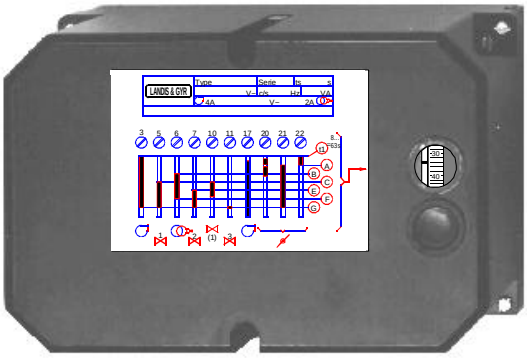
ISO 9001

Oil Burner Controls

LAE1

Series 02

Supplementary data sheet 7713



Oil burner controls for use with burners of any capacity in intermittent operation. For safety reasons, at least one controlled shutdown must take place every 24 hours!

The LAE1 are tested and certified to EN 230.

The LAE1 and this data sheet are intended for use by OEMs which integrate the burner controls in their products!

Use

The LAE1 in conjunction with the flame detector RAR7 or RAR8 is used for the fully automatic startup and supervision of

– single-stage forced draught burners
– multi-stage forced draught burners
– modulating forced draught burners
– of any oil throughput

Design, control sequence and setting choices of the LAE1 allow the burner control to be used in almost any type and size of oil-fired combustion plant.

Warning notes

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

To ensure protection against electric shock:

- Completely isolate the unit from the mains supply before opening it and before performing any wiring changes in the connection area of the LAE1!
- The LAE1 may only be opened by authorized staff!
- Damaged or faulty units may not be put into operation!

To eliminate the risk of an explosion:

- Check wiring and all safety functions when first commissioning the unit and after any service or maintenance work has been carried out!
- Factory settings may only be changed by authorized staff!

Mounting notes

- Observe the relevant national safety regulations!
- Mount and adjust the flame detector such that it only detects the flame to be supervised!

Installation notes

- Installation and commissioning work may only be carried out by qualified staff!
- Observe the permissible length and shielding of the detector cables!
  → Refer to «Technical data»
- For the connection of valves and other components, refer to the plant diagram and the mounting and commissioning instructions supplied by the burner manufacturer!
- Always run the ignition cable separate from the unit and other cables while observing the greatest possible distance!
- Do not interchange live and neutral wires!
- In the event of flame failure during operation, the burner control will initiate lockout!
  If start repetition is required, the clearly marked wire link «B» on the burner control's plug-in section must be cut away!
  → Just cutting the wire is not permitted!

Mechanical design

LAE1

– For mounting on the burner, in control panels or on panel fronts
– Housing and plug-in base made of impact-proof and heavily inflammable plastic
– Plug-in design, secured to the base with four screws
– Large wiring compartment in the plug-in base
– Unit fuse to protect the control contacts from overloads
– Robust printed circuit board with
  - sequence switch driven by a synchronous motor
  - auxiliary relay
  - electronic detector current amplifier
  - switching, control and setting elements

Specific features

– Pre-purge time adjustable between 8 and 63 s
– Operation with or without post-purging (optional)
– Fully automatic control of air damper possible
  → With any actuator running time
– Possibility of air check, in connection with the functional check of the air pressure monitor prior to startup
– Ignition (optional):
  Direct ignition or pilot burner
– Pre-ignition time adjustable:
  «Long» - during pre-purging
  «Short» - 3 s
– Safety time adjustable between 0 and 9 s
– Operation without or with one-time start repetition in the event of flame failure during operation
– Automatic extraneous light test in the burner off periods and during the pre- and post-purge time
– Integrated lockout warning lamp
– Electric remote test
– Cover with two additional sealing screws to provide protection against tampering (refer to «Dimensions»)

Flame detectors RAR...

→ Refer to data sheet 7713

Type summary and ordering information

		Factory settings			
Type reference	Mains voltage	Hz	t1 (s)	TSA (s)	t9 (s)
LAE1 / 1355	AC 220 - 240 V	50	30	5	5
LAE1 / 8846	AC 220 - 240 V	50	30	2	2
LAE1 / 8863	AC 100 - 110 V	50	30	2	2
LAE1 / 8864	AC 100 - 110 V	60	30	2	2
LAE1 / 8865	AC 220 - 240 V	60	30	2	2
LAE1.1 / 8847	AC 220 - 240 V	50	15	2	2

LAE1 are supplied without terminal base.
Order terminal base separately, using type reference **AGG41041713(AE)**

Technical data

LAE1

Mains voltage	AC 220 V -15 %...AC 240 V +10 % AC 100 V -15 %...AC 110 V +10 %
Mains frequency	50 Hz ±6 %
Pre-fuse (external)	max. 10 A (slow)
Degree of protection	IP 40
Mounting orientation	optional
Cable glands	Pg 11 or BSP ¾“
Weight	approx. 1.85 kg

Environmental conditions

Transport	IEC 721-3-2
Climatic conditions	class 2K2
Temperature range	-20...+60 °C
Humidity	< 95 % r.h.
Mechanical conditions	class 2M2
Operation	IEC 721-3-3
Climatic conditions	class 3K5
Temperature range	-20...+60 °C
Humidity	< 95 % r.h.

Condensation, formation of ice and ingress of water are not permitted!

Unit fuse (built in)	T6.3H250V to IEC 127
Power consumption	
- At startup	9 VA
- In operation	6 VA
Max. perm. rating of control outputs	
- Per terminal	4 A to VDE 0660 AC3
- Total - input current terminal 1	5 A to VDE 0660 AC3

CE conformity

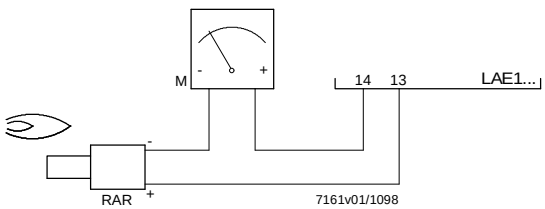
According to the directives of the European Union
Electromagnetic compatibility EMC 89/336 EEC incl. 92/31 EEC
Low voltage directive 73/23 EEC

Flame detectors RAR...

Refer to data sheet 7713

Perm. length of connecting cable	20 m
With longer distances, use low-capacitance cable, e.g. single-wire, and the RAR8!	
Min. detector current required	8 µA
Max. possible detector current	approx. 25 µA

Measuring circuit for LAE1



Legend

RAR...	Flame detector
M	Microammeter

Function

Prerequisites for burner startup

The burner will be started only if
– the sequence switch of the LAE1 is in its start position
– the LAE1 is not interlocked in lockout position
– the contacts of all control and monitoring devices in the control loop between terminals 8 and 9 are closed
– the air pressure monitor - if included in the test circuit - does not signal air pressure

Faults in flame supervision or in the LAE1 prevent startup or, in the case of startup, lead to lockout.

If the air damper is not controlled by the LAE1, terminals 20, 21 and 22 must be interconnected!

The LAE1 can control the following components of the burner plant:
– Fan motor
– Flue gas fan
– Air damper
– Ignition transformer
– One to three fuel valves
– One external fault indication unit

It is also possible to connect a load controller with a 3-position output.

Startup sequence

Specific features

– Continuous indication of program cycle in the viewing window of the unit cover
– In the event of faults, the program indicator shows the program phase during which lockout occurred
– The motor of the sequence switch can be switched off to facilitate the burner settings
– The cam shaft can be rotated manually

- **Startup**

First, the fan motor is switched on via terminal 3 and the actuator controlled via terminal 22.
When the air damper reaches its maximum position, the sequence switch of the LAE1 starts and the pre-purge time commences.
The minimum air pressure set on the air pressure monitor must then be reached within 10 s (or within 7 s in the case of operation with post-purging) and maintained until controlled shutdown occurs. Otherwise, the burner control will initiate lockout.
A flame signal during the pre-purge time also leads to lockout.

On completion of the adjusted pre-purge time, the air damper is given the control command to return to the minimum position.
During the time the air damper is closed, the sequence switch stands still.
As soon as the signal contact for the minimum throttling setting is actuated by the actuator, the sequence switch starts again and controls the program sequence which can no longer be influenced from outside:

– Pre-ignition
  → If the ignition equipment had not already been switched on during the pre-purge time
– Release of first fuel valve connected to terminal 5
  → The fuel valve of a pilot burner which, on completion of the 2nd safety time, must be switched off, is to be connected to terminal 10, however
– Completion of adjusted safety time.
  If, during this period of time, no flame is established, the burner control will initiate lockout with interlocking
– 11 s after release of the first fuel valve, the second fuel valve will be released
– The pilot burner - if present and connected to terminal 10 - will be shut down
– The load controller will be switched on after another time interval of 12 s, which means that the burner's operating position is now reached.
  From now on, the load controller controls the burner's output by increasing or decreasing the oil throughput and the amount of air, depending on the demand for heat.

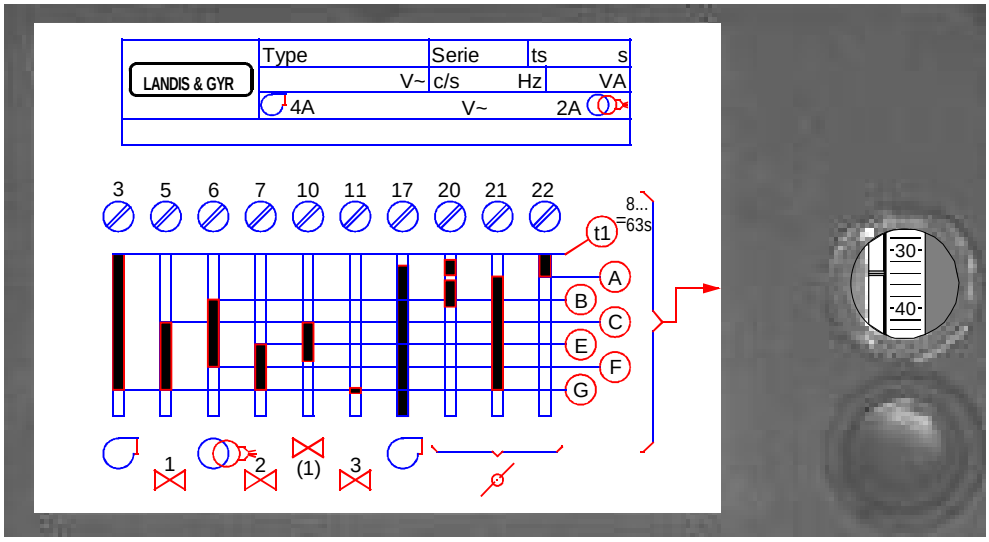
If the flame is lost **during operation,** the burner control will initiate lockout or - if operating mode «with start repetition» is used - make a new start.
In that case, the sequence switch will return to its start position, however, and post-purging takes place, if programmed.

Control program

After a controlled shutdown
Controlled shutdown occurs as soon as a control or monitoring device in the control loop between terminals 8 and 9 opens its contact.
The fuel valves are immediately shut and post-purging, if included, starts.
The sequence switch will return to its start position where it remains until the next switch on command is given.

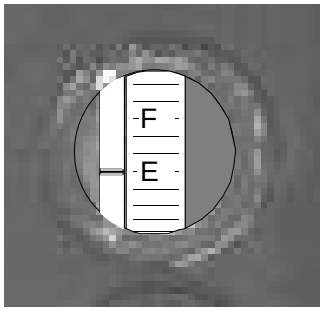
After lockout of LAE1
After pressing the built-in or external reset button, the sequence switch will return to its start position, provided the fault has been corrected.
The only component of the burner plant that is switched on here is the fan motor connected to terminal 17.
Since, in normal circumstances, the control thermostat or pressurestat continues to call for heat, the sequence switch initiates a new start after it has reached its start position.

Program sequence indicator

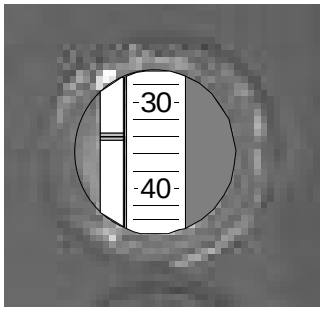


The program sequence indicator shows the current startup position.
The **letters** correspond to those given in the sequence switch diagram beside the viewing window.
The **numbers** give the remaining pre-purge time.
In the event of a lockout, the sequence switch and the program sequence indicator stop, thus indicating the operating phase during which lockout occurred.

Reading the program sequence indicator



Valve 2 connected to terminal 7 will be opened

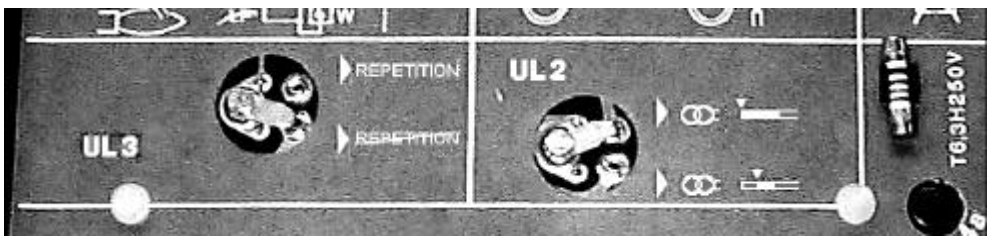


Pre-purge time lasts another 35 s

Changing the control sequence
Two changeover latches on the underside of the burner control can be used to make the following settings:

UL2	«Long pre-ignition time»	During pre-purging	**Factory setting**
	«Short pre-ignition time»	3 s	
UL3	«With repetition»	In the event of loss of flame during operation	
	«Without repetition»	In the event of loss of flame during operation	**Factory setting**

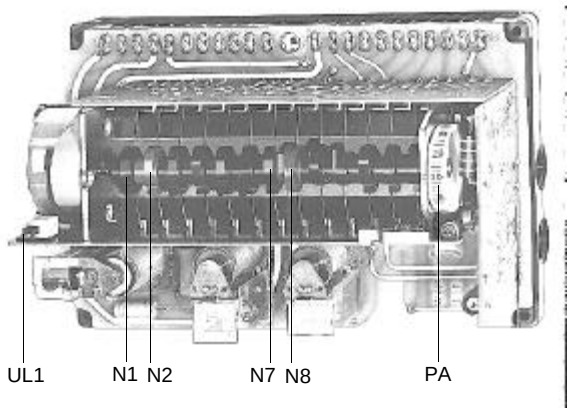
The factory setting can only be changed after loosening the screw.
Retighten screw properly!



Settings and adjustments on the burner control

- Loosen all six screws and remove the unit cover
- Always start counting the switching cams from the motor side
- You can manually turn the cam shaft to any position

→ Clockwise direction of rotation, as seen from the motor



Setting elements

N1	Cam 1, fixed
N2	Cam 2, adjustable (safety time)
N3	Cam 3, adjustable (safety time)
N7	Cam 7, fixed
N8	Cam 8, adjustable (pre-purge time)
PA	Sequence position indicator
UL1	Operating switch «ON / OFF» for sequence switch motor

On the underside of the base

UL2	Changeover latch «Short / long» pre-ignition time
UL3	Changeover latch «With / without» repetition

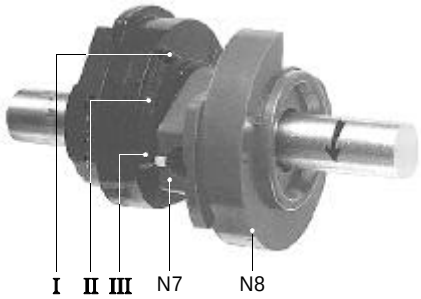
Adjustment of pre-purge time «t1»

- Loosen the securing screw of red cam N8
- Turn cam shaft manually until the required pre-purge time is indicated next to the index notch on the sequence switch carrier
- Hold the cam shaft firm and turn cam N8 until the tappet operated by it trips, or until the cam stops at this tappet
- Tighten the cam securing screw **carefully** and then check the adjusted time.

  The adjusted time is also visible through the viewing window when the LAE1 is in its start position

Adjustment of the mark of the red cam N8 to the graduation marks of the block cam N7 results in the pre-purge times given in the adjacent table.

Adjustment to	t1
Graduation mark I	8 s
Graduation mark II	18 s
Graduation mark III	28 s
At stop	63 s
Factory setting	approx. 30 s



Adjustment of safety time «TSA»

- Loosen stop screws of cams N2 and N3
- Hold cam N1 firm and align the graduation mark of cam N2 to the corresponding time marking of cam N1

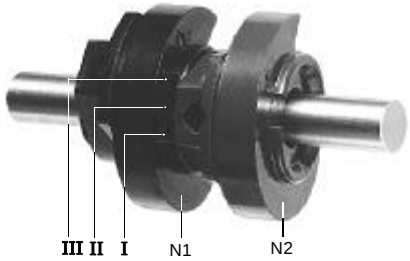
  → See adjacent illustration and table

  → Intermediate positions possible

  Lock cam N2
- Set adjustment mark of cam N3 to the lowest stop of cam N2 and lock cam N3
- Check the adjusted safety time and adjust the new value on the rating plate of the cover

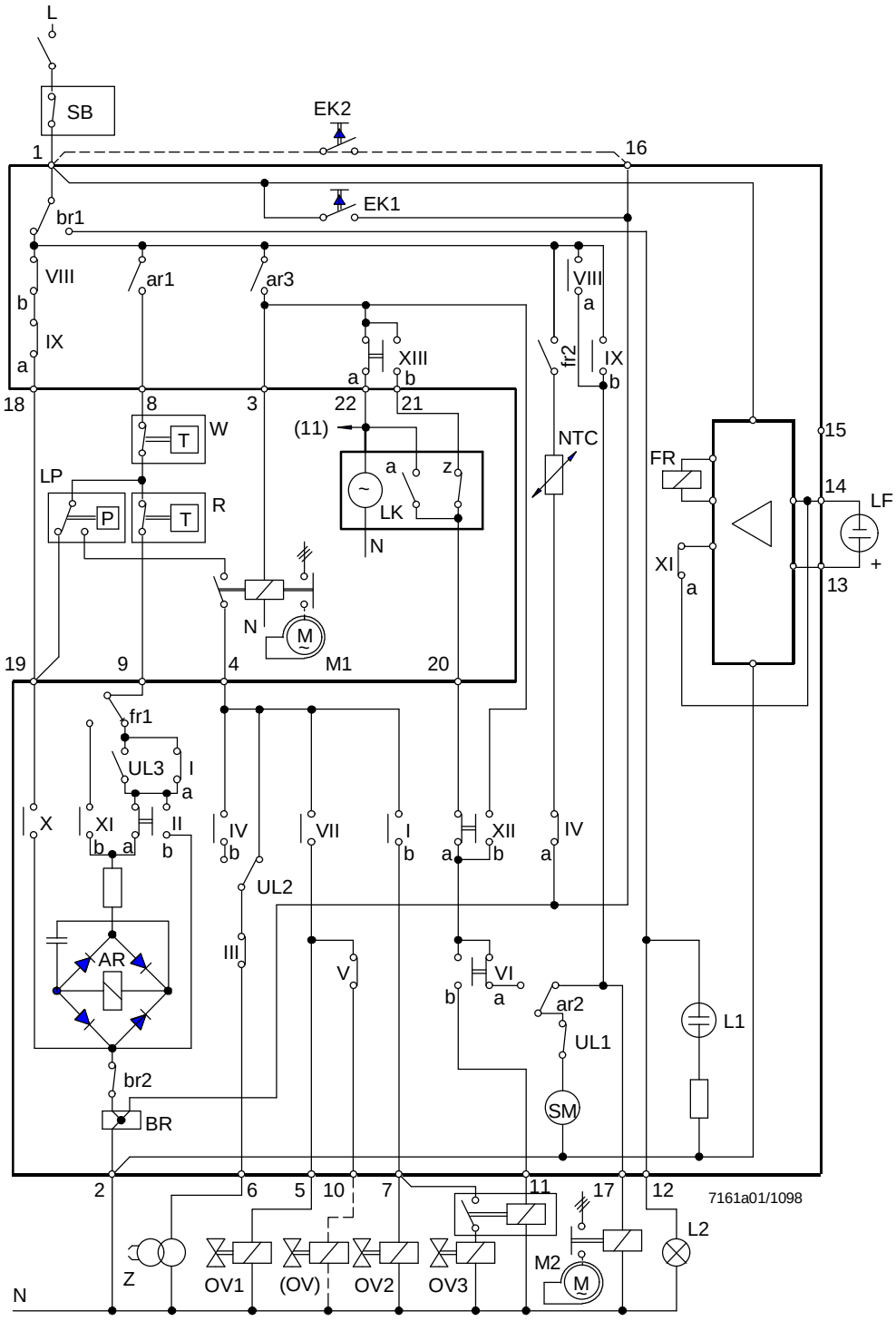
  → Adjustment slot on the underside of the cover

Adjustment to	TSA
Graduation mark I	0 s
Graduation mark II	4.5 s
Graduation mark III	9 s
Factory setting	≤ 5 s



Basic diagram

Unit fuse 6.3 A (slow) in the current path between terminal 1 and relay contact «br...» is not shown.



Legend

AR	Load relay with contacts «ar...»
BR	Lockout relay with contacts «br...»
EK1	Reset button on LAE1 (do not press «EK1» for more than 10 s!)
EK2	Remote reset button (do not press «EK2» for more than 10 s!)
FR	Flame relay with contacts «fr...»
L1	Fault indication lamp (integrated)
L2	Fault indication lamp (external)
LF	Flame detector RAR...
LK	Air damper actuator with limit or auxiliary switches a = actuator travels into «open» position (max. air volume) z = actuator travels into «closed» position (min. air volume)
LP	Air pressure monitor
M...	Fan
NTC	High temperature conductor (delay device)
OV...	Oil valve
(OV)	Fuel valve for a pilot burner which will be switched off on completion of the 2nd safety time
R	Control thermostat or pressurestat
SB	Manual reset safety limit thermostat
SM	Synchronous motor of sequence switch
UL1	Operating switch for sequence switch motor (only accessible when cover is removed)
UL2	Changeover latch «Long / short pre-ignition time»
UL3	Changeover latch «With / without repetition»
W	Limit thermostat or pressure monitor
Z	Ignition transformer

Time diagram of sequence switch

Maximum permissible after-burn time 7 s, from the start of «t6».
Customer-specific pre-settings of the times on demand!

Legend

T	120 s	Cycle time of sequence switch
TSA	0...9 s	Adjustable 1st safety time
t1	8...63 s	Adjustable pre-purge time
t3	t1 + t11 + t12 + 7 s	«Long» pre-ignition time
t3´	3 s	«Short» pre-ignition time
t4	11 s	Interval between release of 1st and 2nd fuel valve
t5	12 s	Interval between release of 2nd and 3rd fuel valve or load controller
t6	T - (30 + t1)	Post-purge time
t7	3 s	Delay time
t8	t1 + 30 + t11 + t12	Total startup time
t9	5 s	2nd safety time (only with pilot burner)
t10	10 s	Bridging time (predefined time for air control)
t11	optional	Opening or closing time for air damper
t12	optional	Opening or closing time for air damper

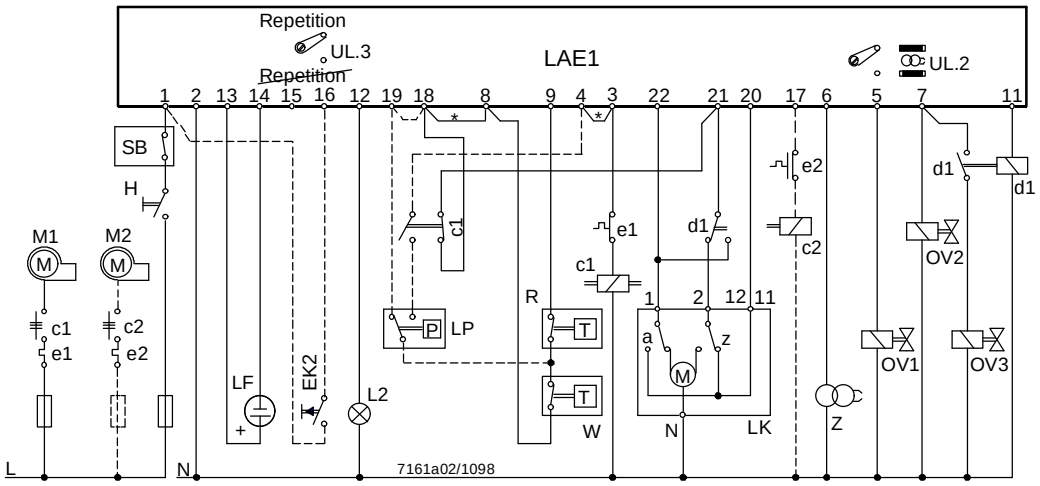
Connection examples

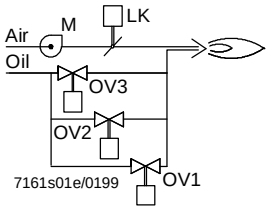
Connection diagram and sequence program for operation with long pre-ignition and repetition

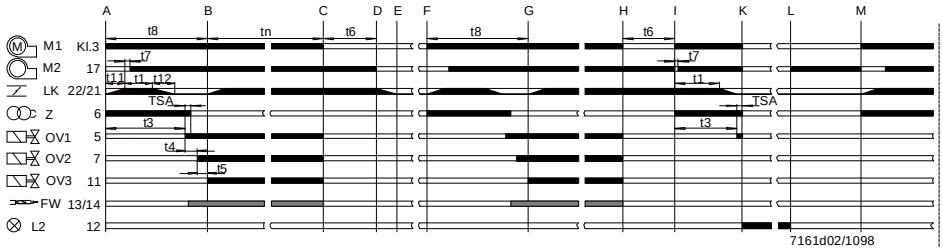
→ Actuator control checked

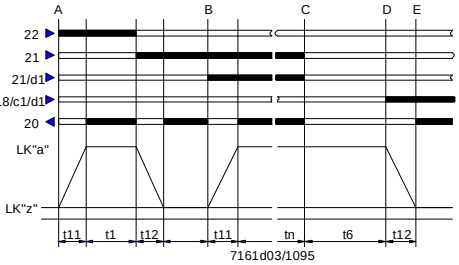
→ No load control

* When using an air pressure monitor «LP», the connections between terminals 3 and 4 and 8 and 18 are note required









Air damper control (in detail)

In the case of burners without air damper or an air damper not controlled by the LAE1, terminals 20, 21 and 22 must be interconnected.

Current path 18-c1-21 is not required!

Legend

c...	Fan contactor with contacts «c...»
d...	Auxiliary relay with contacts «d...»
e...	Thermal overcurrent release
EK2	Remote reset button
FW	Flame supervision
H	Main switch
L2	Fault indication lamp (external)
LK	Air damper actuator with limit or auxiliary switches a = actuator travels into «open» position (max. air volume) z = actuator travels into «closed» position (min. air volume)
LF	Flame detector RAR...
LP	Air pressure monitor
M...	Fan
OV...	Oil valve
R...	Control thermostat or pressurestat
SB	Manual reset safety limit thermostat
UL2	Changeover latch «Long / short pre-ignition time»
UL3	Changeover latch «With / without repetition»
W	Limit thermostat or pressure monitor
Z	Ignition transformer

A	Start
A-B	Normal startup
B-C	Operation
C	Controlled shutdown
C-D	Post-purging
D-E	Closing air damper
E-F	Burner off period
F	Restart
F-G	Startup
G-H	Operation
H	Loss of flame
H-I	Return to start position
I	Repetition
I-K	Startup without establishment of flame
K-L	Fault
L	Reset
L-M	Return to start position
M	Restart

TSA	Adjustable 1st safety time
t1	Adjustable pre-purge time
t3	«Long» pre-ignition time
t4	Interval between release of 1st and 2nd fuel valve
t5	Interval between release of 2nd and 3rd fuel valve or load controller
t6	Post-purge time
t7	Delay time
t8	Total startup time
t11	Opening or closing time for air damper
t12	Opening or closing time for air damper

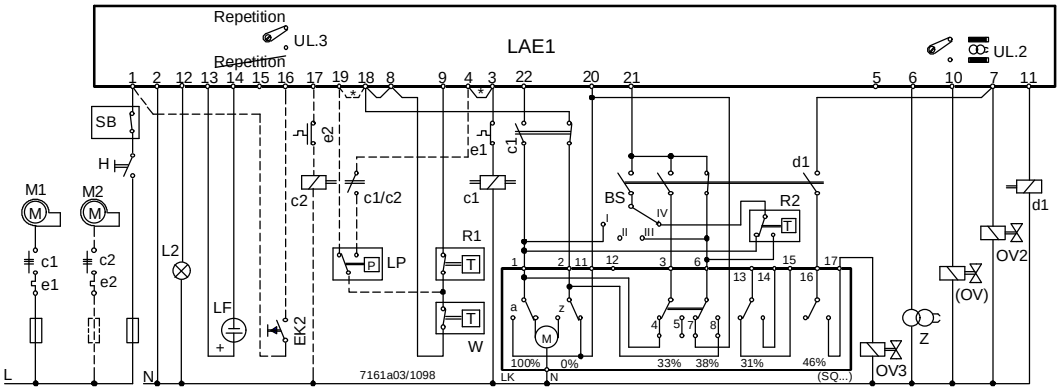
Connection examples

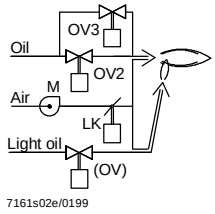
Connection diagram and sequence program for operation with short pre-ignition and without repetition

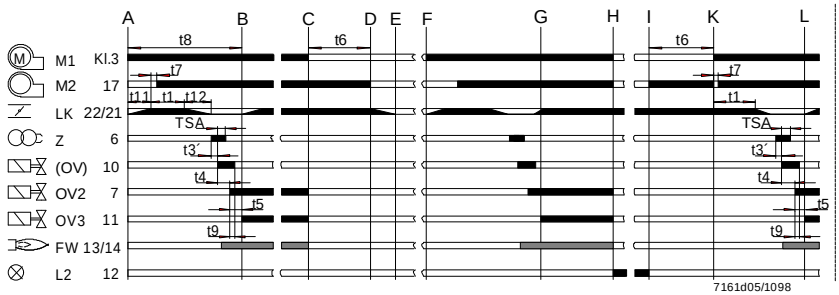
Ignition of main burner with light oil pilot burner.

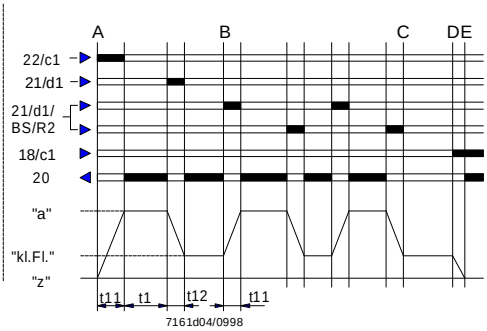
On / off control with checked actuator control.

* When using an air pressure monitor «LP», the connections between terminals 3 and 4 and 8 and 18 are not required









Air damper control (in detail)

Legend

BS	Control switch
c...	Fan contactor with contacts «c...»
d...	Auxiliary relay with contacts «d...»
e...	Thermal overcurrent release
EK2	Remote reset button
FW	Flame supervision
H	Main switch
L2	Fault indication lamp (external)
LK	Air damper actuator with limit or auxiliary switches a = actuator travels into «open» position (max. air volume) z = actuator travels into «closed» position (min. air volume)
LF	Flame detector RAR...
LP	Air pressure monitor
M...	Fan
OV...	Oil valve
(OV)	Fuel valve for a pilot burner which will be switched off on completion of the 2nd safety time
R...	Control thermostat or pressurestat
SB	Manual reset safety limit thermostat
UL2	Changeover latch «Long / short pre-ignition time»
UL3	Changeover latch «With / without repetition»
W	Limit thermostat or pressure monitor
Z	Ignition transformer

A	Start
A-B	Normal startup
B-C	Operation
C	Controlled shutdown
C-D	Post-purging
D-E	Closing air damper
E-F	Burner off period
F	Restart
F-G	Startup
G-H	Operation
H	Loss of flame
H-I	Fault
I	Reset
I-K	Return to start position
K	Restart
K-L	Startup
L	Operation

TSA	Adjustable 1st safety time
t1	Adjustable pre-purge time
t3´	«Short» pre-ignition time
t4	Interval between release of 1st and 2nd fuel valve
t5	Interval between release of 2nd and 3rd fuel valve or load controller
t6	Post-purge time
t7	Delay time
t8	Total startup time
t9	2nd safety time (only with pilot burner)
t11	Opening or closing time for air damper
t12	Opening or closing time for air damper

Control switch «BS»

I	High flame
II	Stop
III	Low flame
IV	Automatic control

Connection examples

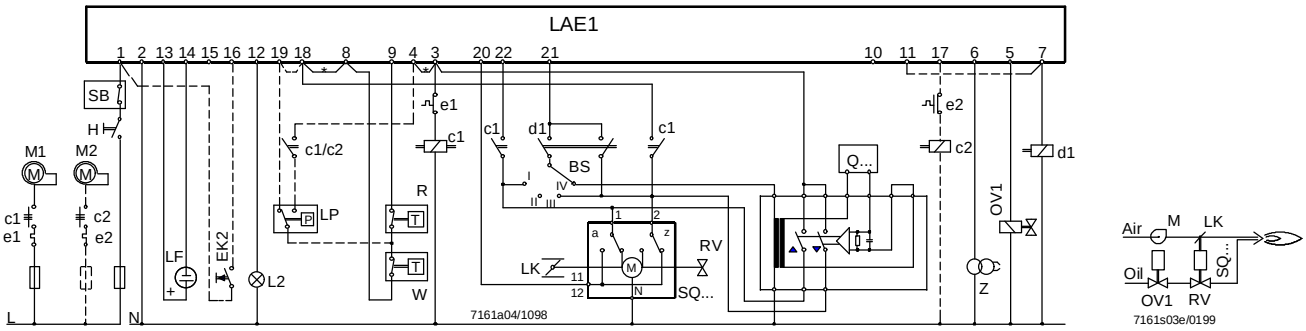
Connection diagram for modulating burner control with checked actuator control.

Burners designed for modulating burner control also use the devices of the temperature or pressure control loop, in addition to the standard burner control equipment.

Example:

- One modulating controller with a 3-position output
- Temperature or pressure sensor — QA... / QB...
- One actuator for the control of the air damper and oil throughput (air / fuel ratio control) — SQ...
- One auxiliary relay — d1
- One control switch — BS
- One oil volume controller — RV

* When using an air pressure monitor «LP», the connections between terminals 3 and 4 and 8 and 18 are not required

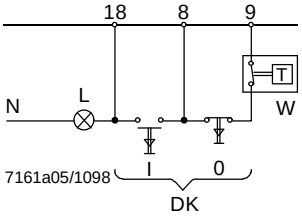


Control of semi-automatic operating mode

This operating mode is used when, for specific reasons, fully automatic operation is not desired.

Example: with industrial burners

The burner is started by actuating impulse contact I. Burner shutdown is achieved either by pressing the circuit-breaking contact 0 or when there is a response from the limit thermostat.



Air pressure monitor «LP»

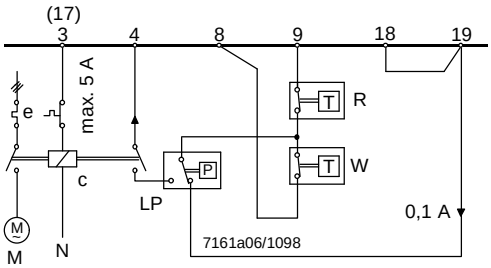
→ Recommended for burners that use separate motors for the fan and the fuel pump

The air pressure is continnously monitored from burner startup through controlled shutdown.

If 10 s after the start of pre-purging, or 7 s with the program with pre- and post-purging, the adjusted and required minimum air pressure is not reached, or if the air pressure drops again, the burner control will initiate lockout.

If the air pressure monitor «LP» is connected as shown in the adjacent diagram, it is automatically subjected to a functional check prior to each start.

If the contact position is wrong, there will be no start.



Legend

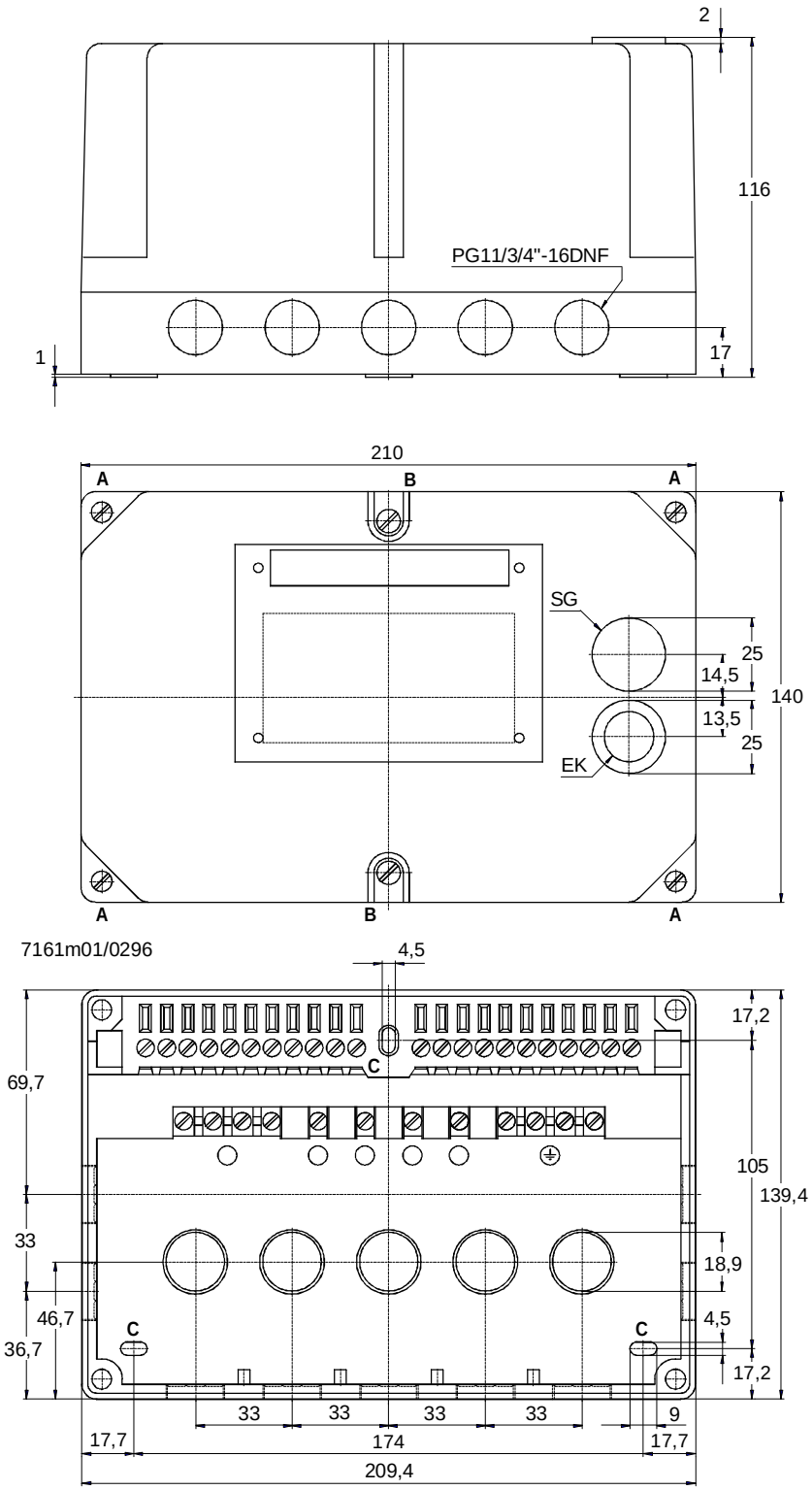
BS	Control switch	L2	Fault indication lamp (external)
c...	Fan contactor with contacts «c...»	LF	Flame detector RAR...
d...	Auxiliary relay with contacts «d...»	LP	Air pressure monitor
DK	Button	M...	Fan
e...	Thermal overcurrent release	OV...	Oil valve
EK2	Remote reset button	R...	Control thermostat or pressurestat
H	Main switch	RV	Control valve
LK	Air damper actuator with limit or auxiliary switches	SB	Manual reset safety limit thermostat
	a = actuator travels into «open» position (max. air volume)	W	Limit thermostat or pressure monitor
	z = actuator travels into «closed» position (min. air volume)	Z	Ignition transformer
L	Lamp		

Control switch «BS»

I	High flame	III	Low flame
II	Stop	IV	Automatic control

Dimensions

Dimensions in mm



To remove the LAE1 from its plug-in base, it is **merely** necessary to loosen the four screws **A**.
To remove the unit cover, the two screws **B** must **also** be loosened.

C Elongated holes for fixing the plug-in base

SG Viewing window

EK Reset button