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Control Units LEC1...

Control unit for double- or multiflame supervision of oil, gas or forced draft oil / gas burners of any fuel throughput, suited for continuous or intermittent operation.

The LEC1... and this Data Sheet are intended for use by OEMs which integrate the control units in their products!

Use

The LEC1... is designed for the fully automatic startup and supervision of forced draft oil or gas burners where flame supervision should or must be carried out by separate flame safeguards, e.g. with:

- Double supervision of the main flame or pilot and main flame by 2 identical or different detectors
- Supervision of forced draft oil / gas burners with different types of detectors, depending on the selected operating mode
- Multiflame supervision, that is, central and simultaneous control of the startup and supervision sequence of several burners the flames of which must be individually supervised by 1 or 2 flame safeguards each

Supplementary Data Sheets

- LAE10 Data Sheet N7781
- LFE10 Data Sheet N7781
- LFE50 Data Sheet N7783

Use (cont´d)

The following types of flame safeguards are available:

LAE10	For the supervision of oil burners with an active selenium photocell detector RAR… in intermittent operation
LFE10	For the supervision with an ionization probe (gas burners) or with UV detectors QRA… (gas, oil or dual-fuel burners, with or without ignition spark proving) in intermittent operation
LFE50	For the supervision with UV detectors QRA50… / QRA51…(gas, oil or dual-fuel burners) in intermittent or continuous operation

All units comply with the relevant European standards for oil, gas and forced draft burners of any fuel throughput.

The LEC1... can control the following burner plant components:
Fan motor, flue gas fan, air damper, ignition transformer, 1 to 3 fuel valves, load controller, and an external fault signaling device.

A load controller with 3-position output can be connected.

Design, control sequence and adjustment facilities of the control unit make it suitable for use on combustion plants of any size and type, be it in connection with expanding flame or interrupted pilot burners, continuously operating burners or any other special burners.

Special features

- Prepurge time adjustable between 8 and 63 seconds
- Operation with or without postpurging
- Fully automatic control of air damper possible, irrespective of the actuator run time
- Possibility of air pressure check in connection with functional control of the air pressure switch prior to startup
- Choice of ignition: Direct ignition with pilot burner, with or without ignition spark proving
- Preignition time can be set to «Long» (during the prepurge time) or «Short» (3 seconds, e.g. for forced draft gas burners)
- 1st and 2nd safety time adjustable between 0 and 9 seconds
- Automatic extraneous light test during burner off periods and during the purging times (with lockout in the event of faulty flame signals)
- Semi-automatic burner startup and operation possible
- Built-in lockout warning lamp
- Electrical remote reset facility
- Cover with 2 additional sealing screws to provide protection against tampering (refer to «Dimensions»)
- Continuous display of the program sequence in the cover's viewing window
- In the event of a fault, the program indicator shows the operating phase during which the fault occurred
- Motor of the programming mechanism can be switched off to simplify burner adjustments
- Camshaft can be rotated manually

Warning notes

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

Only authorized staff may open, interfere with or modify the unit!

- All activities (mounting, installation and service work, etc.) must be performed by qualified staff
- Before performing any wiring changes in the connection area of the LEC1…, completely isolate the unit from the mains supply (all-polar disconnection)
- Ensure protection against electrical shock hazard by providing adequate protection for the unit's 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 lockout reset button only manually (applying a force of no more than 10 N), without using any tools or pointed objects
- 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
- Do not press the lockout reset button on the unit or the remote lockout reset button for more than 10 seconds since this damages the lockout relay in the unit

Mounting notes

- Ensure that the relevant national safety regulations are complied with
- Locate ignition electrode and ionization probe such that the ignition spark cannot arc over to the ionization probe (risk of electrical overloads)

Installation notes

- Always run the high-voltage ignition cables separately while observing the greatest possible distances to the unit and to other cables
- 4 extra terminals for the earth conductor, 4 extra terminals for the neutral conductor, and 4 auxiliary terminals
- In the event of loss of flame during operation, the control unit will initiate lockout
- Do not mix up live and neutral conductors
- Install switches, fuses, earthing, etc., in compliance with local regulations
- Observe the maximum permissible current load of the connecting terminals

Electrical connection of the flame detectors

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 maximum permissible lengths of the detector cables (refer to «Technical data» at current flame safeguards
- The ionization probe is not protected against electric shock hazard
- Locate the ignition electrode and ionization probe such that the ignition spark cannot arc over to the ionization probe (risk of electrical overloads) and a override of ionization supervision via ignition spark must be avoided
- Insulation resistance
  – Must be a minimum of 50 MΩ between ionization probe and ground
  – Soiled detector holders reduce the insulation resistance, thus supporting creepage currents
- Earth the burner in compliance with the relevant regulations; earthing the boiler alone does not suffice

Commissioning notes

- Continuous display of the program sequence in the viewing window:
  It is also possible to program the unit by means of a changeover link (UL3) in a way that the programming mechanism does not stop in case of lockout, but that it runs to the end of the program. The only component that receives power during that period of time is the fan for postpurging (connected to terminal 17)
- The motor of the programming mechanism can be switched off (simplifies burner adjustments)
- The camshaft can be rotated manually
- For setting instructions, refer to «Adjustment facilities on the unit»
- When commissioning the plant or when carrying out maintenance work, make the following checks:

	Safety check	**Anticipated response**
a)	Burner startup with flame detector darkened	Lockout at the end of «TSA»
b)	Burner startup with flame detector exposed to extraneous light	Lockout after no more than 40 seconds
c)	Burner operation with simulated loss of flame	Immediate lockout
d)	Burner startup with open-circuit of air pressure switch (not with atmospheric burners)	Lockout at the end of the specified time «t10»
e)	Burner operation with simulated air pressure failure (not with atmospheric burners)	Immediate lockout

Standards and certificates

CE

Conformity to ECC directives

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

ISO 9001: 2000
Cert. 00739

ISO 14001: 2004
Cert. 38233

- **Identification code to EN298** **F B L L B N**

Disposal notes

The unit contains electric and electronic components and must not be disposed of as household waste.
Local and currently valid legislation must be observed.

Mechanical design

The LEC1... as well as the flame safeguards LAE10 and LFE10 are of plug-in design and suitable for mounting in any position on the burner, on control desks or in control panels.
The spacious terminal bases and housings are made of impact-proof and heat-resistant plastic.
The programming mechanism of the unit (driven by a synchronous motor), its auxiliary relays and all other switching, control and adjusting elements are mounted on robust printed circuit boards.

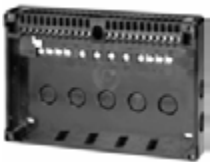
Type summary and ordering

Type reference *	Rated voltage	Factory settings for			
		mains frequency	t1	TSA	t9
LEC1 / 8851	AC 220...240 V	50 Hz	60 s	2 s	2 s
LEC1 / 8853	AC 220...240 V	50 Hz	30 s	2 s	2 s
LEC1 / 8866	AC 100...110 V	50 Hz	30 s	2 s	2 s
LEC1 / 8867	AC 100...110 V	60 Hz	30 s	2 s	2 s
LEC1 / 8868	AC 220...240 V	60 Hz	30 s	2 s	2 s
LEC1 / 8892	AC 220...240 V	50 Hz	60 s	5 s	5 s
LEC1.1 / 8854	AC 220...240 V	50 Hz	17 s	2 s	2 s
LEC1 / 9500	AC 230 V	60 Hz	60 s	4.5 s	4.5 s
LEC1 / 9501	AC 100...110 V	50 Hz	60 s	4.5 s	4.5 s
LEC1 / 9502	AC 100...110 V	60 Hz	60 s	4.5 s	4.5 s
LEC1 / 9503	AC 230 V	50 Hz	60 s	4.5 s	4.5 s

The control unit is delivered without terminal base.
The latter must be ordered as a separate item using the following part number:
AGG41041713 (EC) or **AGG12.1**

* The type reference is given near the terminals inside the housing

Accessories



Terminal base **AGG41041713 (EC)**
- To be ordered as a separate item
- For Pg 11

Terminal base **AGG12.1**
- To be ordered as a separate item
- For M16 x 1.5

Technical data

General unit data	Mains voltage	AC 220 V -15 %...AC 240 V +10 % AC 100 V -15 %...AC 110 V +10 %
	Mains frequency	50...60 Hz ±6 %
	Unit fuse, built-in	T6.3H250V to DIN EN 60 127
	External fuse	max. 10 A (slow)
	Power consumption	
	- During startup	8 VA
	- During operation	5 VA
	Permissible load on the control outputs	
	- Per terminal	max. 4 A to VDE 0660 AC3
	- Total	max. 5 A to VDE 0660 AC3
	Degree of protection	IP 40 (to be ensured through mounting)
	Mounting position	Optional
	Cable glands	- Pg11 or - BSP ¾“ or - metric M16 x 1.5
	Weight	approx. 2 kg
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 60 721-3-2
	Climatic conditions	class 2K2
	Mechanical conditions	class 2M2
	Temperature	-50...+60 °C
	Humidity	< 95 % r.h.
	Operation	DIN EN 60 721-3-3
	Climatic conditions	class 3K5
	Mechanical conditions	class 3M2
	Temperature	-20...+60 °C
	Humidity	< 95 % r.h.

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

Flame supervision

- With LAE10
- With LFE10
- With LFE50

The following description of the unit's function refers to the startup and supervision of a single burner. With multiflame supervision, all burners connected to the control unit are put into operation and supervised simultaneously in the same manner. A fault causing lockout of one of the burners therefore results in the shutdown of all burners. Prerequisite for the immediate restart of the non-faulty burners is the bridging of the flame safeguard of the faulty burner by means of an operating switch. This switch must simultaneously cut all control lines to the ignition transformer and the fuel valves. For connection examples, refer to the Data Sheet on the LAE10 / LFE10.

Prerequisites for burner startup

The burner starts only if:
- The unit's switching sequence is in the start position
- The control unit is not in the lockout position, e.g. due to a faulty UV tube
- The contacts of all the control and safety devices in the control loop between terminal 8 and 9 are closed
- The air pressure switch does not indicate any air pressure – if connected in the test circuit

Faults in the flame safeguard or in the control unit prevent startup or lead to a lockout during startup.

☞ If the air damper is not controlled by the control unit, terminals 20, 21 and 22 must be interconnected.

Startup sequence...

... on startup

First, the fan motor is switched on via terminal 3 and the actuator is controlled via terminal 22. When the air damper reaches its fully open position, the programming mechanism of the unit starts to run – the prepurge time commences. The minimum air pressure set on the air pressure switch must then be reached within 10 seconds (or within 7 seconds in operation with postpurging) and must be maintained until controlled shutdown occurs. Otherwise, lockout will take place. A flame signal during the prepurge time also leads to lockout. On completion of the set prepurge time, the air damper is given the control command to return to the minimum air position. During the air damper's closing time, the programming mechanism does not move.

As soon as the signal contact for the minimum throttling position is operated by the actuator, the programming mechanism starts again and now controls the program sequence which can no longer be influenced from outside.
- Preignition (provided the ignition equipment was not already switched on during the prepurge time)
- Release of the 1st fuel valve connected to terminal 5 (the fuel valve of a pilot burner which must be closed on completion of the 2nd safety time must, however, be connected to terminal 10)
- The set safety time elapses. If no flame is established during that period of time, lockout will be initiated (control unit always locks itself)
- On completion of an interval of 11 seconds after the release of the 1st valve, the 2nd fuel valve will be released
- The pilot burner – if present – is switched off (connected to terminal 10)
- The load controller is switched on after a further interval of 12 seconds. Now the burner has reached its operating position. From now on, the load controller controls the burner's output by either increasing or decreasing the fuel throughput and the air volume depending on heat demand (fuel / air ratio control). This can be accomplished in stages, i.e. by means of thermostats or continuously (modulating) by a modulating controller

Loss of flame during operation always leads to lockout of the burner.

Function (cont´d)

Burner startup with ignition spark proving

In principle, the program sequence is the same as with burner startup without ignition spark proving.

Exceptions:

- If the UV flame detector does not receive any input signal during the **short preignition time** (UL2 on «Short preignition»), lockout occurs before any gas is released, i.e. safety time TSA = 0 seconds
- With ignition spark proving, the safety time for the pilot burner can only be adjusted between 0...6 seconds (in the time diagram of the programming mechanism: TSA´)

Control sequence...

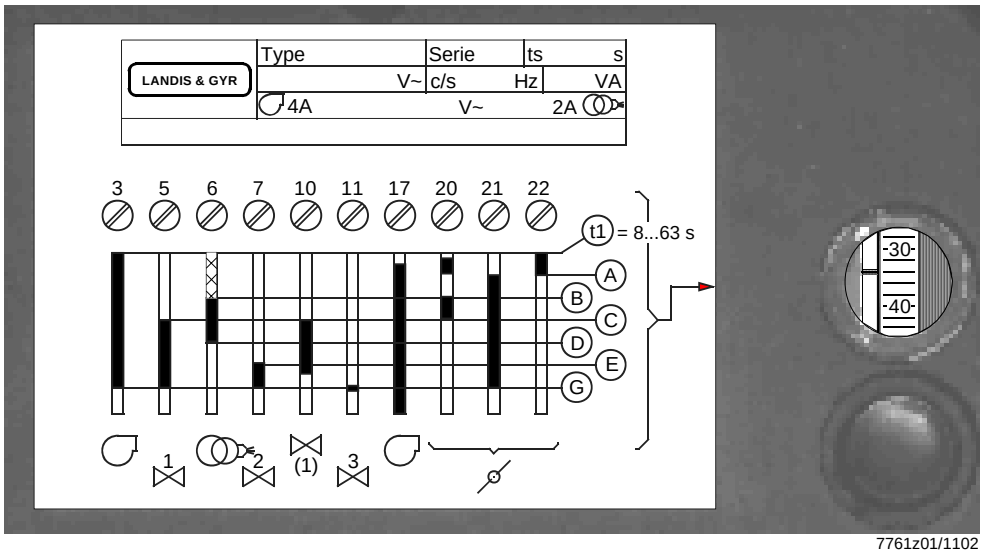
... after a controlled shutdown

Controlled shutdown occurs as soon as one one of the control or supervision devices in the control loop between terminal 8 and 9 opens its contact. In that case, the fuel valves will immediately be shut. The programming mechanism starts again and now programs postpurging, if required. On completion of the postpurge time, the programming mechanism has again reached its start position where it remains until the next switch on command is received. The flame supervision restarts again during the postpurge time. Therefore, any flame signal during that period of time will lead to lockout.

... after resetting the LEC1...

After pressing the built-in or the external lockout reset button, the programming mechanism will return to its start position. The only burner plant component that is operated during that period time is a fan motor connected to terminal 17. As the control thermostat or pressurestat normally continues to call for heat, the programming mechanism will initiate a restart after reaching the start position.

Program indicator



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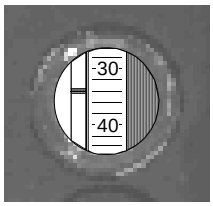
The program indicator continuously shows the respective phase of the burner startup sequence. The **letters** correspond to those of the programming mechanism diagram next to the viewing window. The **figures** indicate the remaining prepurge time. If lockout occurs, the programming mechanism and the program indicator stop, thus indicating the operating phase during which lockout occurred.

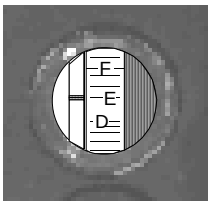
Reading the program indicator

Examples:



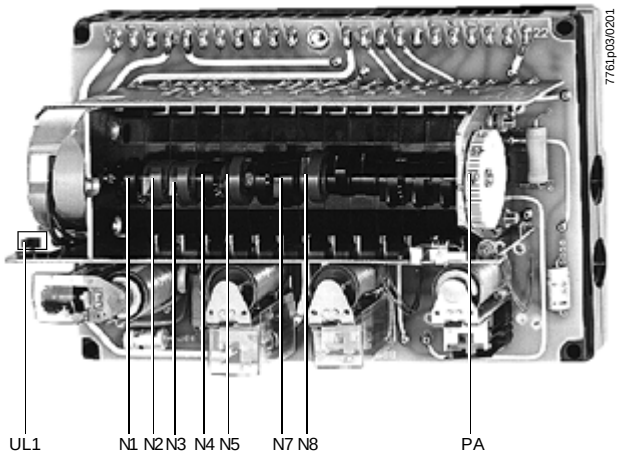
← Prepurge time will last another 35 seconds

Valve 2 at terminal 7 is opened →



Adjustment facilities on the unit

- Before making any adjustments, disconnect the unit from the mains supply
- Loosen all 6 retaining screws and only remove the unit cover
- The numbering of the switching cams always starts from the motor
- The camshaft can be manually turned into any position (clockwise direction of rotation as seen from the motor)



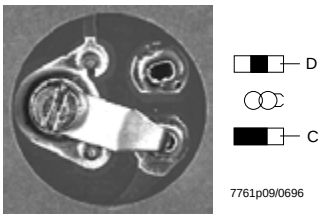
Setting elements:

N1	Cam 1, fixed
N2	Cam 2, adjustable (1st safety time)
N3	Cam 3 adjustable (1st safety time)
N4	Cam 4, fixed
N5	Cam 5, adjustable (2nd safety time)
N7	Cam 7, fixed
N8	Cam 8, adjustable (prepurge time)
PA	Program indicator
UL1	ON / OFF switch for the motor of the switching mechanism

On the rear side of the base:

UL2	Changeover link for «Short / long preignition», in position «Short preignition» locked with varnish
UL3	Changeover link for «STOP» of the control sequence following lockout or «restart». Only the fan for postpurging connected to terminal 17 remains energized

Adjusting the preignition time



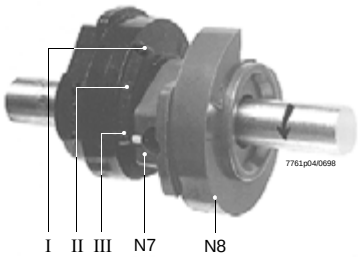
C	«Long preignition time» (during prepurging)
D	«Short preignition time» (3 s, factory setting)

Loosen the screw before making the adjustment and then tighten it carefully.

Adjusting the prepurge time t1»

- Loosen the fixing screw of the red cam N8
- Turn camshaft manually until the required prepurge time is indicated next to the index notch on the carrier of the programming mechanism
- Hold camshaft firmly and rotate cam N8 until the contact tappet operated by it just jumps out or the cam strikes this tappet
- Carefully tighten the fixing screw of the cam and check the adjusted time for **accuracy**. The set time is also visible in the viewing window, if the unit is in its start position

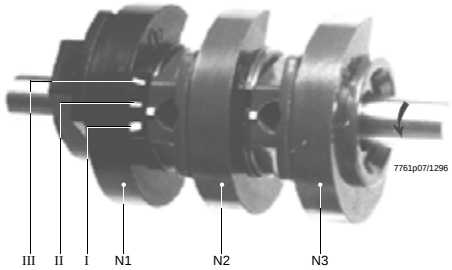
Adjustment of the mark of the red cam N8 to the graduation marks of the black cam N7 results in the prepurge times given in the opposite table.



Adjustment to	t1
Graduation mark I	8 s
Graduation mark II	18 s
Graduation mark III	28 s
Adjustment at stop	63 s
Facory setting	approx. 30 s or 60 s

Adjusting the safety times «TSA»

The safety times are adjusted by setting the red cams of the programming mechanism.
Their time marks serve as a setting aid.
After the adjustment, the fixing screws of the cams must be tightened very carefully to make any unintentional readjustment impossible.



Ignition safety time «TSA»

(Operation with ignition spark proving)

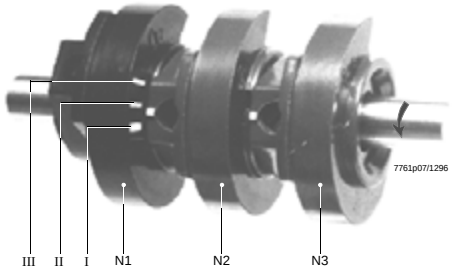
- Loosen the fixing screws of cams N2 and N3
- Hold cam N1 firmly and align the setting mark of cam N2 with the corresponding time mark I of cam N1 (see illustration and table, intermediate positions possible). Lock cam N2
- Rotate cam N3 in such a way that its setting mark is set against the lower stop of cam N2. Lock cam N3
- Check the adjusted safety time and set the new value on the rating plate of the unit cover (adjustment slot at the rear of the cover)

Adjusted to	TSA
Graduation mark I	0 s
Graduation mark II	4.5 s
Graduation mark III	9 s
Factory setting	< 2 s

1st safety time «TSA´»

(Operation with ignition spark proving)

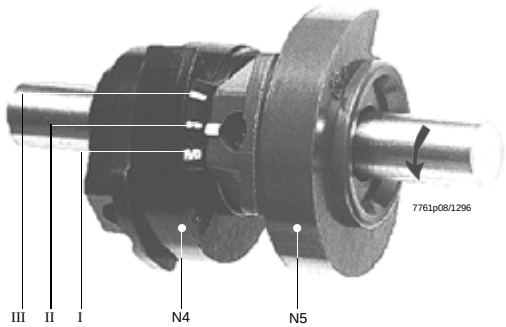
- Loosen the fixing screws of cams N2 and N3
- Hold cam N1 firmly, set the setting mark of cam N2 to the time mark I of cam N1 (see illustration and table). Lock cam N2
- Hold cam N2 firmly, set the setting mark of cam N3 to the required time and lock cam N3 (see illustration and table)
- Check adjusted safety time and set the new value on the cover's type field (setting slot underneath the cover)



Adjusted to	TSA´
stop in the direction of the arrow	0 s
the other stop	6 s
Factory setting	0 s

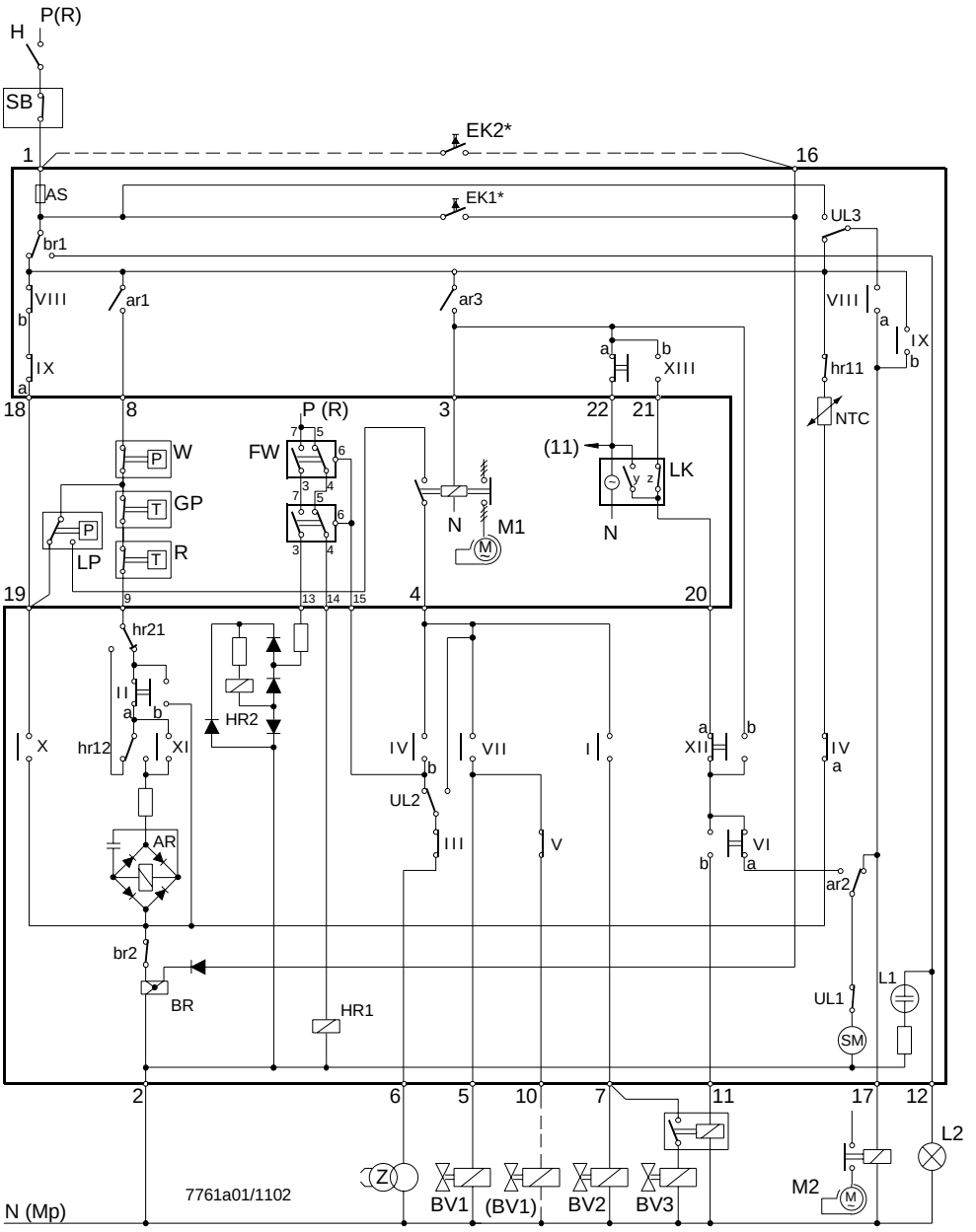
2nd safety time «t9»

- Loosen the fixing screw of cam N5 and align its setting mark to the corresponding time marks of cam N4 (see illustration and table, intermediate positions possible)



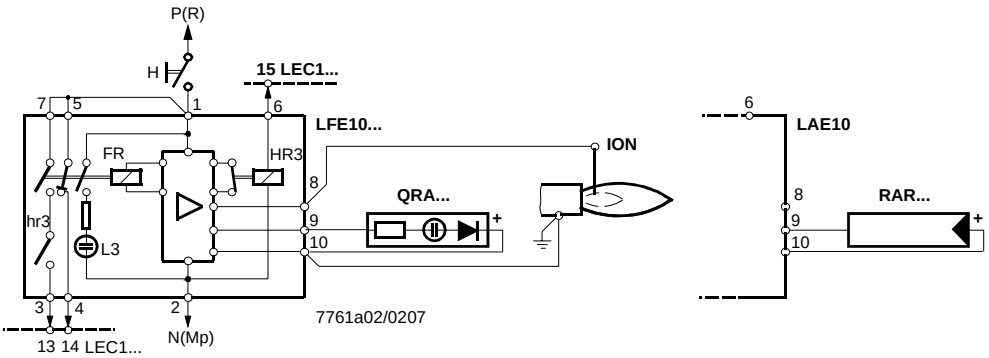
Adjusted to	t9
Graduation mark I	0 s
Graduation mark II	4.5 s
Graduation mark III	9 s
Factory setting	< 2 s

Basic diagram



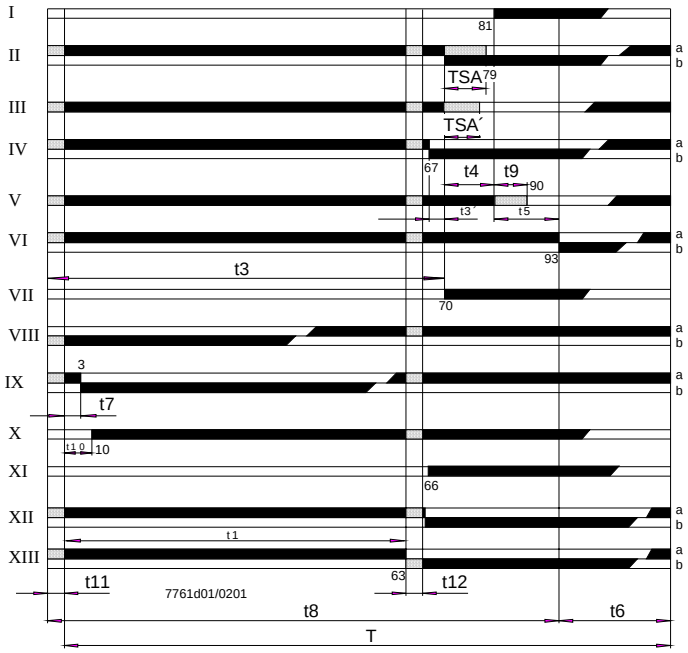
* Do not press EK… for more than 10 seconds!

LAE10... / LFE10...



⚠ When using UV detector QRA..., terminal 10 must be connected to earth!

Sequence diagram of programming mechanism



Legend

AS	Unit fuse	LK	Actuator with limit or auxiliary switches (refer so «Connection examples»)
AR	Load relay with contacts «ar...»		a = actuator travels to the OPEN position (maximum air volume)
BR	Lockout relay with contacts «br...»		z = actuator travels to the CLOSED position (minimum air volume)
BV...	Fuel valve	LP	Air pressure switch
(BV...)	Fuel valve for a pilot burner that is switched off on completion of the 2nd safety time	M...	Fan motor, fan
c...	Fan contactor with contacts «c...»	NTC	Resistor with negative temperature coefficient
d...	Auxiliary relay with contacts «d...»	OV...	Oil valve
e...	Thermal cutout	Q	Temperature or pressure sensor
EK1	Lockout reset button on LEC1...	QRA...	UV detector
EK2	Remote lockout reset button	R...	Control thermostat or pressurestat
ION	Ionization probe	RAR...	Selenium photocell detector
FR	Flame relay with contacts	RV	Control valve
FW	Contacts of flame safeguards LAE10..., LFE10... or LFE50...	SB	Safety limiter
GP	Gas pressure switch	SM	Synchronous motor of programming mechanism
GV...	Gas valve	SQ...	Type reference of air damper actuator
H	Main switch	UL1	Operating switch for motor of programming mechanism – can only be accessed after removal of housing cover
HR1	Auxiliary relay with contacts «hr11 / hr12»	UL2	Changeover link for «Short / long preignition time»
HR2	Auxiliary relay with contact «hr21»	UL3	Changeover link for «STOP» or «Run» of the programming mechanism after lockout
HR3	Auxiliary relay for flame detector or flame simulation Test	W	Limit thermostat or pressure switch
L1	Lockout warning lamp, built-in	Z	Ignition transformer
L2	Lockout warning lamp, external		
L3	Signal lamp for flame indication		

Switching times

T	120 s	Run time of programming mechanism
TSA	0...9 s	Ignition safety time (setting = 0 s in the case Ignition safety time of ignition spark proving)
TSA´	0...6 s	First safety time for the pilot burner in the case of startup with ignition spark proving
t1	8...63 s	Adjustable prepurge time
t3	t11 + t1 + t12 + 7 s	Long preignition time (during the entire prepurge)
t3´	3 s	Short preignition time
t4	11 s	Interval between release of the 1st and 2nd fuel valve
t5	12 s	Interval between release of the 2nd and 3rd fuel valve or the load controller
t6	T – (30 + t1)	Postpurge time
t7	3 s	Delay time
t8	t1 + 30 + t11 + t12	Total startup time startup sequence
t9	0...9 s	2nd safety time with interrupted pilot burner
t10	10 s	Transition time - preset time for air pressure signal
t11	optional	Programmed opening time for actuator «SA»
t12	optional	Programmed closing time for actuator «SA»

For the factory setting of the different types, please refer to «Type summary».

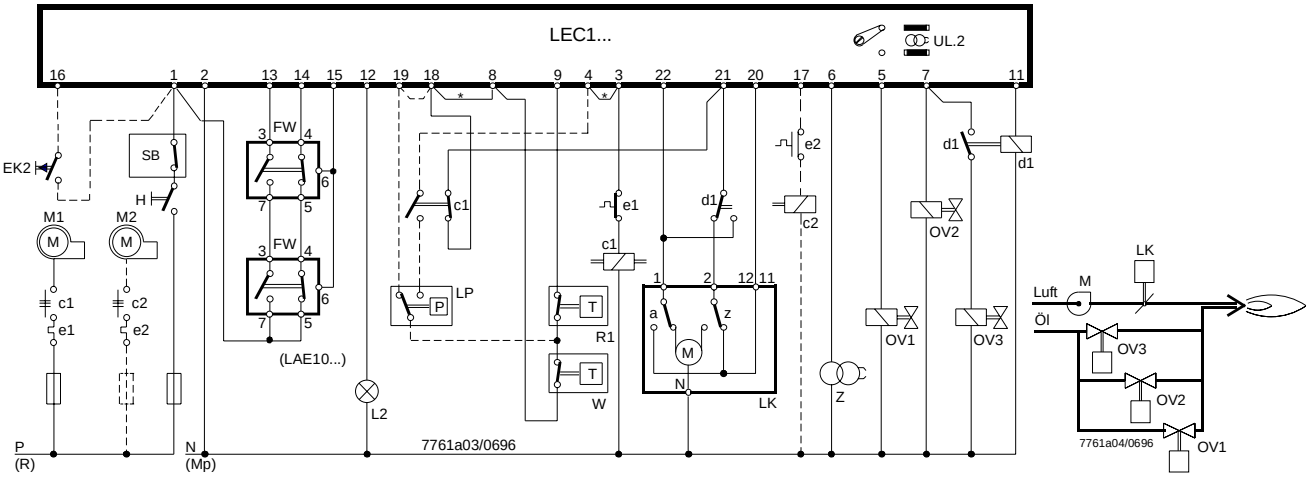
Connection examples and sequence diagrams

For connection examples and switching program for flame supervision with DETACTOGYR® LFE50..., refer to Data Sheet 7783.

Double- or multiflame supervision of oil burners

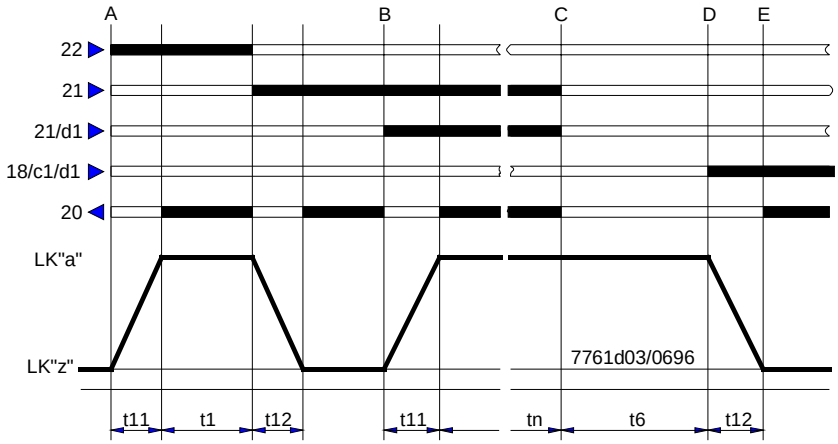
Startup with long preignition «t3» and checked actuator control.
Air pressure supervision from the start to controlled shutdown.
No load control.
Required type of flame safeguards: LAE10... with selenium photocell detector RAR...

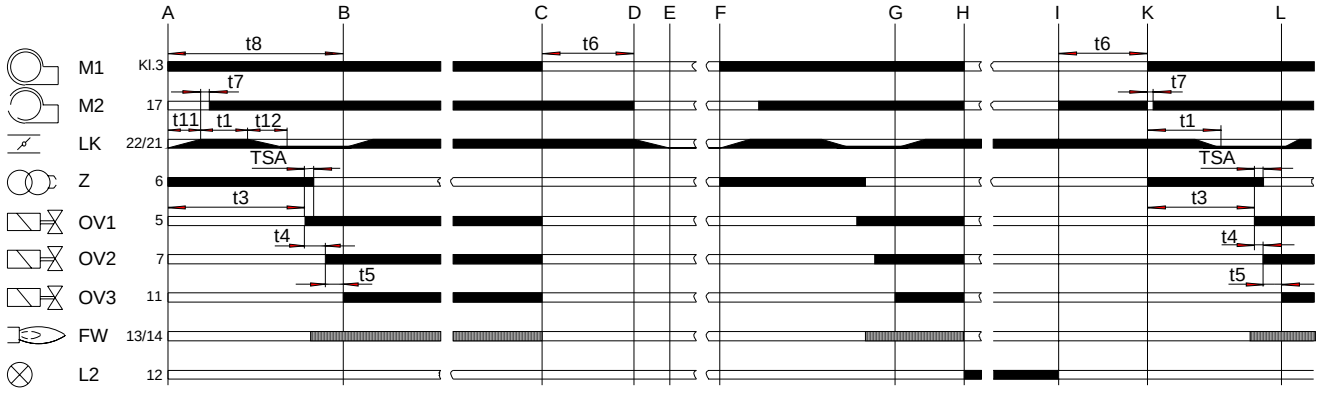
* When using an air pressure switch «LP», the connections between terminals 3 and 4 and 8 and 18 are not required



Air damper control, detailed

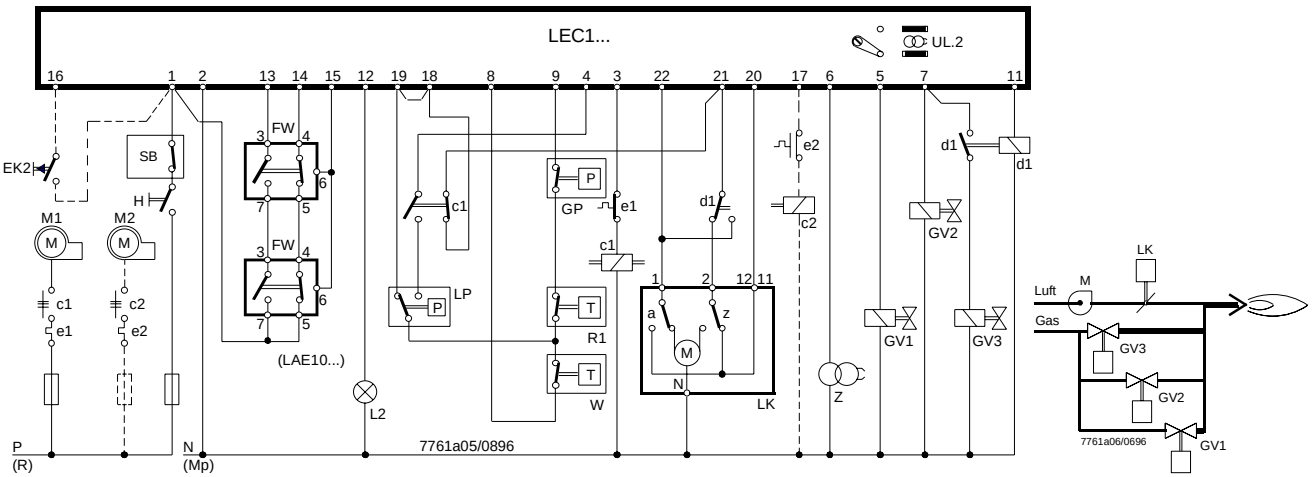
In the case of burners without air damper or with an air damper not controlled by the control unit, terminals 20, 21 and 22 must be interconnected.
Link 18-c1-21 is not permitted however!





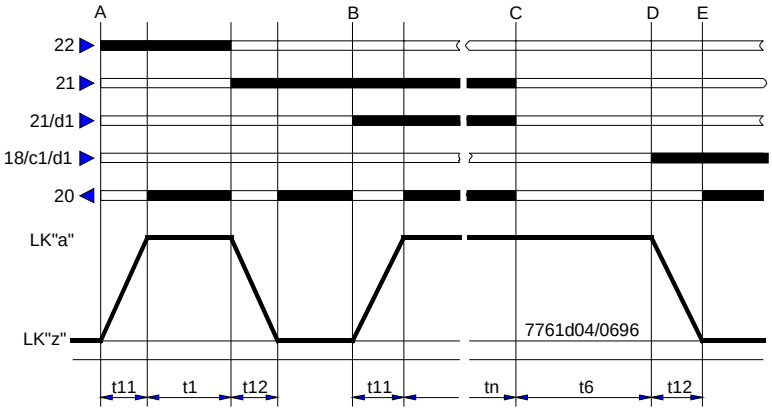
Double- or multiflame supervision of gas burners (expanding flame burners)

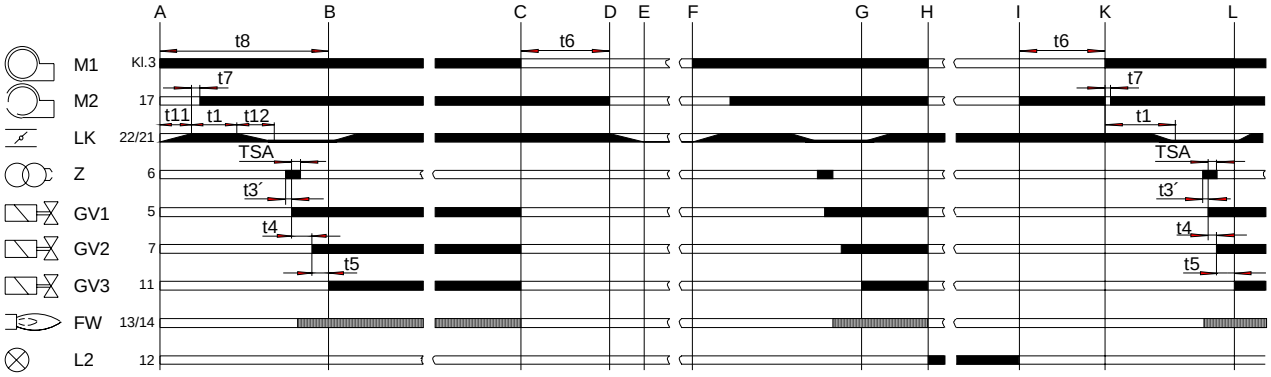
Startup with short preignition (3 seconds) and checked actuator control.
Required type of flame safeguards: LFE10... with UV detectors QRA... or ionization probe.



Air damper control, detailed

In the case of burners without air damper or with an air damper not controlled by the control unit, terminals 20, 21 and 22 must be interconnected.
Link 18-c1-21 is not permitted however!



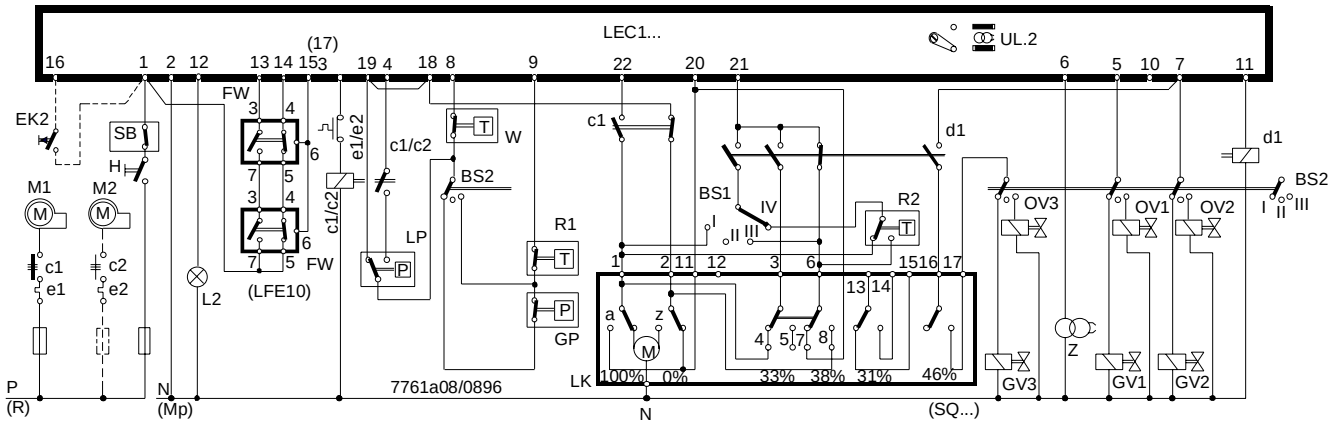


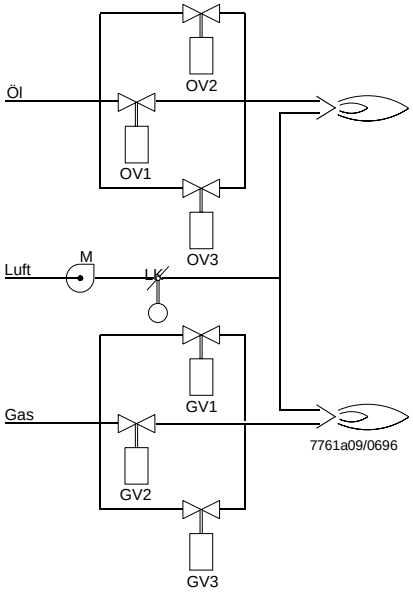
Legend

A	Startup	G-H	Operation
A-B	Normal startup	H	Loss of flame
B-C	Operation	H-I	Lockout
C	Controlled shutdown	I	Reset
C-D	Postpurging	I-K	Home run
D-E	Closing of the air damper	K	Restart
E-F	Burner off period	K-L	Startup
F	Restart	L ▸	Operation
F-G	Startup		

Double- or multiflame supervision of burners for selectable operation with oil or gas (expanding flame burner)

Startup with short preignition (3 seconds) and checked actuator control.
Control of the 2nd output stage via on / off controller «R2».
Required type of flame safeguards: LFE10... with UV detectors QRA...





Operating switch BS1

I	Nominal load
II	Stop
III	Partial load
IV	Automatic control

Operating mode selector BS2

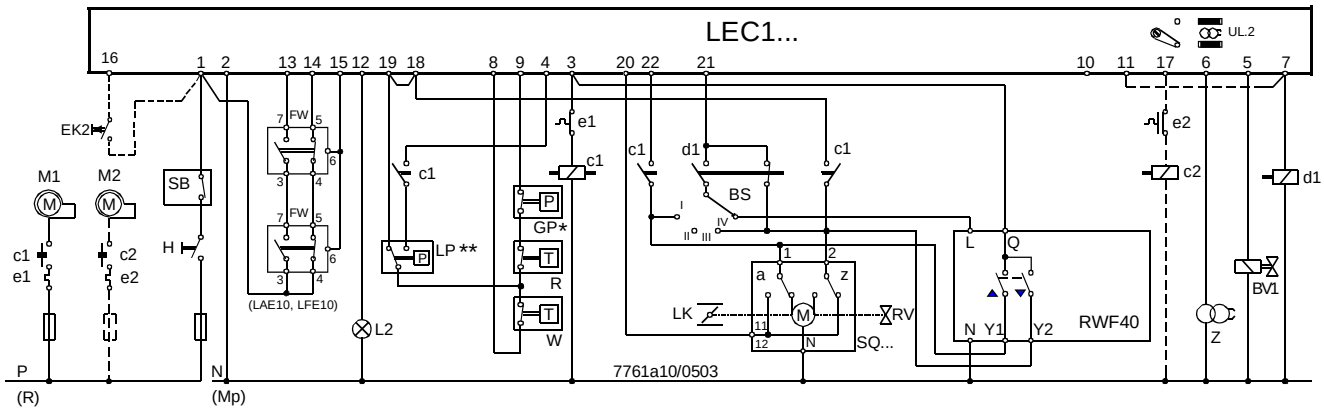
I	Gas
II	Off
III	Oil

Double- or multiflame supervision of modulating burners

Including checked actuator control.

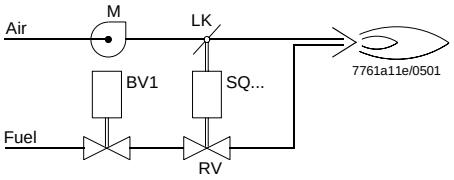
Required type of flame safeguards:

For oil	LAE10 with active selenium photocell detectors RAR...
For gas	LFE10 with UV detectors QRA... or ionization probe
For oil / gas	LFE10 with UV detectors QRA...



* GP: Not required with oil burners

** LP: Recommended for oil burners, if the oil pump is not coupled to the fan motor



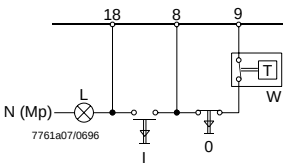
Operating switch BS1

I	Nominal load
II	Stop
III	Partial load
IV	Automatic control

Burners designed for continuous adjustment of the burner's output (modulating burners) require the devices of the temperature or pressure control circuit, in addition to the standard burner equipment, e.g.

1	Modulating controller	RWF40...
1	Temperature or pressure sensor	QA... / QB...
1	Remote setting unit, if required	FZA...
1	Actuator for the control of the air damper and the fuel throughput (fuel / air ratio control)	SQ...
1	Auxiliary relay	d1
1	Operating switch	BS
1	Control valve or similar for adjustment of the fuel throughput	RV

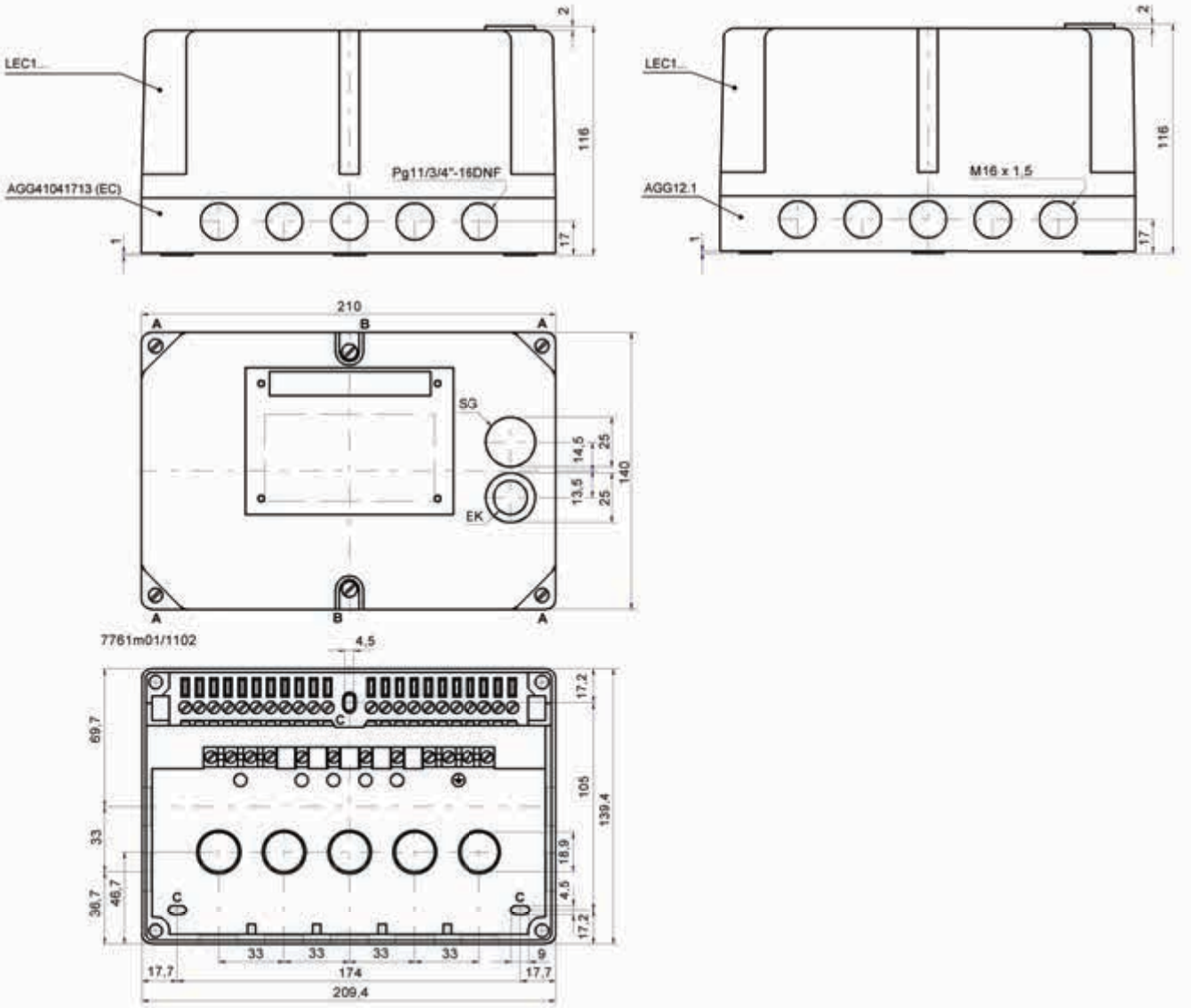
Control for semiautomatic operating mode



This circuit is used if, for certain reasons, fully automatic operation is not required (e.g. with industrial burners).
The burner is started up by actuating impulse contact I; the burner is shut down by either pressing circuit-breaking contact 0 or when the limit thermostat cuts out.

Dimensions

Dimensions in mm



To remove the control unit from the plug-in base, loosen **only** the 4 screws **A**.
To remove the unit cover, also loosen the 2 screws **B**.

Legend

C Elongated holes for fixing the base
EK Lockout reset button
SG Viewing window

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