter	*Air actuator (deactivated, activated, air influen)*
	Auxiliary actuator 1 (deactivated, activated, air influen)
	Auxiliary actuator 2 (deactivated, activated, air influen)
	Auxiliary actuator 3 (deactivated, activated, air influen)
	VSD (deactivated, activated, air influen)

19.10.2 Parameterizing the type of fuel

For calculating precontrol and combustion efficiency, the type of fuel must be selected. Also refer to chapter *Setting fuel-air ratio control.*

For firing on gas, there are 4 preprogrammed fuel types available, plus 1 type of fuel that can be defined by the user.

For firing on oil, there are 2 preprogrammed types of fuel available, plus 1 type that can be defined by the user.

Parameter	*Gas: Type of Fuel (user def, naturalGasH, naturalGasL, propane, butane)*
	Oil: Type of Fuel (user def, LightOilLO, LightOilHO)

19.10.3 Setting the user-defined type of fuel

If, when firing on gas or oil, the user-defined fuel type is selected, the relevant fuel parameters must be manually set.

Parameter	*V_LNmin*

Amount of air required for stoichiometric combustion (λ = 1) [m³ air per m³ gas] or [m³ air per kg oil]. This value is used for calculating O2 trim control / precontrol.

Parameter	*V_afNmin*

Flue gas volume «wet» with stoichiometric combustion (λ = 1) in [m³ flue gas «wet» per m³ gas] or in [m³ flue gas «wet» per kg oil]. This value is used for calculating O2 trim control / precontrol or the combustion efficiency.

Parameter	*V_atrNmin*

Flue gas volume «dry» with stoichiometric combustion (λ = 1) in [m³ flue gas «dry» per m³ gas] or in [m³ flue gas «dry» per kg oil]. This value is used for calculating O2 trim control / precontrol or the combustion efficiency.

Parameter	*A2*

This value is used for calculating the combustion efficiency. It is in compliance with the definition given in the first BimScHV.

Parameter	*B/1000*

This value is used for calculating the combustion efficiency. It is in compliance with the definition given in the first BimScHV. The parameters are set using a resolution of 1/1000. This means that a parameterized value of 8 corresponds to 0.008.

Preset fuel parameters

	Natural gas H	Natural gas L	Propane	Butane	Light oil	Heavy oil
V_Lnmin	9.90	8.41	23.80	30.94	11.20	10.73
V_afNmin	10.93	9.43	25.80	33.44	12.02	11.39
V_atrNmin	8.89	7.69	21.80	28.44	10.53	10.08
A2	0.66	0.66	0.63	0.63	0.68	0.68
B/1000	9 ≈ 0.009	9 ≈ 0.009	8 ≈ 0.008	8 ≈ 0.008	7 ≈ 0.007	7 ≈ 0.007

19.11 Commissioning the O2 trim control system

19.11.1 Setting fuel-air ratio control

Caution!
First, adjust the ratio control curves the same way as with the LMV51 The excess O2 rate must be selected high enough, ensuring that at all possible ambient conditions (combustion chamber and fuel pressure, temperature and pressure of the combustion air), **the O2 level will not fall below the O2 setpoint of O2 trim control.**

Parameterize the loads at the curvepoints proportional to the effective fuel rate (amount of fuel). For that purpose, ascertain the load with the help of the fuel meter.
The curvepoint identifies the smallest load where O2 trim control is still possible.
In normal situations, this is the low-fire position.
Typically, this curvepoint 2 is defined as the low-fire position by setting the *MinLoadGas* or the *MinLoadOil* parameter to the load of the second curvepoint.
Point 1 defines the curve for reducing the air rate below point 2.
The O2 ratio value between the curvepoints should be linear. When O2 trim control is activated, precontrol will transfer any nonlinearity to the actual O2 value. When adjusting the load, the actual O2 value fluctuates about the O2 setpoint. Check the linearity of the O2 progression by approaching the loads between the curvepoints. If the O2 ratio value has such nonlinearities, they can be corrected by setting intermediate curvepoints.
The more thoroughly the ratio control curve is set, the easier the subsequent adjustment of O2 trim control, and the more accurate O2 trim control will be.

Note!
If the ratio control curves are changed later, the O2 trim controller must also be readjusted.

19.11.2 Setting the O2 alarm

Next, the O2 alarm must be adjusted. When making the adjustment for the first time, the O2 alarm should remain deactivated to avoid undesired responses. When changing settings later, it can stay activated.

Set the O2 min. value as low as possible to ensure a high level of availability. The O2 min. value marks the boundary between the permanently non-hazardous range and the potentially hazardous range.

Caution!
Above or at the O2 min. value, hazardous conditions must not constantly occur.

Guide values (for Europe): CO = 2,000 ppm, soot number 3.
The values vary, depending on the type of plant. They need to be checked.

After setting all O2 min. values, the O2 alarm can be activated.
The setting can be made in 2 different ways.

19.11.3 Direct entry of O2 min. values

If the limit values of a plant are known, and if the CO limit need not be remeasured, the O2 min. values can be entered directly.

```
Point:     2
O2 Min Val  :  1.2
P Air Man   :  0.0
```

On the first line, *Point*, select the point number to be changed and confirm by pressing **Enter** (point 1 can be adjusted). With the second line, *O2 Min Value*, the O2 min. value can be directly parameterized. The points are approached only if, previously, setting choice *P-Air Man* has been used.

19.11.4 Measuring the O2 min. values by lowering the air rate

On the first line, select the point number and confirm by pressing **Enter**. Now, select line *P-Air Man* and confirm. After confirming with **Enter**, the fuel-air ratio control system approaches this point on the parameterized ratio control curve, that is, air rate reduction *P-Air Man* is set to «0». The display on the second line changes to *Actual O2 Value*, which will then be displayed.

```
Point:     3
Act O2 Val  :  1.4
P Air Man   : 21.3
```

By readjusting the air rate *P-Air Man*, the amount of combustion air and thus the O2 value can be reduced. *P-Air Man* corresponds to the relative air rate reduction. During the readjustment, all actuators on the curve parameterized as air influen will travel to the relevant positions. When the O2 min. value is found, the acquired *Actual O2 Value* is entered as the *O2 Min Value* by pressing **Enter**.

19.11.5 Setting O2 trim control

Since with O2 trim control activated, the O2 alarm is always active too, the O2 alarm should already be set. For the initial setting, O2 trim control should remain deactivated, and the O2 alarm can be activated. Prior to setting the O2 trim controller, both fuel-air ratio control and the loads of the curvepoints should be correctly set. This facilitates correct functioning of precontrol. Also refer to chapter *Setting fuel-air ratio control.*

> Note!
> If the ratio control curves are changed later, O2 trim control must also be readjusted.

It is important to make all settings of the O2 trim controller when environmental conditions do not change. For this reason, when making corrections later, all points must be set again. When setting O2 trim control, you are guided through the necessary setting steps.

For adaption of the O2 trim controller during low-fire operation, the following parameter is available:

Parameter	*LowfireAdaptPtNo*

This parameter is intended for plant where the flue gas speed at curvepoint 2 is too low to produce valid adaption values.

> Note!
> O2 trim control is not performed below the parameterized *LowfireAdaptPtNo*.

First, select the required curvepoint and confirm by pressing **Enter** (curvepoints under *LowfireAdaptPtNo* cannot be set, since loads below *LowfireAdaptPtNo* cannot be approached with O2 trim control). The system approaches the selected point on the ratio control curve.

```
Point:  2      §
O2 RatioCon:####
O2 Setpoint:####
StandardVal:####
```

The display changes. During this step, the system acquires the O2 value on the ratio control curve. The actual O2 value is displayed and the operator is prompted to confirm when a stable O2 value is reached. This is important since the value is used for calculating precontrol. In the future, the PC software will be useful for making checks.

```
Point:  2      §
O2 RatioCon: 5.4
When Value stble
continue w ENTER
```

Then, the measured O2 ratio value is displayed. The pointer now indicates the standardized value. By changing this value, the relative amount of air is reduced, whereby the standardized value corresponds to the relative air rate reduction. The standardized value is only changed until the actual O2 value reaches the required O2 setpoint, which is then displayed. The setting may only be confirmed after a constant O2 value has been attained. The PC software will be useful for making checks.

```
Point:    2
O2 RatioCon:  5.2
Act O2 Val :  2.0
StandardVal: 15.3
```

Now, the operator must decide whether he wants to adopt or discard the settings.

```
Point
Store  ->ENTER
Cancel ->ESC
```

At curvepoint *LowfireAdaptPtNo* and at the highest curvepoint, system adaption takes place during the storage process. This is accomplished by measuring the delay time (τ) of the boiler plant. Based on these values, the PI control parameters, the controller locking time after load readjustment, and the min. value delay for the O2 alarm are calculated. To measure the time constant (τ), the burner is driven back to the ratio control curve. With the other curvepoints, the system returns to the ratio control curve without adaption after setting the O2 setpoint. After setting all points, O2 trim control can be activated.

19.11.6 Checking and changing the controller parameters

The adapted controller parameters and the measured time constant (τ) of the boiler can be viewed on the *Controller parameters* → *PI* menu, and changed, if required.
If the adapted Tau values are changed manually, the PI values determined from the adaption remain unchanged. If these are to be recalculated based on the changed Tau values, this can be done using the *Calc PI again* parameter.

The O2 setpoint must be between the O2 minimum value and the O2 ratio value.

19.12 Setting notes

(Summary of the most important rules for setting O2 trim control)

19.12.1 Parameterizations

Parameterize all truly air-regulating actuators as such
If the parameter settings are changed, O2 trim control must be readjusted.

19.12.2 Setting fuel-air ratio control

Caution!
Set sufficient excess O2
Set the amount of excess air of the ratio control curve such that, whatever the environmental conditions (combustion chamber and fuel pressure, temperature and pressure of the combustion air), the set residual O2 content will lie above the O2 setpoints required by O2 trim control.

Example:

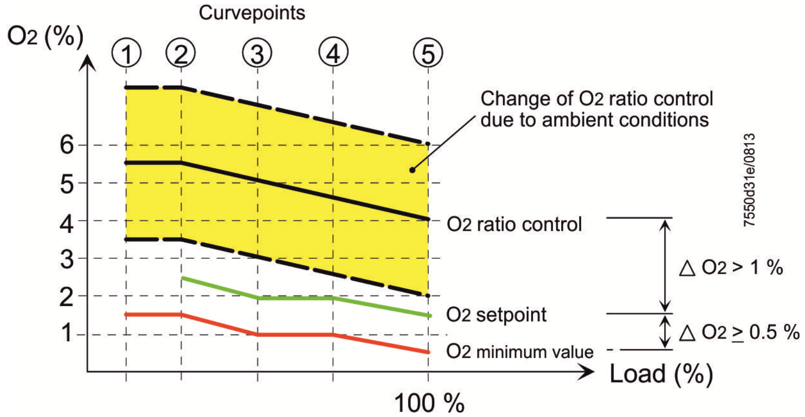


Figure 123: Setting fuel-air ratio control

- **Parameterized load proportional to the fuel rate**
  The burner load parameterized at the curvepoints must be proportional to the actual burner load. To make the correct setting, determine the burner load with the help of the fuel meter.
- **Curvepoint 1**
  The first curvepoint should have an adequate distance below curvepoint ②. This means that the curve for reducing the air rate is also defined below point ②. As a guide value, point ① should lie at about half the load of point ②. Point ② should be smaller than or equal to the low-fire load.

Note!
The following values can be entered at the AZL52 from software version V05.00 for the LMV52.2 and software version V10.10 for the LMV52.4:
- ∆ (O2 ratio control - O2 setpoint) ≥0.1%
- ∆ (O2 setpoint - *O2 min value*) ≥0.1%

- **Linear progression of O2 value between the curvepoints**
  The O2 value between the curvepoints should progress in a linear fashion. To make checks, approach load positions between the curvepoints and check the O2 value. If the progression is not linear, additional curvepoints should be set and the O2 progression should be appropriately corrected.

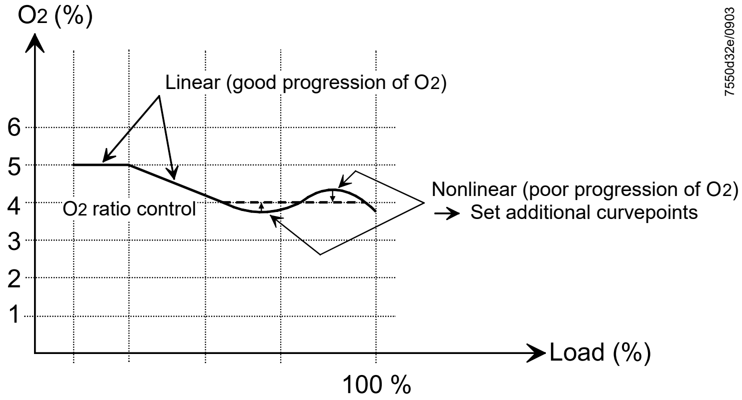


Figure 124: Linear progression of O2 value between the curvepoints

- **Checking the transfer range between damper and VSD**
  When using several air-regulating actuators (e.g. air damper or VSD), it should be made certain that the curves are as smooth as possible. Irregularities should be avoided.

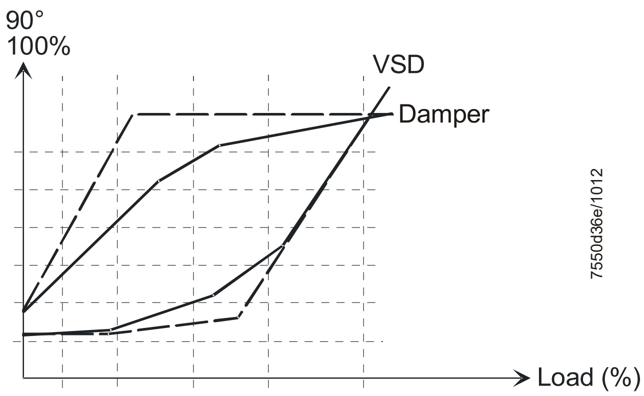


Figure 125: Checking the transfer range between damper and VSD

_____ good

------ poor

19.12.3 Setting the O2 trim controller

- **Setting the O2 min. value**
  The O2 min. value should be set as low as possible to ensure a high level of availability.

Caution!
Above or at the O2 min. value, hazardous conditions must not permanently occur.

Guide values: CO = 2,000 ppm, soot number 3.
The values can vary, depending on the type of plant.

- **Adequate distance between O2 setpoint and O2 min. value**
  The distance should be a minimum of 1...1.5% O2. If a smaller distance is used, the ratio control curve must be set as accurately as possible, in accordance with chapter *Setting notes- Setting fuel-air ratio control*.

- **All O2 setpoints must be adjusted under the same environmental conditions**
  It is important to adjust the O2 setpoints at the same ambient temperatures. If, later, individual setpoints are changed, all setpoints of the curvepoints must be readjusted since environmental conditions will probably be different from those at the time the initial settings were made.

19.12.4 Other notes

When firing on oil and using a VSD, the oil pump must be driven separately.
If this is not observed, the fan speed has an impact on the amount of oil delivered. This can cause problems in connection with precontrol or O2 trim control.

19.13 Technical data

LMV52

Refer to chapter Technical Data!

PLL52

Mains voltage X89-01	AC 120 V -15% / +10%	AC 230 V -15% / +10%
Safety class	I with parts according to II as per DIN EN 60730-1	
Mains frequency	50/60 Hz ±6%	
Power consumption	Approx. 4 VA	Approx. 4 VA
Degree of protection	IP54, housing closed	

Transformer AGG5.210 - Primary side - Secondary side	 AC 120 V AC 12 V (3x)
Transformer AGG5.220 - Primary side - Secondary side	 AC 230 V AC 12 V (3x)

19.14 Loads on terminals, cable lengths and cross-sectional areas

LMV52

Refer to chapter *Technical Data / LMV5 and AZL5*!

PLL52

Cable lengths / cross-sectional areas	
Electrical connection X89	Screw terminals up to max. 2.5 mm²
Cable lengths	≤10 m to QGO20
Cross-sectional areas	Refer to description of QGO20 Twisted pairs

Analog inputs:	
Fresh air temperature detector	Pt1000 / LG-Ni1000
Flue gas temperature detector	Pt1000 / LG-Ni1000
QGO20	Refer to Data Sheet N7842
Interface	Communication bus for LMV52

20 Flue gas recirculation (FGR) function (LMV50/LMV51.3/LMV52)

20.1 Function principle of flue gas recirculation (FGR)

The flue gas recirculation (FGR) function is used to reduce the NOx content of flue gases. This is accomplished by feeding a certain proportion of the flue gas back to the combustion chamber, causing the flame's temperature to drop. The amount of recirculated flue gas is set via auxiliary actuator 3.

Caution!
When carrying out the settings, it is important to remember that, if the flue gas recirculation quantity is too high, the flame may lift off the burner (stability limit of the flame).

Caution!
Use of flue gas recirculation in combination with O2 control.
This does not affect the "O2 alarm" function.

It is essential for the following physical effects to be taken into consideration:

1. Mutual influence of pressures
2. O2 reduction can lead to a strong increase in NOx values

As a result of these interactions, it is essential for the on-site startup engineer to check the ratio control settings, the O2 control, and the "flue gas recirculation" function. Even if the settings are correct, the physical effects mentioned above can still result in the flame becoming unstable or the desired NOx values not being reached during operation.
Any flame instability or failure to achieve the desired NOx levels can be attributed to the application or burner design rather than the functionality of the unit.

Note!
Problems in connection with condensation near the intake

In the intake duct, the hot and humid flue gas mixes with cold supply air.
This means that the recirculated flue gas can lead to condensation in the vicinity of the burner intake, depending on flue gas and supply air temperature.

Result:
Water enters the burner; in the case of oil-firing possibly with parts of sulfurous acid.

Note!
Reduction of maximum burner output

Use of the flue gas recirculation (FGR) function or the flue gas mass introduced to the supply air duct might lower the burner's maximum output.
This means that the maximum amount of combustion air that can be introduced will be reduced.
Hence, the amount of fuel for high-fire operation must be reduced to ensure correct combustion values.

Attention!
If at an dual-fuel burner the FGR function is used for only one fuel (e.g. gas operation with FGR and oil operation without FGR) pay attention to the following:
When the fuel selection is switched over to the fuel without FGR it must be assured that the FGR actuator is closed and is supervised kept in the closed position.

This is accomplished by making the following settings for the fuel without FGR:
- **Activation of the AUX3 actuator**
- **Parameterization of the positions Home, Prepurge , Ignition and Postpurge to *closed***
- **Parameterization of all AUX3 actuator positions at all curve points to *closed***
- **Parameterization of the FGR operating mode to *Aux3onCurve***

Attention!
The LMV52.4 was specially developed for temperature-compensated flue gas recirculation.
The LMV52.4 is *not* suitable for performing combustion air temperature compensation.

The LMV5 supports 2 different flue gas recirculation (FGR) functions:
1. Flue gas recirculation (FGR) without temperature compensation (operating mode flue gas recirculation (FGR) = *time* or *temperature*).
   With these operating principles, the positions of auxiliary actuator 3 can only change between *CLOSED* (ignition position) and the positions on the ratio control curves.
   The point in time transition from the ignition position to a position on the ratio control curve takes place depends either on the progression of the parameterized time (*ThresholdFGR Oil*) or the point in time the parameterized temperature threshold is reached (*ThresholdFGR Gas / ThresholdFGR Oil)*.
2. Flue gas recirculation (FGR) with temperature compensation (operating mode flue gas recirculation (FGR) = *Temp.komp.* or *TCautoDeact).*
   With temperature-compensated flue gas recirculation (FGR), the amount of flue gas fed back is also affected by the flue gas temperature.
   With this operating principle, the positions of auxiliary actuator 3 can lie between the parameterized minimum position (*DeactMinPos*) and the calculated positions.
   Calculation of the positions is based on the value pairs *Operating temperature and associated positions of the ratio control curve* plus the *Current flue gas temperature*.
3. LMV51.3 and LMV52.2 only provide flue gas recirculation (FGR) without temperature compensation.
   The LMV52.4 also features flue gas recirculation (FGR) with temperature compensation.

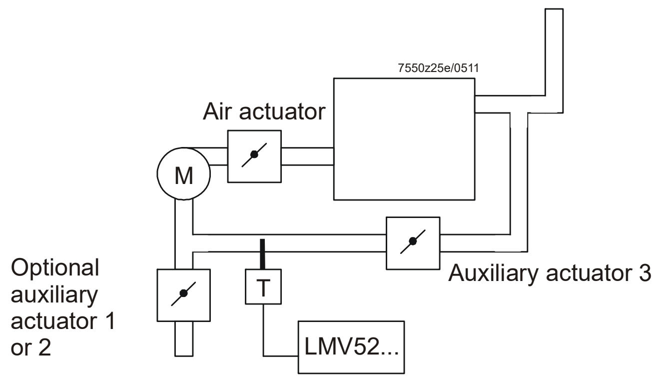


Figure 126: Typical application example

20.2 Parameter for the flue gas recirculation (FGR) function

Parameter *Operating mode FGR* defines the way and the point in time auxiliary actuator 3 is driven to the ratio control curve or to the positions calculated from the flue gas temperature and the ratio control curve.

FGR-Mode	**Description**	**LMV50 LMV51.3 LMV52.2**	**LMV52.4**
Aux3onCurve	Flue gas recirculation (FGR) function is deactivated. Auxiliary actuator 3 is driven along its parameterized ratio control curve	●	●
deactivated	After the ignition position, auxiliary actuator 3 is always held at the minimum position for flue gas recirculation (indicated with #) and the flue gas recirculation temperature is not evaluated (display XXX). This ensures that the system is operated in a safe state if the flue gas recirculation setting could not be fully realized. We recommend performing burner startup using this setting prior to setting the flue gas recirculation curve		●
time	Auxiliary actuator 3 maintains the ignition position until an adjustable time is reached	●	●
temperature	Auxiliary actuator 3 maintains the ignition position until an adjustable temperature is reached	●	●
temp.contr.	The position of auxiliary actuator 3 is determined depending on the flue gas temperature and the ratio control curve. In addition, the actuator can maintain the ignition position until an adjustable time (parameter *DelaytimeFGRGas / DelaytimeFGROil)* is reached		●
TCautoDeact	Same manner of operation as *temp.contr.*, but the function is automatically deactivated should the flue gas sensor become faulty. The actuator is driven to the minimum flue gas recirculation (FGR) position and a warning is issued		●
deactMinpos	After the ignition position, auxiliary actuator 3 always maintains the minimum flue gas recirculation (FGR) position (indicated by #) and the flue gas recirculation (FGR) temperature is not evaluated (display of XXX). The system can thus be driven to a secure state, if it was not possible to fully complete the flue gas recirculation (FGR) settings. It is recommended to use this setting for commissioning the burner before adjusting the flue gas recirculation (FGR) curve		●
auto deact	Flue gas recirculation (FGR) with temperature compensation was automatically deactivated. Same operation mode as *deactMinpos*, but a warning is issued **Caution!** **Do not use this setting.** **To deactivate the flue gas recirculation (FGR) function, use *deactMinpos*.**		●

☞ Note!
The full scope of setting *TCautoDeact* is possible only when the flue gas temperature is acquired via the load controller input (X60…).
When the temperature is acquired via the PLL52 input (X86…) and the O2 trim controller / alarm is active (not *CtrlAutoDeac*), flue gas recirculation (FGR) mode *temperature-compensated* cannot be used (would lead to error *C:F6 D:2*).
When operating mode *O2 Control* is deactivated (*man deact*), operating mode *TCautoDeact* can be used if the flue gas temperature is acquired via PLL52 (X86…).

☞ Note!
Setting *deactMinpos* is recommended when commissioning the plant, since *erroneous temperature values* will not be stored.

Parameter	*FGR-Mode (deactivated / time / temperature / temp.contr. / TCautoDeact / Aux3 Minpos / auto deact)*

Parameter	Description	Active with flue gas recirculation (FGR)	
		without temperature compensation	with temperature compensation
FRG On Time Gas or *FRG On Time Oil*	Setting of delay time for auxiliary actuator 3 to be kept in the ignition position after entering phase *OPERATION*	●	●
FRG On Temp Gas or *FRG On Temp Oil*	The adjustment of the temperature to be achieved so that auxiliary actuator 3 moves from the ignition position to the flue gas recirculation position.	●	
FGR sensor *(*X86 PtNi1000 / X60 Pt1000 / X60 Ni1000)	Selection of temperature sensors for temperature-compensated flue gas recirculation (FGR)	●	●
FGR factor gas or *FGR factor oil*	Readjustment of calculated temperature-dependent position of auxiliary actuator 3. The setting is made in steps of 1%. 100% means no readjustment. Settings <100% reduce the amount of recirculated flue gas (moving the damper toward the fully closed position). The factor has an impact only when there is a deviation from the learned flue gas recirculation (FGR) temperature. This means that when reaching the initially acquired flue gas recirculation (FGR) temperature, the stored position is approached, independent of the flue gas recirculation (FGR) factor. See the *Examples of tables showing the damper positions with FGR*		●
FGR Minpos	Minimum limitation of position of auxiliary actuator 3 for *temp.comp.* and *TCautoDeact* modes. The setting is made as an absolute value and ensures that flue gas recirculation (FGR) always operates with at least a minimum amount of flue gas. The position is also used to ensure a defined damper position for emergency operation or automatically deactivated flue gas recirculation (FGR)		●
FGR Maxpos factor	Maximum limitation of the required position of auxiliary actuator 3 calculated from the current temperature and the warm position. The setting is made in steps of 1% and refers to the relevant curvepoint. Interpolation between the curvepoints is linear		●

Note!
Parameter *FGR sensor*:
The configuration of the selected sensor must be correctly made!
Example of X60 Pt1000:
Select suitable measuring range from the load controller menu. If not observed, an error message due to Pt1000 sensor line interruption might appear!

Only LMV52.4:
Examples of tables showing the damper positions with flue gas recirculation (FGR)

Table with setting values:

Output	37.5%	62.5%	75%	100%
Flue gas recirculation (FGR) curve	19.3°	25.0°	28.5°	37.0°
Flue gas recirculation (FGR) temperature	72 °C	105 °C	121 °C	150 °C

The LMV52.4 uses these setting values to calculate a *zero curve*:
Example of flue gas recirculation (FGR) positions calculated by the LMV52.4 for a flue gas recirculation (FGR) factor of 100%:

Position flue gas recirculation with T = 0 °C zero curve	15.2°	18.0°	19.7°	23.8°

Example of flue gas recirculation (FGR) positions calculated from the identical setting values for a flue gas recirculation (FGR) factor of 50%:

Position flue gas recirculation with T = 0 °C zero curve	7.6°	9.0°	9.8°	11.9°

The above example shows that – with the *zero curve* – a flue gas recirculation (FGR) factor of 50% leads to a 50% reduction of the damper positions.

The LMV52.4 performs a linear interpolation of the damper positions between the setting values and the *zero curve*, depending on the current flue gas temperature. When the flue gas temperatures lie above the setting values, the calculated damper positions are higher than the setting values.

20.3 Setting electronic fuel-air ratio control in connection with flue gas recirculation (FGR)

20.3.1 Settings in *Time* or *Temperature* mode (without temperature compensation)

The curve of auxiliary actuator 3 can be set the same way as fuel-air ratio control.

Recommendation:
Commission the plant with no influence from flue gas recirculation (FGR).

This enables the fuel-air ratio control system to be set as if the plant operated without flue gas recirculation (FGR).
For that purpose, in flue gas recirculation (FGR) mode *Time,* set the switch-on time to its maximum or parameterize it at such a level that auxiliary actuator 3 will not be positioned until the curve settings become active.

Analogously, in flue gas recirculation (FGR) mode *Temperature,* set the *switch-on temperature* to a level that cannot be reached.

After completing the settings of the fuel-air ratio control curves without flue gas recirculation (FGR), the actual settings with an active auxiliary actuator 3 can now be made.
Since this might have an impact on the combustion settings, the fuel- and air-regulating actuators may have to be readjusted.

Select the required curvepoint, then continue by pressing **Enter**.

⇓

```
Point | Point
   :3 | change?
Hand  | delete?
      |
```

The pointer position can vary between *change* and *delete*. To edit the curvepoint, select *change* here.

- Continue by pressing **Enter**

⇓

New: Select whether the actuators shall follow the adjustment (only during operation).

```
Actuator         -
Positions
 Followed
 Not followed
```

- Continue by pressing **Enter**

⇓

```
Point | Power :23.5
   :3 | Fuel  :23.2
Hand  | Air   :41.6
      | Aux3  #33.3
```

If auxiliary actuator 3 still maintains the ignition position (recirculation duct CLOSED), it is marked with **#**.
The position value of auxiliary actuator 3 can be changed, but the actuator will not follow the readjustment for that period of time!
The changed value can also be stored.
If auxiliary actuator 3 is not marked with **#** when making the setting, it is already on the ratio control curve, in which case it also follows the readjustment of the position value. If marked with # or in case of selection *without driving,* the curve position can be readjusted without having the actuator following the position value.

☞ Note!
During the time the curve menu is used, the state of the flue gas recirculation (FGR) function does not change. This means that if auxiliary actuator 3 is still at the *Flue Gas Recirc.* position (ignition position) when activating the parameterization of curves, and it maintains that position until parameterization is completed.

20.3.2 Settings in temperature-compensated mode (only LMV52.4)

Note!
Recommendation:
First, make the initial settings with no influence from flue gas recirculation (FGR).

This enables the fuel-air ratio control system to be set as if the plant operated without flue gas recirculation (FGR).

For that purpose, set flue gas recirculation (FGR) mode *temp.comp.* or *TCautoDeact* to *deactMinpos*.
This way, auxiliary actuator 3 is always maintained at the minimum position of flue gas recirculation (FGR).

After completing the settings of the fuel-air ratio control curves without flue gas recirculation (FGR), the actual settings with an active auxiliary actuator 3 can now be made.

When setting the fuel-air ratio control curves of auxiliary actuator 3 in flue gas recirculation (FGR) mode *temp-compensated,* the current flue gas recirculation (FGR) temperature is also displayed.

Select the required curvepoint, then continue by pressing **Enter**.

⇓

Point	Point
: 3	change?
O2	delete?
2.8	

Here, the cursor position can be changed between *change* and *delete*.
The edit a curvepoint, select *change*.

- Continue by pressing **Enter**

⇓

Selection whether the actuators shall follow the adjustment.

Caution!
Temperature-compensated flue gas recirculation (FGR) can be correctly set only when selecting with *DriveLowfire* in operation!
A change in the curve point without the corresponding flue gas recirculation temperature (e.g. *without driving* in operation or in standby) results in an incorrect *pairing* of the values *Flue gas recirculation position* and *Flue gas recirculation temperature*.
This can lead to excessive amounts of recirculated flue gas, which might cause the flame to lift: Stability limit of flame.

```
Actuator
Positions
 Followed
 Not followed
```

- Continue by pressing **Enter**

⇓

```
Point |Load   :23.5
      |Fuel   :23.2
 O2   |Air    :41.6
      |Aux3   :33.3
```

If auxiliary actuator 3 is still in the ignition position (recirculation duct CLOSED), symbol **#** appears for a short moment.
After entering the curve settings, auxiliary actuator 3 in flue gas recirculation (FGR) mode *temp-compensated* is immediately driven to the selected point.
When selecting without *DriveLowfire,* the curve position can be readjusted without having the actuator follow the position value.

⇓ Change of display when selecting auxiliary actuator 3

```
FGR-T |Load   :23.5
  133 |Fuel   :23.2
 O2   |Air    :41.6
  2.8 |Aux3   :33.3
```

When selecting auxiliary actuator 3, the display shows the current flue gas recirculation (FGR) temperature in place of the curvepoint number.
The availability of this temperature is a means that enables you to correctly select the functionality of flue gas recirculation (FGR).
After a change of the position of auxiliary actuator 3, the position value must not be stored until the flue gas recirculation (FGR) temperature has really settled.
This is the only way to ensure a correct assignment of flue gas recirculation (FGR) damper position and flue gas recirculation (FGR) temperature.
As soon as the change of the current curvepoint is stored, the current flue gas recirculation (FGR) temperature is stored within the temperature curve.
This ensures a correct pair of values.

Note!
The valuation of the input *Oil pressure switch-min* in the program *Heavy oil with gas pilot* has been moved from phase 38 to phase 44.

To subsequently change this assignment, 2 choices are available:

1. Without *DriveLowfire* in operation.
   When selecting without *DriveLowfire* in operation, the initial temperature value is not changed.
   In that case, the flue gas recirculation (FGR) position should be slightly changed to compensate for dynamic effects, for example.
   The effects must be verified via manual operation outside of the curve setting!
2. Curve setting in standby (deactivation of an individual curvepoint of flue gas recirculation (FGR)).
   When changing a curvepoint in standby, the LMV5 stores an invalid flue gas recirculation (FGR) temperature (XXXX when reading the temperature values) in the temperature curve.
   This approach can be used to subsequently exclude a curvepoint from the flue gas recirculation (FGR) process.
   In that case, the flue gas recirculation (FGR) actuator is operated at the respective output with a damper position as much as possible closed.

Caution!
A subsequent change of the curvepoint without an associated flue gas recirculation (FGR) temperature (e.g. without *DriveLowfire* in operation or standby) leads to an incorrect pairing of *flue gas recirculation-position* and *flue gas recirculation-temperature*.
This can lead to excessive amounts of recirculated flue gas, which might cause the flame to lift: Stability limit of flame.

20.3.3 Settings in ***deactMinpos*** or ***auto deact*** mode (only LMV52.4) :

In flue gas recirculation (FGR) mode *deactMinpos* or *auto deact*, the flue gas temperature sensor is not evaluated and the value used internally for the flue gas temperature is always maintained at 0 °C.
As a result, the display that appears for auxiliary actuator 3 while the curve setting is made is XXXX.
While storing the curvepoint, an invalid value is entered in the temperature curve (corresponding to presetting or temperature curve deleted).
In flue gas recirculation mode *deactMinpos* or *auto deact* , auxiliary actuator 3 is always kept in the minimal flue gas recirculation position.
During the time the curve settings are made, this is indicated by the # symbol, meaning modulating.

F	G	R	-	T	I	L	o	a	d		:	2	3	.	5
		1	3	3	I	F	u	e	l		:	2	3	.	2
	O	2			I	A	i	r			:	4	1	.	6
		2	.	8	I	A	u	x	3		:	3	3	.	3

Note!
Recommendation:
Commission the plant with temperature-compensated flue gas recirculation (FGR) in *deactMinpos* mode.

This means that auxiliary actuator 3 is always kept in the minimal flue gas recirculation position during curve setting.
As a result, the initial settings of the fuel-air ratio control system can be made without getting any influence from flue gas recirculation (FGR).

20.4 Reading the flue gas recirculation (FGR) operating temperature (only LMV52.4)

The temperature values of temperature-compensated flue gas recirculation (FGR) stored while the curve settings are made can be read out via menu item *Params & Display*, *Flue Gas Recirc.*, *OperationTempGas* or *OperationTempOil*.

O	p	e	r	a	t	i	o	n	T	e	m	p	G	a	s
P	o	i	n	t					:				1		
L	o	a	d						:	1	0	.	0	%	
F	G	R	-	T	e	m	p		:		1	2	3	°	C

Using this function, all possible temperature values (15) can be read out.
Invalid or non-existing curvepoints are identified by XXXX.
The valid value range of the flue gas recirculation (FGR) temperature is 30...508 °C and has a resolution of 2 °C.

XXXX on the 2 lines *Load* und *FGR Temp* denotes that the respective curvepoint does not exist.

See the example below:

O	p	e	r	a	t	i	o	n	T	e	m	p	G	a	s
P	o	i	n	t					:				1	5	
L	o	a	d						:	#	#	#	#	%	
F	G	R	-	T	e	m	p		:	#	#	#	#	°	C

21 Dimensions

Dimensions in mm

PLL52

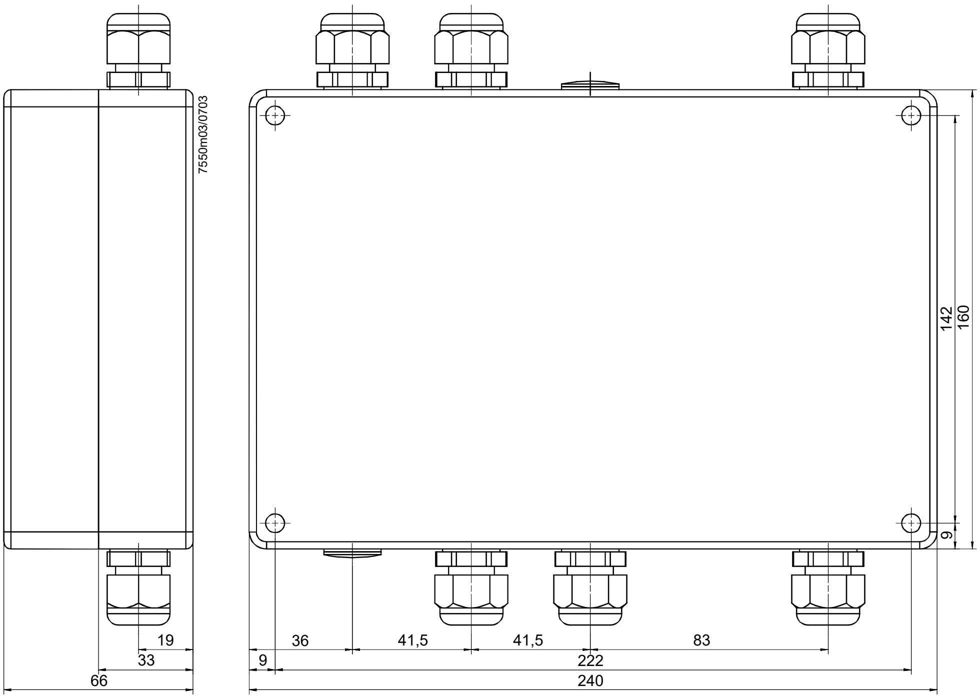


Figure 127: Dimension PLL52

22 Revision history

22.1 Changes of LMV51 from series A to B

The new release of the LMV5 is identified by the series letter B in the type (LMV51.XXX**B**XXX).

☞ Notes on compatibility!

- When changing from A-series to B-series units, the parameter sets can be copied
- The added parameters are preset in a way that they correspond to the former functioning mode
- An update to a new unit, which is no longer in the state supplied, should not be made since it is only the parameters of the A-series that can be stored back
- The compatibility of the load controller must be set manually, with the sign reversed
- Due to the change to the external analog predefined load and the analog load output (load controller V01.50), it may be necessary to make adaptions on the associated external controllers or BACS

22.2 Changes in the LMV5 release upgrade

22.2.1 Changes to basic unit LMV5

22.2.1.1 Basic unit LMV51; Software from V02.10 in V02.20

The software of the basic card has been changed from V02.10 to V02.20.
The following changes have been made:

Program stop
When the unit reaches the *Program stop* position, the AZL5 displays *Programstop active.*

Deactivating the alarm
The alarm relay can be deactivated via the menu of the AZL5, which means that the actual lockout or start prevention is maintained.
Deactivation remains active until the next reset is made, system reset or startup occurs.
Then, normal alarms are resumed, that is, deactivation of the alarm applies to the current alarm.

Pressure switch-min in the oil program
Pressure switch-min can also be activated for the oil program only.

Shutoff-valve oil, switch-off time
In the case of oil-firing, the external shutoff valve closes on completion of the permissible afterburn time (end of phase 70).
The burner motor operates until phase 79 is reached.
Using the relevant parameter, it is now possible to choose between the present function (when using the magnetic clutch) and direct coupling of the oil pump.
In that case, shutoff valve oil must be connected to the output for the oil pump (X6-02).
This output is not safety-related and is not used in the case of direct oil pump coupling.
Shutoff valve oil (X6-02) is always controlled when the fan runs, plus another 15 seconds.

DWminOil* in program *Heavy oil with gas pilot
The valuation of input *oil pressure switch-min* in program *Heavy oil with gas pilot* has been moved from phase 38 to phase 44.
DWminOil is only valued during the safety time after a delay time has elapsed

Pressure switch relief valve, inverted control
The signal can be inverted via the relevant parameter.
The output is only active when the fan operates.

External controller contact with *Manually on*
If the burner is in operation with *Manually on*, the external controller on contact (X5-03 pin 1) acts as a shutoff device should overtemperatures occur.
With the exception of operating mode 1 (extLC), the controller contact can be deactivated if not used as a switch-off device.

Prepurge time after safety shutdown
After safety shutdown, the longer prepurge time *PrepurgeSafeGas/Oil* becomes active.

Changes to the supplied parameter set
The parameter set has been changed from V20.02.00 to V20.03.00.
The software of the basic card has been changed from V02.20 to V02.30.
The following changes have been introduced:

Driving to the low-fire positions
After ignition, first the positions of curvepoint P1 are approached, independent of whether or not the minimum load has been set to a higher value. Once the positions of P1 are reached, the set minimum load is approached.

22.2.1.2 Basic unit LMV52, introduction V01.10

Introduction of serial software version V01.10.

22.2.1.3 Basic unit LMV51, Software from V02.30 to V02.50

22.2.1.4 Basic unit LMV52, Software from V01.30 to V04.10

The product nos. of the LMV5 will change as follows:

LMV51.0x0Bx	LMV51.0x0Cx
LMV51.1x0Bx	LMV51.1x0Cx
LMV51.200Ax	no modification
LMV52.2x0Ax	LMV52.2x0Bx

To operate the LMV5, it is necessary to have AZL5 software version 04.10 or higher installed. Using this software, all AZL51 of the B-series or higher and all AZL52 can be updated. The passwords are now encoded.

1. Introduction of a preset load for testing the safety limit thermostat.
2. Introduction of burner startup without prepurging.
3. Prepurge times 1 (t30) and 3 (t34) can be set at the OEM level.
4. Introduction of repetition counter at the OEM level for loss of flame during operation (factory setting = 2).
5. Alarm in the event of start prevention in standby mode.
   In the case of start prevention with no request for heat, it has previously not been possible to set off an alarm. Now, via parameterization, an alarm can also be triggered in standby mode.
6. The inputs for oil are no longer checked when firing on gas. Likewise, the inputs for gas are no longer checked when firing on oil.
7. The maximum filling and evacuation times for gas valve proving are now limited by the maximum permissible safety time for startup. This affects in particular the burner control versions that use the American standard parameter set.
8. Introduction of maximum load limitation at the Enduser level.
9. Hiding an adjustable load range aimed at reducing resonance phenomena in the burner-boiler-stack system.
10. The fuel actuator can be deactivated (only with LMV52).
11. Flue gas recirculation (FGR) (only with LMV52).
    Actuator AUX3 can be employed for controlling the damper used with flue gas recirculation (FGR). To improve the burner’s startup characteristics, only this actuator can be driven from its ignition position to the adjusted curve, either delayed or depending on the flue gas temperature.
12. Option: No prepurge for gas burners.
    As per EN 676, the prepurge time can be skipped if a valve proving system is installed.
13. Changing the external light test for OEMs.
    Now the OEM is able to skip the extraneous light test in the start sequence.
14. The curvepoints can now be adjusted without actually running the actuators to the adjusted positions.
15. The guard (alarm) for the maximum pressure can be opened with heavy oil in the phases 38 and 44 for the duration of the pressure switch-response time.

22.2.1.5 Basic unit LMV52, Software from V04.10 to V04.20

1. Check of AZL5 software version changed to V03.60 or higher.
2. Handling of open / closed release contact changed.
3. Delayed O2 sensor test until test conditions are reached.
4. The plausibility check for the running time control with multistage operation was corrected.
5. Timing problem in connection with flying start of VSD rectified.

22.2.1.6 Basic unit LMV52, Software from V04.20 to V04.50

1. Abortion of speed test during operation by leaving the left operating position with controlled shutdown.
2. Implementation of functionality *to reach the operating position after ignition via a curvepoint other than point 1* (*StartPoint Op*).
3. No more writing of diagnostic data in the ignition phases (not yet implemented with the VSD module).
4. Position valuation of actuators and VSD in phases 20...22 removed.
5. Introduction of timeout (ramp time) for opening the release contact when speed is not reached in standby and home run.
6. Valuation of extraneous light during shutdown in phase 76 (2nd part of afterburn time) shifted.
7. Implementation of load adjustment with *ExtR-X5* and deactivated fuel actuator.
8. With error activated in standby and cold QGO20 → response of start prevention changed.

22.2.1.7 Basic unit LMV52, Software from V04.50 to V04.80

1. Flame failure during second safety time.
2. Error code and repetition counter for flame failure during second safety time changed from *Loss of flame during operation* to *No flame at the end of the safety time*.
3. Fuel train with direct ignition.
   In the case of fuel trains with direct ignition (G, LO, HO), phases 50 (second safety time) and 52 (interval 2) are skipped.
4. Minimum extraneous light test before ignition.
   Introduction of a minimum test time of 5 seconds for extraneous light during startup in phase 36 (driving to ignition position).
5. Flying start.
   In the case of flying start, the VSD test is skipped.
6. *MinLoad*...
   Parameter *MinLoadGas* at the heating engineer level is valued higher than parameter *User MaxLoad...* at the Enduser level.
7. *StartPoint Op*.
   When deleting the curve parameters, *StartPoint Op,* the value used for overwriting parameters was too high. This has been rectified with version 4.80.
8. Flame valuation after reset.
   A parasitic effect in the QRI2 during the reset phase leads to a short signal pulse. Flame valuation during the reset is delayed.

22.2.1.8 Basic unit LMV52.4, Software from V04.80 to V10.00

1. New function: Temperature-compensated flue gas recirculation (FGR).
2. Driving to the low-fire positions from phase 50 is adjustable.
3. Extended monitoring of air pressure switch: New mode *deactInStby.*
   When using this setting, the signal of the air pressure switch in standby is not valued. In case of continuous purging, only start prevention is triggered and a message appears, in place of a response in the form of shutdown.
4. Extended monitoring of air pressure switch for flue gas recirculation (FGR):
   - New mode *deactInStby.*
     When using this setting, the signal of the air pressure switch for flue gas recirculation (FGR) in standby is not valued. In case of continuous purging, only start prevention is triggered and a message appears, in place of a response in the form of shutdown.
   - New mode *PS VSD.*
     When using this setting, the pressure switch for flue gas recirculation (FGR) must deliver an ON signal, if the VSD speed lies above the speed set via parameter *RotSpeed PS on*.
     If the VSD speed lies below the speed set via parameter *RotSpeed PS off,* the pressure switch for flue gas recirculation (FGR) must deliver an OFF signal.

22.2.1.9 Software versions of the 2012/2013 release upgrade

The changeover is expected to take place in Siemens production facilities in autumn 2013:

ASN		2012/2013 version release
LMV50:	V10.20	
LMV51 :	V05.10	
LMV51.3:		V05.10
LMV52.2..:		V05.10
LMV52.4:		V10.20
Internal LC module:		V02.10
Internal VSD module:		V01.50
AZL52:	V05.00	
PLL52:	V01.50	

22.2.1.10 Basic unit LMV51.0 and LMV51.1, Software from V02.50 to V05.10

With the 2012/2013 release upgrade for the LMV5, the microcomputer PCB in the variants named above will be converted to the same microcomputer PCB as in the LMV51.3 and LMV52 (known as platform conversion).
This means that from the date of the switchover, these variants will also have the additional hardware input X7-03 pin 2 *(start release gas* or *CPI*), which was previously only available for the LMV51.3 and LMV52.
Additionally, the assignment of the software functions to the LMV5 variants has also been rearranged, meaning that the release upgrade includes functions from higher LMV5 variants as well as completely new functions:

1. Configuration of new input X7-03 pin 2 for *start release gas* or for various valve closure contact via parameter *StartReleaseGas,* refer to chapter *Start release - gas / CPI*
2. Flue gas recirculation pressure switch (X4-01 pin 3) can be parameterized to *don´t care* in standby mode.
   Configuration of input X4-01 pin 3 via parameter *FGR-PS/FCC*, refer to chapter F*an contactor contact / flue gas recirculation pressure switch*
3. Configuration of load controller inputs X5-03 pin 2 and X5-03 pin 2 via parameter *Config X5-03.*
   This enables the same input function as in the LMV2/LMV3 to be achieved, refer to chapter *External boiler controller OPEN/CLOSED or STAGE2 / STAGE3*
4. Connection of a pressure switch for valve proving (PS-VP) or valve closure contacts (CPI). Configuration of input X9-03 pin 2 via parameter *PS-VP/CPI*, refer to chapter *Gas pressure switch - valve proving or valve closure contacts (X9-03 pin 2)*
5. Configuration of input X9-03 pin 4 via parameter *GasPressureMin*.
   deact xOGP setting available (for deactivating *LOgp* and *HOgp*), refer to chapter *Gas pressure switch-min (X9-03 pin 4)*
6. Heavy oil direct start X6-01 pin 3 with minimum temperature supervision in phases 21...61 and 38...62, refer to chapter *Heavy oil - direct start (X6-01 pin 3)*
7. Air pressure supervision can be deactivated in standby mode, refer to chapter *Air pressure switch (X3-02 pin 1)*
8. Option to adjust the reaction time for loss of flame and also the safety time in operation via parameter *ReacTmeLossFlame*, refer to chapter *Reaction time for loss of flame / safety time in operation*
9. *Startup stop* (start/stop in phase 36).
   Configuration of input X5-03 pin 3 via parameter *Config X5-03*, refer to chapter *Startup sequence stop in phase 36*
10. In connection with an air actuator and gas control valve, all gas fuel trains (modulating) can now also be used for burners with pneumatic or mechanical fuel-air ratio control → actuators can be deactivated, refer to chapter *Activating / deactivating the actuators*
11. Parameter *StartPoint Op* available, refer to chapter *Startpoint operation*
12. Approaching low-fire starting in phase 50, refer to chapter *Approaching low fire in phase 50 / 54*
13. Skipping phases 50 and 52 if a non-pilot fuel train has been selected, refer to chapter *Sequence diagrams*
14. Manual output should be unaffected by the load for setting the curve parameter, block the impact of the value when setting curve parameters via Modbus.
15. With an external load controller at input X5, the integration time of the input signals is now established as a function of the ramp time.
    Examples:
    - For 30-second ramp time, ➔ load increase of approx. 0.6% per cycle
    - For 60-second ramp time ➔ load increase of approx. 0.3% per cycle
16. The minimum actuator step should also apply when operating the Modbus and eBus remotely in order to protect the actuators, refer to chapter *Settling of the manipulated variable*

17. Quick shutdown in multistage operation with a variable speed drive is only still performed if speed deviations are actually present that are above the parameterized threshold *TolQuickShutdown*.
18. Gas with flue gas recirculation function (FGR), oil without flue gas recirculation: When switching over to oil, it must be ensured that the flue gas recirculation actuator has been/is closed.
19. Correcting the problem:
    When the air rate is adjusted, the message *Ramp time too fast "actuator name*" may appear.
20. Extension of the setting range for the valve proving test times (phases 81 and 83) from 63 seconds to 63 minutes.

Only LMV51.1 (with integrated load controller)**:**
At analog output X63 of the load controller, other values apart from the load can be delivered (as was previously only possible for the LMV52), refer to chapter *Analog output X63*

22.2.1.11 Basic unit LMV51.3, Software from V04.80 to V05.10

With the 2012/2013 release upgrade for the LMV5, the assignment of the software functions to the LMV5 variants has been rearranged, meaning that the release upgrade includes functions from the LMV52 as well as completely new functions:
The LMV51.3 contains all the new functions that the LMV51.1 variant has, refer to previous section for description.

The LMV51.3 also has the following new function:
Additional air pressure switch for VSD application (X4-01 pin 3), refer to chapter *Fan contactor contact / flue gas recirculation pressure switch*

22.2.1.12 Basic unit LMV50, relaunch with V10.20 software

With the 2012/2013 release upgrade for the LMV5, a new LMV50 variant for industrial applications (EN 746-2) has been introduced.

The LMV50 has the same hardware and software functions as the LMV51.3 variant but also has the following additional functions:

1. Separate flame supervision with 2 flame detectors, refer to chapter *Separate flame supervision*
2. High-temperature supervision via an external safety limit thermostat, refer to chapter *High temperature supervision*
3. Repetition in the event of *No flame at the end of first safety time*, up to 2 repetitions for gas and oil, refer to chapter *Repetition counter*
4. Continuous pilot
   For fuel trains using a pilot, the pilot valve is activated in phases 52…62, refer to chapter *Continuous pilot*
5. Cooling function in standby mode, can be activated / deactivated at input X5-03 pin 3.
   - The fan is switched on and monitored as for *continuous fan*.
   - The actuators used for determining the amount of air are driven to the postpurge positions, refer to *Cooling function in standby mode*
6. Maximum safety time gas and maximum safety time oil (for the first safety time and second safety time) increased to 10 seconds, see section *Parameter list*.
7. Flame supervision via external, safety-related flame safeguard, refer to chapter *External flame supervision*
8. Long postpurge time (tn3) up to 65,535 minutes can be set, refer to chapter *Long postpurge time*

22.2.1.13 Basic unit LMV52.2, Software from V04.80 to V05.10

With the 2012/2013 release upgrade for the LMV5, the LMV52.2 now includes all the same functions as the LMV51.0, LMV51.1, and LMV51.3 variants, refer to previous sections for description.

Additionally, the LMV52.2 contains the following new functions:

1. Flame supervision via an external, safety-related flame safeguard, refer to chapter *External flame supervision*
2. Continuous pilot
   For fuel trains using a pilot, the pilot valve is activated in phases 52…62, refer to chapter *Continuous pilot*
3. A new calculation process is available for O2 precontrol.
   The *Type ofAirChange* parameter was enhanced to include the *LambdaFact1* setting option, refer to chapter *Calculation of precontrol*
4. When setting the electronic ratio control, the minimum intervals accepted by the LMV52 have been reduced as follows:
   Interval between O2 ratio control value and O2 setpoint: from 1% to 0.1%
   Interval between O2 setpoint and O2 minimum value: from 0.5% to 0.1%
   refer to chapter *Setting fuel-air ratio control*
5. In the *operating mode* of the O2 controller *(conAutoDeac)* and when the O2 minimum value switch is triggered, the LMV5 initially moves along the ratio control curves.
   The O2 minimum value alarm remains active even once O2 trim control has been deactivated, refer to chapter *Operating modes of O2 trim controller / O2 alarm*
6. There is no waiting time following mains failures, if the QGO20 cell temperature is higher than 690 °C at start-up, refer to chapter *Heating up the QGO20 sensor after power On*
7. O2 trim control behavior can be altered using the *O2TrimBehavior* parameter, refer to chapter *O2 trim control behavior*
8. Limitation of the O2 controller manipulated variable via new parameters *O2MinManVariable* and *O2MaxManVariable,* refer to chapter *Limiting the O2 trim controller manipulated variable with shutdown*
9. Activation / deactivation of O2 trim control via an external contact can be configured at input X5-03 pin 2 using parameter *Config X5-03,* refer to chapter *Deactivating O2 trim control via a contact*
10. The status of the O2 controller can be displayed via data point *State O2 Ctrl,* refer to chapter *Displaying the O2 trim controller status*
11. O2 maximum value alarm revised, for function and parameters refer to chapter *O2 alarm*
12. New service timer for O2 sensor available. This can be adjusted via parameter *O2SensServTim* and reset via parameter *O2SensServTimRes*, refer to chapter *Service timer for QGO20*
13. In order to calculate the combustion efficiency, the supply air temperature sensor can now be connected to input X60 of the load controller's temperature sensor, as well as to input X87 on the PLL52, which was already available, refer to chapter *Combustion efficiency*

22.2.1.14 Basic unit LMV52.4, Software from V10.00 to V10.20

With the 2012/2013 release upgrade for the LMV5, the LMV52.4 now includes all the same functions as the LMV51.0, LMV51.1, LMV51.3, and LMV52.2 variants, refer to previous sections for description.

Additionally, the LMV52.4 contains the following new functions:

1. Various new start options for the burner start were implemented specifically for burner heads with metal mesh for the operating mode *O2 controller*, which can be set via the parameter *Startmode*, refer to chapter *Burner start mode of the O2 trim control*
2. Long postpurge time (tn3) up to 65,535 minutes can be set, refer to chapter *Long postpurge time*

22.2.1.15 Basic unit LMV5, software from V05.10 to V05.20, 10.20 to V10.30

Expansion for SQM45 / SQM48 (release 2015) with parameters *Tolerancia pos.* for variable changing of the tolerance of the drives and VSD.

22.2.2 Changes to the load controller

22.2.2.1 Load controller, Software from V01.40 to V01.50

The software of the load controller has been changed from V01.40 to V01.50.

The following changes have been made:

- Auxiliary sensor for cold start thermal shock protection
- Straightforward changeover of operation to internal load controller

Using a potential-free contact at terminals X62 pin 1 and X62 pin 2, it is possible to switch from external load controllers to the internal load controller of the LMV51.100.

The following operating modes can be switched over:

Operating mode 4	→ 2	= Int LC X62	→ intLC
Operating mode 5	→ 2	= Ext LC X62	→ intLC
Operating mode 3	→ 2	= Int LC Bus	→ intLC
Operating mode 6	→ 2	= Ext LC Bus	→ intLC
Operating mode 1	→ 2	= ExtLC X5-03	→ intLC

With software version V01.50 or higher, Pt100 sensors in operating mode 6 are permitted

New load controller function for analog input for predefined load and load output

Manipulated variable input, modulating:

<3 mA	Line interruption	
4 mA	or 2 V	Low-fire (min. load)
20 mA	or 10 V	Nominal load (max. load)

Burner shutdown at <5 mA not used.

Load output, modulating:

<3 mA	Line interruption
4 mA	0% load
xx mA	Low-fire (min. load)
xx mA	Nominal load (max. load)
20 mA	100% load

Shutting the burner down = no impact on signal.

Manipulated variable input, multistage burner:

Stage 1:	5 mA	or 2.5 V
Stage 2:	10 mA	or 5 V
Stage 3:	15 mA	or 7.5 V

Switching thresholds at:

7.5 mA	and 12 mA	with 0.5 mA	hysteresis
3.75 V	and 6.25 V	with 0.25 V	hysteresis

Burner shutdown at <5 mA not used.
<3 mA: Line interruption

Load output, multistage:

Burner off:	4 mA
Stage 1:	5 mA
Stage 2:	10 mA
Stage 3:	15 mA

22.2.2.2 Load controller, Software from V01.50 to V01.60

The following changes have been introduced:

Plausibility check at inputs X61 and X62

The plausibility check at inputs X61 and X62 is not made anymore. This means that fast value changes at these inputs will no longer result in safety shutdown.

22.2.2.3 Load controller, Software from V01.60 to V01.80

1. Analog inputs 2 and 3 (X61, X62) were extended by the ranges DC 0…10 V and 0…20 mA.
2. Analog output was extended by the range 0…20 mA.
3. Now, the value presented at the analog output (e.g. load, temperatures, O2, etc.) can be selected.
4. Introduction of measuring range up to 850 °C (1562 °F) for Pt100, Pt1000 and Ni1000 temperature input.
5. Inputs 2 (X61) and 3 (X62) also with DC 0...10 V range.
6. Implementation of a variable temperature range.
7. The minimal step for burner output *Minimum actuator step* also becomes active for external load controllers.
8.

22.2.2.4 Load controller, Software from V01.80 to V02.10

1. Cold start *thermal shock protection.*
   The starting point for *thermal shock protection* was increased from 0% output to minimum output.
   At the end of *thermal shock protection,* the load controller is initiated with the current output.
   After *thermal shock protection, the LMV5* does not move to low-fire and not back up again.
2. Extra temperature sensor.
   At the end of the thermal shock protection program, the current temperature acquired by the Ni/Pt1000 sensor programmed as an extra sensor is now updated.
   The change only applies to the Ni/Pt1000 sensor, not to the Ni/Pt100 sensor.
   The temperature is displayed by the AZL52 / Modbus.
3. Change in connection with temperature-compensated flue gas recirculation (FGR).
   In the event of a fault in the Pt / Ni1000 sensor and the operating mode *Flue Gas Recirc.→ auto deact*, no lockout is initiated.

22.2.2.5 Load controller, software for 2012/2013 release upgrade

For the 2012/2013 release upgrade for the LMV5, the internal load controller's software was **not** changed, meaning that the **V02.10** version is still current.

22.2.3 Changes to the variable speed drive module (VSD module)

22.2.3.1 VSD module, Software from V01.30 to V01.40

1. Opening of the release contact during shutdown can be parameterized. This enables the VSD module to use a DC break.
2. Quick shutdown of the burner when speed deviation exceeds a certain level.

22.2.3.2 VSD module, Software from V01.40 to V01.50

1. Diagnostic data.
   To avoid error EC A9, DC 18 (*Page disrupted)*, statistics data are now only stored in standby and operation.
2. Offset at setpoint output.
   In some cases, the correction offset for the speed setpoint was not reset after a safety shutdown.
   This could lead to error messages. The new version eliminates this effect.
3. Internal tests.
   Internal system tests have been modified, allowing the VSD test initialized by the LMV5 to be dropped.
4. Quick shutdown.
   Now, quick shutdown of the VSD is also effected in programming mode.

22.2.3.3 VSD module, software for 2012/2013 release upgrade

For the 2012/2013 release upgrade for the LMV5, the internal VSD module's software was **not** changed, meaning that the **V01.50** version is still current.

22.2.4 Changes to the display and operating unit AZL52

22.2.4.1 Display and operating unit AZL5, Software from V2.20 to V02.50

In connection with the new type of LMV5 (LMV51.XXX**C**XXX), the type of AZL52.XX**A**XXX has been changed as well.
Hence, the types indicate the state of release and show the unit versions that work together.

Software changes to the flash memory

The software version of the flash memory has been changed from V02.20 to V02.50.

New designations of load controller inputs

For the load controller inputs 1 / 2 / 4 and the associated parameters, the following new names have been assigned:

Inp1/2/4Selection	→ Sensor selection
Inp1/4BerEnd	→ Measuring range PtNi
Inp2TempBerEnd	→ MRange TempSens
Ino2PressBerEnd	→ MRange PressSens
Inp3Config_I/U	→ Ext Inp X62 U/I
Inp3MinSetpoint	→ Ext MinSetpoint
Inp3MaxSetpoint	→ Ext MaxSetpoint

Fuel meter with reading in liters

A blank has been introduced between the value and the unit.

Preventing the transfer of parameter copies from new LMV5 to the backup memory of the AZL5

Copying is not possible and a message is delivered.

Parameter changes

The default settings of the following parameters have been changed:

Prepurging time oil:	15 s
Maximum time low-fire:	45 s
Postpurging position air (gas-firing):	15°
Postpurging position air (oil-firing):	15°
Postpurging position auxiliary actuator / variable speed drive (firing on gas):	25°
Postpurging position auxiliary actuator / variable speed drive (firing on oil):	25°
Load controller: *SD_Stage1On*:	-2%

Name changes of load controller operating modes

extLR	→ ExtLC X5-03
intLR	→ IntLC
intLR via BACS	→ IntLC Bus
intLR Building automation ON	→ IntLC X62
extLRanalg	→ ExtLC X62
extLR via BACS	→ ExtLC Bus

New display text for actuator faults

The AZL5 indicates a new fault carrying code 0x0E (too short ramp time):

Text message
- Too short ramp time, air actuator
- Too short ramp time, gas actuator
- Too short ramp time, oil actuator
- Too short ramp time, auxiliary actuator 1
- Too short ramp time, auxiliary actuator 2   only LMV52
- Too short ramp time, auxiliary actuator 3   only LMV52

22.2.4.2 Display and operating unit AZL52, Software from V04.00 to V04.10

1. The unintentional safety shutdown with error code 16 if the permissible position tolerances were not observed on reaching the low-fire position has been remedied. This effect occurred mainly in very flat or very steep curve sections between the ignition position and the low-fire position.
   With the LMV52, this effect was remedied from software version 01.20 and with the LMV51 from software version 02.50.
2. Monitoring of the microprocessor's power supply is now more tolerant.
3. Error code 1E, diagnostic code 10, after standardization of the VSD:
   This error code occurred with ramp times above 35 seconds. The problem has been eliminated.
4. Change of load controller mode 6 to 2: The output can now be changed.
5. VSD 0% with prepurging: Smallest adjustable value has been changed to 10% speed.
6. VSD correction with speed deviations has been changed.
7. Using the PC software, a parameter set can now be stored in a new LMV5
8. Modbus setpoint W3 (*writing after reset)* has been corrected.

22.2.4.3 Display and operating unit AZL52, Software from V04.10 to V04.20

1. Display of additional temperature for steam plants with thermal shock protection.
2. The system is now capable of handling imperial and metric units.
3. The Siemens AZL52 is supplied with English settings.
4. Modbus: The nonresettable fuel meters have been replaced by resettable ones.
   Following new parameters are now available:
   - Temperature acquired by the extra temperature sensor for overtemperature protection
   - Flame signal (LMV51) / flame signal channel A (LMV52)
   - Flame signal channel B (LMV52)

22.2.4.4 Display and operating unit AZL52, Software from V04.20 to V04.30

Introduction of Cyrillic character set.

22.2.4.5 Display and operating unit AZL52, Software from V04.30 to V04.50

1. Presentation of load controller's switching thresholds in absolute values.
   But the setting values are still relative values.
2. *ABmaxLoadMod* is now limited by *MinLoad* and *MaxLoad*.
3. Correction of Italian translation.
4. Transmission of pressure values via eBus has been corrected.
5. Access level of activation parameter for the flame detector test has been changed to **AB**.
6. Introduction of parameter *StartPoint Op*.

22.2.4.6 Display and operating unit AZL52, Software from V04.50 to V04.60

Effect of *Error message 3163 in communication with ACS450* has been rectified.

22.2.4.7 Display and operating unit AZL52, Software from V04.60 to V04.80

1. Changes in connection with the new LMV5 version LMV52.4

   General
   In connection with the new LMV52.4, only the new AZL52 with software version V04.80 can be used.
   This AZL52 can also be used with all other types of LMV5.
   Due to the new parameters, the initially reserved storage space in the AZL52 has been exceeded → this has been rectified; for this reason, specific product nos. (ASN) had to be introduced for the LMV52.4.

   - Change to function *Modulating curve parameterization.*
     The temperature currently acquired by the flue gas recirculation (FGR) sensor is displayed if the flue gas recirculation (FGR) function is activated and auxiliary actuator 3 has been selected for making the setting
   - New function: Reading and display of stored curves of the flue gas recirculation (FGR) temperatures *OperationTempGas* and *OperationTempOil*
   - New function: Reading and display of temperature currently acquired by the flue gas recirculation sensor, provided the AZL5 operates in interface mode. This is provided because the value is not displayed by the PC software ACS450
   - New function: Support of the new flue gas recirculation (FGR) parameters
   - Compatibility: The new AZL52 accepts backup data from older software versions – both AZL52 and ACS450 backups
   - Name changes: For settings for the operating mode *Flue Gas Recirc.*
     To avoid misunderstanding, 2 names have been changed:
     1. *deactivated* in *Aux3onCurve*
        Explanation:
        When this operating mode is selected, the flue gas recirculation (FGR) function is deactivated, auxiliary actuator 3 is used as the standard actuator and is driven to the ratio control curve. This means that if, on this application, auxiliary actuator 3 was used as a flue gas feedback actuator, flue gas would be recirculated.
     2. *Hilf3 Minpos* in *deactMinpos*
        Explanation:
        Since the word *deact* was replaced by *Aux3onCurve* (see 1.), the word *deact* is added here. This denotes that auxiliary actuator 3 is driven to the minimum position so that no flue gas is recirculated – or only very small amounts.
2. Further change.
   New function: The cold start thermal shock ON and OFF values are now also displayed as absolute values – in addition to the relative values.

22.2.4.8 Display and operating unit AZL52, Software from V04.80 to V05.00

For the 2012/2013 release upgrade for the LMV5, the software of the AZL52 has been changed as follows:

1. 3 new languages for the AZL52.09 (Cyrillic):
   Bulgarian, Romanian, and Turkish
2. Improved display of cold start thermal shock protection:
   The display no longer alternates between *Coldstart is activated* and *Warning,* instead of *Warning,* a display showing, for example, the actual values (temperature / pressure) appears.
3. During interface mode, the actual values for pressure or temperature, and flue gas recirculation temperature are now displayed.
4. A message appears when speed standardization is started and the safety loop is open.
5. Display of the raw flame signals even for LMV50 and LMV51.
6. The combustion efficiency is transmitted via Modbus or eBus as the value **0**, if a valid value cannot be calculated.
7. Support of functions for the new LMV50 variant for industrial burners.
8. The new functions of the LMV52.4 variant for burner heads with metal mesh are supported.
9. The absolute values of the *SD_ModOn* and *SD_ModOff* activation / deactivation values for the load controller with the units *°F / PSI* are now displayed correctly.
10. Display text 1 for the LMV5 AZL5 update function
    The text displayed on the AZL52 when parameters are being uploaded from the LMV5 to the AZL5 has been changed from *Backup is made,* when the backup is in progress, to *Backup is being made,* in order to avoid misunderstandings.
11. Display text 2 for the LMV5 AZL5 update function
    The text displayed on the AZL5 when parameters are being downloaded from the AZL5 to the LMV5 has been changed from *Backup restore is carried out,* when the backup is in progress, to *Backup restore is being carried out,* in order to avoid misunderstandings.
12. Display text corrected for the O2 trim control delay time, *Delay Time…* is now shown instead of *Dela Time…*.
13. Italian display text for backup corrected from *eseguio* (incorrect) in *eseguito*.
14. Designation for *O2 guard (O2 limiter, O2 monitor*) changed to *O2 alarm* for English.
15. All new and advanced parameters are supported.
16. From software version V05.00 of the AZL52, the restoring of backup data from LMV5 devices with a larger scope of functions and with more parameters into LMV5 devices with a smaller scope of functions and fewer parameters is prevented.

    Backup files from a LMV50 can only be restored again into a LMV50.

    Example:
    - Backup file from LMV52 cannot be restored into a LMV51.
    - Backup file from a LMV51 can be restored into a LMV52.

22.2.4.9 Display unit and operating unit AZL52, software from V05.00 to V05.10

1. The AZL52 normal operation indicator is switched between the internal and external setpoint depending on the switch position X62.
2. For parameters *SD_ModOn* and *SD_ModOff,* larger values are permitted for the switch-off hysteresis.
3. Parameter name corrections *Dutch 1*.
4. Parameter name corrections *Dutch 2*.
5. Parameter name corrections *French*.
6. Additional display value *Fahrenheit* / *Temperature*, is calculated correctly / displayed for the load controller from V02.20.
7. The maximum value of the safety times can be changed on the OEM access level.
8. New parameter *Tolerancia pos.* for variable tolerance specification of the actuators and the VSD.
9. Parameter name correction *German Handbetrieb* replaced with *Manueller Betrieb*

Parameter name	Selection	Comment
Type of Gateway	eBus / Modbus / Data output	New setting
Gateway Status	Display the Gateway Status	New process data
Autom/Manual/Off	Automatic / Manual / Burner off	New marking (old: Hand or Burner ON)
Local / Remote		New German marking (old: Local)
PostpurgeT3long		New parameter
ContinuousPurge	deactivated / activated / off Sloop / deac/VSD-SL	New setting
DriveLowfire Gas	LowfireP50 / LowfireP54	New parameter
DriveLowfire Oil	LowfireP50 / LowfireP55	New parameter
StartReleaseOil	deactivated / activated / HT/FG-RedCo	New setting
AirPressureTest	deactivated / activated / deactInStby	New setting
FGR-PS/FCC	FCC / FGR-PS / deactivated / PSdeactStby / PS VSD	New setting
RotSpeed PS on	RotSpeed PS off..100%	New parameter
RotSpeed PS off	10%..RotSpeed PS on	New parameter
Config X5-03	LMV5x std / LMV2/3 std / LMV2/3 inv / *DeaO2/Stp36* / CoolFctStby / AutoDeactO2	New parameter
HeavyOilDirStart	deactivated / activ 38/44 / 38/44..62 / act 21..62 / HTempGuard / ext.FlameGd	New settings
ReacTmeLossFlame		New parameter
NoFlame_ts		New parameter for LMV50
O2 Alarm		New English marking
Time O2 Alarm		New parameter
NumMinUntilDeact		New parameter
Type O2 MaxValue	O2MaxValue / O2MaxCurve	New parameter
O2 MaxValue		New parameter
O2ModOffset		New marking (old: O2Offset)
O2TrimBehavior	ForcdAirAdd / ForcdAirRed / symmetric	New parameter
Type Air Change	LambdaFact1	New setting
O2MaxManVariable		New parameter
O2MinManVariable		New parameter
Startmode	standard / Ign Load TC / IgnPtWithTC / IgnPtWoutTC	New parameter
Load of Ignition		New parameter
O2InitOffset		New parameter
NumberTauSuspend		New parameter
Adjust. Temp O2		New parameter
State O2 Ctrl	deactivated / locked / LockTStart / InitContr / LockTLoad / active / LockTCAct / LockCOx	New process data
O2SensServTim		New parameter
O2SensServTimRes		New parameter
Remote Mode	Automatic / Manual / Burner off	New marking (old: Burner ON)
AirTempX60PT1000	deactivated / activated	New parameter
Calc PI again	deactivated / activated	New parameter

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