



ISO 9001

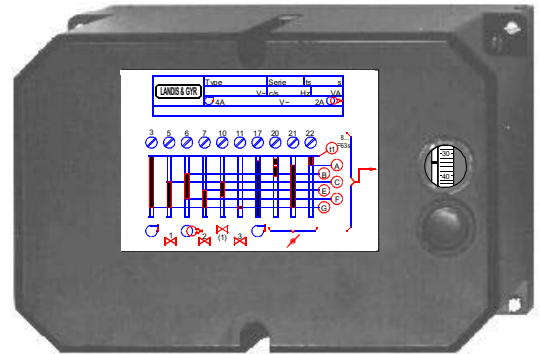


## Oil Burner Controls

## LAE1

Series 02

Supplementary data sheet 7713




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**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

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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



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**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!

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## Mounting notes

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

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## 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

Type reference	Mains voltage	Hz	Factory settings		
			t1 (s)	TSA (s)	t9 (s)
<b>LAE1 / 1355</b>	AC 220 - 240 V	50	30	5	5
<b>LAE1 / 8846</b>	AC 220 - 240 V	50	30	2	2
<b>LAE1 / 8863</b>	AC 100 - 110 V	50	30	2	2
<b>LAE1 / 8864</b>	AC 100 - 110 V	60	30	2	2
<b>LAE1 / 8865</b>	AC 220 - 240 V	60	30	2	2
<b>LAE1.1 / 8847</b>	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 %	Unit fuse (built in)	T6.3H250V to IEC 127
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Mains frequency	50 Hz ±6 %	Power consumption	
		- At startup	9 VA
Pre-fuse (external)	max. 10 A (slow)	- In operation	6 VA

Degree of protection	IP 40	Max. perm. rating of control outputs	
		- Per terminal	4 A to VDE 0660 AC3
Mounting orientation	optional	- Total - input current terminal 1	5 A to VDE 0660 AC3

Cable glands Pg 11 or BSP ¾"

Weight approx. 1.85 kg

### 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

### Environmental conditions

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

### Flame detectors RAR...

Refer to data sheet 7713

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

### Measuring circuit for LAE1



## 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 2<sup>nd</sup> 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.

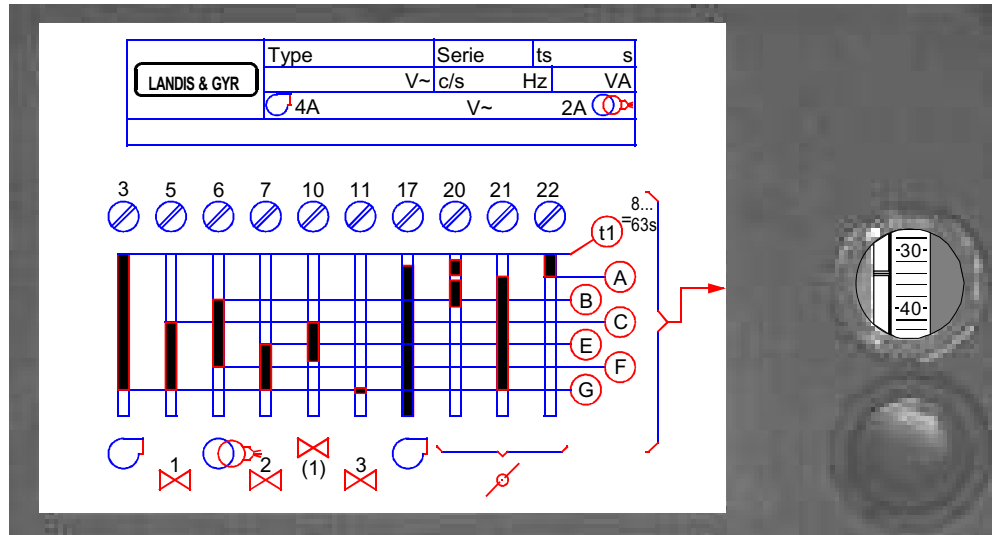
### **After lockout of LAE1**

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.

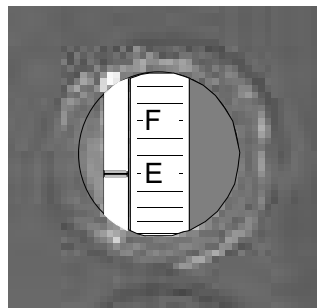
Since, in normal circumstances, the control thermostat or pressurestat continues to call for heat, the sequence switch initiates a new start after it has reached its start position.

**Program sequence indicator**

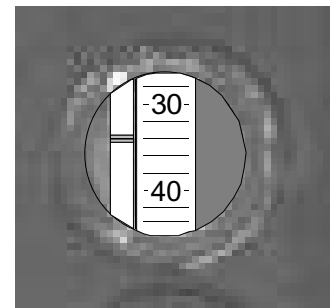


The program sequence indicator shows the current startup position. The **letters** correspond to those given in the sequence switch diagram beside the viewing window. The **numbers** give the remaining pre-purge time. In the event of a lockout, the sequence switch and the program sequence indicator stop,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

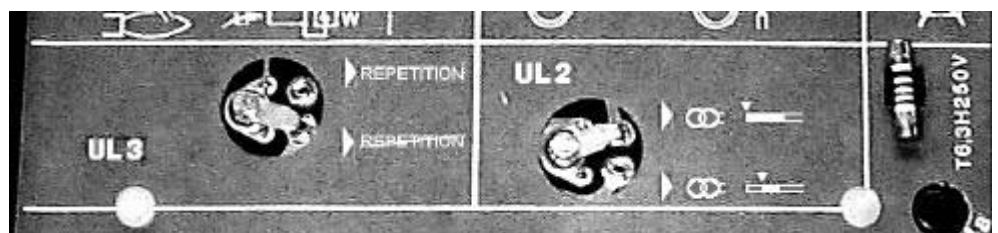
**Changing the control sequence**

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

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

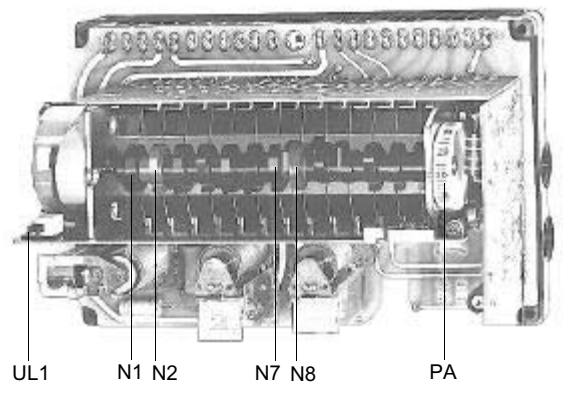


The factory setting can only be changed after loosening the screw. Retighten screw properly!



## 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

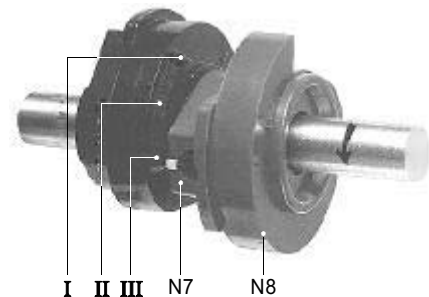
#### On the underside of the base

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

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

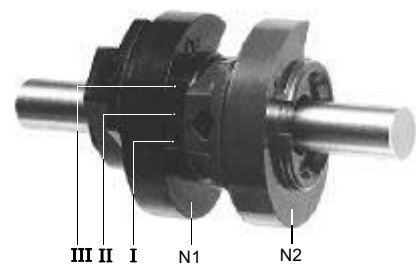


Adjustment of the mark of the red cam N8 to the graduation marks of the block cam N7 results in the pre-purge times given in the adjacent table.

#### Adjustment 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

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







# 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 1 <sup>st</sup> 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 1 <sup>st</sup> and 2 <sup>nd</sup> fuel valve
t5	12 s	Interval between release of 2 <sup>nd</sup> and 3 <sup>rd</sup> 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	2 <sup>nd</sup> 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

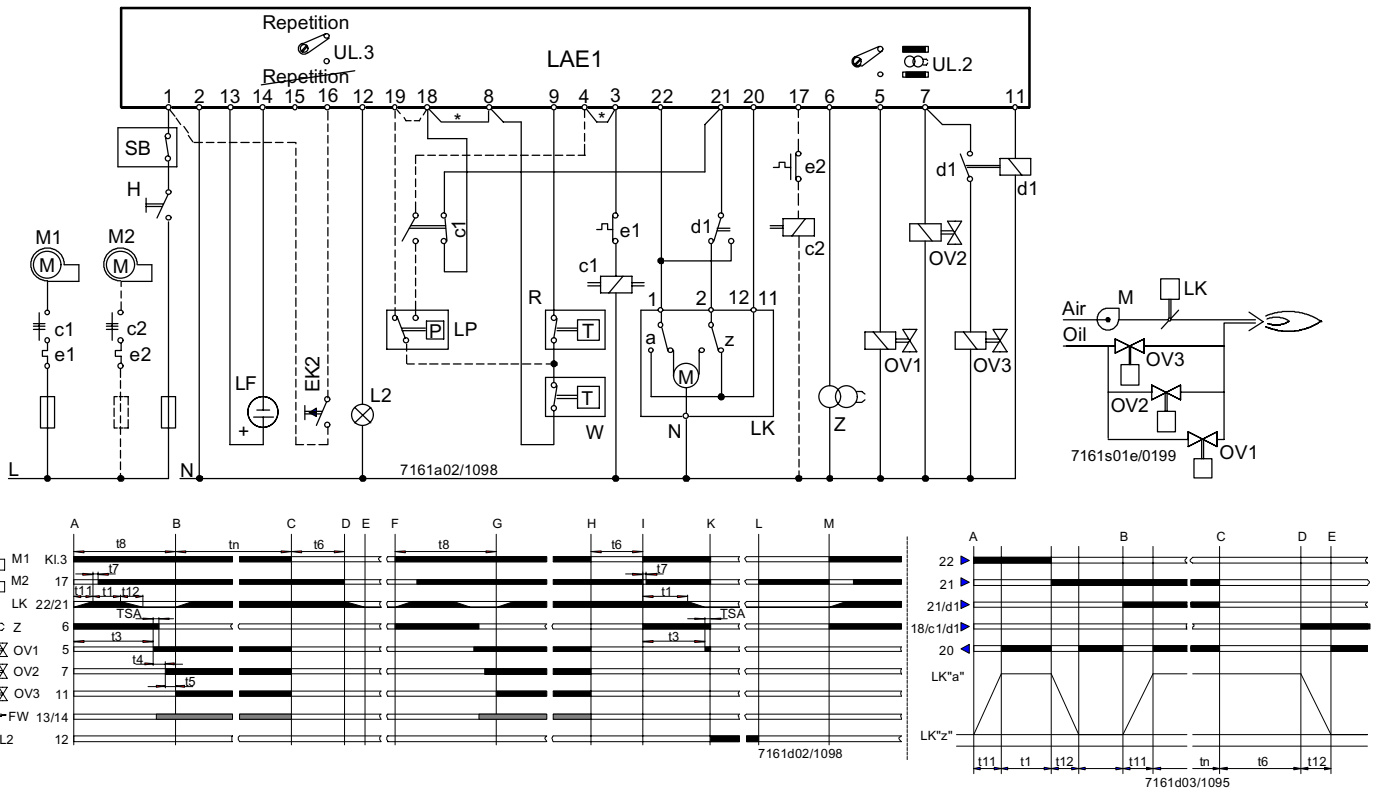
# Connection examples

## 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...»  | LF    | Flame detector RAR...                             |
| d... | Auxiliary relay with contacts «d...»  | LP    | Air pressure monitor                              |
| e... | Thermal overcurrent release   | M...  | Fan   |
| EK2  | Remote reset button   | OV... | Oil valve   |
| FW   | Flame supervision   | R...  | Control thermostat or pressurestat                |
| H    | Main switch   | SB    | Manual reset safety limit thermostat              |
| L2   | Fault indication lamp (external)  | UL2   | Changeover latch «Long / short pre-ignition time» |
| LK   | Air damper actuator with limit or auxiliary switches  | UL3   | Changeover latch «With / without repetition»      |
| 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                              |
| A    | Start   | G-H   | Operation   |
| A-B  | Normal startup  | H     | Loss of flame                                     |
| B-C  | Operation   | H-I   | Return to start position                          |
| C    | Controlled shutdown   | I     | Repetition  |
| C-D  | Post-purging  | I-K   | Startup without establishment of flame            |
| D-E  | Closing air damper  | K-L   | Fault   |
| E-F  | Burner off period   | L     | Reset   |
| F    | Restart   | L-M   | Return to start position                          |
| F-G  | Startup   | M     | Restart   |
| TSA  | Adjustable 1 <sup>st</sup> safety time  | t6    | Post-purge time                                   |
| t1   | Adjustable pre-purge time   | t7    | Delay time  |
| t3   | «Long» pre-ignition time  | t8    | Total startup time                                |
| t4   | Interval between release of 1 <sup>st</sup> and 2 <sup>nd</sup> fuel valve                    | t11   | Opening or closing time for air damper            |
| t5   | Interval between release of 2 <sup>nd</sup> and 3 <sup>rd</sup> fuel valve or load controller | t12   | Opening or closing time for air damper            |

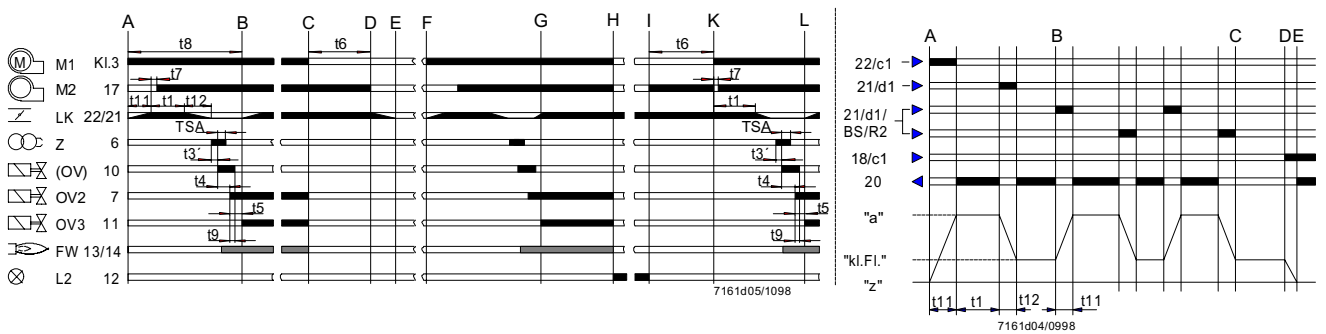
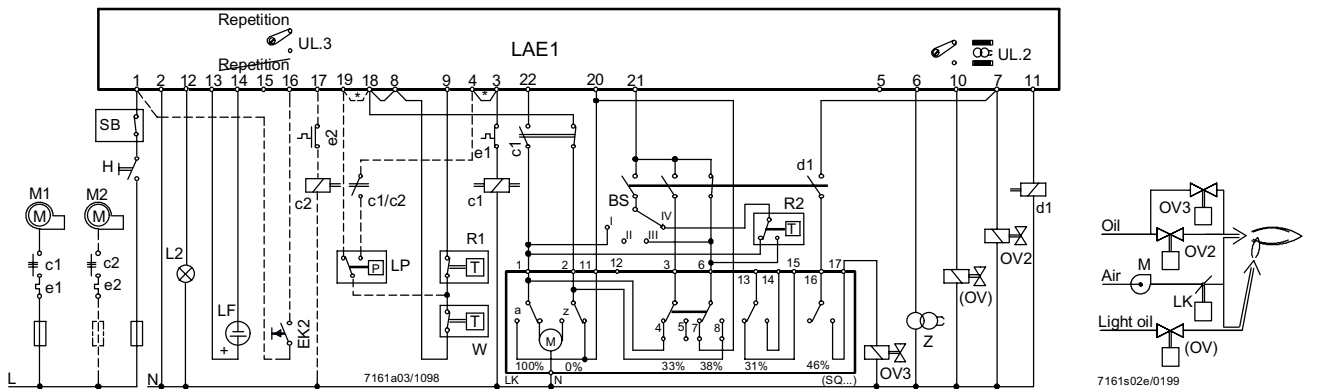
# Connection examples

## 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)**

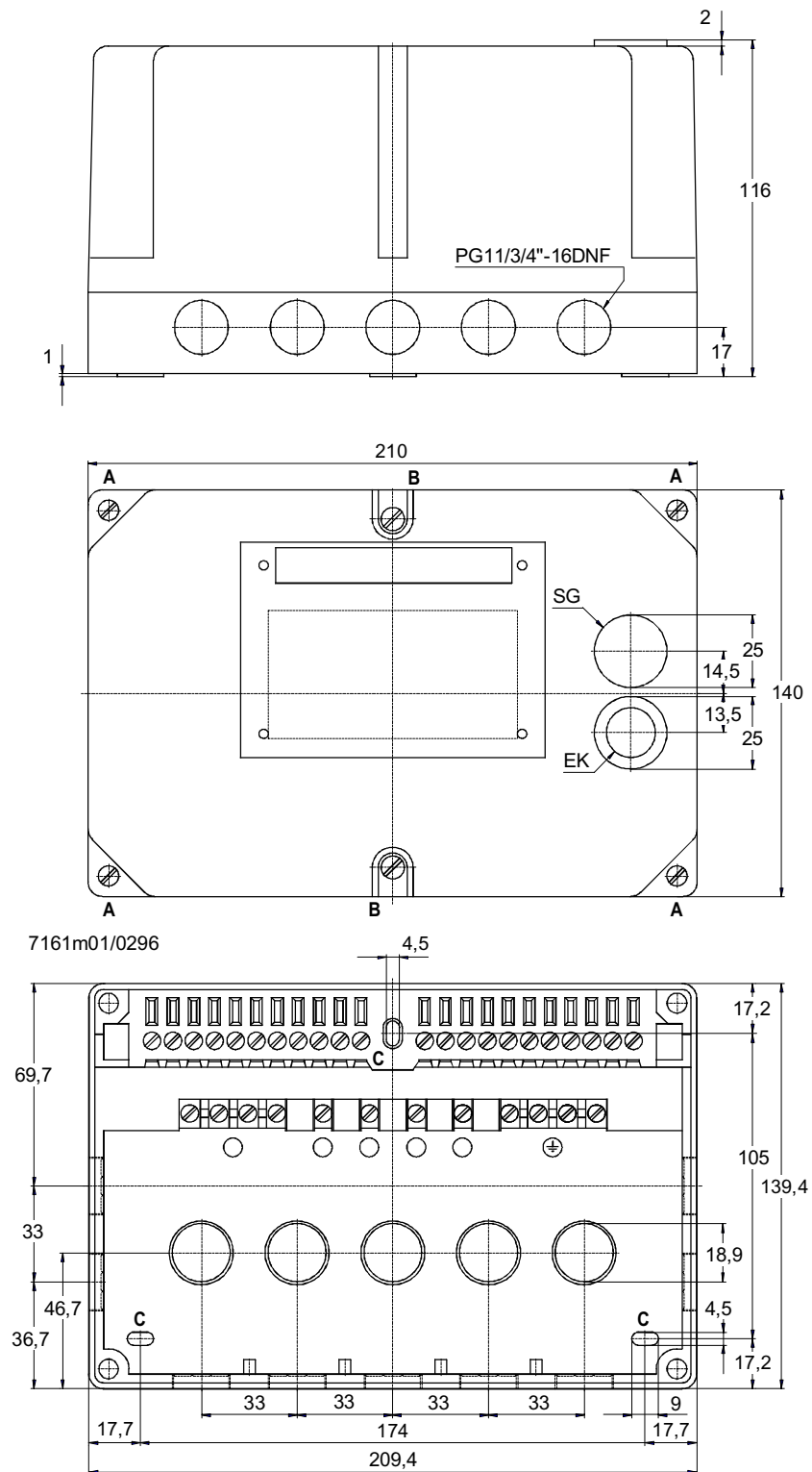
### Legend

- |                     |  |       |   |
|---------------------|--|-------|---|
| BS                  | Control switch   | LP    | Air pressure monitor  |
| c...                | Fan contactor with contacts «c...»   | M...  | Fan   |
| d...                | Auxiliary relay with contacts «d...»   | OV... | Oil valve   |
| e...                | Thermal overcurrent release  | (OV)  | Fuel valve for a pilot burner which will be switched off on completion of the 2 <sup>nd</sup> safety time |
| EK2                 | Remote reset button  | R...  | Control thermostat or pressurestat  |
| FW                  | Flame supervision  | SB    | Manual reset safety limit thermostat  |
| H                   | Main switch  | UL2   | Changeover latch «Long / short pre-ignition time»   |
| L2                  | Fault indication lamp (external)   | UL3   | Changeover latch «With / without repetition»  |
| LK                  | Air damper actuator with limit or auxiliary switches<br>a = actuator travels into «open» position (max. air volume)<br>z = actuator travels into «closed» position (min. air volume) | W     | Limit thermostat or pressure monitor  |
| LF                  | Flame detector RAR...  | Z     | Ignition transformer  |
| A                   | Start  | G-H   | Operation   |
| A-B                 | Normal startup   | H     | Loss of flame   |
| B-C                 | Operation  | H-I   | Fault   |
| C                   | Controlled shutdown  | I     | Reset   |
| C-D                 | Post-purging   | I-K   | Return to start position  |
| D-E                 | Closing air damper   | K     | Restart   |
| E-F                 | Burner off period  | K-L   | Startup   |
| F                   | Restart  | L     | Operation   |
| F-G                 | Startup  |       |   |
| TSA                 | Adjustable 1 <sup>st</sup> safety time   | t6    | Post-purge time   |
| t1                  | Adjustable pre-purge time  | t7    | Delay time  |
| t3'                 | «Short» pre-ignition time  | t8    | Total startup time  |
| t4                  | Interval between release of 1 <sup>st</sup> and 2 <sup>nd</sup> fuel valve   | t9    | 2 <sup>nd</sup> safety time (only with pilot burner)  |
| t5                  | Interval between release of 2 <sup>nd</sup> and 3 <sup>rd</sup> fuel valve or load controller  | t11   | Opening or closing time for air damper  |
|                     |  | t12   | Opening or closing time for air damper  |
| Control switch «BS» |  | III   | Low flame   |
| I                   | High flame   | IV    | Automatic control   |
| II                  | Stop   |       |   |



# 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

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