SIEMENS

7153


# Oil Burner Controls LAL...

**Oil burner controls**

- **For oil atomizing burners of medium to large capacity**
- **For multistage or modulating burners in intermittent operation**
- **With or without air pressure supervision for checked air damper control**
- **Flame supervision**
  - **– with photoresistive detector QRB**
  - **– or blue-flame detector QRC1**
  - **– or photocell detector RAR9**

**The LAL and this Data Sheet are intended for OEMs which integrate the oil burner controls in their products!**

## Use

- For the control and supervision of oil atomization burners
- For burners of medium to high capacity
- For intermittent operation (at least one controlled shutdown every 24 hours)
- Can be universally used with multistage or modulating burners
- Suited for use with stationary air heaters (WLE)

Flame supervision is ensured by means of photoresistive detector QRB, blue flame detector QRC1, or photocell detector RAR9.

| | |
|---|---|
| LAL1 | - Yellow- and blue-flame burners without air pressure supervision |
| LAL2 | - Yellow-flame burners with air pressure supervision |
| LAL3.25 | - For special applications, e.g. burners of incinerator plant (for details, refer to «Type summary» and «Notes») |

## Supplementary documentation

| Product type | Type of documentation | Documentation number |
|---|---|---|
| LOK16 (For burner controls used in connection with burners for continuous operation) | Data Sheet | N7785 |

## Warning notes

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

**Do not open, interfere with or modify the unit!**

- All activities (mounting, installation and service work, etc.) must be performed by qualified staff
- Before making any wiring changes in the connection area, 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 hazard
- Ensure protection against electric shock hazard by providing adequate protection for the burner control's connection terminals
- Each time work has been carried out (mounting, installation, service work, etc.), check to ensure that wiring is in an orderly state and make the safety checks as described in «Commissioning notes»
- Press the lockout reset button only manually (applying a force of no more than 10 N), without using any tools or pointed objects
- Do not press the lockout reset button on the unit or the remote reset button (input 21) for more than 10 seconds since this will damage the lockout relay in the unit
- 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
- For safety reasons – self-test of the flame supervision circuit, etc. – at least one controlled shutdown must take place every 24 hours

## Mounting notes

- Ensure that the relevant safety regulations are complied with
- Connect the earthing lug inside the terminal base to burner ground using a screw with a lockwasher

Note!
In applications involving air heaters (WLE), or in the case of oil burners with a maximum throughput of >30 kW/h, removing wire link **B** is not permitted.

## Installation notes

- Always run high-voltage ignition cables separately, with the greatest possible distance to the unit and to other cables
- Live and neutral conductors must not be mixed up
- Install switches, fuses, earthing, etc., in compliance with local regulations
- Make certain that the maximum permissible current rating of the connection terminals will not be exceeded
- The insulation on internal wiring which is subjected to the mains voltage must withstand the electrical stress occurring during correct use

## Electrical connection of the flame detector

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

- Never run the detector cable together with other cables
  – Line capacitance reduces the magnitude of the flame signal
  – Use a separate cable
- Observe the permissible cable lengths (refer to «Technical data»)

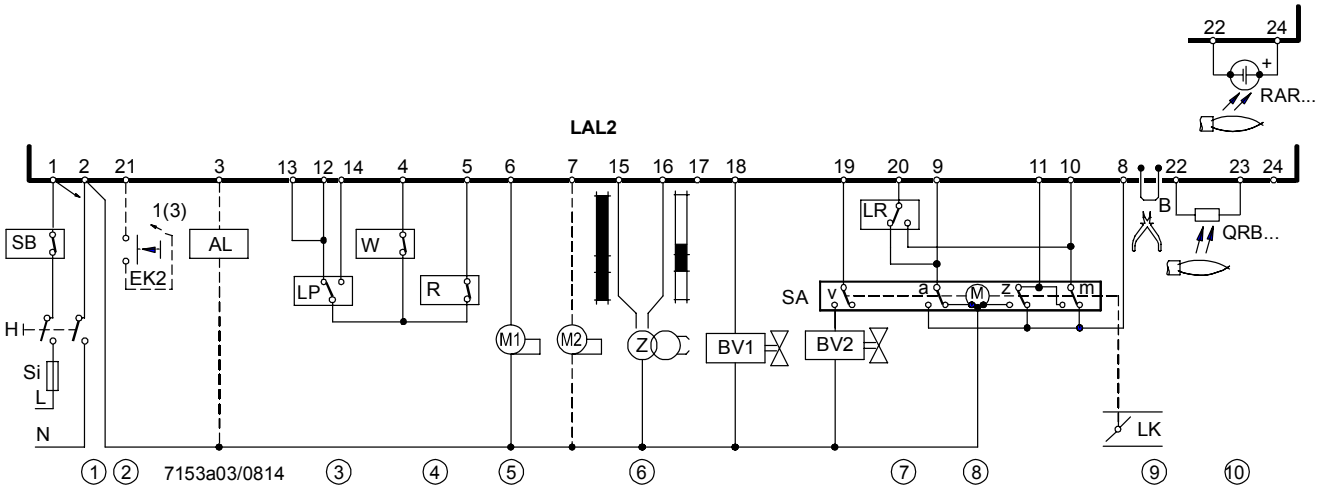
## Commissioning notes

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

| | Safety check to be carried out | Anticipated response |
|---|---|---|
| a) | Burner startup with flame detector darkened | Lockout at the end of safety time (TSA) |
| b) | Burner startup with flame detector exposed to extraneous light | Lockout after 40 seconds at the latest |
| c) | With wire strap «B»:<br>Simulation of loss of flame during operation. For that purpose, darken the flame detector during operation and maintain that state | Lockout |
| d) | Without wire strap «B»:<br>Simulation of loss of flame during operation. For that purpose, darken the flame detector during operation and maintain that state | Repetition followed by lockout at the end of «TSA» |
| e) | Burner startup with response of air pressure switch | Prevention of startup/lockout during prepurge time |
| f) | Burner operation with simulated air pressure failure | Immediate lockout |

## Engineering notes

- Install switches, fuses, earthing, etc., in compliance with local regulations
- Connect valves and other plant components as specified in the burner manufacturer's documentation



**Engineering notes** (cont'd)

| | |
|---|---|
| ① | Connect safety limit thermostats (manual reset) in the line (e.g. «SB») |
| ② | Remote reset<br>When connecting lockout reset button «EK2» between terminals 21 and<br>- terminal 3: For remote reset only<br>- terminal 1: For remote reset and remote emergency shutdown |
| ③ | With LAL1…: Required switching capacity of<br>- switching devices connected between terminals 4 and 5 (refer to «Technical data») |
| | With LAL2 / LAL3: Required switching capacity of<br>- switching devices connected between terminal 12 and «LP» (refer to «Technical data»)<br>- «LP» (refer to «Technical data») |
| ④ | When using series connection, the control contacts of other devices contained in the burner plant must be connected as follows: |
| | - to terminal 4 or 5 → contacts that must be closed from startup to controlled shutdown → otherwise no startup or shutdown |
| | - to terminal 12 (not with LAL1) → contacts that must only be closed on startup → otherwise no startup |
| | - to terminal 14 (not with LAL1) → contacts that must be closed no later than at the beginning of short preignition or long preignition and that must remain closed until controlled shutdown occurs → otherwise lockout |
| ⑤ | Maximum current draw, refer to «Technical data» |
| ⑥ | «Z» connected to terminal 15 → short and long preignition |
| | ☞ For use in applications with short preignition, the oil supply must be equipped with two shutoff valves connected in series.<br><br>Observe the following:<br>EN 298:2012, Section 7.101.3.3 *Prepurge time for oil burner control systems and the corresponding application standards*. |
| ⑦ | Connection of «BVx» to terminal 20, refer to «Connection examples» |
| ⑧ | When using burners without air damper, or with an air damper not controlled and monitored by the LAL…, terminal 8 must be connected to terminal 6 |
| ⑨ | Wire link «B» clearly marked on the underside of the LAL…<br>When wire link «B» is fitted, the LAL initiates lockout if loss of flame occurs during operation. For repetition of the startup sequence, wire link «B» on the plug-in section of the LAL must be cut away. Just cutting is not permitted! |
| | ☞ Note!<br>In applications involving air heaters (WLE), or in the case of oil burners with a maximum throughput of >30 kW/h, removing wire link **B** is not permitted. |
| ⑩ | For the permissible lengths and laying of detector cables, refer to «Flame supervision» |

## Standards and certificates

**Applied directives:**

- Low-voltage directive 2014/35/EC
- Directive for pressure devices 2014/68/EC
- Electromagnetic compatibility EMC (immunity) *) 2014/30/EC

*) The compliance with EMC emission requirements must be checked after the burner control 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
- 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 LAL and the AGM 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

**Certified with plug-in base and flame detector:**

| Type | | | | | | Only with QRB | |
|---|---|---|---|---|---|---|---|
| LAL1.25 | ● | ● | ● | ● | ● | --- | --- |
| LAL2.14 | ● | ● | ● | ● | ● | ● | --- |
| LAL2.25 | ● | ● | ● | ● | ● | ● | ● |
| LAL2.65 | ● | ● | ● | ● | ● | ● | --- |
| LAL3.25 | ● | ● | ● | --- | ● | ● | ● |

## Life cycle

Burner controls LAL 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 lifetime is based on the endurance tests in the standard 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 controls according to the manufacturer's Data Sheet. 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

## Disposal notes

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

## Mechanical design

LAL

- Plug-in design
- Exchangeable unit fuse (including spare fuse)

LAL3.25

Difference to LAL1 / LAL2:

- Extraneous light does not initiate lockout, during burner off times or during the prepurge time
- Extraneous light prevents burner startup

Housing

- Made of impact-proof and heat-resistance black plastic
- Lockout reset button with viewing window; located behind it:
  – Lockout warning lamp
  – Lockout indicator
    - coupled to the spindle of the sequence switch
    - visible in the transparent lockout reset button
    - uses easy-to-remember symbols to indicate the type of fault and the point in time lockout occurred

## Type summary

The type references given below apply to the LAL without plug-in base and without flame detector. For ordering information for plug-in bases and other accessories, see *Accessories*.
Switching times are given in the order of the startup sequence, valid for 50 Hz mains frequency. At 60 Hz frequency, switching times are about 17 % shorter.
**The type references apply to burner controls operating on AC 230 V, 50...60 Hz.**

| Article no. | Type | Flame supervision with ... | | | Air pressure supervision | Semi-automatic startup | No lockout | Start prevention in extraneous light | Flash steam generators | Universal use | Medium- or heavy-oil burners | Times in seconds | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | QRB | QRC | RAR9 | | | | | | | | t1 | TSA | t3 | t3‘ | t3n | t4 | t5 | t6 | t7 | t8 | t10 | t11 | t12 | t13 | t16 | t20 |
| BPZ:LAL1.25 | LAL1.25 [3] | ● | ● | | | | | | | ● | | 22,5 | 5 | 2,5 | From the start [1] | 15 | 7,5 | 7,5 | 15 | 2,5 | 47 | 10 [2] | Optional | Optional | 15 | 5 | 35 |
| BPZ:LAL2.14 | LAL2.14 | ● | | ● | ● | ● | | | ● | | | 10 | 4 | 2 | From the start [1] | 10 | 8 | 4 | 10 | 2 | 30 | 6 | Optional | Optional | 10 | 4 | 32 |
| BPZ:LAL2.25 | LAL2.25 [3] | ● | | ● | ● | ● | | | | ● | | 22,5 | 5 | 2,5 | From the start [1] | 15 | 7,5 | 7,5 | 15 | 2,5 | 47 | 10 [2] | Optional | Optional | 15 | 5 | 35 |
| BPZ:LAL2.65 | LAL2.65 [3] | ● | | ● | ● | ● | | | | | ● | 66,5 | 5 | 2,5 | From the start [1] | 15 | 7,5 | 7,5 | 15 | 2,5 | 91 | 10 | Optional | Optional | 15 | 5 | 12,5 |
| BPZ:LAL3.25 | LAL3.25 [3][4] | ● | | ● | ● | ● | ● | ● | | ● | | 22,5 | 5 | 2,5 | From the start [1] | 15 | 7,5 | 7,5 | 15 | 2,5 | 47 | 10 [2] | Optional | Optional | 15 | 5 | 35 |

[1]) With air pressure supervision: From the time the air pressure signal is received
[2]) Does not apply to LAL1
[3]) Available as AC 100...110 V versions; add type suffix «– 110 V» when ordering. Flame supervision only with QRB or RAR
[4]) Special applications such as incinerator plants

**Legend of times**

TSA Ignition safety time
t1 Prepurge time with air damper open
t3 Preignition time, short (ignition (Z) to terminal 16)
t3‘ Preignition time, long (ignition (Z) to terminal 15)
t3n Postignition time (ignition (Z) to terminal 15)
t4 Interval between voltage at terminals 18 and 19 (fuel valve 1 (BV1) - fuel valve 2 (BV2))
t5 Interval between power at terminals 19 and 20 (fuel valve 2 (BV2) - load controller)
t6 Postpurge time (with fan motor «M2»)
t7 Interval between start command and power at terminal 7 (start delay for fan motor «M2»)
t8 Duration of startup sequence (without running time «t11» and running time «t12»)
t10 Only with LAL2 / LAL3: Interval from start to the beginning of the air pressure check
t11 Air damper running time to the OPEN position
t12 Air damper running time to the low-fire position MIN
t13 Permissible afterburn time
t16 Interval until OPEN command for the air damper is given
t20 Not with all LAL: Interval to the self-shutdown of the sequence switch after startup

**Accessories** (to be ordered separately)

| | | |
|---|---|---|
| Flame detectors | Photoresistive detectors **QRB**<br>See Data Sheet N7714 |  |
| | Blue-flame detectors **QRC1**<br>See Data Sheet N7716 | Frontal illumination:<br>  <br>Lateral illumination:<br>  |
| | Photocell detector **RAR9**<br>See Data Sheet N7713 |  |
| **Actuators** | Actuator **SQN3**<br>See Data Sheet N7808 |  |
| Accessories for medium-capacity burner controls | Plug-in base **AGM410490500**<br>Article no.: **BPZ:AGM410490500**<br>• With Pg11 thread for cable entry glands<br>• See Data Sheet N7230<br><br>Plug-in base **AGM13.1**<br>Article no.: **BPZ:AGM13.1**<br>• With M16 thread for cable entry glands<br>• See Data Sheet N7230 |  |
| **Others** | Coaxial cable **RG62**<br>Supplied by customer. |  |

## Technical data

| | | |
|---|---|---|
| General unit data LAL | Mains voltage | AC 230 V –15 / +10 % |
| | • With LAL1 / LAL2 / LAL3 | AC 100 V –15 %...AC 110 V +10 % |
| | Mains frequency | 50...60 Hz ±6 % |
| | Unit fuse (built-in) | T6.3H250V to DIN EN 60127 |
| | Primary fuse (external) | Max. 10 A (slow) |
| | Weight | Approx. 1,000 g |
| | Power consumption | Approx. AC 3.5 VA |
| | Mounting position | Optional |
| | Degree of protection | IP40, when fitted, with the exception of the connection area (terminal base) |
| | Safety class | II |
| | Perm. input current at terminal 1 | Max. 5 A continuously<br>(peaks of 20 A / 20 ms) |
| | Perm. current rating of control terminals 3, 6, 7, 9...11 and 15...20 | Max. 4 A continuously<br>(peaks of 20 A / 20 ms) |
| | Required switching capacity of switching devices | |
| | • Between terminals 4 and 5 | 1 A, AC 250 V |
| | • Between terminals 4 and 12 | 1 A, AC 250 V |
| | • Between terminals 12 and «LP» | 1 A, AC 250 V |
| | • Between terminals 4 and 14 | 5 A (peaks of 20 A) |
| | • «LP» | 5 A |
| | Permissible length of the standard detector cable (laid separately) | See *Technical data*, section *Flame supervision* |
| | Capacity | |
| | • Starting output (without fan) | Optional (with ignition < 120 kW) |
| | • Nominal output | Optional |
| Environmental conditions | **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 | -40...+60 °C |
| | Humidity | <95 % r.h. |
| | **Operation** | DIN EN 60721-3-3 |
| | Climatic conditions | Class 3K5 |
| | Mechanical conditions | Class 3M2 |
| | Temperature range | -20...+60 °C |
| | Humidity | <95 % r.h. |
| | Installation altitude | Max. 2,000 m above sea level |

**Warning!**
**Condensation, formation of ice and ingress of water are not permitted!**
**If this is not observed, there is a risk of loss of safety functions and a risk of electric shock.**

## **Technical data** (cont´d)

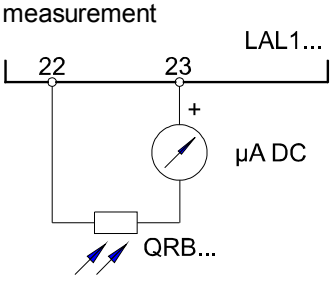
Flame supervision

| | **LAL1 with** | | **LAL2 * / LAL3 * with** | |
|---|---|---|---|---|
| | QRB | QRC1 | QRB | RAR9 |
| Min. detector current required at AC 230 V | 95 µA | 80 µA | 8 µA | 6,5 µA |
| Max. permissible detector current with no flame | 12 µA | 12 µA | 0.8 µA | 0.7 µA |
| Max. detector current that can occur | 160 µA | 130 µA | 35 µA | 45 µA |
| Instrument's +pole | To terminal 23 | To terminal 23 | To terminal 22 | To terminal 22 |
| | | | | |
| Length of detector cable | | | | |
| In the same cable as the control lines | Max. 30 m | --- | Not permitted | --- |
| Separate cable in cable duct | Max. 1000 m | --- | 20 m | 30 m |
| 3-core cable | --- | Max. 1 m | --- | --- |
| 2-core cable for the detector line (bl, sw); separate single-core cable for the live conductor (br) | --- | Max. 20 m | --- | --- |
| Shielded cable (e.g. RG62, shield insulated) | --- | --- | 200 m | RAR9: 100 m |
| Shield | --- | --- | To terminal 23 | --- |

* To comply with requirement of EN 298 clause 8.5 «Surge immunity test», for cable lengths above 10 m appropriate filter elements would have to be used. Experience has shown that filters are sometimes not necessary for normal operation even for cable lengths above 10 m.

## **Detector current measurement**

Measuring circuit for detector current measurement

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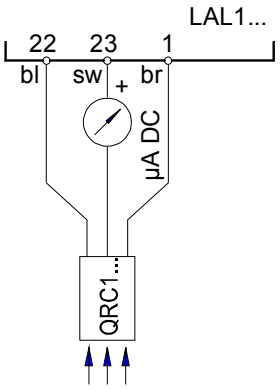


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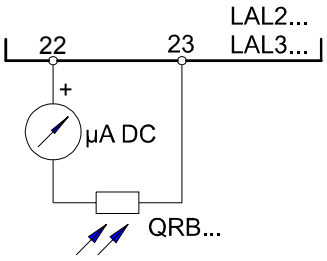


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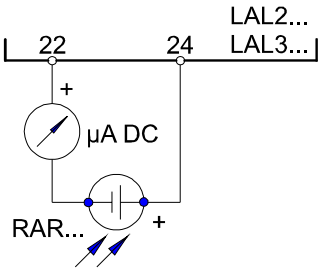


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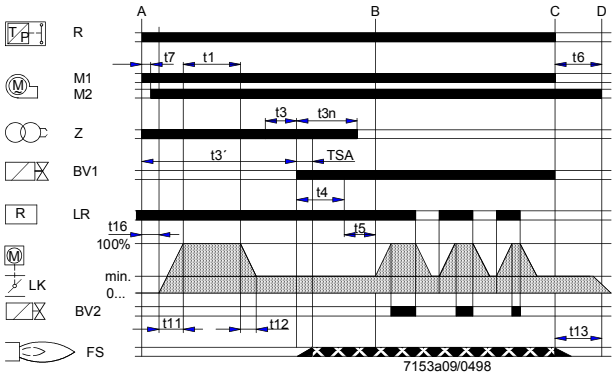
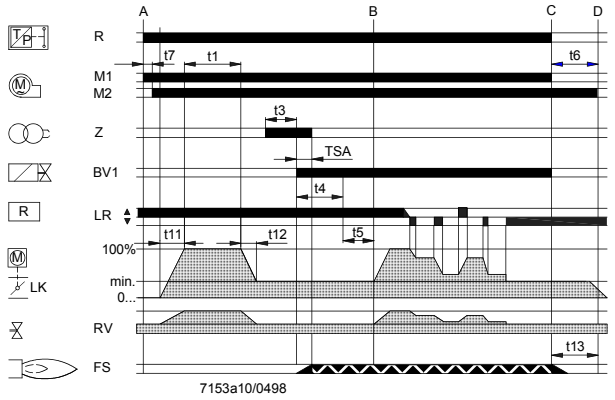
## Function

2-stage expanding flame burner




Modulating expanding flame burner




Legend

| | |
|---|---|
| BV... | Fuel valve |
| FS | Flame signal amplifier |
| LK | Air damper |
| LR | Load controller |
| M... | Fan or burner motor |
| R | Control thermostat or pressurestat |
| RV | Modulating fuel valve |
| Z | Ignition transformer |
| | |
| A | Start command by «R» |
| B | Operating position of burner |
| B-C | Burner operation |
| C | Controlled shutdown |
| C-D | Sequence switch travels to start position «A», postpurging |
| D-A | End of control sequence |
| | |
| t1 | Prepurge time with air damper open |
| t3 | Preignition time |
| t4 | Interval fuel valve 1 (BV1) - fuel valve 2 (BV2) or fuel valve 1 (BV1) - load controller (LR) |
| t5 | Interval between voltage at terminal 19 and terminal 20 |
| t6 | Postpurge time |
| t7 | Interval between start command and power at terminal 7 |
| t11 | Air damper running time to the OPEN position |
| t12 | Air damper running time to the low-fire position |
| t13 | Permissible afterburn time |
| TSA | Ignition safety time |

General

The following features of the LAL afford a high level of safety:

- Detector and flame simulation test are restarted on completion of the afterburn time «t13». Open or not fully closed fuel valves immediately initiate lockout at the end of afterburn time «t13». The test ends on completion of the prepurge time «t1» of the next startup sequence
- The correct functioning of the flame supervision circuit is automatically checked during each burner startup sequence
- The control contacts for the release of fuel are checked to ensure they have not welded postpurge time «t6»
- A built-in unit fuse protects the control contacts against overloads

**Function** (cont´d)

Control of the burner

- Burner operation with or without postpurge
- Fan motors with a current draw of up to 4 A can be connected directly → starting current max. 20 A (for max. 20 ms)
- Separate control outputs for
  – preignition from start command
  – postignition until shortly before the burner startup sequence is completed
  – short preignition with postignition up to the end of «TSA»
- Separate control outputs for the actuator's positioning directions «OPEN», «CLOSE» and «MIN»
- Checked air damper operation to ensure prepurging with the nominal air volume
- Checked positions:
  - «CLOSED» or «MIN» on startup → low-fire position
  - «OPEN» at the beginning of prepurging
  - «MIN» on completion of prepurging
  If the actuator does not drive the air damper to the required position, the burner startup sequence will be stopped
- 2 control outputs for the release of the second and third output stage or for load control
- When load control is enabled, the control outputs for the actuator will be galvanically separated from the burner control's control section
- Connection facilities for
  – remote lockout warning device
  – remote reset
  – remote emergency shutdown
- In addition, with LAL2 / LAL3:
  – possibility of air pressure supervision with functional test of the air pressure monitor on startup
  – possibility of semiautomatic burner startup

Flame supervision

- Flame detector and flame simulation test are made automatically during burner off times and the prepurge time «t1»
- If loss of flame occurs during operation, the burner control will initiate lockout
- If automatic repetition of the startup sequence is required, the clearly marked wire link on the plug-in section of the LAL must be cut away → start repetition

Preconditions for burner startup

- Burner control is not in the lockout position
- Sequence switch is in its start position
  → with LAL1, voltage is present at terminals 4 and 11
  → with LAL2 / LAL3, voltage is present at terminals 11 and 12
- Air damper is closed
- End switch «z» for the «CLOSED» position must feed power from terminal 11 to terminal 8
- Contact of the limit thermostat or pressure switch «W» and the contacts of any other switching devices in the control loop between terminals 4 and 5 must be closed → e.g. a control contact for the oil preheaters temperature

*With the exception of LAL1* Normally closed contact of the air pressure switch must be closed → «LP» test.